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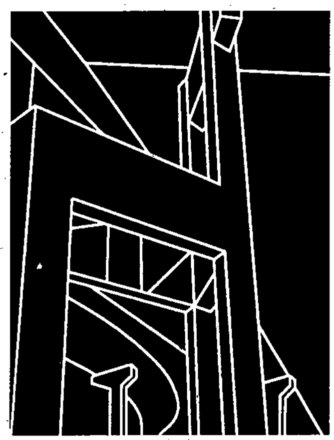
REMOTE BRIDGE SCOUR MONITORING: A PRIORITIZATION AND IMPLEMENTATION GUIDELINE

Carl Haas, José Weissmann, and Tom Groll



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16. Abstract

Having the largest bridge population in the nation, the state of Texas stands to gain much through the development of bridge scour-monitoring and evaluation practices. Because it has such a large bridge population to manage, the Texas Department of Transportation (TxDOT) needs a logical and low-cost method of prioritizing and monitoring bridges for scour damage. An algorithm based on code contained in the BRINSAP database can be used effectively to prioritize bridge sites for further consideration of scour countermeasure implementation. Remote mechanical monitoring is an emerging method for detecting and tracking bridge scour. Mechanical scour monitors equipped with data telemetry equipment can provide a safe and effective means of tracking scour at bridge piers and abutments. Because remote mechanical scour monitoring is a relatively new approach, TxDOT should support extensive research and planning regarding methods of system development and implementation.

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A PRIORITIZATION AND IMPLEMENTATION GUIDELINE

by

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ABSTRACT

Having the largest bridge population in the nation, the state of Texas stands to gain much through the development of bridge scour-monitoring and evaluation practices. Because it has such a large bridge population to manage, the Texas Department of Transportation (TxDOT) needs a logical and low-cost method of prioritizing and monitoring bridges for scour damage. An algorithm based on code contained in the BRINSAP database can be used effectively to prioritize bridge sites for further consideration of scour countermeasure implementation. Remote mechanical monitoring is an emerging method for detecting and tracking bridge scour. Mechanical scour monitors equipped with data telemetry equipment can provide a safe and effective means of tracking scour at bridge piers and abutments. Because remote mechanical scour monitoring is a relatively new approach, TxDOT should support extensive research and planning regarding methods of system development and implementation.

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The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Texas Department of Transportation. This report does not constitute a standard, specification, or regulation.

There was no invention or discovery conceived or first actually reduced to practice in the course of or under this contract, including any art, method, process, machine, manufacture, design or composition of matter, or any new and useful improvement thereof, or any variety of plant, which is or may be patentable under the patent laws of the United States of America or any foreign country.

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Research performed in cooperation with the Texas Department of Transportation.

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1. Develop an editing procedure to review code before it is entered into the BRINSAP database. The procedure should be designed to reduce the amount of incomplete records, minimize inappropriate code for prioritization parameters, and ensure compatibility of code between the parameters.
2. Evaluate bridges with an Item 113 code of "6" until all bridges in the inventory system have been evaluated.
3. Update the code in Item 113.1 ("Scour Vulnerability Assessment") to be compatible with the actual scour condition. Item 113.1 should be modified to reflect TxDOT's current scour evaluation practices.
4. Refine the parameter weights in the prioritization algorithm presented in this report by following the guidelines established in Section 3.2.4.
5. Insert a field in the BRINSAP database to indicate if flood control structures, mining or dredging operations, a nearby confluence with another stream, or sharp bends in the stream exist near the bridge site. This information should be included in the analysis and decision-making process when investigating the practicality of scour countermeasures.
6. Incorporate the information in recommendation #5 into the prioritization algorithm.
7. Insert a field in the BRINSAP database to contain the priority score. Link the database to a computer program (such as the one in Appendix A) to generate priority scores.
8. The prioritized bridge lists do not infer that each bridge on the list should receive a scour-monitoring system. The list should be reviewed in the order shown and an analysis should be performed as to whether monitoring or some other scour countermeasure should be implemented.
9. Continue with the development of remote mechanical scour-monitoring systems. Telemetry equipment employed by these systems should be compatible with low-water monitoring systems and bridge ice detection systems described in TxDOT Project 0-1380.

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10. Investigate a backup data telemetry system (such as the USGS GOES system) to ensure redundancy in the monitoring systems described in this report and in TxDOT Project 0-1380.

CHAPTER 1. INTRODUCTION

1.1 BACKGROUND

This section of the report will introduce the concept of remote mechanical bridge scour monitoring and the motivation for researching its feasibility. The applicable regulations governing bridge scour inspections are provided, as well as a brief description of the scour process that will familiarize the reader with the problems that must be confronted when attempting to monitor bridge scour.

1.1.1 Remote Monitoring of Bridge Scour

One area of major concern to transportation officials is the scouring of bridge foundations during flood conditions. Although all states have monitoring procedures for predicting and detecting bridge scour, many of the procedures are inefficient, labor intensive, and may present unsafe working conditions for bridge inspectors. Poor correlation exists between calculated and observed scour depths primarily because scour prediction equations developed under laboratory conditions do not adequately account for all the variables found in the field. When predicting scour depth, extensive data collection is necessary to perform a detailed hydraulic analysis of a bridge waterway (with that data collection effort frequently representing the majority of the cost of such analysis). Furthermore, there is often some uncertainty associated with the data, which can decrease the reliability of the detailed analyses. When making actual scour measurements, maintenance personnel may subject themselves to flood waters and severe weather, which is undesirable from a safety standpoint. The state departments of transportation (DOTs) and the Federal Highway Administration (FHWA) recognize the need to improve bridge scour-monitoring methods to make them more reliable and less costly while maintaining safety for their workers.

Bridge scour monitoring often requires manual inspection of bridge foundations during flood events. Current practices typically include probing the streambed adjacent to piers and abutments with long poles or lowering a tethered sounding weight from the bridge deck. Regardless of the detection mechanism, these methods require maintenance personnel to be physically present at the bridge site to determine if scour holes are developing at or near bridge piers and abutments. Furthermore, there are invariably more bridges in need of inspection during flood events than there are personnel to perform the inspections.

The need for maintenance personnel to be present at a bridge site could be removed by automating the collection and transmission of scour data, thereby making the scour-monitoring process safer and more efficient. A permanently installed mechanical monitor fitted with data telemetry equipment can provide the ability to collect and transmit data to a maintenance office. Remote monitoring could mitigate the inefficiencies and dangers inherent in the current practices, as well as provide early warning of impending bridge failure and the ability to track long-term degradation as a result of scouring. Additional benefits of remote monitoring include the potential reduction in the labor required to perform monitoring, and the acquisition of real-time data for calibrating scour prediction equations and enhancing the state of knowledge about the scour-monitoring process.

1.1.2 Motivation for Study

Two notable bridge failures that occurred in the late 1980s resulted in seventeen deaths. In April 1987, US 90 over Schoharie Creek in Schenectady, New York, failed as a result of flooding that scoured soil away from the base of the piers of the bridge. Two years later, US 51 over the Hatachie River in Tennessee failed because of long-term lateral migration of the streambed. In both cases, soil eroded from around and beneath the foundations of the bridges, causing their collapse. These two catastrophic failures brought national attention to the problem of bridge scour and streambed instability.

Approximately 84 percent of the nation's 577,000 bridges span either a stream or river, many of which experience flooding each year. An analysis of 823 documented bridge failures that occurred in the United States between 1951 and 1988 indicates that in 60 percent of the cases, flooding was the major contributing factor to the structure's failure (Huber, 1991). Further, scour is the most common type of damage to bridges caused by floods. Although the cost of making a bridge less vulnerable to scour can seem very high, the expense is actually very small considering that the cost of bridge failure can be up to 10 times the cost of the bridge itself (Richardson, 1993). In 1991, the U.S. Army Corps of Engineers estimated the average annual cost of all flood damage in the U.S. exceeded $2 billion. Approximately 75 percent of this cost pertained to the repair and reconstruction of roads and bridges damaged by flooding (Trent, 1993).

In Texas, the Texas Department of Transportation (TxDOT) maintains records on more than 48,000 bridges and bridge class culverts — the largest population of bridges in the nation. It is reasonable to assume that with such an extensive bridge population, Texas will incur tremendous expense every year in its effort to combat the effects of bridge scour. A proactive approach, one that includes early scour detection through continuous monitoring, can potentially ensure that the state's limited resources are used more effectively.

1.1.3 Applicable Regulations

In 1991, in response to the Schoharie Creek and Hatachie River bridge failures, the FHWA issued to the state DOTs the technical advisory T 5140.23 requiring all bridges on the National Bridge Inventory (NBI) to be inspected and evaluated for susceptibility to scour. The advisory refers to the National Bridge Inspection Standards (NBIS) found in the Code of Federal Regulations, 23 CFR 650, Subpart C. In Section (5)(c) of the advisory, the FHWA endorses the procedures for performing scour evaluations found in the "Manual for Maintenance Inspection of Bridges" published by the American Association of State Highway and Transportation Officials (AASHTO). Section (5)(d) of the advisory references the NBIS requirement that "bridge owners maintain a bridge inspection program that includes procedures for underwater inspection." Section 650.305(a) of the NBIS states that "each bridge is to be inspected at regular intervals not to exceed 2 years in accordance with Section 2.3 of the AASHTO manual." There are also provisions for requiring more frequent inspections of a bridge when there are "known deficiencies." Scour hole development qualifies as such a deficiency. The advisory and the FHWA's Hydraulic Engineering Circular No. 18 (HEC 18) "provide guidance on the development and implementation of procedures for evaluating bridge scour to meet the requirements of the regulation" (FHWA, 1991).

1.1.4 Description of the Scour Process

Scour is the result of erosion of a streambed or embankment. During the rising stage of a flood, the velocity of the flowing water increases, which results in an increase in the shear stress on the stream bottom material. When the shear stress becomes sufficiently great, the material is lifted from the stream bottom and transported away with the flow. The net migration of streambed material away from a section of the stream increases the cross-sectional area and, to satisfy flow continuity, the velocity of flow through the scoured area decreases. As the velocity decreases, the shear stress also decreases. Eventually equilibrium is reached and there is no longer a net migration of streambed material. During the falling stage of a flood, the flow velocity decreases, allowing suspended sediments to settle. The nature of the scour process is thus cyclic: Scour holes become deeper during the rising stage of a flood and then fill in during the falling stage of a flood.

All soil types are subject to scour. Loose sands and clays can reach their maximum scour depth in a matter of hours or days, whereas more cohesive materials may require years. Rock and cemented materials may not reach their maximum scour depth for decades.

The total amount of scour that occurs in a stream or river can be broken down into three types: long-term aggradation and degradation, contraction scour, and local scour. Aggradation and degradation is a long-term process where streambed material is transported into, or away from, the reach of a stream. Aggradation is a net increase in sediment deposition, and degradation is a net migration of sediments from a location. Contraction scour occurs at constrictions in stream cross sections. The reduced cross-sectional area at a constriction causes increased flow velocity and, therefore, increased shear stress on the streambed. Bridge approachways, piers, and abutments in a flow path reduce a stream's cross-sectional area and may cause contraction scour. Local scour is the result of vortices formed around piers and abutments under flooding conditions. Increased flow velocities in the vortices cause scour holes to develop, which may fill in during the falling stage of a flood as flow velocity decreases and sediments are able to settle. Local scour holes may pose the most acute danger to a bridge because, by definition, the holes develop adjacent to the piers. When all three of these scour mechanisms occur simultaneously, their combined effect is termed *total scour.*

The two common classifications for scour are *clear water scour* and *live bed scour.* Clear water scour occurs when the amount of sediment transported from upstream of the scour hole is insufficient to fill the hole during the falling stage of the flood. Live bed scour occurs when sediments transported from upstream of a scour hole settle into the hole, sometimes completely refilling the hole, during the falling stage of the flood. Live bed scour can be very difficult to detect by probing or visual inspection when the scour hole fills in after the process has occurred.

The nature of streambed scour does not lend itself to favorable working conditions for those attempting to monitor the process. Because scour typically occurs under flooding conditions, it may be unsafe for bridge inspectors to monitor a bridge when the scour is occurring. Yet it is during floods that scour can compromise the stability of a bridge the most. Further, most highway maintenance departments are not adequately staffed to monitor all the bridges in their district; nor is it likely that they can mobilize quickly during severe weather to close a bridge that is in jeopardy of sustaining scour damage. There is a need to improve the safety of the motoring public by reducing the detection and response time required to enact bridge closures. There is a need to improve the safety of highway maintenance workers by removing the necessity of their presence at a bridge during flooding and severe weather. Installation of remote-monitoring devices can help accomplish these goals.

1.2 PURPOSE

The purpose of this report is twofold. The first objective is to present a method for prioritizing bridge sites that may benefit from remote mechanical scour monitoring. The second objective is to provide information on the cost and performance of currently available remote scour-monitoring systems. The compatibility between this project and TxDOT project

0-1380 ("Develop a Remote Automatic Monitoring and Public Information System for Hazardous Conditions") is explored in an effort to show that both projects should be considered as a single implementable system. A system implementation guideline is provided that describes how TxDOT can implement the prioritization method developed in this report. The prioritization method is designed to be easily and inexpensively implemented by taking advantage of TxDOT's current scour-monitoring practices.

1.3 SCOPE

The scope of this report is to provide data on existing scour-monitoring systems and practices and to develop a logical method of prioritizing bridge sites for the implementation of scour countermeasures. An algorithm that uses codes from various fields in the Bridge Inventory, Inspection and Appraisal Program (BRINSAP) database determines the priority of each site. The algorithm can be used by TxDOT to identify the number and location of bridges that may benefit from remote monitoring. It is not intended that all prioritized bridges should receive a scour-monitoring system. Rather, they should be evaluated in the order shown on the priority list to determine if a monitoring system is a feasible scour countermeasure. A conceptual framework for analyzing the economy of remote scour monitoring is presented. A comparison of the prioritization method developed in this report to the risk-based approach is presented, as well as a comparison to a prioritization tool known as CAESAR, which was developed at the University of Washington. An implementation guideline that integrates the prioritization tool and information about monitoring system configuration and performance is also proposed.

1.4 ORGANIZATION

Chapter 2 of this report describes current scour-monitoring practices. TxDOT's use of the BRINSAP database and the flow of information for inputting data into the database are described. This information is presented as the basis for using BRINSAP code to prioritize bridges. Chapter 3 outlines the methodology used to develop the prioritization algorithm. The input parameters are introduced along with an explanation of their selection for use in the algorithm. Comparisons between the method developed in this report and other methods of analysis are made. Chapter 4 describes several commercially available scour monitors and discusses their capabilities and limitations. In this chapter, TxDOT's experiences with past monitor installations are documented. Chapter 5 proposes a method for performing an economic analysis of bridge scour-monitoring system implementation. Chapter 6 contains case studies of the 1998 floods in south and east Texas. Lessons learned from those events are incorporated into the implementation guideline presented in Chapter 7. Finally, Chapter 8 presents the conclusions of this research effort and makes recommendations for future studies in the area of bridge scour monitoring.

CHAPTER 2. BRIDGE SCOUR EVALUATION AND MONITORING PRACTICES

2.1 COMPONENTS OF A SCOUR EVALUATION PROGRAM

This chapter describes the elements that compose a scour evaluation program. The essential components consist of an inventory and appraisal system, as well as procedures for identifying the potential for scour to damage a structure. Section 2.2 of this chapter provides a description of these components based on the Texas Department of Transportation's (TxDOT's) procedures, which follow those found in T 5140.23, the Federal Highway Administration's (FHWA's) Hydraulic Engineering Circular No. 18 (HEC 18) and the American Association of State Highway Transportation Officials (AASHTO) manual. Section 2.2.1 provides a description of the inventory system, Section 2.2.2 discusses the inspection procedures and data transmission, while Section 2.2.3 and 2.2.4 detail the screening and higher level analysis methods, respectively. Section 2.3 builds upon the information presented in Section 2.2 to justify the selection of the parameters used in the prioritization algorithm.

2.2 BRIDGE SCOUR EVALUATION PRACTICES IN TEXAS

Since its inception in 1991, TxDOT's bridge scour evaluation and mitigation program has evolved to include two fields in the bridge inventory database, scour inspection procedures, and several levels of screening processes. The Bridge Inventory, Inspection and Appraisal Program (BRINSAP) database fulfills the inventory system requirements of Section 650.311(a) of the National Bridge Inspection Standards (NBIS). In the BRINSAP database, Item 113 provides the scour rating while Item 113.1 provides a scour vulnerability assessment for each bridge. The inspection procedures consist of initial, routine, and special inspections, and under specific circumstances damage inspections and follow-up, in-depth inspections as outlined in HEC 18 and the AASHTO manual. The screening processes are intended to reduce program costs by excluding bridges from extensive hydraulic analyses based on characteristics indicative of a low vulnerability to scour. TxDOT uses these mechanisms to comply with the NBIS regulations and to determine an appropriate course of action to ensure the safety of bridges. Similarly, these mechanisms can also help to prioritize bridge sites to receive scour countermeasures by providing data that indicate the level of risk of scour-related damage associated with each bridge.

2.2.1 The BRINSAP Database

At the national level, the FHWA maintains the National Bridge Inventory (NBI) database to track the conditions of the nation's bridges. In Texas, the BRINSAP database is equivalent to the NBI. The BRINSAP database contains 135 fields for each bridge record and provides a comprehensive account of the physical and functional characteristics of each bridge and bridge class culvert in the state.

The database consists of two major categories of structures: on-system and off-system. In general, the on-system structures are those that belong to and are the responsibility of the state highway department or some other state or federal agency to maintain. The off-system structures generally belong to local municipalities. Roughly 98 percent of the structures in the state are maintained by the same agency that owns the structure.

The state's 254 counties are subdivided into twenty-five districts. Because of the variety of geologic and climatic conditions found across the state, most scour problems occur in East Texas, where yearly rainfall measures are higher and the soils more erodible. The BRINSAP database has fields for identifying the district and county in which each structure is located. Table 2.1 provides the name of each district, while Figure 2.1 shows the location of TxDOT's twenty-five districts.

Table 2.1 TxDOT District Identification.

# - Name	# - Name	# - Name	# - Name	# - Name
1 - Paris	6 - Odessa	11 - Lufkin	16 - Corpus Christi	21 - Pharr
2 - Ft. Worth	7 - San Angelo	12 - Houston	17 - Bryan	22 - Laredo
3 - Wichita Falls	8 - Abilene	13 - Yoakum	18 - Dallas	23 - Brownwood
4 - Amarillo	9 - Waco	14 - Austin	19 - Atlanta	24 - El Paso
5 - Lubbock	10 -Tyler	15 - San Antonio	20 - Beaumont	25 - Childress

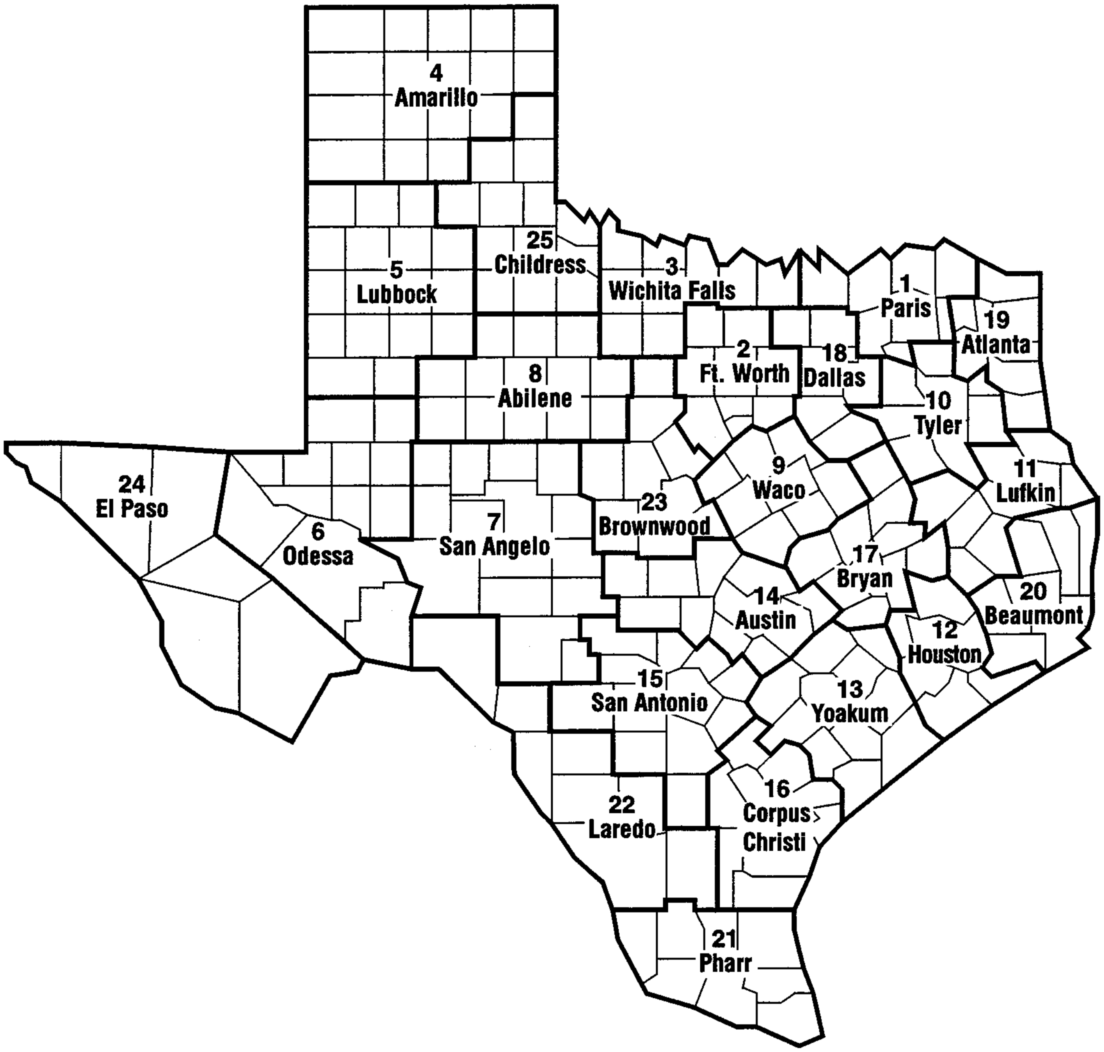

Figure 2.1 Map of the Twenty-Five Districts of Texas.

The state's bridges and bridge class culverts are categorized as on-system or off-system, generally depending on whether the state or a local municipality has ownership and maintenance responsibility for the structure. With respect to scour monitoring, it is important to distinguish between on- and off-system structures, as well as between bridges and culverts. In the BRINSAP database, the records for on-system and off-system structures are contained in separate files.

The characteristics of on-system structures can differ significantly from those of off-system structures. Aside from maintenance responsibility, on-system bridges tend to have higher average daily traffic counts and better records indicating their foundation type, both influential factors for determining scour-monitoring prioritization. Off-system structures tend to have lower average daily traffic counts, are smaller structures that may be more easily replaced, and often lack as-built drawings, making it difficult to determine the foundation type and, therefore, the allowable scour depth. Of all the off-system span bridges, more than 76 percent have unknown foundation types; by contrast, less than 2 percent of the on-system span bridges have unknown foundation types. These characteristic differences suggest that the two categories of structures should be evaluated differently when prioritizing for scour monitoring.

The characteristics of bridges differ significantly from those of bridge class culverts. Although many culverts convey a perennial waterway, more than 99 percent are the concrete box or pipe type; because of their construction, they seldom present a danger of scour-related failure. Conversely, bridges that span waterways can be particularly vulnerable to scour, and thus it is the intent of this report to target these structures for scour monitoring. Accordingly, prioritization of bridge structures will apply primarily to on-system span bridges. The off-system span bridges may also be prioritized, but only in those cases where the foundation type and depth are known. With few exceptions, the economics of monitor installation at bridge class culverts for both on- and off-system structures indicates that they should be excluded from the prioritization process. An in-depth discussion that further details the logic for prioritizing bridges is contained in Chapter 3. Bridges and bridge class culverts are differentiated in Items 43 and 62 of the BRINSAP database. Table 2.2 shows the distribution of on- and off-system bridges and bridge class culverts in the state.

Table 2.2 Distribution of On- and Off-System Structures.

TYPE	BRIDGES	CULVERTS	ROW TOTAL
On-system	19,171	12,967	32,138
Off-system	12,402	3,891	16,293
Column total	31,573	16,858	**48,431**

2.2.2 Inspection Procedures and Data Transmission

The AASHTO manual outlines five types of inspection that address the proper level of detail for determining the condition of bridge structures. These inspections include:

- Initial Inspections
- Routine Inspections
- Special Inspections
- Damage Inspections
- In-depth Inspections

Although these inspections pertain to all the relevant physical and functional characteristics of a bridge, a brief description of each is provided only with respect to how it applies to scour evaluation and monitoring.

The initial inspection provides the baseline conditions of a structure when it becomes a part of the inventory system or when the structure has undergone physical changes or a change in ownership. For existing bridges, the scour condition is noted and detailed drawings are prepared showing the location and depth of scour holes relative to bridge piers and abutments. These drawings serve as a reference for the subsequent routine inspections that occur biennially as required by the NBIS. Typically, routine underwater inspection of a substructure of a bridge is limited to periods of low flow. During the routine inspection, it may be determined that the scour condition has changed, in which case the bridge owner may request a special inspection. The special inspection may focus on a particular deficiency, such as scour hole development or the settlement of a foundation. If it is determined at any point during the inspection process that scour has damaged the structure, a damage inspection may be performed to assess the need to restrict use of the structure or to assess the appropriate scour countermeasure to mitigate the effects of the damage. An in-depth inspection provides a thorough follow-up inspection of deficiencies identified during any of the previous inspections. It is clear that these inspections must occur at discrete time intervals that are influenced by the regulations, environmental factors, available resources, the risk of scour-related failure, and the consequences of failure. Further, it is clear that scour may occur at any time. For these reasons, there is a need to provide a means of continuous monitoring that would obviate the need for some of the inspection procedures and that would provide shorter response times in addressing the dangers presented by scour hole development.

Because decisions as to whether a bridge requires remedial action to resolve a deficiency with the structure are usually made based on the inspection process, the efficiency of the program relies on the timely and accurate transmission of data.

Data entry into the BRINSAP database is a multistep process. District field engineers or consultants perform inspections of each bridge as required by NBIS. Data from the field report forms are transmitted from the inspector to the appropriate district coordinator. Each district then reviews and edits the information and submits it to the BRINSAP section at the central office, where the information is then entered into the database. Because the NBIS requires biennial inspections, each year approximately 24,000 of the state's bridges are inspected. Owing to the tremendous amount of data transferred, there is significant opportunity for recording inaccurate information, which can include not entering the information at all. For example, three fields in the database allow the code "N" to be entered, indicating that the "bridge is not over a waterway." These fields are Item 61 (Channel and Channel Protection), Item 71 (Waterway Adequacy), and Item 113 (Scour Critical Bridges). For any given set of bridges, there should be numerical agreement between the three fields as to whether they span a waterway or not. As shown in Table 2.3, numerical agreement between these items does not exist for on-system or off-system bridges.

Table 2.3 Example of Inaccurate Data for On-System and Off-System Bridges.

Code indication	On-System			Off-System		
	Item 61	Item 71	Item 113	Item 61	Item 71	Item 113
Over water	24,610	24,657	24,561	15,781	15,783	15,773
Not over water	7,432	7,463	7,488	494	490	444
Subtotal	32,042	32,120	32,049	16,275	16,273	16,217
Missing code	96	18	89	18	20	76
Total	32,138	32,138	32,138	16,293	16,293	16,293

2.2.3 Initial Screening Method for Scour Evaluation (SVEAR)

In response to T 5140.23, issued by the FHWA in 1991, TxDOT developed an initial scour-screening process to identify bridges that may require further evaluation. The process consisted of a cursory geomorphic survey of all existing bridge sites over waterways, excluding bridge class culverts. Bridges were evaluated by performing a field survey of the hydraulic and physical characteristics of the site, with the results used to complete the Scour Vulnerability Examination and Ranking Format (SVEAR). The SVEAR process categorized bridges as having known scour problems, being highly susceptible to scour, having a medium susceptibility to scour, or having low risk (Olona, 1992). The intent of the program was to identify the magnitude of the problem, and to provide a basis for prioritizing sites to receive further evaluation. In 1992, TxDOT identified 7,803 bridges, nearly 20 percent of the bridges over waterways, as being potentially vulnerable to scour-related damage. Figure 2.2 depicts the SVEAR process.

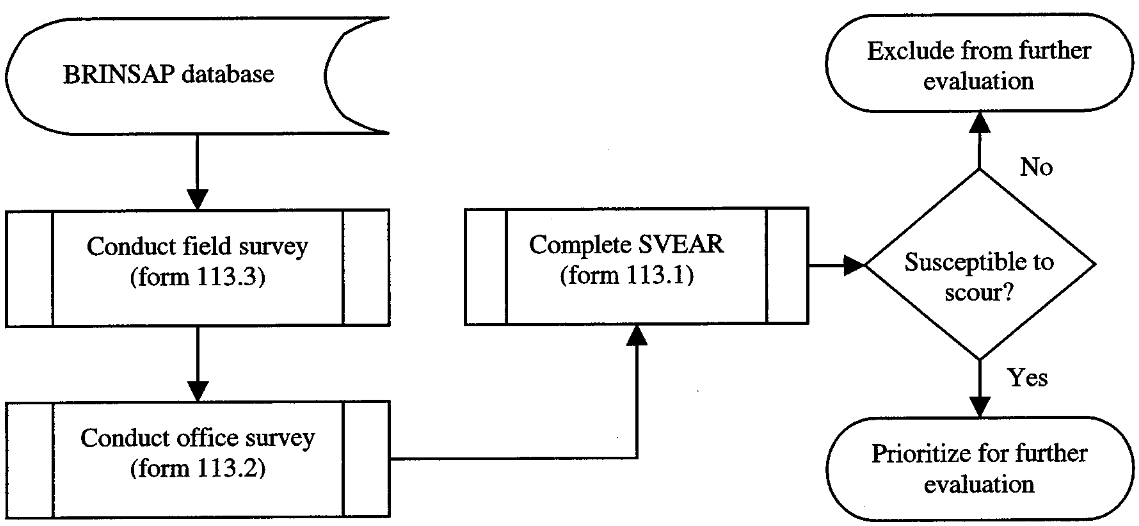

Figure 2.2 The SVEAR Screening Process Flow Diagram.

The objectives of the initial screening process were to identify the number of scour-susceptible bridges, and then to prioritize the bridges to receive further evaluation as necessary. The prioritization of bridges relied on the ranking obtained from the SVEAR process and on the data contained in the BRINSAP database. The factors that were chosen from the database were viewed as indicators of the level of risk associated with each bridge site. Aside from the scour susceptibility designations assigned in Item 113.1, the prioritization also considered Item 29 (Average Daily Traffic), Item 44 (Substructure Type), and Item 43 (Structure Type). Each of these factors was given equal weight, with a computer program written to assist with the prioritization. A list of prioritized sites was generated and subdivided by maintenance district. The districts were then directed to perform detailed scour evaluations for each site on their respective list.

There are potential problems inherent in this approach. First, the assignment of equal weights to the prioritization parameters did not necessarily reflect the true priority of the sites. Second, because of the variety of environmental conditions found across the state, districts in East Texas were faced with much larger workloads than some of the more arid regions found in West Texas. Third, given the large number of sites that presumably were in need of a higher-level analysis, there were not enough resources to complete all the investigations. TxDOT estimated the cost of a detailed scour analysis to be greater than $8,000 per site. This meant it would cost more than $15,000,000 per year to comply with the January 1997 deadline established by the FHWA for completing scour evaluations (TxDOT, 1993).

2.2.4 Texas Secondary Evaluation and Analysis for Scour

Because the results of the initial screening indicated a large population of scour-vulnerable bridges, there was a need to refine the evaluation process. To fulfill this need TxDOT developed the Texas Secondary Evaluation and Analysis for Scour (TSEAS). TSEAS is a two-step evaluation approach consisting of a secondary screening similar to the initial screening process, and a concise analysis that provides a conservative estimate of predicted scour depths.

Like the initial screening process, the secondary screening is a survey consisting of eleven questions that address whether the factors necessary for scour hole development exist at the site. The answers to most of the questions should correspond directly to the code for Items 44, 60, 61, 65, 71, and 113 in the BRINSAP database. Risk factors used for prioritization of sites to receive further analysis correspond to Items 29, 43, 44, and 113.1. The remaining questions pertain to physical characteristics of the bridge site, such as whether the bridge is located near a sharp bend in the stream or near a confluence of another major stream, or if dredging or in-stream mining operations or a control structure is located near the bridge. The BRINSAP database does not contain fields in which the answers to these latter questions can be found; that information should be contained in the as-built drawings or otherwise determined by conducting a field survey at the site. Table 2.4(A) shows the parameters used for bridge scour evaluations, 2.4(B) shows the parameters used for prioritization, and 2.4(C) shows the parameters indicative of scour risk factors not found in the BRINSAP database.

The second part of the TSEAS process is the concise analysis, which provides a conservative estimate of scour depth by implementing default hydraulic parameters and making simplified assumptions about allowable scour depths. When the predicted scour depth is greater than allowable for the subject site, a detailed analysis is recommended. Figure 2.3 summarizes the TSEAS process.

2.3 SCOUR MONITORING AND SITE PRIORITIZATION

Section 2.2 of this chapter presents the chronological development of TxDOT's bridge scour evaluation and mitigation program. The SVEAR screening process was developed in 1991 as a means of identifying the magnitude of Texas' scour vulnerable bridge population, and to provide a basis for prioritizing sites to receive more in-depth scour analyses. In order to reduce program costs, TxDOT developed in 1993 the TSEAS process to prevent bridges from receiving unnecessary and costly detailed hydraulic analyses. Through these two processes, TxDOT has gained significant experience with scour evaluations, such that today the magnitude of the scour problem is known with more certainty.

Table 2.4 (A) Bridge Scour Evaluation Parameters.

Parameter	Item	Description
Is there a history of scour at the bridge? Are there any exposed footings? Are scour countermeasures in place and functioning?	113	Scour Critical Bridges
Is the highway embankment damaged by scour?	71	Waterway Adequacy
Does the bridge approach embankment have a history of flood damage?	65	Roadway Approach
Does the bridge collect debris during flooding? Is there evidence of streambed aggradation? Is there evidence of channel migration?	61	Channel & Channel Protection
Has scour occurred below the original ground line? Is other scour or erosion present in the streambed?	60	Substructure Evaluation
Does the bridge have any spread footings?	44	Substructure Type

Table 2.4 (B) Scour Evaluation Prioritization Parameters.

Parameter	Item	Description
What is the bridge's vulnerability to scour?	113.1	Scour Vulnerability Assessment
What is the traffic volume at the bridge site?	29	Average Daily Traffic
What is the foundation type?	44	Substructure Type
Is the bridge a simple or continuous span?	43.1	Structure Type

Table 2.4 (C) Scour Risk Indication Parameters.

Parameter	Determined by:
Is the bridge on an alluvial fan or sand bed channel?	As-built drawings
Is the bridge located at or near a sharp bend in the stream? Is the bridge within 1 mile of a confluence with another stream? Is the bridge located near a commercial in-stream mining operation? Is the bridge located near a dredging operation or flood control structure? Are the bridge piers skewed against the primary direction of flow?	Field survey

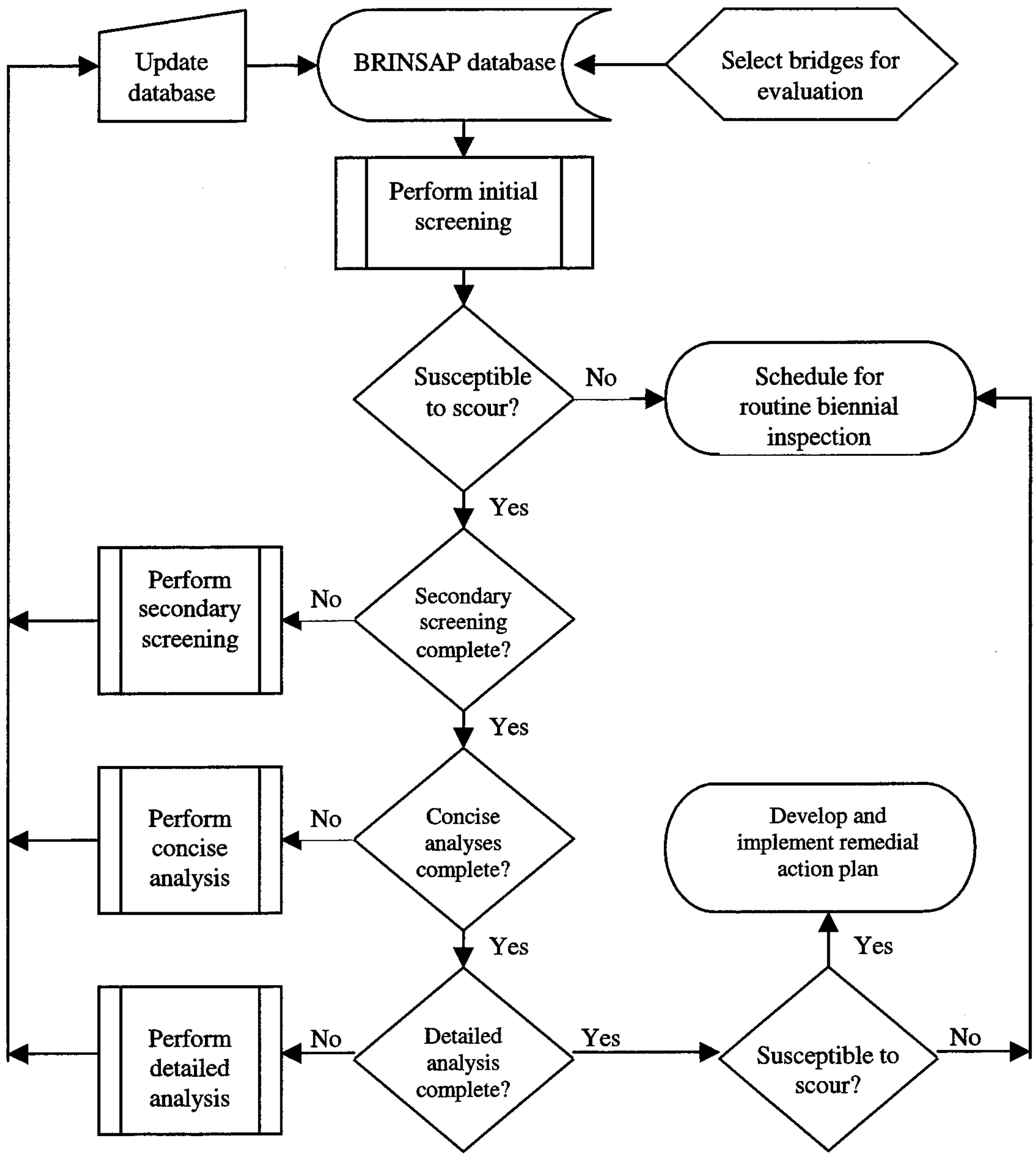

Figure 2.3 The TSEAS Process Flow Diagram.

The next logical step in the progression of the scour evaluation and mitigation program should be to enhance the state of knowledge about scour countermeasures, and to establish an appropriate site prioritization method. Numerous documents published by the FHWA acknowledge monitoring as a viable scour countermeasure. Research performed by Ayres Associates of Fort Collins, Colorado, promotes the use of mechanical monitoring devices as a means for collecting real-time scour data. They concluded that real-time scour data collection is necessary for enhancing the state of knowledge about the scour process and for calibrating the existing scour prediction equations (Richardson et al., 1997). Because of limited resources, all of Texas' scour critical bridges cannot be immediately repaired or replaced. Therefore, a prioritization method that takes advantage of TxDOT's existing data collection process and scour evaluation experience should be developed.

2.3.1 Estimation of the Number of Bridges To Be Prioritized

An analysis of the December 1998 version of the BRINSAP database in which Item 113.1 is cross tabulated with Item 113 indicates that 6,432 bridges have received a scour evaluation through the TSEAS process. Consequently, 5,929 of them are now considered stable for the calculated scour depth. If the bridges with Item 113.1 codes of 1, 2, 3, B, C, or D need evaluation, then only 5,815 bridges remain to be processed by TSEAS. However, of the 5,815 remaining, 4,397 have unknown foundation types and will require additional investigation to determine their scour vulnerability. Therefore, 1,418 bridges can be evaluated by TSEAS. The remaining bridges either do not cross a waterway, are low risk owing to the proximity of the foundation relative to the waterway, or have unknown foundation types. Table 2.5 shows the cross tabulation of Item 113.1 with Item 113. Table 2.6 provides the key to the codes for Items 113.1 and 113.

Table 2.5 shows that TxDOT has evaluated a large majority of the bridges that are subject to the TSEAS process. As the remaining bridges undergo the evaluation process, the data contained in Item 113 (Scour Critical Bridges) become more consistent with the actual scour condition. Currently there are 834 bridges (on- and off-system combined) with an Item 113 code of 3 or lower, indicating that they are scour critical. During 1998, TxDOT evaluated 1,238 bridges, 325 (~26 percent) of which were determined to be scour critical. If the same proportion of the remaining unevaluated bridges is determined to be scour critical, the population of scour critical bridges should rise to approximately 1,200 by the time the remaining bridges are evaluated.

Table 2.5 Cross Tabulation of Item 113.1 with Item 113.

All districts Dec-98

M & BC = Either missing code or bad code.

[shaded cell] = Not a possible combination of scour rating and scour vulnerability assessment.

Scour Vulner-ability	Scour Rating														Row total
	M & BC	0	1	2	3	4	5	6	7	8	9	N	T	U	
M&BC	150	2	230			2	2	54		399	4	7,893		2,861	11,598
1		1		8	24	11	6	76		17		1	2	20	166
2	1				28	18	44	420		165	1	2	23	92	794
3	2				34	2	10	181		145			7	41	432
A	1	2	2	1		1	16	106	3	2,162	24	23		2,598	4,940
B			1	1	1	9	1	11		3		1		378	406
C	1			5	2	1	9	46	2	29				2,212	2,307
D					5		5	20		26				1,654	1,710
E			1		1	1	325	5		2,453				2	2,788
Q	1					34	298	24	367	4,124	1	1	11	12	4,873
R						22	615	1		316					954
S							35		1	65					102
T				11	425	5	6	1		2					450
U					49	1	1	1		1					53
Column total	156	5	234	26	569	107	1,373	946	373	9,907	30	7,921	56	9,870	31,573

Table 2.6 Key to Item 113.1 and Item 113 Code.

Item 113.1 – Scour Vulnerability Assessment
1 – Known scour problem
2 – High susceptibility to scour
3 – Medium susceptibility to scour
A – Low risk to scour
B – Known scour problems; no plans exist showing foundation depths
C – High susceptibility to scour; no plans exist showing foundation depths
D – Medium susceptibility to scour; no plans exist showing foundation depths
E – Plans exist and foundation depths are in bedrock in accordance with construction plans
Q – Stable by secondary screening
R – Stable by concise analysis
S – Stable by detailed analysis
T – Unstable by concise analysis
U – Unstable by detailed analysis
Item 113 – Scour Critical Bridges
0 – Bridge is scour critical. Bridge has failed and is closed to traffic.
1 – Bridge is scour critical. Failure of piers/abutments is imminent. Bridge is closed to traffic.
2 – Bridge is scour critical. Immediate action is required to provide scour countermeasures.
3 – Bridge is scour critical. Foundation determined to be unstable for calculated scour.
4 – Foundations stable for calculated scour. Action required to protect against additional erosion.
5 – Foundations stable for calculated scour. Scour is within limits of footings or pilings.
6 – Scour calculation/evaluation has not been made.
7 – Scour countermeasures have been installed to correct a previously existing problem.
8 – Foundations stable for calculated scour. Calculated scour is above top of footing.
9 – Foundations (including pilings) are well above floodwater elevations.
N – Bridge is not over waterway.
U – Bridge foundation type is unknown.
T – Bridge is over tidally influenced waterway and the bridge is considered low risk.

2.3.2 Selection of Prioritization Parameters

Because the scour evaluation procedures influence the code assigned to certain items in the BRINSAP database, it follows that an analysis of those items should provide an indication of the risk of scour-related failure. The parameters chosen for evaluation and prioritization in the past pertain primarily to the scour condition, substructure condition, channel condition, structure type, and exposure to the motoring public. (Refer to Table 2.4 [A] and [B] to review these parameters.) For developing a prioritization method in this report, the parameters were chosen from those found in Table 2.4(A) and 2.4(B). Table 2.7 shows the parameters selected for the prioritization algorithm.

Table 2.7 Parameters Chosen for Prioritization Algorithm.

Item #	Description
113	Scour Critical Bridges
71	Waterway Adequacy
65	Roadway Approach
61	Channel and Channel Protection
60	Substructure Evaluation
44	Substructure Type
43	Structure Type
29	Average Daily Traffic
26	Functional Classification

2.3.3 The Role of Monitoring in a Bridge Management System

There are three types of solutions to address a scour problem at a bridge site. The waterway can be altered, the bridge structure can be altered, or the condition can be monitored. Monitoring may consist of periodic inspections by bridge inspectors or may be performed by mechanical means. Figure 2.4 shows where monitoring resides in the hierarchy of a bridge management system, while Figure 2.5 shows where monitoring and site prioritization fit into TxDOT's scour evaluation program. The shaded areas indicate additions to the program.

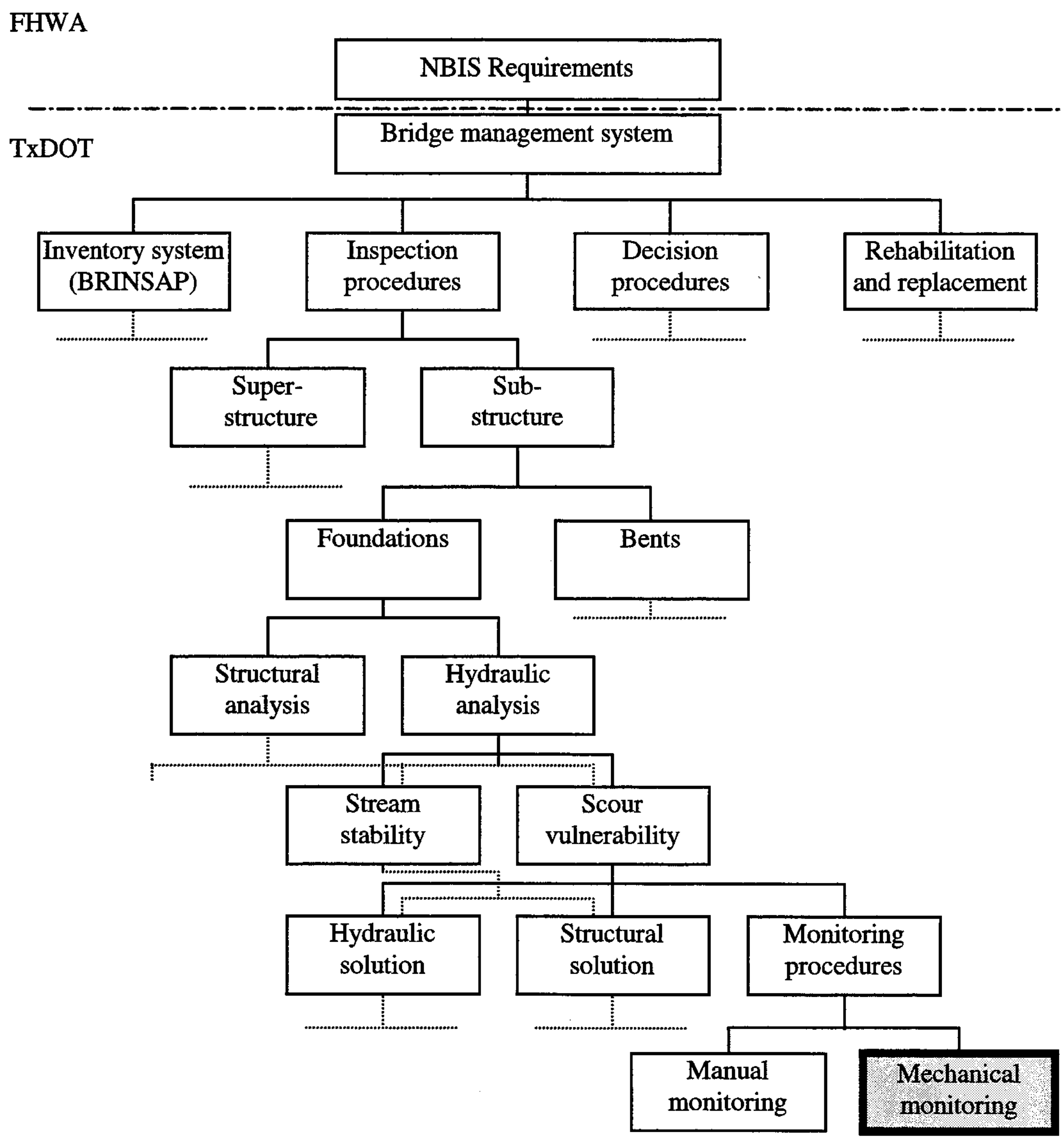

Figure 2.4 Hierarchical Breakdown Structure of Bridge Management System.

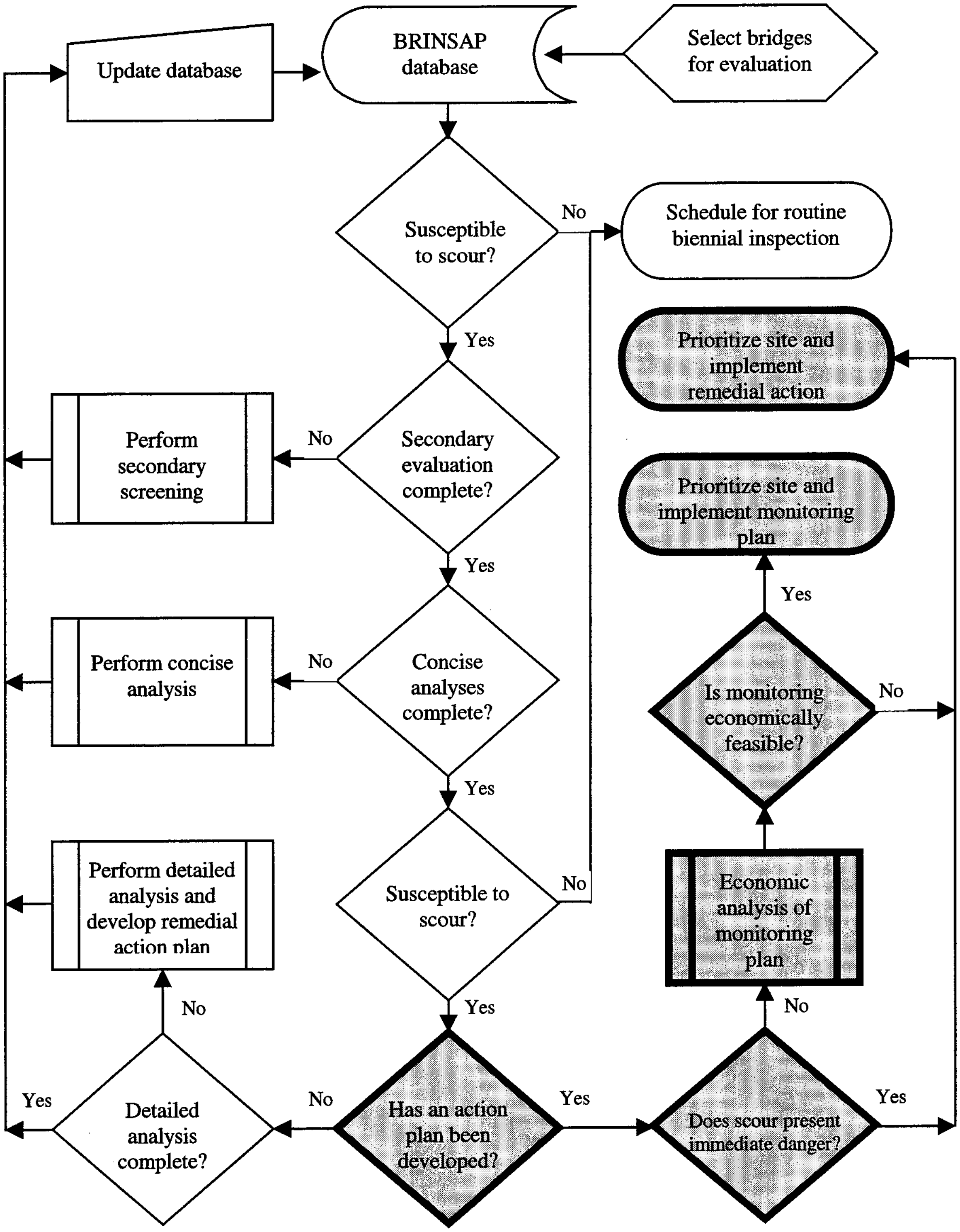

Figure 2.5 Improved Scour Evaluation and Monitoring Flow Diagram.

As shown in Figure 2.5, the additions to the scour evaluation and monitoring program include a series of questions that ask if a remedial action plan has been developed, and whether the scour condition presents an immediate danger to the bridge structure. An economic analysis method to determine if monitoring is a feasible alternative is also included. The process concludes with prioritizing the sites that fall into the categories of monitoring or other scour countermeasures. The development of the prioritization method is presented in Chapter 3. A conceptual framework of an economic analysis for selection of a scour countermeasure is presented in Chapter 5.

CHAPTER 3. DEVELOPMENT OF THE PRIORITIZATION MODEL

3.1 COMPONENTS OF THE PRIORITIZATION MODEL

The prioritization model developed for this project is an additive function in which the sum of the products of the parameter weight and score produce a total score for the site being prioritized; the lower the site score, the higher the priority of the site. The model consists of the nine parameters (P_i) found in Table 2.7, a weight (λ_i) assigned to each parameter, and the total site score (SS). Equation 3.1 shows the structure of the prioritization model:

$$\sum_{i=1}^{9} \lambda_i P_i = SS \qquad \text{(Eq. 3.1)}$$

Data collection for the model development process consisted in surveying the Texas Department of Transportation's (TxDOT's) district Bridge Inventory, Inspection and Appraisal Program (BRINSAP) coordinators, and analyzing the BRINSAP database using SAS® software. The analysis method consists in using responses from the district coordinators to calibrate the weights assigned to the parameters. The goal is to achieve the highest possible correlation between the model output and site priority rankings provided by the district engineers.

3.1.1 Rank Ordering of the Prioritization Parameters

The first step in developing the prioritization model was to determine the order of importance of the parameters identified in Chapter 2. A list containing the nine parameters in Table 2.7 was distributed to the twenty-five maintenance districts. The district coordinators were asked to rank the parameters according to how important each was in terms of prioritizing bridge sites for scour monitoring. Table 3.1 shows the ranking provided by each of the eleven respondents.

Table 3.1 Respondents' Ranking of the Prioritization Parameters.

Item #	Description	Houston	Paris	Childress	Lufkin	Ft. Worth	Dallas	Bryan	Corpus Christi	Pharr	Wichita Falls	Amarillo	Σ Row	μ
113	Scour Critical Bridges	1	1	1	1	1	1	2	1	1	1	1	12	1.09
60	Substructure Evaluation	2	2	4	2	2	2	3	2	3	6	4	32	2.91
61	Channel and Channel Condition	3	4	2	5	3	3	1	4	4	4	5	38	3.45
44	Substructure Type	4	3	3	3	4	4	4	5	2	2	7	41	3.73
71	Waterway Adequacy	5	5	5	4	7	8	6	3	8	3	6	60	5.45
29	Average Daily Traffic	6	7	6	7	5	6	5	8	5	8	2	65	5.91
43	Structure Type	9	6	7	6	9	5	9	6	7	5	8	77	7.00
26	Functional Classification	7	9	9	8	6	7	8	9	6	7	3	79	7.18
65	Roadway Approach	8	8	8	9	8	9	7	7	9	9	9	91	8.27
Correlation to combined ranking		0.95	0.95	0.93	0.93	0.88	0.88	0.87	0.87	0.83	0.72	0.50		0.99

The order of importance was established by sorting the parameters in ascending order according to the district engineers' mean response shown in the last column in Table 3.1. The bottom row in the table shows the correlation coefficient between each respondent's ranking and the combined ranking based on the mean response. Nine of the eleven respondents have a correlation coefficient >0.80, and all are above 0.50, indicating there is reasonable agreement between the respondents regarding the order of importance of the parameters.

3.1.2 Assignment of Weights to the Parameters

The second step in developing the prioritization model was to assign weights (λ_i) to each of the parameters. Given the number of decision makers involved in this process, it was not practical to determine immediately the difference in importance between each parameter. Rather, as a starting point, weights were assigned based on the mean value of the responses to the parameter-ranking survey (refer to Table 3.1). This approach allowed the group response to be reflected in the initial weights without trying to incorporate differences of opinion about how much more important one parameter is than another parameter. Section 3.2.4 proposes a method to adjust the weights to determine the differences in each parameter's importance.

To assign the initial weight, the mean value of each parameter (found in the last column in Table 3.1) was multiplied by 11 (the number of respondents). Mathematically, this corresponds to the row sum. The inverse of the row sum was then assigned to the column labeled α_I in Table 3.2. The sum of all α_i was calculated to act as a multiplying constant (K) so that the sum of all weights would be equal to 1. The product of α_i and the multiplying constant generates the weight for each parameter. Equation 3.2a shows the formula for determining α_i, equation 3.2b shows the formula for determining the multiplying constant, and 3.2c calculates the initial parameter weight.

$\alpha_i = 1/(n^*\mu_i)$ where $n = 11$ and μ_i = the mean response from Table 3.1 (Eq. 3.2a)

$K = 1/\Sigma\,\alpha_i$ (Eq. 3.2b)

$\lambda_i = K^*\alpha_i$ (Eq. 3.2c)

Table 3.2 shows the initial weights assigned to each of the parameters based on the respondents' rankings. The parameter weight is contained in the column labeled λ_i.

Table 3.2 Initial Weights Assigned to Each Parameter.

Rank #	Item #	Description	μ_i	σ_i	c.o.v.	α_i	λ_i
1	113	Scour Critical Bridges	1.09	0.30	0.28	0.083	0.356
2	60	Substructure Evaluation	2.91	1.30	0.45	0.031	0.134
3	61	Channel and Channel Condition	3.45	1.21	0.35	0.026	0.112
4	44	Substructure Type	3.73	1.42	0.38	0.024	0.104
5	71	Waterway Adequacy	5.45	1.75	0.32	0.017	0.071
6	29	Average Daily Traffic	5.91	1.70	0.29	0.015	0.066
7	43	Structure Type	7.00	1.55	0.22	0.013	0.056
8	26	Functional Classification	7.18	1.78	0.25	0.013	0.054
9	65	Roadway Approach	8.27	0.79	0.10	0.011	0.047
	$n = 11$ $\alpha_i = 1/(n^*\mu_i)$ $K = 1/(\Sigma\,\alpha i)$				$\Sigma\alpha_i =$	0.234	1.000
	$\lambda_i = K^*\alpha_i$ = parameter weight				$K =$	4.274	

3.1.3 Assignment of Scores to the Parameters

The third step in developing the prioritization model was to assign scores to each of the parameters. Each parameter can be assigned a score between 1 and 10 based on its code in the BRINSAP database. The range of scores from 1 to 10 was chosen because it conveniently matches the code structure for most of the selected parameters.

With respect to five of the parameters (Items 113, 71, 65, 61, and 60), the lower code indicates the poorer condition of the structure or its environment. Possible codes in the BRINSAP database for these five items are alphanumeric, range from 0 to 9, and include "N" for either "not applicable" or "bridge is not over a waterway." A code of 0 for these items, which indicates the worst possible condition, must be assigned a value of 1 or it will not add to the total score for site prioritization. Table 3.3 shows the conversion of code for Items 113, 71, 65, 61, and 60.

Table 3.3 Code Conversion for Items 113, 71, 65, 61, and 60.

	BRINSAP Item #					
	113 Scour Rating	71 Waterway Adequacy	65 Roadway Approach	61 Channel Condition	60 Substructure Evaluation	Converts to:
Possible BRINSAP Code ↓	0	0	0	0	0	1
	1	2	1	1	1	2
	2	3	2	2	2	3
	3	4	3	3	3	4
	4	5	4	4	4	5
	5	6	5	5	5	6
	7	7	6	6	6	7
	8	8	7	7	7	8
	9	9	8	8	8	9
	N	N	9	9	9	10
	T, U, 6		N	N	N	NA

In Table 3.3, Items 113, 71, 65, 61, and 60 all provide a measure of the physical condition of the bridge or the waterway. The BRINSAP code structure for these items generally follows the convention where the lower code indicates greater deterioration from scouring of the bridge site or waterway. For Item 113 (Scour Critical Bridges) the codes of "T," "U," and "6" are not applicable for prioritization. An Item 113 code of "T" indicates that the bridge is over a tidally influenced waterway and is considered low risk. The code "U" indicates that the foundation type is unknown, and therefore, the allowable scour depth is unknown. The code "6" indicates that the bridge has not been evaluated for scour, in which case it is unknown whether a scour problem exists at the site or not. For Items 65, 61, and 60, the code "N" indicates "not applicable."

The remaining four parameters (Items 44, 43, 29, and 26) do not follow the convention of lower codes indicating poorer condition, but their scores can be converted to indicate their level of risk of scour-related failure. Items 44 (Substructure Type) and 43 (Structure Type) are ranked according to the percentage of their total population that is scour critical. Items 29 (ADT) and 26 (Functional Classification) are ranked according to risk exposure. The higher the ADT or the facility's level of service, the lower the parameter score. Table 3.4 shows the code conversion for Items 44, 43, 29, and 26.

Table 3.4 Code Conversion for Items 44, 43, 29, and 26.

	BRINSAP Item					
	44 Foundation type	43 Structure type	29 ADT Low -	High	26 Functional classification	Converts to:
Possible BRINSAP Code ↓	8	5	100,001	508,133	01, 11, 21, 41	1
	2	7	44,363	100,000	12, 22, 42	2
	5	4	19,681	44,362	23, 43	3
	9	1	8,731	19,680	02, 13	4
	7	2	3,874	8,730	24, 44	5
	1	3	1,719	3,873	03, 14	6
	6	6	763	1,718	25, 45	7
	4	8	339	762	04, 15	8
	-	9	151	338	26, 46	9
	3	-	0	150	05, 06, 16	10

In Table 3.4, Items 44, 43, 29, and 26 provide a measure of the risk of scour-related failure. Item 44 (Substructure Type) allows for identification of the bridge foundation type below the ground level. The code used for this item is numeric and ranges from 1–9. In Table 3.4, the foundation types are arranged according to the scour critical percentage of their respective total population. The logic for using this measure is that if a bridge is scour critical (Item 113 code of 0, 1, 2, or 3), the foundation type does not matter and the remaining parameters will dictate the priority of the site. However, for questionable bridges (for instance, Item 113 code of 4 or 5), foundation types that exhibit a greater tendency to be scour critical will produce a higher priority than foundation types that are not as susceptible to scour.

The same logic is applied to Item 43 (Structure Type) where the superstructure types are arranged according to the percentage of their total population that is scour critical. While acknowledging that scour does not discriminate by superstructure type, it should be noted that 99 percent of all span bridges in Texas are either a simple span (82 percent) or a continuous span (17 percent). It is widely agreed among bridge engineers that a simple span presents a greater risk of catastrophic failure than a continuous span owing to the lack of structural redundancy. This characteristic is accounted for in Table 3.4 where simple spans receive a lower score than continuous spans. Tables 3.5 and 3.6 provide the code descriptions for Items 44 and 43, respectively.

Table 3.5 Code Description for Item 44, Substructure Type.

BRINSAP Code	Item 44 – Substructure Type (below ground portion). Description
8	Pile cap on timber piling
2	Concrete piling
5	Spread footing
9	Other
7	Pile cap on concrete piling
1	Steel piling
6	Pile cap on steel piling
4	Drilled shafts
-	Missing a foundation type entry
3	Timber piling

Table 3.6 Code Description for Item 43, Superstructure Type.

BRINSAP Code	Item 43 – Superstructure Type. Description
5	Arch
7	Movable
4	Cantilever with suspended span
1	Simple span
2	Continuous span
3	Cantilever
6	Rigid frame
8	Suspension or stayed
9	Other
-	Missing a superstructure type entry

In Table 3.4, Item 29, average daily traffic (ADT), is scored according to the volume of traffic crossing the bridge on a daily basis. Values of ADT for on- and off-system bridges range from 1 to 916,750 vehicles per day, with mean values of 18,236 and 2,222 vehicles per day, respectively. However, there are no scour critical bridges with an ADT > 100,000 vehicles per day. Therefore, it was desired to have a function where an ADT of 150 or lower would produce a score of 10, where mean values of ADT would produce a mid-range score, and where an ADT of 100,000 or higher would produce a score of 1. Solving simultaneous equations to accomplish these goals produced a logarithmic function. Equation 3.3 shows the mathematical form of the function, and Figure 3.1 shows the ADT scoring function.

$$\text{ADT score} = -1.23 \text{ Ln (ADT)} + 16.17 \quad [R^2 = 1] \qquad \text{(Eq. 3.3)}$$

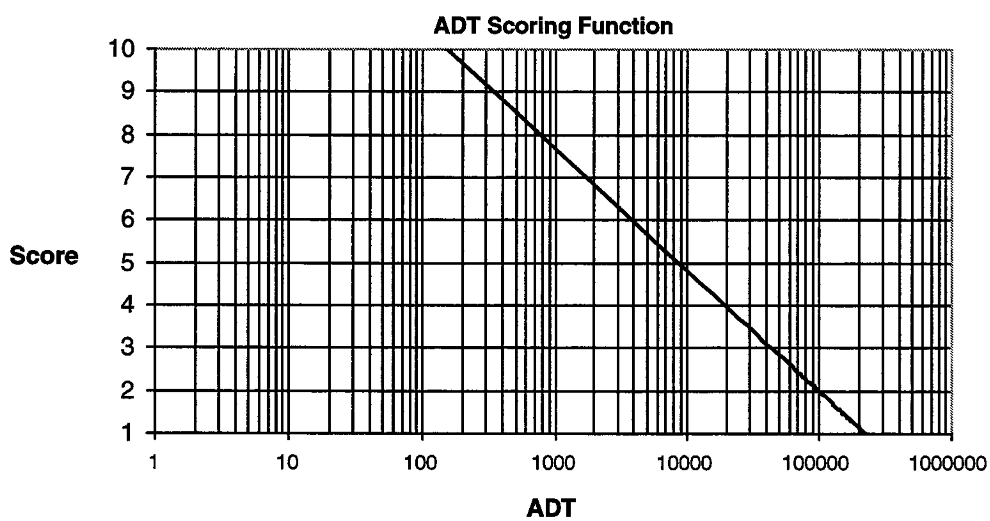

Figure 3.1 ADT Scoring Function.

In Table 3.4, Item 26 is scored so that the higher level of service facilities are given higher priority. Table 3.7 provides the code description for Item 26.

Table 3.7 Code Description for Item 26, Functional Classification.

Item 26 – Functional Classification				
Urban Code (Pop x 1000)			Functional	Rural
5–25	25–50	50+	Classification	Code
11	21	41	Interstate	01
12	22	42	Freeway & Expressway	-
13	23	43	Other Principal Arterial	02
14	24	44	Minor Arterial	03
15	25	45	Collector	-
-	-	-	Major	04
-	-	-	Minor	05
16	26	46	Local	06

3.2 PRIORITIZATION MODEL PERFORMANCE AND CALIBRATION

After the initial development of the prioritization model, it was necessary to check the performance of the model and calibrate it to reflect the priorities of the district engineers. The method used consisted in distributing lists of bridges to the districts and asking the district engineer to prioritize the list according to his or her concern about each bridge with respect to scour problems. This approach was used because the district engineers' knowledge of the problems with the bridges in their district is presumably more intimate than can be reflected in the code contained in the BRINSAP database. The model output was compared with the responses from the districts. The weights should be adjusted to maximize the correlation between model output and the engineers' responses.

3.2.1 *The Initial Model Output*

To produce the initial model output, the parameter scores as described in Section 3.1 had to be generated from the code existing in the BRINSAP database. To accomplish this task a SAS® program (see Appendix A) was written to convert the code to the appropriate score. The output of the SAS® program was imported into Excel®, where the parameter weights were then multiplied by the scores to produce a site score. In Excel, the list of bridges was sorted by district and then in ascending order by site score, thereby producing prioritized lists for each district. This process was applied to all on-system bridges with Item 113 codes of five or lower (see Appendix D), which resulted in the prioritization of 1,974 bridges. It was found that there was too much missing code in the off-system bridge file to use this method effectively in some districts (see Appendix E). Table 3.8 shows an example of a partial list of prioritized sites for the Yoakum District; the control, section, and number are provided so the district engineer can identify the bridge.

Table 3.8 Partial List of Prioritized Sites from the Yoakum District.

District	Cont.	Sec.	Num.	Location	Crosses	Score
13	88	4	16	4.34 MI S OF US 77	BOGGY CRK	4.538
13	266	6	36	0.25 MI NW OF FM 653	TRES PALACIOS RIVER	4.710
13	89	15	25	0.90 MI S OF SH 71	TRES PALACIOS RIVER	4.762
13	153	2	7	2.55 MI SE OF FM 1586	CANOE CRK	4.991
13	153	2	4	0.30 MI SE OF FM 1586	ARTESIA CRK	5.077
13	515	1	17	AT JACKSON - VICTORIA C/L	GARCITAS CRK	5.086
13	89	7	30	1.70 MI SW OF FM 961	BOSQUE SLOUGH	5.098
13	535	7	75	3.90 MI E OF FM 2238	WEST NAVIDAD RIVER	5.125
13	153	2	10	5.85 MI SE OF FM 1586	SMITH CRK	5.164
13	1302	1	7	2.20 MI W OF SH 71	DRAINAGE CANAL	5.209

3.2.2 Bridge Lists Prioritized by District Engineers

After the prioritized lists were produced and sorted by district, ten bridges were chosen from each of thirteen districts that represent the vast majority of scour critical bridge locations in the state. The parameter scores and site scores were removed from the lists and replaced with the corresponding BRINSAP code. The bridge lists were also arbitrarily rearranged so that there was no bias inadvertently introduced when the lists were presented to the district engineers. The lists were then sent to their respective districts and the engineers were asked to prioritize them based on their knowledge of the condition of the bridge.

Twelve lists were returned, and the prioritization produced by the engineers was compared to that produced by the initial model output. A matrix was set up in Excel to determine the correlation between the model output and the engineers' responses. Table 3.9 shows the comparison matrix.

Table 3.9 Model Output versus Engineers' Prioritization Comparison Matrix

Model Output	Ft. Worth	San Antonio	Beaumont	Tyler	Waco	Yoakum	Bryan	Wichita Falls	Houston	Amarillo	Paris	Atlanta	μ	σ	c.o.v.
1	2	1	2	1	1	2	7	3	1	5	7	3	1.4	2.2	1.60
2	1	2	3	3	2	1	2	5	2	9	10	4	2.2	3.0	1.35
3	4	3	1	2	8	10	1	9	4	2	4	6	3.6	3.1	0.86
4	3	6	4	7	7	3	3	4	10	6	2	7	5.4	2.4	0.44
5	5	4	10	8	4	5	6	2	9	1	1	10	6.2	3.3	0.53
6	6	8	5	9	5	7	10	7	5	10	5	8	6.6	1.9	0.29
7	7	5	7	4	3	4	5	1	6	4	8	1	5.2	2.2	0.43
8		7	9	5	6	9	4	6	8	8	3	5	6.8	2.0	0.30
9		9	6	6	10	6	8	8	3	3	6	9	7.8	2.3	0.30
10		10	8	10	9	8	9	10	7	7	9	2	9.3	2.3	0.25
ρ=	0.93	0.92	0.72	0.66	0.65	0.54	0.52	0.39	0.39	0.05	0.04	0.01	0.94		

3.2.3 Prioritization Model Performance

In Table 3.9, the left-hand column contains the rank order produced by the prioritization model. The columns beneath the district names contain the rank provided by that district for the bridge ranked by the model. For example, the Fort Worth district engineer's second highest ranked bridge was the bridge ranked highest by the model. The mean response for each ranking category was calculated to be used as a measure of model performance. Figure 3.2 shows the model ranking versus the engineers' mean response. The diagonal dashed line represents the line of perfect agreement. A linear regression trend line was imposed on the response data as a graphical aid to show the model performance.

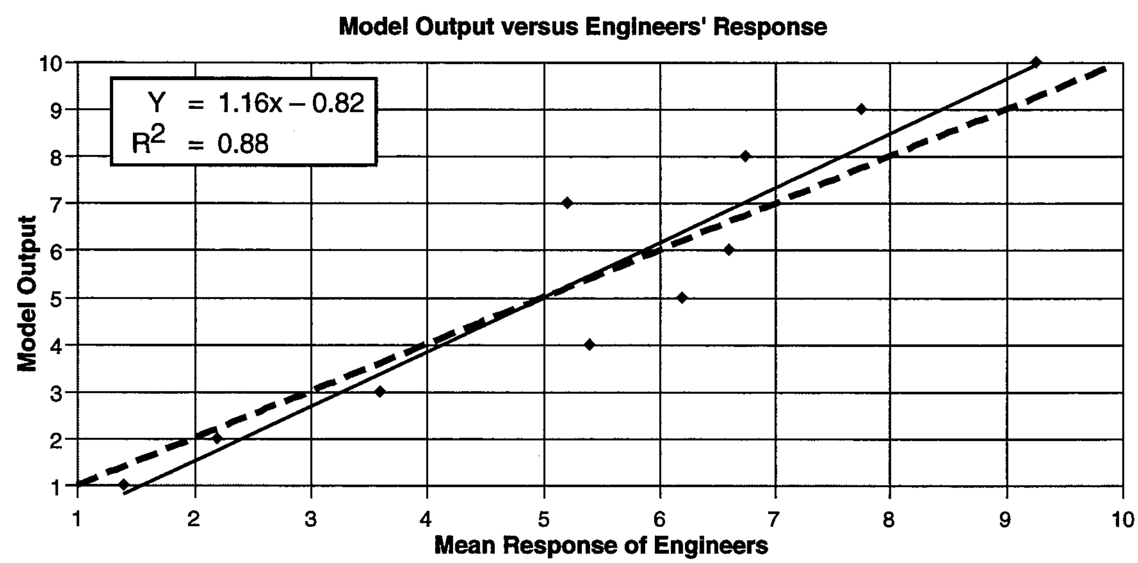

Figure 3.2 Model Output versus Mean Response of District Engineers.

In Table 3.9, the standard deviation and coefficient of variation were also calculated to assist in judging model performance. The coefficient of variation is significantly high for the higher priority sites produced by the model, but reduces to a more reasonable level for the lower priority bridges. Furthermore, when individual district responses are plotted against the model output, some show low correlation. The individual correlation coefficients for each district are shown in the bottom row of Table 3.9. Because of the high coefficient of variation values and the number of correlation coefficients below 0.80, it seems necessary to calibrate the model in an attempt to improve these performance measures.

3.2.4 Prioritization Model Calibration

The order of importance of the prioritization parameters was well established through surveys of the district engineers, and confirmed by observing the high correlation coefficients in Table 3.1 and the low coefficient of variation values in Table 3.2. Furthermore, the parameter scoring method follows a logical pattern that clearly reflects lower scores for worsening structure and/or site conditions, or increasing levels of risk exposure. Therefore, it is proposed that the potential sources of error with the model output stem from one or both of the following areas: 1) the weights assigned to the parameters do not accurately reflect the difference in importance between the parameters, and 2) the code provided in the database may not accurately reflect the actual scour conditions at the bridge site.

Within the constraints of this project, there is no way to control the source of error presented by inaccurate code in the database. Therefore, the weights assigned to the parameters should be adjusted to maximize the correlation between model output and the engineers' rankings. The following method is proposed to accomplish this task.

1. Generate a series of weights that adheres to the following constraints:
   a) A higher priority parameter cannot have a weight equal to or lower than a lower priority parameter.
   b) The sum of the weights must equal 1.
2. Distribute multiple lists of bridges to each district that has scour critical bridges. The lists within each district should have several entries in common so that overlap exists. Have the district engineer prioritize each list.
3. Analyze the engineers' prioritization to produce a single prioritized list for each district.

4. Develop a computer program that can generate various combinations of weights subject to the constraints described in Step 1. Use the different combinations to produce prioritized bridge lists that contain the same bridges that have been prioritized by the engineers.
5. Continually change the weights in the model until the maximum correlation between model output and district engineers' response is achieved.
6. Adopt the set of weights that produces the maximum correlation as the measure of difference in importance between the parameters.
7. Repeat this process periodically to ensure a current set of weights.

3.3 COMPARISON BETWEEN PRIORITIZATION METHODS

Two separate prioritization methods were studied for comparison to the model developed in this report. The University of Washington Department of Civil Engineering developed the first method, known as CAESAR. The second method, known as HYRISK, was developed for the Federal Highway Administration (FHWA). Both methods incorporate estimates of bridge failure probabilities and information contained in bridge inspection files to establish a priority ranking for the bridge site. A description of each method follows.

3.3.1 The CAESAR Scour Evaluation for Prioritization Method

The Cataloging and Expert Evaluation of Scour Risk and River Stability at Bridge Sites, or CAESAR, was developed at the University of Washington in cooperation with the National Cooperative Highway Research Program (NCHRP) Project 24-6, and the Washington State Department of Transportation. CAESAR is a computer program written in Visual Basic® language that operates in the Windows® environment. The system requires user input to define bridge conditions and then calculates scour depths based on historical data. The executable file for CAESAR is located on the World Wide Web at http://www.ce.washington.edu/~scour.

CAESAR is a very comprehensive program. It contains eighty basic questions that pertain to all elements of the bridge substructure and channel configuration. In the category of basic questions, there are an additional ten questions per abutment and eight questions per pier that also require input in order to calculate the risk of scour. Depending on the answers supplied to the basic questions, there may be an additional twenty-three questions to answer. The user, through a series of windows, inputs all data. By relying on default parameters in the program code, CAESAR will allow certain fields to remain incomplete. The researchers for this project conducted a trial run of the CAESAR program. To simulate a typical bridge evaluation, fictitious bridge data based on the average scour critical bridge were used as the input data. Approximately 1 hour was required to complete an evaluation for one bridge. Of all the questions required by CAESAR, none could be answered directly from the BRINSAP database.

Although CAESAR is a comprehensive tool for estimating scour, it is not necessarily compatible with TxDOT's current scour evaluation program. CAESAR could work well as an electronic repository for information more detailed than that currently contained in the BRINSAP database. However, as a prioritization tool, every bridge in the state, or at least every scour critical bridge, would have to be re-inspected and the information entered into CAESAR so that a priority list could be generated. It is not within the scope of this project to attempt to determine how well the prioritization produced by CAESAR correlates with the prioritization produced by the method developed in this report.

3.3.2 The HYRISK Prioritization Method

GKY & Associates of Springfield, Virginia, developed HYRISK, which is a computerized prioritization program that operates only a machine running Windows 3.1. The documentation for this program is contained in National Technical Information Service publication FHWA-RD-92-030. The publication is titled "Strategies for Managing Unknown Bridge Foundations" and was written by Earth Engineering & Sciences, Inc. of Baltimore, Maryland, for the FHWA (Elias, 1994). It is a risk-based model that uses failure probabilities and financial consequences to produce an expected cost of failure, where higher expected costs produce higher priority rankings. The program was written to provide a means of assessing the priority of bridges with unknown foundation types, but is also equally applicable to bridges where the foundation type is known.

Similar to the approach used in this report's prioritization model, HYRISK incorporates twelve parameters from the National Bridge Inventory (NBI) database as its input data. However, HYRISK uses expected cost as the measure of priority, whereas the model developed in this report uses rational numbers to indicate the priority ranking. Consequently, the parameters selected by each model differ slightly. Table 3.10 shows the parameters used by each prioritization model.

Table 3.10 Comparison of Parameters Used by the Prioritization Models.

Item #	Description	Project 3970	HYRISK
113	Scour Critical Bridges	X	X
109	Truck ADT		X
71	Waterway Adequacy	X	X
65	Roadway Approach	X	
61	Channel and Channel Protection	X	X
60	Substructure Evaluation	X	
52	Bridge Width		X
49	Bridge Length		X
44	Substructure Type	X	X
43	Structure Type	X	X
29	Average Daily Traffic	X	X
27	Year Built		X
26	Functional Classification	X	X
19	Detour Length		X

Prioritizing a sample list of bridges by both methods and checking their correlation against the engineers' response provided a comparison of the output of these two models. The list of bridges selected was the same as the one distributed to the districts during the model performance evaluation described in Section 3.2. Although the HYRISK model did not appear to perform as well as the model developed in this report, there are several possible explanations. The documentation manual for HYRISK states that some of the default values used by the model should be adjusted for local conditions. Further, the method for assessing the probability of failure is highly subjective. A more accurate estimation of failure probability would require the input of engineers familiar with each bridge site. The comparison made here used only the default parameters and tables provided for estimating failure probabilities. Table 3.11 shows a comparison matrix of the HYRISK model output versus the engineers' response. The convention is the same as that shown in Table 3.9.

Table 3.11 HYRISK Output versus Engineers' Prioritization Comparison Matrix.

HYRISK Output	Tyler	Waco	Beaumont	Yoakum	Bryan	Atlanta	San Antonio	Wichita Falls	Ft. Worth	Amarillo	Paris	Houston	μ	σ	c.o.v.
1	3	1	5	6	5	1	1	1	5	5	8	8	4.08	2.64	0.65
2	1	3	1	3	2	4	10	10	3	8	10	9	5.33	3.73	0.70
3	2	7	2	5	3	3	4	6	2	1	2	6	3.58	1.98	0.55
4	4	8	4	2	6	10	3	4	7	3	1	2	4.50	2.71	0.60
5	8	4	10	8	9	6	7	3	1	7	6	4	6.08	2.64	0.43
6	6	2	8	1	7	7	2	2	4	9	3	1	4.33	2.90	0.67
7	7	6	6	9	4	9	6	9	6	10	7	7	7.17	1.75	0.24
8	9	5	9	7	1	2	8	7		2	4	3	5.18	2.96	0.57
9	5	10	3	4	10	5	5	8		4	9	10	6.64	2.77	0.42
10	10	9	7	10	8	8	9	5		6	5	5	7.45	1.97	0.26
ρ=	0.81	0.62	0.43	0.41	0.39	0.38	0.37	0.25	0.14	0.05	-0.05	-0.14	0.73		

Figure 3.3 shows the HYRISK model output versus the engineers' mean response. As with Figure 3.2, the diagonal dashed line represents the line of perfect agreement. The linear regression trend line imposed on the response data for the HYRISK model has a slope of 1.64, compared with 1.16 for the model developed in this project. A comparison of Tables 3.9 and 3.11 also indicates that the individual correlation between the model output and engineers' response is higher for the model developed in this project.

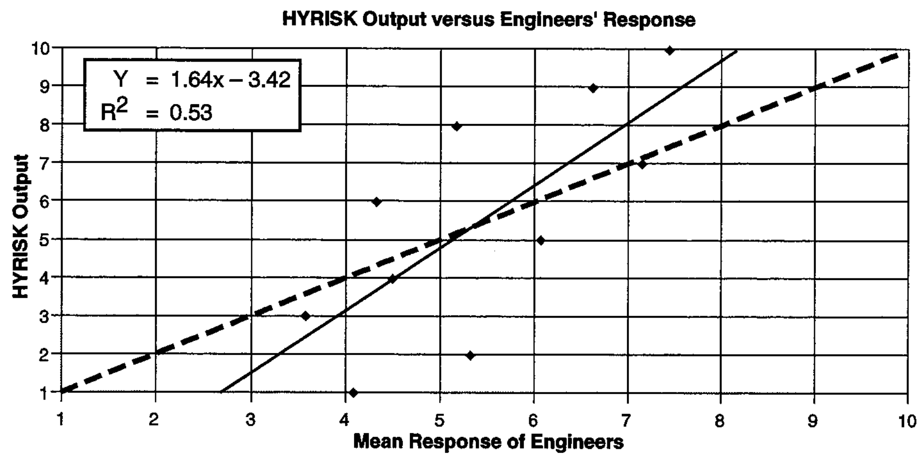

Figure 3.3 HYRISK Model Output versus Mean Response of District Engineers.

The HYRISK method is similar to the prioritization model developed in this report in that it links directly to the database to get its input data. However, for HYRISK it appears that it is necessary to manipulate the data to produce a reasonable probability of failure from scouring. This aspect of HYRISK infers that the model requires more manual input than is necessary for the model developed in this report. However, an advantage to HYRISK is that it quantifies the difference in priority between bridge sites by supplying an expected cost of bridge failure, whereas CAESAR and Project 3970 provide only rank ordering of the sites. Table 3.12 summarizes the characteristics of the three models compared in this section.

Table 3.12 Summary of Model Comparison Information.

Attribute	Project 3970	CAESAR	HYRISK
Data input directly from BRINSAP database.	Yes	No	Yes
Manual data input requirements.	None	Very high	Moderate
Method prioritizes incomplete bridge records.	No	Yes	Yes
Method can prioritize unknown foundation types.	No	Yes	Yes
Method quantifies difference in priority.	No	No	Yes
Method can store extraneous bridge information.	No	Yes	No.
Correlation to district engineers' ranking.	Moderate	Unknown	Low
Application programs required.	SAS	None	None
Operating environment. (required)*	Windows NT/95/98	Windows NT/95/98	Windows 3.1*

CHAPTER 4. REMOTE SCOUR-MONITORING SYSTEMS

4.1 REVIEW OF AVAILABLE SCOUR-MONITORING SYSTEMS

This chapter describes four types of monitoring systems — several of which are commercially available — that have been field tested. These systems include: 1) magnetic sliding collar, 2) sonic fathometer, 3) sounding rod, and 4) other buried devices.

National Cooperative Highway Research Program (NCHRP) Project 21-3 performed by Lagasse and others indicates that the first two types show the most promise for widespread implementation. The magnetic sliding collar system and the low-cost sonic fathometer met or exceeded the mandatory and desirable criteria established for evaluating scour-monitoring equipment in that project. These two monitoring systems are the same ones being fitted with data telemetry capabilities at The University of Texas at San Antonio.

4.1.1 Magnetic Sliding Collar Monitoring Systems

Several methods of measuring the total depth of scour at a point in a stream are currently available. One method is to use a magnetic sliding collar scour-monitoring system. The system consists of a heavy-gauge stainless-steel pipe, a magnetic collar that slides down the exterior of the pipe, an electronic trip switch insert, and a data logger. The collar is free to slide down the vertical stainless-steel pipe as stream bottom material washes out from underneath the collar. A series of switches located inside the pipe at 6" intervals detect the magnetic field as the collar moves downward. A data logger located in the instrumentation panel on the bridge deck records the scour depth. Figure 4.1 shows the system configuration.

The magnetic sliding collar system can easily be fitted with data telemetry equipment developed in Texas Department of Transportation (TxDOT) Project 1380. In that project, sensors were attached to remote processing units where data were transmitted by way of radio frequency waves or cellular communications to a central processing unit. From there, information was downloaded to a remote terminal in a maintenance office. A more detailed description of the system architecture is provided in Section 4.4.1 of this report.

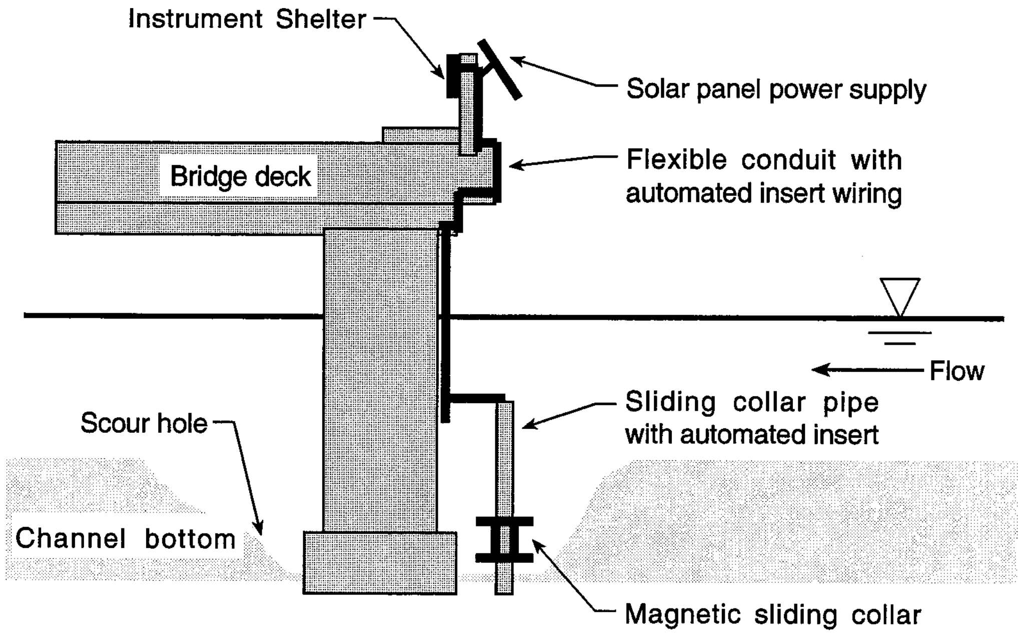

Figure 4.1 Magnetic Sliding Collar Scour-Monitoring System Configuration.
(Adapted from NCHRP Report 21-3)

4.1.2 Low-Cost Sonic Fathometer Monitoring Systems

Another method of scour monitoring involves the use of sonar. Sonar measures scour hole development by measuring the time required for a sound wave to travel from the transducer to the streambed and back. The low-cost sonar scour monitor consists of a commercially available "fish-finder" connected to a data logger. As with the sliding collar system, the sonar system can also be easily fitted with the telemetry equipment developed in Project 1380. Figure 4.2 shows a typical sonar scour-monitoring system configuration.

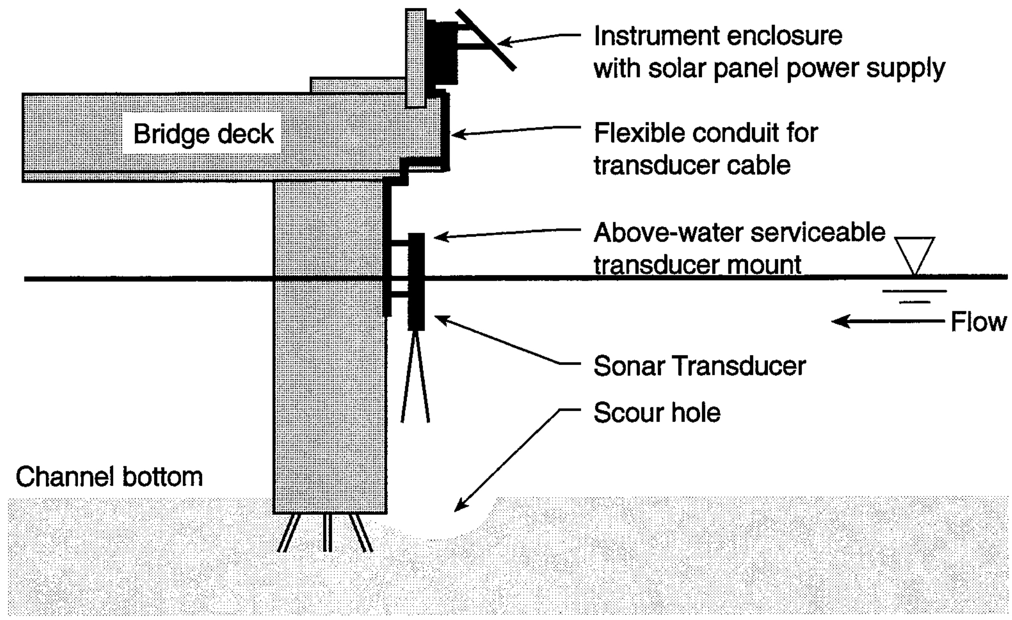

Figure 4.2 Low-Cost Sonic Fathometer Scour-Monitoring System Configuration.
(Adapted from NCHRP Report 21-3)

4.1.3 Sounding Rod Scour-Monitoring Systems

Sounding rods have been used for decades to determine the depth of flow in streams. A sounding rod system for scour monitoring consists of a support pipe, mounting brackets, a sounding rod with base plate, a pulse counter, and a data logger. The sounding rod rests inside the support pipe that is mounted vertically on a bridge pier. To prevent the rod from burying itself in the streambed, a base plate large enough to distribute the load so as not to exceed the bearing capacity of the streambed material is placed at the bottom of the rod. As material washes from beneath the base plate, the sounding rod lowers through the support pipe, and the distance is measured and recorded in the data logger. This system could also be fitted with telemetry equipment developed in Project 1380. Figure 4.3 shows a sounding rod monitoring system configuration.

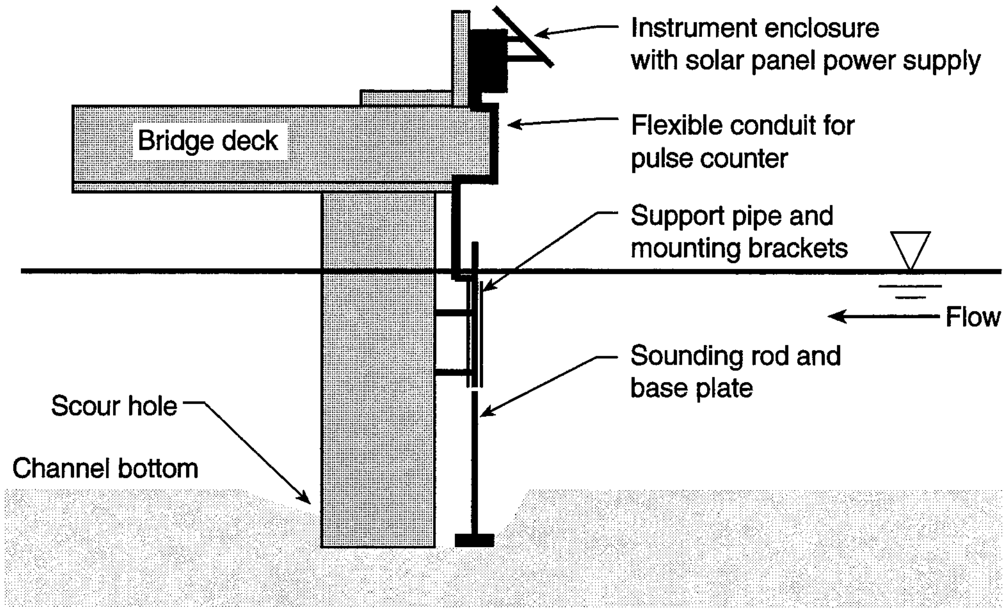

Figure 4.3 Sounding Rod Scour-Monitoring System Configuration.

4.1.4 Other Buried Devices for Scour Monitoring

One class of scour-monitoring systems includes buried or driven devices. Although the magnetic sliding collar falls into this category, it was presented separately in Section 4.1.1 because of its applicability to this research project. Other buried or driven devices evaluated in Project 21-3 include those sensors that can be buried in a streambed at various elevations so that their presence is detected as they are uncovered during the scour process. These sensors also can be connected to data telemetry equipment. Examples of such sensors include:

- Piezoelectric film switches
- Mercury tip switches
- Float out transmitters

The piezoelectric film-monitoring system consists of a series of piezoelectric sensors spaced at the desired interval and attached to a rigid pipe. The pipe is driven into the streambed at the face of a pier where scour is expected to occur. As soil washes from around the pipe, the switches are uncovered and exposed to the flow field. The mechanical stress induced by the flowing water generates a voltage, which in turn sends a signal to a data logger.

Mercury tip switches are attached to a rigid pipe so that as the pipe is driven into the streambed the switches are folded upward, thereby closing their circuit. As soil erodes from around the supporting pipe the switches flip downward, breaking the circuit. A data logger records the depth at which circuits are open and closed. As soil washes from around the switches, the depth of open circuits increases, indicating scour hole development.

Float out transmitters are buried in a location where scour is expected to occur. As soil washes away, the floats rise to the surface and bob in the flowing water. A motion-activated switch can be installed in the float so that a signal is transmitted to a receiver on the bridge deck or shore. Assigning a different signal to each float allows for identification of which float was exposed by scour hole development and thus allows for determination of scour depth.

4.1.5 Capabilities and Limitations of Scour-Monitoring Equipment

Each of the scour-monitoring systems described above was evaluated in the NCHRP Project 21-3. A major conclusion of the report is that none of the monitoring systems can be expected to work in every situation. Site conditions must be evaluated before deciding upon the appropriate monitoring system. Factors that heavily influence the system selection process include bridge configuration and location relative to control structures, depth of flow, sediment loading, debris loading, streambed material size, and temperature variations (Lagasse et al., 1997). A summary of their evaluation follows.

Although they showed promise for specific applications, tests conducted on the sounding rod and other buried devices revealed that further development was required before the equipment could be considered as feasible alternatives for widespread use. Research is currently being conducted by private concerns.

The magnetic sliding collar and the sonar system proved applicable to the widest variety of conditions identified in the NCHRP research project. Because the magnetic sliding collar and sonar systems are the focus of further development of remote sensing capabilities at The University of Texas at San Antonio, a comparison of their capabilities and limitations is made in this section.

The sonar scour-monitoring system provides a distinct advantage in that it is able to perform continuous measurement of scour hole development and refilling. Continuous measurement is helpful for furthering the understanding of scour processes and calibration of scour prediction equations; both of these are major goals of the Federal Highway Administration's (FHWA's) scour evaluation program. The sonar system installs relatively easily at piers and vertical abutments, as well as at sloped spill-through abutments, but may require some modification for installation at the latter. If lateral migration of the streambed requires that the system be relocated, this can be accomplished without loss or damage to the system's equipment. In addition, the sonar system works well for deepwater or large bridge installations.

Some disadvantages of the sonar system are that installation and maintenance generally requires the services of a diver. Furthermore, the complexity of the system may require a rigorous maintenance program. The sonar system does not work when ice or debris becomes lodged beneath the transducer, or when heavy sediment transport prevents it from seeing the channel bottom. It was also noted that sonar becomes less effective when air entrainment becomes too high because of turbulence. In addition, this system may not work well if the flow is too shallow to allow accurate and reliable return signals from the streambed. As such, the sonar system is best suited for depths greater than approximately 5 feet and where live-bed scour with heavy sediment transport, heavy debris loading, and high air entrainment is not expected.

The magnetic sliding collar system installs relatively easily at vertical piers and abutments and at sloped spill-through abutments. This system can operate in any depth of water, but is particularly applicable in shallow flows. Because this system relies on gravity to move the collar down its support pipe, heavy sediment transport and air entrainment should not affect its performance. Debris loading is not as much of a concern as the sonar system, but it can occasionally jam the collar in place and render the system inoperable. Aside from clearing debris to dislodge the collar, the rugged construction and simplicity of this system should require little maintenance if installed properly.

One disadvantage of the sliding collar system relative to the sonar system is that it can measure only the total depth of scour. Because the collar only slides downward on the support pipe and becomes buried when refilling occurs, it does not provide any measurement of the refilling process. The collar remains buried at the deepest scour depth achieved at that location until a deeper scour hole develops or the system is removed from the site. If lateral migration of the streambed requires relocation of the monitoring system, a hoist or crane is necessary to pull the support pipe from the ground, and the collar may not be recovered during this process. Also, because the support pipe must be driven or augured into the streambed, it is possible that a large buried rock can prevent the pipe from being buried deep enough to operate over the predicted range of scour depths. With these limitations in mind, the magnetic sliding collar monitoring system is best suited for shallow flows where the predicted scour depth is not large and lateral migration of the streambed is not expected.

Table 4.1 summarizes the comparison of capabilities and limitations between the magnetic sliding collar and the sonar scour-monitoring systems. For an in-depth description of the performance evaluation of all the scour-monitoring systems referred to in this section, see NCHRP Report 21-3.

Table 4.1 Summary of Capabilities and Limitations Comparison.

Attribute description	Magnetic sliding collar	Sonic fathometer
Range of installation depths	Any depth	Any depth > 5 ft.
Affect of debris, sediment, air entrainment	Little or no affect	Adverse affect
Ease of installation	Installs easily	Installs easily
Maintenance requirements	Low maintenance	High maintenance
Ease of relocation	Potential for difficulties	Relocates easily
Ability to measure refilling process	Does not measure	Measures

4.2 SURVEY OF OTHER STATES' EXPERIENCE WITH SCOUR MONITORING

A survey of other state departments of transportation (DOTs) was conducted in this study to determine the level of effort being put forth by those departments to develop remote scour-monitoring capabilities and to capture their experience with scour-monitoring equipment. The survey consisted of ten questions that were designed to identify the point of contact for each state, the size of the state's bridge population, their method and cost of performing scour evaluations, and their experience with scour-monitoring systems. The survey was distributed to forty-nine states and the District of Columbia, with thirty-six responses returned. A copy of the survey is located in Appendix B.

It is clear from the responses to the survey that the development and use of mechanical scour-monitoring equipment is in its infancy. Only seventeen of the thirty-six responding state DOTs had any experience with mechanical scour monitors, and the majority of those were with one monitor that was installed by the U.S. Geological Survey (USGS) for research purposes. Only seven state DOTs (AK, AZ, CT, FL, KS, NV, and VA) indicated that they had experience with scour data telemetry, with most of that experience limited to research and development in cooperation with the USGS.

In general, the respondents indicated mixed feelings about their experience with mechanical scour-monitoring systems. Most felt that the monitoring systems have some value in that they provide early warning of impending bridge failure, but the systems need further development to be considered reliable. There were also numerous complaints about installation and maintenance problems. Several respondents commented that a comprehensive training program is required to operate the systems. Particularly with remote scour-monitoring systems, it is necessary to have personnel dedicated to system operation and maintenance, which includes responding to scour alarms and knowing how to react to them. Event reporting and bridge closure procedures need to be standardized and updated continually so that personnel turnover within highway maintenance departments does not render the monitoring program useless. The policy regarding scour-monitoring system operation is vital to efficient and effective use of such systems. Table 4.2 provides a summary of the responses to the survey.

Table 4.2 Summary of Responses to Survey of Other State DOTs.

Question	Response
Who performs scour monitoring in your state?	25 states use only DOT personnel. 11 states use DOT personnel and private contractors.
What methods of scour monitoring are used?	27 states indicate use of scour prediction equations. 27 states indicate crew deployment during or after floods. 11 states indicate use of mechanical monitors w/o data telemetry. 7 states indicate use of mechanical monitors with data telemetry.
Where are the mechanical monitors manufactured?	14 states purchased monitors from private manufacturer. 3 states manufactured their own equipment.
What types of mechanical monitors are in use?	10/17 have used sonar. 7/17 have used magnetic sliding collar. 3/17 have used sounding rods. 4/17 have used piezoelectric film or other buried devices.
What is the cost to purchase and install a mechanical monitor?	There was a wide range of responses to this question. The majority of responses indicated that monitoring systems w/o data telemetry cost between $5,000 - $7,000 to manufacture and install. Systems with data telemetry cost substantially more.
Has maintenance of monitors been difficult?	Debris and sediment loading are a big problem with the sonar systems. Vandalism has been a problem where solar panels and cellular telephones are used.

4.3 DOCUMENTATION OF SCOUR-MONITOR INSTALLATIONS IN TEXAS

In cooperation with NCHRP 21-3 and FHWA Demonstration Project (DP) 97, TxDOT installed several mechanical scour-monitoring devices. One magnetic sliding collar system was installed in the Abilene District, and one sonar system was installed in the Houston, Lufkin, and Beaumont districts. None of these units had data telemetry capabilities. As part of this research, a sonar system with data telemetry has been installed in the Yoakum District as a pilot test site. Documentation of each of these installations follows.

4.3.1 Magnetic Sliding Collar System Installation in the Abilene District

A manual readout magnetic sliding collar system was installed in Haskell County on the US Hwy 380 bridge (ID # 360-2-26) over the Double Mountain Fork of the Brazos River, approximately 4 miles west of Rule, Texas. The bridge has an average daily traffic (ADT) of 920 vehicles per day and an Item 113 code of 8. The system was manufactured by ETI, Inc. of Fort Collins, Colorado, and installed by TxDOT personnel with technical assistance from the NCHRP 21-3 research team and funded by the FHWA. The site was selected based on a known history of scour hole development and refilling.

Prior to the installation, up to 20 feet of scour had been observed at the site. The support pipe for the system was driven 19 feet into the refilled scour hole in the streambed. After the first significant storm event, the collar had dropped approximately 5 feet and has not been recovered. Because the system is a manual readout type, and Abilene District maintenance personnel have not routinely collected data from the monitor, it is unknown if the collar has dropped to a lower depth or whether the system is still operable. Figure 4.4 shows the location of the magnetic sliding collar system in Haskell County.

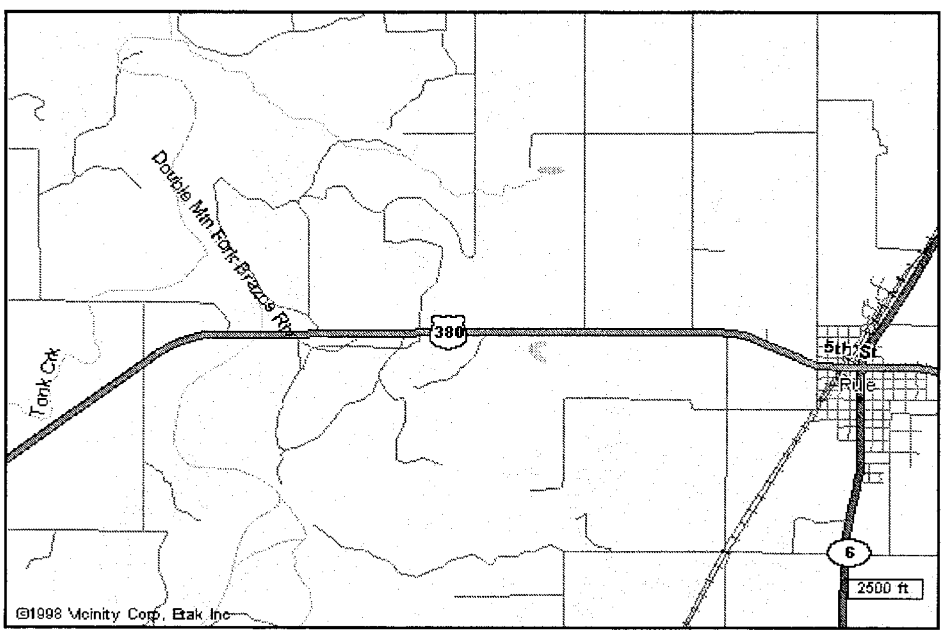

Figure 4.4 Location of Magnetic Sliding Collar System in Haskell County.

4.3.2 Sonar System Installation in the Houston District

A sonar scour-monitoring system was installed in Fort Bend County on the westbound lanes of the US Hwy 59 bridge (ID # 27-12-132) over the Brazos River, approximately 6 miles east of Richmond, Texas. The bridge has an ADT of 33,000 vehicles per day and an Item 113 code of 3. The system was manufactured by Design Analysis, Inc. of Logan, Utah, and installed by TxDOT personnel, again with technical assistance from the NCHRP 21-3 research team and funding provided by the FHWA.

Debris loading on the bridge piers presented a problem during the installation. After the installation was complete, vandals stole the solar panel, which required replacement. Because of the high ADT at the site (33,000 vpd), downloading data from the data logger was difficult, as it required a lane closure to do so. The system is still in place and presumed to be operable, but no scour data are available and it does not appear that the Houston District makes use of the system. Figure 4.5 shows the location of the sonar system in Fort Bend County.

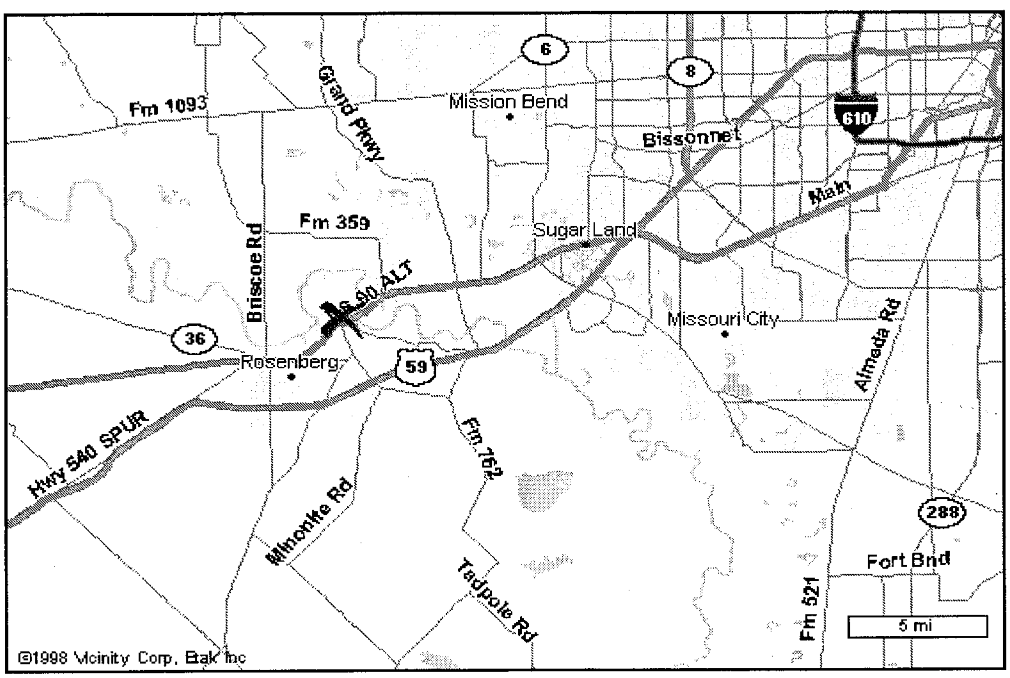

Figure 4.5 Location of Sonar System in Fort Bend County.

4.3.3 Sonar System Installation in the Lufkin District

A sonar scour-monitoring system was installed in Polk County on the US Hwy 59 bridge (ID # 177-1-47) over the Trinity River, approximately 10 miles south of Livingston, Texas. The bridge has an ADT of 10,000 vehicles per day and an Item 113 code of 6. This system was also manufactured by Design Analysis, Inc. of Logan, Utah, and installed by TxDOT personnel.

During installation of the system, the bridge height of 60 feet made it difficult to run the electrical conduit from the scour monitor located at the water level to the data logger located at the bridge deck. After the system installation, the bridge was replaced and the system was decommissioned. The system now resides in the Yoakum District as the test unit for this research project. Figure 4.6 shows the former location of the sonar system in Polk County.

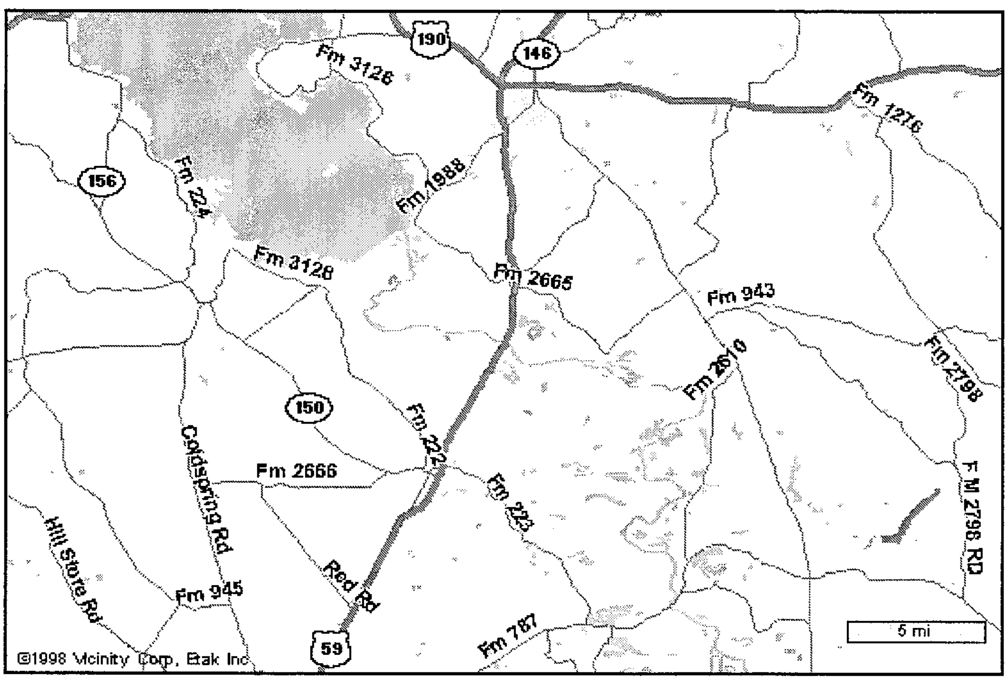

Figure 4.6 Location of Sonar System in Polk County.

4.3.4 Sonar System Installation in the Beaumont District

A sonar scour-monitoring system was installed in Liberty County on the US Hwy 90 bridge (ID # 28-3-22) over the Trinity River, approximately 1 mile west of Liberty, Texas. The bridge has an ADT of 9,200 vehicles per day and an Item 113 code of 6. This system was also manufactured by Design Analysis, Inc., of Logan, Utah, and installed by TxDOT personnel.

During installation of the system, the bridge height of 80 feet made it difficult to run the electrical conduit from the scour monitor located at water level to the data logger located at the bridge deck. During a flood event, a barge collided with the pier and damaged the unit. Figure 4.7 shows the location of the sonar system in Liberty County.

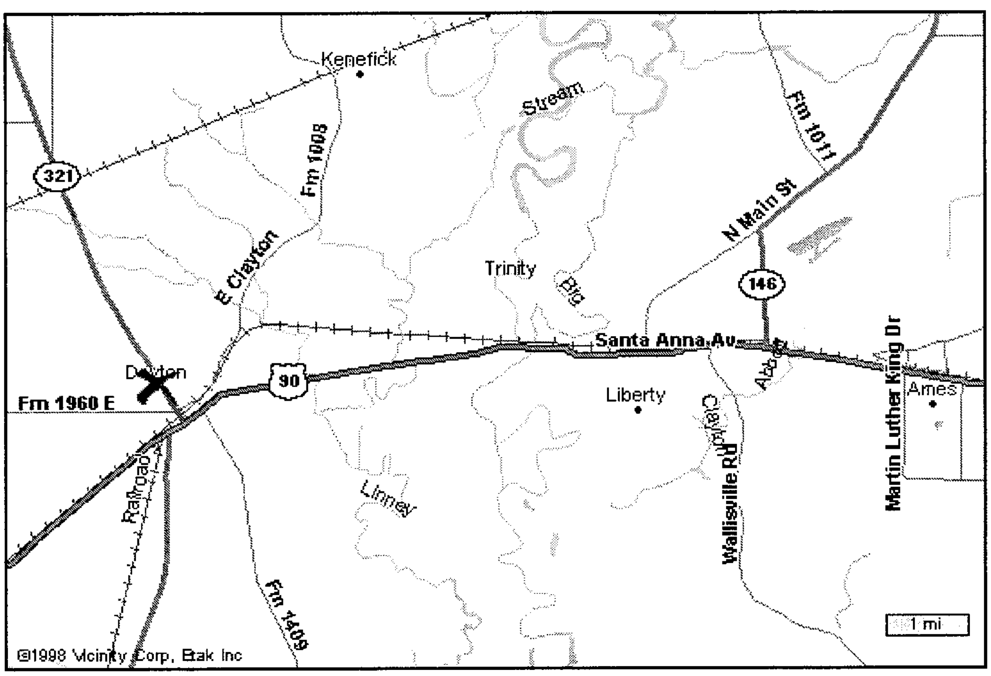

Figure 4.7 Sonar System Installation in Liberty County.

4.3.5 Sonar System Installation in the Yoakum District

One sonar scour-monitoring system was installed in Jackson County on the FM 1157 bridge (ID # 1307-1-5) over Mustang Creek, approximately 2 miles east of Ganado, Texas. The bridge has an ADT of 560 vehicles per day and an Item 113 code of 4. This system was recovered from the Lufkin District installation described in Section 4.3.3, and installed by TxDOT personnel with technical assistance from the Project 3970 research team. The system consists of four transducers located on four separate piers, a water-level sensor that activates the system, and a data logger that stores data from all four transducers. The scour data are transmitted by cellular telephone to a remote computer terminal on The University of Texas at San Antonio campus, approximately 135 miles from the bridge site. Figure 4.8 shows the location of the sonar system in Jackson County.

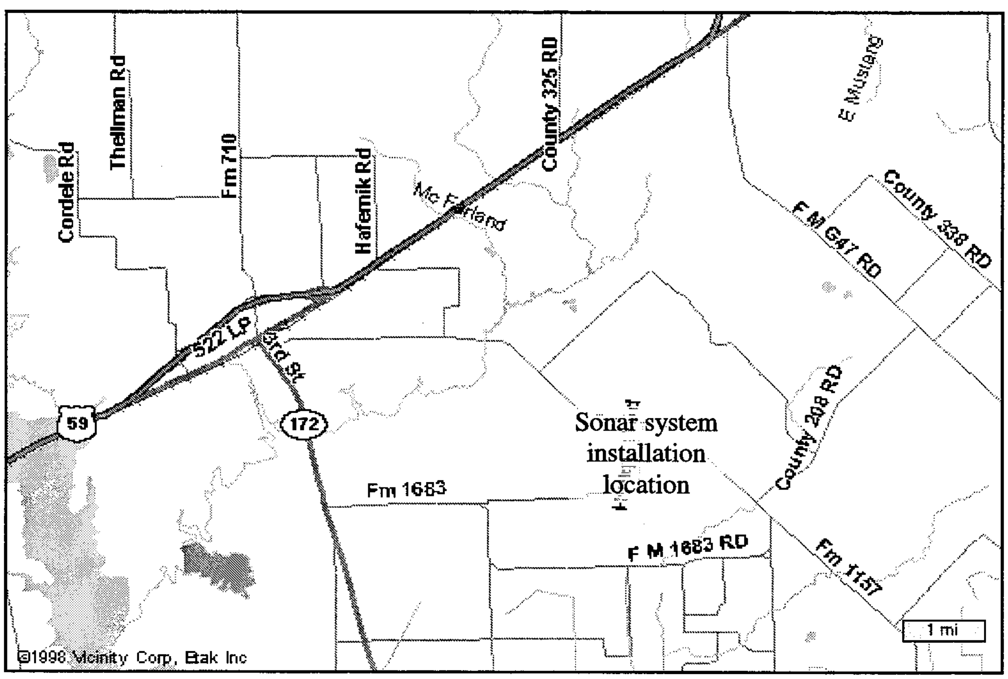

Figure 4.8 Sonar System Installation in Jackson County.

4.4 REVIEW OF EQUIPMENT COMPATIBILITY AND AVAILABILITY

A goal of this research project is to develop an architecture for the scour monitor communication network that is compatible with the network designed for Project 1380. It is desired that each system's communications components be interchangeable to minimize the amount and type of hardware and software required to maintain the network infrastructure. Below we review the equipment used in Project 1380, discuss the two projects' compatibility, and, finally, provide a vendor list.

4.4.1 Review of Communications Equipment Used in Project 1380

In Project 1380, a monitoring system was described that could provide early warning to TxDOT maintenance offices of impending floods at low-water crossings. The equipment used for communicating the information consists of:

- Water-level sensors
- Atmospheric sensors (air temperature, wind speed, precipitation, etc.)
- Remote processing unit
- Changeable warning sign at the low-water crossing (optional)
- Communications link (cellular telephone, radio, or satellite link)
- Central processing unit server
- Remote computer terminals

Figure 4.9 shows the major components of the low-water crossing monitoring system.

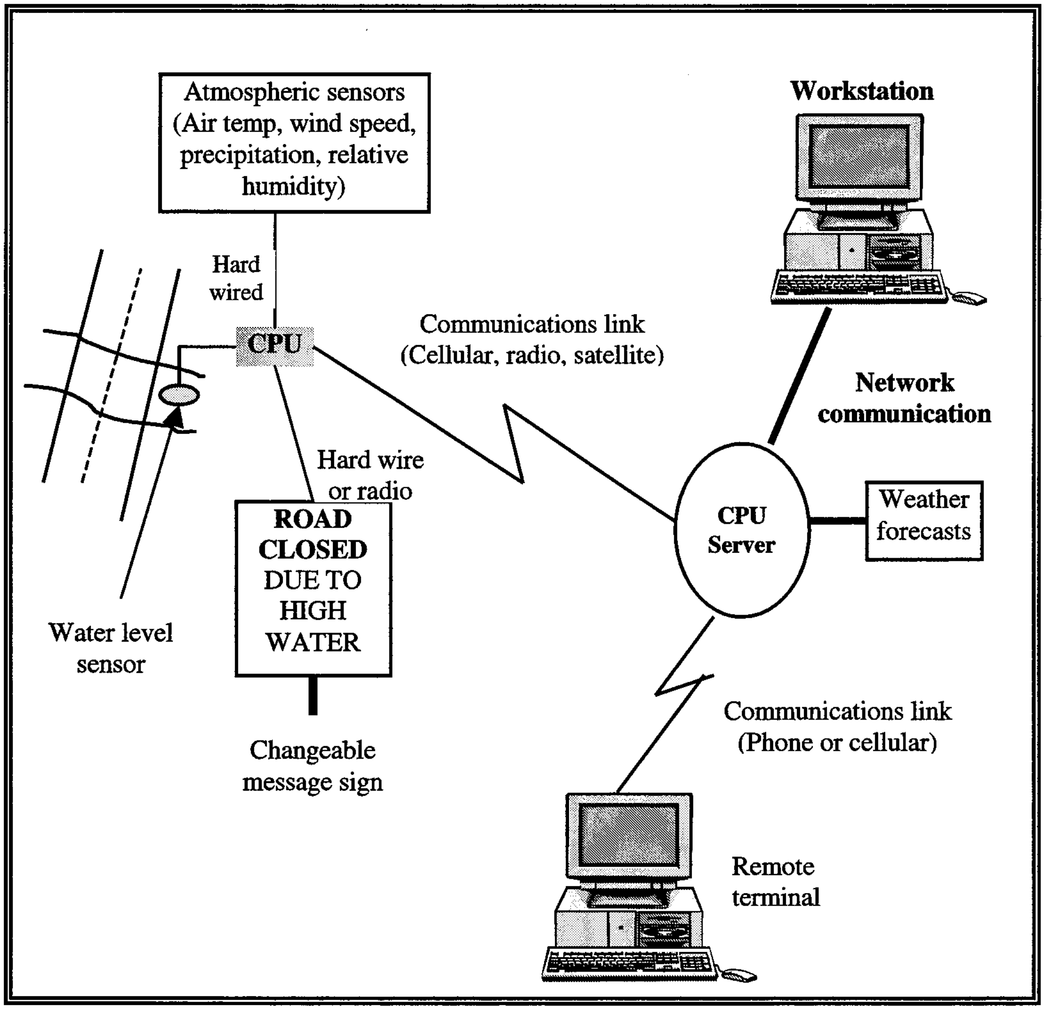

Figure 4.9 Major Components of the Low-Water Crossing Monitoring System.
(Adapted from McKeever 1997)

With a few alterations, the architecture of this system can be made to work for the bridge scour-monitoring system. At the bridge site, a scour-monitoring system, along with a data logger, would be added. A flow velocity sensor, which could substitute for the water-level sensor used in Project 0-1380, could be used to trigger a scour-monitoring system to begin taking measurements. A changeable sign could also be part of the system, but is not necessary. Otherwise, the two communications systems are identical.

4.4.2 Compatibility Between Project 0-1380 and Project 7-3970

Both Project 0-1380 and Project 7-3970 are designed to provide TxDOT district maintenance personnel with early warning about hazardous road conditions. Both systems rely on mechanical measurement of conditions at stream crossings, and both transmit data to a remote location. For these reasons, the two projects can and should be viewed as a single system in which the individual methods of monitoring are subsystems. In order to minimize the inventory, it is important to make as many of each subsystem's components compatible with the other subsystems. Table 4.3 shows that much of the data communication equipment is compatible between the systems, and only the actual monitoring device needs to vary from site to site, depending on the environmental conditions and the type of information desired.

Table 4.3 Compatibility of Project 0-1380 and Project 7-3970 Equipment.

Equipment description	Location being monitored		
	Low-water crossing	Large bridge and deep water	Small bridge and shallow water
Water-level and flow velocity sensors	X	X	X
Atmospheric sensors	X		
Remote Processing Unit	X	X	X
Communications link	X	X	X
Communications software	X	X	X
Data loggers and enclosures	X	X	X
Solar power and 33 Amp-hr batteries	X	X	X
Remote terminals/work stations	X	X	X
Central Processing Unit	X	X	X
Changeable warning sign	X	X	X
Sonar system		X	
Magnetic sliding collar system			X
Site survey	X	X	X

4.4.3 Vendors of Equipment for Project 7-3970

A review of the manufacturers of scour monitoring and data telemetry equipment was performed. It was determined that these systems can be built by selecting individual components from various manufacturers of specialty equipment, or can be purchased as a complete system. Several vendors also provide system installation and maintenance services. For the purpose of this research, remote terminals and workstations are not included in the vendors' section because TxDOT already has those items. A list of manufacturers and points of contact are located in Appendix C.

CHAPTER 5. THE ECONOMICS OF SCOUR MONITORING

5.1 THE VALUE OF INFORMATION PROVIDED BY SCOUR MONITORING

The value of information provided by a scour-monitoring system should be determined to establish the feasibility of the system installation. The elements to consider in determining the value of information consist of the cost of bridge failure, the cost of monitoring, and the benefit provided by continuous monitoring. The benefit of continuous monitoring is the reduction of the probability of scour-related damage or failure. A conceptual framework for establishing the value of information is presented in this chapter.

Ideally, a scour-monitoring system could eliminate the possibility of structural damage or catastrophic bridge failure by providing adequate warning of scour hole development. Theoretically, the early warning would allow for implementation of a permanent remedial action, such as a structural or hydraulic repair. However, a monitoring system does not protect a bridge in case of a super-flood in which damage or failure can occur unexpectedly from a single flood event. Thus, the value of continuous monitoring lies in its ability to provide information that otherwise would not have been realized through routine periodic inspections or special inspections.

As a practical matter, continuous monitoring can provide three different types of benefits. First, it can provide early warning of impending failure during flooding so that the bridge can be closed to the public. Second, it can reduce the probability of damage or failure by providing information about a developing scour problem. Third, it can provide real-time data for calibrating scour prediction equations. The responsibility for acting upon the information remains with those in charge of maintenance of the bridge. These concepts are particularly relevant to bridges with known scour problems.

In this analysis, the value of information provided by continuous monitoring is related to the reduction in the expected cost of failure. It is reasonable to anticipate a reduction in expected failure costs because a monitoring system can provide more timely and accurate information than periodic routine inspections. As the quality of information improves, the actual scour condition is known with more certainty and the probability of failure should decrease because maintenance departments will act upon the information to develop an appropriate solution.

5.1.1 Determining the Cost of Bridge Failure

The three elements of failure costs used in this analysis are the direct cost of rebuilding the damaged structure, the cost associated with the loss of life and personal property damage, and the additional user-mileage costs. A rebuilding unit cost of $70/ft^2 and a user-mileage unit cost of $15/vehicle-hour were obtained during interviews with Texas Department of Transportation (TxDOT) personnel. The rebuilding unit cost is a combined average cost for design work, contractor mobilization, removal of the damaged structure, and construction of a replacement bridge. The user-mileage unit cost is a weighted average that considers vehicle operating costs, occupancy rates, and the percentage of average daily traffic (ADT) that is commercial truck traffic. The cost for the loss of life is $1.7 million per person, which includes personal property damage. Equation 5.1 shows the form of the bridge failure cost estimation.

$$\text{Bridge failure cost} = [(C_1)(ADT)(D_l)/D_s](D_R) + [(C_2)(L)(W) + (C_3)(L_L)] \qquad \text{(Eq. 5.1)}$$

Where:
C_1 = User-mileage unit cost ($15/vehicle-hr)
ADT = Average Daily Traffic in vehicles/day (Item 29)
D_L = Detour length in miles (Item 19)
D_S = Detour speed in mph (as posted at site)
D_R = Duration of repairs in days
C_2 = Unit rebuilding cost ($70/ft^2)
L = Bridge length in feet (Item 49)
W = Bridge width in feet (Item 52)
C_3 = Unit cost for loss of life ($1.7M/person)
L_L = Expected number of lives lost through bridge failure
$L_L = \Sigma p(X = x) * O_R$, where O_R = vehicle occupancy rate (1.56 persons/vehicle)

The total expected number of lives lost (L_L) is equal to the sum of the products of the probability of there being X (where X = 1, 2, 3, etc.) number of vehicles on the bridge at the time of failure and the vehicle occupancy rate (O_R = *1.56* persons/vehicle). The probability of vehicles being on the bridge at the time of failure is established under the assumption that vehicle arrivals at a bridge follow a Poisson distribution. Equation 5.2 shows the Poisson formula.

$$p(X = x) = e^{-\lambda}\lambda^{x}/x! \qquad \text{(Eq. 5.2)}$$

The vehicle arrival rate (λ) is determined from the ADT and bridge length for the average scour critical bridge. An average travel speed of 50 mph was assumed for this calculation. Table 5.1 shows the expected number of lives lost for the average scour critical on- and off-system bridge. The columns labeled $p(X = x)$ in Table 5.1 show the probability of there being X number of vehicles on the average scour critical bridge for (x = 0, 1, 2, 3, 4, 5, 6, 7, and 8) vehicles.

Table 5.1 Expected Number of Lives Lost for On- and Off-System Bridges.

# of Vehicles	On-System			Off-System		
x	λ^x	p(X = x)	$E(L_L)$	λ^x	p(X = x)	$E(L_L)$
0	1.000	0.710	0.000	1.000	0.736	0.000
1	0.342	0.243	0.379	0.306	0.225	0.352
2	0.117	0.042	0.130	0.094	0.035	0.108
3	0.040	0.005	0.022	0.029	0.004	0.016
4	0.014	0.000	0.003	0.009	0.000	0.002
5	0.005	0.000	0.000	0.003	0.000	0.000
6	0.002	0.000	0.000	0.001	0.000	0.000
7	0.001	0.000	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000	0.000	0.000
		$\Sigma E(L_L)$ =	0.533			0.478

Figure 5.1 shows failure costs versus time to repair for the average scour critical bridge. The duration of repairs varies between 0 and 720 days to show how costs increase with time.

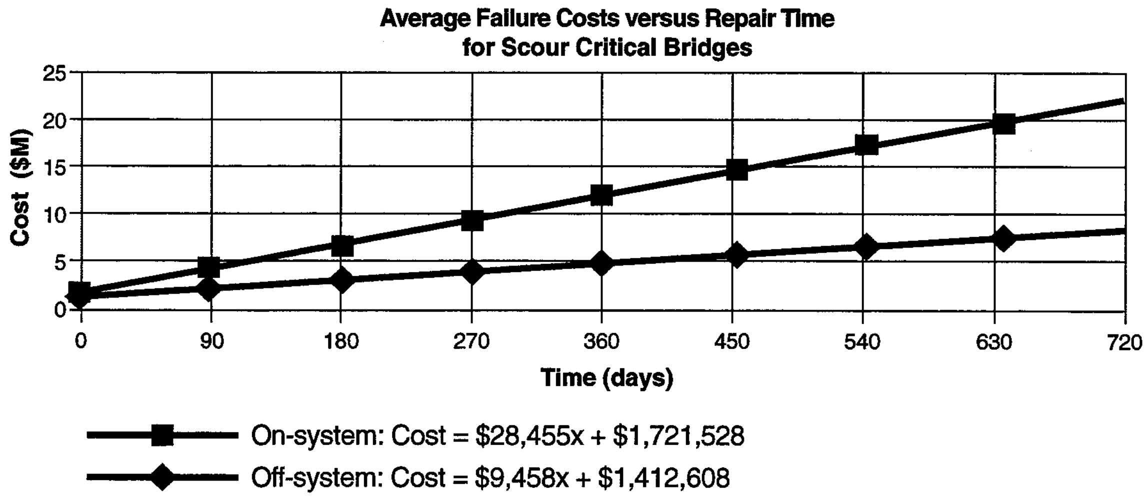

Figure 5.1 Average Scour Critical Bridge Failure Costs versus Time to Repair.

The equations of the lines in Figure 5.1 are linear in form $(y = mx + b)$, in which the slope of the line is a combination of the unit cost, ADT, detour length, and the detour speed, and has units of $/day. For the purpose of this illustration, a detour speed of 40 mph is assumed; the actual detour speed would be as posted on the detour route. The intercept of the line consists of the sum of the rebuilding cost of the structure and the value of lives lost, and has units of dollars. The x axis represents time in days to repair or replace the structure. Table 5.2 shows the mean values of the parameters used in Equation 5.1 for on- and off-system scour critical bridges.

Table 5.2 Mean Values for Determining Scour Critical Bridge Failure Costs.

Parameter	On-system	Off-system
Expected number of lives lost	0.533	0.478
Value of loss of life =	$1,700,000	$1,700,000
Bridge width (ft)	39.6	42.9
Bridge length (ft)	294	200
Unit rebuilding cost ($/ft^2)	70	70
Average rebuilding cost =	$ 814,968	$ 600,600
ADT (vehicles/day)	7,367	9,700
Detour length (miles)	10.3	2.6
Detour speed* (mph) (* assumed)	40	40
Unit travel cost ($/vehicle-hr)	15	15
Average daily user-mileage cost =	$ 28,455/day	$ 9,458/day

It is obvious that the user-mileage costs quickly exceed the rebuilding costs for the average scour critical bridge. Although an increase in ADT increases the probability of vehicles being on a bridge at the time of collapse, the increased user costs become even more pronounced. Table 5.3 provides a comparison of the value of lives lost versus increased user costs for several values of ADT. The bridge size is assumed average and repair time is decreased with increasing ADT.

Table 5.3 Comparison of Value of Lives Lost versus Increased User-Mileage Costs.

ADT	Duration of repairs	Expected loss of life	Value of lives lost	Additional user-mileage cost
25,000	150 days	1	$1,700,000	$17,000,000
50,000	120 days	3	$5,100,000	$25,700,000
100,000	90 days	5	$8,500,000	$37,277,000

5.1.2 Determining the Cost of a Scour-Monitoring System

Determining the cost of a scour-monitoring system requires choosing a planning horizon over which costs can be summed. The associated costs include the purchase, installation, operation, and maintenance costs. Because continuous remote mechanical monitoring is relatively new, there is an insufficient amount of data to support the operating and maintenance costs or the expected lifetime of a system. For the purpose of this analysis, operating and maintenance costs are estimated, and it is assumed that the system has no salvage value at the end of the period. A 6-year planning horizon is selected because it is anticipated that advances in monitoring technology will make currently available systems obsolete within that period.

A survey of several scour-monitoring system manufacturers indicates that regardless of the type of system selected, a purchase price of approximately $8,000 can be expected. Data collected during the course of this research indicate that installation costs for systems similar to those described in Chapter 4 are approximately $2,000 each, including labor and equipment. Annual operating and maintenance costs are assumed to be 25 percent of the capital investment.

To calculate the cost of a system, the equivalent uniform annual worth (EUAW) is determined without including the benefit provided by continuous monitoring. An interest rate of 6 percent is assumed for this calculation. To determine the equivalent uniform annual cost (EUAC) of the system, the net present worth (NPW) is calculated and then distributed over the 6-year planning horizon. The equivalent uniform annual cost of the system as calculated by this method is $4,534/year. As experience is gained with mechanical monitoring, it is anticipated that system life expectancy will increase and life-cycle operating and maintenance costs will decrease. Figure 5.2 shows a cash-flow diagram for a 6-year life cycle.

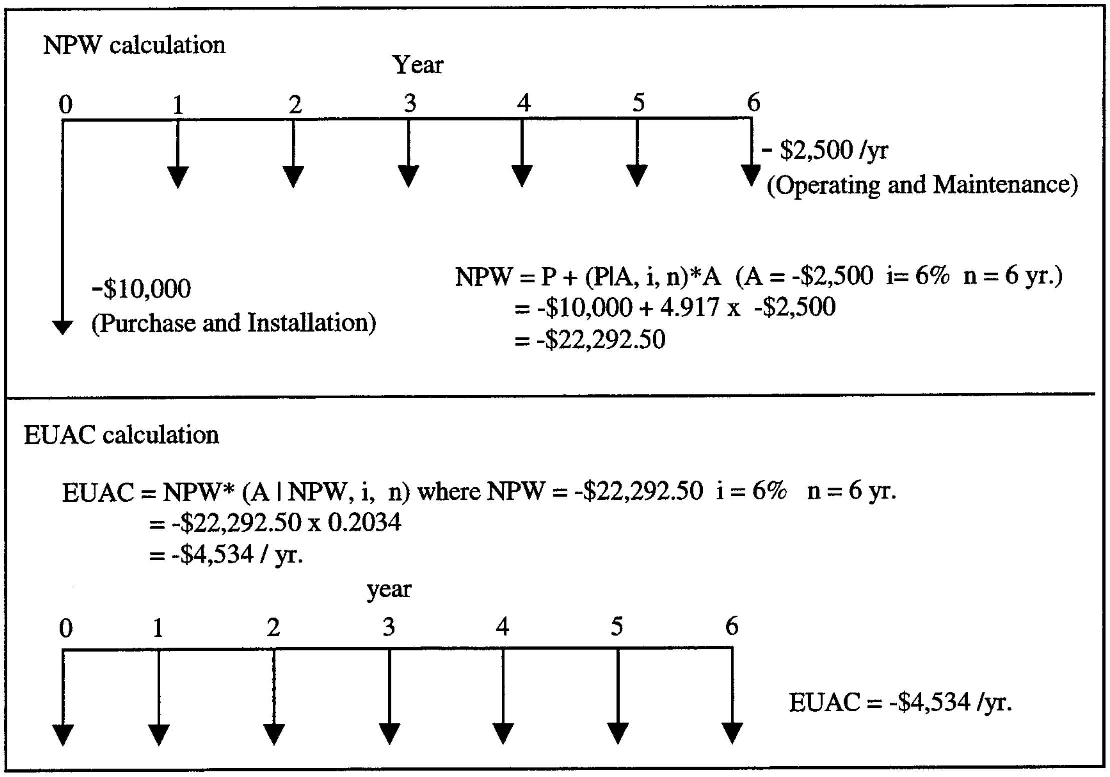

Figure 5.2 Cash Flow Diagram of System Life-Cycle Costs.

5.1.3 The Value of Information Gained by Continuous Scour Monitoring

The benefit of continuous monitoring is the reduction of the probability of scour-related damage or failure. The baseline condition used to determine failure probability is that established under current conditions of monitoring, specifically, periodic routine inspections and special inspections after a flood event. The HYRISK method establishes a failure probability based on code contained in the National Bridge Inventory (NBI) or, in TxDOT's case, from code contained in the Bridge Inventory, Inspection and Appraisal Program (BRINSAP) database.

To determine the benefit of continuous monitoring, the expected failure cost of manual monitoring (the current condition) and continuous monitoring is compared. The failure probability under current monitoring conditions is approximately 5 percent and is established using the HYRISK method and mean values for the average scour critical bridge.

To make comparisons on a site-specific basis, the actual failure probability needs to be calculated for each individual bridge. Figure 5.3 shows the expected cost of bridge failure versus time to repair for the average scour critical bridge. The graph assumes the failure probability is correct, and that the p(lives lost) = 1 − p(no vehicles on bridge).

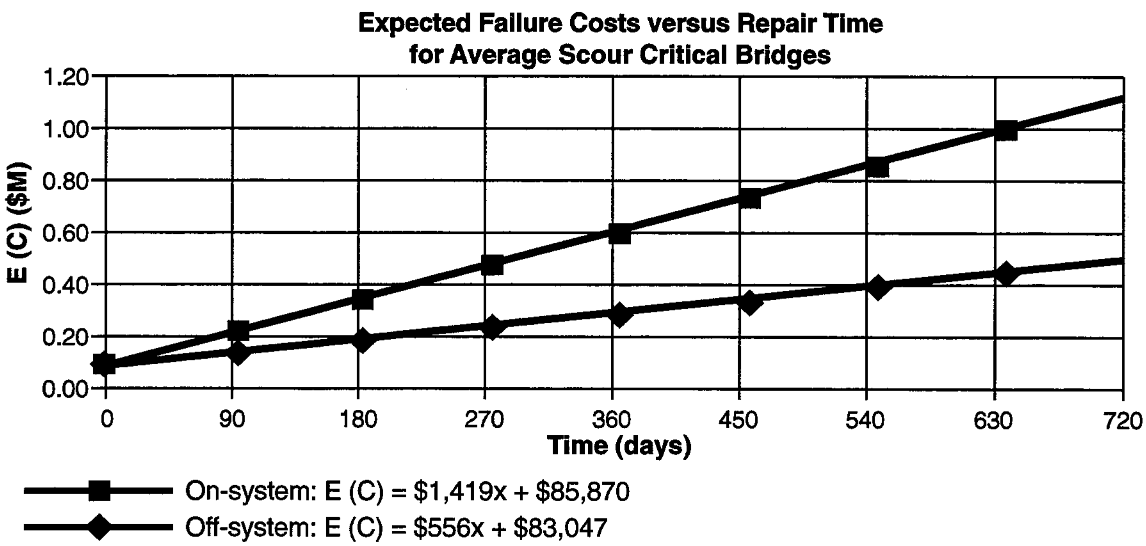

Figure 5.3 Expected Cost versus Repair Time for the Average Scour Critical Bridge.

In Figure 5.3, the expected cost of failure, excluding any additional user-mileage costs, is approximately $85,000. If a perfect monitoring system were available that could guarantee that scour would always be detected accurately and in time to prevent bridge failure and loss of life, then up to $85,000 could be spent on the system for the average scour critical bridge. This figure represents the value of perfect information. The $85,000 value will vary between bridges depending on site-specific characteristics.

In reality, continuous monitoring systems are not perfect and cannot prevent failure in the event of a major flood. Therefore, a qualitative analysis is used to gain insight about the potential benefit of a continuous scour-monitoring system. Using the cost of $4,534/yr as calculated by EUAC in Section 5.1.2, the reduction in failure probability required to cover the cost of installing, operating, and maintaining a system is < 1 percent, which corresponds to a 20 percent improvement in the ability to detect scour hole development. Based on the results of the pilot system installation for this research project, it is reasonable to expect that continuous monitoring can achieve this level of improvement over manual monitoring. As remote continuous monitors are further developed, the value of information will increase.

Because this analysis was based on the characteristics of the average scour critical bridge, and because it has been shown that additional user-mileage costs constitute a significant portion of bridge failure costs, the economics of monitor installation are even more favorable for large bridges with high ADT counts. The only time a monitor may not be feasible would be for small bridges with very low ADTs, and for bridge class culverts, which already exhibit an extremely low probability of scour-related failure.

5.1.4 Sensitivity to Errors in Failure Probability Estimation

A sensitivity analysis is performed to determine if errors in the estimated failure probability have a significant effect on the outcome of the qualitative economic analysis. By assuming that a scour critical bridge will eventually collapse if left unchecked, the failure probability can be related to the probability that monitoring will detect the scour critical condition. Further, the degree of scour hole development will influence the cost of implementing remedial action. For example, if a developing scour problem is detected early enough, the remedial action may be only a fraction of the cost to repair a bridge that has sustained serious scour damage. In this analysis, it is assumed that early detection can reduce the cost of remedial action by one-third. It is necessary to point out that this analysis is merely a conceptual framework for determining the value of a continuous scour-monitoring system. The assumptions made regarding the decrease in remedial action costs have no basis in fact because there is no evidence that a mechanical scour-monitoring system has ever prompted a scour damage mitigation effort. To apply this method appropriately, real data concerning the reduction in remedial costs would need to be collected, as well as data concerning the actual cost of installing, operating, and maintaining a remote mechanical scour-monitoring system. Figure 5.4 provides a conceptual view of how the failure probability affects the economics of continuous monitoring.

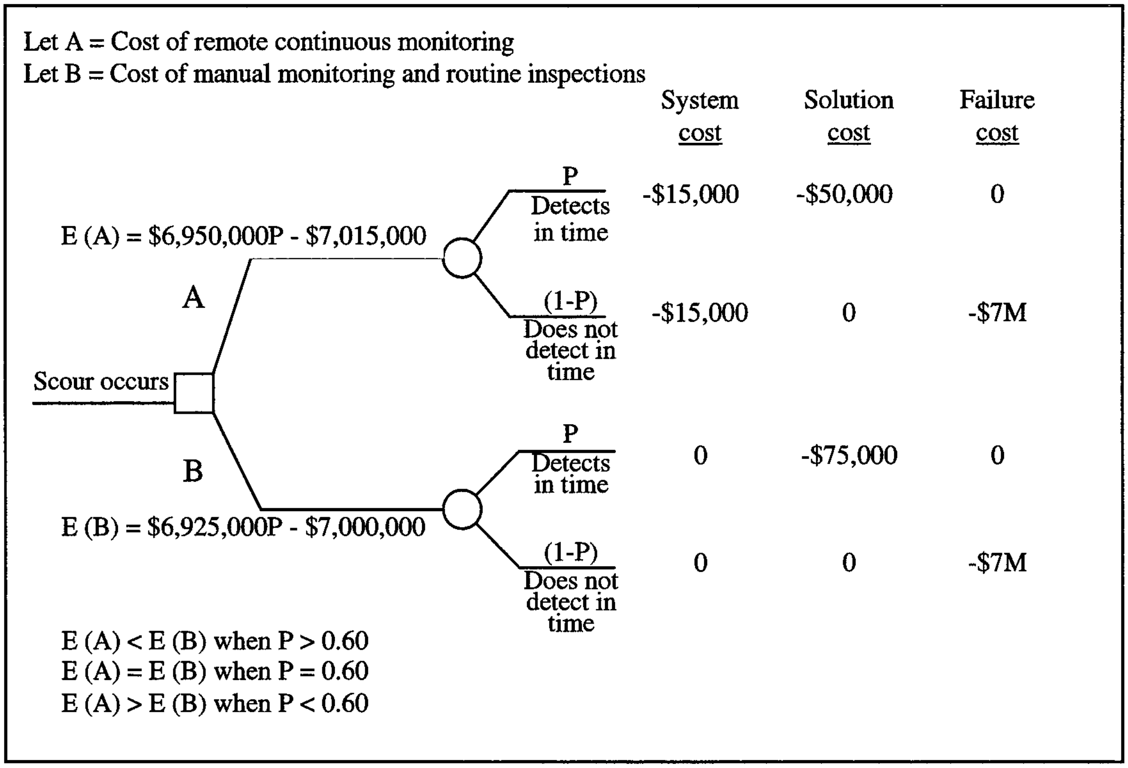

Figure 5.4 Analysis of the Sensitivity of Errors in Estimating Failure Probabilities.

In Figure 5.4, the failure probability is related to the probability of detecting scour hole development — the higher the probability of detection, the lower the probability of bridge failure. The result of the analysis indicates that if the probability of detecting scour hole development by either method is greater than 60 percent, and early detection actually reduces remedial costs by one-third, then remote continuous monitoring should be selected as the preferred monitoring method. Because it is known that scour hole development can be detected easily at least 60 percent of the time, it follows that remote continuous monitoring should be economically feasible when compared with manual monitoring and routine inspections.

CHAPTER 6. CASE STUDY: THE 1998 FLOOD IN SOUTH TEXAS

6.1 SURVEY OF THE DISTRICT ENGINEERS' RESPONSE TO THE FLOOD

In October 1998, a flood of approximately the 500-year magnitude struck south Texas. Seven river basins were flooded during a storm that dropped up to 22 inches of rain in some places. The Austin, Beaumont, Bryan, Corpus Christi, Houston, San Antonio, and Yoakum districts were affected by the flooding, with the latter two districts sustaining the most damage. The flood killed thirty-one people and caused more than $750 million in damage. The Texas Department of Transportation (TxDOT) estimated that $5.6 million would be needed to restore traffic conditions to normal and to protect bridges and roadways from further damage.

A survey was conducted soon after the event to record the district engineers' insight concerning scour damage and to determine if remote mechanical monitoring systems might have helped to alleviate their concerns during the storm. The following are the responses from the San Antonio and Yoakum district engineers.

6.1.1 San Antonio District

The San Antonio District sustained significant damage to both on- and off-system structures. The majority of the damage was due to undermining of abutments and approach slabs, and bridge railings being torn from the structure because of high water. The district engineers were not as concerned with catastrophic bridge failure as they were with erosion of approach slabs and embankments. There was adequate manpower to close the roadways; however, there was not adequate manpower to locate which roads needed closing because there were not enough inspectors.

Many bridges were inaccessible owing to water over the roadway. When the water had subsided, many of these bridges had large drift material jammed into the bridge structure and laying on the roadway. Engineers were mobilized from other districts to assist in identifying structures that might have sustained serious damage. The highest priority for inspecting bridges was based on obvious signs of damage and high average daily traffic (ADT) roadways. There were only a few instances where the public had access to a bridge that might have sustained scour damage before an inspection of the foundations could be performed.

6.1.2 Yoakum District

The Yoakum District sustained significant damage to both on- and off-system structures. The majority of the damage was due to undermining of abutments, approach slabs, and wing walls. Pier scour was not as much of a concern as abutment scour and approach slab erosion.

Many bridges were inaccessible owing to water over the roadway. This was advantageous for the inspecting engineers because they did not have enough manpower to close all the bridges that needed closing. When the water had subsided, many of these bridges had large drift material jammed into the bridge structure and laying on the roadway. Engineers were mobilized from other districts to assist in identifying structures that might have sustained serious damage. The highest priority for inspecting bridges was based on the order in which roadways were likely to be re-opened. There were only a few instances where the public had access to a bridge that might have sustained scour damage before an inspection of the foundations could be performed.

6.2 LESSONS LEARNED FROM THE FLOOD OF 1998

The flood that struck south Texas in October 1998 provided opportunities to gain valuable insight about the effects of a major flood, and whether mechanical scour-monitoring systems could have assisted in the reaction to the flood. The following are the main points regarding scour monitoring noted by the engineers who responded to the survey:

- The majority of the scour problems associated with this flood pertained to abutments and approach embankments, rather than to piers, piles, or spread footings.
- A mechanical monitor would provide little useful information in situations where the foundation depth of the bridge was unknown.

- The presence of a mechanical monitoring system would not change the amount of inspection work needed after a flood. All scour-critical bridges, and bridges that showed signs of damage, still need to be manually inspected after a flood.
- A mechanical monitor may be useful at stream crossings where the road becomes inaccessible because of high water.
- It would be useful to have mechanical monitors where scour problems are known to exist, or where calculated scour depths indicate a potential problem. Such locations include sand bed channels and laterally shifting channels.

Owing to the magnitude of the storm, the National Weather Service communications network that is designed to provide early warning to residents along creeks and rivers experienced some difficulty. Poor communications and equipment failures led to some areas not receiving accurate information about the rate at which floodwaters were rising. At least seventeen of the thirty-one drownings occurred at low-water crossings where people ignored warnings about rapidly rising floodwater. Several U.S. Geological Survey (USGS) gauge stations along the Guadalupe River failed, resulting in the emergency evacuation of the residents of Cuero.

There are several important lessons to be learned from this event. First, redundancy in communications networks is essential during such public emergencies as widespread major flooding. Second, during flash flooding situations, it is impossible to monitor manually the conditions of all roads, low-water crossings, and bridges. Third, it is necessary for emergency management officials to know that evacuation routes are safe for public use.

It is obvious that during such disasters the public needs to have accurate and timely information to avoid life-threatening situations. Hazardous road conditions need to be reported promptly and efficiently so transportation officials can direct traffic flow in an appropriate manner. This idea relates particularly well to the topics of this research project and to Project 0-1380.

CHAPTER 7. SYSTEM IMPLEMENTATION GUIDELINES

7.1 IMPLEMENTATION OF THE PRIORITIZATION MODEL

The prioritization model developed in Chapter 3 of this report relies solely on data contained in the Bridge Inventory, Inspection and Appraisal Program (BRINSAP) database to produce a rank ordering of bridge sites that should receive further consideration for monitoring or other scour countermeasures. The model can be used at the central level to identify the number of bridges in each district that should receive further consideration. The prioritized lists may be used for budgeting purposes, or for directing resources to those districts most in need of assistance with scour-damaged bridges. The model may also be used at the district level as a means of documenting why certain projects were given higher priority than others.

Implementing the prioritization model can be easily achieved by installing a new field in the BRINSAP database for the priority score. The conversion of code described in Chapter 3 can be performed by linking the database to another computer program such as SAS®, or by writing code within the BRINSAP database to handle this task. Priority lists should be generated at the central level periodically and distributed to the districts for their input concerning the severity of scour-related problems at each site. As input from district engineers is gained through the interactive process, the weights assigned to each of the prioritization parameters should be refined to reflect more closely the engineers' priorities. Part of this interactive approach requires that BRINSAP code be updated to reflect the most current conditions at the bridge site. An editing procedure to ensure accurate, complete, and consistent data should accompany this effort.

7.2 REMOTE-MONITORING SYSTEM SELECTION PROCEDURES

As described in Chapter 4 of this report, a monitoring system applicable to all situations does not currently exist. Site specific surveys must be conducted to match the system with the type of information desired. If data are needed to track a scour hole

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development and refilling process, then the sonar-monitoring system is recommended. If only the total depth of scour is required, then the magnetic sliding collar system may be more appropriate. In either event, bridge pier configurations, debris and sediment loading, and other extenuating circumstances that could affect monitor performance must be reviewed to decide on the most effective scour-monitoring system.

7.3 INSTALLING SYSTEM REDUNDANCY

For both low-water crossing and bridge scour monitoring, it is necessary to have redundancy in the communication network. Several options exist to accomplish this requirement, including a cooperative effort with the U.S. Geological Survey (USGS). The USGS already has an extensive network of stream gauging stations with data telemetry capabilities installed through its GOES satellite system. As remote-monitoring equipment is further developed, it should be designed to be SDI-12 compatible to take advantage of USGS systems, thus allowing an opportunity for low-cost redundancy installation in the communications network.

CHAPTER 8. CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS OF THIS RESEARCH EFFORT

The main objective of this research was to develop a logical method for prioritizing bridge sites to receive remote monitoring capabilities or some other scour countermeasure. This objective was met by developing an algorithm based on code contained in the Bridge Inventory, Inspection and Appraisal Program (BRINSAP) database. It was shown through the progressive development of the Texas Department of Transportation's (TxDOT's) scour evaluation program that the appropriate parameters for prioritizing bridge sites were already contained in the database and could be effectively used.

The prioritization method developed in this project relies on data contained in the BRINSAP database. Compared with other available prioritization methods, the method developed herein is most compatible with TxDOT's current scour evaluation program. Significant expenditures of labor and money would be required to implement either of the alternative procedures investigated in this report. A minimal amount of labor or money would be required to implement the method developed for this project, and it would be relatively easy to institute a program to continually refine the prioritization process. A potential weakness of the approach developed in this report is that the code for some items in the database is missing or inaccurate. This is especially true for off-system bridges. Furthermore, this method does not apply to bridges with unknown foundation types or bridges that have not received a scour evaluation.

The vast majority of scour-critical bridges are located in the eastern and southeastern part of the state. During the parameter selection process and assignment of weights to the parameters, it was discovered that the district engineers agreed about the order of importance of the parameters. The parameter weights should be continually refined, with particular attention paid to the priorities of the engineers in the districts with the most scour-critical bridges.

There are three direct benefits provided by remote mechanical monitoring. First, the ability to provide early warning of scour hole development can prevent motorists from using a bridge that is in imminent danger of collapse. Second, the reduction in the probability of scour-related failure should lead directly to a reduction in expected costs of remedying such failures. Third, it can provide real-time data, which are sought by researchers and the Federal Highway Administration (FHWA) for use in calibrating scour prediction equations. Other potential benefits include the possible reduction in labor required to perform scour monitoring and improvements in safety for maintenance workers by removing the need for their presence at a bridge site during flood conditions.

This project and Project 1380 have significant compatibility with each other. The two projects share a common goal and require much of the same equipment to accomplish that goal. The projects should be considered as a single system and research should continue to develop them as such.

Finally, mechanical scour monitoring does not relieve the responsibility for conducting periodic bridge inspections required by the National Bridge Inspection Standards (NBIS). However, the information provided by continuous monitoring has significant value, and it should be feasible to install monitors, especially at large bridges with high average daily traffic (ADT).

8.2 RECOMMENDATIONS FOR ENHANCING THE TEXAS DEPARTMENT OF TRANSPORTATION'S SCOUR EVALUATION PRACTICES

The following recommendations are made to improve the prioritization model developed in this report, and to further TxDOT's state of knowledge regarding scour monitoring. These recommendations are not presented in any specific order that would indicate their importance to the scour evaluation program.

Recommendations:

1. An editing procedure should be developed to review code before it is entered into the BRINSAP database. The procedure should be designed to reduce the amount of

incomplete records, minimize inappropriate code for prioritization parameters, and ensure compatibility of code between the parameters.

2. Update the code in Item 113.1 (Scour Vulnerability Assessment) to be compatible with the actual scour condition. Eventually Item 113.1 should be modified to reflect TxDOT's current sour evaluation practices.

3. Continue to refine the parameter weights assigned in Chapter 3 by following the guidelines established in Section 3.2.4 of that chapter.

4. Continue to evaluate bridges with an Item 113 code of "6" until all bridges in the inventory system have been evaluated.

5. Insert a field in the BRINSAP database to indicate if flood control structures, mining or dredging operations, a nearby confluence with another stream, or sharp bends in the stream exist near the bridge site. This information should be included in the analysis and decision-making process when investigating the practicality of scour countermeasures.

6. Incorporate the information in recommendation #5 into the prioritization algorithm.

7. Insert a field in the BRINSAP database to contain the priority score. Link the database to a program (such as the one in Appendix A) to generate priority scores.

8. The prioritized bridge lists do not infer that each bridge on the list should receive a scour-monitoring system. The list should be reviewed in the order shown and an analysis should be performed as to whether monitoring or some other scour countermeasure should be implemented.

9. Research of remote scour-monitoring systems should continue. Future research should include types of monitors other than those identified in this report.

10. Any monitoring systems that are developed with data telemetry capabilities should have interchangeable telemetry equipment and should be compatible with a backup system (such as the U.S. Geological Survey's [USGS's] GOES satellite system).

11. TxDOT should install monitors at several (six–ten) locations. The monitors should be placed in districts having many scour critical bridges so the district engineers can gain experience with installation and maintenance of the systems. This effort could be in conjunction with future research to further develop monitoring systems, or it could be coordinated by a private contractor.

In summary, because remote mechanical scour-monitoring systems have shown much promise, TxDOT should continue to explore their development and applicability. And because remote mechanical scour monitoring is a relatively new idea, TxDOT should support extensive research and planning regarding methods of system development and implementation. The information and methods presented in this report should be used as a foundation for future research efforts.

REFERENCES

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4. Federal Highway Administration. 1991. T 5140.23, FHWA.

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9. Richardson, E. V., Harrison, L. J., Richardson, J. R., Davis, S. R. 1993. *Evaluating Scour at Bridges-HEC 18.* Federal Highway Administration Publication No. FHWA-IP-90-017.

10. Texas Department of Transportation. 1993. *Texas Secondary Evaluation and Analysis for Scour.* Division of Bridges and Structures — Hydraulics Section.

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12. Interviews with TxDOT's Design Division, 9/3/98 at 10:30 a.m., and with the Construction Division, 9/3/98 at 8:30 a.m.

APPENDIX A: STORED SAS PROGRAM

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APPENDIX A: STORED SAS PROGRAM

```
Options replace LINESIZE=160 PAGESIZE=70 nodate nonumber;
FILENAME brinsap 'c:\windows\temp\brgon~2.TXT' LRECL=610;

DATA temp;
INFILE brinsap lrecl=610;

INPUT structyp 229-230
        scour $ 441-441
        substruc $ 305-305
        channel $ 306-306
        submain 233-233
        ADT 181-186
        adequacy $ 319-319
        function 171-172
        maintype 217-217
        approach $ 311-311

        district 2-3
        control 7-10
        section 11-12
        number 18-20
        latitude 138-142
        longitud 143-148
        location $ 109-133
        crosses $ 53-77;


/*** Item #s 2 & 3 - District and County selection.
     Counties are sorted into their respective districts ***/
/***
if district = '1' then delete;
     if county = '60' then delete;
     if county = '75' then delete;
     if county = '81' then delete;
     if county = '92' then delete;
     if county = '113' then delete;
     if county = '117' then delete;
     if county = '139' then delete;
     if county = '190' then delete;
     if county = '194' then delete;
```

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```
if district = '2' then delete;
      if county = '73' then delete;
      if county = '112' then delete;
      if county = '120' then delete;
      if county = '127' then delete;
      if county = '182' then delete;
      if county = '184' then delete;
      if county = '213' then delete;
      if county = '220' then delete;
      if county = '249' then delete;

if district = '3' then delete;
      if county = '5' then delete;
      if county = '12' then delete;
      if county = '39' then delete;
      if county = '49' then delete;
      if county = '169' then delete;
      if county = '224' then delete;
      if county = '243' then delete;
      if county = '244' then delete;
      if county = '252' then delete;

if district = '4' then delete;
      if county = '6' then delete;
      if county = '33' then delete;
      if county = '56' then delete;
      if county = '59' then delete;
      if county = '91' then delete;
      if county = '99' then delete;
      if county = '104' then delete;
      if county = '107' then delete;
      if county = '118' then delete;
      if county = '148' then delete;
      if county = '171' then delete;
      if county = '179' then delete;
      if county = '180' then delete;
      if county = '188' then delete;
      if county = '191' then delete;
      if county = '197' then delete;
      if county = '211' then delete;
```

```
if district = '5' then delete;
    if county = '9' then delete;
    if county = '35' then delete;
    if county = '40' then delete;
    if county = '54' then delete;
    if county = '58' then delete;
    if county = '78' then delete;
    if county = '84' then delete;
    if county = '86' then delete;
    if county = '96' then delete;
    if county = '111' then delete;
    if county = '140' then delete;
    if county = '152' then delete;
    if county = '153' then delete;
    if county = '185' then delete;
    if county = '219' then delete;
    if county = '223' then delete;
    if county = '251' then delete;

if district = '6' then delete;
    if county = '2' then delete;
    if county = '52' then delete;
    if county = '69' then delete;
    if county = '151' then delete;
    if county = '156' then delete;
    if county = '165' then delete;
    if county = '186' then delete;
    if county = '195' then delete;
    if county = '222' then delete;
    if county = '231' then delete;
    if county = '238' then delete;
    if county = '248' then delete;

if district = '7' then delete;
    if county = '41' then delete;
    if county = '48' then delete;
    if county = '53' then delete;
    if county = '70' then delete;
    if county = '88' then delete;
    if county = '119' then delete;
    if county = '134' then delete;
    if county = '164' then delete;
    if county = '192' then delete;
    if county = '193' then delete;
```

```
      if county = '200' then delete;
      if county = '207' then delete;
      if county = '216' then delete;
      if county = '218' then delete;
      if county = '226' then delete;

if district = '8' then delete;
      if county = '17' then delete;
      if county = '30' then delete;
      if county = '77' then delete;
      if county = '105' then delete;
      if county = '115' then delete;
      if county = '128' then delete;
      if county = '132' then delete;
      if county = '168' then delete;
      if county = '177' then delete;
      if county = '208' then delete;
      if county = '209' then delete;
      if county = '217' then delete;
      if county = '221' then delete;

if district = '9' then delete;
      if county = '14' then delete;
      if county = '18' then delete;
      if county = '50' then delete;
      if county = '74' then delete;
      if county = '98' then delete;
      if county = '110' then delete;
      if county = '147' then delete;
      if county = '161' then delete;

if district = '10' then delete;
      if county = '1' then delete;
      if county = '37' then delete;
      if county = '93' then delete;
      if county = '108' then delete;
      if county = '201' then delete;
      if county = '212' then delete;
      if county = '234' then delete;
      if county = '250' then delete;
```

```
if district = '11' then delete;
	if county = '3' then delete;
	if county = '114' then delete;
	if county = '174' then delete;
	if county = '187' then delete;
	if county = '202' then delete;
	if county = '203' then delete;
	if county = '204' then delete;
	if county = '210' then delete;
	if county = '228' then delete;

if district = '12' then delete;
	if county = '20' then delete;
	if county = '80' then delete;
	if county = '85' then delete;
	if county = '102' then delete;
	if county = '170' then delete;
	if county = '237' then delete;

if district = '13' then delete;
	if county = '8' then delete;
	if county = '29' then delete;
	if county = '45' then delete;
	if county = '62' then delete;
	if county = '76' then delete;
	if county = '90' then delete;
	if county = '121' then delete;
	if county = '143' then delete;
	if county = '158' then delete;
	if county = '235' then delete;
	if county = '241' then delete;

if district = '14' then delete;
	if county = '11' then delete;
	if county = '16' then delete;
	if county = '27' then delete;
	if county = '28' then delete;
	if county = '87' then delete;
	if county = '106' then delete;
	if county = '144' then delete;
	if county = '150' then delete;
	if county = '157' then delete;
	if county = '227' then delete;
	if county = '246' then delete;
```

```
if district = '15' then delete;
        if county = '7' then delete;
        if county = '10' then delete;
        if county = '15' then delete;
        if county = '46' then delete;
        if county = '83' then delete;
        if county = '95' then delete;
        if county = '131' then delete;
        if county = '133' then delete;
        if county = '162' then delete;
        if county = '163' then delete;
        if county = '232' then delete;
        if county = '247' then delete;

if district = '16' then delete;
        if county = '4' then delete;
        if county = '13' then delete;
        if county = '89' then delete;
        if county = '126' then delete;
        if county = '129' then delete;
        if county = '137' then delete;
        if county = '149' then delete;
        if county = '178' then delete;
        if county = '196' then delete;
        if county = '205' then delete;

if district = '17' then delete;
        if county = '21' then delete;
        if county = '26' then delete;
        if county = '82' then delete;
        if county = '94' then delete;
        if county = '145' then delete;
        if county = '154' then delete;
        if county = '166' then delete;
        if county = '198' then delete;
        if county = '236' then delete;
        if county = '239' then delete;
```

```
if district = '18' then delete;
      if county = '43' then delete;
      if county = '57' then delete;
      if county = '61' then delete;
      if county = '71' then delete;
      if county = '130' then delete;
      if county = '175' then delete;
      if county = '199' then delete;

if district = '19' then delete;
      if county = '19' then delete;
      if county = '32' then delete;
      if county = '34' then delete;
      if county = '103' then delete;
      if county = '155' then delete;
      if county = '172' then delete;
      if county = '183' then delete;
      if county = '225' then delete;
      if county = '230' then delete;

if district = '20' then delete;
      if county = '36' then delete;
      if county = '101' then delete;
      if county = '122' then delete;
      if county = '124' then delete;
      if county = '146' then delete;
      if county = '176' then delete;
      if county = '181' then delete;
      if county = '229' then delete;

if district = '21' then delete;
      if county = '24' then delete;
      if county = '31' then delete;
      if county = '66' then delete;
      if county = '109' then delete;
      if county = '125' then delete;
      if county = '214' then delete;
      if county = '245' then delete;
      if county = '253' then delete;

if district = '22' then delete;
      if county = '64' then delete;
      if county = '67' then delete;
      if county = '136' then delete;
```

```
    if county = '142' then delete;
    if county = '159' then delete;
    if county = '233' then delete;
    if county = '240' then delete;
    if county = '254' then delete;

if district = '23' then delete;
    if county = '25' then delete;
    if county = '42' then delete;
    if county = '47' then delete;
    if county = '68' then delete;
    if county = '141' then delete;
    if county = '160' then delete;
    if county = '167' then delete;
    if county = '206' then delete;
    if county = '215' then delete;

if district = '24' then delete;
    if county = '22' then delete;
    if county = '55' then delete;
    if county = '72' then delete;
    if county = '116' then delete;
    if county = '123' then delete;
    if county = '189' then delete;

if district = '25' then delete;
    if county = '23' then delete;
    if county = '38' then delete;
    if county = '44' then delete;
    if county = '51' then delete;
    if county = '63' then delete;
    if county = '65' then delete;
    if county = '79' then delete;
    if county = '97' then delete;
    if county = '100' then delete;
    if county = '135' then delete;
    if county = '138' then delete;
    if county = '173' then delete;
    if county = '242' then delete; ***/
```

```
/*** Item #s 43.4 and 44.5 - Structure Type Selection.
     Item 43.4 is left blank where the bridge is other than a culvert.
     Item 43.5 is left blank where the bridge is other than a tunnel.
***/
/***
if structyp = ' '  then delete; ***/
if structyp = '2'  then delete;
if structyp = '12' then delete;
if structyp = '13' then delete;
if structyp = '17' then delete;
if structyp = '22' then delete;
if structyp = '23' then delete;
if structyp = '24' then delete;
if structyp = '25' then delete;
if structyp = '27' then delete;
if structyp = '31' then delete;
if structyp = '32' then delete;
if structyp = '33' then delete;
if structyp = '41' then delete;
if structyp = '42' then delete;
if structyp = '43' then delete;
if structyp = '92' then delete;
if structyp = '93' then delete;
if structyp = '95' then delete;

/*** Item 113 - Scour Critical Bridges.
     A, B, Y, E, I, Q are bad code for this item.
     T, N, 9, 8, 7 indicate low risk/remote monitoring not necessary.
     6 means bridge has not been evaluated for scour.
     5, 4, 3, 2, 1, 0, U indicates that monitoring may be necessary.
***/

if scour = 'A' then delete;
if scour = 'B' then delete;
if scour = 'Y' then delete;
if scour = 'E' then delete;
if scour = 'I' then delete;
if scour = 'Q' then delete;
if scour = '-' then delete;
if scour = ' ' then delete;

if scour = '6' then delete;
if scour = 'U' then delete;
if scour = 'T' then delete;
```

```
/***
if scour = 'N' then delete;
if scour = '9' then delete;
if scour = '8' then delete;
if scour = '7' then delete;
if scour = '5' then delete;
if scour = '4' then delete;
if scour = '3' then delete;
if scour = '2' then delete;
if scour = '1' then delete;
if scour = '0' then delete; ***/


if scour = 'N' then Item113 = 10;
if scour = '9' then Item113 = 9;
if scour = '8' then Item113 = 8;
if scour = '7' then Item113 = 7;
if scour = '5' then Item113 = 6;
if scour = '4' then Item113 = 5;
if scour = '3' then Item113 = 4;
if scour = '2' then Item113 = 3;
if scour = '1' then Item113 = 2;
if scour = '0' then Item113 = 1;


/*** Item 60 - Substructure evaluation section.
     The code for this item follows the General Conditions Rating code.
     The variable name for this item is 'substruc'.
***/
/***
if substruc = 'N' then delete;
if substruc = '9' then delete;
if substruc = '8' then delete;
if substruc = '7' then delete;
if substruc = '6' then delete;
if substruc = '5' then delete;
if substruc = '4' then delete;
if substruc = '3' then delete;
if substruc = '2' then delete;
if substruc = '1' then delete;
if substruc = '0' then delete;
if substruc = ' '  then delete; ***/
```

```
if substruc = '9' then Item60 = 10;
if substruc = '8' then Item60 = 9;
if substruc = '7' then Item60 = 8;
if substruc = '6' then Item60 = 7;
if substruc = '5' then Item60 = 6;
if substruc = '4' then Item60 = 5;
if substruc = '3' then Item60 = 4;
if substruc = '2' then Item60 = 3;
if substruc = '1' then Item60 = 2;
if substruc = '0' then Item60 = 1;


/*** Item 61 - Channel and Channel Protection.
     The code for this item is found on page 32, and is not the same code as for Item 60.
     The variable name for this item is 'channel'.
***/
/***
if channel = 'N' then delete;
if channel = '9' then delete;
if channel = '8' then delete;
if channel = '7' then delete;
if channel = '6' then delete;
if channel = '5' then delete;
if channel = '4' then delete;
if channel = '3' then delete;
if channel = '2' then delete;
if channel = '1' then delete;
if channel = '0' then delete; ***/

if channel = '9' then Item61 = 10;
if channel = '8' then Item61 = 9;
if channel = '7' then Item61 = 8;
if channel = '6' then Item61 = 7;
if channel = '5' then Item61 = 6;
if channel = '4' then Item61 = 5;
if channel = '3' then Item61 = 4;
if channel = '2' then Item61 = 3;
if channel = '1' then Item61 = 2;
if channel = '0' then Item61 = 1;
```

```
/***
Item 44.1 - Substructure Type for the Main Span.
     'submain' is the name for this variable.
     The first digit pertains to above-ground structure type.
     The second digit pertains to below-ground structure type.
     The third digit pertains to the bent cap material type.
        To count only the below-ground portion of the foundation types,
        change the variable field in the input section to 233-233.***/

/***
if submain = ' ' then delete;
if submain = '1' then delete;
if submain = '2' then delete;
if submain = '3' then delete;
if submain = '4' then delete;
if submain = '5' then delete;
if submain = '6' then delete;
if submain = '7' then delete;
if submain = '8' then delete;
if submain = '9' then delete; ***/

if submain = ' '  then Item44 = 9;
if submain = '1' then Item44 = 6;
if submain = '2' then Item44 = 2;
if submain = '3' then Item44 = 10;
if submain = '4' then Item44 = 8;
if submain = '5' then Item44 = 3;
if submain = '6' then Item44 = 7;
if submain = '7' then Item44 = 5;
if submain = '8' then Item44 = 1;
if submain = '9' then Item44 = 4;

/*** Item 29 - Annual Average Daily Traffic ***/

if ADT > '99999'  then Item29 = 1;
if ADT < '100000' then Item29 = 2;
if ADT < '44362'  then Item29 = 3;
if ADT < '19680'  then Item29 = 4;
if ADT < '8730'   then Item29 = 5;
if ADT < '3873'   then Item29 = 6;
if ADT < '1718'   then Item29 = 7;
if ADT < '762'    then Item29 = 8;
if ADT < '338'    then Item29 = 9;
if ADT < '150'    then Item29 = 10;
```

```
/*** Item 71 - Waterway Adequacy.
     Table 4 on page 44 of the coding guide codes this item.
***/
/***
if adequacy = 'N' then delete;
if adequacy = '9' then delete;
if adequacy = '8' then delete;
if adequacy = '7' then delete;
if adequacy = '6' then delete;
if adequacy = '5' then delete;
if adequacy = '4' then delete;
if adequacy = '3' then delete;
if adequacy = '2' then delete;
if adequacy = '1' then delete;
if adequacy = '0' then delete; ***/

if adequacy = 'N' then Item71= 10;
if adequacy = '9' then Item71 = 9;
if adequacy = '8' then Item71 = 8;
if adequacy = '7' then Item71 = 7;
if adequacy = '6' then Item71 = 6;
if adequacy = '5' then Item71 = 5;
if adequacy = '4' then Item71 = 4;
if adequacy = '3' then Item71 = 3;
if adequacy = '2' then Item71 = 2;
if adequacy = '1' then Item71 = 1;
if adequacy = '0' then Item71 = 1;
```

```
/*** Item 26 - Functional Classification
     'function' is the name for this variable
     codes ending in '1' indicate interstate highway
     codes ending in '2' indicate freeways and expressways
     codes ending in '3' indicate principal arterials
     codes ending in '4' indicate minor arterials
     codes ending in '5' indicate collectors
     codes ending in '6' indicate locals
***/

if function = '01' then Item26 = 1;
if function = '11' then Item26 = 1;
if function = '21' then Item26 = 1;
if function = '41' then Item26 = 1;

if function = '12' then Item26 = 2;
if function = '22' then Item26 = 2;
if function = '42' then Item26 = 2;

if function = '23' then Item26 = 3;
if function = '43' then Item26 = 3;

if function = '02' then Item26 = 4;
if function = '13' then Item26 = 4;

if function = '24' then Item26 = 5;
if function = '44' then Item26 = 5;

if function = '03' then Item26 = 6;
if function = '14' then Item26 = 6;

if function = '25' then Item26 = 7;
if function = '45' then Item26 = 7;

if function = '04' then Item26 = 8;
if function = '15' then Item26 = 8;

if function = '26' then Item26 = 9;
if function = '46' then Item26 = 9;

if function = '05' then Item26 = 10;
if function = '06' then Item26 = 10;
if function = '16' then Item26 = 10;
```

```
/***
Item 43.1 - Superstructure Type for the Main Span.
      'maintype' is the name for this variable.
      This item has a four-digit code;
      the first digit pertains to the span type. ***/

if maintype = '5' then Item43 = 1;
if maintype = '7' then Item43 = 2;
if maintype = '4' then item43 = 3;
if maintype = '1' then Item43 = 4;
if maintype = '2' then Item43 = 5;
if maintype = '3' then Item43 = 6;
if maintype = '6' then Item43 = 7;
if maintype = '8' then Item43 = 8;
if maintype = '9' then Item43 = 9;
if maintype = ' ' then Item43 = 10;


/*** Item 65 - Approach Roadway Condition
      code for this item follows the general condition rating.

if approach = 'N' then delete;
If approach = ' ' then delete; ***/

if approach = '0' then Item65 = 1;
if approach = '1' then Item65 = 2;
if approach = '2' then Item65 = 3;
if approach = '3' then Item65 = 4;
if approach = '4' then Item65 = 5;
if approach = '5' then item65 = 6;
if approach = '6' then Item65 = 7;
if approach = '7' then Item65 = 8;
if approach = '8' then Item65 = 9;
if approach = '9' then Item65 = 10;
```

```
/*** Currently running proc statements follow ***/

title1 On-system bridges, All Districts;
title2 Sorted by District and Scour Rating;

proc sort data=temp; by Item113;
proc print data=temp label split='*';
var district control section number Item113;
where Item113<'6';
label district='District*ID Number' control='Control*Number'
    section='Section*Number' number='Bridge*Number'
    Item113='Scour*Rating';

run;

/*** Labels and variables used in program.
Item113 Item60 Item61 Item44 Item71 Item29 Item43 Item26 Item65
Item113='Scour*Rating' Item60='Substructure*Evaluation'
Item61='Channel*Condition' Item44='Foundation*Type'
Item71='Waterway*Adequacy' Item29='ADT' Item43='Span Type'
Item26='Functional*Classification' Item65='Approach*Roadway';
latitude='Latitude' longitud='Longitude'

scour substruc channel submain adequacy ADT maintype function
approach structyp district control section number location
crosses longitud latitude duplicat
***/
```

APPENDIX B: SURVEY OF OTHER STATE DOTS

APPENDIX B: SURVEY OF OTHER STATE DOTS

Dear «Title» «LastName»,

My name is Tom Groll, and I am a graduate student in the civil engineering department at The University of Texas at Austin. I am currently working on the "Remote Sensing of Bridge Scour" research project for the Texas Department of Transportation. My goals for the project are to develop a prioritization scheme to assist TxDOT in selecting the order in which bridges should be fitted with scour-monitoring equipment and an implementation guide to assist in equipment selection. To that end, I am soliciting information from DOTs outside of Texas to determine the range of practices and types of equipment that are currently being used for bridge scour monitoring. I would like to ask for your assistance by filling out the attached survey and returning it in the envelope provided. If you are not the appropriate person to respond to this survey, please forward it to those involved with bridge scour monitoring in your state.

If you have any questions regarding this research project, please feel free to contact me at the address below, or by sending email to tgroll@mail.utexas.edu. If you would like to receive a copy of the results of this survey please indicate so in question 11. Thank you in advance for your cooperation, your input is very much appreciated.

Sincerely,

Thomas J. Groll
Graduate Research Assistant
Construction Engineering and Project Management Dept.
Ernst Cockrell Jr. Hall, Room 5.200
The University of Texas at Austin
Austin, TX 78712

Office: (512) 471-4648
Fax: (512) 471-3191

Instructions:

This survey consists of 11 questions pertaining to bridge scour monitoring. Circle all appropriate answers. Please include any additional comments that you feel are relevant. When completed, return this survey in the envelope provided. Thank you for your time and consideration.

1) Please fill in the following information:

Name/title ______________________________
Address ______________________________
____

If I may contact you about your responses to this survey, please indicate the best way to do so:

A. Phone ____________________
B. Regular mail
C. Email ____________________
D. Do not contact

2) Approximately how many bridges is your department responsible for in your state?

A. < 5,000
B. 5,001 to 10,000
C. 10,001 to 20,000
D. > 20,000

3) In your state, bridge scour monitoring is performed by:

A. State DOT maintenance personnel.
B. Private contractors.
C. Both state and private entities (if both, please estimate percentage of each)
State personnel ________% private contractors ________%.

4) Which method(s) of scour monitoring are used in your state?

A. Use scour prediction equations to estimate scour depth.
B. Manual monitoring (deploy a crew to a site during flooding).
C. Mechanical monitoring without data telemetry.
D. Mechanical monitoring with data telemetry.
E. Other (please specify) ______________________________.

5) If your state uses mechanical monitors, the monitors are:

A. Purchased from private manufacturers.
B. Manufactured by the state DOT as needed.
C. Both A and B (if both, please estimate percentage of each)
Private manufacturers ______% by state DOT______%.
D. Not applicable.

6) If your state uses mechanical monitors, the type(s) in use are:
   A. Sonar.
   B. Buried/driven rod (for example, magnetic sliding collar type).
   C. Sounding rod (for example, Briscoe monitors).
   D. Piezoelectric film/other buried devices.

7) The approximate number of mechanical monitors currently in use in your state is:
   A. < 10
   B. 10 to 50
   C. 50 to 100
   D. > 100

8) Based on your experience, the estimated cost to purchase/manufacture (circle one) and install a monitor is:
   A. < $2,500
   B. $2,500 to $5,000
   C. $5,000 to $7,500
   D. $7,500 to $10,000
   E. > $10,000

9) If mechanical monitors are used in your state, has maintenance of the monitor been difficult?
   A. Yes (please explain briefly)
   B. No
   C. Not applicable

10) Based on your experience, the estimated cost to perform a detailed scour analysis on a bridge is:
   A. < $2,500
   B. $2,500 to $5,000
   C. $5,000 to $7,500
   D. $7,500 to $10,000
   E. > $10,000

11) Would you like to receive the results of this survey by mail?
   A. Yes
   B. No

APPENDIX C: VENDORS AND MANUFACTURERS LIST

APPENDIX C: VENDORS AND MANUFACTURERS LIST

Manufacturers of sonar, magnetic sliding collar, piezoelectric film, and float out scour-monitoring systems:

ETI Instrument Systems, Inc.
1317 Webster Ave.
Fort Collins, CO 80524
Telephone: (970) 484-9393
Fax phone: (970) 484-9397
Contact: Jerry Price – President

Manufacturers of sonar scour-monitoring systems:

Design Analysis Associates, Inc.
75 West 100 South
Logan, UT 84321
Telephone: (801) 753-2212
Fax phone: (801) 753-7669
Contact: Bill Fletcher – President

Datasonics, Inc.
P.O. Box 8
Cataumet, MA 02534
Telephone: (508) 563-5511
Fax phone: (508) 563-9312
Contact: Brian Wilson – Sales representative

APPENDIX D:

PRIORITIZED BRIDGE LISTS

ON-SYSTEM

District	Control	Section	Number	Location	Crosses	Score
1	136	12	10	3.1 MI S JCT FM512&SH24	SO. SULPHUR RIV	3.178
1	45	4	25	1.8 MI W JCT US69&US82	MILL CREEK	4.228
1	316	3	7	4.3 MI S JCT FM120&FM1753	CHOCTAW CR	4.423
1	45	4	22	5.7 MI W JCT US69&US82	CHOCTAW CREEK	4.434
1	45	5	28	2.1 MI W JCT US82&FM898	BIG CANEY CRK	4.467
1	45	5	27	2.1 MI W JCT US 82&FM898	LITTLE CANEY CRK	4.554
1	10	2	2	3.7 MI W JCT IH30&FM69	ROCK CRK SLOUGH	4.566
1	688	2	16	1.4 MI W JCT FM 197	SLOUGH CRK	4.614
1	47	1	119	5.8 MI N JCT US75&US69	RED RIVER	4.637
1	45	3	16	0.9MI W JCT US82 AND US75	SAND CR	4.665
1	10	2	4	5.7MI E JCT SH 19	ROCK CREEK SLOUGH	4.700
1	45	3	17	0.1MI W JCT US75	L POST OAK CR	4.749
1	45	12	104	4.0 MI W JCT SH 37	BRUTON CREEK	4.753
1	81	10	55	5.6 MI N JCT US82&US377	SANDY CREEK	4.791
1	10	2	3	5.6MI E JCT SH 19	ROCK CRK SLOUGH	4.812
1	47	3	12	1.6 MI S JCT US75&FM1417	CHOWTAW CRK	4.900
1	81	10	54	7.5 MI N JCT US82&US377	BRUSHY CREEK	4.903
1	764	4	9	2.3 MI S JCT SH11&FM896	BOIS D'ARC CRK	4.948
1	45	6	34	1.5 MI E JCT US82&SH78	BOIS D ARC CR	4.967
1	9	6	32	5.5 MI NE ROCKWALL CO LN	W. CADDO SLOUGH	4.978
1	9	6	30	2.7 MI NE ROCKWALL CO LN	BRUSHY CRK	5.022
1	47	3	156	1.6 MI S JCT US75&FM1417	CHOCTAW CR	5.058
1	9	6	35	8.9 MI NE ROCKWALL CO LN	RELIEF CRK	5.068
1	45	12	105	1.7 MI W JCT SH 37	MC COY CR.	5.086
1	9	6	36	9.1 MI NE ROCKWALL CO LN	CADDO CRK	5.090
1	1379	1	2	2.2 MI N JCT US82&FM901	MINERAL CRK	5.115
1	81	10	66	1.1 MI N JCT US82&US377	N FORK BIG MINERAL C	5.160
1	9	6	37	10.4 MI NE ROCKWALL CO LN	BLACK CRK	5.202
1	45	6	33	1.3 MI E JCT US82&SH78	BOIS D ARC CR	5.220
1	1379	1	4	7.6 MI N JCT US82&FM901	BRUSHY CRK	5.222
1	1379	1	5	4.7 MI N JCT US82&FM901	SANDY CRK	5.222
1	510	1	9	7.8 MI E JCT US377&FM902	RANGE CRK	5.233
1	136	3	57	.9 MI EAST HUNT CO LINE	BARNETT CREEK	5.235
1	9	6	31	5.3 MI NE ROCKWALL CO LN	W. CADDO SLOUGH	5.249
1	9	6	34	7.8 MI NE ROCKWALL CO LN	ELM CRK	5.249
1	9	22	52	.5MI W JCT SH50	LYNN CRK	5.255
1	410	1	11	7.8 MI E JCT SP503&US69	MILL CR.	5.273
1	1709	2	8	1.8MI E GRAYSON CL	BRUSHY CREEK	5.286
1	9	13	122	1.3 MI NE JCT US69&IH30	SABINE RIVER *	5.306
1	279	3	20	2.7 MI S JCT SH56&SH78	BOIS D'ARC CREEK	5.318
1	688	2	19	0.8 MI E JCT FM 2352	SANDERS CRK	5.323
1	45	6	38	1.8 MI E OF FM 897	BIG BULLARD CREEK	5.363
1	9	6	29	1.7 MI NE ROCKWALL CO LN	PAYNE RIVER	5.380
1	9	6	33	5.5 MI NE ROCKWALL CO LN	E. CADDO SLOUGH	5.383
1	9	13	121	1.3 MI NE JCT US69&IH30	SABINE RIVER *	5.393
1	2139	2	2	2.9 MI E JCT US69&SH11	BOIS D'ARC CRK	5.417
1	510	5	10	1.6 MI N JCT US82&FM898	CANEY CRK	5.431

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District	Control	Section	Number	Location	Crosses	Score
1	410	1	2	4.0 MI E JCT SP503&US69	IRON ORE CR.	5.449
1	136	5	77	0.2MI N LAMAR-DELTA CO LN	N SULPHUR RIVER	5.469
1	45	18	128	1.2 MI E JCT FM 901 US 82	MUSTANG CR.	5.478
1	9	13	140	3.5 MI E ROCKWALL CO LN	BRUSHY CREEK	5.479
1	47	3	154	4.5 MI S JCT US82&US75	CHOCTAW CRK	5.539
1	45	18	129	1.2 MI E. JCT US82 FM 90	MUSTANG CR.	5.547
1	688	2	20	0.6 MI E JCT FM 2352	SANDERS CRK	5.550
1	9	13	141	3.5 MI E ROCKWALL CO LN	BRUSHY CREEK	5.591
1	45	12	103	7.6 MI E LAMAR CO LINE	SCATTER CR.	5.624
1	45	3	153	0.1MI W JCT US75	POST OAK CRK.	5.624
1	9	7	41	.55 MI W JCT B67t & FM499	SABINE RIVER	5.653
1	2454	1	1	2.4 MI S JCT FM120&FM131	IRON CRK	5.654
1	9	13	143	0.6 MI W JCT FM36&IH30	WEST CADDO CRK	5.664
1	136	3	21	3.8MI E HUNT CO LINE	JERNIGAN CREEK REL.	5.671
1	2139	3	13	4.1 MI W JCT SH11&SH78	BOIS D'ARC CRK	5.674
1	190	1	33	9.4MI S JCT IH 30	BIG CYPRESS CREEK	5.679
1	1709	2	9	2.6MI E JCT FM2645 FM1753	CANEY CREEK	5.693
1	1488	1	3	0.1 MI W JCT SH11&FM1553	BURR OAK CREEK	5.699
1	1979	1	2	7.5 MI NW OF US 82	BOIS D'ARC CREEK	5.702
1	9	13	144	0.6 MI W JCT FM36&IH30	WEST CADDO CRK	5.711
1	2139	3	14	3.3 MI W JCT SH11&SH78	BURR OAK CRK	5.714
1	108	9	40	4.3 MI S JCT IH30&SH19	CHAFFIN CREEK	5.722
1	9	13	147	0.5 MI W JCT FM1903&IH30	ELM CREEK	5.733
1	45	6	39	2.05 MI E OF FM 897	LITTLE BULLARD CREEK	5.743
1	190	1	32	8.2MI S JCT IH 30	LITTLE CYPRESS CR.	5.744
1	47	2	79	0.25 MI S JCT SH91&SP503	IRON ORE CREEK	5.754
1	221	4	29	8.5 E JCT SH37	SULPHUR RIVER RELIEF	5.760
1	47	3	131	1.6 MIS.JCT US82 US75	POST OAK CR	5.795
1	47	3	132	1.6 MI S JCT US 75 SH 56	POST OAK CR	5.795
1	1705	1	3	3.0 MI N JCT FM 195	PINE CRK	5.815
1	81	10	67	0.8 MI N JCT US82&US377	S FORK BIG MINERAL C	5.833
1	510	1	8	6.7 MI E JCT US377&FM902	CASE CRK	5.843
1	47	3	129	1.6 MI S JCT US 75 SH 56	POST OAK CRK	5.866
1	45	12	88	1.3 MI E LAMAR CO LINE	WILDCAT CR.	5.974
1	47	3	130	1.6 MI S JCT US 75 SH 56	POST OAK CRK	6.000
1	9	13	230	0.5MI W JCT FM36 AND IH30	CADDO CRK	6.011
1	1690	1	20	0.2 MI S JCT US 271	BIG SANDY CREEK	6.024
1	1488	1	5	0.5 MI W JCT SH78&FM1553	FREEMAN CRK	6.055
1	136	8	92	5.3 MI N JCT US 82	HICKS CREEK	6.070
1	189	3	36	2.5 MI S JCT US 82	BOGGY CRK	6.081
1	1690	1	17	0.2 MI S JCT US 271	BIG SANDY CREEK	6.098
1	620	1	1	0.6 MI S OF FM 271	ALLEN CREEK	6.115
1	2874	1	2	2.2 MI N JCT SH11&FM2815	HENSON CRK	6.118
1	2459	2	5	1.2 MI W JCT US377&FM902	JORDAN CRK	6.119
1	9	13	226	3.5 MI E ROCKWALL CO LINE	BRUSHY CRK	6.152
1	9	13	234	0.5 MI W JCT FM1903&IH30	ELM CREEK	6.168
1	766	1	25	7.9 MI N JCT IH30&FM69	CROSS TIMBER CRK	6.183

District	Control	Section	Number	Location	Crosses	Score
1	136	1	6	1.0MI W JCT FM118 & SH224	HORSE CREEK	6.185
1	610	2	16	0.2MI W JCT SH 37	DENTON CREEK	6.187
1	9	13	377	3.5 MI E ROCKWALL CO LINE	BRUSHY CREEK	6.190
1	642	1	6	11.0 MI N JCT US380&FM36	ELM BR	6.206
1	2003	1	1	1.0 MI SW JCT FM 1506	MALLORY CREEK	6.229
1	3452	1	3	2.7MI N JCT FM1537&FM3236	CANEY CRK	6.232
1	610	2	15	0.2MI W JCT SH 37	DENTON CREEK	6.234
1	723	1	14	4.2 MI. S. JCT FM 307	BRUSHY CRK	6.249
1	189	2	27	7.3 MI N JCT US 82	PECAN BAYOU REL	6.261
1	279	2	24	JCT TEXAS & OKLAHOMA	RED RIVER N TO OKLAHOMA	6.325
1	735	1	25	2.1 MI N JCT SH24&FM128	BIG CREEK	6.387
1	136	4	79	0.5MI S LAMAR CO LINE	NORTH SULPHUR REL.	6.389
1	549	2	11	2.0 MI S JCT SH121&SH11	BOIS D'ARC CR	6.389
1	9	13	378	0.5 MI W JCT FM36 IH30	WEST CADDO CREEK	6.414
1	610	2	17	0.2MI W JCT SH 37	DENTON CREEK	6.417
1	769	2	4	10.0 MI E JCT US 271	PINE CR	6.418
1	769	1	7	2.2 MI W JCT US 271	SANDERS CREEK	6.435
1	136	3	27	7.6MI E HUNT CO LINE	JOHNS CREEK	6.503
1	279	2	3	0.7 MI N JCT FM 898	TIMBER CR.	6.535
1	549	2	13	1.9 MI S JCT SH121&SH11	BOIS D'ARC REL	6.570
1	279	2	1	2.5 MI N JCT SH78&SH121	WOLF CR	6.604
1	279	2	2	0.9 MI N JCT SH78&SH121	LITTLE TBR. CR.	6.604
1	2874	1	3	0.4 MI N JCT SH11&FM2815	DYER CRK	6.690
1	1177	1	1	4.1 MI S JCT US 82	BOGGY CRK	6.721
1	690	1	8	0.4 MI E JCT SH 78&FM271	BOIS D'ARC	6.991
1	2733	1	1	3.2 MI N OF FM 1396	COFFEE MILL CREEK	6.994
1	1154	1	1	2.4 MI S OF SH 56	WAFER CREEK	6.996
1	189	5	47	5.3 MI N JCT US 67 SH 37	WHITE OAK RELIEF B1	7.004
1	1379	1	6	3.9 MI W JCT US377&FM901	ROCK CRK	7.071
1	764	4	13	1.5 MI S JCT SH11 & FM896	BOIS D'ARC	7.076
1	189	5	48	5.5 MI N JCT US 67 SH 37	WHITE OAK RELIEF B2	7.116
1	189	5	49	5.9 M N JCT US 67 SH 37	WHITE OAK CREEK	7.138
1	189	5	50	6.2 MI N JCT US 67 SH37	WHITE OAK CREEK BR3	7.138
1	3145	1	1	4.2 MI W JCT SH34&FM1564	ELM CREEK	7.237
1	1482	2	5	4.6 MI E OF SH 34	BLEDSOE CREEK	7.329

District	Control	Section	Number	Location	Crosses		Score
2	312	5	40	1 MI S OF FM 1542	WALNUT CREEK		4.574
2	363	1	1	0.3 MI SW OF SH 26	BIG FOSSIL CREEK		4.592
2	134	8	39	8.1 MI E OF BUS 81	CATLETT CREEK		4.669
2	171	4	15	0.9 MI S OF FM 730 NB	ASH CREEK		4.768
2	314	1	4	1.5 MI E OF FM 1189	LITTLE GRINDSTONE CK		4.793
2	314	1	6	1.78 MI W OF FM 113	BRAZOS RIVER		4.831
2	14	4	59	0.3 MI S OF FM2258	S CHAMBERS CREEK		4.859
2	314	3	13	2.9 MI W OF FM 4	SUNDAY CREEK		4.901
2	353	1	2	0.6 MI W OF DENTON CO LIN	ELIZABETH CREEK		4.953
2	363	1	5	2.3 MI W OF SH 114	BIG BEAR CREEK		4.962
2	134	7	66	0.7 MI E OF FM 1655	SANDY CREEK		5.021
2	8	5	47	0.5 MI E OF US-287	SYCAMORE CREEK		5.069
2	363	3	12	SH121 OVER TRINITY RIVER	TRINITY RIVER		5.073
2	363	3	13	SH121 OVER TRINITY RIVER	TRINITY RIVER		5.073
2	14	4	58	2.5 MI S OF US67	TURKEY CREEK		5.083
2	250	3	15	0.3 MI S OF MORGAN MILL	N PALUXY RIVER		5.108
2	171	5	17	0.6 MI N WHT SETTLEMT RD	W FRK TRINITY RIVER		5.109
2	8	6	54	3.2 MI E OF IH-820	RUSH CREEK RELIEF		5.115
2	7	10	48	0.85 MI WEST OF US 281	POLLARD CREEK		5.128
2	8	6	52	2.8 MI E OF IH-820	E REL OF VILLAGE CRK		5.162
2	312	5	18	1.5 MI N OF SH-199	WALNUT CREEK RELIEF		5.169
2	8	14	258	1.8 MI NE OF SILVER CK RD	LAKEWORTH & CITY ST	*	5.173
2	8	14	259	1.8 MI NE OF SILVER CK RD	LAKEWORTH & CITY ST	*	5.173
2	1178	1	3	2.1 MI N OF SH-193	PANTHER CK REL.		5.197
2	391	6	22	0.3 MI S OF FM-2190	NORTH CREEK RELIEF		5.206
2	343	1	2	2.1 MI E OF SH-16	ROCKY CK		5.227
2	249	7	25	1.1 MI N OF FM 2210	KEECHI CREEK		5.233
2	80	2	52	1.2 MI W OF FM 2481	SOUTH PALUXY RIVER		5.252
2	1178	1	1	2.6 MI N OF SH-193	SNIDER BR		5.254
2	81	1	1	US377 OVER TRINITY RIVER	TRINITY RIVER		5.270
2	385	2	7	1.1 MI W OF FM 1189 S	W FRK KICKAPOO CREEK		5.282
2	385	2	8	0.7 MI W OF FM 1189 S	KICKAPOO CREEK		5.282
2	1606	1	7	0.2 MILES WEST OF FM 2952	LAKE BRIDGEPORT SPLW		5.302
2	343	4	20	1.0 MI N OF FM 2303	N FORK OF N BOSQUE		5.318
2	2266	2	1	1.9 MI S OF SH-183	WEST FORK TRINITY RI		5.339
2	343	4	21	0.1 MI S OF FM 2303	S FORK OF N BOSQUE		5.365
2	2266	2	18	1.9 MI S OF SH-183	WEST FRK TRINITY RIV		5.386
2	8	6	53	3.1 MI E OF IH-820	RUSH CREEK		5.463
2	736	1	16	0.1 MI N OF US 180	TOWN BRANCH		5.484
2	249	6	16	2.2 MI NW OF SH-114	NORTH CREEK		5.503
2	314	1	75	2.2 MI E OF FM113	BIG GRINDSTONE CR		5.529
2	314	1	71	1.5 MI E OF FM 1189	LITTLE GRINDSTONE CR		5.551
2	314	1	73	1.4 MI E OF FM1189	LITTLE GRINDSTONE CR		5.551
2	364	1	76	0.6 MI N OF JOHNSON RD.	BIG BEAR CREEK		5.633
2	314	1	72	1.5 MI E OF FM 1189	LITTLE GRINDSTONE CR		5.645
2	8	14	239	1.9 MI W OF FM 156	CEMENT PLANT HAUL RD		5.646
2	712	2	1	2.0 MI E OF I35W	CHAMBERS CREEK		5.650

District	Control	Section	Number	Location	Crosses	Score
2	1993	1	1	0.9 MI E OF FM 4	SUNDAY CREEK	5.661
2	649	2	2	6.9 MI NW OF FM-920	DRY CREEK	5.673
2	260	1	14	0.7 MI W OF I35W	CHAMBERS CREEK	5.685
2	364	1	79	.6 MI N OF JOHNSON RD	BIG BEAR CREEK	5.707
2	314	7	48	0.3 MI E OF FM2552	TOWN CR	5.728
2	364	1	77	.6 MI N OF JOHNSON RD	BIG BEAR CREEK	5.745
2	314	1	76	0.8 MI W OF FM1189	BIG GRINDSTONE CR	5.757
2	314	7	49	0.3 MI E OF FM2552	TOWN CR	5.775
2	13	6	68	1.7 MI N OF LOOP 249	BRUSHY CREEK	5.779
2	8	14	240	1.9 MI W OF FM 156	CEMENT PLANT HAUL RD	5.780
2	7	8	22	100 FT S OF FM-207	TRIB OF LAKE CREEK	5.791
2	314	7	43	0.3 MI E OF E BANKHEAD DR	WILLOW CR	5.822
2	314	7	44	1.7 MI E OF FM2552	WILLOW CR	5.822
2	391	6	34	4.8 MI S OF FM-2127	W. FORK OF TRINITY	5.941
2	1605	1	3	3.9 MI E OF FM 730	SILVER CREEK	5.946
2	550	2	8	4.0 MI W OF FM 219	ARMSTRONG CREEK	5.991
2	2266	2	89	SH 360 AT CREEK	BIG BEAR CREEK	5.994
2	312	5	39	0.5 MI N OF FM 2257	BRIAR BRANCH	6.020
2	385	2	12	0.1 MI E OF FM-1189	WEAVER BR	6.056
2	1991	2	3	6.9 MI N OF FM 219	ARMSTRONG CREEK	6.072
2	1604	2	2	7.0 MI N OF ALVORD	PANTHER CREEK	6.073
2	385	2	13	1.0 MI E OF FM-1189	CROCKERY CREEK	6.103
2	3010	2	1	1.5 MI N OF LILLIAN	WALNUT CREEK	6.120
2	2418	1	4	2.0 MILES EAST OF FM1655S	BIG SANDY CREEK	6.171
2	2681	2	2	0.8 MI N OF SH 26	DENTON CREEK	6.191
2	1332	1	3	1.1 MI S OF FM1189	NAIL CREEK	6.220
2	3123	1	1	3.0 MI SE OF FM-167	FALL CREEK	6.286
2	1991	2	2	3.0 MI N OF FM 219	COW CREEK	6.315
2	343	3	26	3.9 MI S OF IH 20	SALT CREEK	6.347
2	736	2	5	7.4 MI E OF FM 4	PALO PINTO CREEK	6.357
2	1331	1	2	7.3 MI NE OF 1188	TRIB OF KICKAPOO CRK	6.412
2	1990	2	4	2.9 MI W OF FM 51	SYCAMORE CREEK	6.414
2	2681	2	3	0.8 MI N OF SH 26	DENTON CREEK	6.437
2	3123	1	2	3.5 MI SE OF FM-167	STATION BRANCH	6.532
2	172	2	193	0.7 MI N OF W BROAD ST	WALNUT CREEK	6.566
2	1332	1	10	1.3 MI N OF US 377	N FORK PALUXY RIV	6.582
2	1991	2	1	6.0 MI N OF FM 219	SAND BRANCH	6.608
2	1332	2	6	1.6 MI W OF US 281	COUNTS CREEK	6.691
2	1094	4	6	1.607 MI S OF SH 174	VILLAGE CREEK	7.025

District	Control	Section	Number	Location	Crosses	Score
3	44	3	20	5.9 MI EAST JCT SPUR 510	EAST FORK LITTLE WICHITA	4.880
3	44	6	50	5.4 MI EAST OF JCT FM 103	WEST BRANCH FARMERS CRK	5.058
3	43	5	15	2.1 W OF FM 432 ON US 287	BOGGY CRK	5.107
3	43	5	16	1 M W OF FM 432 ON US287	SMALL CR	5.219
3	43	6	22	.3 M W OF FM 433 ON US 70	DUGAN CREEK	5.235
3	845	3	14	0.2 MILES WEST OF FM 373	WILLIAM CREEK	5.266
3	1770	1	1	2M SE JCT 1763 ON FM 1811	DRAW	5.294
3	823	1	8	5 M N MUENSTER ON FM 373	DRY ELM CRK	5.323
3	249	2	6	3.5 MI S JCT FM 1954	LAKE CREEK	5.411
3	361	2	3	1.2 MI E OF JCT FM 578	ELM CREEK	5.600
3	1609	1	3	5.5 MI WEST OF JCT FM 373	CLEAR CREEK	5.679
3	156	7	27	AT OKLAHOMA STATE LINE	RED RIVER	5.731
3	283	3	9	6.4 MI SOUTH JCT FM 2224	LITTLE WICHITA RIVER	5.770
3	1769	1	1	1.4 MI NE OF JCT US 287	DRAW	5.847
3	815	1	3	1.7 MILES SOUTH OF FM 902	DRAW	5.855
3	845	3	15	0.2 MILES EAST OF FM 373	WHEAT CREEK	5.947
3	156	2	3	1.25 MI SE OF IH 44	GILBERT CREEK	5.966
3	529	2	1	0.5 MI SE OF JCT SH 24	DRY CREEK	6.010
3	845	3	13	1.3 MILES WEST OF FM 373	BLOCKER CREEK	6.012
3	147	2	3	1.4 MI N OF JCT FM 1763	RED RIVER	6.036
3	1769	1	3	2.5 MI W OF JCT US 70	DUGAN CRK	6.075
3	124	4	16	1.4 MI S OF JCT FM 1763	BEAVER CREEK	6.086
3	156	7	66	TEXAS & OKLA STATE LINE	RED RIVER	6.139
3	239	1	6	4.0 MI S. JCT US 82	SALT CREEK	6.166
3	137	3	34	0.8 MI N OF JCT SH 258	WICHITA RIVER	6.210
3	44	2	79	6.6 MI EAST JCT FM 2393	LITTLE WICHITA RIVER REL	6.429
3	44	2	80	6.7 MI WAST JCT FM 2393	LITTLE WICHITA RIVER	6.451
3	239	4	19	0.05 MI SOUTH OF FM 2634	PANTHER CREEK	6.541
3	1355	1	1	1.0 MI E OF JCT US 283	TURKEY CRK	6.615
3	845	3	12	3.3 MILES WEST OF FM 373	CLEAR CREEK	6.659
3	1837	1	1	1.5 MI E OF JCT FM 368	HOLLIDAY CREEK	6.902
3	391	3	65	1.3 MI NORTH JCT US 82	LITTLE WICHITA RIVER	6.922
3	351	3	11	1.4 MI. NE. OF SH 101	BRUSHY CREEK	6.922
3	2763	1	1	2.0 MI N OF JCT US 82	ELM CRK	7.013

District	Control	Section	Number	Location	Crosses		Score
4	41	7	10	5.2 MI N JCT FM 2176	AMARILLO CREEK		4.469
4	238	5	9	1.8 MI WEST JCT US 287	COLDWATER CREEK		4.901
4	66	5	26	6.7 MI NORTH JCT SH 354	BIG BLUE CREEK		4.948
4	791	5	4	2.9 MI N JCT FM 1520	PALO DURO CREEK		4.981
4	168	9	9	0.1 MI S OF JCT FM 1331	PALO DURO CREEK		4.998
4	41	5	26	7.3 MI N CANADIAN RV	JOHN REY CREEK		5.174
4	2126	2	2	1.2 MI E OF CARSON CO LN	DRAW		5.176
4	1621	1	2	1.3 MI W JCT SH 136	PALO DURO CREEK		5.371
4	30	3	24	14.0 MI SOUTH JCT 15	SO. WOLF CREEK		5.504
4	66	4	5	0.2 NORTH JCT FM 119	SOUTH PALO DURO CRK		5.515
4	308	1	7	3.8 MI N OF JCT SH 15	FARWELL DRAW		5.526
4	66	5	17	6.7 MI NORTH JCT SH 354	BIG BLUE CREEK		5.526
4	30	5	28	6.3 MI N US60 AT CANADIAN	HORSE CREEK		5.585
4	30	3	23	10.8 SOUTH JCT SH 15	WOLF CREEK		5.614
4	40	1	3	2.9MI EAST JCT FM 296	RITA BLANCO CREEK		5.635
4	557	4	9	2.5 MI E STINNETT	COTTONWOOD CREEK		5.669
4	357	3	2	3.1 MI S JCT FM 1151	DRAW		5.684
4	2614	1	1	3.7 MI. N. OF US 60	SPRING DRAW		5.719
4	41	5	53	11.5 MI S MOORE CO LINE	CANADIAN RIVER	*	5.720
4	238	1	8	2.3 MI NORTH JCT FM 767	PUNTA DE AQUA CREEK		5.729
4	355	1	1	5.6 MI E FM1454IN FOLLETT	IVANHOE CREEK		5.734
4	41	5	64	11.5 MI S MOORE CO LINE	CANADIAN RIVER	*	5.759
4	308	2	2	1.3 MI S JCT FM 2018	PALO DURO CREEK		5.782
4	1243	2	4	0.3 MI SOUTH JCT US 60	TIERRA BLANCA CREEK		5.809
4	356	2	5	10.4 MI N JCT US 60	MIDDLE DIXON CREEK		5.823
4	309	1	3	16.2 MI N JCT IH 40	NO FORK OF RED RIVER		5.869
4	1337	1	2	1.2 MI SOUTH OF JCT SH 15	KIOWA CREEK		5.882
4	356	2	4	14.6 MI N JCT US 60	WEST DIXON CREEK		5.898
4	41	5	6	7.3 MI N CANADIAN RV	JOHN REY CREEK		5.931
4	455	1	1	0.2 MI W JCT FM 2171	DIXON CREEK		5.973
4	490	4	3	1.2 MI SOUTH JCT FM 283	CHICKEN CREEK		6.020
4	2317	1	1	3.6 MI E JCT SH273-FM1321	MCCLELLAN CREEK		6.030
4	791	5	3	0.3 MI N CO LINE	SO FORK PALO DURO CR		6.052
4	309	1	4	0.8 MI N JCT IH 40	MCCLELLAND CREEK		6.054
4	2221	2	1	2.9 MI NORTH JCT US 60	RED DEER CREEK		6.086
4	1337	2	6	13.0 MI S JCT SH 15	WOLF CREEK		6.109
4	66	4	20	.226 MI NO OF FM 119	SOUTH PALO DURO CRK		6.112
4	41	7	48	5.2 MI N JCT FM 2176	AMERILLO CREEK		6.119
4	356	1	9	APPROX 4 MI N OF BORGER	ROCK CREEK		6.119
4	355	1	3	.9 MI EAST OF JCT FM 2172	KIOWA CREEK		6.139
4	791	1	7	5.5 MI S STATE LINE	COLDWATER CREEK		6.153
4	790	5	2	.5 MI WEST OF JCT SH 207	DRAWW		6.175
4	1339	2	3	12.8 MI S OF JCT SH 15	WOLF CREEK		6.189
4	490	1	6	3.6 MI NORTH JCT US 60	DRAW		6.195
4	2335	1	1	5.8 MI NORTH JCT SH 15	FARWELL CREEK		6.195
4	355	1	4	0.3 MI E OF JCT FM 2172	DARROUZETT CREEK		6.196
4	460	2	5	3.9 MI SOUTH JCT US 60	DRAW		6.219

District	Control	Section	Number	Location	Crosses	Score
4	1244	3	2	1.5 MI NORTH COUNTY LINE	PALO DURO CREEK	6.241
4	790	1	4	0.2 MI SOUTH JCT FM 2586	E.RITA BLANCA CREEK	6.246
4	560	2	11	0.3 MI N JCT FM 291	N FORK OF RED RIVER	6.246
4	1245	2	7	4.38 MI SE OLDHAM CO LN	DRAW	6.246
4	238	1	13	1.5 MI NORTH JCT FM 767	CRAMER CREEK	6.291
4	308	2	3	0.8 MI E JCT FM 2387	HORSE CREEK	6.294
4	2335	1	2	5.0 MI NORTH OF JCT SH 15	PALO DURO CREEK	6.329
4	30	5	29	2.95 MI N.W. US 60 JCT	BIG TIMBER CREEK	6.337
4	310	4	4	0.1 MI NORTH JCT FM 2375	N FK RED RIVER	6.353
4	2127	1	1	1.6 MI W JCT SH 136	COTTONWOOD CREEK	6.375
4	66	4	23	1.5 MI NORTH FM 281 JCT	NORTH PALO DURO CRK	6.385
4	168	9	22	0.1 MI S OF JCT FM 1331	PALO DURO CREEK	6.390
4	582	1	4	4.6 MI NORTH JCT SH 213	WOLF CREEK	6.394
4	1480	2	1	CAMP DON HARRINGTON	FORK OF RED RIVER	6.410
4	67	17	142	.3 MI N. FM 3331	P.D.T.FK. RED RIVER	6.421
4	379	1	19	1.6 MI W SH 207 IN BORGER	ROCK CREEK	6.429
4	30	3	25	19.2 MI SOUTH JCT SH 15	NORTHUP CREEK	6.438
4	30	5	2	10.6 MI N US60AT CANADIAN	W FORK OF HORSE CRK	6.464
4	356	1	8	4.6 MI N JCT SH136&SH207	CANADIAN RIVER	6.469
4	30	5	30	.1 MI N.W. US 60 JCT	DRY CREEK	6.471
4	66	5	19	3.5 MI NORTH JCT SH 354	LITTLE BLUE CREEK	6.508
4	794	6	3	0.6 MI EAST JCT SH 136	SO. PALO DURO CREEK	6.611
4	356	1	14	CANA RV N OF BORGER	CANADIAN RIVER	6.621
4	226	2	17	1.5 MI NORTH JCT FM 1061	CANADIAN RIVER	6.626
4	727	1	8	7.3 MI E JCT US 287	SO. PALO DURO CREEK	6.656
4	66	3	1	17.8 MI NORTH JCT FM 297	COLDWATER CREEK	6.666
4	66	3	25	1.6 MI S. US 54 JCT	COLDWATER CREEK	6.695
4	308	2	4	1.7MI EAST OF GRUVER	FARWELL CREEK	6.715
4	791	6	8	1.4 MI E JCT FM 1319	BIG CREEK	6.727
4	357	5	3	5.3 MI N JCT FM 285	FORD OF RED RIVER	6.784
4	30	5	3	9.0 MI N US60 AT CANADIAN	W FORK OF HORSE CRK	6.800
4	1819	1	4	6.8 MI WEST JCT SH 305	SAND CREEK	6.820
4	560	2	25	2.5 MI. S JCT FM 2473	MCCLELLAN CREEK	6.831
4	791	3	2	4.0 MI N OF PRINGLE	SO PALO DURO CREEK	6.840
4	3527	1	1	0.3 MI E US 60-87	PALO DURO CREEK	6.856
4	3527	1	3	0.7 MI E US 60-87	TIERRA BLANCA CREEK	6.856
4	557	7	8	NE JCT 152 SH 2.5 MI	BEAR CREEK	6.859
4	464	1	1	1.6 MI E JCT US 87	TIERRR BLANCA CREEK	6.890
4	1244	2	3	9.3 MI SOUTH JCT SH 152	BIG BLUE CREEK	6.900

District	Control	Section	Number	Location	Crosses	Score
5	1041	2	6	4.20 MI N OF BU US 84	NF DMF BRAZOS RIVER	5.854
5	131	5	2	4.7 MI E OF FM 651	WHITE RIVER	6.098
5	131	5	16	4.7 MI E OF FM 651	WHITE RIVER	6.098
5	53	5	85	0.8 MI SE OF FM 2458	DMF BRAZOS RIVER	6.281
5	740	2	1	6.2 MI N OF FM 97	LOS LINGOS CREEK	6.298
5	53	5	86	0.8 MI SE OF FM 2458	DMF BRAZOS RIVER	6.328
5	461	6	6	3.70 MI S OF SH 86	RUNNING WATER DRAW	6.390
5	2616	1	1	1.1 MI N OF US 82	WHITE RIVER	6.465
5	53	6	88	1.3 MI N OF FM 1269	SAND CREEK	6.527
5	740	2	2	5.2 MI N OF FM 97	QUITAQUE CREEK	6.591
5	949	2	2	8.6 MI E OF FM 651	WHITE RIVER	6.920

District	Control	Section	Number	Location	Crosses	Score
6	292	4	3	JCT PECOS CO LN	PECOS RIVER	5.158
6	76	6	23	0.85 MI W OF SH 329	RANKIN DRAW	5.494
6	1640	1	2	2.58 MI E OF FM 305	RICHBURG DRAW	5.559
6	1640	1	3	0.78 MI E OF FM 305	DRAW	5.561
6	4	7	37	1.14 MI E OF FM 1882	MONAHANS DRAW	5.623
6	4	7	36	1.14 MI E OF FM 1882	MONAHANS DRAW	5.894
6	1001	1	1	8.65 MI NW OF IH 20 BUS	DRAW	6.089
6	441	9	60	1.11 MI E JEFF DAVIS C/L	COLD SPRINGS DRAW	6.166
6	293	4	41	0.23 MI S OF PECOS CO LN	DOWNIE DRAW	6.291
6	441	9	56	0.43 MI E JEFF DAVIS C/L	W COWAN DRAW	6.324
6	441	9	57	0.57 MI E JEFF DAVIS C/L	E COWAN DRAW	6.346
6	441	9	102	7.90 MI SE OF IH 20	FIVE MILE DRAW	6.347
6	441	9	108	9.36 MI SE OF IH 20	KC DRAW	6.459
6	3	5	88	0.52 MI NE OF IH 10	COWAN DRAW	6.524
6	3	5	87	AT INT WITH IH 10	COLD SPRINGS DRAW	6.571
6	441	9	107	9.35 MI SE OF IH 20	KC DRAW	6.571
6	441	9	114	10.45 MI E OF IH 20	HACKBERRY DRAW	6.658
6	441	9	103	7.40 MI SE OF IH 20	FIVE MILE DRAW	6.672
6	441	9	176	AT INT E BND LN OF IH 20	IH 20 & COLD SPR DRW	6.681
6	21	7	37	3.63 MI E OF PECOS CO LN	SANDERSON CANYON	6.753
6	2968	2	9	1.73 MI S OF IH 10	TOYAH CREEK	7.348

District	Control	Section	Number	Location	Crosses	Score
8	6	3	15	27.88 MI E MITCHELL CO LN	BIG STINK CRK	5.558
8	6	4	23	4.1 MI E OF FM 126	MULBERRY CREEK	5.558
8	6	3	14	26.39 MI E MITCHELL CO LN	LITTLE STINK CR	5.673
8	34	1	5	3.91 MI S OF FM 707	CEDAR CREEK	5.855
8	54	1	1	0.45 MI S OF FM 613	EAST JIM NED CREEK	5.916

District	Control	Section	Number	Location	Crosses	Score
9	15	1	5	1.20 MI SW OF SH 6	S FRK FLAT CRK	4.894
9	56	1	10	5.00 MI E INT SH 31	WILLIAMS CRK	5.061
9	183	6	17	0.6 MI N INT US 84	STILLHOUSE BR	5.138
9	418	2	31	3.2 MI SE INT FM308	COTTONWOOD CRK	5.230
9	121	1	38	14.9 MI E HAMILTON CL	BOSQUE RV	5.328
9	49	4	52	4.5 MI N ROBERTSON CL	FISH CRK	5.385
9	418	2	28	1 MI SE INT FM 308	ASH CRK	5.397
9	56	3	37	13.8 MI W FREESTONE CL	NAVASOTA RI E REL	5.401
9	49	1	6	2.30 MI SE OF LP 340	TEHUACANA CRK	5.479
9	2395	1	2	1.7 MI E INT LP 340	WILLIAMS CRK	5.501
9	833	6	25	5.5 MI S INT SH 320	POOLE CRK	5.597
9	121	2	35	0.1 MI E INT FM3050	AQUILLA CRK	5.630
9	752	5	25	1.4 MI SW LIMESTONE CL	BIG ELM CRK	5.661
9	567	4	2	2.5 MI W INT SH 317	TONK CRK	5.672
9	398	1	26	16.8 MI SW INT SH22	BOSQUE RV	5.675
9	14	23	285	0.6 MI S JOHNSON CL	ISLAND CRK-SBML	5.689
9	120	5	17	1.9 MI E MILLS CL	BUZZARD CRK	5.692
9	724	2	16	0.5 MI E INT SH 6	BOSQUE RV REL	5.805
9	14	23	284	0.6 MI S JOHNSON CL	ISLAND CRK-NBML	5.823
9	162	1	7	0.8 MI SW INT SH 31	TEHUACANA DRK REL	5.923
9	413	2	6	3.3 MI E MCLENNAN CL	LITTLE COTTONWOOD CRK	6.007
9	834	2	25	0.9 MI N INT SH 171	BYNUM CRK	6.099
9	643	2	38	5.2 MI NW LEON CL	SANDERS CRK	6.127
9	752	5	9	6.4 MI SW LIMESTONE CL	KEECHI CRK	6.164
9	3331	1	1	0.6 MI E INT SH 6	SHAW CRK	6.200
9	643	2	39	8.1 MI NW LEON CL	BIG CRK	6.239
9	752	4	31	1.8 MI NE INT US 77	DEER CRK	6.259
9	834	3	18	0.9 MI N MCLENNAN CL	BROOKEEN CRK	6.260
9	183	3	51	0.2 MI SE INT US 281	PECAN CRK	6.311
9	1191	4	1	15.2 MI NW ROBERTSON CL	FAULKENBERRY CRK	6.337
9	834	2	22	4.4 MI N INT SH 171	WHITE ROCK CRK REL#2	6.345
9	231	16	53	9.6MI E INT IH35 & SH317	BOGGY CRK	6.402
9	183	3	22	8.4 MI NW CORYELL CL	FARNASH CRK	6.447
9	183	3	30	6.0 MI NW CORYELL CL	WALLACE CRK	6.473
9	14	6	75	0.2 MI N INT FM 2959	LOVE LACE CRK	6.581
9	2061	4	6	3.1 MI NW INT SH171	COTTONWOOD CRK	6.627
9	1665	2	2	1.2 MI NW INT FM 147	LITTLE ELM CRK	6.630
9	1308	1	1	O.5MI S INTS FM436	MITCHELL BR	6.652
9	14	6	77	2.2 MI S INT FM 2959	LITTLE HACKBERRY CRK	6.693
9	1665	2	1	2.1 MI NW INT FM 147	BIG ELM CRK	6.742
9	724	1	18	12.1 MI S INT US 84	COWHOUSE CRK	6.764
9	1661	3	5	4.8 MI NW INT US 77	RICHLAND CRK	6.784
9	1191	2	4	6.1 MI S HILL CL	TRIB NAVASOTA RI	6.820
9	1077	1	12	0.4 MI S MCLENNAN CL	BULLHIDE CRK	6.923
9	1077	1	9	5.3 MI S MCLENNAN CL	LONG BR	6.948
9	1594	2	2	4.5 MI E SLATER	COWHOUSE CRK	6.962
9	1926	1	6	1 MI N INT SH 36	LEON RI	7.048

District	Control	Section	Number	Location	Crosses	Score
9	550	7	34	5.0 MI N OF SH 22	LEON RIVER	7.147
9	3234	1	3	0.60 MI NE OF IH 35	BR LITTLE TEHUACANA CRK	7.328
9	3031	1	1	1.9 MI S INT SH 22	IRON CRK	7.569

District	Control	Section	Number	Location	Crosses	Score
10	95	6	40	10.137 MI FR KAUF-VZANDT	GILADON CRK	4.711
10	96	6	52	2.410 MI FR GREGG CL	GRACES CRK	4.762
10	96	4	61	7.014 MI FR UPSHUR-GREGG	HAWKINS CRK	4.948
10	190	3	29	3.00 MI S OF US 80	SABINE RIV REL #2	4.972
10	190	3	30	3.40 MI S OF US 80	SABINE RIVER	4.972
10	393	2	21	0.10 MI S OF GREGG C/L	CHEROKEE BAYOU REL	4.987
10	95	9	128	0.45 MI E OF SMITH C/L	SABINE RIVER REL	4.987
10	522	2	8	0.514 MI FR KAUF CL	CANEY CRK	4.997
10	393	1	22	7.234 MI FR INT GREEN & M	CHEROKEE BAYOU	5.012
10	245	5	34	1.207 MI FR SMITH-VZANDT	PRAIRIE CRK	5.049
10	2075	1	6	1.0 MI FR INT US 69	BLACK FORK CRK	5.061
10	95	6	133	10.137 MI FR KAUF-VZANDT	GILADON CRK	5.085
10	138	1	4	4.948 MI FR US80 IN LONGV	SABINE RIV REL	5.092
10	190	3	37	2.50 MI S OF SH 154	LAKE FORK CRK	5.099
10	190	3	28	2.60 MI S OF US 80	SABINE RIV REL #1	5.106
10	2075	1	2	1.0 MI FR INT US 69	BLACK FORK CRK	5.126
10	95	9	66	0.45 MI E OF SMITH C/L	SABINE RIVER REL	5.146
10	95	6	42	14.544 MI FR KAUF-VZANDT	MILL CRK	5.154
10	495	5	140	2.261 MI FR US 69	SALINE CRK	5.198
10	495	5	141	2.261 MI FR US 69	SALINE CRK	5.198
10	95	6	41	13.854 MI FR KAUF-VZANDT	CRKOOKED CRK	5.201
10	522	2	9	1.035 MI FR KAUF-VZANDT	CANEY CRK REL	5.218
10	96	1	59	2.50 MI NW OF FM 778	LAKE FORK CRK REL	5.231
10	1791	2	2	1.90 MI S OF FM 2422	SABINE RIVER	5.282
10	138	5	92	10.55MI S OF SH 64	OWENS CRK	5.285
10	197	6	55	10.7 MI NW OF FM 317	SOUTH TWIN CRK	5.303
10	545	4	16	3.104 MI FR INT US80	SABINE RIV REL	5.310
10	545	4	18	4.368 MI FR INT US80	DRAW	5.310
10	58	4	9	3.0 MI W OF US 69	BOWLES CRK	5.321
10	95	9	65	0.00 MI E OF SMITH C/L	SABINE RIVER *	5.346
10	1931	1	2	2.695 MI FR JUNCT FM1845	SABINE RIV	5.368
10	138	1	1	1.211 MI FR US80 IN LONGV	GRACES CRK	5.384
10	591	2	8	7.20 MI W OF US 64	JOHNSON CRK	5.386
10	495	7	282	9.950 MI FR SMITH-GREGG	RABBIT CRK REL	5.387
10	138	1	72	4.970 MI FR US80 IN LONGV	SABINE RIV REL	5.432
10	545	4	17	3.463 MI FR INT US80	SABINE RIV REL	5.444
10	138	5	94	13.4 MI S OF US 79	HAM CRK	5.451
10	345	3	27	2.029 MI SOUTH SMITH C/L	CLEAR FORK CRK	5.454
10	2477	1	1	1.72 MI FR FM47	MCBEE CRK	5.457
10	118	4	74	HOUSTON-CHEROKEE CL	NECHES RIVER	5.483
10	647	2	7	3.70 MI E OF FM 14	BIG SANDY CRK	5.513
10	198	3	14	1.0 MI SE OF FM 1632	NECHES RIVER *	5.526
10	401	3	5	3.60 MI E OF FM 14	BIG SANDY CRK REL	5.529
10	401	3	6	1.40 MI W OF FM 312	BIG SANDY CRK REL	5.529
10	1936	1	2	1.00 MI E OF FM 14	BIG SANDY CRK	5.535
10	2409	1	1	2.11 MI E OF SH 154	GLADE CREEK	5.540
10	1933	1	2	0.452 MI FR RUSK CL	RABBIT CRK	5.541

District	Control	Section	Number	Location	Crosses	Score
10	2265	1	5	2.512 MI FR INT FM773	CRKEAM LEVEL CRK	5.542
10	378	8	19	2.59 MI SW JCT US84	BEANS CRK	5.544
10	95	9	127	0.00 MI E OF SMITH C/L	SABINE RIVER *	5.563
10	203	9	27	6.45 MI FR INT SH 110	PRAIRIE CRK	5.591
10	2918	1	2	1.50 MI S OF FM 49	BIG SANDY CRK	5.607
10	164	3	20	0.4 MI W OF SMITH CL	NECHES RIVER RELIEF *	5.619
10	95	7	130	27.5 MI FR KAUF-VZANDT	GRAND SALINE CRK	5.622
10	495	7	291	14.274 MI FR SMITH-GREGG	SABINE RIV REL	5.622
10	495	7	293	14.941 MI FR SMITH-GREGG	SABINE RIV REL	5.622
10	495	7	294	14.941 MI FR SMITH-GREGG	SABINE RIV REL	5.622
10	1707	1	5	5.0 MI S OF FM 321	LAKE CREEK	5.635
10	203	8	32	0.557 MI FR JCT US 80	DRY CRK	5.637
10	138	1	74	3.725 MI FR US80 IN LONGV	SABINE RIV	5.653
10	3023	1	1	0.50 MI N OF SH 154	DRY CRK	5.654
10	495	7	292	14.274 MI FR SMITH-GREGG	SABINE RIV REL	5.669
10	495	7	283	9.950 MI FR SMITH-GREGG	RABBIT CRK REL	5.680
10	58	4	14	5.6 MI W OF US 69	WHITE OAK CRK	5.701
10	108	6	21	4.8 MI S OF HENDERSON CL	OTTER CREEK	5.702
10	95	7	46	27.5 MI FR KAUF-VZANDT	GRAND SALINE CRK	5.704
10	96	1	58	8.00 MI E OF US 69	LAKE FORK CRK	5.705
10	401	2	4	0.75 MI S JCT SH182	DRY CREEK	5.715
10	495	7	289	13.297 MI FR SMITH-GREGG	SABINE RIV *	5.725
10	495	7	290	13.358 MI FR SMITH-GREGG	SABINE RIV *	5.725
10	495	7	295	15.300 MI FR SMITH-GREGG	MO-PAC R.R./SABINE RIV	5.725
10	198	7	23	7.26 MI S JCT US79	TURNPIKE CRK	5.727
10	1931	1	1	2.048 MI FR INT FM1845	BULLHIDE SLOUGH	5.736
10	719	4	6	1.7 MI SW OF FM 2613	TRINITY RIVER RELIEF	5.748
10	2475	1	1	1.8 MI N OF SH 31	KICKAPOO CREEK	5.765
10	246	1	5	5.80 MI W OF PANOLA C/L	MARTIN CREEK	5.765
10	594	3	26	19.8 MI SE OF US 79	E. FRK. ANGELINA RIV	5.767
10	138	5	51	2.20 MI S OF US 84	WOOTEN CRK	5.772
10	745	1	16	2.07 MI FR FM16	NECHES RIV REL	5.777
10	697	2	29	4.3 MI E OF SH 274	PRAIRIE CREEK	5.788
10	108	6	22	8.05 MI S OF HENDERSON CL	BEAVER CREEK	5.790
10	522	5	34	0.51 MI E OF WINONA	HARRIS CRK	5.796
10	163	3	16	2.8 MI E OF NAVARRO CL	CEDAR CREEK	5.797
10	197	6	60	1.70 MI NW OF FM 317	CANEY CRK	5.797
10	495	3	70	14.4 MI FR KAUF-VZANDT	MILL CRK	5.798
10	206	3	34	ANDERSON-CHEROKEE CO	NECHES RIV	5.807
10	108	5	17	7.90 MI S OF FM 783	CATFISH CRK	5.815
10	108	12	45	4.578 MI FR VZANDT-RAINS	GILADON CRK	5.826
10	3085	1	2	4.5 MI FR INT FM2710&FM16	SALINE CRK	5.836
10	138	3	81	2.20 MI N FM 2276	CHAMBERS CREEK	5.837
10	495	7	296	15.300 MI FR SMITH-GREGG	MO-PAC R.R./SABINE REL	5.837
10	138	1	5	5.383 MI FR US80 IN LONGV	SABINE RIV REL	5.851
10	206	7	29	2.00 MI SW OF SH 64	BROMLEY CRK	5.853
10	138	3	17	2.20 MI N FM 2276	CHAMBERS CREEK	5.854

District	Control	Section	Number	Location	Crosses	Score
10	1322	2	5	8.131 MI FR INT FM17	LITTLE SALINE CRK	5.858
10	206	1	4	6.0 MI E OF US 287	MOUND PRAIRIE CREEK	5.862
10	377	1	16	3.219 MI FR INT US271	PRAIRIE CRK	5.884
10	377	1	28	.245 MI FR INT SH31	RABBIT CRK REL	5.884
10	164	3	40	3.5 MI W OF SMITH CL	KICKAPOO CREEK	5.884
10	1929	1	3	2.90 MI S JCT FM23	ONE-EYED CRK	5.897
10	771	4	5	1.052 MI FR INT US80	GRAND SALINE CRK	5.904
10	164	3	16	3.6 MI W OF SMITH CL	KICKAPOO CREEK RELIEF #2	5.931
10	164	3	39	3.6 MI W OF SMITH CL	KICKAPOO CREEK RELIEF #2	5.931
10	634	1	4	4.791 MI E JCT US69	TURNPIKE CRK	5.946
10	108	3	10	3.70 MI N OF FM 317	THIRD CANEY CREEK	5.946
10	2265	1	1	FM 2339 E/W BND	SLATER CRK	5.950
10	646	1	21	0.53 MI FR RAINS-VZANDT	SPILLWAY - SABINE RIV	5.950
10	138	2	34	0.10 MI S OF FM 918	TIAWICHI CREEK	5.950
10	138	2	78	0.10 MI S OF FM 918	TIAWICHI CREEK	5.950
10	138	5	50	13.4 MI S OF US 259	HAM CRK	5.950
10	123	3	54	1.7 MI FR RUSK CL	MUD CRK	5.971
10	458	3	3	1.2 MI W OF SH 19	OTTER CREEK	5.977
10	108	3	11	1.60 MI N OF FM 317	SECOND CANEY CRK	5.992
10	122	5	31	3.6 MI NW OF SH 19	KEECHI CREEK	6.002
10	1172	2	6	1.477 MI FR INT SH19	KICKAPOO CRK	6.017
10	495	3	71	14.4 MI FR KAUF-VZANDT	MILL CRK	6.044
10	429	3	15	0.57 MI E OF FM 49	PATTON CRK	6.052
10	393	1	17	5.684 MI FR INT GREEN & M	SABINE RIV	6.086
10	495	2	9	0.098 MI E OF KAUF-VZANDT	WOLF CRK	6.107
10	122	4	26	1.0 MI NW OF FM 660	CATFISH CREEK	6.114
10	1390	3	5	5.40 MI NE OF SH 37	LAKE FORK CRK	6.138
10	245	5	33	0.00 MI FR SMITH-VZANDT	NECHES RIV	6.143
10	635	1	10	2.9 MI S OF FM 1857	ONE EYE CREEK	6.145
10	118	4	75	4.1 MI SW OF FM 220	NECHES RIVER RELIEF	6.147
10	495	2	8	.098 MI FR KAUF-VZANDT	WOLF CRK	6.148
10	545	4	5	7.27 MI FR INT US80	RABBIT CRK REL	6.153
10	122	4	27	0.4 MI SE OF FM 660	BEAVER CREEK	6.161
10	594	2	20	3.60 MI S OF GREGG C/L	BARNES CREEK	6.166
10	594	2	21	3.70 MI S OF GREGG C/L	TIAWICHI CREEK	6.166
10	640	5	21	0.234 MI FR GREGG-UPSHUR	GLADE CRK	6.167
10	592	2	9	1.10 MI E OF FM 1798	MURVAUL CRK	6.186
10	245	6	20	13.470 MI FR W TYLER CITY	LAKE TYLER EAST-MUD CRK	6.205
10	520	8	57	15.5 MI S OF US 175	MOUND PRAIRIE CREEK	6.206
10	138	5	95	2.20 MI S OF US 84	WOOTEN CRK	6.231
10	591	2	7	3.00 MI W OF SH 42	BOWLES CRK	6.232
10	1666	1	4	5.2 MI SW OF SH 155	BRUSHY CREEK	6.235
10	122	5	30	5.4 MI NW OF SH 19	LAKE CREEK	6.248
10	138	1	71	5.408 MI FR US80 IN LONGV	SABINE RIV REL	6.256
10	123	2	52	3.68 MI E OF W END NE CO	TAILES CRK	6.258
10	522	5	33	0.357 MI E OF WINONA	HARRIS CRK REL	6.262
10	2426	1	1	3.9 MI E OF SH 31	FLAT CREEK	6.264

District	Control	Section	Number	Location	Crosses	Score
10	108	1	65	0.84 MI FR JCT IH 20	KELLIS CRK	6.268
10	1707	1	4	9.8 MI S OF FM 321	TOWN CREEK	6.273
10	2195	2	2	3.7 MI E OF FM 860	OTTER CREEK	6.278
10	345	3	28	8.277 MI S SMITH CL	TWIN CRK	6.279
10	889	1	7	7.36 MI E OF SH 31	SANDY CREEK	6.286
10	2793	1	2	0.8 MI FR US 69	WEST MUD CRK	6.296
10	1608	2	7	3.40 MI N OF FM 850	RABIT CREEK	6.300
10	108	1	68	7.2 MI OF US80	CANEY CRK	6.303
10	1150	5	6	9.368 MI S JCT US69	LARRISON CRK	6.322
10	245	9	8	0.00 MI FR VZANDT-SMITH	NECHES RIV	6.326
10	520	8	11	0.6 MI S OF US 175	CADDO CREEK	6.330
10	520	8	13	7.7 MI S OF US 175	BRUSHY CREEK	6.330
10	892	1	6	3.4 MI NW OF FM 645	CATFISH CREEK	6.365
10	1388	1	3	0.52 MI E OF FM 2658	MARTIN CREEK	6.365
10	2152	1	1	2.6 MI SE OF SH 155	WALNUT CREEK	6.366
10	58	4	13	9.6 MI W OF US 69	BOXES CRK	6.366
10	1789	1	2	1.32 MI S OF FM 317	FLAT CRK	6.366
10	108	1	67	6.30 MI S OF US080 W OF F	SANDY CRK	6.368
10	245	4	37	3.88 MI FR EDOM TX BEG CL	BATTLE CRK	6.395
10	520	8	16	15.5 MI S OF US 175	MOUND PRAIRIE CREEK	6.396
10	58	1	17	1.7 MI E OF US 79	MACK CREEK	6.420
10	138	1	100	3.533 MI FR US 80 IN LONG	SABINE RIVER	6.443
10	1172	2	7	5.577 MI FR INT SH19	CRKEAM LEVEL CRK	6.454
10	926	1	4	2.8 MI E OF FM 851	ANGELINA RIV REL	6.455
10	745	2	12	0.5 MI N OF SH 31	KICKAPOO CREEK	6.473
10	492	5	11	3.768 MI FR INT 110 IN WH	PRAIRIE CRK	6.473
10	1930	1	1	6.512 MI S OF JCT FM 347	MUD CRK	6.477
10	559	1	10	0.8 MI S OF SH 155	CADDO CREEK	6.477
10	3019	1	1	6.2 MI E OF FM 59	CATFISH CREEK	6.504
10	378	6	7	4.0 MI S OF SMITH CO	MUD CRK REL	6.514
10	378	6	8	3.515 MI S SMITH C/L	MUD CRK	6.514
10	1673	2	5	4.21 MI FR JCT FM858	KICKAPOO CRK	6.543
10	492	5	12	5.574 MI FR INT 110 IN WH	MUD CRK	6.544
10	1625	1	5	2.15 MI S OF SH 19	COON CRK	6.553
10	634	1	5	5.059 MI E JCT US69	TURNPIKE CRK	6.611
10	771	4	4	0.726 MI FR JCT US80	GRAND SALINE CRK REL	6.616
10	559	1	18	11.3 MI S OF SH 155	WALNUT CREEK	6.649
10	1707	1	7	7.3 MI S OF FM 321	KEECHIE CREEK	6.672
10	3411	1	1	0.6 MI W OF FM 645	LAKE CREEK	6.672
10	1161	2	4	6.885 MI NE JCT US175	FLAT CRK	6.677
10	1670	1	1	2.77 MI E OF FM 839	ANGELINA RIV	6.714
10	559	1	12	9.0 MI S OF SH 155	BRUSHY CREEK	6.743
10	890	2	9	2.5 MI NE OF FM 837	BRUSHY CREEK	6.757
10	559	2	19	2.7 MI NE OF FM 314	CANEY CREEK	6.757
10	2476	1	3	4.3 MI S OF SH 31	CEDAR CREEK	6.778
10	163	3	40	HENDERSON - NAVARRO CL	TRINITY RIVER *	6.796
10	108	12	46	6.07 MIS OF RAINS CO	CRKOOKED CRK	6.806

District	Control	Section	Number	Location	Crosses	Score
10	1089	1	7	7.117 MI FR HUNT VZANDT	MC BEE CRK	6.823
10	745	1	17	2.2 MI FR INT OF FM16	NECHES RIV	6.905
10	1100	1	4	2.9 MI E OF US 175	ALLIGATOR CREEK	6.912
10	1100	1	6	5.8 MI E OF US 175	NEW YORK CREEK	6.912
10	122	4	37	ANDERSON - FREESTONE CL	TRINITY RIVER	6.917
10	1875	4	3	2.8 MI S OF SH 294	SADDLER CREEK	6.940
10	891	2	6	14.9 MI S OF US 84	SQUIRREL CREEK	6.981
10	559	2	15	2.5 MI S OF SH 31	KICKAPOO CREEK	7.002
10	58	4	16	0.6 MI S OF FM 23	NECHES RIV	7.004
10	559	2	14	2.2 MI S OF SH 31	KICKAPOO CREEK RELIEF #1	7.049
10	559	2	16	2.7 MI S OF SH 31	KICKAPOO CREEK RELIEF #2	7.049

District	Control	Section	Number	Location	Crosses	Score
11	64	6	59	5.1 MI S JCT FM 1	MCKIM CR.	4.822
11	177	1	85	5.79 MI S JCT US 190 LIVI	MORGAN CREEK	4.890
11	176	5	52	13.45 MI FROM CONTROL COR	ALEXANDER CR	4.933
11	340	1	3	0.512MI S OF LOOP304 IN C	BEAVER CREEK	4.949
11	176	4	74	5.78MI S NECHES RIVER BRI	PINEY CREEK	4.955
11	3162	1	1	S OF LP 287	HURRICANE CREEK	4.955
11	176	3	59	21.363 MI FROM ANGELINA R	WHITE OAK CREEK	4.972
11	177	1	87	8.96 MI S JCT US 190 LIVI	MCCARDELL SLOUGH	4.980
11	64	6	58	3.8 MI S JCT FM 1	DEVIL'S FORD	4.981
11	118	10	43	1.8 MI W JCT US 96	PERKINS CREEK	4.987
11	304	3	70	3.2 MI N JCT FM 83	BOREGAS CREEK	4.996
11	177	2	14	2.2 MI N OF LIBERTY CO LN	TARKINGTON BAYOU	5.019
11	117	7	50	5.19MI W OF SH7&21 INTERS	BIG CR	5.025
11	176	3	11	10.351	HURRICANE CREEK	5.030
11	118	10	47	2.6 MI E JCT FM 1196	NICIPER CREEK	5.034
11	176	4	46	9.10 MI S NECHES RIVER	BEAR CREEK	5.038
11	64	6	57	2.8 MI S JCT FM 1	POMPONAUGH CR.	5.052
11	336	3	7	7.706 MI FROM JCT SH 7	CRAWFORD CREEK REL	5.060
11	336	3	8	7.826 MI FROM JCT SH 7	CRAWFORD CREEK	5.060
11	340	1	7	2.387MI S OF FM232	COLLINS CREEK	5.062
11	176	2	73	.479 FROM ANGELINA RIVER	PROCELLA CREEK	5.067
11	176	5	76	9.66 MI FROM CONTROL CORR	WILLS CREEK	5.090
11	1877	1	5	2.23 MI JCT US59 1.8MI N	PINEY CREEK RELIEF	5.094
11	403	1	15	3.92 MI S JCT US 190 POIN	STEPHENS CR	5.111
11	177	1	39	8.96 MI S JCT US 190 LIVI	MCCARDELL SLOUGH	5.114
11	304	4	57	2.6 MI S JCT FM 944	HOUSEN BAYOU REL.	5.130
11	118	8	60	20.8 MI E JCT LOOP 495	AMALADEROS CREEK	5.137
11	304	4	59	3.5 MI S JCT FM 2928	BIG SANDY CRK REL.	5.143
11	118	8	58	5.9 MI E JCT LOOP 495	CARRIZO CREEK	5.156
11	694	1	17	1.8 MI S JCT FM 1175	HOUSEN BAYOU	5.169
11	175	4	11	002.8 MI NORTH TIMPSON	FLAT FORK CREEK	5.178
11	118	6	17	03.9 MI E ANGELINA RIVER	NELSON CREEK	5.180
11	341	2	30	2.85 MI E POLK TRINITY C	WHITE OAK CREEK	5.187
11	336	7	21	0.5 MI E JCT FM 705	AYISH CREEK	5.187
11	176	1	66	011.3 MI SOUTH JCT SH 21	ANGELINA R	5.192
11	175	2	31	009.9 MI EAST TENAHA	MORRIS CREEK	5.211
11	1407	2	1	000.4 MI WEST JCT LOOP 49	BANITA CR	5.215
11	177	2	83	11.65MI SW POLK-SAN JACIN	TARKINGTON BAYOU	5.218
11	304	4	66	4.5 MI S JCT FM 2928	SO. PRONG SANDY CRK	5.237
11	341	2	23	0.94 MI E POLK-TRINITY CO	BULL CREEK	5.243
11	176	3	68	21.363 FROM ANGELINA RIVE	WHITE OAK CREEK	5.248
11	213	5	83	17.77 MI E JCT US 59 LIVI	HICKORY CR	5.251
11	1879	1	2	009.7 MI EAST JCT FM 1645	SMITH CR	5.262
11	175	4	10	003.1 MI NORTH TIMPSON	FLAT FORK CRK SL	5.267
11	1810	1	4	05.2 MI E JCT LOOP 495	CARRIZO CREEK	5.274
11	176	4	55	0.43 MI S END NECHES RIVE	NECHES RIV. REL.	5.282
11	2071	3	1	0.96 MI S OF SH94	HACKBERRY CR	5.285

District	Control	Section	Number	Location	Crosses	Score
11	2300	1	1	16.1 MI E ANGELINA RIVER	LOCO CR	5.289
11	341	2	32	5.88 MI E POLK TRINITY C	PACES CREEK	5.299
11	59	1	24	07.3 MI E JCT SH 21	ATASCOSO CREEK	5.305
11	177	1	37	5.79 M S JCT US 190 LIVIN	MORGAN CREEK	5.306
11	2589	1	2	3.496 MI FROM JCT SH 94	JACK CREEK RELIEF	5.315
11	340	1	2	0.663MI S OF LOOP304 CROC	ARNOLD CREEK	5.320
11	2591	1	1	4.73 MI JCT SH 146	MENARD CREEK	5.323
11	395	2	13	8.74MI E WALKER-SAN JACIN	MILLER CR	5.324
11	1582	1	2	10.36 MI NW LIBERTY COUNT	NEBLETT CR	5.340
11	475	11	94	2.26 MI S POLK-TRINITY C/	BRUSHY CREEK	5.341
11	176	1	3	011.3 MI SOUTH JCT SH 21	ANGELINA R	5.344
11	1810	2	2	09.1 MI E LEGGS STORE	MORAL BAYOU	5.345
11	304	4	65	3.3 MI S JCT FM 2928	SANDY CRK	5.349
11	893	1	11	11.4 MI SOUTH JCT SH 21	MOSS CREEK	5.361
11	176	5	75	1.22 MI FROM CONTROL CORR	DRY CREEK	5.361
11	213	3	45	5.0 MI W JCT US 59	EAST TEMPE CRK.	5.375
11	213	4	91	5.65 MI E JCT US 59 LIVIN	MENARD CREEK	5.375
11	213	4	92	8.35 MI E JCT US 59 LIVIN	BLUFF CREEK	5.375
11	1877	1	6	3.23MI JCT US59 1.8MI N C	PINEY CREEK	5.383
11	200	2	62	13.6 MI FROM JCT US 59	SHAWNEE CREEK	5.385
11	304	1	80	9.3 MI SOUTH JCT SH 147	PATROON BAYOU	5.390
11	2071	2	3	1.38 MI N OF SH 94	SOUTH CEDAR CREEK	5.406
11	213	5	80	14.44 MI E JCT US 59 LIVI	BEAR CR	5.410
11	2637	2	4	2.1 MI W JCT US 96	BEAR CREEK	5.416
11	118	1	2	4.35MI E OF CROCKETT	HURRICANE BAYOU	5.429
11	706	3	8	008.0 MI SOUTH JCT US 59	NACENICHE CR	5.430
11	123	7	46	000.1 MI EAST RUSK CO LIN	ATTOYAC RIV. REL	5.433
11	336	8	32	1.9 MI E JCT FM 1592	PALO GAUCHO BAYOU	5.470
11	2590	1	1	000.5 MI EAST JCT LOOP 49	LA NANA BAYOU	5.471
11	118	6	62	00.8 MI E ANGELINA RIVER	ANGELENA RIV REL	5.490
11	743	2	11	ATTOYAC RIVER	ATTOYAC RIVER	5.498
11	694	1	18	2.1 MI S JCT FM 1175	HOUSEN BAYOU REL.	5.518
11	340	4	17	3.0MI W OF LOOP304 W INTE	HURRICANE REL	5.520
11	213	5	82	14.82 MI E JCT US 59 LIVI	MILL CR	5.522
11	395	3	17	2.2 MI WEST OF US 59	BIG CREEK	5.524
11	1678	1	3	3.8 MI E JCT FM 3121	COMA CREEK	5.545
11	390	4	58	4.337 MI FROM JCT US 69	SHAWNEE CREEK RELIEF	5.555
11	213	3	96	4.81MI E POLK.SAN JACINTO	KICKAPOO CREEK	5.556
11	336	3	15	OVER NECHES RIVER ON SH 7	NECHES RIVER	5.558
11	706	4	16	009.4 MI SOUTH JCT SH 7	ALOMODEROS CREEK	5.561
11	2662	1	1	14.363 MI FROM JCT 1669	POPHERS CREEK	5.586
11	59	1	6	014.7 MI EAST JCT SH 21	ATTOYAC RIVER	5.587
11	1510	1	3	1.9MI N JCT SH 184	TEBO CREEK	5.591
11	1675	1	2	2.290 MI FROM JCT 103	LISTON CREEK	5.597
11	1680	3	7	7.1 MI N JCT FM 83	CHIAMON RELIEF	5.603
11	1193	2	8	0.93MI W JCT US59 LEGGETT	LONG KING CRK RELIEF	5.605
11	931	4	22	2.25 MI W OF JCT SH 94	SOUTH CEDAR CR	5.608

District	Control	Section	Number	Location	Crosses	Score
11	1794	1	1	10.194 MI FROM JCT 58	SHAWNEE CREEK	5.627
11	2387	1	1	0.67 MI S OF SH 94	HACKBERRY CR	5.629
11	2116	1	1	08.3 MI E JCT FM 1275	CARRIZO CREEK	5.631
11	176	2	62	4.646 MI FROM ANGELINA RI	MILL CREEK	5.640
11	1874	2	2	10.74 MI FROM JCT SH 103	MILL CREEK	5.647
11	809	4	5	2.3 MI S JCT 147	AYISH BAYOU	5.647
11	118	6	61	00.3 MI E ANGELINA RIVER	ANGELINA RIV	5.650
11	340	1	19	1.52 MI S JCT FM 232	LAKE CREEK	5.658
11	937	2	12	4.88MI E OF JCT US287 GRA	SAN PEDRO CREEK	5.667
11	553	3	6	ANGELINA RIVER	ANGELINA RIVER	5.681
11	59	4	10	002.0 MI WEST JCT US 96	HOUANA CREEK	5.693
11	1810	1	1	0.7 MI E JCT LOOP 495	LA NANA CREEK	5.696
11	553	3	4	001.1 MI EAST ANGELINA RI	LOCO CREEK	5.702
11	304	4	60	3.1 MI S JCT FM 2928	SANDY CRK RELIEF	5.703
11	939	1	4	4.29MI N OF JUNCTION OF U	WHITE ROCK CREEK	5.714
11	3038	1	2	4.0 MI E INT SH 150 AND F	HUFFMAN BRANCH	5.715
11	597	2	7	1.3 MI N JCT SH 103	SPEER CREEK	5.715
11	2117	1	6	0.51 MI W OF FM 357	ALABAMA CR	5.718
11	118	10	42	3.5 MI W JCT US 96	VENADO CREEK	5.724
11	175	4	9	003.2 MI NORTH TIMPSON	FLAT FORK CRK SL	5.744
11	340	1	4	6.291MI S OF LOOP304 IN C	DICKEY CREEK	5.752
11	176	2	41	ONE HALF SOUTH ANG RIVER	PROCELLA CREEK	5.757
11	742	1	11	013.1 MI SOUTH JCT SH 7	PAUL'S CR	5.758
11	395	2	12	10.44MI E WALKER-SAN JACI	E FK SAN JACINTO RIV	5.765
11	304	4	61	2.5 MI S JCT FM 944	HOUSEN BAYOU	5.771
11	340	1	5	1.204MI S OF FM232	WHITE ROCK CREEK	5.773
11	175	7	17	004.2 MI SOUTH RUSK CO LI	WANDERS CR	5.780
11	706	3	4	004.5 MI SOUTH JCT US 59	DOG CREEK	5.781
11	929	1	9	4.13MI JCT US-59 CORRIGAN	MCMANUS CREEK	5.782
11	175	4	8	005.3 MI NORTH TIMPSON	LIGHTFOOT CREEK	5.791
11	176	8	65	3.982 FROM JCT SH 94	HURRICANE CREEK	5.794
11	64	5	54	0.6 MI S JCT SH 103	DONAHUE CREEK	5.794
11	335	2	19	12.6MI W OF CROCKETT TEXA	TRINITY RIVER	5.816
11	336	3	11	2.960 MI FROM JCT SH 7	BODAN CREEK	5.816
11	931	5	16	1.5 MI E OF FM 3154	PINEY CR	5.818
11	319	2	16	6.6 MI NE OF US 287	PINEY CR	5.831
11	931	2	14	5.01MI E OF INTERSECTION	WHITE ROCK CREEK	5.838
11	2560	2	13	4.7 MI N JCT SH 7	LA NANA CR.	5.840
11	1193	2	10	0.65MI W JCT US 59 LEGGET	MUD CREEK	5.851
11	1875	2	5	1.1MI S OF FM227 INTERSEC	SAN PEDRO CREEK	5.853
11	176	5	50	9.66 MI FROM CONTROL CORR	WILLS CREEK	5.867
11	1675	1	1	5.170 MI FROM JCT 103	ODEL CREEK	5.867
11	200	1	58	7.274 FROM JCT US 59	BUCK CREEK	5.867
11	395	2	15	4.39MI E WALKER-SAN JACIN	WINTERS BAYOU RELIEF	5.878
11	213	13	44	6.01 MI E TRINITY RIVER W	WEST TEMPE CREEK	5.880
11	1877	2	4	5.64 MI. JCT US 59 CORRIG	MCMANUS CREEK	5.885
11	64	1	50	003.9 MI SOUTH JCT SH 7	DRAW	5.890

District	Control	Section	Number	Location	Crosses	Score
11	117	7	51	3.4MI W OF SH 7 & 21 INTE	DRAW	5.890
11	63	6	81	000.01 S PANOLA CO. LINE	MC FADDEN C	5.891
11	1876	1	1	2.54 MI W JCT US59 S LIVI	TEMPE CREEK	5.892
11	341	2	31	4.17 MI E POLK TRINTY CO	SALT CREEK	5.899
11	395	2	16	4.25MI E WALKER SAN JACIN	WINTERS BAYOU	5.900
11	1810	2	5	03.6 MI E LEGGS STORE	LOCO CR	5.901
11	931	1	3	2.00MI W OF LOVELADY	TABTABOGUE TRIBUTARY	5.901
11	304	2	40	6.0 MI N JCT FM 276	COLOROW CREEK	5.902
11	336	6	38	002.0 MI E ANGELINA RIVER	DURAZNO BAYOU REL.	5.926
11	304	3	71	2.5 MI N JCT FM 83	PALO GAUCHO BAYOU	5.932
11	654	2	7	8.97 MI JCT US 59 MOSCOW	LONG TOM CREEK	5.937
11	938	1	1	2.35MI W OF JUNCTION WITH	TANTABOGUE CREEK	5.939
11	319	2	50	3.7 MI N OF US 287	CANEY CR. RELIEF	5.946
11	340	2	14	1.92 MI S OF FM 2781	BROWNLES CR	5.946
11	336	6	36	ANGELINA RIVER	ANGELINA RIVER	5.952
11	1879	1	1	007.4 MI EAST JCT FM 1645	CHICKEN BAYOU	5.952
11	1875	2	1	2.96 MI S OF FM2663 INTER	HURRICANE BAYOU	5.953
11	1193	2	11	5.26 MI W JCT US 59 LEGGE	TOM CREEK	5.956
11	1195	1	2	003.1 MI EAST JCT US 59	NELSON CR	5.961
11	894	1	3	4.376 MI FROM INT SH 103	REDS BAYOU	5.965
11	319	2	14	3.9 MI N OF US 287	CANEY CR	5.971
11	390	1	61	4.8 MI S JCT US 96	CANEY CRK	5.973
11	176	5	77	11.00 MI FROM CONTROL COR	MUD CR	5.979
11	336	8	35	2.5 MI E JCT FM 1592	MADDOX CR	5.983
11	336	7	20	1.0 MI E JCT FM 1992	TURKEY CRK	5.989
11	319	4	62	04.980MI EAST NECHES RIVE	JACK CREEK	5.992
11	336	1	3	1.02MI E OF KENNARD	COCHINO BAYOU	5.992
11	930	1	3	4.6 MI S OF US 287	TRIB OF FOUNTAIN CR	5.994
11	1193	1	15	12.23 MI FROM JCT FM 62 C	BIG SANDY CREEK	5.995
11	118	8	59	8.5 MI E JCT LOOP 495	ATASCOSO CREEK	6.002
11	177	1	141	1.33 MI S JCT US 190	S.P.RR & CHOATES CR	6.003
11	177	1	142	1.31 MI S JCT US 190	S.P. RR & CHOATES CR	6.003
11	893	1	8	016.2 MI SOUTH JCT SH 21	DURAZNO CREEK	6.008
11	3038	1	1	0.7 MI E INT SH 150 AND F	BIG CREEK	6.008
11	340	1	1	0.520MI S OF LOOP304 CROC	GRANNY CREEK	6.010
11	341	2	33	8.90 MI E POLK TRINITY C	BEAR CREEK	6.011
11	319	1	56	12.3 MI E OF SH19 TRINITY	WEST CANEY CR	6.012
11	553	3	3	006.9 MI EAST ANGELINA RI	MORAL CREEK	6.017
11	388	1	14	0.189 FROM JCT US 190 LIV	CHOATES CREEK	6.022
11	553	3	1	005.1 MI EAST ANGELINA RI	ALAZAN CREEK	6.026
11	176	5	51	11.00 MI FROM CONTROL COR	MUD CR	6.026
11	1877	1	7	3.41MI JCT US59 1.8MI N C	PINEY CREEK RELIEF	6.030
11	118	9	44	1.13 FROM SH 21	AYISH BAYOU	6.032
11	928	1	4	2.57 MI S JCT US 190	TEMPE CREEK	6.032
11	118	6	22	10.4 MI E ANGELINA RIVER	BIG LOCO CREEK	6.034
11	2637	2	5	1.8 MI W JCT US 96	BEAR CREEK REL	6.035
11	336	7	39	2.0 MI W JCT FM 1277	ATTOYAC BAYOU	6.040

District	Control	Section	Number	Location	Crosses	Score
11	123	8	37	006.0 MI SOUTH JCT SH 87	BEAR BAYOU	6.042
11	1794	1	3	4.358 MI FROM JCT FM 58	BUCK CREEK	6.051
11	1079	1	5	1.3 MI N JCT FM 83	SANDY CR	6.059
11	59	1	27	03.8 MI E JCT SH 21	CARRIZO CREEK	6.063
11	1680	1	9	10.1 MI N JCT US 96	ARENOSA CREEK	6.066
11	336	2	14	10.00MI E OF RATCLIFF	NECHES RV REL	6.070
11	2700	1	1	001.0 MI EAST JCT FM 417	BEAUCHAMP CRK.	6.071
11	937	3	13	5.52MI N OF SH7 IN RATCLI	HICKORY CREEK	6.071
11	937	3	14	5.39MI N OF SH7 IN RATCLI	HICKORY CR RELIEF	6.071
11	2589	1	4	5.236 FROM JCT SH 94	CEDAR CREEK RELIEF	6.073
11	175	7	18	007.8 MI SOUTH RUSK CO LI	NACONICHE CR	6.073
11	176	5	47	1.22 MI FROM CONTROL CORR	DRY CREEK	6.073
11	175	5	25	003.4 MI SOUTH TIMPSON	HARDAGE CREEK	6.073
11	809	1	6	005.2 MI SOUTH JCT US 84	FLAT FORK CREEK	6.086
11	1876	1	3	0.38MI W JCT US 59 S LIVI	LONG KING CREEK	6.090
11	336	2	13	9.84MI E OF RATCLIFF	NECHES RV REL	6.092
11	893	1	10	013.7 MI SOUTH JCT SH 21	LAVACA CR	6.098
11	200	1	57	4.10 MI JCT US 59	BILOXI BRANCH	6.102
11	931	1	18	2.46MI W OF LOVELADY	TANTABOUGE CREEK	6.109
11	213	3	100	5.0 MI W JCT US 59	EAST TEMPE CRK.	6.111
11	1676	2	2	3.73MI W OF LOVELADY TEXA	TANTABOGUE CR	6.111
11	1676	2	4	1.2 MI E OF SH 21	CANEY BAYOU RELIEF	6.113
11	1409	3	5	003.4 MI EAST JCT SH 87	GOODWIN CR	6.113
11	2117	1	4	3.23 MI NE OF US 287	PINEY CR	6.118
11	213	5	81	14.62 MI E JCT US 59 LIVI	BEAR & MILL CR REL	6.122
11	1079	1	15	2.4 MI S JCT FM 83	COUCHATAMA CREEK	6.123
11	1157	1	1	3.352 MI FROM JCT FM 325	BILOXI CREEK	6.128
11	117	6	67	3.0MI SW OF JUNCTION FM24	TRINITY RIVER	6.132
11	213	4	90	2.56 MI E JCT US 59 LIVIN	CHOATES CREEK	6.134
11	742	1	12	016.9 MI SOUTH JCT SH 7	GRANNIE CR	6.134
11	109	4	7	0.33MI N OF CROCKETT N CI	HURRICANE REL	6.147
11	1193	1	13	9.69 MI FROM JCT FM 62 CA	HICKMAN CREEK	6.154
11	1195	1	1	003.8 MI EAST JCT US 59	FLAT FORK CREEK	6.156
11	1079	1	13	0.2 MI N JCT FM 83	COPELLE CREEK	6.164
11	706	5	13	001.7 MI SOUTH CHIRENO	POLYSOT CR	6.164
11	176	6	87	0.20MI S. OF US 190 INT.	CHOATES CREEK	6.170
11	1408	1	4	12.97 MI FROM JCT US 190	BIG SANDY CREEK	6.172
11	336	6	37	001.5 MI E ANGELINA RIVER	DURAZNO BAYOU REL.	6.174
11	742	1	5	020.6 MI SOUTH JCT SH 7	BAYOU SIEP REL.	6.178
11	937	1	17	4.20MI W OF JUNCTION OF F	BIG ELKHART CREEK	6.179
11	213	3	95	0.00 MI W BANK TRINITY RI	TRINITY RIVER	6.182
11	1794	1	2	1.560 FROM GRIMES STORE	BILOXI CREEK	6.185
11	1794	1	4	4.935 MI FROM JCT 58	LITTLE BUCK CREEK	6.185
11	931	1	19	13.71MI E OF TRINITY TEXA	WRIGHT'S CREEK	6.186
11	403	1	13	1.00 MI S JCT OLD US 190	MCGEE CREEK	6.189
11	390	1	62	2.8 MI S JCT US 96	VENADO CRK	6.195
11	118	10	46	0.3 MI W JCT FM 1196	ATTOYAC RIV REL	6.200

District	Control	Section	Number	Location	Crosses	Score
11	756	5	7	21.69 MI S JCT SH 150	SAN JACINTO RELIEF	6.206
11	743	2	12	000.2 MI EAST ATTOYAC RIV	ATTOYAC RIVER	6.210
11	3535	1	1	2.4 MI E JCT FM 139	BLUE BAYOU	6.211
11	1409	3	4	002.0 MI EAST JCT SH 87	INDIAN CR	6.225
11	336	8	33	2.0 MI E JCT FM 1592	PALO GAUCHO REL.	6.229
11	809	2	2	004.6 MI SOUTH JCT SH 7	MILL CR	6.230
11	893	2	2	8.314 MI FROM JCT 1669	STANLEY CREEK	6.232
11	2589	1	3	4.852 MI FROM JCT SH 94	CEDAR CREEK	6.232
11	340	4	16	2.7MI W OF LOOP304 INTERS	HURRICANE BAYOU	6.232
11	304	4	75	1.0 MI S JCT FM 2928	SIX MILE CR	6.244
11	1676	2	5	1.1 MI E OF SH 21	CANEY BAYOU	6.247
11	2594	1	1	5.81 MI NE JCT SH 150	FK SAN JACINTO RIVER	6.247
11	1409	3	3	000.6 MI EAST JCT SH 87	WOODFIN CR	6.247
11	756	5	6	21.64MI S JCT SH150 W COL	SAN JACINTO RIVER	6.250
11	810	3	5	003.7 MI SOUTH JCT FM 139	GRANNIES CREEK	6.257
11	1879	1	4	003.9 MI EAST JCT FM 1645	PENSON CR	6.265
11	929	1	10	4.01MI JCT US-59 CORRIGAN	DRAIN	6.266
11	390	4	57	4.117 FROM JCT US 69	SHAWNEE CREEK	6.267
11	2509	3	1	00.4 MI S SACUL	INDIAN CREEK	6.272
11	809	2	3	002.3 MI SOUTH JCT SH 7	HUANA CR	6.277
11	931	2	13	4.91MI E OF INTERSECTION	WHITE ROCK RELIEF	6.282
11	931	2	15	5.18MI E OF INTERSECTION	WHITE ROCK RELIEF	6.282
11	1676	2	1	3.78MI W OF LOVELADY TEXA	TANTABOGUE RELIEF	6.288
11	475	9	95	1.4 MI E JCT FM 355	MILL CREEK	6.290
11	475	9	93	6.95MI E OF SH19 IN TRINI	WHITE ROCK CR	6.290
11	390	4	56	3.792 FROM JCT US 69	SHAWNEE CREEK RELIEF	6.292
11	2594	1	2	6.89 MI NE JCT SH 150	LOVE CREEK	6.294
11	2443	2	4	6.52 MI NW OF US HWY 190	POOL'S CRK	6.297
11	2589	1	1	3.226 FROM JCT SH 94	JACK CREEK	6.298
11	756	4	8	2.82 NW JCT ST 150 W COLD	CANEY CR	6.299
11	213	3	97	5.43 MI E POLK-SAN JACINT	SANDY CREEK	6.303
11	706	3	20	9.7 MI SOUTH JCT US 59	TURKEY CREEK	6.306
11	390	2	59	2.0 MI S JCT FM 2851	ANGELINA RIV	6.307
11	654	2	6	7.42 MI JCT US 59 MOSCOW	MEADOW CREEK	6.317
11	1678	2	2	2.0 MI S JCT FM 83	HOUSEN BAYOU	6.319
11	2560	1	2	03.8 MI E JCT SH 21 W	LA NANA CREEK	6.325
11	109	7	46	.01 MI S OF CRICKETT CO L	TANTABOGUE CREEK	6.334
11	1194	1	3	8.17 MI JCT S.H. 146	MENARD CREEK	6.334
11	1406	1	1	.725 MI FROM JCT LP 287	CEDAR CREEK	6.335
11	63	6	31	008.1 MI SOUTH TENAHA	SMITH CREEK	6.338
11	2387	1	2	4.67 MI S JCT SH 94	HACKBERRY CREEK	6.339
11	895	2	10	5.8MI N JCT SH 21	ARENOSA CREEK	6.343
11	64	6	42	0.4 MI S JCT FM 83	EASLEY CR	6.344
11	2667	1	1	3.73 MI E JCT US 59 GOODR	COPELAND CREEK	6.344
11	123	9	51	001.4 MI NORTH JCT SH 7	WEST CR	6.352
11	1877	2	1	0.41MI JCT US 59 IN CORR	DRY CREEK	6.355
11	2117	1	3	3.03 MI NE OF US 287	PINEY CREEK RELIEF	6.364

District	Control	Section	Number	Location	Crosses	Score
11	119	1	13	0.7 MI E JCT FM 1	PALO GAUCHO BAYOU	6.365
11	2448	2	2	4.861 MI. WEST OF FM 230	KELLISONS CREEK	6.379
11	1195	1	3	001.6 MI EAST JCT US 59	SHIP CREEK	6.380
11	3269	1	1	3.85 MI SE OF SH 94	SANDY CREEK	6.381
11	109	7	47	AT CROCKETT CO LINE	TANTABOGUE SLOUGH CREEK	6.381
11	2509	3	2	04.6 MI S SACUL	BEECH CREEK	6.384
11	336	1	4	1.20MI E OF KENNARD	E FK OF COCHINO BAYO	6.393
11	1193	1	6	2.288MI FROM JCT FM 62 CA	DOBBS CREEK	6.395
11	1193	2	9	0.98 MI W JCT US 59 LEGGE	LONG KING CREEK	6.407
11	403	2	16	2.93MI E JCT SH 156COLDSP	INDIAN CREEK	6.413
11	2637	1	2	1.3 MI E JCT SH 147	HARVEY CREEK	6.426
11	742	1	13	017.1 MI SOUTH JCT SH 7	BROWLEY CR	6.427
11	743	2	9	005.1 MI EAST ATTOYAC RIV	WEST CREEK	6.427
11	931	2	20	2.61 MI E INTER SH 19	GAIL CREEK	6.432
11	1079	1	16	2.32 MI S. OF SH 103	TURKEY CR.	6.435
11	1680	3	1	1.2 MI S JCT SH 103	CHINQUAPIN CREEK	6.446
11	336	1	5	2.49 MI E OF KENNARD	LEE CREEK	6.449
11	1408	1	5	13.06MI FROM JCT US 190	BIG SANDY CRK RELIEF	6.451
11	118	8	70	0.2 MI W JCT LOOP 495	BANITO CREEK	6.452
11	2560	2	15	0.3 MI W OF JCT LP 495	S.P. R.R.&BONITA CRK	6.454
11	940	1	1	1.1MI E OF SH7 IN KENNARD	ELM CREEK	6.457
11	1584	3	4	1.27 MI. W POLK-TYLER C/L	CANEY CREEK	6.461
11	1193	2	7	5.83 MI W JCT US 59 LEGGE	BARNEY CREEK	6.465
11	1877	2	2	3.61 MI JCT US 59 CORRIGA	KENNEDY CREEK	6.467
11	810	1	1	005.4 MI EAST US 96	PORTER CR	6.467
11	597	2	6	12.0 MI W JCT 96	BRUSHY CREEK	6.468
11	931	3	27	6.6 MI W JCT OF US 287	LITTLE WHITE ROCK CREEK	6.470
11	742	1	6	020.9 MI SOUTH JCT SH 7	BAYOU SIEP	6.471
11	939	1	2	4.85MI N OF JUNCTION OF U	PINE TREE CREEK	6.473
11	1680	2	3	2.1 MI S JCT SH 21	CARRIZO CREEK	6.473
11	2117	2	7	0.8 MI S OF FM 2262	ALABAMA CR	6.476
11	63	6	27	000.01 SOUTH PANOLA CO LI	MCFADDEN CR	6.478
11	3418	1	1	.884 MI WEST OF FM 324	CEDAR CREEK	6.493
11	635	3	8	9.9MI E OF US287 IN GRAPE	RICH CREEK	6.495
11	64	4	53	2.2 MI S JCT SH 21	TIGER CREEK	6.539
11	63	6	30	005.9 MI SOUTH TENAHA	CHICKEN BAYOU	6.543
11	928	2	3	5.45 MI N JCT US 190 W LI	PLUM CREEK	6.555
11	1875	2	4	0.4MI N OF FM227 INTERSEC	WINTERS BAYOU RELIEF	6.557
11	1680	3	2	1.2 MI S JCT SH 103	CHINQUAPIN CR REL	6.558
11	336	7	29	2.0 MI W INT US 96	CHINQUAPIN CR	6.559
11	59	1	5	13.1 MI E JCT SH 21	TERRAPIN CREEK	6.559
11	118	8	55	0.5 MI E JCT LOOP 495	LA NANA CREEK	6.562
11	1680	3	8	6.8 MI N JCT FM 83	CHIAMON CREEK	6.580
11	937	2	21	2.10 MI WEST OF JCT SH 21	SAN PEDRO CREEK	6.584
11	1408	1	3	12.87 MI FROM JCT US 190	BIG SANDY CRK RELIEF	6.610
11	304	2	81	2.7 MI N JCT FM 276	BOURGHS CREEK	6.614
11	59	5	32	007.1 MI EAST JCT US 96	FLAT FORK CREEK	6.616

District	Control	Section	Number	Location	Crosses	Score
11	2637	1	3	1.4 MI W JCT 705	AYISH BAYOU	6.618
11	403	2	14	4.763 FROM JCT SH156 COLD	WOLF CREEK	6.620
11	1582	1	1	2.46 MI NW LIBERTY COUNTY	DRAW	6.626
11	1876	1	4	8.81 MI SW JCT US 59 S LI	LONG KING CREEK	6.631
11	64	1	61	6.4 MI SOUTH JCT SH 7	TENAHA SLOUGH	6.646
11	213	3	101	1.7 MI W JCT US 59	LONG KING CRK.	6.650
11	63	6	93	3.8MI. SOUTH OF TENAHA	FLAT FORK CREEK	6.650
11	939	1	3	5.90MI N OF JUNCTION OF U	PINE TREE RELIEF	6.650
11	119	5	17	SABINE RIVER	SABINE RIV. *	6.662
11	450	4	25	0.7 MI W JCT FM 1648	ANGELINA RIVER	6.707
11	706	3	3	003.7 MI SOUTH JCT US 59	PARALLEL CREEK	6.717
11	119	4	16	2.0 MI E JCT FM 3121	CARRICE CREEK	6.718
11	929	1	6	6.61 MI JCT US 59 CORRIGA	BEAVERS CREEK	6.751
11	576	2	2	1700 FT EAST US 59	WHITE OAK CREEK	6.752
11	742	1	14	010.9 MI SOUTH JCT SH 7	TENAHA BAYOU	6.755
11	3170	1	1	3.1 MI N JCT FM 83	PALO GAUCHO BAYOU	6.757
11	64	5	33	3.7 MI N JCT FM 83	BEAR CREEK	6.759
11	2443	2	5	4.101 MI NW OF US HWY 19	PALMETTO CRK	6.763
11	175	4	7	006.0 MI NORTH TIMPSON	BOWLIN CREEK	6.793
11	319	1	54	3.4 MI E OF SH19	WHITE ROCK CR REL	6.808
11	743	3	6	004.5 MI EAST JCT SH 87	CANEY CR	6.821
11	1878	1	1	2.2 MI S JCT SH 184	HOUSEN BAYOU	6.825
11	118	10	76	0.6 MI E. OF US 96	AYISH	6.829
11	2443	2	2	13.89 MI NW US HWY 190 I	E. CAROLINA CRK	6.832
11	893	1	13	3.3 MI SOUTH JCT SH 21	ATASCOSO CREEK	6.857
11	635	3	5	6.70MI E OF US287 IN GRAP	DRAW	6.858
11	926	2	5	ANGELINA RIVER	ANGELINA RIVER	6.865
11	64	2	62	005.4 MI SOUTH JCT SH 87	LITTLE RASCAL CREEK	6.885
11	64	2	63	005.9 MI SOUTH JCT SH 87	PATROON CREEK	6.885
11	64	2	64	06.0MI SOUTH JCT SH-87	SANDY CREEK	6.885
11	743	3	5	001.0 MI EAST JCT SH 87	PRAIRIE CR	6.889
11	1679	1	2	2.9 MI E JCT SH 87	PATROON BAYOU	6.889
11	742	1	17	03.8MI. SOUTH JCT SH-7	STYLES CREEK REL	6.902
11	893	1	14	3.50 MI SOUTH JCT SH 21	ATASCOSO RELIEF	6.922
11	1681	1	2	1.60MI. SE JCT US-59	MUSSEL SHOAL CREEK	6.922
11	742	1	18	03.9MI.SOUTH JCT SH-7	STYLES CREEK	6.927
11	635	3	7	8.6MI E OF US287 IN GRAPE	SILVER CREEK	6.927
11	118	12	77	0.77 MI E. OF SH 147	CARRIZO CREEK	6.938
11	1795	2	1	1.626 MI FROM CHEROKEE CO	SUPULPA CREEK	6.945
11	940	1	2	2.1MI E OF SH7 IN KENNARD	WALLACE CREEK	6.949
11	896	1	1	2.0 MI W JCT SH 87	N.BRANCH COLOROW	6.977
11	304	2	82	1.7 MI N JCT FM 276	REEVES CREEK	6.978
11	3436	1	1	9 MILES SE OF HEMPHILL TX	TOLEDO BEND RESERVOIR	6.994
11	319	1	53	3.3 MI E OF SH 19	WHITE ROCK CR REL	7.032
11	1677	1	1	5.23MI N OF SH7 INTERSECT	HICKORY CREEK	7.050
11	1677	1	2	5.16MI N OF SH7 INTERSECT	HICKORY CREEK RELIEF	7.050
11	1408	1	6	4.221 MI FROM JCT US 190	BIG SANDY CREEK	7.064

District	Control	Section	Number	Location	Crosses	Score
11	810	2	7	5.1MI.EAST JCT SH-87	DRAW	7.101
11	810	2	6	3.5MI.EAST JCT SH-87	BEAUCHAMP CREEK	7.123
11	1682	1	5	1.4MI.SOUTH JCT US-59	FLAT FORK CREEK	7.123
11	896	3	3	0.6 MI N JCT FM 1592	DRAIN	7.126
11	390	5	2	1.4 MI S JCT FM 83	LITTLE OWL CRK	7.133
11	3266	1	1	0.4 MI N JCT SH 87	TOLEDO BEND SLOUGH	7.165
11	635	3	6	7.9MI E OF US287 IN GRAPE	IRONSIDE CREEK	7.192
11	3436	1	2	9 MI SE OF HEMPHILL	TOLEDO BEND	7.216
11	390	5	1	1.1 MI S JCT FM 83	BIG OWL CREEK	7.220
11	896	1	2	2.3 MI W JCT SH 87	S.BRANCH COLOROW	7.226

District	Control	Section	Number	Location	Crosses	Score
12	27	12	137	1.35 MI SW OF SH 6	BULLHEAD SLOUGH	3.726
12	27	12	138	1.35 MI SW OF SH 6	BULLHEAD SLOUGH	3.726
12	110	5	90	1.0 MI N OF FM 1960	CYPRESS CREEK	4.566
12	178	3	24	1.20 MI SW OF FM 2917	DRAINAGE DITCH	4.629
12	110	5	44	1.0 MI N OF FM 1960	CYPRESS CREEK	4.700
12	110	5	21	1.0 MI N OF FM 1960	CYPRESS CREEK	4.749
12	178	3	25	2.80 MI NE OF SP 28	AUSTIN BAYOU	4.788
12	27	12	133	3.50 MI SW OF SH 6	BRAZOS RI	4.808
12	89	9	48	0.45 MI SW OF FM 360	SNAKE CRK	4.838
12	28	1	7	12.5MI E IH610 & US90	SAN JACINTO RELIEF	4.850
12	188	2	23	3.90 MI S OF US 59	BIG CRK	4.860
12	110	5	94	1.0 MI N OF FM 1960	CYPRESS CREEK	4.930
12	27	12	132	3.50 MI SW OF SH 6	BRAZOS RI	4.942
12	976	1	13	5MI.N.OF HARRIS/BRAZ. C/L	SIMMS BAYOU	4.951
12	177	5	105	0.8 MI N OF FM 1485	CANEY CREEK	4.972
12	177	5	120	2.3 MI S OF FM 2090	PEACH CR & MARE BR	4.972
12	508	7	250	72 501T	GOOSE CREEK	4.998
12	2523	2	17	1.35 MI S OF SH 332	BRAZOS RIVER	5.025
12	177	5	113	2.4 MI N OF HARRIS C/L	BEN'S BRANCH	5.040
12	177	5	42	2.3 MI S OF FM 2090	PEACH CR & MARE BR	5.043
12	27	10	37	1.25 MI N OF IH 45	COUNTRY CLUB BAYOU	5.080
12	177	6	27	1.7 MI N OF FM 1960	SAN JACINTO RIVER	5.094
12	338	4	54	2.00 MI E OF IH 45	STEWART CRK	5.099
12	177	5	104	0.8 MI N OF FM 1485	CANEY CREEK	5.106
12	177	5	150	2.3 MI S OF FM 2090	PEACH CR & MARE BR	5.106
12	720	2	33	JCT HARRIS C/L	SPRING CREEK	5.106
12	177	5	114	2.4 MI N OF HARRIS C/L	BENS BRANCH	5.111
12	110	4	91	8.44 MI N OF FM 1488	SAN JACINTO RI *	5.112
12	271	14	124	1.3 MI N OF IH 10	HUNTING BAYOU	5.138
12	720	3	46	2.0 MI S OF FM 2920	WILLOW CREEK	5.148
12	338	4	59	3.00 MI E OF LP 336	HURRICANE CRK	5.153
12	177	5	119	0.1 MI W OF US 59	PEACH CREEK	5.177
12	271	6	441	6.10 MI W OF SH 6	MASON CREEK	5.204
12	271	6	442	6.10 MI W OF SH 6	MASON CREEK	5.204
12	89	9	47	2.70 MI NE OF FM 2919	TURKEY CRK	5.219
12	720	2	49	JCT HARRIS C/L	SPRING CREEK	5.240
12	27	8	92	0.60 MI NE OF FM 762	BRAZOS RI	5.242
12	1418	2	2	1.90 MI N OF FM 1093	BESSIES CRK	5.274
12	523	2	18	4.00 MI S OF US 290	CYPRESS CRK	5.274
12	89	9	50	4.00 MI W OF SH 36	COON CRK	5.287
12	508	1	222	5.8 MI. E OF BW8 E	SAN JACINTO RIVER *	5.303
12	389	13	74	0.4 MI E OF MAIN ST	GOOSE CREEK	5.312
12	500	3	210	0.10 MI W OF ALLEN PKWY	BUFFALO BYU	5.315
12	110	4	47	8.44 MI N OF FM 1488	SAN JACINTO RI *	5.320
12	508	1	265	1MI W OF LYNCHBURG RD	SAN JACINTO RELIEF	5.343
12	271	14	123	1.3 MI N OF IH 10	HUNTING BAYOU	5.346
12	1258	2	10	2.60 MI SW OF FM 1489	BRAZOS RI	5.349

District	Control	Section	Number	Location	Crosses	Score
12	50	5	137	0.50 MI W OF FM 359	CLEAR CRK	5.369
12	508	1	261	.5MI.E. OF MAGNOLIA	SAN JACINTO RELIEF	5.373
12	1062	1	11	5.4 MI E OF LP 494	E FK SAN JACINTO RIV	5.388
12	3050	2	1	JCT HARRIS C/L	SPRING CREEK	5.388
12	598	1	23	3.5MI.S.OF IHH-610&SH-288	SIMS BAYOU	5.398
12	188	9	27	0.60 MI N OF US 90A	BRAZOS RI	5.398
12	89	17	46	0.50 MI NE OF FM 2919	BROOKS BR	5.408
12	2744	1	1	3.2 MI W OF IH 45	SAN JACINTO RIV REL	5.410
12	1417	1	7	2.80 MI NE OF FM 2432	MCREA CREEK	5.433
12	3158	1	4	3.2 MI SE OF SH 336	W FORK CRYSTAL CRK	5.435
12	838	3	15	6.40 MI SE OF SH 36	DEER CRK	5.439
12	3312	1	1	1.00 MI SE OF NASA RD 1	CLEAR CREEK	5.439
12	28	1	157	12MI E OF IH610	SAN JACINTO RIVER	5.443
12	508	1	239	0.00 MI N OF IH 10	BUFFALO BAYOU & IH 10	5.445
12	838	3	14	0.20 MI SE OF FM 2977	FAIRCHILDS CRK	5.454
12	177	6	134	1.7 MI N OF FM 1960	SAN JACINTO RIVER	5.457
12	976	1	20	5MI.N.OF HARRIS/BRAZ.C/L	SIMMS BAYOU	5.472
12	178	3	41	1.05 MI S OF SH 6	MUSTANG BAYOU	5.482
12	500	3	214	0.10 MI N OF DALLAS ST	BUFFALO BYU,ALLEN PKWY	5.492
12	1062	4	7	4.5MI S OF FM1960/FM2100	GUM GULLY	5.493
12	389	5	58	3.25 MI N OF NASA RD 1	TAYLOR BAYOU	5.500
12	598	1	22	3.5MI.S.OF IH-610&SHH-288	SIMS BAYOU	5.510
12	177	6	81	1.7 MI N OF FM 1960	SAN JACINTO RIVER	5.513
12	543	2	24	0.25 MI W OF FM 1463	FLEWELLEN CRK	5.522
12	2744	1	2	2.6 MI W OF IH 45	SAN JACINTO RIVER	5.522
12	179	2	50	3.10 MI NW OF SH 36	BRAZOS RIVER	5.528
12	192	1	2	5.75 MI SE OF US 59	FLAT BANK CRK	5.540
12	1685	5	9	0.75 MI N OF IH 10	SOUTH MAYDE CREEK	5.542
12	1417	1	4	0.85 MI NE OF FM 2432	CAMP CREEK	5.547
12	271	6	440	6.10 MI W OF SH 6	MASON CREEK	5.560
12	271	14	56	1.3 MI N OF IH 10	HUNTING BAYOU	5.583
12	720	2	43	.4MI N OF BNRR	LAKE CREEK RELIEF	5.588
12	1402	3	5	3.10 MI E OF FM 149	CANEY CREEK	5.592
12	178	3	40	1.05 MI S OF SH 6	MUSTANG BAYOU	5.598
12	27	12	156	0.30 MI NE OF FM 2218	DRY CRK	5.598
12	27	12	155	0.30 MI NE OF FM 2218	DRY CRK	5.622
12	720	2	42	.6MI N OF BN RR	LAKE CREEK	5.635
12	111	1	60	4.5MI.S.OF IH-610 & FM521	SIMS BAYOU	5.652
12	271	4	258	3.50 MI E OF BRAZOS RI	KELLNER CRK	5.656
12	500	3	69	0.10 MI N OF DALLAS ST	BUFFALO BYU/ALLEN PKWY	5.658
12	271	5	292	0.35 MI E OF FM 1463	CANE BR OF BUFFALO BYU	5.661
12	271	5	295	0.35 MI E OF FM 1463	CANE BR OF BUFFALO BYU	5.661
12	3047	2	3	5.50 MI W OF FM 359	BRAZOS RI	5.664
12	978	2	6	0.40 MI W OF FM 3436	GUM BAYOU	5.667
12	3256	1	90	0.90 MI N OF US 290	WHITE OAK BAYOU	5.669
12	1006	1	7	0.90 MI N OF US 290	HORSEPEN CREEK	5.676
12	188	6	37	8.65 MI E OF FM 2004	BRAZOS RIVER & SH 288	5.692

District	Control	Section	Number	Location	Crosses	Score
12	188	10	30	0.20 MI SW OF IH 10	BUFFALO BYU	5.700
12	50	6	101	0.40 MI NW OF BARKER-CYPR	CYPRESS CRK	5.705
12	177	5	112	2.4 MI N OF HARRIS C/L	BEN'S BRANCH	5.705
12	27	12	158	0.30 MI NE OF FM 2218	DRY CRK	5.709
12	27	12	157	0.30 MI NE OF FM 2218	DRY CRK	5.710
12	3256	1	184	0.90 MI N OF US 290	WHITE OAK BAYOU	5.710
12	1414	4	15	JCT @ FT BEND C/L	BRAZOS RIVER	5.710
12	177	5	109	1.3 MI N OF FM 1314	WHITE OAK CREEK	5.711
12	1685	1	27	1.05 MI NE OF US 290	DRAINAGE DITCH	5.745
12	177	5	107	1.3 MI N OF FM 1314	WHITE OAK CREEK	5.752
12	177	5	108	1.3 MI N OF FM 1314	WHITE OAK CREEK	5.752
12	3256	1	183	0.90 MI N OF US 290	WHITE OAK BAYOU	5.757
12	389	15	18	.5MI.S.OF FAIRMONT PKWY	LITTLE CEDAR BAYOU	5.757
12	1257	1	6	0.50 MI N OF SH 6	OYSTER CRK	5.760
12	271	17	130	1.50 MI S OF IH 10	BUFFALO BAYOU	5.770
12	89	9	201	0.40 MI NE OF FM 2919	BROOKS BR	5.777
12	3256	1	89	0.90 MI N OF US 290	WHITE OAK BAYOU	5.781
12	409	2	9	4.40 MI SW OF US 290 BUS	BRAZOS RI	5.784
12	1685	3	38	3.00 MI W OF CROSBY-HMAN	LAKE HOUSTON (W BRIDGE)	5.790
12	500	3	106	0.10 MI N OF DALLAS ST	ALLEN PKWY/BUFFALO BYU	5.802
12	500	3	215	0.10 MI N OF ALLEN PKWY	BUFFALO BYU	5.817
12	89	9	190	4.00 MI W OF SH 36	COON CRK	5.818
12	389	5	102	3.25 MI N OF NASA RD 1	TAYLOR BAYOU	5.818
12	177	5	111	2.4 MI N OF HARRIS C/L	BEN'S BRANCH	5.823
12	188	6	36	8.65 MI E OF FM 2004	BRAZOS RIVER & SH 288	5.826
12	3256	1	64	1.1 MI N OF BRIAR FOREST	BUFFALO BAYOU	5.849
12	1414	3	10	5.10 MI SW OF SH 35	CHOCOLATE BAYOU	5.851
12	50	4	21	5.00 MI N OF US 290	DONAHOE CRK	5.858
12	192	1	3	5.30 MI NW OF FM 521	OYSTER CRK	5.876
12	50	4	99	7.20 MI N OF US 290	CEDAR CRK	5.880
12	508	1	317	12MI E OF IH10+IH610	SAN JACINTO RIVER *	5.883
12	50	6	105	0.40 MI NW OF BARKER-CYPR	CYPRESS CRK	5.889
12	27	13	130	0.5MI S OF BELTWAY 8	KEEGANS BAYOU	5.890
12	27	13	265	0.12MI N OF W BELLFORT	KEEGANS BAYOU	5.890
12	271	7	146	0.01 MI N OF FRANKLIN ST	BUFFALO BYU N BANK	5.897
12	1685	3	39	3.00 MI W OF CROSBY-HMAN	LAKE HOUSTON (E BRIDGE)	5.902
12	179	2	5	3.50 MI SW OF FM 521	MIDDLE BAYOU	5.905
12	338	3	201	3.10 MI NW OF LP 336	WEST SAN JACINTO RI	5.911
12	1416	2	16	1.7 MI N OF SH 105	INDIAN CREEK NORTH	5.921
12	27	8	436	0.60 MI NE OF FM 762	BRAZOS RI	5.933
12	598	2	49	2.12 MI N OF FM 1462	HAYES CREEK	5.938
12	389	5	54	.3MI N OF FAIRMONT	LITTLE CEDAR BAYOU	5.940
12	271	16	375	INTER.LOOP IH-610 S.&W.	BRAYS BAY/610SB	5.949
12	89	9	184	0.40 MI NE OF FM 2919	BROOKS BR	5.952
12	177	5	106	1.3 MI N OF FM 1314	WHITE OAK CREEK	5.957
12	50	6	102	0.40 MI N OF BARKER-CYPR	CYPRESS CRK	5.958
12	271	16	153	1.6MI W US90A/IH610S	WILLOW WATERHOLE BAY	5.964

District	Control	Section	Number	Location	Crosses	Score
12	3420	1	1	0.75 MI E OF FM 1092	STAFFORD RUN CRK	5.984
12	523	2	17	1.10 MI S OF US 290	MOUND CRK	5.991
12	89	9	187	2.70 MI NE OF FM 2919	TURKEY CRK	5.996
12	89	9	185	0.40 MI NE OF FM 2919	BROOKS BR	5.999
12	2941	2	1	9.00 MI W OF IH 45	WILLOW CREEK	6.006
12	3510	4	17	1.65 MI NE OF US 59	BRAZOS RI	6.007
12	271	16	376	INTER.LOOP 610 S & W	BRAYS BAY.&CITY ST.	6.014
12	720	3	45	2.2 MI. NW OF 1960	CYPRESS CREEK	6.015
12	89	9	188	0.45 MI SW OF FM 360	SNAKE CRK	6.018
12	271	4	271	5.30 MI W OF FM 359	BRAZOS RI *	6.024
12	271	4	434	5.30 MI W OF FM 359	BRAZOS RI	6.024
12	27	13	71	.5MI.N.OF FT.BEND C/L.	KEEGANS BAYOU	6.027
12	389	12	35	1.0 MI E OF SH 146	GOOSE CREEK	6.029
12	271	16	154	1.6MI W US90A/IH610S	WILLOW WATERHOLE BAY	6.029
12	598	2	15	2.11 MI S OF FM 518	MUSTANG BAYOU	6.031
12	598	2	16	2.11 MI S OF FM 518	MUSTANG BAYOU	6.031
12	508	1	209	0.55 MI W OF US 59	IH 10	6.037
12	89	9	196	2.70 MI NE OF FM 2919	TURKEY CRK	6.039
12	2093	1	2	0.30 MI NE OF US 59	DRY CRK	6.060
12	110	4	121	AT HARRIS C/L	SPRING CRK	6.080
12	271	17	158	1.50 MI S OF IH 10	BUFFALO BAYOU	6.082
12	271	17	415	1.50 MI S OF IH 10	BUFFALO BAYOU	6.082
12	271	16	373	INTER.LOOP 610 S. & W.	BRAYS BAY/BRAESWOOD *	6.083
12	271	16	374	INTER.LOOP IH-610 S.& W.	BRAYS BAY/BRAESWOOD *	6.083
12	720	2	40	1.0 MI N OF FM 1774	MILL CREEK	6.100
12	3050	2	3	3.9 MI S OF FM 1488	DRY CREEK	6.100
12	1006	1	4	5.00 MI E OF WALLER C/L	BEAR CRK	6.119
12	523	9	19	0.9 MI W OF FM 149	MILL CREEK	6.126
12	114	11	116	6.70 MI W OF SH 6	BRAZOS RI *	6.140
12	114	11	117	6.70 MI W OF SH 6	BRAZOS RI *	6.140
12	89	9	200	4.00 MI W OF SH 36	COON CRK	6.155
12	177	14	45	2.2 MI N OF HARRIS C/L	BEN'S BRANCH	6.156
12	3256	1	156	S OF BW8 & SWF INTER.	KEEGAN'S BAYOU	6.157
12	3256	1	140	1.1 MI N OF BRIAR FOREST	BUFFALO BAYOU	6.164
12	110	4	123	0.2 MI N OF HARRIS C/L	SPRING CREEK RELIEF	6.164
12	523	4	10	2.60 MI E OF FM 362	THREE MILE CRK	6.166
12	2523	2	10	3.30 MI NE OF FM 2917	HALLS BAYOU	6.192
12	1416	3	10	9.1 MI S OF SH 105	MILL CREEK	6.206
12	271	7	424	FROM IH 10 TO ALLEN PKWY	IH10EB,SP RR,BUF BYU,ETC	6.217
12	720	2	41	1.2 MI N OF FM 1774	MILL CREEK RELIEF	6.234
12	50	4	100	5.00 MI N OF US 290	DONAHOE CRK	6.238
12	27	13	199	.5MI.S.OF BLTWY 8	KEEGAN'S BAYOU	6.273
12	543	1	28	1.00 MI NW OF SH 6	PONDS CRK	6.274
12	543	1	29	1.00 MI NW OF SH 6	PONDS CRK	6.274
12	110	4	124	0.2 MI N OF HARRIS C/L	SPRING CREEK RELIEF	6.276
12	1684	1	4	3.20 MI N OF SH 6	MUSTANG BAYOU	6.278
12	3048	1	4	5.45 MI NE OF FM 361	DRY CRK	6.278

District	Control	Section	Number	Location	Crosses	Score
12	3256	1	155	S OF BW8 & SWF INTER.	KEEGAN'S BAYOU	6.291
12	523	4	22	3.95 MI E OF FM 362	BRUSHY CRK	6.300
12	523	4	23	6.45 MI E OF FM 362	WALNUT CRK	6.300
12	543	1	27	2.95 MI N OF FM 529	IRONS CRK	6.300
12	110	4	119	AT HARRIS C/L	SPRING CRK	6.332
12	110	4	120	AT HARRIS C/L	SPRING CRK	6.332
12	110	4	122	0.2 MI N OF HARRIS C/L	SPRING CREEK RELIEF	6.342
12	110	4	125	0.2 MI N OF HARRIS C/L	SPRING CREEK RELIEF	6.342
12	523	4	24	6.80 MI E OF FM 362	BIRCH CRK	6.347
12	2523	2	7	4.45 MI NE OF FM 523	AUSTIN BAYOU	6.370
12	543	1	21	1.90 MI S OF IH 10	BROOKSHIRE CRK	6.371
12	2483	1	42	0.30 MI N OF FM 1960	CYPRESS CREEK	6.374
12	27	13	198	.5MI.S.OF BLTWY 8	KEEGAN'S BAYOU	6.407
12	2483	1	43	0.30 MI N OF FM 1960	CYPRESS CREEK	6.440
12	110	4	118	AT HARRIS C/L	SPRING CRK	6.464
12	1745	1	1	4.40 MI S OF FM 3346	CLEAR CRK	6.513
12	3445	1	3	1.40 MI E OF FM 1887	CLEAR CRK	6.524
12	2483	1	46	0.40 MI N OF FM 1960	CYPRESS CREEK REL.	6.587
12	977	1	1	0.40 MI E OF FM 1459	SAN BERNARD RIVER	6.588
12	389	12	66	1.0 MI E OF SH 146	GOOSE CREEK	6.613
12	178	1	59	2 MI S OF IH 45	SIMS BAYOU	6.634
12	178	1	60	2 MI S OF IH 45	SIMS BAYOU	6.634
12	2483	1	47	0.40 MI N OF FM 1960	CYPRESS CREEK REL.	6.653
12	543	1	30	2.00 MI S OF FM 3346	THREE MILE CRK	6.672
12	543	3	22	2.05 MI E OF FM 1994	BIG CRK	6.678
12	944	2	9	1.90 MI S OF FM 2979	THREE MILE CRK	6.704
12	28	2	187	AT SAN JAC RIVER	SAN JACINTO RIVER	6.715
12	28	2	188	AT SAN JACINTO RIVER	SAN JACINTO RIVER	6.715
12	114	11	157	0.45 MI W OF FM 1488	CLEAR CRK	6.723
12	1062	2	13	3.20 MI N OF FM 1960	LUCE BYU	6.724
12	114	11	158	0.45 MI W OF FM 1488	CLEAR CRK	6.770
12	527	2	17	2.60 MI N OF IH 10	BRAZOS RI	6.842

District	Control	Section	Number	Location	Crosses	Score
13	88	4	16	4.34 MI S OF US 77	BOGGY CRK	4.538
13	266	6	36	0.25 MI NW OF FM 653	TRES PALACIOS RIVER	4.710
13	89	15	25	0.90 MI S OF SH 71	TRES PALACIOS RIVER	4.762
13	153	2	7	2.55 MI SE OF FM 1586	CANOE CRK	4.991
13	153	2	4	0.30 MI SE OF FM 1586	ARTESIA CRK	5.077
13	515	1	17	AT JACKSON - VICTORIA C/L	GARCITAS CRK	5.086
13	89	7	30	1.70 MI SW OF FM 961	BOSQUE SLOUGH	5.098
13	535	7	75	3.90 MI E OF FM 2238	WEST NAVIDAD RIVER	5.125
13	153	2	10	5.85 MI SE OF FM 1586	SMITH CRK	5.164
13	1302	1	7	2.20 MI W OF SH 71	DRAINAGE CANAL	5.209
13	187	3	6	0.75 MI S OF FM 949	DEADMAN CRK	5.219
13	269	5	19	0.70 MI SW OF SH 111	BIG BRUSHY CRK RELIEF	5.255
13	324	3	7	0.08 MI S OF FM 966	ROCKY CRK	5.265
13	2348	2	2	1.80 MI S OF FM 155	WILLIAMS CREEK	5.270
13	535	7	76	3.90 MI E OF FM 2238	WEST NAVIDAD RIVER	5.284
13	269	3	8	0.50 MI SW OF FM 340	SPRING BR	5.293
13	324	3	6	0.30 MI NE OF US 90A	BOGGY CRK	5.333
13	269	2	7	0.85 MI W OF FM 530	LAVACA RI	5.365
13	143	8	18	0.82 MI S OF FM 240	THOMAS CREEK	5.389
13	154	1	3	0.78 MI S OF SH 97	CROSS TIMBERS CRK	5.389
13	266	4	29	0.85 MI S OF US 90A	DRY CREEK	5.403
13	1007	1	21	3.20 MI E OF SH 95	NORTH FORK OF LAVACA RIV	5.411
13	265	14	1	0.61 MI E OF SH 159	CEDAR CREEK	5.446
13	270	10	31	0.48 MI W OF US 87	GOHLKE CREEK	5.450
13	271	2	207	6.55 MI W OF SH 36	CROOKED BRANCH	5.457
13	287	3	16	0.53 MI S OF US 90A	GUADALUPE RI	5.467
13	846	3	9	4.20 MI SW OF SH 60	COLORADO RIVER	5.494
13	267	1	3	0.54 MI S OF FM 1457	CUMMINS CREEK	5.558
13	324	3	9	2.74 MI S OF FM 966	NORTH FORK MUSTANG CRK	5.558
13	840	2	6	2.40 MI S OF FM 1447	BEAR CRK	5.567
13	271	2	208	6.55 MI W OF SH 36	CROOKED BRANCH	5.569
13	2516	1	3	6.37 MI S OF US 59	GARCITAS CRK	5.572
13	807	3	8	0.15 MI E OF BASTROP C/L	BIG PIN OAK CREEK	5.578
13	1696	1	2	2.80 MI NE OF SH 111	KELLEY CRK	5.592
13	270	2	10	1.37 MI E OF KARNES C/L	CABEZA CREEK	5.602
13	267	6	25	1.65 MI S OF FAYETTE C/L	BIG ROCKY CRK	5.611
13	840	2	4	1.50 MI SW OF LAVACA C/L	TONQUA CRK	5.612
13	838	1	18	3.60 MI NE OF FM 1301	BEE TREE BAYOU	5.649
13	535	4	143	2.00 MI E OF SH 304	SANDY FORK CRK	5.657
13	535	4	144	2.00 MI E OF SH 304	SANDY FORK CRK	5.657
13	89	5	19	1.31 MI S OF WHARTON C/L	MUSTANG CREEK	5.685
13	1113	2	4	11.91 MI E OF US 183	LITTLE BRUSHY CRK	5.690
13	497	2	5	2.55 MI E OF FM 234	LAVACA RIVER	5.701
13	1307	1	5	2.66 MI E OF SH 172	MUSTANG CRK	5.711
13	1696	1	1	0.75 MI NE OF SH 111	SUPPLEJACK CRK	5.726
13	840	2	7	3.96 MI S OF FM 1447	HOG BRANCH	5.744
13	370	4	32	8.34 MI S OF FM 682	GARCITAS CRK	5.746

District	Control	Section	Number	Location	Crosses	Score
13	89	7	130	0.70 MI S OF FM 102	COLORADO RIVER N RELIEF	5.750
13	89	7	131	0.70 MI S OF FM 102	COLORADO RIVER N RELIEF	5.750
13	846	3	7	1.00 MI W OF FM 2668	COLORADO RIVER RELIEF	5.761
13	187	3	8	2.90 MI S OF FM 331	BULLINGER CRK	5.772
13	180	1	33	1.30 MI NE OF FM 2433	LITTLE CHOCOLATE BYU	5.772
13	89	1	3	1.70 MI SW OF JCT FM 444	GARCITAS CRK	5.775
13	271	2	206	6.55 MI W OF SH 36	CROOKED BRANCH	5.792
13	267	1	2	2.98 MI S OF LP 458	DRAW	5.802
13	446	5	34	0.50 MI E OF FM 2764	MIDDLE BERNARD CREEK	5.806
13	2350	1	1	0.92 MI E OF US 87	SPRING CRK	5.811
13	143	8	20	1.02 MI S OF FM 953	DEER CREEK	5.816
13	89	5	152	1.33 MI S OF WHARTON C/L	MUSTANG CREEK	5.819
13	89	1	146	1.91 MI S OF FM 444	GARCITAS CRK	5.819
13	89	1	147	1.92 MI S OF FM 444	GARCITAS CRK	5.819
13	420	10	7	1.75 MI W OF FM 1160	PORTERS CREEK	5.846
13	89	7	126	1.25 MI S OF FM 102	COLORADO RIVER S RELIEF	5.884
13	89	7	127	1.25 MI S OF FM 102	COLORADO RIVER S RELIEF	5.884
13	269	5	18	0.45 MI SW OF SH 111	BIG BRUSHY CRK	5.885
13	846	3	6	2.35 MI SW OF FM 2668	LAWSONS SLOUGH	5.898
13	2320	1	2	2.05 MI S OF SH 36	MILL CRK	5.920
13	420	10	10	0.45 MI E OF JACKSON C/L	GOLDENROD CREEK	5.926
13	88	5	46	3.30 MI SW OF FM 404	GUADALUPE WEST REL#1	5.931
13	1410	1	7	1.85 MI N OF SH 36	PINEY CRK	5.945
13	839	2	5	0.78 MI S OF GONZALES C/L	DRAW	5.945
13	89	7	128	0.85 MI S OF FM 102	COLORADO RIVER	5.968
13	897	2	5	0.40 MI E OF SH 71	COLORADO RIVER	5.975
13	240	1	8	2.50 MI SW OF SH 36	SAN BERNARD RI	5.986
13	271	2	48	6.80 MI W OF SH 36	CROOKED BRANCH	5.991
13	269	3	9	0.82 MI SW OF FM 340	SMOTHERS CRK	5.991
13	89	7	129	0.85 MI S OF FM 102	COLORADO RIVER	6.033
13	497	1	22	1.75 MI E OF JACKSON C/L	EAST CARANCAHUA CRK	6.052
13	1412	3	17	0.50 MI SE OF FM 1096	CANEY CREEK	6.053
13	324	2	2	0.70 MI S OF FM 532	W PRONG LAVACA RI	6.073
13	88	4	19	0.67 MI S OF FM 1685	GUADALUPE RIVER REL #1	6.079
13	371	1	48	1.30 MI S OF LP 175	COLETO CRK	6.080
13	88	5	49	2.10 MI SW OF FM 404	GUADALUPE RIVER	6.093
13	1265	1	5	1.70 MI S OF US 290	CUMMINS CREEK	6.098
13	88	4	70	1.10 MI S OF US 87	GUADALUPE RIVER	6.100
13	1442	3	6	0.10 MI E OF IH 10	DRAW	6.116
13	144	5	42	5.77 MI S OF FM 1289	WEST COLOMA CR	6.120
13	573	3	6	0.30 MI S OF US 90	SANDY FORK	6.123
13	155	1	17	1.57 MI S OF FM 237	15 MILE COLETO CRK	6.157
13	1132	1	6	1.87 MI S OF US 87	CHOCOLATE BYU	6.159
13	265	7	90	1.30 MI E OF BASTROP C/L	BARTONS CREEK	6.170
13	155	1	15	9.21 MI S OF FM 2718	12 MILE COLETO CRK	6.171
13	324	2	1	0.40 MI N OF FM 532	LAVACA RI	6.177
13	324	2	3	1.10 MI S OF FM 532	KUEHNS CRK	6.177

District	Control	Section	Number	Location	Crosses	Score
13	269	2	31	3.7 MI N OF FM 532W	WEST NAVIDAD RI	6.180
13	267	1	1	2.31 MI S OF LP 458	BRANCH ROCKY CREEK	6.182
13	269	2	4	1.60 MI S OF FM 532	MIXON CRK	6.184
13	269	3	11	2.10 MI SW OF US 90A	ROCKY CRK	6.192
13	268	1	8	0.70 MI S OF SH 71	COLORADO RIVER	6.197
13	840	2	13	0.85 MI S OF FM 1447	LITTLE BRUSHY CRK	6.199
13	716	2	17	5.10 MI S OF FM 1291	REDGATE CREEK	6.232
13	1307	2	7	5.79 MI S OF SH 111	CARANCAHUA CRK	6.250
13	1441	1	1	1.21 MI E OF SH 237	ROCKY CREEK	6.268
13	346	2	38	0.1 MI W OF MATAGORDA CO	E.CARANCAHUA CREEK REL.	6.297
13	241	4	9	0.70 MI S OF FM 521	BIG BOGGY CREEK	6.297
13	515	4	9	0.70 MI W OF FM 2437	NAVIDAD RI	6.322
13	346	2	37	0.3 MI W OF MATAGORDA CO	E CARANCAHUA CRK	6.344
13	841	1	8	1.80 MI W OF LP 175	COLETO CRK	6.350
13	346	6	23	1.90 MI E OF US 77	BRUSHY CRK	6.357
13	445	2	16	2.39 MI E OF FM 531	PONTON CRK	6.371
13	143	8	19	1.79 MI S OF FM 2816	CLEAR CREEK	6.374
13	371	1	51	1.30 MI S OF LP 175	COLETO CRK	6.382
13	89	13	23	0.15 MI N OF FM 1160	EAST MUSTANG CREEK	6.469
13	446	1	24	0.53 MI E OF FM 3283	SANDY BR	6.493
13	2349	2	1	0.07 MI S OF COLORADO C/L	SANDY CRK	6.503
13	515	1	5	2.8 MI SW OF FM 234	VENADO CREEK	6.505
13	446	3	33	3.05 MI E OF SH 71	COLORADO RIVER	6.522
13	370	1	14	1.42 MI S OF FM 531	CLARKS CRK	6.522
13	346	6	25	7.30 MI E OF US 77	LAVACA RI	6.535
13	154	1	1	0.80 MI N OF SH 97	GUADALUPE RI *	6.538
13	446	1	25	2.70 MI E OF FM 3283	CROOKED CRK	6.540
13	88	5	50	2.10 MI SW OF FM 404	GUADALUPE RIVER	6.561
13	497	3	14	3.21 MI E OF SH 172	WEST CARANCAHUA CRK	6.601
13	842	2	12	2.98 MI W OF US 87	GUADALUPE RIVER	6.677
13	2600	1	2	6.68 MI S OF FM 530	GRAFE BR	6.768
13	2513	1	1	0.73 MI E OF FM 240	ANDERSON CREEK	6.790
13	143	10	81	7.75 MI S OF FM 447	SPRING CRK	6.894
13	1696	2	5	2.50 MI SW OF US 77	ROCKY CRK	6.914
13	265	8	92	1.10 MI W OF US 77	COLORADO RIVER	6.941

District	Control	Section	Number	Location	Crosses	Score
14	113	1	30	2.3 MI E OF INT US 87	BARON'S CREEK	5.263
14	112	3	13	3.1 MI W OF INT US 87	LIVE OAK CREEK	5.396
14	535	3	126	4.0 MI E OF GUADALUPE CO	PLUM CREEK	5.435
14	114	2	76	3.1 MI W OF FM 3177	WALNUT CREEK	5.464
14	114	7	84	6 MI E OF FM 141	DRAW	5.517
14	114	7	83	5.7 MI E OF FM 141	CUMMINGS CREEK	5.582
14	29	3	26	3.2 MI E OF JCT 183	PLUM CREEK	5.585
14	114	3	59	1.7 MI W BASTROP CO LINE	BIG DRY CREEK	5.619
14	1200	3	15	3.9 MI S OF FM 969	COLORADO RIVER	5.630
14	1898	1	1	1 MI W. OF SH 80	SAN MARCOS RIVER	5.660
14	151	9	40	.7 MI N OF FM969	LITTLE WALNUT CREEK	5.688
14	320	3	42	13.7 MI N OF JCT SH 79	LONG BRANCH	5.747
14	114	2	106	2.8 MI W OF FM 3177	DRAW & PROPOSED MO-KAN	5.801
14	72	1	2	3.5 MI S. OF US 290	PEDERNALES RIVER	5.807
14	29	3	13	3.2 MI E OF JCT US 183	PLUM CREEK	5.885
14	1186	1	15	0.6 MI E OF US 183	WALNUT CREEK	5.920
14	320	3	39	5.8 MI N OF JCT SH 79	PECAN BRANCH	5.927
14	334	5	39	4.9 MI N US 290	NAILS CREEK	5.986
14	151	9	42	1.7 MI S OF FM-969	BOGGY CREEK & MKT RR	6.021
14	151	9	43	1.7 MI S OF FM-969	BOGGY CREEK & MKT RR	6.021
14	1434	3	2	2.5 MI W OF SH 80	SAN MARCOS RIVER	6.082
14	535	3	125	4.0 MI E OF GUADALUPE CO	PLUM CREEK	6.160
14	151	9	39	.7 MI N OF FM969	LITTLE WALNUT CREEK	6.178
14	287	1	14	1.0 MI S OF JCT US 90	SAN MARCOS RIVER	6.187
14	265	13	43	1.4 MI FROM SH-71	COLORADO RIVER	6.203
14	334	1	26	10.4 MI E SH 95	WEST BRUSHY CREEK RELIEF	6.302
14	334	1	27	10.9 MI E SH 95	EAST BRUSHY CREEK RELIEF	6.302
14	986	1	2	1.6 MI S FM 112	MUSTANG CREEK RELIEF	6.342
14	29	3	9	3.4 MI W OF JCT US 183	SAN MARCOS RIVER	6.388
14	265	4	52	.9 MI W OF JCT SH 95	COLORADO RIVER	6.436
14	211	2	32	16.4 MI S OF JCT INT SH 2	ALLEN CREEK	6.463
14	1200	4	7	5.7 MI N OF INT SPUR 277	LITTLE BRUSHY CREEK	6.469
14	265	5	13	6.0 MI E OF SH-95	ALUM CREEK	6.507
14	3131	4	1	10.0 MI N JCT LOOP 308	LAMPASAS RIVER	6.567
14	320	4	73	3.7-MI-S-OF-INT-US-79	MUSTANG CREEK	6.596
14	1060	1	11	2.1 MI SW US 183	WEST FORK PLUM CREEK	6.719
14	1200	5	23	1.6 MI N OF INTER US 183	SOUTH FORK DRY CREEK	6.771
14	334	1	49	10.6-MI-E-SH-95	BRUSHY CREEK	6.920

District	Control	Section	Number	Location	Crosses	Score
15	2104	2	8	0.12 ML S OF FM 471	CULEBRA CREEK	4.786
15	17	3	50	4.70 MI N OF ATASCOSA C/L	ELM CREEK	5.048
15	369	3	3	4.2 MI S OF US 90 JCT	RANCHERO CREEK	5.058
15	2442	2	1	GUADALUPE & BEXAR CO LINE	CIBOLO CREEK	5.220
15	17	2	46	1.75 MI S OF IH 410	MEDIO CREEK	5.276
15	521	4	250	0.5 MI NE OF MILITARY DR	LEON CREEK	5.336
15	17	10	83	0.02 MI W OF IH 35	ALAZAN CREEK	5.513
15	535	2	131	4.30 MI E OF FM 1104	SMITH CREEK	5.630
15	253	6	29	1.1 MI SO OF IH 10	SAN ANTONIO RIVER	5.703
15	291	10	68	2.85 MI N OF IH 410	LEON CREEK	5.715
15	143	1	56	1.2 MI FR BEG CON 143-1	SALADO CREEK	5.727
15	291	10	69	1.00 MI N 0F IH 410	HUEBNER CREEK	5.737
15	143	1	55	0.3 MI FROM IH 410	ROSILLO CR	5.764
15	17	2	270	1.40 MI S OF IH 410	MEDIO CREEK	5.765
15	253	3	6	COMAL-BEXAR CL	CIBOLO CREEK	5.825
15	253	4	9	7.3 MI FROM COMAL C L	MUD CREEK	5.861
15	17	1	45	7.3 MI FR BEG CON 17-1	INDIAN CREEK	5.896
15	253	6	30	1.3 MI SO OF LOOP 13	SIX MILE CREEK	5.939
15	17	3	103	4.65 MI N OF ATASCOSA C/L	ELM CREEK	5.956
15	72	14	22	0.3 MI S OF SH 46	MENGER CREEK	5.979
15	73	2	4	@ MEDINA RIVER	MEDINA RIVER	5.990
15	17	2	271	1.40 MI S OF IH 410	MEDIO CREEK	5.993
15	72	14	21	0.1 MI S OF SH46	CIBILO CREEK	6.026
15	17	3	278	4.60 MI N OF ATASCOSA C/L	ELM CREEK	6.027
15	535	2	133	4.30 MI E OF FM 1104	SMITH CREEK	6.034
15	17	1	44	6.2 MI FR BEG CON 17-1	LEON CREEK RELIEF	6.055
15	253	3	19	6.0 MI S OF BLANCO CL	GUADALUPE RIVER	6.066
15	73	8	122	AT SAN ANTONIO RIVER	SAN ANTONIO RIVER	6.090
15	73	8	149	AT SAN ANTONIO RIVER	SAN ANTONIO RIVER	6.090
15	17	2	100	1.75 MI S OF IH 410	MEDIO CREEK	6.090
15	17	9	111	5.10 MI S OF LP 13	LEON CR/CASSIN RD	6.090
15	72	2	7	1.06 MI FROM GILLESPIE C/	BEAR CREEK	6.097
15	535	2	134	4.30 MI E OF FM 1104	SMITH CREEK	6.114
15	72	8	29	0.65 MI N OF LP 1604	LEON CREEK	6.126
15	253	4	56	0.72 MI S OF BITTERS RD	SALADO CRK.	6.156
15	535	2	132	4.30 MI E OF FM 1104	SMITH CREEK	6.168
15	25	2	310	1.1 MI E OF IH 37	SP 536 & SAN ANTONIO RI	6.204
15	25	2	311	1.1 MI E OF IH 37	SP 536 & SAN ANTONIO RI	6.204
15	72	10	14	3 MI S OF HOLIDAY INTR.	BIG JOSHUA CR.	6.245
15	25	2	151	0.6 MI E OF IH 35	SAN PEDRO CREEK	6.250
15	291	10	87	1.00 MI N OF IH 410	HUEBNER CREEK	6.257
15	291	9	32	1.10 MI E OF MEDINA C L	HABEY CREEK	6.262
15	287	2	15	0.50 MI S OF CALDWELL C/L	LOW SMITH CRK	6.270
15	16	4	86	9.6 MI FROM HAYS CL	GUADALUPE RIVER *	6.270
15	73	2	27	@ MEDINA RIVER	MEDINA RIVER	6.273
15	291	2	1	1 MI FROM GILLESPIE C/L	DRAW	6.275
15	16	4	145	.8 MI FROM HAYS CL	YORK CREEK	6.285

District	Control	Section	Number	Location	Crosses	Score
15	73	8	259	0.1 MI S OF JONES MALTSBE	DRAIN	6.288
15	73	2	5	0.8 MI SO OF MEDINA R	PALO BLANCO CRK	6.316
15	16	4	87	9.6 MI FROM HAYS CL	GUADALUPE RIVER *	6.317
15	24	7	149	@ MEDIO CREEK	MEDIO CREEK	6.334
15	17	9	112	5.10 MI S OF LP 13	LEON CR/ CASSIN RD	6.336
15	521	5	126	0.83 MI W OF SH 16	LEON CREEK	6.336
15	521	5	127	0.90 MI W OF SH 16	LEON CREEK	6.336
15	72	6	133	19.39 MI FROM KERR C/L	FREDERICKS CREEK	6.346
15	291	10	86	0.50 MI N OF FM 1571	LEON CREEK	6.347
15	24	8	129	@ LEON CREEK	LEON CREEK	6.349
15	24	8	130	@ LEON CREEK	LEON CREEK	6.349
15	521	5	257	0.6 MI W OF SH 16	LEON CREEK	6.351
15	24	7	151	@ MEDIO CREEK	MEDIO CREEK	6.358
15	24	7	152	@ MEDIO CREEK	MEDIO CREEK	6.358
15	366	3	13	4.20 MI S OF US 90A	COTTONWOOD CREEK	6.366
15	613	1	8	2.80 MI S OF IH 410	LEON CREEK	6.379
15	24	7	150	@ MEDIO CREEK	MEDIO CREEK	6.381
15	25	9	55	10.7 MI EAST OF IH 410	DRAW	6.388
15	142	12	140	2.5 MI W OF GILLESPIE CL	FESSENDEN BRANCH CREEK	6.393
15	142	2	152	0.9 SO OF KIMBLE CO LINE	NO NAME CREEK	6.412
15	16	6	194	BEXAR/GUADALUPE C/L	CIBOLO CREEK	6.419
15	369	1	1	0.8 MI E OF US 83 JCT	FRIO RIVER	6.435
15	142	14	89	13.3 MI SE OF SH 16	NO NAME CRK & CO ROAD	6.447
15	142	14	90	13.3 MI SE OF SH 16	NO NAME CRK, COUNTY RD	6.447
15	72	5	165	11.03 MI FROM KERR C/L	LITTLE JOSHUA CR & FM289	6.458
15	72	5	166	11.04 MI FROM KERR C/L	LITTLE JOSHUA CR & FM289	6.458
15	987	2	4	2.5 MI WEST OF SH 123	ALLIGATOR CRK	6.467
15	17	3	277	4.65 MI N OF ATASCOSA C/L	ELM CREEK	6.485
15	521	5	258	0.6 MI W OF SH 16	LEON CREEK	6.485
15	72	5	173	2.98 MI FROM KERR C/L	GUADALUPE RIVER & FM 473*	6.503
15	72	5	176	5.69 MI FROM KERR C/L	HOLIDAY CREEK	6.505
15	17	11	89	1.8 MI FROM IH 35	SAN ANTONIO RIVER	6.515
15	142	12	139	2.5 MI W OF GILLESPIE CL	FESSENDEN BRANCH CREEK	6.535
15	142	14	76	6.3 MI SE OF SH 16	N FRK CYPRESS CRK, LOCAL	6.559
15	142	14	78	7.6 MI EAST OF SH 16	EAST FORK CYPRESS CREEK	6.559
15	142	14	79	7.7 MI SE OF SH 16	E FORK CYPRESS CREEK	6.559
15	216	1	24	0.9 MI N OF IH 35	DRY COMAL CREEK	6.562
15	142	9	49	0.02 MI W OF FM 1376	SISTER CREEK	6.575
15	142	2	151	0.9 S KIMBLE COUNTY LINE	NO NAME CREEK	6.578
15	142	14	119	400 FT NORTH OF FM 1338	GOAT CREEK	6.622
15	72	5	125	0.03 MI S OF RANGER RD	CIBOLO CREEK	6.625
15	253	4	50	0.8 MI NO. OF F.M.1604 AT	MUD CREEK	6.627
15	25	9	139	7.5 MI EAST OF IH 410	SALATRILLO CR. BR.	6.634
15	72	6	132	19.39 MI FROM KERR C/L	FREDERICKS CREEK	6.639
15	2230	1	7	4.95 MI N OF FM 471	HELOTES CREEK	6.641
15	142	14	112	0.1 MI SE OF FM 783	TOWN CREEK	6.669
15	72	5	177	5.73 MI FROM KERR C/L	HOLIDAY CREEK	6.671

District	Control	Section	Number	Location	Crosses	Score
15	72	5	178	5.75 MI FROM KERR C/L	HOLIDAY CRK	6.671
15	253	3	47	6.0 MI S OF BLANCO CL	GUADALUPE RIVER	6.672
15	16	6	192	BEXAR & GUADALUPE C/L	CIBOLO CREEK & FM 1518	6.673
15	16	6	193	BEXAR & GUADALUPE C/L	CIBOLO CREEK & FM 1518	6.673
15	1730	1	1	3.98 MI S OF SH 16	RED BLUFF CREEK	6.678
15	421	5	38	0.1 MI N OF FM 48O	VERDE CREEK	6.682
15	142	12	146	0.2 MI EAST OF FM 479	WEST DRY BRANCH CREEK	6.688
15	253	3	51	AT COMAL/BEXAR C/L	CIBOLO CREEK	6.717
15	142	12	145	.2 MI EAST OF FM 479	W. DRY BRANCH CREEK	6.740
15	421	7	21	2.21 MI S OF SH 16	JULIAN CREEK	6.748
15	421	8	27	4.65 MI FROM BANDERA CL	MIDDLE VERDE CREEK	6.748
15	421	5	37	5.2 MI N OF FM 48O	TURTLE CREEK	6.753
15	421	7	39	0.15 MI SE SH 16	MEDINA RIVER	6.758
15	291	8	109	3.2 MI S OF BANDERA C/L	SAN GERONIMO CREEK	6.777
15	855	1	17	0.22 MI SO OF SH 27	GUADALUPE RIVER	6.790
15	193	2	8	6.2 MI WEST OF SH 27	S FRK GUADALUPE RIV	6.806
15	142	9	156	13.09 MI E OF US 87	EAST SISTER CREEK	6.810
15	291	8	110	3.2 MI S OF BANDERA C/L	SAN GERONIMO CREEK	6.824
15	142	14	122	0.1 MI NORTH OF FM 1338	GOAT CREEK	6.857
15	291	10	78	2.50 MI N OF LP 1604	HELOTES CREEK	6.863
15	291	10	79	2.50 MI N OF LP 1604	HELOTES CREEK	6.863
15	1135	3	6	0.56 MI FROM SH 16	QUINLAN CREEK	6.887
15	291	5	122	0.55 MI W OF FM 470	MEDINA RIVER	6.890
15	855	1	14	2.0 MI SO OF SH 27	VERDE CREEK	6.903
15	1544	1	3	4.1 MI NO OF SH 27	GOAT CREEK	6.903
15	25	10	56	1.6 MI EAST OF BEXAR CO L	DIETZ CREEK	6.904
15	1042	3	5	2.10 MI NE OF SH 16	RED BLUFF CREEK	6.924
15	25	10	57	3.2 MI EAST OF BEXAR CO L	TOWN CREEK	6.954
15	829	4	2	10.9 MI SO OF SH 41	N FRK GUADALUPE RIV	6.993
15	193	2	11	0.8 MI FROM SH 27	JOHNSON CREEK	6.993
15	2519	1	1	0.57 MI E OF US 87	HOLIDAY CREEK	7.022
15	291	5	99	0.6 MI S OF FM 2828	MEDINA RIVER	7.024
15	3212	3	2	2.83 MI SW OF FM 473	CURRY CREEK	7.036
15	142	9	149	1.5 MI E OF US 87	FLAT ROCK CREEK	7.037
15	1899	1	6	0.82 MI S OF FM 473	GUADALUPE RIVER *	7.056
15	1899	2	3	6.93 MI N OF FM 473	PLATTEN CREEK	7.056
15	25	10	93	.2 MI EAST OF FM 725	GUADALUPE RIVER	7.059
15	848	4	24	4.52 MI FROM BANDERA C L	HONDO CREEK NO 2	7.122
15	3212	3	1	1.03 MI SW OF FM 473	RAWLS CREEK	7.148
15	25	10	58	6.3 MI EAST OF BEXAR CO L	BRANCH SANTA CLARA CREEK	7.151
15	25	10	59	7.7 MI EAST OF BEXAR CO L	BRANCH SANTA CLARA CREEK	7.151
15	3212	3	3	6.9 MI SW OF FM 473	GUADALUPE RIVER	7.243
15	855	4	19	0.05 MI E OF FM 187	SABINAL RIVER	7.311
15	829	4	4	6.8 MI SO OF SH 41	N. FORK GUADALUPE RIVER	7.330
15	829	4	6	5 MI SO OF SH 41	N FORK GUADALUPE RIV	7.377

District	Control	Section	Number	Location	Crosses	Score
16	254	3	22	2.80 MI S OF FM 624	AGUA DULCE CREEK	5.720
16	88	2	6	1.5 NE OF BLANCO CREEK	MILLERS CREEK	5.808
16	102	3	54	0.50 MI S OF FM 70	BISHOP CHANNEL	5.884
16	87	1	5	1.00 MI N OF FM 2044	PALO HUECO CRK	5.920
16	254	1	47	11.03MI FR US281 AND SH9	SALT BRANCH	5.950
16	155	4	7	1.3 MI S OF US 59	SAN ANTONIO RIVER	5.993
16	516	1	2	7.2 MI SE OF SH 72	COTTONWOOD CREEK	6.073
16	74	4	118	0.5 MI S OF SH 188	ARROYO NOMBRE DE DIOS	6.125
16	1088	4	6	12.38 MI S OF US 77	DRAW	6.231
16	1122	2	9	0.1 MI NE OF US 181	MARCELINA CREEK	6.235
16	100	6	69	0.4 MI N OF SH 72	ESCONDIDO CREEK	6.257
16	74	4	120	0.5 MI S OF SH 188	ARROYO NOMBRE DE DIOS	6.324
16	3339	1	2	1.40 MI E OF US 281	RESACA DE ENMEDIO	6.344
16	74	2	141	6.287MI NO SAN PAT. CO LI	WEATHERSBY HOLLOW	6.346
16	1196	3	8	5.4 MI W OF SH 119	MANAHUILLA CREEK	6.364
16	1551	1	3	3.4 MI N OF US 59	MUD CREEK	6.364
16	74	4	119	0.5 MI SO OF SH 188	ARROYO NOMBRE DE DIOS	6.401
16	1196	2	7	2.0 MI N OF FM 1961	HOOSIER CREEK	6.431
16	371	4	91	0.70 MI N OF SH 188	CHILTIPIN CREEK	6.442
16	1808	2	2	2.02MI FROM LAGARTO TOWNS	BARBONE HOLLOW	6.473
16	73	7	224	0.3 MI S OF FM 99	SALT BRANCH	6.488
16	2373	5	7	4.00 MI W OF US 281	LAGARTO CREEK	6.517
16	1088	4	5	11.17 MI S OF US 77	PETRONILA CREEK	6.655
16	990	2	1	5.60 MI E OF US 281	SAN FERNANDO CREEK	6.661
16	86	19	31	0.50 MI W OF FM 1930	SAN FERNANDO CREEK	6.682
16	1052	2	20	2.93 MI E OF US 77	PETRONILA CREEK	6.719
16	87	2	12	6.5 MI N OF FM 624	WADE CREEK	6.786
16	359	2	16	4.8 MI NW OF US 183	18 MILE COLETO CREEK	6.788
16	254	1	1	4.737MI SO JCT SH 9	OLDS SLOUGH	6.814
16	1063	1	20	0.4 MI NW OF US 59	POESTA CREEK	6.840
16	2234	1	1	0.8 MI W OF SH 72	PANTHER CREEK	6.866
16	348	6	27	2.8 MI SW OF US 181	ESCONDIDO CREEK	6.993

District	Control	Section	Number	Location	Crosses	Score
17	315	3	27	1.9 MI. SOUTH JCT. SH90-F	WHITNEY BRANCH	4.812
17	459	1	1	1.5 MI.S.JCT.FM488-FM416	TEHUACANA SLOUGH	4.864
17	315	7	41	0.1 MI. WEST JCT. SH90-FM	NEW YEARS CREEK	4.950
17	122	3	36	0.5 MI.SO.JCT US287-FM488	ALLIGATOR CREEK	5.092
17	1299	1	3	4 MI. NORTH JCT. FM2447-F	RED GULLY	5.164
17	457	3	7	0.5 MI. NORTH JCT. FM50-F	PENN CREEK	5.171
17	459	1	2	1.0 MI.S.JCT.FM488-FM416	TEHUACANA CREEK	5.267
17	457	3	2	4.0 MI. SOUTH JCT. FM50-F	LITTLE ROCKY CREEK	5.275
17	2446	1	1	2 MI. EAST JCT. SH6-SH30	CARTER CREEK	5.346
17	117	4	58	0.3 MI. EAST JCT. US190-F	IRON CREEK	5.428
17	185	4	28	1.8 MI. NORTH JCT. US77-S	LITTLE RIVER *	5.513
17	212	3	6	0.1MI.W.JCT.FM158-FM1179	CARTERS CREEK	5.664
17	675	6	40	2 MILES SOUTH JCT. IH45-F	SO BEDIAS CREEK REL	5.664
17	49	6	63	0.6 MI. SOUTH JCT. FM2159	WALNUT CREEK	5.836
17	675	6	39	2 MILES SOUTH JCT. IH45-F	SO BEDIAS CREEK REL	5.845
17	212	3	13	0.5 MI.W.GRIMES CO.LINE	NAVASOTA RIVER REL.	5.929
17	1145	1	10	1 MILE SOUTH JCT. FM1511-	SERASCA CREEK	5.982
17	166	4	52	0.6 MI. SOUTH JCT. US75-F	BLISS CREEK	6.054
17	166	3	14	2.5 MI. N. JCT.US75-FM489	HOG CREEK	6.090
17	315	1	69	0.9 MI.NO. GRIMES CO.LINE	BEDIAS CREEK SLOUGH	6.129
17	212	4	7	0.7 MI. EAST JCT. SH30-FM	GIBBONS CREEK	6.133
17	166	2	12	1.1 MI. N.JCT.US75-FM2547	COTTONWOOD CREEK	6.186
17	475	2	87	1.9 MI.W.JCT. OSR - FM 46	CEDAR CREEK	6.216
17	2584	1	1	2 MILES EAST JCT. FM2621-	KUYKENDALL CREEK	6.231
17	166	6	26	1.5 MI. NORTH JCT. US75-F	MUSTANG CREEK	6.247
17	1404	2	5	3 MI. EAST JCT. FM1155-FM	JACKSON CREEK	6.257
17	262	7	31	2.8 MI. NORTH JCT. FM485-	NORTH ELM CREEK REL.	6.276
17	1399	1	6	3.5 MI EAST OF JCT FM1361	DAVIDSON CREEK REL.	6.303
17	1706	1	7	1 MI. NORTH JCT. FM1791-F	POLECAT BRANCH	6.317
17	643	4	25	3.0 MI. SOUTH JCT. FM244-	BULL CREEK	6.322
17	1223	1	11	0.5 MILE NORTH MADISON CO	COBBS CREEK	6.359
17	1416	4	15	1.4 MI. NORTH JCT. FM1486	LAKE CREEK	6.383
17	382	5	21	AT ROBERTSON-LEON CO. LIN	NAVASOTA RIVER	6.459
17	1416	4	14	1.3 MI. NORTH JCT. FM1486	LAKE CREEK RELIEF	6.477
17	166	7	60	3.0 MI. SOUTH JCT. US75-O	LARRISON CREEK	6.488
17	262	7	30	0.4 MI. SOUTH JCT. FM485-	COW CREEK	6.489
17	166	7	46	9.2 MI. SOUTH JCT. US75-U	NO. BEDIAS CREEK	6.496
17	2131	1	3	0.5 MI. SOUTH JCT. FM833-	CANEY CREEK	6.502
17	1960	1	7	4 MI. SO. JCT. FM389	MILL CREEK RELIEF	6.523
17	1145	2	13	1.5 MI. EAST JCT. FM1119-	KEECHI CREEK	6.525
17	166	7	47	9.6 MI. SOUTH JCT. US75-U	NO. BEDIAS CREEK	6.544
17	262	6	29	5.1 MI. EAST JCT. FM391-U	PIN OAK CREEK	6.558
17	1400	1	16	5 MILES SOUTH JCT. FM1774	HAYNIE CREEK	6.574
17	2236	1	1	1 MI. E.JCT.FM2038-FM1179	BOWMAN CREEK	6.603
17	1706	1	8	1.5 MILE SOUTH JCT. FM179	WEST SANDY CREEK	6.629
17	540	5	35	1.3MI. N. JCT.FM159-SH90	BIG SPRING CREEK	6.718

District	Control	Section	Number	Location	Crosses	Score
18	1451	2	9	3.35 MI SE OF SH 34	CHAMBERS CREEK	5.750
18	48	5	20	1.5 MI SW OF SH 34	HOG CREEK	5.934
18	568	1	34	2.30 MI E OF FM 667	CHAMBERS CREEK	6.157
18	1451	3	5	1.05 MI NW OF FM 2930	MILL CREEK	6.390
18	1663	3	5	0.50 MI W OF FM 1126	RUSH CREEK	6.402
18	1289	1	4	1.95 MI W OF IH 45	CUMMINGS CREEK	6.517
18	135	2	103	2.1 MI E OF FM 2478	WILSON CREEK	6.697
18	162	8	83	2.05 MI NW OF FM 709	RICHLAND CREEK	6.876
18	162	9	72	2.35 MI W OF FM 55	DRAW	6.876
18	48	5	19	0.5 MI S OF SH 34	HOUSTON CREEK	6.891

District	Control	Section	Number	Location	Crosses	Score
19	63	9	72	4.1 MI SOUTH OF FM1186	SABINE RIVER	5.202
19	246	2	7	1.5 MI WEST OF FM1970	IRONS BAYOU	5.266
19	640	1	4	0.7 MI SOUTH OF FM 2625	QUAPAW CREEK RELIEF	5.358
19	63	9	71	4.1 MI SOUTH OF FM1186	SABINE RIVER	5.470
19	610	3	137	1.8 MI EAST OF FM 1993	HORSE CREEK	5.475
19	843	8	7	2.1MI EAST OF US59	EIGHTMILE CREEK	5.587
19	221	5	30	1.4 MI NORTH OF FM 71	SULPHUR RIVER RELIEF	5.626
19	1385	1	6	5.0 MI SOUTH OF US 271	CLEAR CREEK	5.685
19	610	5	163	AT MORRIS C/L	SULPHER RIVER *	5.695
19	495	8	269	0.90 MI E OF LP 281	MASON CREEK	5.703
19	495	8	270	0.90 MI E OF LP 281	MASON CREEK	5.703
19	63	4	38	1.4 MI SOUTH OF FM2517	ELM CREEK	5.748
19	3041	3	2	2.4MI SOUTH OF FM2208	LITTLE CYPRESS BAYOU	5.759
19	247	1	16	1.2 MI W OF SABINE RIVER	LOG SLOUGH	5.782
19	248	2	2	1.50 MI S OF TITUS C/L	WALKERS CREEK	5.788
19	221	5	35	0.7 MI NORTH OF FM 1896	WHITE OAK CREEK REL	5.806
19	640	1	1	0.1 MI NORTH OF IH-20	EIGHTMILE CREEK	5.810
19	610	4	176	0.05 MI NE OF TITUS C/L	BEAR CRK	5.815
19	610	4	177	0.05 MI NE OF TITUS C/L	BEAR CREEK	5.815
19	610	4	178	0.40 MI NE OF TITUS C/L	WHITE OAK CREEK	5.815
19	610	4	179	0.40 MI NE OF TITUS C/L	WHITE OAK CREEK	5.815
19	248	4	32	2.75 MI SOUTH OF FM 2088	LITTLE CYPRESS REL	5.829
19	520	5	38	0.6 MI WEST OF FM 2263	LITTLE CYPRESS CR	5.831
19	221	5	34	1.2 MI NORTH OF FM 1896	WHITE OAK CREEK	5.837
19	520	5	37	0.85 MI WEST OF FM 2263	SLOUGH	5.878
19	1384	1	5	2.3 MI S OF FM 71	WHITE OAK CREEK	5.881
19	520	2	10	0.5 MI SOUTH OF FM 1002	BIG SANDY CR	5.881
19	63	4	36	1.2 MI NORTH OF FM2517	SIX MILE CR. REL	5.882
19	63	4	37	1.1 MI NORTH OF FM2517	SIX MILE CREEK	5.904
19	640	4	27	1.3 MILES EAST OF FM 726	CLEAR CREEK	5.908
19	392	2	14	3.4 MI SOUTH OF SH 154	GLADE CREEK	5.914
19	63	4	90	2.4 MI SOUTH OF FM 2517	MURVAUL CREEK RELIEF	5.916
19	640	1	3	0.5 MI SOUTH OF FM 2625	QUAPAW CREEK	5.920
19	221	5	33	2.4 MI SOUTH OF FM 71	BIG SLOUGH	5.940
19	393	3	25	2.0 MI. SOUTHEAST OF SH43	MARTINS CREEK	5.946
19	63	4	40	1.5 MI NORTH OF FM999	MURVAUL CREEK	5.972
19	63	4	91	1.5 MI NORTH OF FM 999	MURVAUL CREEK	5.985
19	393	3	27	3.7 MI. SOUTHEAST OF SH43	HOGANS CREEK	6.009
19	392	2	12	2.6 MI SOUTH OF SH 154	LITTLE CYPRESS CRK	6.033
19	392	1	38	0.30 MI S OF FM 250	BARNES CRK	6.039
19	63	3	75	0.9 MI. NORTH FM 124	MARTINS CREEK	6.051
19	3041	3	1	1.9MI SOUTH OF FM2208	LITTLE CYPRESS BYU REL	6.052
19	63	9	69	3.0 MI SOUTH OF FM1186	PINEY BRANCH	6.062
19	63	9	70	3.0 MI SOUTH OF FM1186	PINEY BRANCH	6.062
19	843	7	5	0.9MI EAST OF SH43	POTTERS CRK	6.102
19	222	4	47	3.60 MI SE OF SH 11	HUGHES CREEK	6.105
19	520	5	39	0.4 MI WEST OF FM 2263	LITTLE CYPRESS CR RELIEF	6.146

District	Control	Section	Number	Location	Crosses	Score
19	63	4	39	2.4 MI SOUTH OF FM2517	MURVAUL REL	6.153
19	495	9	220	0.3 MI WEST OF FM 31	EIGHTMILE CREEK	6.155
19	750	2	6	4.60 MI W OF US 259	BOGGY CREEK	6.164
19	732	1	1	1.1 MI NORTH OF US79	WALDROP CREEK	6.170
19	401	4	9	0.7 MI EAST OF FM 1795	KELSEY CRK	6.183
19	1894	1	5	4.2MI SOUTH OF SH315	MURVAUL BAYOU	6.189
19	3151	1	1	0.4 MI W LOUISIANA LINE	MILL CR.	6.193
19	394	1	17	1.8 MI S OF FM 1794	MARTIN CRK	6.194
19	495	9	221	0.3 MI. W. OF FM 31	EIGHTMILE CREEK	6.202
19	843	7	4	0.7MI EAST OF SH43	POTTERS CRK REL	6.214
19	222	4	45	4.30 MI SE OF SH 11	COWHORN CREEK	6.217
19	222	4	46	4.00 MI SE OF SH 11	VILLAGE CREEK	6.217
19	60	1	5	AT RED RIVER	RED RIVER	6.231
19	2239	1	3	4.5MI EAST OF FM699	SABINE RIV	6.237
19	428	2	4	2.5MI NORTH OF FM999	MURVAUL CRK	6.262
19	640	3	25	1.3 MI S OF FM 2088	CANEY CRK BR	6.281
19	2338	2	1	0.5MI SOUTH OF FM556	LILY CRK	6.304
19	402	2	32	0.15 MI EAST OF FM 726	CYPRESS CR REL 1	6.344
19	2239	1	1	3.4MI EAST OF FM699	SIX MILE CRK	6.357
19	2239	2	5	0.6MI EAST OF FM31	SOCAGEE CRK	6.374
19	218	2	46	WESTLAWN DR. & US 59	WAGGONER CREEK	6.383
19	2239	1	4	2.7MI WEST OF FM31	SABINE RIVER RELIEF	6.420
19	402	3	20	3.30 MI SE OF FM 2208	LITTLE CYPRESS REL	6.438
19	1221	2	7	4.6 MI. EAST OF FM 31	SOCAGEE CR	6.440
19	1221	2	8	4.9 MI. EAST OF FM 31	SOCAGEE CR. REL	6.440
19	402	2	34	0.65 MI EAST OF FM 726	LITTLE CYPRESS	6.445
19	2157	1	2	1.2MI NORTH OF FM1404	GLADE CRK	6.460
19	946	1	3	0.65 MI SW OF FM 130	BLACK CYPRESS CREEK	6.471
19	402	2	33	0.35 MI EAST OF FM 726	LITTLE CYPRESS REL 2	6.486
19	1018	2	5	0.6 MI S OF FM 1972	LITTLE CYPRESS CRK	6.511
19	277	2	7	3.20 MI S OF SH 8	POWELL CREEK	6.525
19	1222	1	5	0.9 MI NORTH OF FM 2260	MURVAUL CREEK RELIEF	6.545
19	428	1	6	1.2 MI W OF US 59	BRUSHY CREEK RELIEF	6.552
19	1222	1	3	1.1 MI NORTH OF FM 2260	MURVAUL CREEK RELIEF	6.567
19	946	1	2	0.75 MI SW OF FM 130	BLACK CYPRESS CREEK	6.583
19	750	3	7	0.55 MI E OF US 259	PEACOCK CREEK	6.591
19	734	1	5	1.8 MI SOUTH OF US 271	TANKERSLEY CREEK	6.596
19	402	4	21	3.60 MI SE OF FM 2208	LITTLE CYPRESS BAYOU	6.597
19	1382	4	6	2.9MI EAST OF FM555	GUM CREEK	6.728
19	85	1	39	1.30 MI S OF IH 30	WHITE OAK CREEK	6.729
19	3344	3	1	0.1 MI EAST OF US 259	WALNUT CREEK	6.734
19	1019	2	3	0.65 MI N OF FM 1975	PRAIRIE CREEK	6.749
19	10	11	82	2.5 MI S OF FM 990	HOLBROOK CREEK	6.826
19	85	1	38	1.60 MI S OF IH 30	WHITE OAK RELIEF	6.841
19	1019	2	2	0.75 MI N OF FM 1975	PRAIRIE CREEK RELIEF	6.843
19	812	4	4	1.05 MI W OF ARKANSAS SL	LITTLE CYPRESS CREEK	6.875

District	Control	Section	Number	Location	Crosses	Score
19	208	2	6	4.2 MI. SOUTH OF FM 2682	HAGGERTY CREEK	6.902
19	138	10	56	3.45 MI SW OF SH 43	CAMP CREEK	6.975
19	138	10	54	2.85 MI SW OF SH 43	FRAZIER CREEK	7.087
19	138	10	55	3.15 MI SW OF SH 43	FRAZIER CREEK RELIEF	7.087

District	Control	Section	Number	Location	Crosses	Score
20	508	3	138	AT IH 10-FM 1724 INT	IH10 ML	3.414
20	951	1	4	4 MI W OF SH 146 INTERSE	TRINITY RIVER	3.733
20	1300	2	5	1.60 MI N OF SH 63	MCGRAW CRK	4.522
20	813	1	28	2.4 MI W OF INT. FM 2610	TRINITY RIVER	4.597
20	177	3	40	1.8MI NE OF MONTGOMERY CO	E FORK SAN JACINTO R	4.657
20	28	14	64	2.0 MI E OF LP 358	SABINE RIVER *	4.751
20	214	4	5	TX-LA STATE LINE	SABINE RI	4.836
20	508	2	89	3.4 MI E OF SH 146 INT	COTTON BAYOU	4.888
20	177	3	121	1.8MI NE OF MONTGOMERY CO	E FORK SAN JACINTO R	4.895
20	508	2	145	3.4 MI E OF SH 146 INT	COTTON GULLEY	4.903
20	368	4	36	1.1MI SW OF US 69-96-287	HILDABRANDT BAYOU	4.911
20	65	2	5	0.4 MI S OF FM 363 INT	TROUT CREEK	4.969
20	1277	1	4	5.50 MI S OF SH 63	BIG COW CREEK	4.999
20	367	1	19	2.8 MI S OF SH 65 INT	SPINDLETOP BAYOU	5.121
20	508	2	144	3.4 MI E OF SH 146 INT	COTTON GULLEY	5.127
20	28	4	26	.6 MI E OF FM 2830 INTERS	DRAIN	5.168
20	739	2	6	3.0MI SW OF FM 364 OVERPA	KIDD GULLY	5.186
20	65	6	79	HARDIN-JEFFERSON CO LINE	PINE ISLAND BAYOU	5.228
20	762	3	4	1.3 MI S LIBERTY CO LINE	OLD RIVER	5.232
20	65	6	67	HARDIN-JEFFERSON CO LINE	PINE ISLAND BAYOU	5.315
20	739	2	7	3.1MI SW OF FM 364 OVERPA	KIDD GULLEY	5.316
20	65	2	4	0.8 MI N OF FM 363 INT	DAVIS CREEK	5.331
20	28	6	43	1.7 MI W OF JCT FM 364	WILLOW MARSH BAYOU	5.332
20	28	14	167	2.2 MI E OF MP RR	ADAMS BAYOU	5.355
20	28	11	118	0.4 MI W OF FM 1136	COLES CREEK	5.385
20	602	1	7	2.5 MI E OF US 69 INT	VILLAGE CREEK	5.393
20	932	1	13	1.1MI SW OF US 69-96-287	MAIN "C" CANAL	5.406
20	932	2	5	4.9MI SE OF FM 1406 INTER	GREEN POND GULLY	5.427
20	242	3	12	0.1 MI N OF FM 2041 INT	WHITES BAYOU	5.437
20	213	6	78	.8 MI E OF FM 256 EAST IN	LITTLE CYPRESS CREEK	5.456
20	28	14	106	2.2 MI E OF MPRR	ADAMS BAYOU	5.457
20	28	14	107	2.2 MI E OF MPRR	ADAMS BAYOU	5.457
20	508	2	4	3.4 MI E OF SH 146 INT	COTTON BAYOU	5.468
20	952	1	1	1.7MI NE OF SH 321 INTERS	LINNEY CR	5.475
20	28	14	166	2.2 MI E OF MP RR	ADAMS BAYOU	5.514
20	367	1	21	0.3 MI S OF FM 1985 INT	BIG ELM BAYOU	5.527
20	65	5	124	4.5 MI N OF US 69 INT	VILLAGE CREEK	5.534
20	65	1	73	1.5 MI S OF US 190 INT	BIG WALNUT RUN	5.550
20	28	15	61	0.8 MI E OF LP 358	ADAMS BAYOU	5.564
20	28	9	65	JEFF-ORANGE COUNTY LINE	NECHES RIVER	5.580
20	1023	2	14	.7 MI S OF US 90 INTERSEC	ABBOTT'S CREEK	5.597
20	28	6	134	1.2 MI W OF JCT FM 364	PAFW CANAL	5.606
20	28	6	136	1.2 MI W OF FM 364	PAFW CANAL	5.606
20	739	2	10	.6 MI NE OF FM 364 OVERPA	WILLOW MARSH BAYOU	5.609
20	739	2	27	2.8MI E OF CHAMBERS COUNT	S FORK TAYLOR BAYOU	5.615
20	338	5	87	.2 MI E OF FM 1725 INTERS	E FK SAN JACINTO RIV	5.625
20	739	2	25	2.9MI E OF CHAMBERS COUNT	S FORK TAYLOR BAYOU	5.634

District	Control	Section	Number	Location	Crosses	Score
20	739	2	11	.6 MI NE OF FM 364 OVERPA	WILLOW MARSH BAYOU	5.656
20	64	7	60	.6 MI S OF SABINE CO LINE	MILL CREEK	5.685
20	368	1	38	1.1 MI E OF FM 1724 INT	E FK DOUBLE BAYOU	5.690
20	1024	1	7	2.4 MI NE OF FM 2354 INT	COTTON BAYOU	5.694
20	242	3	8	0.5 MI S OF FM 1663 INT	ALBRITTON GULLEY	5.730
20	786	1	2	.7 MI N OF IH 10 OVERPASS	WILLOW MARSH BAYOU	5.733
20	1284	2	4	0.3 MI E OF SH 87	LITTLE CYPRESS BAYOU	5.733
20	593	1	14	1.4MI SE OF FM 686 INTERS	N FRK OF LINNEY CR	5.746
20	368	2	27	2.1MI SW OF FM 365 INTERS	N FORK TAYLOR BAYOU	5.747
20	1109	1	3	3.8 MI SW OF US 190 INTER	BIG WALNUT RUN	5.765
20	28	5	30	.3 MI E OF SH 61 INTERSEC	BLAU GULLY	5.768
20	739	2	39	.6MI.NE OF FM-364 O-PASS	WILLOW MARSH BAYOU	5.774
20	601	1	1	1.0 MI W OF US 69 INT	CYPRESS CREEK	5.779
20	304	6	56	3.00 MI S OF SH 63	YELLOW BAYOU	5.790
20	1096	1	4	0.2 MI SW OF FM 787 INT	LTL. PINE IS. BAYOU	5.801
20	499	1	1	3.3 MI SE OF SH 87	SABINE RIVER	5.804
20	813	1	9	2.3MI E OF SH 321 INTERSE	TARKINGTON BAYOU	5.807
20	1237	2	8	4.4MI W OF FM 1005 INTERS	NECHES RIVER	5.812
20	213	6	76	1.4MI E OF POLK COUNTY LI	HORSE PEN CREEK	5.812
20	242	3	3	0.4 MI N OF FM 1663 INT	DRAW	5.813
20	739	2	26	2.9MI E OF CHAMBERS COUNT	S FORK TAYLOR BAYOU	5.815
20	1324	1	2	0.6 MI S OF FM 365	VOGEL GULLY	5.827
20	1024	1	6	2 MI NE OF FM 2354 INTER	HACKBERRY GULLEY	5.828
20	627	3	5	3.7 MI E OF SH 87	COW CREEK	5.852
20	499	3	13	0.9 MI SW OF FM 1136	COW BAYOU	5.858
20	627	3	4	0.7 MI E OF SH 87	THICKETY CREEK	5.860
20	1023	2	12	6.3 MI. S. OF US 90	REDMOND CREEK	5.864
20	1300	1	9	3.40 MI S OF SH 63	YELLOW BAYOU	5.897
20	593	1	11	3.2MI SE OF US 59 INTERSE	TARKINGTON BAYOU	5.930
20	200	8	107	0.4 MI N. OF FM 2827 INTE	HICKORY CREEK *	5.931
20	593	1	9	2.9MI SE OF US 59 INTERSE	TARKINGTON BAYOU REL	5.952
20	947	1	2	3.1 MI E SH 62 INTER	CYPRESS CRK	5.961
20	305	7	42	0.3 MI N OF FM 1130	LITTLE CYPRESS BAYOU	5.963
20	932	2	6	.6 MI SE OF IH 10 OVERPAS	DRAIN	5.967
20	305	4	39	3.4 MI N OF FM 253	NICHOLS CREEK	5.967
20	1585	1	2	3.7MI SE OF US 190 INTERS	THEUVININS CREEK	5.986
20	952	1	2	2.1MI NE OF SH 321 INTERS	BOWIE CREEK	5.988
20	28	5	35	1.7MI W OF JEFFERSON COUN	DRAW	5.992
20	627	4	14	0.2 MI NE OF SH 87	BIG COW CREEK	6.005
20	65	5	103	5.3 MI N OF US 69	VILLAGE CREEK REL.	6.009
20	739	2	24	2 MI W OF FM 365 INTERSE	N FORK TAYLOR BAYOU	6.029
20	305	1	52	0.3 MI N OF FM 2939	BIG COW CREEK	6.032
20	305	4	38	3.5 MI N OF FM 253	NICHOLS CREEK RELIEF	6.032
20	813	3	26	1.1 MI W OF US 69 INT	BOGGY CREEK	6.033
20	244	4	51	0.2 MI E OF SH 87	CANEY CREEK	6.039
20	813	1	22	.1 MI W OF FM 223 INTERSE	DRAW	6.054
20	65	5	57	5.3 MI N OF US 69	VILLAGE CREEK REL.	6.056

District	Control	Section	Number	Location	Crosses	Score
20	65	5	60	3.9 MI N OF US 69 INT	WALTON'S CREEK	6.056
20	784	1	7	2.5 MI W OF FM 1122 INT	VILLAGE CREEK	6.058
20	244	5	43	0.6 MI E OF FM 1416	CANEY CREEK	6.058
20	244	5	70	0.5 MI W OF SABINE RIVER	QUICKSAND CREEK	6.058
20	388	4	20	1.5MI S OF US 90 INTERSEC	GUM SLOUGH	6.075
20	739	2	23	1.6MI W OF FM 365 INTERSE	N FORK TAYLOR BAYOU	6.076
20	305	2	47	0.9 MI N OF FM 363	THICKETY CREEK	6.079
20	242	3	9	0.1 MI N OF SH 65 INT	LONE STAR CANAL	6.083
20	304	8	58	0.30 MI SW OF SH 87	LITTLE COW CRK	6.084
20	1022	1	4	1.9 MI S OF SH 61-65 INT	N FK DOUBLE BAYOU	6.093
20	305	7	43	3.2 MI S OF NEWTON CO LN	DRAINAGE DITCH	6.095
20	813	1	8	1.4MI E OF SH 321 INTERSE	TARKINGTON BAYOU REL	6.100
20	627	4	12	5.4 MI S OF US 190	DEMPSEY CREEK	6.123
20	65	5	101	2.4 MI SW OF SH 327	VILLAGE CREEK DRAW	6.130
20	1584	1	5	2.3MI NW OF FM 256 INTERS	BILLIAM CREEK	6.139
20	951	1	6	5.5MI NW OF SH 146 INTERS	GAYLOR LAKE RELIEF	6.139
20	388	2	16	3.9 MI S OF FM787 INTK	BEEF HEAD CREEK	6.156
20	1096	1	19	1.8 MI S OF SH 105	MAYHOW CREEK	6.166
20	813	1	23	1.2MI. W OF SH146	NEVILLES BAYOU	6.166
20	304	6	73	0.7 MI N OF FM 2626	QUICKSAND CREEK	6.166
20	304	6	76	2.9MI S OF FM 2626 INTERS	CANEY CREEK BRIDGE	6.166
20	65	5	58	4.9 MI N OF US 69	VILLAGE CREEK REL.	6.190
20	305	3	50	0.5 MI N OF FM 1004	TROUT CREEK	6.213
20	65	5	59	4.5 MI N OF US 69 INT	VILLAGE CREEK	6.216
20	2618	1	3	4.7 MI SE OF SH 87	QUICKSAND CREEK	6.231
20	2618	1	4	6.0 MI SE OF SH 87	LITTLE QUICKSAND CREEK	6.231
20	200	9	61	1.6 MI S OF FM 3063 INT	VILLAGE CREEK *	6.235
20	1419	1	2	.54 MI NW OF US 190 INTER	MELHOMES CRK	6.273
20	2482	1	2	1.8MI NW OF SH 146 INTERS	JOSE BAYOU	6.279
20	1023	2	5	.03 MI. NW. OF FM 77	SHILOH CREEK	6.293
20	1109	1	7	2.37MI S OF US 190 INTERS	BIG WALNUT RUN REL	6.297
20	703	3	15	7.3MI SE OF US 69 INTERSE	CLEAR FORK CREEK	6.298
20	1419	1	1	1.25 MI NW US 190 INTER	MELHOMS CREEK	6.338
20	65	5	102	3.1 MI SW OF SH 327	VILLAGE CREEK DRAW	6.343
20	388	4	19	0.4 MI S OF US 90 INT	DRAW	6.354
20	1828	2	9	7.2MI W OF US 69-287 INTE	JACKS BRANCH	6.366
20	627	4	9	0.8 MI NE OF FM 2460	DRAW	6.369
20	65	5	123	4.9 MI N OF US 69	VILLAGE CREEK REL	6.380
20	1947	2	5	0.8 MI E OF FM 1003	CYPRESS CREEK RELIEF	6.413
20	627	4	8	3.6 MI S OF US 190	DAVIS CREEK	6.416
20	1464	1	8	2.3 MI E OF FM 1410 INT	RUSH DITCH	6.434
20	877	3	3	3 MI SW OF US 69 INTERSE	BELT CREEK	6.436
20	388	2	18	.9 MI S OF POLK COUNTY LI	MENARD CREEK	6.461
20	244	9	50	.2 MI E OF FM 777 INTER	TROTTI CREEK	6.470
20	3092	1	1	1.8MI S OF FM 256 INTERSE	BEAN CREEK BRANCH	6.475
20	1584	1	2	2.6MI E OF US 287 INTERSE	RUSSELL CREEK	6.481
20	1580	2	5	7.9 MI S OF SH 65 INT	ONION BAYOU	6.497

District	Control	Section	Number	Location	Crosses	Score
20	1828	2	4	2.9MI W OF US 69-287 INTE	HORSE PEN CREEK	6.545
20	762	2	5	5.7MI SE OF US 90 INTERSE	OLD RIVER DRAIN	6.549
20	2271	1	1	.3 MI N OF US 287 INTERSE	DRY CREEK	6.590
20	947	2	13	1.2 MI E OF SH 87	NICHOLS CREEK	6.605
20	813	3	25	2.7 MI E OF SH 326 INT	BLACK CREEK	6.739

District	Control	Section	Number	Location	Crosses	Score
21	621	1	7	3.50 MI S OF US 83	HACKNEY LAKE FLOODWAY	5.183
21	1426	1	8	2.20 MI SE OF SH 4	DRAINAGE DITCH	5.190
21	1425	2	2	1.00 MI N OF JCT FM 508	DRAINAGE DITCH	5.323
21	220	5	8	0.20 MI W OF JCT FM 511	DRAINAGE D	5.411
21	630	1	7	4.50 MI NE OF BU 77	DRAIN	5.452
21	863	1	7	1.10 MI N OF US 281	MAIN FLDWY PILOT CHANNEL	5.526
21	698	3	2	2.90 MI S OF US 83	LLANO GRANDE LAKE	5.618
21	342	2	1	0.85 MI E OF FM 491	N FLOODWAY PILOT CHANNEL	5.646
21	327	8	17	0.55 MI SE OF JCT LP 499	DRAINAGE DITCH	5.653
21	39	7	45	1.40 MI NW OF JCT FM 801	ARROYO COLORADO	5.677
21	1429	1	2	2.50 MI S OF BU 83	MAIN FLOODWAY	5.790
21	39	12	33	0.20 MI NW OF JCT SH 345	RESACA DE LOS FRESNOS	5.820
21	861	5	8	1.50 MI S OF BU 83	ARROYO COLORADO	5.880
21	1057	1	9	1.45 MI NW OF FM 2520	DRAINAGE D	5.891
21	327	8	30	5.20 MI NW OF JCT FM 508	N FLOODWAY	5.901
21	1140	3	2	0.20 MI SE OF JCT SH 48	DRAINAGE DITCH	5.914
21	1136	2	1	1.33 MI N OF JCT FM 3067	ARROYO COLORADO	5.935
21	327	8	29	5.20 MI NW OF JCT FM 508	N FLOODWAY	5.948
21	873	2	3	0.70 MI N OF JCT FM 508	DRAINAGE DITCH	5.961
21	1138	1	3	0.50 MI N OF JCT FM 510	RESACA DE LOS FRESNOS	6.031
21	39	12	35	0.40 MI N OF JCT LP 499	ARROYO COLORADO	6.033
21	39	7	44	1.40 MI NW OF JCT FM 801	ARROYO COLORADO	6.035
21	1137	2	1	0.50 MI S OF JCT FM 106	ARROYO COLORADO	6.076
21	1426	1	5	0.10 MI SE OF FM 511	DRAINAGE DITCH	6.086
21	1136	2	6	0.43 MI NW OF JCT FM 2520	DRAINAGE DITCH	6.094
21	630	2	3	1.00 MI W OF SH 345	ARROYO COLORADO	6.194
21	39	7	66	1.40 MI NW OF JCT FM 801	ARROYO COL & FM 1479	6.225
21	39	7	49	AT JCT OF FM 732	FM 732; MPRR; DRAIN	6.231
21	39	7	65	1.40 MI NW OF JCT FM 801	ARROYO COL & FM 1479	6.272
21	1586	1	7	3.1 MI S OF BUSINESS 83	MAIN FLOODWAY PILOT CH	6.300
21	255	5	27	7.4 MI S OF FM 755	BUFFALO HOLLOW	6.314
21	872	4	4	0.90 MI N OF JCT FM 3067	ARROYO COLORADO	6.319
21	1136	2	7	2.77 MI W OF JCT FM 1479	DRAINAGE DITCH	6.396
21	2529	2	1	2.90 MI N OF JCT US 281	ARROYO COLORADO	6.396
21	630	3	8	1.50 MI W OF JCT FM 1847	DRAINAGE DITCH	6.441
21	38	3	15	APPX 2.7 MI N OF FM 3169	ARROYO SAN FRANCISCO	6.508
21	698	4	4	2.00 MI N OF US 281	MAIN FLOODWAY	6.691
21	2369	1	1	0.55 MI S OF FM 106	ARROYO COLORADO	6.729

District	Control	Section	Number	Location	Crosses	Score
22	300	2	10	21.8 MI E OF US 57	COMANCHE CREEK	4.518
22	299	3	16	13.6 MI S OF KINNEY CO LI	QUEMADO CREEK	4.630
22	300	3	16	14.5 MI SE OF MAVERICK CO	PENA CREEK	5.950
22	301	1	1	0.4 MI FROM JCT WITH US 8	CARRIZO CREEK	5.992
22	37	8	29	5.5 MI N OF WEBB C/L	SAN ROQUE CREEK	6.025
22	23	1	57	0.9 MI E JCT US277	E FORK SAN FELIPE CR	6.273
22	301	1	20	4.6 MI NE OF CARRIZO SPRI	SOLDIERS LAKE SLOUGH	6.345
22	23	1	56	0.8 MI E JCT US 277	W FORK SAN FELIPE CR	6.432
22	37	6	76	ADJACENT SO.C/L OF CARRIZ	CARRIZO CREEK	6.508
22	301	1	5	6.9 MI NE OF US 83 IN CAR	NUECES RIVER	6.543
22	22	9	69	14.2 MI E COMSTOCK	EVANS CREEK	6.574
22	23	1	2	0.9 MI E JCT US 277	E FORK SAN FELIPE CR	6.588
22	23	1	1	0.8 MI E JCT US 277	W FORK SAN FELIPE CR	6.700

District	Control	Section	Number	Location	Crosses	Score
23	314	5	18	2.30 MI E OF SH 16	S FORK PALO PINTO CREEK	5.435
23	183	1	42	0.34 MI E OF FM 1702	CHAPPEL BRANCH	5.946
23	183	1	47	0.70 MI NW OF HAMILTON CL	DRAW	5.946
23	54	4	56	0.22 MI S OF US 283	HORDS CREEK	6.044
23	183	1	44	2.62 MI E OF FM 1702	TATUM BRANCH	6.058
23	288	4	18	3.86 MI N OF SH 6	LEON RIVER	6.099
23	714	3	5	0.45 MI S OF US 180	CADD0 CREEK # 1	6.121
23	714	3	7	6.20 MI S OF US 180	CADD0 CREEK # 2	6.200
23	314	5	35	2.00 MI E SH 16	MIDDLE CREEK	6.212
23	231	17	43	0.49 MI E OF US 281	SULPHUR CREEK	6.223
23	289	3	7	7.77 MI S OF US 183	PRESCOTT CREEK	6.224
23	1031	1	7	1.02 MI S OF FM 1481	HUBBARD CREEK	6.231
23	314	5	34	2.00 MI E OF SH 16	MIDDLE CREEK	6.259
23	480	8	8	3.77 MI S OF COLORADO RI	WILBARGER CREEK	6.287
23	1039	1	1	1.47 MI SE OF US 67	WALNUT CREEK	6.298
23	183	1	35	1.70 MI E OF LP 130	S LEON RIVER	6.330
23	7	3	156	2.15 MI NE OF SH 6	LEON RIVER	6.346
23	11	9	53	0.15 MI W OF FM 717	SAW BRANCH	6.362
23	7	3	155	2.15 MI NE OF SH 6	LEON RIVER	6.433
23	1293	2	1	1.80 MI E OF FM 3253	VEALE CREEK	6.468
23	550	1	20	3.02 MI NE OF FM 571	LEON RIVER	6.473
23	1039	3	2	0.33 MI S OF SH 6	COW CREEK	6.490
23	289	1	6	1.84 MI S OF FM 1476	MOUNTAIN CREEK	6.498
23	1241	1	4	2.00 MI SE OF US 190	DRY SIMPSON CREEK	6.516
23	869	1	22	1.58 MI N OF FM 2134	PANTHER CREEK	6.561
23	272	3	52	2.22 MI W OF FM 2732	HARKEY SLOUGH	6.575
23	1028	1	10	0.35 MI E OF FM 45	BIG ROCKY CREEK	6.576
23	3216	1	1	0.15 MI SE OF US 190	MESQUITE CREEK	6.674
23	78	5	34	0.78 MI E OF FM 2131	LOSS CREEK	6.696
23	404	2	24	2.80 MI S OF THROCK. C/L	CLEAR FK BRAZOS RI REL	6.702
23	1780	1	1	3.60 MI S OF US 84	BENNETT BRANCH	6.731
23	452	3	24	0.36 MI NE OF FM 1176	JIM NED CREEK S REL	6.744
23	1366	1	1	1.99 MI S OF FM 587	N COPPERAS CREEK	6.765
23	11	9	69	0.45 MI E OF FM 717	ELM CREEK	6.860
23	452	3	25	0.65 MI SW OF FM 585	HAY CREEK	6.878
23	2285	1	1	1.46 MI SE OF US 281	MILL BRANCH	6.901
23	404	2	15	3.48 MI NW OF FM 578	HUBBARD CREEK	6.917
23	1028	1	11	2.99 MI E OF FM 45	BUFFALO CREEK	6.941
23	2391	1	7	2.05 MI SE OF FM 1476	S LEON RIVER	6.962
23	480	8	23	0.73 MI N OF US 190	RICHLAND CREEK	6.968
23	289	4	48	1.25 MI N OF US 190	SAN SABA RIVER	6.980
23	2703	1	1	2.11 MI SW OF FM 587	SABANA RIVER	7.055
23	1030	1	1	3.75 MI N OF FM 2005	NORTH BENNETT CREEK	7.137
23	1938	1	1	9.96 MI SE OF US 283	HOME CREEK	7.300
23	868	2	4	1.15 MI W OF FM 45	WILBARGER CREEK	7.345
23	2285	2	3	0.31 MI S OF FM 1690	SCHOOL CREEK	7.371
23	1240	2	2	4.65 MI NE OF SH 16	RABBITT CREEK	7.583

District	Control	Section	Number	Location	Crosses	Score
24	20	8	46	0.30 MI E OF SH 17	ALAMITO CREEK	5.445
24	2451	2	8	12.15 MI E OF FM 1165	KIMBLE DRAW	5.820
25	1233	1	1	0.800MI S JCT LOOP 6 IN K	DRAW	5.716
25	31	6	11	5.05MI S OF S END RED RIV	CONKLIN CREEK	5.972
25	449	1	2	4.91 MI SE OF US 83	SAND CREEK	5.976
25	32	1	36	9.190MI S JCT US287 IN CH	DRAW	6.107
25	98	4	24	12.170M FROM KNOX-FOARD C	S. WICHITA RIVER	6.142
25	971	2	7	1.97 MILES FROM BRISCOE C	QUIATQUE CREEK	6.709
25	311	2	16	14.2 MI W OF FM 657	PRAIRIE DOG TN FK RED RI	7.320

APPENDIX E:

PRIORITIZED BRIDGE LISTS

OFF-SYSTEM

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District	Control	Section	Number	Location	Crosses	Score
1	8529	1	1	GRAND AVE JCT R.R.	GRAND AVE RR O-PASS	*4.439
1	8760	1	1	0.2 MI N FM 1507	BRANCH BIG SANDY CREEK	5.378
1		31	3	0.7 MI. EAST OF FM 3134	TRIB. OF SULPHUR RIVER	5.779
2		87	1	0.8 MI S OF SH 183	W FORK TRINITY RIVER	5.442
2		50	1	0.7 MI N WESTERN CTR BLVD	TRIB OF BIG FOSSIL CK	5.523
2		53	1	0.4 MI E US 281 N FM 1195	FORK OF WHATLEY CR.	6.083
4	8003	4	8	W 3RD ST	CRI & P RR U-PASS	*3.402
4	8003	4	7	E 3RD ST	SANTA FE RR U-PASS	*3.456
4	8503	4	1	IN PAMPA ON CUYLER ST	SANTA FE RR U-PASS	*3.512
4	8006	4	1	GRAND ST & AT&SF RR	AT&SF RY&CRI&P RR OP	*4.171
4	8017	4	20	.13MI. E. OF IH-27	SANTA FE RY 0-PASS	*4.188
4	8204	4	5	TRISTRAM ST IN BORGER	AT & SF R.R.	*4.492
4	8013	4	7	1.38 MILES N. OF IH-40	FIRST AVE-BW R.R.	*4.503
4	8501	4	1	IN PAMPA	RED DEER CREEK	4.882
5	8002	5	3	.1-MI.S.US.82-ON-AVE-H	MH 41 (AVE H)	*3.432
5	8003	5	2	0.1 MI S OF US 82	MH 41 (TEXAS AVE)	*4.211
5	8003	5	1	INT.TEXAS AV.&6 TH ST	MH 41 (TEXAS AVE)	*4.324
7		39	2	8.15 MI SE OF US 87	BRADY CREEK	4.900
7		10	1	1.10 MI S OF FM 380	CONCHO RIVER	5.269
7		56	44	0.50 MI E OF FM 2647	ELM CREEK	5.472
8	8025	8	4	0.05 MI N OF BUS LOOP 20	MOCKINGBIRD LANE	*3.536
8	8025	8	5	0.05 MI N OF BUS LOOP 20	MOCKINGBIRD LANE	*4.164
8	8014	8	1	0.8 MI NE OF US 83	ELM CREEK	4.257
8	8012	8	1	1.0 MI E OF US 83	ELM CREEK	4.439
8	8040	8	15	0.12 MI S OF BUS LOOP 20	T & P RR	*4.519
8	8405	8	2	0.1 MI W OF AT&SF RR	WOLF HOLLOW DRAW	4.776
8	8003	8	5	0.3 MI E OF BUS US 83	CEDAR CREEK	4.842
8	8022	8	9	1.8 MI W OF FM 89	ELM CREEK	4.911
8	8003	8	3	0.4 MI E OF US 83	ELM CREEK	5.077
8	8303	8	2	0.1 MI N OF LOOP 377	LONE WOLF CREEK	5.218
8	8412	8	1	0.3 MI N OF ALABAMA ST	TOWN CREEK	5.230
8	8027	8	2	0.12 MI E OF US 83	ELM CREEK	5.477
9		21	1	1.20 MI W OF FM 931	LEON RI #20	6.816
9		52	1	0.65 MI S OF SH 36	LEON RI #227	6.918
9		45	3	2.20 MI N OF FM 185	N BOSQUE RI #421	7.392
10	8356	10	86	BET W TYLER & W COTTON ST	HIGH STREET	*3.774

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District	Control	Section	Number	Location	Crosses	Score
12		89	655	0.15 MI W OF IH 610 WLP	BUFFALO BYU	4.638
12		1	1	0.30 MI W OF MAIN ST	BUFFALO BYU	4.713
12		97	552	.1 MI NW OF WHEELER	BRAYS BAYOU	4.878
12		20	1	1.20 MI N OF US 290	PONDS CREEK	4.918
12		21	4	0.25 MI E OF SCOTT	HCFCD DITCH	5.664
12		21	5	E OF SOUTHVIEW	HCFCD DITCH	5.664
12		99	1	.4 MI W/CYPRESS-ROSE HILL	SPRING CRK	5.774
12		69	662	0.40 MI N OF US90A (OST)	BRAYS BYU	5.809
12		69	663	0.40 MI N OF US90A (OST)	BRAYS BYU	5.809
12		33	565	1.7 MI N OF 610 S LP EAST	BRAYS BAYOU	5.827
12		85	13	0.45 MI E OF STUDEMONT	BUFFALO BYU	5.945
12		89	666	0.15 MI N OF IH 610 WLP	BUFFALO BYU	6.171
12		5	3	0.50 MI E OF ANTOINE	WHITE OAK BYU	6.176
12		5	4	0.50 MI E OF ANTOINE	WHITE OAK BYU	6.176
12		20	1	0.20 MI W OF TYRONE	LEMM GULLY	6.185
12		1	2	0.35 MI W OF MAIN ST	BUFFALO BYU	6.220
13		75	1	0.15 MI E OF SH 60	COTTONWOOD CREEK	4.298
13		85	1	0.35 MI E OF SH 60	COTTONWOOD CREEK	4.386
13		55	1	0.30 MI E OF SH 60	COTTONWOOD CREEK	4.547
13		55	2	0.30 MI E OF SH 60	COTTONWOOD CREEK	4.569
13		15	1	0.35 MI SW OF SH 71	TRES PALACIOS RIVER	4.750
13		3	1	0.55 MI NE OF SAM HOUSTON	LONE TREE CRK	5.176
13		10	1	0.58 MI W OF SH 111	DRY CRK	5.254
13		15	1	0.10 MI S OF 6TH ST	TRES PALACIOS RIVER	5.330
13		17	1	0.48 MI N OF DUDLEY ST	DRAIN	5.417
13		31	1	0.45 MI E OF SH 185	DRAIN	5.559
13		57	1	1.25 MI S OF FM 340	SMOTHERS CREEK	6.007
13		57	1	.4 MI N OF CR 205	HARVEY CREEK	6.748
13		55	1	1.50 MI W OF FM 953	CLEAR CREEK	6.882
13		30	1	0.60 MI E OF US 77	RICKAWAY BRANCH	7.184
13		43	1	2.40 MI W OF US 87	GUADALUPE RIVER	7.255
13		73	1	1.70 MI E OF FM 2314	NAVIDAD RIVER	7.260
13		29	2	0.70 MI W OF FM 957	LAVACA RIVER	7.308
13		86	1	0.25 MI S OF SHINER SCL	ROCKY CREEK	7.389
13		36	1	1.20 MI NW OF CREAMERY RD	BUCKNERS CREEK	7.425
13		40	1	0.60 MI NW OF FM 240	YORKTOWN CREEK	7.506
13		73	2	0.20 MI E OF FM 2314	MIXON CREEK	7.553
13		86	1	4.50 MI S OF FM 531	SUPPLEJACK CREEK	7.638

District	Control	Section	Number	Location	Crosses	Score
14		38	7	0.1 MI W OF LAMAR BLVD	SHOAL CREEK	5.568
14		56	5	6.50 MI S BEG SHOAL CK BL	SHOAL CREEK	5.748
14		21	1	0.40 MI S OF FM 2222	DRY CREEK	5.766
14		16	24	0.5 MI WEST OF BURNET RD.	SHOAL CREEK	5.951
14		45	1	0.40 MI E OF SH 71	COLORADO RIVER	*6.052
14		70	2	0.1 MI S OF MLK BLVD	WALLER CREEK	6.357
14		47	1	0.05 MI S OF W 35TH ST	CAMP MABRY DRAW	6.499
14		59	1	0.55 MI NW OF MANOR RD	LITTLE WALNUT CREEK	6.603
14		7	1	0.60 MI W OF OLD S A RD	ONION CREEK	6.976
14		7	2	0.70 MI W OF OLD S A RD	BEAR CREEK	6.976
14		27	1	2.60 MI NE OF FM 969	DRY CREEK	7.227
14		82	1	1.15 MI SE OF BLOCKER LN	MAHA CREEK	7.282
14		26	2	1.25 MI SW OF FM 1322	CLEAR FORK PLUM CRK.	7.498

District	Control	Section	Number	Location	Crosses	Score
15	8097	15	2	.25 MI S.E. OF IH 35(N)	COLISEUM ROAD	*3.566
15	8085	15	4	0.1 MI W OF S OLIVE ST.	S. HACKBERRY	*3.590
15	8067	15	6	0.27 MI E OF N RIO GRANDE	M.K.T. RR U-PASS	*3.620
15	8021	15	33	0.13 MI N OF HILDEBRAND	SAN PEDRO AVE.	*3.914
15	8141	15	2	0.7 MI W OF IH10	M.L. KING	*3.963
15	8136	15	2	0.03 MI S OF VITRA ST.	SP-RR U-PASS	*3.985
15	8136	15	1	0.06 MI S OF VITRA ST.	MKT RR U-PASS	*4.119
15	8067	15	2	.3 M W OF INTER IH10-IH35	MPRR - COMAL & STS	*4.320
15	8083	15	2	0.06 MI E OF RICHTER ST	MPRR SPRR AND 5 STS	*4.320
15	8021	15	5	.05 S.OF N.ST.MARYS ST.	SAN ANTONIO RIVER	4.408
15	8140	15	1	0.2 MI S OF IH35	SPRR - SHERMAN ST.	*4.454
15	8138	15	3	.45 MI W OF E COMMERCE ST	SALADO CREEK	4.465
15	8079	15	10	0.04 MI E OF NW 25TH ST	DRAIN	4.488
15	8067	15	162	AT 26TH.ST. AT APACHE CR.	APACHE CREEK	4.504
15	8021	15	3	0.03 MI S OF MARKET ST	SAN ANTONIO RIVER	4.558
15	8007	15	4	1.5 MI SO OF LP 410	OLMOS CREEK	4.610
15	8067	15	8	0.4 MI SW OF E HOUSTON ST	SALADO CREEK	4.618
15	8021	15	4	AT CROCKETT ST.	SAN ANTONIO RIVER	4.624
15	8403	15	2	0.92 MI S OF LOOP 337	PANTHER CANYON	4.648
15	8067	15	4	0.19 MI E OF SOLEDAD ST.	SAN ANTONIO RIVER	4.657
15	8067	15	5	0.08 MI E OF N PRESA ST.	SAN ANTONIO RIVER	4.657
15	8021	15	17	0.1 MI N. OF BASSE RD	OLMOS CREEK	4.678
15	8083	15	4	0.05 MI W OF ST MARY'S ST	SAN ANTONIO RIVER	4.711
15	8083	15	5	0.02 W OF N ALAMO ST.	SAN ANTONIO RIVER	4.711
15	8079	15	11	0.3 MI E OF NAVIDAD ST.	ALAZAN CREEK	4.713
15	8079	15	13	0.12 MI E OF N PECOS	IH 10 N.B. RAMP O-P	*4.717
15	8156	15	3	.1 MI S OF ESSEX ST	M.K.T. RR	*4.719
15	8137	15	3	0.06 MI E OF SOLEDAD ST.	SAN ANTONIO RIVER	4.729
15	8079	15	15	0.1 MI E OF SOLEDAD ST.	SAN ANTONIO RIVER	4.735
15	8009	15	2	.07 M S OF JACKSON KELLER	DRAIN	4.747
15	8061	15	1	0.1 MI N OF RUIZ ST.	ALAZAN CREEK	4.772
15	8136	15	3	0.02 MI N OF VILLITA ST.	SAN ANTONIO RIVER	4.782
15	8136	15	4	0.04 MI N OF COMMERCE ST.	SAN ANTONIO RIVER	4.782
15	8186	15	5	0.15 MI S OF ST MARYS ST	SAN ANTONIO RIVER	4.793
15	8076	15	5	0.2 MI W OF IH 355	APACHE CREEK	4.825
15	8403	15	5	0.05 MI N OF B46	COMAL RIVER	4.840
15	8120	15	1	0.04 MI W OF S ST MARY'S	SAN ANTONIO RIVER	4.847
15	8068	15	3	0.6 MI W OF CALLAGHAN RD.	LEON CREEK	4.906
15	8030	15	2	0.44 MI S OF LOOP 410	BEITEL CREEK	4.947
15	8065	15	16	0.90 MI NE OF LP 1604	MEDIO CREEK	4.952
15	8405	15	1	0.45 MI S OF B46	DRY COMAL CREEK	4.961
15	8095	15	1	0.1 MI E OF PROBANDT ST.	SAN ANTONIO RIVER	4.982
15	8061	15	2	.04 MI N OF S LAREDO ST	APACHE CREEK	4.999
15	8034	15	4	0.05 MI E OF GRANTHAM RD.	SALADO CREEK	5.000
15	8019	15	2	0.05 MI S OF W MARTIN ST.	ZARZAMORA CREEK	5.018
15	8019	15	3	0.05 S OF W MARTIN ST.	ZARZAMORA CREEK	5.018
15	8178	15	1	0.06 MI S OF ST MARYS ST.	SAN ANTONIO RIVER	5.040

District	Control	Section	Number	Location	Crosses	Score
15	8403	15	3	1.0 MI S OF LOOP 337	COMAL SPRING	5.045
15	8065	15	2	.15 MI W OF PINN RD.	SLICK RANCH CREEK	5.064
15	8018	15	8	1.95 MI SO.BANDERA RD.	ZARZAMORA CREEK	5.065
15	8103	15	3	1.0 MI N OF IH 410	SIX MILE CREEK	5.067
15	8067	15	1	.14 MI W OF N COLORADO ST	ALAZAN CREEK	5.071
15	8064	15	1	0.25 MI N OF MARBACH RD.	TRIB. LEON CREEK	5.088
15	8403	15	4	1.2 MI S OF LOOP 337	COMAL RIVER	5.101
15	8064	15	2	0.25 MI N OF MARBACH RD.	TRIB. LEON CREEK	5.110
15	8126	15	5	.95MI NW OF IH35	MKTRR & WEIDNER RD	5.131
15	8019	15	4	0.28 MI N OF BANDERA RD	DRAIN	5.141
15	8138	15	4	.45 MI W OF E COMMERCE ST	SALADO CREEK	5.143
15	8559	15	1	0.2 M.E. OF GUADLUPE ST.	WALNUT BRANCH	5.150
15	8013	15	12	O.8 M SE VANCE JACKSON R0	OLMOS CREEK	5.152
15	8083	15	3	.03 MI E OF SANTA ROSA ST	SAN PEDRO CREEK	5.169
15	8108	15	10	0.43MI E OF CALLAGHAN RD	ZARZAMORA CREEK	5.177
15	8136	15	6	0.05 MI N OF E MARTIN ST.	SAN ANTONIO RIVER	5.189
15	8103	15	2	1.0 MI N OF IH 410	SIX MILE CREEK	5.201
15	8135	15	1	0.14 MI E OF S HAMILTON	APACHE CREEK	5.201
15	8411	15	1	0.75 MI NE OF UNION ST	GUADALUPE RIVER	5.206
15	8016	15	1	02 MI N OF MITCHELL ST	SAN PEDRO CREEK	5.211
15	8100	15	1	0.2 MI E OF ROOSEVELT AVE	SAN ANTONIO RIVER	5.217
15	8100	15	7	0.1 MI E OF SE LOOP 410	ROSILLO CREEK	5.223
15	8101	15	3	.18 MI W OF S PRESA ST	SAN ANTONIO RIVER	5.233
15	8119	15	2	0.1 MI S OF BUENA VISTA	ALAZAN CREEK	5.233
15	8408	15	1	2.8 MI E OF LOOP 337	COMAL RIVER	5.234
15	8573	15	1	0.25 MI N OF US 90A	WALNUT BRANCH	5.270
15	8141	15	3	0.1 MI E OF BROOKSDALE	SALADO CREEK	5.272
15	8179	15	1	0.1 MI S OF ST MARYS ST.	SAN ANTONIO RIVER	5.288
15	8067	15	3	0.1 MI E OF N LAREDO ST.	SAN PEDRO CREEK	5.302
15	8149	15	1	0.15 MI W. OF IH 10 W	MARTINEZ CREEK	5.313
15	8083	15	1	0.1 MI W OF N COLORADO ST	ALAZAN CREEK	5.318
15	8119	15	1	.15 MI N OF SO LAREDO ST	APACHE CREEK	5.335
15	8079	15	14	0.01 MI W OF CAMARON ST.	SAN PEDRO CREEK	5.346
15	8138	15	1	0.05 MI E OF SANTA ROSA	SAN PEDRO CREEK	5.352
15	8084	15	2	0.06 MI E OF MAIN PLAZA	SAN ANTONIO RIVER	5.360
15	8083	15	6	0.2 MI E OF S ALAMO ST.	SAN ANTONIO RIVER	5.368
15	8137	15	2	0.01 MIW. OF CAMRON ST.	SAN PEDRO CREEK	5.368
15	8135	15	3	0.45 MI W OF IH 35	ALAZAN CREEK	5.389
15	8135	15	4	0.3 MI W OF IH 35	SP-MP RR/ALAZAN CRK	5.389
15	8098	15	1	0.83 MI E OF COLISEUM RD.	SALADO CREEK	5.392
15	8138	15	2	0.05 MI W OF N ST MARY'S	SAN ANTONIO RIVER	5.414
15	8084	15	1	0.1 MI W OF S FLORES ST	SAN PEDRO CREEK	5.417
15	8078	15	2	0.15 MI W OF BRAZOS ST.	MARTINEZ CREEK	5.435
15	8135	15	2	0.45 MI W OF IH 35	ALAZAN CREEK	5.436
15	8085	15	1	0.6 MI E OF I-35 DOWNTOWN	SAN ANTONIO RIVER	5.439
15	8085	15	2	0.6 MI E OF 1-35 DOWNTOWN	SAN ANTONIO RIVER	5.439
15	8089	15	1	0.18 MI S OF MITCHELL ST.	SAN PEDRO CREEK	5.494

District	Control	Section	Number	Location	Crosses	Score
15	8066	15	1	.15 MI SO. OF MARBACH RD.	MUD CREEK	5.540
15	8095	15	2	0.01 MI N OF MARKET ST.	SAN ANTONIO RIVER	5.557
15		10	1	0.35 MILES N. OF S.H. 27	FALL CREEK	6.139
15		74	1	7.2 MI. SOUTH OF KENDALIA	GUADALUPE RIVER	6.271
15		40	1	0.60 MI E OF SH 123	GERONIMO CREEK	6.480
15		28	2	1.25 MI. W. OF S.H. 27	GOAT CREEK	6.687
15		96	1	0.8 MI. N. OF CO. RD. 195	ELM CREEK	6.778
15		90	12	0.21 MI. E. OF TIVY ST.	QUINLAN CREEK	6.871
15		96	2	1.4 MI. N. OF CO. RD. 195	GUADALUPE RIVER	6.983
15		96	5	0.6 MILE S.E. OF FM. 2673	GUADALUPE RIVER	6.984
15		81	1	0.5 MI NO OF US87	DRY HOLLOW CREEK	7.019
15		96	3	3.5 MI. N. OF CO. RD. 195	GUADALUPE RIVER	7.047
15		96	4	6.5 MI. N. OF CO. RD. 195	GUADALUPE RIVER	7.159
15		49	3	3.2 MI WEST OF US 281	GUADALUPE RIVER	7.364

District	Control	Section	Number	Location	Crosses	Score
17	8101	17	2	IN CITY OF BRENHAM	SANTA FE RAILROAD	*4.429
17	8016	17	3	IN CITY OF BRYAN	BURTON CREEK	4.441
17	8251	17	4	IN CITY OF NAVASOTA	CEDAR CREEK	4.805
17	8255	17	1	IN CITY OF NAVASOTA	CEDAR CREEK	4.909
18		25	6	0.3 MI NE OF COLLINS ROAD	DUCK CREEK	3.716
18		44	1	0.20 MI W OF FM 2622	TRIB-DENTON CREEK	5.033
18		9	1	0.20 MI S OF SWITZER RD	POND CREEK	5.291
18		28	1	0.2 N OF MILLER FERRY RD	COTTONWOOD CREEK	5.310
18		80	2	0.1 MI E OF ROCHELLE RD	ELM FORK TRINITY RIV	5.768
18		60	4	0.15 MI N OF KIEST BLVD	FIVE MILE CREEK	5.937
18		80	1	0.20 MI N OF FOREST LANE	FLOYD BRANCH	6.023
18		60	21	0.35 MI W OF SKILLMAN ST	JACKSON BRANCH	6.145
18		10	2	0.45 MI N OF BELTLINE RD	COTTONWOOD BRANCH TRIB	6.222
18		65	2	0.1 MI S OF FARMERS BR LN	FARMERS BRANCH	6.315
18		60	40	0.35 MI W OF SKILLMAN ST	JACKSON BRANCH	6.369
18		25	13	0.75 MI E OF IH 635	SOUTH MESQUITE CREEK	6.470
18		25	14	0.75 MI E OF IH 635	SOUTH MESQUITE CREEK	6.560
18		20	1	0.20 MI S IH30	COOMBS CREEK	6.564
18		80	1	0.15 MI SE OF HAMPTON RD	CROW CREEK	6.577
18		85	1	0.1 MI E OF TREEVIEW LANE	FARMERS BRANCH	6.666
18		47	1	0.2 MI E OF GUS THOMASSON	SOUTH MESQUITE CREEK	6.822
18		0	2	1.2 MI W OF BELTLINE ROAD	MILL BRANCH CREEK	6.974
18		70	2	0.1 MI EAST OF US 75	WHITE ROCK CK & SP RR	7.213
19	8018	19	4	1 MILE EAST FM ROAD 559	KCS RR	*3.714
19	8020	19	2	0.62 MILE EAST ST HWY 93	KCS RR	*3.880
19	8015	19	11	0.2 MILE EAST KCS RR	W. 3RD. STREET	*4.067
19	8317	19	3	0.2 MI. NORTH OF US 80	MOPAC RR	*4.356
19	8024	19	1	75FT N US67 ON ROBISON RD	WAGGONER CREEK	4.555
19	8015	19	10	INTSTN W 4TH ST W/RAMP A	SWAMPPOODLE CREEK	4.577
19	8018	19	11	0.2 MI.W.OF RICHMOND RD.	COWHORN CREEK	4.618
19	8009	19	5	1 MILE WEST STATELINE AVE	SWAMPPOODLE CREEK	4.642
19	8015	19	7	HALF MILE SO W 4TH ST	NIX CREEK	4.662
19	8015	19	8	HALF MILE SOUTH W 4TH ST	NIX CREEK	4.662
19	8015	19	9	0.2 MILE SOUTH W 4TH ST	WEST 3RD ST & KCS RR	4.662
19	8200	19	1	1.3 MILES EAST OF FM 2685	GLADE CRK	4.687
19	8303	19	3	0.2 MI. NORTH OF US 80	UP RR YARD	*4.742
19	8014	19	3	0.1 MILE W KCS RAILROAD	SWAMPPOODLE CREEK	4.776
19	8300	19	1	0.9 MILES NORTH OF SH 43	HAPPY HOLLOW CREEK	4.804
19	8015	19	12	0.1 MILE EAST KCS RR	SWAMPPOODLE CREEK	4.955
19	8013	19	5	HALF MILE EAST US HWY 59	SWAMPPOODLE CREEK	5.043
19	8029	19	3	1 MILE EAST ROBISON ROAD	WAGGONER CREEK	5.290
19	8028	19	4	1 MILE WEST STATELINE AVE	COWHORN CREEK	5.313

District	Control	Section	Number	Location	Crosses	Score
20	8052	20	1	0.2 MI S OF COLLEGE ST	PARK AVE & ORLEANS AVE	*3.454
20	8023	20	1	0.2 MI N OF US 90 INT	MP&SP RR	*4.045
20	8021	20	1	1.8 MI E OF SH 364	HILLEBRANDT BAYOU	4.243
20	8021	20	2	1.8 MI E OF SH 364	HILLEBRANDT BAYOU	4.243
20	8639	20	1	AT WEST CITY LIMIT	ADAMS BAYOU	4.289
20	8648	20	6	2.5 MI E OF SH 87 INT	COW BAYOU	4.384
20	8013	20	4	2.0 MI E OF SH 364	HILLEBRANDT BAYOU	4.421
20	8767	20	1	3.05 MI E OF IH 10-90 INT	TIGER CREEK	4.430
20	8028	20	2	2.2 MI W OF IH 10 INT	CALDWOOD CUTOFF	4.465
20	8028	20	1	1.0 MI W OF IH 10	HILLEBRANDT BAYOU	4.489
20	8630	20	1	2.55 M W OF LP 358 INT	ADAMS BAYOU	4.535
20	8044	20	2	1.2 MI E OF W CITY LIMITS	DRAINAGE DITCH	4.577
20	8028	20	19	0.1 MI W OF IH 10	HILLEBRANDT BAYOU	4.670
20	8645	20	1	.75 MI S OF INT LP 358	HUDSON'S GULLY	4.670
20	8206	20	2	.35MI NW OF SH73 INT	MAIN A CANAL	4.686
20	8206	20	4	.3MI N SH73 INT	PEAR RIDGE MAIN CANAL	4.686
20	8058	20	2	1.3M S OF US69 96 287 INT	DRAIN	4.689
20	8021	20	14	0.8 MI E OF SH 364	PINCHBACK OUTFALL	4.692
20	8703	20	1	0.1 MI N OF DURDIN STREET	DRAIN	4.859
20	8705	20	3	0.9 MI E OF LOOP 498	DRAIN	4.868
20	8005	20	1	0.2 MI N OF GARNER RD	DRAIN	4.872
20	8227	20	6	0.5 MI SE OF SH 87	STORM LEVEE DITCH	5.050
20	8705	20	1	0.1 MI E OF 3RD STREET	DRAIN	5.058
20	8226	20	1	0.7 MI E OF SH 87	CRANE BAYOU	5.073
20	8630	20	2	2.9 MI W OF LOOP 358 INT	DRAIN	5.083
20	8503	20	2	.1MI. E. OF US 96 INT.	SANDY CREEK	5.134
20	8011	20	1	1.6 MI E OF SH 364 INT	HILLEBRANDT BAYOU	5.209
20	8785	20	1	0.1 MI W OF FM 105	DRAIN	5.243
20	8511	20	2	.2MI S INT FM 2799	SANDY CREEK	5.251
20		95	1	.4MI. N. OF BEG. OF STREE	ABBOTS CREEK	5.364
20	8206	20	1	1 MI E FM365 INT	MAIN B CANAL	5.414
20	8247	20	9	.65MI E OF US69 INT	B-1 CANAL	5.417
20	8013	20	3	0.8 MI E OF SH 364	PINCHBACK OUTFALL	5.434
20		98	2	2.70 MI E OF FM 1745	OTTER CREEK SOUTH BRANCH	5.472
20	8514	20	1	0.02 MI S FM 2799 INT	SANDY CREEK	5.495
20	8206	20	5	0.3MI. E SPURLOCK RD INT	PT ARTHUR FR WATER CANAL	5.590
20	8247	20	10	.65MI E US69 INT	B-1 CANAL	5.598
20		98	1	0.50 MI E OF FM 1745	RUSSELL CREEK	5.691
20		43	2	.7MI. N. OF FM-420	VILLAGE CREEK	5.768
20	8000	20	3	0.1 MI W OF VOTH CUTOFF	DRAIN	5.857
20		9	1	0.15 MI N OF FM 1013	PIN OAK CREEK	5.984
20		56	3	0.85 MI N OF US 190	WOLF CREEK	5.998
20	8032	20	2	0.7 MI E OF US 69	DRAIN	6.151
20		18	1	1.50 MI W OF SH 92	BEECH CREEK BRANCH	6.258
20		8	1	1.20 MI E OF FM 1013	DRAW	6.307
20		24	2	0.85 MI E OF US 96	DAVIS CREEK	6.323
20		56	2	5.05 MI S OF R255	HOPSON MILL CREEK	6.424

District	Control	Section	Number	Location	Crosses	Score
20		10	1	0.50 MI E OF US 96	TROUT CREEK	6.565
20		98	3	3.00 MI NE OF FM 1745	OTTER CREEK	6.624
21		71	1	1.0 MI N OF JCT FM 1762	EAST MAIN DRAIN	5.875
21		42	2	3.03 MI E OF JCT ABRAM RD	EDINBURG MAIN CANAL	6.230
21		1	1	0.15 MI SE OF EAST AVE	CCDD NO 1 NORTH DRAIN	6.271
21		2	1	0.08 MI W OF IMPALA ST	CCWID #1 NORTH DRAIN	6.288
21		37	1	0.01 MI NE OF CO RD 309	CCWID #1 NORTH DRAIN	6.318
21		35	1	0.5 MI SE OF JCT SH 100	PORT ISABEL SHIP CHANNEL	6.413
21		57	1	0.25 MI SE OF TULIPAN ST	CCWID #1 NORTH DRAIN	6.413
21		39	1	0.2 MI E OF JCT FM 491	DRAINAGE DITCH	6.477
21		93	1	1.25 MI W OF JCT FM 886	KATHY CREEK	6.494
22	8519	22	1	RAILROAD ST & S. PACIFIC	SP RR&CALAVARAS CR	*3.238
22	8210	21	1	0.85 MI W OF IH 35	UP & TEX-MEX RR	*4.454
22		19	8	0.25 MI EAST OF US 277	DRAINAGE DITCH	4.561
22	8569	22	1	EAGLE PASS AT FERRY ST.	EAGLE PASS CREEK	4.786
22	8205	21	4	0.15 MI E OF IH 35	SAN FRANCISCO DRAIN	5.254
22	8511	22	3	GILLIS ST. DEL RIO TX.	SAN FELIPE CREEK	5.337
22	8565	22	1	BETWEEN MEDINA & PIERCE	EAGLE PASS CREEK	5.544
23	8905	23	1	0.50 MI S OF AT&SF RR	BURLESON CREEK	6.410
23	8905	23	2	0.20 MI S OF AT&SF RR	GIBSON BRANCH	6.544
23		92	4	1.3 MI S OF SH 36	SOUTH LEON RIVER	6.721
23		53	2	0.3 MI NE OF CO RD 348	LEON RIVER	6.828
23		94	1	.5 MI E JCT FM 1467	BLANKET CREEK	6.903
23		3	1	1.0 MI NORTH OF SH 16	DRAW	7.164

District	Control	Section	Number	Location	Crosses	Score
24	8004	24	4	0.4 MI S OF ALTURA AVE	COPIA ST.	*3.268
24	8032	24	6	0.1 MI N OF SH 20	S.P. RAILROAD	*3.381
24	8002	24	1	0.1 MI N OF GRANT AVE	ALABAMA ST.	*3.424
24	8032	24	7	0.1 MI N OF SH 20	S P RAILROAD	*3.515
24	8005	24	3	0.15 MI N OF FRED WILSON	S P RR & RAILROAD DR	*3.548
24	8007	24	1	0.1 MI E OF US 54	RAILROAD DR & S.P RR	*3.595
24	8013	24	1	1.1 MI E OF ALABAMA	ALTURA RD	*3.615
24	8046	24	9	0.02 MI S OF IH-10	SP RR	*3.627
24	8305	24	1	0.65 MI W OF SH 118	SUL ROSS AVE.	*3.783
24	8045	24	5	0.05 MI N SH 20	SPRR & SERVICE RD.	*3.853
24	8032	24	4	0.1 MI N OF FM 76	MESA DRAIN	3.854
24	8046	24	10	.03 MI. S. I-10	SP RR	*3.865
24	8046	24	11	0.02 MI E OF POPLAR ST.	TEXAS ST CONN.	*3.912
24	8016	24	243	2 MI S OF SH 20 (MESA)	IH-10 & SUNLAND PARK	*4.062
24	8039	24	1	JCT NEW MEXICO STATE LINE	RIO GRANDE RIVER	4.084
24	8020	24	3	0.2 MI S OF IH 10	S.P.R.R. (BATAAN)	*4.355
24	8009	24	6	0.2 MI N OF US 62	AIRWAY BLVD. (NB)	*4.377
24	8054	24	10	0.1 MI W OF SH20(ALAMEDA)	PLAYA DRAIN	4.832
24	8013	24	2	.02 MI E PERSHING DR.	GOV'T HILL DRAIN	4.852
24	8307	24	3	0.10 MI E OF SH 118	ALPINE CREEK	4.966
24	8305	24	2	0.15 MI W OF SH 118	ALPINE CREEK	5.037
24	8032	24	1	0.2 MI S OF SH 20	FRANKLIN CANAL	5.056
24	8032	24	3	0.1 MI N OF LOOP 375	PLAYA DRAIN	5.056
24	8033	24	5	JCT N LOOP	MESA DRAIN	5.056
24	8005	24	13	0.6 MI S OF DIANA DR.	DRAIN	5.097
24	8037	24	15	0.15 MI S OF SH 20	PLAYA DRAIN	5.105
24	8037	24	14	0.14 MI S OF SH 20	PLAYA DRAIN	5.127
24	8028	24	11	0.2 MI S OF IH-10	SP RR & ALBERTA	5.157
24	8016	24	6	0.7 MI E OF IH 10	BUENA VISTA CHANNEL	5.168
24	8016	24	7	0.7 MI E OF IH 10	BUENA VISTA CHANNEL	5.168
24	8044	24	9	0.25 MI E OF CROMO DR	BUENA VISTA DIV CHAN	5.233
24	8300	24	5	0.45 MI W OF 5TH ST	ALPINE CREEK	5.308
24		7	1	15.5MI SW END PVMT RM2810	PINTO CANYON	5.415