Improvements on Automated Routing of Overweight/Oversize Vehicles

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Improvements on Automated Routing of Overweight/Oversize Vehicles

by

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AUTOMATED ROUTING OF OVERWEIGHT VEHICLES
PHASE II

Conducted for
Texas Department of Transportation
in cooperation with
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The Center for Highway Materials Research
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16. Abstract

Improvements of GIS Software to perform automated routing of overweight/oversize vehicles for the Texas Department of Transportation are reported. Originally developed in Texas Department of Transportation (TxDOT) Research Study 0-1482, the software was incorporated with functional improvements to consider vehicle turn penalties, to obtain maximal-capacity routes and to speed up the computation process in determining routes by network partitioning. Also included in this report are (a) the description of the procedure to update the GIS information due to periodic changes in the BRINSAP database, and the geographic features of the On-system Highways of Texas as documented in digitized county maps; (b) a summary of observations made during the correction and verification of the bridge locations for all On-system bridges in Texas; and (c) installation and user's guides manual of the routing software. The software is intended to be used by the Motor Carrier Division (MCD) and the Design Division of TxDOT for the evaluation of bridges and clearances along routes of superheavy-vehicles.

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ABSTRACT

Improvements on the GIS Software to perform automated routing of overweight/oversize vehicles for the Texas Department of Transportation are reported. Originally developed for Texas Department of Transportation (TxDOT) in Research Study 0-1482, the software was incorporated with functional improvements to consider vehicle turn penalties, to obtain maximal-capacity routes and to speed up the computation process in determining routes by network partitioning. Also included in this report are (a) the description of the procedure to update the GIS information due to periodic changes in the BRINSAP database and the geographic features of the On-system Highways of Texas as documented in digitized county maps; (b) a summary of observations made during the correction and verification of the bridge locations for all On-system bridges in Texas; and (c) installation and user's guides manual of the routing software. The software is intended to be used by the Motor Carrier Division (MCD) and the Design Division of TxDOT for the evaluation of bridges and clearances along routes of superheavy-vehicles.

EXECUTIVE SUMMARY

The objective of this project was to develop an automatic procedure for evaluating the adequacy of bridges along routes for overweight/oversize vehicles. The procedure developed uses a network representation of the On-system roads to identify inadequate bridges in the vehicle's route. The network model is included within a Geographic Information System operating in the PC environment. The model was based on the On-system roadways and simulates the travel of vehicles within the On-system highways only. The system automatically finds a shortest path between an origin and a destination disabling segments with inadequate bridges due to capacity or clearances for a given overload/oversize vehicle.

The overweight vehicle is first analyzed according to the Texas Administrative Code requirements. If the vehicle fails to meet these requirements, then the determination of a route is performed evaluating the bridges using the Bridge Load Formulae and the rating and description parameters included in BRINSAP.

This report includes:

(a) A summary of the work accomplished by correcting for the bridge locations of all the bridges located on the On-system highways for the entire State of Texas.
(b) A description of improvements incorporated into the GIS routing program to consider turn-penalty information (the inability of large trucks to make sharp turns), to determine maximal-capacity routes, and to accelerate the computation time of determining routes.
(c) A discussion of update issues of BRINSAP and TxDOT County Urban Maps.
(d) A description of procedures to update the GIS information in the routing software due to the periodic releases on new versions of BRINSAP and County Urban files by TxDOT.
(e) An installation manual and a User's Guide for the Routing Software.

TABLE OF CONTENTS

Page

CHAPTER 1- INTRODUCTION
1.1 Introduction 1
1.2 Current Permitting Procedure 1
1.3 Summary of Projects 1266 and 1443 1
1.4 Summary of Project 1482 2
1.5 Objective 3
1.6 Scope of Report 4

CHAPTER 2- CORRECTION OF BRIDGE LOCATIONS
2.1 Introduction 5
2.2 BRINSAP Coordinate Problems and Information Available 5
2.3 Procedure to Correct Bridge Locations 6

CHAPTER 3- IMPROVEMENTS IN THE ROUTING MODEL
3.1 General 33
3.2 Description of the Overweight/Oversize Vehicle Routing Macro 33
3.3 Maximal-Capacity Route Procedure 35
3.4 Turn-Penalty Procedure 35
3.5 Network Partitioning Procedure 37
3.6 Summary 41

CHAPTER 4- PROCEDURES TO UPDATE GIS ROUTING FILES
4.1 Background 43
4.2 Typical BRINSAP Changes 43
4.3 Typical Changes in Road Maps (Urban files) and ROADS Database 44
4.4 GIS Files Update Procedure 44
4.5 Description and Preparation of Files Required for Updating 48
4.5.1 BRINSAP Files 48
4.5.2 Existing County GIS Files 49
4.5.3 TxDOT's County Urban Maps 49
4.6 Updating Tasks of County GIS Files 49
4.6.1 Task One: Backup Existing County GIS Files and Export Existing County BRINSAP 50
4.6.2 Task Two: Identification of New and Modified Links in the County Urban Base Maps 50
4.6.3 Task Three: Incorporate New Links to Road Network 51
4.6.4 Task Four: Comparison of New and Previous BRINSAP 52
4.6.5 Task Five: Update Relational Database 57

Page

4.7 Merge Updated GIS County Files 60
4.8 Problems With the Update Process 61
4.8.1 Problems Associated With ROADS Database 61
4.8.2 Problems Associated With the Urban Maps 64
4.8.3 Problems Associated With BRINSAP 65

CHAPTER 5- SUMMARY AND FUTURE WORK
5.1 Summary 71
5.2 Future Work 72

REFERENCES 73

APPENDIX A - OVERWEIGHT/OVERSIZE ROUTING SOFTWARE INSTALLATION GUIDE 74

APPENDIX B - OVERWEIGHT/OVERSIZE VEHICLE ROUTING PROGRAM USER'S GUIDE 80
B.1 Summary 80
B.2 Software Overview 80
B.3 Opening and Running the Routing Program 81
B.4 Reading a Network File and Selecting an Analysis Algorithm 81
B.5 Vehicle Information 82
B.6 Selection of Path Points 84
B.7 Determination of Route 85

APPENDIX C - OVR MACRO ROUTING REPORT ILLUSTRATING APPLICATIONS DISCUSSED IN CHAPTER 3 89

APPENDIX D - COMPARISON REPORT OF OLD BRINSAP WITH NEW BRINSAP FOR HOUSTON DISTRICT 92
Brazoria County 93
Fort Bend County 94
Galveston County 95
Harris County 96
Montgomery County 106
Waller County 107

LIST OF FIGURES

Figure		Page
2.1	Correction of BRINSAP Coordinates in a Highway Interchange	6
3.1	Overall Routing Procedure	34
3.2	Application of Maximal Capacity Algorithm	36
3.3	Application of Shortest-Path Algorithm using Turn-Penalty Information	38
3.4	Application of Shortest-Path Algorithm using Network Partitioning	40
4.1	General Flowchart for Update Process of the GIS Files for Vehicle Routing	46
4.2	Detailed Flowchart for Update Process of the GIS Files for Vehicle Routing	47
4.3	Case of GIS ROAD Network Updated with New Links	51
4.4	CompareBRG Program. Main Components	53
4.5	CompareBRG Report Format. Report for Fort Bend County	56
4.6	CompareB2R Program. Main Components	58
4.7	Road Network Update Process Including ROADS Database	63
4.8	Case of Repeated Links Identified between Previous and Latest Urban Maps	64

LIST OF TABLES

Table		Page
2.1	BRINSAP Observation Summaries for District 01 - Paris	8
2.2	BRINSAP Observation Summaries for District 02 - Fort Worth	9
2.3	BRINSAP Observation Summaries for District 03 - Wichita Falls	10
2.4	BRINSAP Observation Summaries for District 04 - Amarillo	11
2.5	BRINSAP Observation Summaries for District 05 - Lubbock	12
2.6	BRINSAP Observation Summaries for District 06 - Odessa	13
2.7	BRINSAP Observation Summaries for District 07 - San Angelo	14
2.8	BRINSAP Observation Summaries for District 08 - Abilene	15
2.9	BRINSAP Observation Summaries for District 09 - Waco	16
2.10	BRINSAP Observation Summaries for District 10 - Tyler	17
2.11	BRINSAP Observation Summaries for District 11 - Lufkin	18
2.12	BRINSAP Observation Summaries for District 12 - Houston	19
2.13	BRINSAP Observation Summaries for District 13 - Yoakum	20
2.14	BRINSAP Observation Summaries for District 14 - Austin	21
2.15	BRINSAP Observation Summaries for District 15 - San Antonio	22
2.16	BRINSAP Observation Summaries for District 16 - Corpus Christi	23
2.17	BRINSAP Observation Summaries for District 17 - Bryan	24
2.18	BRINSAP Observation Summaries for District 18 - Dallas	25
2.19	BRINSAP Observation Summaries for District 19 - Atlanta	26
2.20	BRINSAP Observation Summaries for District 20 - Beaumont	27
2.21	BRINSAP Observation Summaries for District 21 - Pharr	28
2.22	BRINSAP Observation Summaries for District 22 - Laredo	29
2.23	BRINSAP Observation Summaries for District 23 - Brownwood	30
2.24	BRINSAP Observation Summaries for District 24 - El Paso	31
2.25	BRINSAP Observation Summaries for District 25 - Childress	32
3.1	Computational Performance of Maximal-Capacity Algorithm	41
4.1	Weighted Optimization Table to Find Replaced/Rebuilt Bridges by Comparing the BRINSAP List of Removed Bridges to the List of Added Bridges	67
4.2	Weighted Optimization Table to Find Bridges Transferred from On- to Off-System and Vice Versa	70

CHAPTER 1

INTRODUCTION

1.1 Introduction

The Motor Carrier Division (MCD) of the Texas Department of Transportation (TxDOT) is in charge of issuing permits for overload and overweight vehicles for the state highways under its jurisdiction. These are referred to as the On-system highways. With the continuing increase in commerce and trade in Texas, the MCD continues to experience increases in the number of permits issued for oversize and overweight vehicles.

Some of the permit requests are for superheavy loads that is vehicles in excess of 300,000 pounds. The customary procedure for processing these requests is time consuming and costly. The process consists of (a) manually establishing a tentative route, (b) identifying all the bridges on the route, (c) obtain the information of the bridges to be crossed, and (d) analyzing for the structural adequacy of the bridge for the superheavy vehicle. Alternate routes are investigated, as some bridge structures are found inadequate. As an effort of reducing the time to process the permits, it is becoming customary to re-use portions of routes already analyzed for greater loads; an approach, which may create future problems due to repeated overloads.

1.2 Current Permitting Procedure

The current method MCD utilized for the routing of overweight/oversize vehicles is governed by the Texas Administrative Code [1] (TAC). These regulations limit the loads based on a gross axle weight criterion (which depends on the number of axles per axle group) and a tire load criterion of 650 lb per inch in of tire width. If either criterion is exceeded, MCD uses another method based on equivalent distributed loads to explore the adequacy of the vehicle. This method allows consideration of factors that provide greater distribution of the axle group's weight. The axle group weights are converted to an equivalent distributed load that is compared to a maximum value allowed. If the vehicle still fails to meet the criteria above, TxDOT's Design Division performs an analysis of the bridges along the vehicle's route to determine if a permit may still be issued. The significant drawback of analyzing each bridge is that the engineering efforts are time consuming and costly.

1.3 Summary of Projects 1266 and 1443

TxDOT sponsored Projects 1266 and 1443 to develop general formulae and procedures for issuing overload permits and to demonstrate the feasibility of an automated routing procedure. In project 1266 [2], formulae for limiting group weights passing over H15, H20 and HS20 simple span bridges were developed, and the feasibility of an automatic routing procedure through the use of network models [3,4] was demonstrated.

As a continuation, Project 1443 defined permit bridge load formulae applicable to bridges designed for the AASHTO H-type and HS-type axle configurations [5]. These efforts included

formulae for bridges that may have been designed by or reduced to designations other than H15, H20, HS-15 and HS-20 (i.e. HX or HSX). Two types of formulae were derived, a general formula, function of the vehicle configuration, and a bridge-specific formula that is additionally function of the span length [5]. These formulae were suitable for implementation in an automated route evaluation system.

1.4 Summary of Project 1482

In project 1482 [6,7], the work focused on research and procedures towards building an operational system to route overweight and oversize vehicles on the system roads of Texas (On-system highways). The system was developed using Geographic Information Systems (GIS) technology, implementing the current TAC procedures and overweight load formulae developed in project 1443.

To develop such system, a survey was required to determine and gather the available information needed for the GIS. The survey focused on available digitized maps, road databases, bridge databases and GIS software. The following decisions were made in project 1482:

1) Use the TxDOT official digitized maps available from the Graphic Office of the Planning Division. The main reason for this selection was because these drawings are the most complete drawings available, containing the geometric characteristics of overpasses, underpasses, interchanges and exit ramps, needed to perform a comprehensive routing through the On-system roads.

2) Use the TransCAD GIS software. This decision was primarily made because this particular software is specifically designed for Transportation applications. In addition, the software is easy to use and flexible for its customization to particular applications.

3) Use TxDOT's roads database attached to the official digitized maps.

4) Use TxDOT's Bride Inventory Inspection and Appraisal Program (BRINSAP) database. BRINSAP is the only bridge database available.

Two critical elements for the success of project 1482 were (a) to accurately account for the correct bridge at its correct location and (b) to have an accurate network of the roads along with the directional flow information.

The procedure utilized for the identification of the correct bridge location was as follows. A GIS map showing points at the BRINSAP longitude and latitude coordinates of the bridges was created. This map was superimposed on another map containing the On-system roads and bridge symbols as defined in the TxDOT's urban files. The superposition allowed for the manual identification of the correct bridge location, each bridge at a time. The BRINSAP bridge locations were verified and corrected based on the location information in the BRINSAP database, the bridge symbol locations of the urban files and the bridge locations indicated in printed maps for the corresponding county.

For the creation of an accurate GIS roads network, a process was developed to convert TxDOT drawings (i.e., urban files) to GIS maps and is described in details in Reference [6]. In summary, this was accomplished by exporting the Intergraph urban files with their corresponding roads database to a TransCAD format and writing and implementing several macro program within TransCAD to facilitate and speed-up the process of converting the "drawings" of the roads into a network of highways suitable for routing. The macros performed tasks such as deleting duplicate lines, correcting connection problems (overshoots and undershoots), transferring database information from the centerlines to the actual road links, definition of overpass and underpasses and the assignment of traffic flow directions for one-way and divided roads.

Once these two critical elements were addressed, a relational database was created between the roads and the BRINSAP databases to automatically identify bridges as functions of routes of vehicles.

Reference [6] also documents the development of a macro that utilizes the vehicle, bridge information and clearance information to route overweight loads using the shortest path and bypassing inadequate bridges and locations of restricted clearances. The procedure uses a network representation of a system of roads and bridges to identify feasible routes. In addition, the routing methodology was consistent with the Texas Administrative Code [1] provisions for legal loads. The approach uses bridge load formulae (BLF) developed by Keating, Litchfield and Zhou [5]. The system automatically finds a shortest path between an origin and a destination disabling segments with inadequate bridges due to capacity or clearances for a given overload/oversize vehicle.

The activities of project 1482 also consisted of (a) enhancing the operations of the routing macro, (b) improving the computational efficiency of the macro in determining feasible routes, (c) expanding the coverage of bridge location corrections, and (d) illustrating bridge management applications of the GIS system [6,7]. The modifications to enhance the routing software included the avoidance of U-turns, the computational procedure to evaluate bridges and sorting of bridges based on rating and the longest span length. Project 1482 culminated with a routing package for overweight/oversize vehicles operational for TxDOT's Houston District.

1.5 Objective

The objective of this document is to report on the progress of the activities undertaken in Study 0-1823 during its first year, towards the development of an automated routing system. The main goals of Project 0-1823 are to correct bridge locations for the entire state of Texas, to enhance the procedure performed by automatic routing macro developed in Project 1482, and to develop procedures for updating the GIS information related to the routing software.

1.6 Scope of Report

The following tasks define the scope of Project 0-1823:

(1) Modify the overweight routing program to make it more "operational" for routing purposes in the MCD.
(2) Correct for bridge locations for all districts of the State.
(3) Modify the routing macro to allow for the consideration of penalty turns, network partitioning, and routes with maximum capacity (defined as safety margins).
(4) Incorporate procedures to upgrade TxDOT databases such as BRINSAP.
(5) Investigate exporting the routing software program in an ARC/Info ARC/view platform.
(6) Convert routing software program to an ARC/Info ARC/view platform for Houston District.

Task (1) has been accomplished by making modifications of the software according to user's input. Personnel of the MCD of TxDOT are currently using the routing software.

Chapter 2 of this report includes a summary of the work accomplished under Task (2), completed for all 25 Districts of the State. Chapter 3 presents a summary of the work accomplished under Task (3). Chapter 4 is based on the work completed in Task (4).

Task (5) consisting of exploring the possibility of exporting the software from TransCAD to Arc/Info has been completed. Most critical TransCAD commands that the routing software utilizes have a similar command in the ARC/View software. Details of this task will be included in the final report.

Task (6) is the subject of the second year of Project 0-1823 and is not discussed in this report.

CHAPTER 2

CORRECTION OF BRIDGE LOCATIONS

2.1 Introduction

On of the most critical elements of the functionality of the routing model developed in this research is to have the correct bridge location properly placed on the correct link of the highway network. The BRINSAP database includes geographic longitude and latitude coordinates that have been entered into the database without a quality control procedure. As a result, some of the coordinates are incorrect. In addition, the coordinates do not have the accuracy needed to match the resolution of the GIS maps created for the routing software. For this reason, the proper location for each bridge in the State of Texas was corrected or verified. This Chapter presents a summary of observations made during the correction of the location of the bridges.

2.2 BRINSAP Coordinates Problems and Information Available

The BRINSAP database has been entered manually over the years. Each bridge has geographic coordinates in a degree-minute format accurate to one-tenth of a minute. However, the method used to determine the original BRINSAP coordinates was a manual interpolation using reference points in printed maps. The accuracy of the coordinates obtained with this method is nowhere near the one that can be obtained today with GPS technology. In contrast, TxDOT developed the County Urban Maps by digitizing USGS Satellite Quad images that are very accurate. In principle, if a bridge is properly located on the County Urban Maps, then accurate geographic coordinates are simultaneously obtained.

The information that was available to identify the correct geographic coordinates of the bridges was the following:

(a) Longitude and latitude coordinates in BRINSAP.
(b) Description of facility carried over, feature crossed, description of location and direction of travel inside BRINSAP.
(c) Bridge symbols indicating the presence of bridges on the road in the County Urban Maps.
(d) Printed maps for most of the Texas Districts indicating the bridge identification at the correct location.
(e) Printed County maps that contain the names of all On-system and Off-system roads along with other geographic features such as rivers, railroad crossings, creeks, etc.

In addition to inaccurate coordinates, some of the bridges in BRINSAP had missing and/or mistyped coordinates. Furthermore, some of BRINSAP's descriptions of location, facility carried over, and the feature crossed were incorrect for some bridges. The County Maps had their problem also; the maps showed bridge symbols at locations where there was no bridge, and for some locations, the bridge symbols were missing.

2.3 Procedure to Correct Bridge Locations

An effective procedure to correct the bridge longitude/latitude coordinates stored in BRINSAP was developed. The geographic coordinates coded in BRINSAP were used to create points on the GIS system indicating the potential location of the bridges. The On-System roads and the bridge symbols included in the geographically accurate Urban Maps were also imported to the GIS system. By overlaying the BRINSAP points and the roads and bridge symbols, the inaccuracies in the BRINSAP coordinates were obvious because the points and the symbols usually did not coincide (see Figure 2.1).

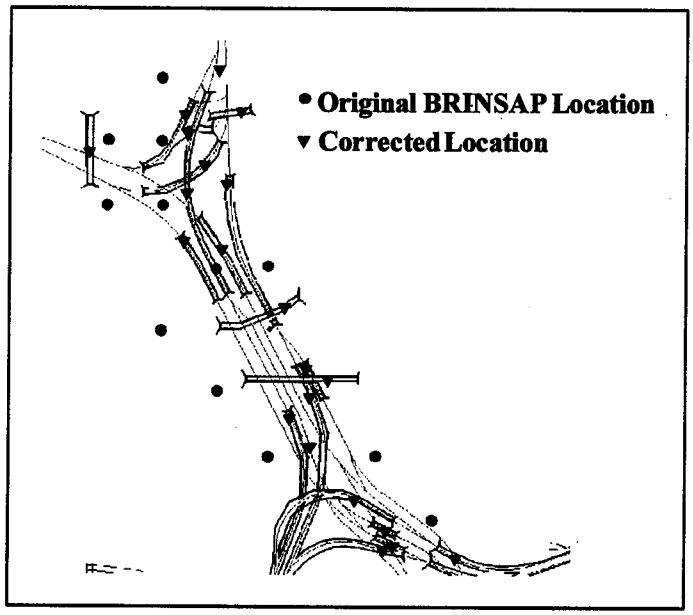


Figure 2.1 Correction of BRINSAP Coordinates in a Highway Interchange.

The following procedure for correcting the coordinates was used:

1) Every bridge in a county was considered one at a time.
2) Its location was first checked in printed maps that were provided by TxDOT's Design Division.
3) The BRINSAP information that provides the description and location of the bridge, such as feature crossed, facility carried over, location description, and etc. was revised.
4) The correct location was then found in the GIS maps, and the point corresponding to the bridge was moved to its correct location, automatically providing accurate longitude/latitude coordinates that were updated. For most bridges, the above procedure was sufficient to correctly locate them. However, for those bridges with missing bridge symbols, without coordinates, or in complicated interchanges, individual attention was required in the localization process. This process was very safe, however, it was time consuming.

During the process undertaken for correcting bridge locations, general observations on the bridge locations were meticulously documented. The observations were compiled in files containing

information pertaining to the identification and location of each bridge. The observation reports include the bridge identification (in ascending order), the BRINSAP Structure number, the check status, observations or comments regarding its location status, feature carried over, location description, original longitude and latitude coordinates and the updated or modified coordinates. Appendices A through F of Reference [6] contain the observation reports for the Houston District. The observation reports of Austin, Beaumont, Bryan, Dallas, Lufkin, Waco and Yoakum Districts can be found in Appendices A through G of Reference [7].

As of the end of fiscal year 1997-1998 the rest of the Districts in the State of Texas have been completed. However, due to extensive amount of information, the observation reports are not included in this report. Instead, a summary of the observation reports is listed in Tables 2.1 through 2.25, corresponding to all 25 Districts of the State.

The completion of this task demonstrated two major benefits for TxDOT:

1) A link was created between the BRINSAP data and the bridge locations on the base maps. This was performed by a clever utilization of the BRINSAP latitude / longitude and other BRINSAP data without the use of GPS receivers, and
2) By correcting BRINSAP longitude/latitude coordinates and merging BRINSAP to a GIS system, capabilities were developed to quickly display bridges as function of their attributes.

Table 2.1 BRINSAP Observation Summaries for District 01 – Paris

	Delta	Fannin	Franklin	Grayson	Hopkins	Hunt	Lamar	Rains	Red River	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Originally near another location	5	7		13	11	13	3	2	3	**57**
Originally outside of the boundary	3				9	3			2	**17**
Uncertain direction				53		65				**118**
Uncertain location							2		1	**3**
Uncertain overpass				27	10					**37**
Uncertain underpass				3						**3**
Missing bridge	6					11	6	1	1	**25**
Missing boulevard/road						1				**1**
Two structures have the same DGN symbol										**0**
Wrong reference to location distance (F9)										**0**
Reference F9 location not on map										**0**
Moved to uncertain position										**0**
Cannot measure from referenced FM										**0**
Either wrong feature crossed or carry over				10						**10**
Wrong reference F6_1 FEATXE										**0**
Unspecified location	2		2		2	16		4	1	**27**
Unspecified underpass		8				8				**16**
Unspecified overpass		2				14				**16**
Unspecified up/op										**0**
Unspecified direction	2									**2**
Assumption neded for correct location										**0**
Reference F9 distance off or junction incorrect										**0**
Inverted Heading									3	**3**
TOTAL	**18**	**17**	**2**	**106**	**32**	**131**	**11**	**7**	**11**	**335**
TOTAL NUM. OF RECORDS W/ERROR	**17**	**15**	**2**	**103**	**32**	**112**	**11**	**7**	**11**	**310**
TOTAL BRINSAP RECORDS	**64**	**156**	**51**	**257**	**172**	**287**	**178**	**34**	**119**	**1318**
% ERROR	**27%**	**10%**	**4%**	**40%**	**19%**	**39%**	**6%**	**21%**	**9%**	**24%**

Table 2.2 BRINSAP Observation Summaries for District 02 - Forth Worth

	Erath	Hood	Jack	Johnson	Palo Pinto	Parker	Somervell	Tarrant	Wise	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Originally near another location	3	5	4	12		7		154	14	**199**
Originally out of county boundary	6	1	2	14	3	2	1	208	1	**238**
Uncertain direction								4		**4**
Uncertain location								4		**4**
Uncertain overpass								3		**3**
Uncertain underpass								2		**2**
Missing bridge	1		1	29	5	13		245	5	**299**
Missing boulevard/road				5		1		8	1	**15**
Two structures have the same DGN symbol										**0**
Wrong reference to location distance (F9)				12					1	**13**
Reference F9 location not on map										**0**
Moved to uncertain position										**0**
Cannot measure from referenced FM										**0**
Either wrong feature crossed or carry over										**0**
Wrong reference F6_1 FEATXE										**0**
Unspecified location								3	1	**4**
Unspecified underpass					3			19		**22**
Unspecified overpass								2		**2**
Unspecified up/op										**0**
Unspecified direction		2								**2**
Assumption neded for correct location										**0**
Reference F9 distance off or junction incorrect		3								**3**
Inverted Heading					1			6		**7**
One structure has two DGN symbols										**0**
Incorrect location description										**0**
Unknown location description										**0**
TOTAL	**10**	**11**	**7**	**72**	**12**	**23**	**1**	**658**	**23**	**817**
TOTAL NUM. OF RECORDS W/ERROR	**10**	**10**	**7**	**55**	**11**	**20**	**1**	**438**	**23**	**575**
TOTAL BRINSAP RECORDS	**110**	**55**	**76**	**191**	**180**	**153**	**23**	**1187**	**126**	**2101**
% ERROR	**9%**	**18%**	**9%**	**29%**	**6%**	**13%**	**4%**	**37%**	**18%**	**27%**

Table 2.3 BRINSAP Observation Summaries for District 03 - Wichita Falls

	Archer	Baylor	Clay	Cooke	Montague	Throckmorton	Wichita	Wilbarger	Young	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Originally near another location			4	4	3		15	8	1	**35**
Originally outside of the boundary	1	1	1	10	9		25	3		**50**
Uncertain direction			7	4			14	6		**31**
Uncertain location										**0**
Uncertain overpass										**0**
Uncertain underpass							2			**2**
Missing bridge	2	1	4	9	4	2	37	3	7	**69**
Missing boulevard/road				6	3		4			**13**
Two structures have the same DGN symbol										**0**
Wrong reference to location distance (F9)										**0**
Reference F9 location not on map										**0**
Moved to uncertain position										**0**
Cannot measure from referenced FM										**0**
Either wrong feature crossed or carry over										**0**
Wrong reference F6_1 FEATXE										**0**
Unspecified location	7	5	6	6		2			5	**31**
Unspecified underpass							23			**23**
Unspecified overpass							3			**3**
Unspecified up/op									2	**2**
Unspecified direction					8					**8**
Assumption neded for correct location										**0**
Incorrect location description										**0**
Unknown location description										**0**
Incomplete bridge symbol										**0**
TOTAL	**10**	**7**	**22**	**39**	**27**	**4**	**123**	**20**	**15**	**267**
TOTAL NUM. OF RECORDS W/ERROR	**10**	**7**	**22**	**27**	**25**	**4**	**85**	**20**	**14**	**214**
TOTAL BRINSAP RECORDS	**83**	**39**	**122**	**140**	**104**	**45**	**304**	**119**	**84**	**1040**
% ERROR	**12%**	**18%**	**18%**	**19%**	**24%**	**9%**	**28%**	**17%**	**17%**	**21%**

Table 2.4 BRINSAP Observation Summaries for District 04 - Amarillo

	Armstrong	Carson	Dallam	Deaf Smith	Gray	Hansford	Hartley	Hemphill	Hutchinson	Lipscomb	Moore	Ochiltree	Oldham	Potter	Randall	Roberts	Sherman	TOTAL
Types of Observations:	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors
Originally near another location			1	2					5			1		36	3	1		49
Originally outside of the boundary					7	1			2		1			4	5			20
Uncertain direction					4			3			7		6	23	14		2	59
Uncertain location	1			1		2					1			5	1	1		12
Uncertain overpass																		0
Uncertain underpass																		0
Uncertain up/op														1				0
Missing bridge		26	3	6	12	3	1		5				3	14	4	1		78
Missing boulevard/road																		0
Two structures have the same DGN symbol																		0
Wrong reference to location distance (F9)																		0
Reference F9 location not on map																		0
Moved to uncertain position																		0
Cannot measure from referenced FM																		0
Either wrong feature crossed or carry over																		0
Wrong reference F6_1 FEATXE																		0
Unspecified location	2	1			1					1					2			7
Unspecified underpass																		0
Unspecified overpass																		0
Unspecified up/op	1																	1
Unspecified direction														2				2
Assumption needed for correct location																		0
Reference F9 distance off or junction incorrect																		0
Inverted Heading						1			3									4
One structure has two DGN symbols																		0
TOTAL	4	27	4	9	24	7	1	3	15	1	9	1	9	85	29	3	2	232
TOTAL NUM OF RECORDS W/ERROR	4	27	3	8	19	6	1	3	19	1	9	1	9	75	29	3	2	219
TOTAL BRINSAP RECORDS	11	35	22	25	62	30	16	30	39	37	23	24	53	186	86	21	25	725
%ERROR	36%	77%	14%	32%	31%	20%	6%	10%	49%	3%	39%	4%	17%	40%	34%	14%	8%	30%

Table 2.5 BRINSAP Observation Summaries for District 05 - Lubbock

	Bayley	Castro	Crosby	Dawson	Floyd	Garza	Hale	Hockley	Lamb	Lubbock	Lynn	Parmer	Swisher	Terry	Cochran	Gaines	Yoakum	TOTAL
Types of Observations:	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors
Originally near another locatior			1				1			6			2					10
Originally outside of the boundary		2			1					1								4
Uncertain directior																		0
Uncertain locatior													1					1
Uncertain overpass																		0
Uncertain underpass																		0
Missing bridge		1	1						1	21			4	2				30
Missing boulevard/road										2								2
Two structures have the same DGN symbol																		0
Wrong reference to location distance (F9)																		0
Reference F9 location not on map																		0
Moved to uncertain positior																		0
Cannot measure from referenced FM																		0
Either wrong feature crossed or carry over																		0
Wrong reference F6_1 FEATXE																		0
Unspecified location							1			1		2	1					5
Unspecified underpass										2								2
Unspecified overpass						1												1
Unspecified up/op																		0
Unspecified direction							2			2		4		2				10
Assumption neded for correct locatior																		0
Reference F9 distance off or junction incorrect																		0
Inverted Heading													2					2
One structure has two DGN symbols																		0
Incorrect location descriptior																		0
Unknown location descriptior																		0
Incomplete bridge symbol																		0
TOTAL	0	3	2	0	1	1	4	0	1	35	0	6	10	4	0	0	0	67
TOTAL NUM OF RECORDS W/ERROR	0	3	2	0	1	1	4	0	1	32	0	4	9	4	0	0	0	61
TOTAL BRINSAP RECORDS	4	10	11	3	10	48	47	3	14	190	5	23	68	5	0	0	0	441
%ERROR	0%	30%	18%	0%	10%	2%	9%	0%	7%	17%	0%	17%	13%	80%	0%	0%	0%	14%

Table 2.6 BRINSAP Observation Summaries for District 06 - Odessa

	Andrew	Crane	Ector	Loving	Martin	Midland	Pecos	Reeves	Terrell	Upton	Ward	Winkler	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Originally near another location			2		1	3	89						**95**
Originally outside of the boundary			7			7	7	2			2		**25**
Uncertain direction							1				2		**3**
Uncertain location							1				1		**2**
Uncertain overpass													**0**
Uncertain underpass					1		19		2				**22**
Missing bridge			8		5	8	38	26	13	1	6		**105**
Missing entrance ramp							1						**1**
Missing boulevard/road						1	1	4					**6**
Two structures have the same DGN symbol								1					**0**
Wrong reference to location distance (F9)													**0**
Reference F9 location not on map													**0**
Moved to uncertain position													**0**
Cannot measure from referenced FM													**0**
Either wrong feature crossed or carry over													**0**
Wrong reference F6_1 FEATXE													**0**
Unspecified location													**0**
Unspecified underpass													**0**
Unspecified overpass													**0**
Unspecified up/op													**0**
Unspecified direction													**0**
Assumption neded for correct location													**0**
Reference F9 distance off or junction incorrect													**0**
Incomplete bridge symbol								1					**1**
Inverted Heading													**0**
Incorrect location description													**0**
Unknown location description													**0**
TOTAL	**0**	**0**	**17**	**0**	**7**	**19**	**157**	**34**	**15**	**1**	**11**	**0**	**260**
TOTAL NUM. OF RECORDS W/ERROR		**0**	**17**	**0**	**7**	**21**	**140**	**32**	**13**	**1**	**10**	**0**	**241**
TOTAL BRINSAP RECORDS	**0**	**19**	**110**	**4**	**14**	**72**	**466**	**208**	**52**	**39**	**54**	**1**	**1039**
% ERROR	**0%**	**0%**	**15%**	**0%**	**50%**	**29%**	**30%**	**15%**	**25%**	**3%**	**19%**	**0%**	**23%**

Table 2.7 BRINSAP Observation Summaries for District 07 - San Angelo

	Coke	Concho	Crockett	Edwards	Glasscock	Irion	Kimble	Menard	Reagan	Real	Runnels	Schleicher	Sterling	Sutton	Tom Green	TOTAL
Types of Observations:	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors
Originally near another location	4	3	20		13		17				8				5	65
Originally outside of the boundary		1	3	2			5		1		2				22	14
Uncertain direction																0
Uncertain location			1												1	1
Uncertain overpass																0
Uncertain underpass	1	3	2			6			7		1					20
Missing bridge		4	12	1	1		12	3				3	2	2	33	36
Missing entrance ramp																0
Missing boulevard/road			1												36	1
Two structures have the same DGN symbol																0
Wrong reference to location distance (F9)																0
Reference F9 location not on map																0
Moved to uncertain position																0
Cannot measure from referenced FM																0
Either wrong feature crossed or carry over																0
Unspecified heading							2									2
Wrong reference F6_1 FEATXE																0
Unspecified location			6			6								2		12
Unspecified underpass			6				5	3	2				1	16		16
Unspecified overpass							1		1							2
Unspecified up/op															2	0
Unspecified direction																0
Assumption needed for correct location																0
Reference F9 distance off or junction incorrect			2													2
Inverted Heading																0
Incorrect location description																0
TOTAL	5	11	53	3	14	12	42	6	11	0	11	3	3	20	99	171
TOTAL NUM OF RECORDS W/ERROR	4	10	51	3	14	12	41	5	11	0	11	3	2	18	82	165
TOTAL BRINSAP RECORDS	82	66	161	24	26	50	143	60	26	25	112	28	56	90	240	803
%ERROR	5%	15%	32%	13%	54%	24%	29%	8%	42%	0%	10%	11%	4%	20%	34%	21%

Table 2.8 BRINSAP Observation Summaries for District 08 - Abilene

	Borden	Callahan	Fisher	Haskell	Jones	Kent	Mitchell	Nolan	Scurry	Shakelford	Stonewall	Taylor	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Brn moved to DGN position													
Originally near another location		4	5	1	1		3	5		3		5	27
Originally outside of the boundary	1	5	1	3	11		1	2	10	1	1	10	46
Uncertain direction													0
Uncertain location		1			1				1			2	5
Uncertain overpass													0
Uncertain underpass					1								1
Missing bridge		2	3	9	3	1	7	7	2	1	5	22	62
Missing entrance ramp													0
Missing boulevard/road													0
Two structures have the same DGN symbol													
Wrong reference to location distance (F9)													0
Reference F9 location not on map													0
Moved to uncertain position													0
Cannot measure from referenced FM													0
Either wrong feature crossed or carry over													0
Unspecified heading													0
Wrong reference F6_1 FEATXE													0
Unspecified location	1		2									9	12
Unspecified underpass	4		1									6	11
Unspecified overpass													0
Unspecified up/op													0
Unspecified direction												2	2
Assumption neded for correct location													0
Inverted Heading													0
Incorrect location description													0
Unknown location description													0
TOTAL	**6**	**12**	**12**	**13**	**17**	**1**	**11**	**14**	**13**	**5**	**6**	**56**	**166**
TOTAL NUM. OF RECORDS W/ERROR	**6**	**12**	**12**	**13**	**17**	**1**	**11**	**14**	**13**	**5**	**6**	**51**	**161**
TOTAL BRINSAP RECORDS	**49**	**140**	**77**	**61**	**122**	**25**	**120**	**137**	**94**	**68**	**36**	**331**	**1260**
% ERROR	**12%**	**9%**	**16%**	**21%**	**14%**	**4%**	**9%**	**10%**	**14%**	**7%**	**17%**	**15%**	**13%**

Table 2.9 BRINSAP Observation Summaries for District 09 - Waco

	Bell	Bosque	Coryell	Falls	Hamilton	Hill	Limestone	Mc Lennan	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Originally near another location	12		1	2		1	8	33	**57**
Originally outside of the boundary	10	1	2	3		5	5	11	**37**
Uncertain direction	6							4	**10**
Uncertain location								1	**1**
Uncertain overpass									**0**
Uncertain underpass									**0**
Missing bridge	32	6	7	15	1	7	3	50	**121**
Missing entrance ramp									**0**
Missing boulevard/road	4			2		2		12	**20**
Two structures have the same DGN symbol									**0**
Wrong reference to location distance (F9)									**0**
Reference F9 location not on map									**0**
verified position, o.k.									**0**
Location description incomplete									**0**
Cannot measure from referenced FM									**0**
Either wrong feature crossed or carry over									**0**
Uncertain F7FACCARRD	1						1		**0**
Unspecified heading									**0**
Wrong reference F6_1 FEATXE									**0**
Unspecified location		4			1	5			**10**
Unspecified underpass		1							**1**
Unspecified overpass					1				**1**
Unspecified up/op						5			**5**
Unspecified direction									**0**
Assumption neded for correct location									**0**
Reference F9 distance off or junction incorrect									**0**
Inverted Heading									**0**
TOTAL	**65**	**12**	**10**	**22**	**3**	**25**	**17**	**111**	**263**
TOTAL NUM. OF RECORDS W/ERROR	**62**	**11**	**51**	**19**	**3**	**22**	**16**	**91**	**275**
TOTAL BRINSAP RECORDS	**343**	**110**	**161**	**152**	**80**	**245**	**131**	**419**	**1641**
% ERROR	**18%**	**10%**	**32%**	**13%**	**4%**	**9%**	**12%**	**22%**	**17%**

Table 2.10 BRINSAP Observation Summaries for District 10 - Tyler

	Anderson	Cherokee	Gregg	Henderson	Rusk	Smith	Van Zandt	Wood	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Originally near another location	4				1	21	5		**31**
Originally outside of the boundary			17	4	5	1			**27**
Uncertain direction	2						2		**4**
Uncertain location	2		1			8	1		**12**
Uncertain overpass									**0**
Uncertain underpass									**0**
Missing bridge		4	6	4	7	1	5	2	**29**
Missing entrance ramp									**0**
Missing boulevard/road			1			1			**2**
Wrong reference F102DIRTRA									**0**
Two structures have the same DGN symbol									**0**
Wrong reference to location distance (F9)						4			**4**
Reference F9 location not on map									**0**
Moved to uncertain position									**0**
Cannot measure from referenced FM									**0**
Wrong F7 FACCARD									**0**
Either wrong feature crossed or carry over						18	9		**27**
Incorrect location			2						**0**
Incorrect distance			5						**0**
Unspecified heading									**0**
Wrong reference F6_1 FEATXE									**0**
Unspecified location				3	1				**4**
Unspecified underpass		6	17	23	8				**54**
Unspecified overpass			3	1	3				**7**
Unspecified up/op									**0**
Unspecified direction									**0**
Reference F9 distance off or junction incorrect									**0**
TOTAL	**8**	**10**	**52**	**35**	**25**	**54**	**22**	**2**	**201**
TOTAL NUM. OF RECORDS W/ERROR	**8**	**7**	**43**	**34**	**25**	**57**	**21**	**5**	**200**
TOTAL BRINSAP RECORDS	**113**	**121**	**134**	**144**	**151**	**206**	**183**	**60**	**1112**
% ERROR	**7%**	**6%**	**32%**	**24%**	**17%**	**28%**	**11%**	**8%**	**18%**

Table 2.11 BRINSAP Observation Summaries for District 11 – Lufkin

	Angelina	Houston	Nachogdoches	Polk	Sabine	San Augustine	San Jacinto	Shelby	Trinity	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Originally near another location			2		1		1		1	5
Originally outside of the boundary										0
Inverted heading										0
Uncertain direction	6			6						12
Uncertain location	1	5	1							7
Uncertain overpass										0
Uncertain underpass										0
Missing bridge	2	3	2		1	2	3	1	2	16
Missing boulevard/road	1					1		1		3
Unspecified direction										0
Unspecified location										0
Unspecified overpass										0
Unspecified underpass					2	1	1	3		7
Two structures have the same DGN symbol										0
Reference not located within county line										0
Switched overpass/underpass										0
Incorrect location description	18	16	10	11	3	7	5	2	6	0
One bridge for two structures										0
Verified position, o.k.										0
Overpass description does not match										0
TOTAL	**28**	**24**	**15**	**17**	**7**	**11**	**10**	**7**	**9**	**50**
TOTAL NUM. OF RECORDS W/ERROR	**27**	**21**	**15**	**15**	**7**	**10**	**6**	**10**	**9**	**120**
TOTAL BRINSAP RECORDS	**106**	**96**	**123**	**118**	**62**	**43**	**102**	**73**	**56**	**779**
% ERROR	**25%**	**22%**	**12%**	**13%**	**11%**	**23%**	**6%**	**14%**	**16%**	**15%**

Table 2.12 BRINSAP Observation Summaries for District 12 - Houston

	Brazoria	Fort Bend	Galveston	Harris	Montgomery	Waller	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Originally near another location	14	4	8	89	24	1	**140**
Originally outside of the boundary	17	34	16	432	17	12	**528**
Inverted heading							**0**
Uncertain direction				31			**31**
Uncertain location			1		14		**15**
Uncertain overpass				1			**1**
Uncertain underpass							**0**
Missing bridge		10		464		10	**484**
Missing boulevard/road	16		9	169			**194**
Unspecified direction	8						**8**
Unspecified location				2			**2**
Unspecified overpass							**0**
Unspecified underpass							**0**
Two structures have the same DGN symbol				20			**20**
Reference not located within county line							**0**
Switched overpass/underpass							**0**
Incorrect location description							**0**
One bridge for two structures							**0**
Verified position, o.k.							**0**
Overpass description does not match							**0**
TOTAL	**55**	**48**	**34**	**1208**	**55**	**23**	**1423**
TOTAL NUM. OF RECORDS W/ERROR	**71**	**75**	**69**	**695**	**54**	**20**	**984**
TOTAL BRINSAP RECORDS	**262**	**245**	**190**	**1848**	**241**	**105**	**2891**
% ERROR	**27%**	**31%**	**36%**	**38%**	**22%**	**19%**	**34%**

Table 2.13 BRINSAP Observation Summaries for District 13 - Yoakum

	Austin	Calhoun	Colorado	De Witt	Fayette	Gonzales	Jackson	Lavaca	Matagorda	Victoria	Wharton	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Originally near another location	1	2	19	5	4	1	3	2	2	1	2	40
Originally outside of the boundary		1	2	5	11	5	6	1	1	27	22	59
Inverted heading												0
Uncertain direction									10			10
Uncertain location												0
Uncertain overpass												0
Uncertain underpass												0
Missing bridge	1		1	3	4	7	5	3	16	18	6	58
Missing boulevard/road				1		2	2		4	13	7	22
Unspecified direction												0
Unspecified location												0
Unspecified overpass												0
Unspecified underpass												0
Two structures have the same DGN symbol												0
Switched overpass/underpass												0
Location description is incomplete												0
Verified position, o.k.												0
Overpass description does not match												0
TOTAL	**2**	**3**	**22**	**14**	**19**	**15**	**16**	**6**	**33**	**59**	**37**	**189**
TOTAL NUM. OF RECORDS W/ERROR	**2**	**3**	**22**	**12**	**18**	**11**	**12**	**6**	**29**	**33**	**36**	**184**
TOTAL BRINSAP RECORDS	**105**	**73**	**153**	**146**	**232**	**237**	**128**	**119**	**88**	**169**	**180**	**1630**
% ERROR	**2%**	**4%**	**14%**	**8%**	**8%**	**5%**	**9%**	**5%**	**33%**	**20%**	**20%**	**11%**

Table 2.14 BRINSAP Observation Summaries for District 14 - Austin

	Bastrop	Blanco	Burnet	Caldwell	Gillespie	Hays	Lee	Llano	Marion	Travis	Williamson	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Originally near another location										7		7
Originally outside of the boundary	2	1	2	2	10	6		1	1	91	9	116
Inverted heading	1		1			1	7		1	7	2	18
Uncertain direction										2		2
Uncertain location										4	2	4
Uncertain overpass										1		1
Uncertain underpass	2											2
Missing bridge	21		3	2	10	21	2	8		131	19	198
Missing boulevard/road				1		4				84	5	89
Unspecified direction										1		1
Unspecified location											1	0
Unspecified overpass										2	4	2
Unspecified underpass				1			2				93	3
Two structures have the same DGN symbol	4									3	2	7
Reference not located within county line						1						1
Switched overpass/underpass												0
Incorrect location description							3					3
Verified position, o.k.												0
Overpass description does not match												0
TOTAL	**30**	**1**	**6**	**6**	**20**	**33**	**14**	**9**	**2**	**333**	**137**	**454**
TOTAL NUM. OF RECORDS W/ERROR	**25**	**1**	**5**	**4**	**13**	**22**	**14**	**11**	**2**	**153**	**113**	**363**
TOTAL BRINSAP RECORDS	**118**	**55**	**79**	**94**	**95**	**102**	**61**	**71**	**74**	**548**	**305**	**1602**
% ERROR	**21%**	**2%**	**6%**	**4%**	**14%**	**22%**	**23%**	**15%**	**3%**	**28%**	**37%**	**23%**

Table 2.15 BRINSAP Observation Summaries for District 15 - San Antonio

	Atascosa	Bandera	Bexar	Comal	Frio	Guadalupe	Kendall	Kerr	McNullen	Medina	Uvalde	Wilson	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Originally near another location	6	4	97	4	2	9	2	5		1	2	4	130
Originally outside of the boundary			131	11	17	2	5	11		7	5	1	184
Inverted heading	3	1				1		1					6
Uncertain direction													0
Uncertain location			17										17
Uncertain overpass			3										3
Uncertain underpass		1	15	2		1		3					22
Missing bridge	21	2	296	32	13	40	2	9		13	4	13	428
Missing boulevard/road	1		13			2							16
Unspecified direction								1					1
Unspecified location													0
Unspecified overpass		3	6	1		4	4	1				1	19
Unspecified underpass	2	1	59	7	1	5	6	4	2	5	2	1	92
Two structures have the same DGN symbol													0
Reference not located within county line													0
Switched overpass/underpass						1							1
Incorrect location description													0
One bridge for two structures			4										4
Verified position, o.k.													0
Overpass description does not match													0
TOTAL	**33**	**12**	**641**	**57**	**33**	**65**	**19**	**35**	**2**	**26**	**13**	**20**	**923**
TOTAL NUM. OF RECORDS W/ERROR	**31**	**11**	**450**	**49**	**33**	**61**	**18**	**31**	**2**	**21**	**11**	**18**	**718**
TOTAL BRINSAP RECORDS	**144**	**55**	**1313**	**130**	**123**	**194**	**80**	**137**	**52**	**143**	**78**	**93**	**2542**
% ERROR	**22%**	**20%**	**34%**	**38%**	**27%**	**31%**	**23%**	**23%**	**4%**	**15%**	**14%**	**19%**	**28%**

Table 2.16 BRINSAP Observation Summaries for District 16 - Corpus Christi

	Aransas	Bee	Goliad	Jim Wells	Karnes	Kleberg	Live Oak	Nueces	Refugio	San Patricio	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Originally outside of the boundary	2									11	**13**
Uncertain direction	2			20		17	15	2	2	2	**60**
Uncertain location				1							**1**
Uncertain overpass							3				**3**
Uncertain underpass				6		4	13		5		**28**
Inverted heading								1			**1**
Missing bridge	1	2		1			13	15	1	22	**55**
Missing boulevard		1								6	**7**
Unspecified direction		18					2			19	**39**
Unspecified location		21				4	3			50	**78**
Unspecified overpass	2									3	**5**
Unspecified underpass		9	7		9					2	**27**
Two structures have the same DGN symbol											**0**
Incorrect location description											**0**
TOTAL	**7**	**51**	**7**	**28**	**9**	**25**	**49**	**18**	**8**	**115**	**317**
TOTAL NUM. OF RECORDS W/ERROR	**5**	**39**	**7**	**28**	**9**	**21**	**44**	**17**	**8**	**90**	**268**
TOTAL BRINSAP RECORDS	**9**	**107**	**72**	**111**	**105**	**43**	**193**	**309**	**107**	**158**	**1214**
% ERROR	**56%**	**36%**	**10%**	**25%**	**9%**	**49%**	**23%**	**6%**	**7%**	**57%**	**22%**

Table 2.17 BRINSAP Observation Summaries for District 17 - Bryan

	Brazos	Burleson	Freestone	Grimes	Leon	Madison	Milam	Robertson	Walker	Washington	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Originally near another location		2		1	3	5	12		8	1	**32**
Originally outside of the boundary	12	2	2	3		3	2		3	6	**33**
Inverted heading	3		2								**5**
Uncertain direction					2				3		**5**
Uncertain location				1			1		4	11	**17**
Uncertain overpass										3	**3**
Uncertain underpass											**0**
Missing bridge	13	2	7	6	7		2		1	1	**39**
Missing boulevard/road	5			3						2	**10**
Unspecified direction				6		2					**8**
Unspecified location	1		1								**2**
Unspecified overpass	2					2	9				**13**
Unspecified underpass						5	5			4	**14**
Two structures have the same DGN symbol											**0**
Switched overpass/underpass	1										**1**
Location description is incomplete											**0**
Verified position, o.k.											**0**
Overpass description does not match										1	**1**
TOTAL	**37**	**6**	**12**	**20**	**12**	**17**	**31**	**0**	**19**	**29**	**183**
TOTAL NUM. OF RECORDS W/ERROR	**24**	**6**	**12**	**13**	**12**	**17**	**28**	**0**	**17**	**29**	**158**
TOTAL BRINSAP RECORDS	**152**	**75**	**116**	**119**	**130**	**103**	**130**	**88**	**108**	**94**	**1115**
% ERROR	**16%**	**8%**	**10%**	**11%**	**9%**	**17%**	**22%**	**0%**	**16%**	**31%**	**14%**

Table 2.18 BRINSAP Observation Summaries for District 18 - Dallas

	Collin	Dallas	Denton	Ellis	Kaufman	Navarro	Rockwall	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Originally near another location	23	56			28	8	3	**118**
Originally outside of the boundary	75	575	30		5		6	**691**
Inverted heading	5	3						**8**
Uncertain direction	2	24	14		2			**42**
Uncertain location	1	166	2		6		2	**177**
Uncertain overpass		67						**67**
Uncertain underpass		38						**38**
Missing bridge	102	680	55	7	22	9	23	**898**
Missing boulevard/road	18	214	9	2		2		**245**
Unspecified direction		20		6	1	1		**28**
Unspecified location	4	12			1			**17**
Unspecified overpass		101	76	64	1	36		**278**
Unspecified underpass	21	73	41	26	2	12	4	**179**
Two structures have the same DGN symbol								**0**
Location description is incomplete								**0**
Verified position, o.k.								**0**
Inverted bridge symbol		2						**2**
Incorrect underpass		4						**4**
Incorrect street name		2						**2**
Moved to uncertain position			2					**2**
Checked dgn position								**0**
One structure has two dgn symbols				1				**1**
Switched information			1					**1**
Wrong distance			1	1	1			**3**
TOTAL	**251**	**2037**	**231**	**107**	**69**	**68**	**38**	**2801**
TOTAL NUM. OF RECORDS W/ERROR	**144**	**1109**	**170**	**99**	**58**	**57**	**30**	**1667**
TOTAL BRINSAP RECORDS	**352**	**2000**	**407**	**419**	**366**	**227**	**55**	**3826**
% ERROR	**41%**	**55%**	**42%**	**24%**	**16%**	**25%**	**55%**	**44%**

Table 2.19 BRINSAP Observation Summaries for District 19 - Atlanta

	Bowie	Camp	Cass	Harrison	Marion	Morris	Panola	Titus	Upshur	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Originally near another location	31	2	10	19		1	7	6	11	**87**
Originally outside of the boundary						2		2		**4**
Uncertain direction	30					10		10		**50**
Uncertain location	1	1		1					1	**4**
Missing bridge	4	1	1	11				1	5	**23**
Missing boulevard/road	3			8					4	**15**
Two structures have the same DGN symbol										**0**
Wrong reference to location distance (F9)										**0**
Reference F9 location not on map										**0**
Moved to uncertain position		2								**2**
Cannot measure from referenced FM										**0**
Either wrong feature crossed or carry over										**0**
Wrong reference F6_1 FEATXE										**0**
TOTAL	**69**	**6**	**11**	**39**	**0**	**13**	**7**	**19**	**21**	**185**
TOTAL NUM. OF RECORDS W/ERROR	**68**	**6**	**11**	**23**	**0**	**13**	**12**	**17**	**21**	**171**
TOTAL BRINSAP RECORDS	**239**	**38**	**133**	**214**	**49**	**51**	**128**	**103**	**132**	**1087**
% ERROR	**28%**	**16%**	**8%**	**11%**	**0%**	**25%**	**9%**	**17%**	**16%**	**16%**

Table 2.20 BRINSAP Observation Summaries for District 20 - Beaumont

	Chambers	Hardin	Jasper	Jefferson	Liberty	Newton	Orange	Tyler	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Originally near another location	8	5	2	10	5	8		2	40
Originally outside of the boundary				2					2
Uncertain location				8		1	3		12
Uncertain overpass				3					3
Missing bridge	16	54	6	48	8		96	2	230
Missing boulevard/road		3	5	40			11		59
Unspecified direction							2		2
Two structures have the same DGN symbol									0
Location description incorrect	1			2	1	4			8
Location description incomplete						1			1
Incorrect FACCARR				5	3				8
Moved short distance to correct location (ie. FR to ML)	25								25
Moved greater distance to correct location (ie. Moved to new location)	4								4
TOTAL	**54**	**62**	**13**	**118**	**17**	**14**	**112**	**4**	**394**
TOTAL NUM. OF RECORDS W/ERROR	**34**	**54**	**8**	**91**	**16**	**14**	**99**	**4**	**320**
TOTAL BRINSAP RECORDS	**109**	**110**	**133**	**296**	**136**	**112**	**116**	**74**	**1086**
% ERROR	**31%**	**49%**	**6%**	**31%**	**12%**	**13%**	**85%**	**5%**	**29%**

Table 2.21 BRINSAP Observation Summaries for District 21 - Pharr

	Brooks	Cameron	Kenedy	Hidalgo	Jim Hogg	Starr	Willacy	Zapata	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Originally near another location									**0**
Originally outside of the boundary									**0**
Inverted heading									**0**
Uncertain direction			2						**2**
Uncertain location									**0**
Uncertain overpass									**0**
Uncertain underpass									**0**
Missing bridge	1	14	8	1		7	3		**34**
Missing boulevard/road		5							**5**
Unspecified direction									**0**
Unspecified location	1					1			**2**
Unspecified overpass									**0**
Unspecified underpass								1	**1**
Two structures have the same DGN symbol			2						**2**
Reference not located within county line									**0**
Switched overpass/underpass									**0**
Incorrect location description									**0**
One bridge for two structures									**0**
Verified position, o.k.									**0**
Overpass description does not match									**0**
TOTAL	**2**	**19**	**12**	**1**	**0**	**8**	**3**	**1**	**46**
TOTAL NUM. OF RECORDS W/ERROR	**2**	**14**	**10**	**1**	**0**	**8**	**3**	**1**	**39**
TOTAL BRINSAP RECORDS	**24**	**209**	**197**	**29**	**15**	**48**	**36**	**35**	**593**
% ERROR	**8%**	**7%**	**5%**	**3%**	**0%**	**17%**	**8%**	**3%**	**7%**

Table 2.22 BRINSAP Observation Summaries for District 22 - Laredo

	Dimmit	Duval	Kinney	Lasalle	Maverick	Val Verde	Webb	Zavala	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Originally near another location						2		1	**3**
Originally outside of the boundary	2	2	2	4	6	3	1		**20**
Inverted heading									**0**
Uncertain direction						1			**1**
Uncertain location		2		3					**5**
Uncertain overpass		3							**3**
Uncertain underpass									**0**
Missing bridge	8		1	7	7	11	31	2	**67**
Missing boulevard/road					3	2			**5**
Unspecified direction									**0**
Unspecified location	1			2	6	2	6		**17**
Unspecified overpass									**0**
Unspecified underpass				1					**1**
Two structures have the same DGN symbol				1					**1**
Reference not located within county line									**0**
Switched overpass/underpass									**0**
Incorrect location description									**0**
One bridge for two structures									**0**
Missing milepoint				2					**2**
Verified position, o.k.									**0**
Overpass description does not match									**0**
TOTAL	**11**	**7**	**3**	**20**	**22**	**21**	**38**	**3**	**125**
TOTAL NUM. OF RECORDS W/ERROR	**11**	**7**	**2**	**13**	**15**	**14**	**38**	**3**	**103**
TOTAL BRINSAP RECORDS	**71**	**117**	**37**	**109**	**79**	**78**	**220**	**71**	**782**
% ERROR	**15%**	**6%**	**5%**	**12%**	**19%**	**18%**	**17%**	**4%**	**13%**

Table 2.23 BRINSAP Observation Summaries for District 23 - Brownwood

	Brown	Coleman	Comanche	Eastland	Lampasas	Mc Culloch	Mills	San Saba	Stephens	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Originally near another location	5	6	2	10	3	2			1	29
Originally outside of the boundary	2	1	5	1	2	1	1	2	1	16
Uncertain direction										0
Uncertain location	5	1		1						7
Uncertain overpass				1						1
Uncertain underpass	2			4	1					7
Missing bridge	10	2	1	7	3	3		2	2	30
Missing boulevard/road				1	2	1			1	5
Two structures have the same DGN symbol										0
Wrong reference to location distance (F9)										0
Reference F9 location not on map										0
Moved to uncertain position										0
Cannot measure from referenced FM										0
Either wrong feature crossed or carry over										0
Wrong reference F6_1 FEATXE										0
Unspecified location					1	2	1	4	5	13
Unspecified underpass				1		1				2
Unspecified overpass										0
Unspecified up/op										0
Unspecified direction										0
Assumption neded for correct location										0
Reference F9 distance off or junction incorrect										0
Inverted Heading	1	1	3		1					6
One structure has two DGN symbols										0
Incorrect location description										0
Unknown location description										0
TOTAL	**25**	**11**	**11**	**26**	**13**	**10**	**2**	**8**	**10**	**116**
TOTAL NUM. OF RECORDS W/ERROR	**21**	**10**	**11**	**26**	**9**	**9**	**2**	**8**	**8**	**104**
TOTAL BRINSAP RECORDS	**136**	**109**	**114**	**168**	**78**	**93**	**57**	**69**	**84**	**908**
% ERROR	**15%**	**9%**	**10%**	**15%**	**12%**	**10%**	**4%**	**12%**	**10%**	**11%**

Table 2.24 BRINSAP Observation Summaries for District 24 - El Paso

	Brewster	Culberson	El Paso	Hudspeth	Jeff Davis	Presidio	TOTAL
Types of Observations:	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**	**Errors**
Originally near another location		26	14	8	7		**55**
Originally outside of the boundary			37	6	16		**59**
Uncertain direction							**0**
Uncertain location	1	1					**2**
Uncertain overpass							**0**
Uncertain underpass							**0**
Missing bridge	13	1	60		3	14	**91**
Missing boulevard/road							**0**
Two structures have the same DGN symbol							**0**
Wrong reference to location distance (F9)							**0**
Reference F9 location not on map							**0**
Moved to uncertain position							**0**
Cannot measure from referenced FM							**0**
Either wrong feature crossed or carry over							**0**
Wrong reference F6_1 FEATXE							**0**
Unspecified location		2	3			2	**7**
Unspecified underpass	2	10	4		6	1	**23**
Unspecified overpass							**0**
Unspecified up/op							**0**
Unspecified direction						2	**2**
Assumption neded for correct location							**0**
Reference F9 distance off or junction incorrect							**0**
Inverted Heading							**0**
One structure has two DGN symbols							**0**
Incorrect location description							**0**
Unknown location description							**0**
TOTAL	**16**	**40**	**118**	**14**	**32**	**19**	**239**
TOTAL NUM. OF RECORDS W/ERROR	**13**	**32**	**83**	**14**	**30**	**18**	**190**
TOTAL BRINSAP RECORDS	**94**	**134**	**429**	**123**	**127**	**73**	**980**
% ERROR	**14%**	**24%**	**19%**	**11%**	**24%**	**25%**	**19%**

Table 2.25 BRINSAP Observation Summaries for District 25 - Childress

	Briscoe	Childress	Collingsworth	Cottle	Dickens	Donley	Foard	Hall	Hardeman	King	Knox	Motley	Wheeler	TOTAL
Types of Observations:	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors	Errors
Originally near another location			2	3	1	1	2	1					7	17
Originally outside of the boundary								2	1				1	4
Uncertain direction														0
Uncertain location					1									1
Uncertain overpass														0
Uncertain underpass														0
Missing bridge	1	1		4	2	14	3	8	2		5	2	36	78
Missing boulevard/road														0
Two structures have the same DGN symbol					4									4
Wrong reference to location distance (F9)														0
Reference F9 location not on map														0
Moved to uncertain position														0
Cannot measure from referenced FM														0
Either wrong feature crossed or carry over														0
Wrong reference F6_1 FEATXE														0
Unspecified location												2		2
Unspecified underpass														0
Unspecified overpass														0
Unspecified up/op														0
Unspecified direction		10	3		2	10		11	8				17	61
Assumption neded for correct location														0
Reference F9 distance off or junction incorrect														0
Inverted Heading														0
One structure has two DGN symbols														0
Incorrect location description														0
Unknown location description														0
Incomplete bridge symbol														0
TOTAL	1	11	5	7	10	25	5	22	11	0	5	4	61	167
TOTAL NUM. OF RECORDS W/ERROR	1	11	5	7	10	25	5	13	11	0	5	4	44	141
TOTAL BRINSAP RECORDS	14	67	45	53	60	61	49	91	56	36	37	44	92	705
% ERROR	7%	16%	11%	13%	17%	41%	10%	14%	20%	0%	14%	9%	48%	20%

CHAPTER 3

IMPROVEMENTS IN THE ROUTING MODEL

3.1 General

The following three improvements have been incorporated in the current version of the overweight/oversized vehicle routing macro during the 1998 fiscal year:

(1) Procedure to include turn-penalty information
(2) Determination of maximal-capacity route
(3) Procedure to partition a network

The main purpose of these improvements into the overall network routing procedure was to accommodate realistic situations, such as highway construction, traffic congestion, unsafe turns, unfeasibility of some turns, and other limitations frequently encounter by the user in issuing overweight/oversize vehicle routing permits.

The organization of this section is as follows. Section 3.2 presents a brief description of the routing macro. Section 3.3 provides the methodology developed to find a maximal-capacity (highest safety margin) route. Section 3.4 outlines the procedure to include turn-penalty information after a shortest route is determined. Section 3.5 outlines the procedure for partitioning a network. Finally, Section 3.6 summarizes computational results related to the performance of the routing macro in finding a maximal-capacity route using the Houston District network.

3.2 Description of the Overweight/Oversized Vehicle Routing Macro

Figure 3.1 shows a flowchart of the overall GIS-based network optimization macro for obtaining shortest routes and maximal-capacity routes. The procedure outlined in this figure starts by loading the network on which a route for a particular vehicle needs to be determined. Once this is accomplished, relevant configuration data for the specific vehicle under consideration, as well as a value for the impact factor [2] are provided by the user. The vehicle configuration data include height, width, number of axles and location of axles. In addition, specific axle information is also provided and includes (a) axle weights, (b) number and width of tires, and (c) the gage of each axle.

The impact factor is a value that depends on the speed of travel of the vehicle. If the vehicle is escorted, its speed can be reduced while crossing the bridges and a lower value for the impact factor would be chosen.

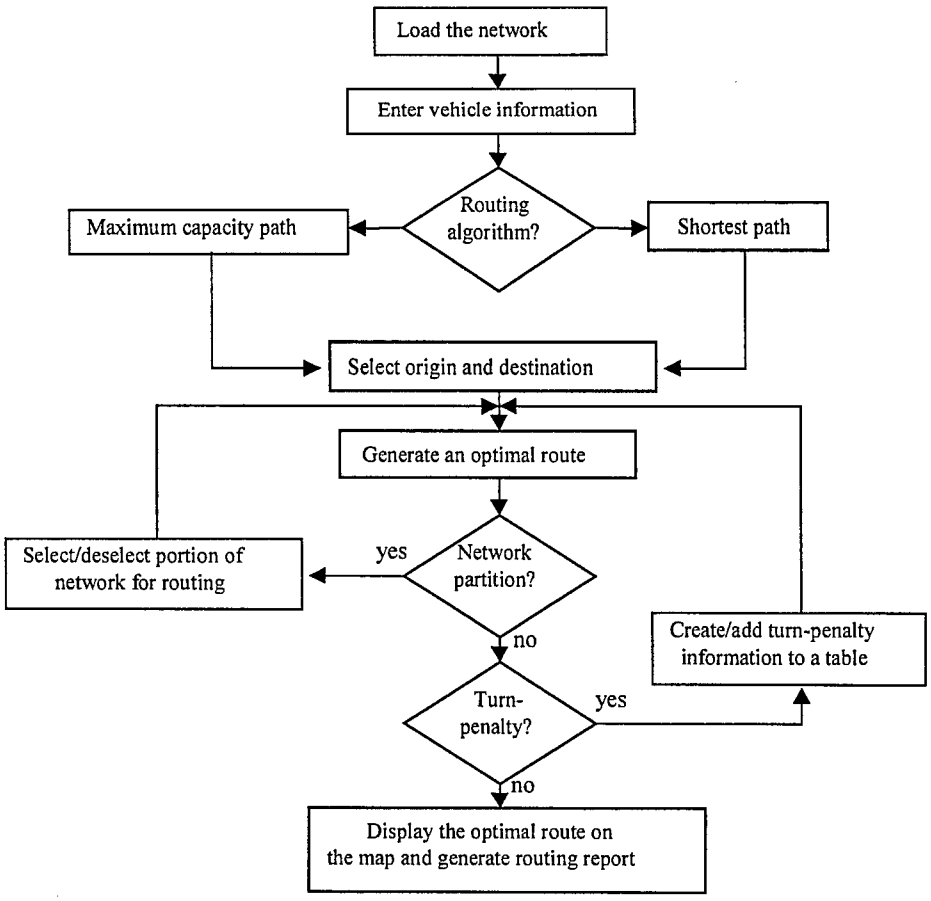


Figure 3.1. Overall Routing Procedure

The next step is the selection of the desired routing algorithm. The user has an option to activate either a *shortest-path* algorithm or a *maximum-capacity* algorithm to determine the optimal route between an origin and a destination for a given a vehicle. The shortest-path algorithm determines a route with minimal length and having all bridges along the route, being adequate for the specified vehicle. Alternatively, the maximum-capacity algorithm determines a bridge-adequate route having maximum allowed weight. That is, a route having a maximal safety margin.

The macro requires the specification of the point of origin (source node) and the point of destination (terminal node) to find a route. This is done by clicking on the terminal nodes of the road links in the network. The program allows zooming in/out of the map containing the road network, to facilitate the specification of the path points. Once this information is entered, the routing macro finds and displays (if found) an optimal path that satisfies vertical clearance, horizontal clearance and vehicle load constraints. Then, by visually inspecting the optimal route the user is presented with the following three options:

Option 1: Accept the route.
Option 2: If the route contains unacceptable turns, provide turn-penalty information and run the macro again.
Option 3: If the route contains unacceptable links, disable these links from the active network and run the macro again.

Once the user determines that the route generated by the macro is satisfactory, an output report is automatically generated, describing the selected route and documenting all the bridges avoided due to clearance or weight restrictions.

3.3 Maximal-Capacity Route Procedure

The capacity of a bridge is defined as the difference between its load carrying capacity and the load of the truck. Because of the high number of bridges within the State of Texas, the determination of a maximal capacity path involves the iterative finding of a large sequence of shortest paths with increasing capacities. In essence, the procedure can be outlined as follows. Once a feasible shortest path is found, which can be done with the currently developed methodology [6], the road section containing a bridge having minimal capacity is disabled from the network. Afterwards, another feasible shortest path is found from the remaining road sections in the network. The new feasible shortest path has higher capacity than the previous one. This basic procedure is repeated until no more feasible routes are found. Once the routing macro stops searching for additional feasible shortest routes, it can be concluded that the last route found is both feasible and has the highest/maximal capacity between the specified origin and destination points.

Application 1

Figure 3.2 shows a portion of the Houston District network with three routes resulting from the application of the maximal-capacity algorithm. The first iteration of the algorithm generated Route 1 with a capacity of 6 kips.; in the second iteration Route 2 was found, with a capacity of 27.6 kips.; and finally, the last iteration of the algorithm yielded Route 3, with a capacity of 30.2 kips. The vehicle information used and a detailed output report generated by the routing macro are included in Appendix C.

3.4 Turn-Penalty Procedure

In the case of oversized-vehicle routing, there exist many turns (i.e. transitions from one link to another) which the user may want to avoid, due to the dimensions of a particular vehicle. As an illustration, if the optimal route, generated either by shortest-path or maximal-capacity path algorithm, contains a turn that the user considers to be highly undesirable, then a high penalty can be assigned to that specific turn.

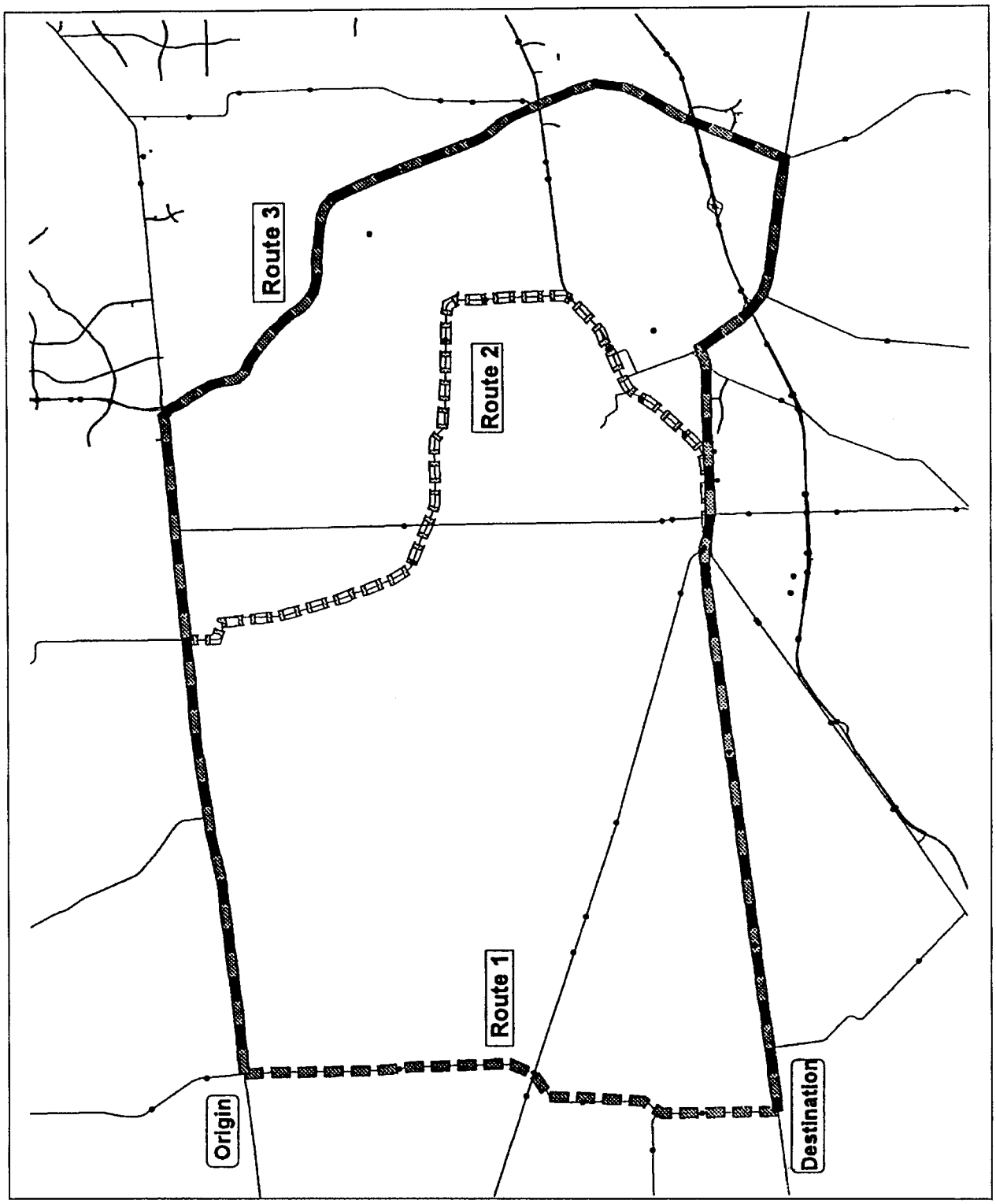


Figure 3.2 Application of Maximal Capacity Algorithm.

To be able to include the turn-penalty capability into the routing macro, a modification was made to the program code using TransCAD's built-in *Shortest Path with Turn Penalty* algorithm instead of *Shortest Path* algorithm.

The following procedure lists the steps to create or include turn-penalty information in a routing analysis, using TransCAD's built-in *Turn Toolbox* utility:

Follow the usual steps outlined in Appendix B when running the OVR program.

1. Identify the turn(s) you want to apply a restriction to.
2. Within TransCAD:
   a. Choose ***Network/Paths-Turn Toolbox*** to display the *Penalty Dataview dialog box*
   b. Choose one of the options from the table:
      New Table: Creates a new table to store turn-penalty information
      Open Table: Open a table file on disk to store turn-penalty information
      Existing Dataview: Choose an existing data-view to store turn-penalty information
      Initially a new table should be created, afterwards, open the existing table to add/delete turn information in the future.
      Save the table under *d:\ mergetx\ turnpen\ data1.dbf*
   c. Click ***OK***. TransCAD displays the *Turn toolbox*
   d. Click "+" bar to activate the add-penalty tool
   e. Click on the first link of the turn from the map
   f. Click on the second link of the turn form the map
   g. Enter penalty value in the *Penalty box* (leave the penalty value blank to prohibit the turn)
   h. Close the toolbox
3. Now save those turn-penalty info into the network file
   a. Go to *network-setting-update*.
   b. Click *turn-penalty* option
   c. In the "*specific*" field, choose path to file (*d:\mergetx\turnpen\data1.dbf*) leave the "*default*" field empty or blank
   d. Click ***OK***
      Now, the network will have turn-penalty information to be used by the OVR program
4. Run the OVR program and when asked whether to use turn penalty information, click ***YES***.

Application 2

Figure 3.3 shows a portion of the Houston district network with two shortest paths found before and after using the turn-penalty information. The undesirable turn is labeled with the letter A. A value of 99 was entered in the Penalty dialog box as the turn penalty value associated with the restriction. The vehicle information used and a detailed output report generated by the routing macro are included in Appendix C.

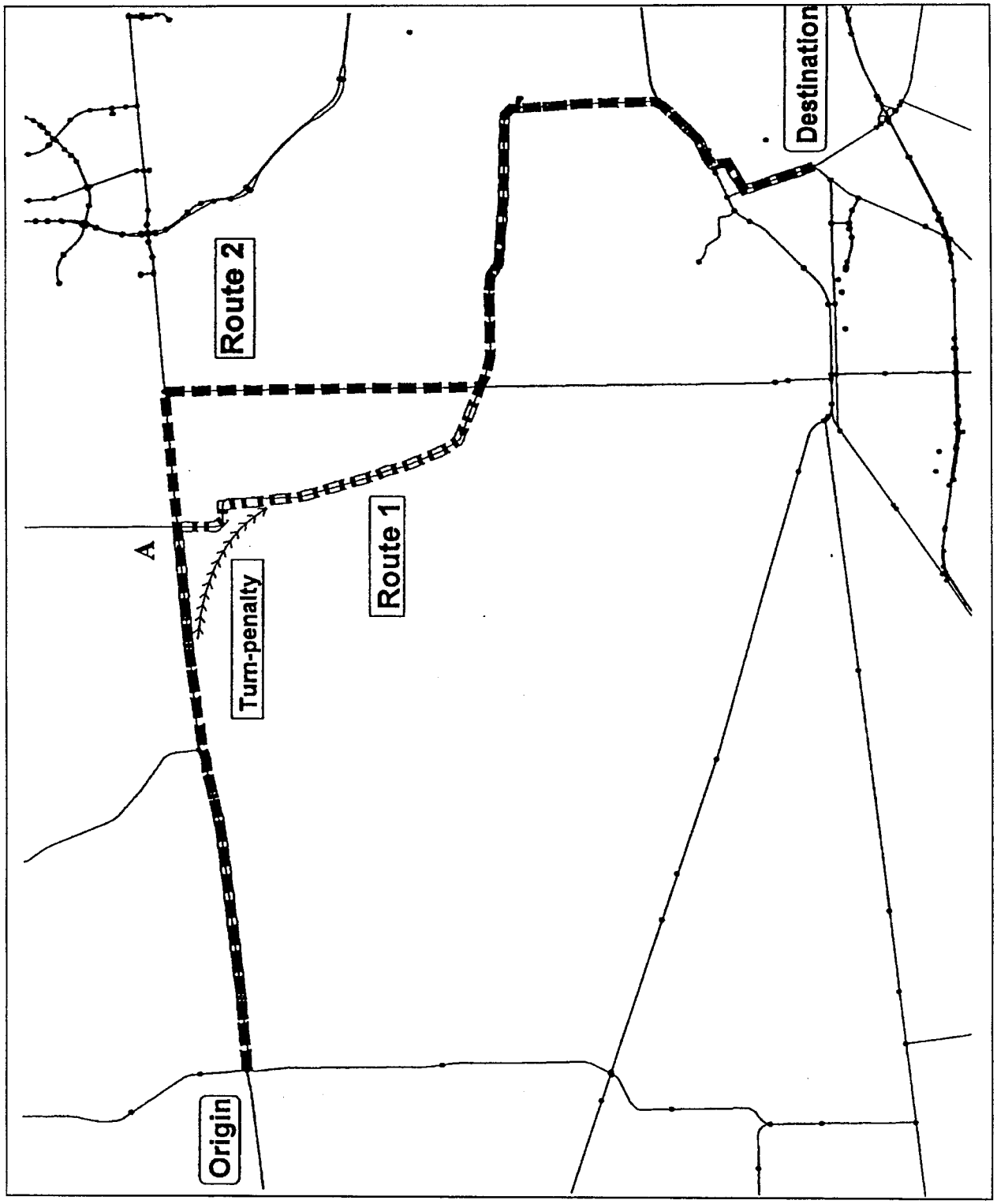


Figure 3.3 Application of Shortest-Path Algorithm using Turn-Penalty Information

3.5 Network Partitioning Procedure

There exist many situations where routing might be restricted and/or should be avoided. These may include:

1) When a road/bridge is closed for construction.
2) When a congested section of the network is not allowed for routing.
3) When the routing is limited within a specified area (e.g. load posted bridges or load-zoned roads).

In these situations it is desirable to temporarily modify the network by disabling and/or enabling links in a network (network partitioning), to model realistic road conditions. TransCAD has the capability to quickly disable any number of the links in a network, perform a routing analysis and then re-enable the links, without having to recreate the entire network file (see Appendix B). TransCAD saves information on links that are enabled and disabled in the separate network file. Therefore, when searching for a feasible route, the new network information is retrieved and used simultaneously with the original network information.

There are two alternatives available in partitioning a given network. First, the user can disable one individual link or a set of links from the network. Second, the user can first disable all links in the network and then select a portion of them and generate a sub-network for further routing. These two procedures are provided below:

Disabling a link or set of links

a. Select a link or set of links from the network by using the *Selection Tool* in TransCAD
b. Choose ***Networks/Path-Settings*** to display the *Network Setting dialog box*
c. Click ***Update*** to display the *Update Network dialog box*
d. Choose ***Disable Links*** from the *Option* drop-down list
e. Choose ***Selection*** from the *Using* drop-down list to display the *Expression dialog box*
f. Click ***OK*** and run the OVR program as usual.

Selecting a portion of a network (sub-network)

a. Choose ***Networks/Path-Settings*** to display the *Network Setting dialog box*
b. Click ***Update*** to display the *Update Network dialog box*
c. Choose ***Disable Links*** from the *Option* drop-down list
d. Choose ***All features*** from the *Using* drop-down list to display the *Expression dialog box*. All links are disabled from the network now
e. Select a portion of the network for routing by using the *Selection Tool* in TransCAD
f. Choose ***Networks/Path-Settings*** to display the *Network Setting dialog box*
g. Click ***Update*** to display the *Update Network dialog box*
h. Choose ***Enable Links*** from the *Option* drop-down list
i. Choose ***Selection*** from the *Using* drop-down list to display the *Expression dialog box.*
j. Click ***OK***.
k. Create a new network (and save it with another name). The desired network is available for routing at this point.
g. Run the OVR program as usual.

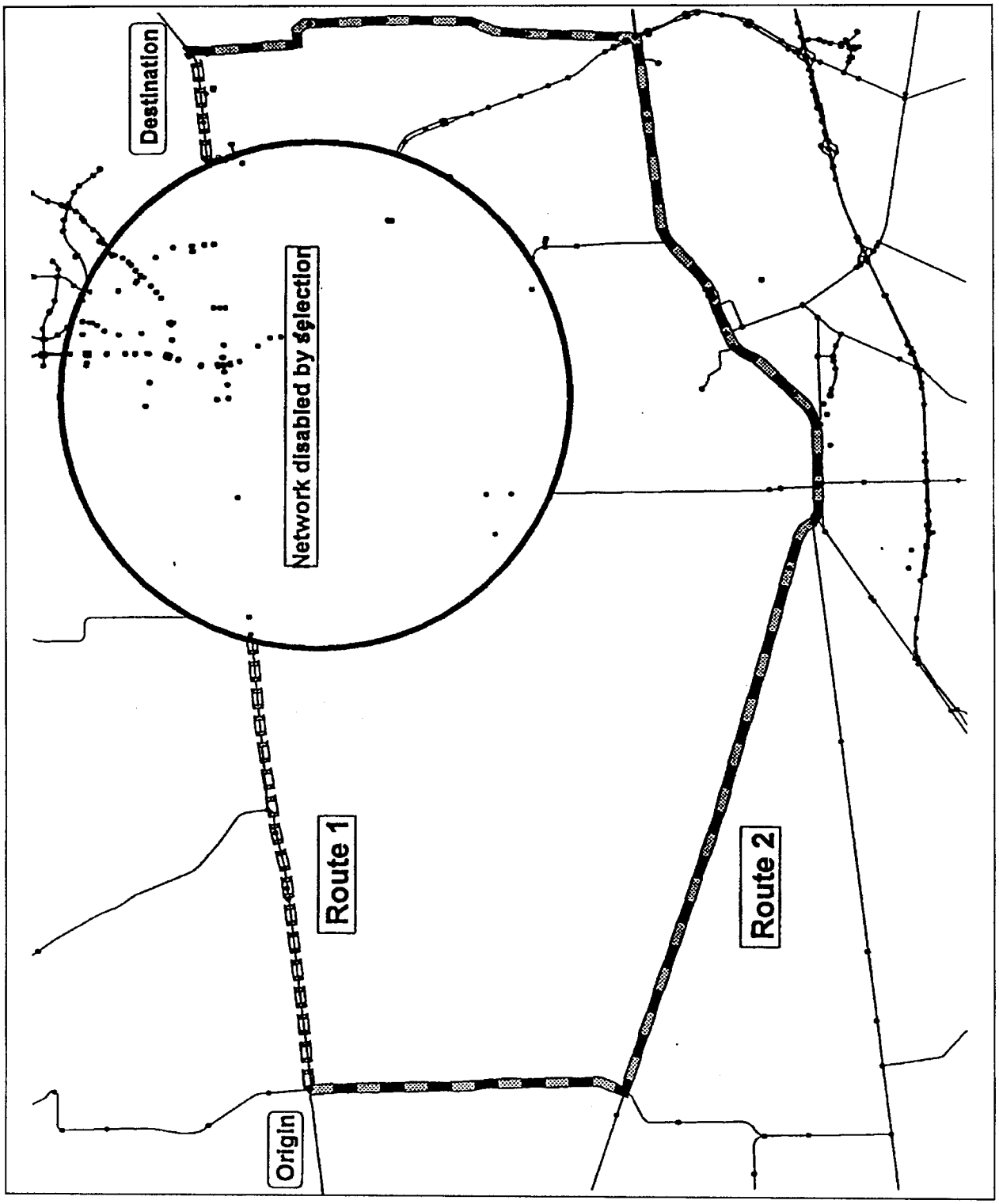


Figure 3.4 Application of Shortest-Path Algorithm using Network Partitioning.

Application 3

Figure 3.4 shows a portion of the Houston District network with two shortest paths found before and after partitioning the network. By using the selection tool provided by TransCAD, 256 links were removed from the network. The vehicle information and a detailed output report generated by the routing macro are also included in Appendix C.

3.6 Summary

This section summarizes the performance analysis of the "maximal-capacity" routing algorithm. A complete description of the "shortest-path" routing procedures and related computational performance results have been documented in the report for fiscal year 1997 [7].

Several applications of the maximal-capacity algorithm have been tested. A summary of the results using the Houston district network is shown in Table 3.1. This network includes approximately 2,800 bridges, 41,000 nodes, and 52,000 arcs. In order to demonstrate the effectiveness of the proposed approach, vehicles with various axle configurations, weights, clearances, and different points of origin and destination were used. In all cases, an impact factor of 10% was used. Table 3.1 shows that the maximal-capacity algorithm finds routes within several minutes (usually within two minutes), depending on the number of axles of the vehicle and the location and number of path points (origin, destination and intermediate points). It was observed, that an average of three shortest-path routes is required before the optimal maximal-capacity route is found.

Table 3.1 Computational Performance of Maximal-Capacity Algorithm

Examples	Total load (kips)	No. of axles	Height of the truck	Width of the truck	No. of unconstrained shortest paths found	No. of feasible shortest paths found	Computational time (sec.)
Truck_1	128	5	15' 4"	15" 4"	21	3	89
Truck_1 *	128	5	15' 4"	15" 4"	17	4	42
Truck_2	201	9	13" 0"	12" 0"	3	1	36
Truck_3	364.9	15	17" 2"	14" 4"	31	6	224
Truck_3 *	364.9	15	17" 2"	14" 4"	13	2	58
Truck_4	486	19	14' 6"	12' 0"	24	3	146
Truck 4*	486	19	14' 6"	12' 0"	43	2	163
Truck 5	610	27	15' 8"	16' 0"	16	2	57
Truck 5*	610	27	15' 8"	16' 0"	7	1	49

(*) denotes the use of trucks 1,3,4 and 5 considering different origin and destination pairs.

The high computational efficiency of the routing macro is due to two major improvements:
a) a path tracing methodology, and
b) a bridge evaluation procedure

A discussion of each of these improvements follows.

Path Tracing Methodology

A path tracing methodology verifies if the road links are adequate for the height, width, and weight requirements of the specified vehicle. The links are evaluated in the alternating order in which they appear on the shortest path (i.e., first link to be checked is the link closest to the source node, second link to be checked is the link closest to the terminal node, third link to be checked is the link second closest to the source node, fourth link to be checked is the link second closes to the terminal node, and so on). By using this proposed methodology, the evaluation of bridges along the shortest path is accomplished in a significantly short time compared to the procedure in which bridges are evaluated in the chronological order in which they appear. It also appears that a significantly lower number of feasible unconstrained shortest paths from the specified origin to the specified destination nodes need to be evaluated.

Bridge Evaluation Procedure

During a routing analysis a link or set of links with one or more bridge(s) attributed may become part of multiple feasible routes. A simple procedure that avoids multiple evaluations is implemented in the routing macro. This procedure consists in storing the list of links with bridges, previously evaluated using Keating's bridge load formulae [7], in an array. If the link(s) with bridges attributed are included in a new possible route, the program skips the evaluation and continues with the next links. This approach reduces the number of bridges to be evaluated, thus reducing the overall computational time.

CHAPTER 4

PROCEDURES TO UPDATE GIS ROUTING FILES

4.1 Background

TxDOT Design Division and Mapping Office periodically update and modify BRINSAP and ROADS databases and the digitized County Urban maps. These changes are natural consequences of the routine growth of the highway system to satisfy new traffic demands. These changes must be accounted for in the GIS routing maps and databases for a proper accountability of the actual highway system. This Chapter describes the update procedure of the routing software due to updates in the BRINSAP and road maps of the On-System highways.

4.2 Typical BRINSAP Changes

The information contained in the BRINSAP database periodically changes as a result of the following factors:

(a) field inspections (changes in the conditions of the bridges),
(b) the construction of new bridges,
(c) the reconstruction of bridges,
(d) change in the jurisdiction of the bridges, and
(e) the closure of bridges or highways.

Although these changes are periodic, updates of BRISAP are usually released in time intervals (usually six months). In order to perform a proper update of the GIS routing software, it is necessary to compare the new updated BRINSAP to its previous version and to reconstruct all changes that have taken place between their release times. To do this however, it is desirable to account for all changes using only the information contained in the old BRINSAP and in the new BRINSAP.

As a result of comparing the new and the old BRINSAP, the following events can be identified:

a) Bridges are removed from the On-System highways, either because the roads are being permanently closed to traffic or because they are being demolished and never rebuilt. Therefore, the bridge records in the old BRINSAP are not contained in the updated database.

b) New bridges are built on existing or new segments of the On-System highways. In this event, new bridge records are included in the updated BRINSAP.

c) Bridges are replaced by or rebuilt with new structures on the same location. In this event, typically, a new bridge record is reflected in the updated BRINSAP and replaces a record of the old BRINSAP. Certain information related to bridge location remains the same and is used to identify the record of the replaced bridge. Bridge specific attributes, needed for routing analysis, such as operating and inventory ratings, span lengths, clearances, and etc. are updated.

d) The jurisdiction of some bridges may have changed from On-System to Off-System when comparing the old and the new BRINSAP records. The records pertaining to the bridge in the old On-System BRINSAP are transferred to the Off-System portion of the new BRINSAP database.

e) Alternately, the jurisdiction of some bridges may have changed from Off-System to On-System. In this case, the records of the Off-System BRINSAP are transferred to the New On-System BRINSAP. Furthermore, these bridges were previously unaccounted for in the routing program, and therefore, their correct location and geographic coordinates need to be determined.

4.3 Typical Changes in Road Maps (Urban Maps) and ROADS Database

As a result of new highway construction, the county Urban drawings experience updates and modifications in the geographic elements. The following events can be identified when comparing a new road map with its previous version:

a) New constructed highways are reflected by new links.
b) New bridges built on existing or new roads are reflected by added bridge symbols.
c) Roads permanently closed to traffic are absent in the new urban files.
d) Roads no longer under the On-System jurisdiction are transferred to different drawing layers within the road map.

In addition, the relational ROADS database associated with the geographical drawings is updated accordingly. As described in Reference [6], the highway tables in the ROADS database contain the attributes associated to the centerlines of the On-System highway-drawing element. These database attributes include the Highway identification, road type (IH, FM, etc.) and the MSLink code that links the geographic map feature to the information in the database.

The following sections describe in detail the procedure to update the existing network model required for the routing of overweight and oversize vehicles.

4.4 GIS Files Update Procedure

The process to update the GIS routing network has been developed to reflect the changes and upgrades that TxDOT makes on their base maps and databases. The core of the automated routing package is composed of a network model of the Texas highway system, with attributes from TxDOT's ROADS database, and a relational database linked to BRINSAP. Two separate processes can be identified:

a) Update of the highway network, and
b) Update of BRINSAP.

After performing each process individually, the update has to be completed by updating the relational database BRINSAP-ROADS inside the routing software.

The update of the GIS routing software files needs to be performed one county at a time. The following items are required:

1. The existing county GIS files to be updated (in standard geographic format);
2. The new version of BRINSAP containing the On-System and Off-system information;
3. The previous version of BRINSAP from which the bridge information in the GIS files was created/updated the last time (On- and Off-System).
4. The new version of the County Urban base maps (with the corresponding ROADS database);
5. The previous version of the County Urban maps from which the GIS files were created/updated the last time.
6. Macros that run in TransCAD to prepare the road network for routing that perform functions such as to compare the links of the old and new digitized maps, fix connectivity problems, assign traffic directions, define overpass/underpasses, and etc.
7. External programs to perform comparisons between the BRINSAP databases to compare the old and new BRINSAP databases and their corresponding relational databases within the routing software.

Figure 4.1 illustrates the overall process to update the GIS files used for routing. The process flows from top to bottom. The process is divided in three main sections A, B and C. Section A illustrates the set of files required to perform the update. Section B illustrates and briefly describes the five main tasks to be performed on each of the existing County GIS files. Section C shows the set of final updated files, on which the routing analysis will be performed. The left-hand side of the flowchart shows the update process pertaining to the BRINSAP database; the right-hand side shows the process pertaining to the ROADS network; and the middle portion shows files and tasks related to both. The oval shapes represent required files and final updated files; the rectangular shapes correspond to tasks to perform with the corresponding files.

The files and tasks involved in the update process are described in the following sections. A detailed flow chart of all the details and steps of the updating process is illustrated in Figure 4.2. File and program names are referred to this figure throughout the chapter.

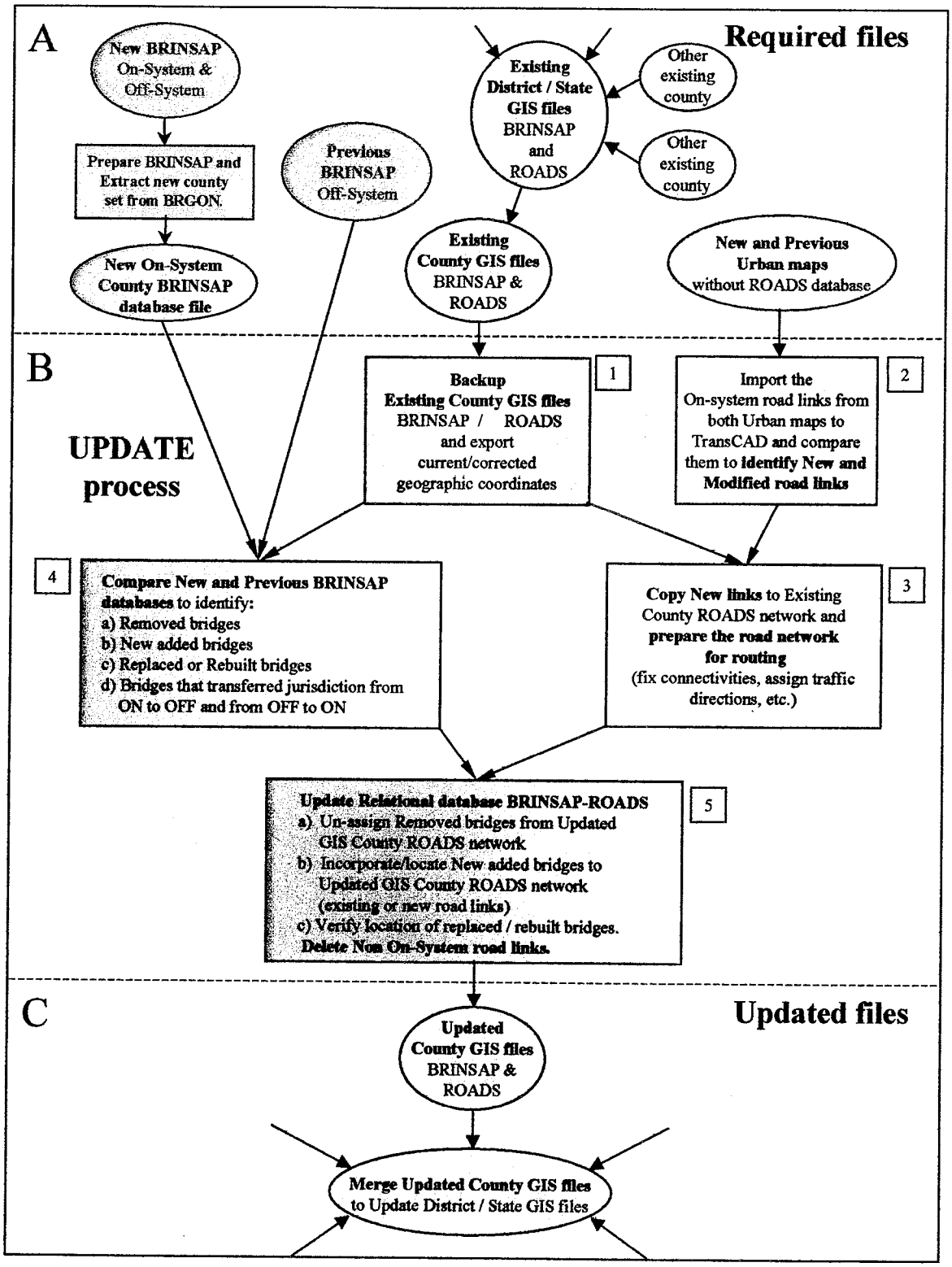


Figure 4.1 General Flowchart for Update Process of the GIS Files for Vehicle Routing.

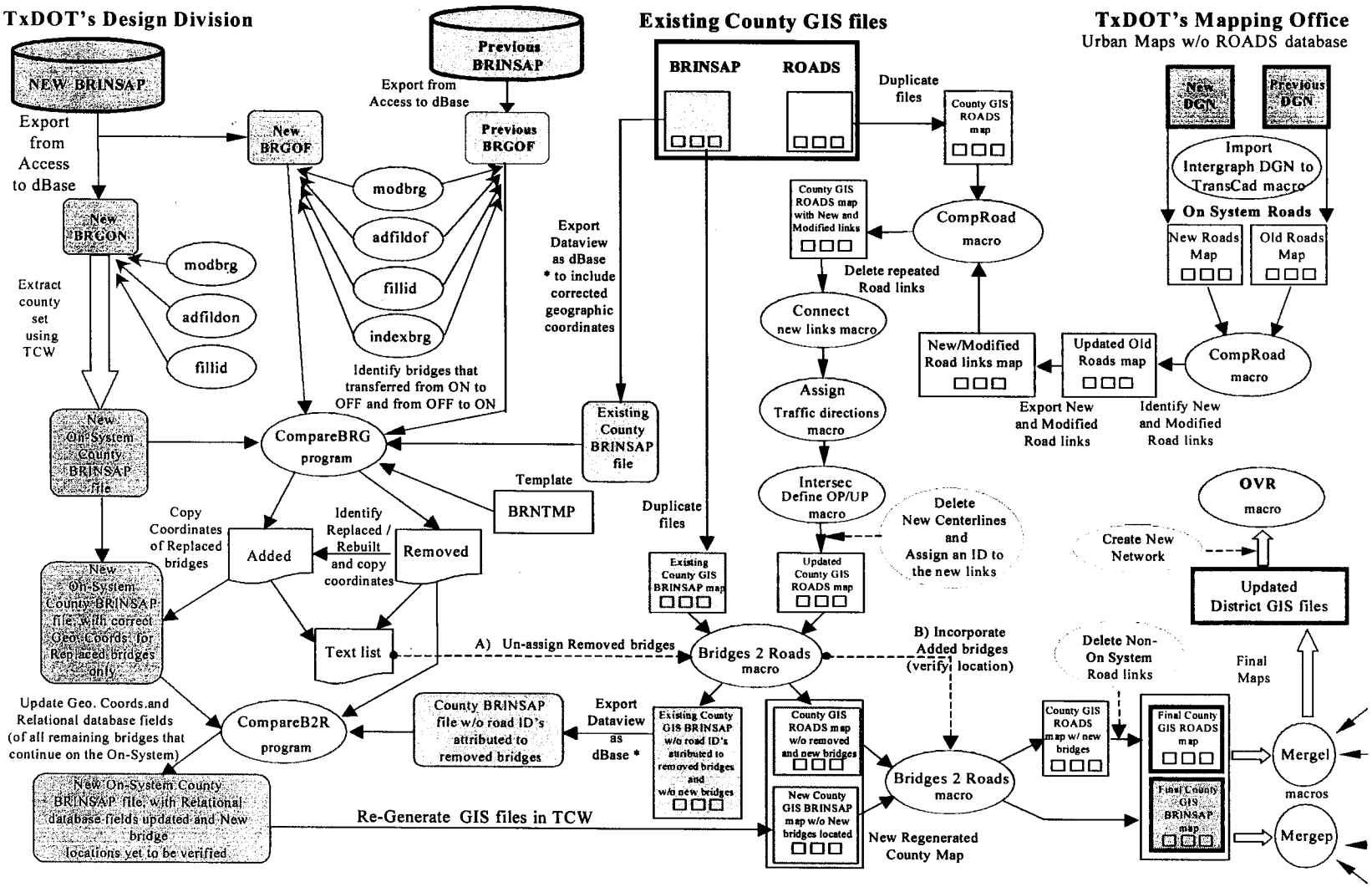


Figure 4.2 Detailed Flowchart for Update Process of the GIS Files for Vehicle Routing.

4.5 Description and Preparation of Files Required for Updating

This section describes in detail the files that are required to perform the update. This includes the "New and Previous BRINSAP" databases, the "Existing County GIS files" and the "NEW and Previous County Urban Maps".

4.5.1 BRINSAP Files

The BRINSAP database files are usually available in a Microsoft Access format. However, TransCAD requires that the databases to be in a dBase format. During the processes of converting from Access to dBase, the names of the record-fields were shortened. As a result, the converted dBase databases were re-structured to have the proper fields re-sized and renamed. In addition, the structure of the database was modified by adding fields needed in the relational database of the GIS routing software. Furthermore, since the update of the GIS files is performed by county, the modified dBase database is separated by counties using an extraction procedure.

The procedures described here assume that the TxDOT's BRINSAP structure will not change. If fields are added or renamed in the future, the macros described here will need modifications to consider the modified or added fields.

The New and Previous BRINSAP containing the updated On-System and Off-System databases must be converted to dBase format and prepared to be fully compatible with TransCAD and the existing GIS files formats. This is required to facilitate the manipulation of database files required in task Four of Section B as shown in Figure 4.1.

The preparation of the database files consists of modifying the internal structure of the databases. The process of the preparation can be seen in the upper-left portion of Figure 4.2. The modifications are made in TransCAD using four customized macros:

a) Macro "modbrg.rsc" renames and resizes the fields of the databases.
b) Macros "adfildon.rsc" and "adfildof.rsc" add blank relational database fields in the On-System and Off-System databases respectively;
c) Macro "fillid.rsc" performs two tasks. One task assigns internal ID's to each record in the databases. The other task converts the record's original geographic coordinates from degrees-minute format to decimal-degrees format. This is required for mapping the bridge locations in TransCAD and generating the GIS point layer representing the location of the bridges.
d) And macro "indexbrg.rsc" creates index files that speed up search procedures utilized in comparing the BRINSAP databases.

These modifications are done only once to each database, containing all the information of all counties to be updated. When the preparation of the files is complete, three files are left, "New BRGON", "New BRGOF", and "Previous BRGOF" as seen in Figure 4.2.

After BRINSAP has been prepared, the corresponding county to be updated can be extracted from the new On-System ("New BRGON") database. The extraction is accomplished using TransCAD's built-in commands. Following is a description of the specifics of the extraction of bridges by county. First, the modified BRGON database is opened in TransCAD as a Dataview only (without creating a geographic file). Second, the corresponding county to be extracted is selected using the "Select by Condition" option under the Dataview menu. The condition is set to the county number (e.g. F3COUNTY= "237") and executed. Once the selection is executed and displayed in the Dataview, it is then saved in dBase format with a unique identifiable filename (e.g. 237brn.dbf). This is repeated for all the counties to be updated.

The results of the above are "New On-System County BRINSAP files" with updated BRINSAP information except for the corrected geographic coordinates. These will be updated later as described in Task Four of Figure 4.2. This completes the preparation of the required BRINSAP files.

4.5.2 Existing County GIS Files

The "Existing County GIS files", in TransCAD format, contain the BRINSAP database, the ROADS database and the BRINSAP-ROADS relational database used in the routing program. The BRINSAP database already contains the corrected geographic coordinates of the bridges that need to be maintained and copied to the new BRINSAP information on Task Four of Section B. As a result, the "Existing County GIS files" are needed for the update. These GIS files correspond to the ones initially created or previously updated and prepared for routing, as described in Reference [6], and merged to generate the GIS files for a larger region (e.g. district or state). These files must be in TransCAD's Standard Geographic format in order to be modified.

4.5.3 TxDOT's County Urban Maps

In order to update changes in the roads, as inventoried by TxDOT in the County Urban maps, it is necessary to have available the new and previous County Urban maps (in Intergraph format, "Microstation Design File or DGN file"). It is extremely important to save and safeguard backup copies of both the previous and the latest County Urban maps used in the update. The reason for this is that the "new" County Urban maps will become the "previous" maps in the next future update. Without these maps, future updates of the ROADS GIS files will be extremely laborious and time consuming. Additional information on this matter is provided in Section 4.8.2.

4.6 Updating Tasks of County GIS Files

In the previous section, detail descriptions of seven files needed for updating were provided. Five tasks are required to perform the update.

4.6.1 Task One: Backup Existing County GIS Files and Export Existing County BRINSAP

This task consists of making a backup copy of all the "Existing County GIS files" (BRINSAP and ROADS), and exporting the County BRINSAP.

The backup copy of all the "Existing County GIS files (BRINSAP and ROADS) is needed because the update will be performed in these files. It is extremely important that the copy be made using TransCAD's copy utility found under the Tools/Geographic File menu. The copied files should be kept in as separate folder; for example, "...\NEWROADS\" and "...\NEWBRINSAP\".

To facilitate the comparison of bridge databases described later in task Four, an additional copy of the entire County BRINSAP database should be exported. This copy must include the actual corrected geographic coordinates of each bridge record. The copy should be made in TransCAD by opening the Dataview (when the BRINSAP layer is active), and saving it in dBase format in a separate folder. This process allows for the current/corrected geographic coordinates, to be included in the exported file (the "Existing County BRINSAP file").

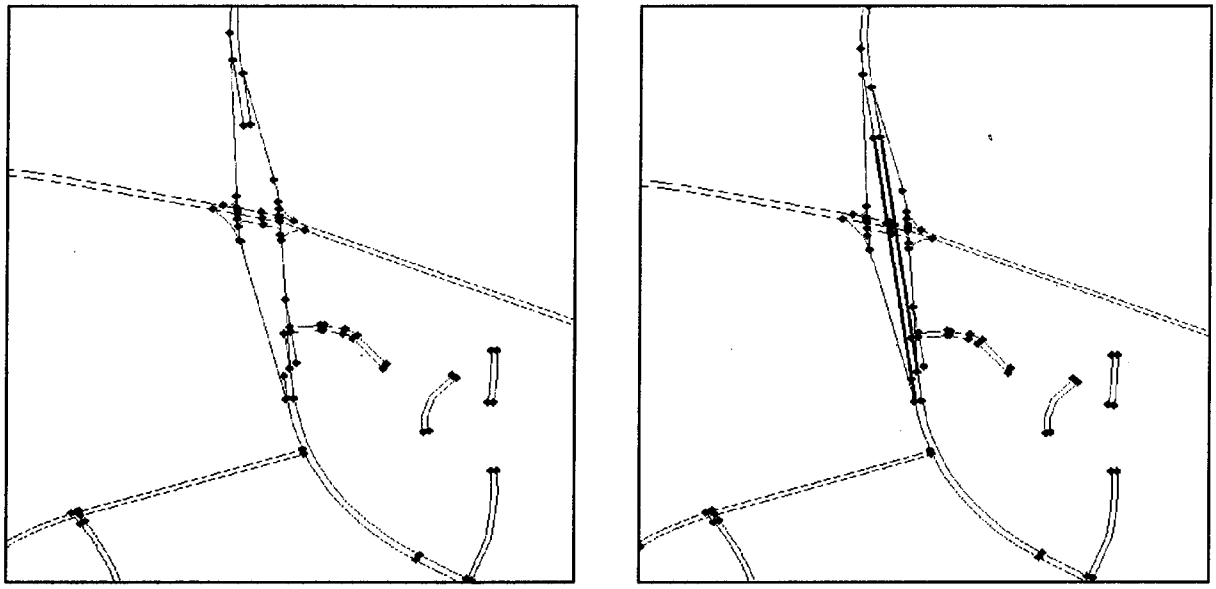
4.6.2 Task Two: Identification of New and Modified Links in the County Urban Base Maps

In this task, the new and previous County Urban maps are compared for the purpose of identifying the new and modified links in the maps. This information provides an insight of the roads modification of the highway system.

The road segments corresponding to the On-system highways of both Urban maps (new and previous) are imported into TransCAD using a readily available TransCAD import utility (Import Intergraph DGN Files). Once imported into TransCAD, maps containing the imported road links are created. An "Old Roads map" contains the road links from the "Previous DGN County Urban file", and a "New Roads map" contains the road links from the "New DGN County Urban file". These maps are compared against each other to identify the new added road segments and/or existing modified road links. Afterwards, a crosscheck comparison can identify deleted road segments.

The comparison of the maps is accomplished by using the customized macro "CompRoad". This macro copies the new and modified lines from the "New Roads map" to the "Old Roads map". At the end of the comparison an "Updated Old Roads map" will contain the old roads and the new roads identified with a different color. Finally, the set of new and modified road segments is exported as a separate set of GIS files, creating a new map. The "New/Modified Road links map" will be used in Task Three to incorporate the new road links into the "Existing County GIS ROADS map". It should be noted that these maps do not contain the ROADS database attributed to the centerlines of the highways, for the reasons explained in Section 4.8.1 and 4.8.2.

Figure 4.3 shows an example in the Brazoria county where new added links were identified in the "New Roads map". The figure in the left depicts the old map and the one on the right shows the "Updated Old Roads map", which consists of the old roads plus the new links.



1. Old Roads map. 2. Updated Old Roads map.

Figure 4.3 Case of GIS ROAD Network Updated with New Links

4.6.3 Task Three: Incorporate New Links to Road Network

This task consists of updating the existing county roads network, by incorporating the new links identified in Task Two. The updating takes place when the "New/Modified Road links map" and the copy of the "County GIS ROADS map" are compared against each other, using the CompRoad macro.

The macro automatically copies the new and modified links into the existing road network. It should be noted that since the copy of the "County GIS ROADS map" already contains the structure of the ROADS database, the new links will automatically have this structure associated to them. The "County GIS ROADS map" is updated with the new and modified road links.

During this task, some road links that appear to be repeated are copied. Section 4.8.2 addresses this issue. Repeated links must be carefully compared by visual means and deleted accordingly.

Afterwards, the updated "County GIS ROADS map with New and Modified links" must be prepared for routing analysis by means of the procedure described in Chapter 4 of Reference [6]. In summary, the preparation of the road network consists of fixing connectivity problems, assigning traffic directions to one-way highways and defining underpasses/overpasses when

applicable. These tasks are accomplished in TransCAD by using the macros "Connect.rsc", "Assign.rsc" and "Intersec.rsc".

Immediately after, if new centerlines are copied to the network, these must be deleted. Finally, an identification code must be assigned to the remaining new links in the county road ID field (CTYRDID) of the GIS ROADS database. This field value is required for updating the relational database BRINSAP-ROADS.

The "Updated County GIS ROADS map" now contains all the new road links, except for centerlines, is fully connected, has traffic directions and overpasses/underpasses defined and properly identified.

4.6.4 Task Four: Comparison of New and Previous BRINSAP

In this task the information extracted from the TxDOT updated On-System BRINSAP ("New On-System County BRINSAP file", Section 4.5.1) is compared against the "Existing County BRINSAP file" (4.6.1) and the both Off-System BRINSAP files ("New and Previous BRGOF") (Section 4.5.1). This comparison is needed to identify the changes made to the On-System database and incorporate the new/updated information into the routing package.

During the comparison the following events are identified:
a) Bridges removed from the On-System database.
b) New bridges added to the On-System database.
c) Rebuilt/replaced bridges within the On-System jurisdiction.
d) On-System bridges transferred to the Off-System jurisdiction.
e) And Off-System bridges transferred to the On-System jurisdiction.

The comparison is made through the use of a stand-alone external program, "CompareBRG". The program was developed in C++ programming language, and is specifically customized to compare four bridge databases. The program can be executed from any drive and/or folder in the computer. However, the program requires that a dBase template file (BRNTMP.dbf) be located under the "d:\Macros" folder. This template is required to create the structure for temporary files during the process of identifying removed and added bridges.

A typical execution is described as follows:

First, the user must choose the four files (in dBase format) to be compared. The files must always be selected in a sequential top-down order as seen in Figure 4.4. The filenames and paths appear on the edit boxes on the right of each choose-file button. Afterwards, click on the "Compare/Report/Update" button to start the comparison. At the end, the window displays the path and filenames associated with reports associated with the removed and added bridges. In addition, in the bar at the bottom of the window (a status bar), the name of a text file containing a list of both removed and added bridges is displayed.

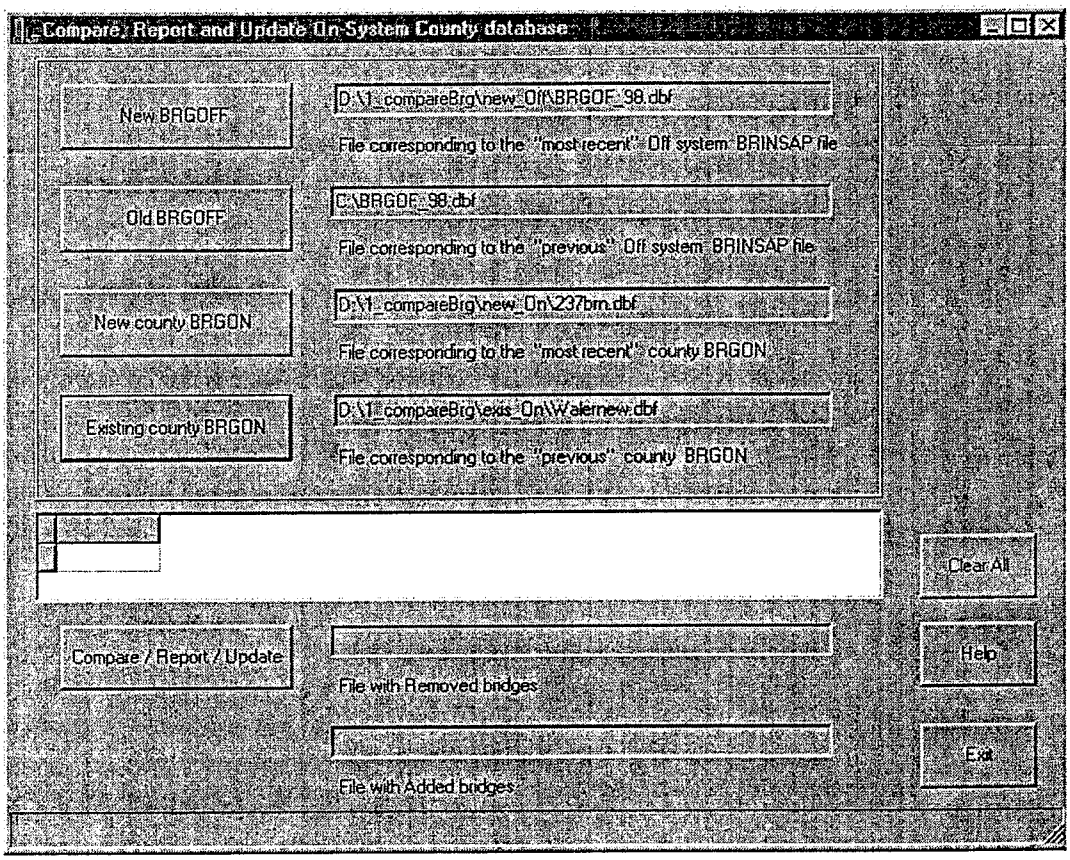


Figure 4.4 CompareBRG Program. Main Components.

Bridges removed.

The program first finds "Removed bridges" by comparing the "Existing County BRINSAP file" to the "New On-System County BRINSAP file". The program scrolls the database files, each record at a time, comparing the fields that contain the bridge's unique structure identification number. When a record is not found in the "New On-System County BRINSAP file", the structure number and additional specific information of the record not found is copied to a temporary dBase file with suffix _rem (e.g. countyname_rem.dbf). The information is copied in the corresponding fields of the dBase file, which was internally created from a template file (BRNTMP.dbf) used for this purpose.

New or Replaced/Rebuilt Bridges.

After all removed records have been found, the program then searches for "Added bridges" by crosschecking the same files. As before, the structure number is used for this purpose. When a record is not found in the "Existing County BRINSAP file", it is considered as a new added record to the On-System database. The predefined information pertaining to the new record is copied to another temporary dBase file with suffix _add (e.g. countyname_add.dbf).

The new added record may correspond to either a "New" bridge or a "Replaced/Rebuilt" bridge in the On-System. To conclude whether the record falls into one category or another, the program compares the temporary file countyname_rem against the file countyname_add. The temporary files now have information pertaining to each bridge record contained in only 12 fields. These include: the structure number, district number, county number, feature crossed, facility carried over, location, control number, section number, original geographic coordinates (latitude and longitude) in degrees-minutes format, milepoint and the year built.

Since the structure numbers of the removed and added bridges are different, the comparison is made assuming that for a replaced/rebuilt bridge, the location, highway identification and original coordinates, should match in both the removed records list and the added records list. The information compared includes (a) the control and section numbers pertaining to the highway section carrying the bridge; (b) the original geographic coordinates (latitude and longitude) in degrees-minutes format; (c) the feature crossed and (d) the facility carried over. Occasionally, the information in a field did not exactly match between the removed bridge record and the added record. The differences where basically due to typing errors (e.g. missing characters, etc.), additional characters present (e.g. parenthesis, commas, etc), different information or missing information. This situation prohibited the proper identification of a replaced bridge since the information in all the fields did not match simultaneously. Section 4.8.3 further addresses this problem and the solution developed. Whenever a bridge is identified as replaced/rebuilt, the corrected coordinates are copied from the removed bridge record to the added bridge record.

Bridges Transferred From On- to Off-System Jurisdiction

After the added records have been properly identified and classified, the program continues with the task of finding bridges that were transferred to the Off-System. This task was accomplished by comparing the temporary file with removed records, countyname_rem, against the "New BRGOF" database file. The process is somewhat similar to the one used for finding replaced/rebuilt bridges. In this case, the comparison does not include the structure number nor the highway control and section number as comparison fields because TxDOT assigns complete different highway identification codes (e.g. control and section numbers) and the structure number contains these codes. Therefore, only the geographic coordinates and the location information, namely the feature crossed, the facility carried over and the location fields were used. The solution to overcome the problem of field information not matching simultaneously is described in Section 4.8.3.

Bridges Transferred From Off- to On-System Jurisdiction

This task was accomplished by comparing the temporary file with the added records, countyname_add, against the "Previous BRGOF" database file. The process is somewhat similar to that described above.

To complete Task Four, the program updates the geographic coordinates in the "New On-System County BRINSAP file" of the records corresponding to the bridges identified in the added list, as rebuilt/replaced. The coordinates for the remaining bridges are updated in Task Five. This

completes the comparison of bridge databases with a "New On-System County BRINSAP file, with correct Geographic Coordinates for Replaced Bridges only".

Also, during this task, the program also generates a report or CSV (Comma Separated Value format) text file that contains both lists of removed bridges and added bridges. Figure 4.5 illustrates the format of the report using the information for Fort Bend county. The reports generated for the counties of the Houston district are shown in Appendix D. The list of removed bridges is presented first. The bridge record information reported includes:

a) The internal ID number already assigned by macro fillid.rsc when preparing BRINSAP.
b) The structure number of the removed bridge records.
c) The feature crossed.
d) The facility carried over.
e) The location description.
f) The route control number.
g) The route section number.
h) The milepoint.
i) And the latitude and longitude (in degrees-decimal minutes format).

If the removed bridge was identified in the new Off-System database, the corresponding Off-System structure number is reported. (An associated match criterion is also included, representing the degree of certainty that the bridge record information matched between the removed list and the new Off-System database). At the end of the list, the total number of records removed is reported.

Immediately after, the list of added bridges continues. The bridge record information is similar to the reported for removed bridges. Except that if the added bridge was identified as replaced/rebuilt, the corresponding structure number from the removed list is appended. (Similarly, an associated match criterion is also included, representing the degree of certainty that the bridge record information matched between the removed and the added list).

If the added bridge was identified in the previous Off-System database, the corresponding Off-System structure number is also reported. (An associated match criterion is also included, representing the degree of certainty that the bridge record information matched between the added list and the previous Off-System database). At the end of the list, the total number of records added is reported, and in addition a balance of bridges removed or added per county is computed.

This text file was generated for two reasons: a) to keep track of the latest changes made to BRINSAP, and b) to aid in the task of un-assigning removed bridges from the roads network, verifying the location of replaced/rebuilt bridges and new bridges. The update of the relational database BRINSAP-ROADS is the subject of the following task. It should be noted that at the end of this task, the integrity of the latest BRINSAP information is maintained (e.g. bridge spans, clearances, rating, etc.).

ID	Removed bridges	Feature Crossed	Facility Carried Over	Location	Control	Section	Milepoint	Lat(DM)	Long(DM)	Yr.Built			OFF-sys bridge	OFF FLAG
1	120800002706007	SAN BERNARD RI	US 90A	3.90 MI W OF FM 1952	27	6	40050	29320	96032	1923	.	.	.	.
14	120800002708056	DRAINAGE D	US-90A(W.B.)	2.9 MI. SW OF SH6	27	8	23677	29361	95410	1943	.	.	.	.
78	120800008909057	SAN BERNARD RI	US 59 SB	0.60 MI SW OF FM 2919	89	9	31719	29262	96010	1939	.	.	.	.
188	120800196501001	GUY CRK	FM 1994	0.30 MI NE OF SH 36	1965	1	3577	29211	95464	1950	.	.	.	.
203	120800342201001	BIG CRK	PR 72	IN BRAZOS BEND STATE PARK	3422	1	4443	29226	95359	1930	.	.	.	.
232	120800813212001	AMERICAN CAN	DULLES AVE	1.50 MI S OF US 90A	8132	12	1800	30000	100000	1987	.	.	120800AA0412003	UNC
233	120800813212002	OYSTER CRK	DULLES RD NB	2.40 MI S OF US 90A	8132	12	900	30000	100000	1986	.	.	120800AA0412001	POS
234	120800813212003	OYSTER CRK	DULLES RD SB	2.40 MI S OF US 90A	8132	12	900	30000	100000	1986	.	.	120800AA0412002	POS
235	120800813712007	DRAINAGE D	S POST OAK RD	0.20 MI S OF COURT RD	8137	12	6500	30000	100000	1986	.	.	120800B52313009	POS
236	120800815312006	DRAINAGE D	FONDREN RD	1.20 MI S 0F CO LINE	8153	12	1200	30000	100000	1973	.	.	120800B24809010	POS
237	120800816812001	KEEGANS BYU	BELKNAP RD	0.05 MI S OF CO LINE	8168	12	1000	30000	100000	1975	.	.	120800AA0139001	POS
238	120800817212003	DRAINAGE D	W AIRPORT BLVD WB	0.75 MI E OF US 59	8172	12	2100	30000	100000	1970	.	.	120800NN0010001	POS
239	120800817212004	DRAINAGE D	W AIRPORT BLVD EB	0.75 MI E OF US 59	8172	12	2100	30000	100000	1970	.	.	120800NN0010002	POS
240	120800880612001	RABBS BYU	GOLFVIEW DR	0.30 MI NE OF THOMPSON	8806	12	800	30000	100000	1975	.	.	120800D00310001	POS
241	120800885512001	DRY CRK	AIRPORT AVE	0.30 MI E OF LOUISE	8855	12	600	30000	100000	1980	.	.	120800C00900001	POS
242	120800886112001	SEABOURNE CRK	BLUME RD	1.30 MI S OF US LP 529	8861	12	1300	30000	100000	1980	.	.	.	.
243	120800886412001	DRY CRK	4TH ST	0.65 MI SOUTH OF FM 1640	8864	12	900	30000	100000	1990	.	.	120800C00245001	POS
244	120800886612001	SEABOURNE CRK	KLAUKE RD	.1M W OF BAMORE RD	8866	12	100	0	0	1990	.	.	.	.
245	120800886812001	DRY CRK	LOUISE RD	0.10 MI N OF AIRPORT AVE	8868	12	600	30000	100000	1986	.	.	120800C00410001	POS
		Total bridges REMOVED =		19										

ID	New bridges	Feature Crossed	Facility Carried Over	Location	Control	Section	Milepoint	Lat(DM)	Long(DM)	Yr.Built	Bridge Rep.	Rep. FLAG	OFF-bridge Rep.	OFF FLAG
12806	120800002706282	SAN BERNARD RIVER	US 90A	0.2 MI E OF W BERNARD RD	27	6	40050	29320	96032	1996	120800002706007	<—	.	.
12821	120800002708280	DRAINAGE DITCH	US90A	.25MI S OF BW8	27	8	33477	(null)	(null)	1998	120800002708056	UNC	120800AA0281002	POS
12893	120800008909204	SAN BERNARD RIVER	US 59 SB	0.6 MI SW OF FM 2919	89	9	40050	29262	96010	1996	120800008909057	<—	.	.
13003	120800342201002	BIG CREEK	PARK RD 72	BRAZOS BEND STATE PARK	3422	1	4443	29226	95359	1996	120800342201001	POS	.	.
		Total NEW bridges =		4										
		Balance =		-15										

Figure 4.5 CompareBRG Report Format. Report For Fort Bend County.

4.6.5 Task Five: Update Relational Database

At this point, both the County BRINSAP and the County GIS ROADS network map are updated. However, the database that relates the two of them also needs to be updated to recognize the changes in the network for the GIS routing program to perform the proper identification of routes. Task Five consists of:

a) Un-assign the removed bridges from the existing road links. These bridges are no longer on the network.
b) Fill/update the relational database fields and correct geographic coordinates for those bridges that remain in the highway network.
c) Locate the new bridges and attribute them to the corresponding new or existing road links. The location of replaced/rebuilt bridges is also verified.
d) Delete road segments no longer corresponding to the On-System network (if required).

Un-assigning Removed Bridges.
The first step is to un-assign the bridges removed from the On-System highways from the roads network. This task consists of removing the corresponding bridge structure number from the relational database fields of the ROADS database. This is accomplished in TransCAD by using the "Bridges2Roads" or "B2R.rsc" macro on a map containing the "Updated County GIS ROADS" and the "Existing County GIS BRINSAP". The macro interactively scrolls over each BRINSAP record, highlighting with different colors, the active bridge and the corresponding road links to which the bridge is attributed as an overpass and/or an underpass. To know which bridges must be un-assigned from the On-System, the user must review the "Removed bridges" list on the CSV text file generated in Task Four.

By means of clicking on the "Deselect" button of the "B2R.rsc" macro, the bridge can be un-assigned simultaneously from all road links to which it is attributed. For example, if the bridge is an overpass or underpass, the bridge structure number is assigned to the link(s) corresponding to the facilities carried and to the link(s) of the facility crossed. Therefore, the bridge structure numbers are automatically removed from the BRGOP1-BRGOP2 fields, if the bridge was attributed to one or more road links as an overpass, and/or from the BRGUP1-BRGUP2 fields, if attributed as an underpass. The changes are saved automatically.

In addition, the relational database in the "Existing County GIS BRINSAP" contains four fields that identify the road links identification numbers (CTYRDID) of the facilities carried and facilities crossed (if it is a highway) which are simultaneously updated. The corresponding county road ID codes are removed from the CTYRDOP1-CTYRDOP2 fields if the bridge was attributed as an overpass and removed from the CTYRDUP1-CTYRDUP2 if assigned as underpass.

The resulting roads network corresponds to the county GIS ROADS and GIS BRINSAP that no longer contain the bridges removed from the On-System network between the releases of the old and new BRINSAP, but still does not contain the added bridges. These files are referred to as the "County GIS ROADS without removed and new bridges" and the "County GIS BRINSAP map without road links attributed to removed bridges and without new bridges".

Update Relational Database Fields and Correct Geographic Coordinates

To incorporate the added bridges into the routing network and have access to the most updated bridge record information when performing a routing analysis, a map showing the correct location of the latest bridge records is required. The file that contains the latest BRINSAP information, is the "New On-System County BRINSAP file, with correct Geographic Coordinates for Replaced bridges only" described in Task Four (Section 4.6.4). Nevertheless, this file only has the correct coordinate information for the bridges identified as rebuilt/replaced. To update the correct coordinates for the records of the remaining bridges, a comparison is made between three database files:

a) The "County BRINSAP file without the road ID's (CTYRDID) attributed to removed bridges" has the corrected coordinates of the all the bridges, except for the bridges corresponding to the ones identified as added (alias Existing county B2R, see Figure 4.6). This database file is obtained by exporting the Dataview of the "Existing County GIS BRINSAP" described in the previous sub-section and saving it in dBase format (see 4.6.1).
b) The corresponding temporary file Countyname_rem file with removed bridges (alias Removed bridges, see Figure 4.6).
c) And, the corresponding "New On-System County BRINSAP file, with correct Geographic Coordinates for Replaced bridges only" (alias New county B2R, see Figure 4.6).

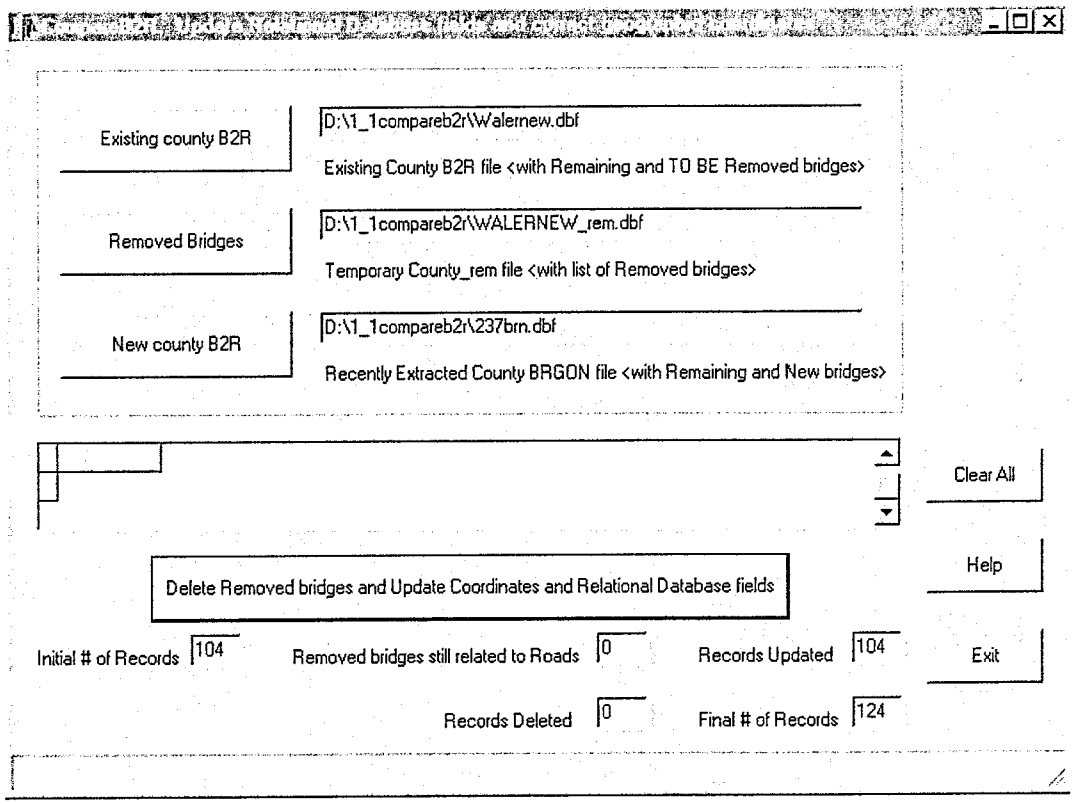


Figure 4.6 CompareB2R Program. Main Components.

The comparison is made through the use of the external stand-alone program CompareB2R developed in C++ programming language. In a typical execution the files (in dBase format) to be compared are chosen in the following order: 'Existing county B2R' file first, followed by the 'Removed Bridges' and then by 'New county B2R' files (see Figure 4.6).

The filenames and paths appear on the edit boxes on the right of each choose-file button. Afterwards, click on the "Delete Removed Bridges and Update Coordinates and Relational Database fields" button to start the comparison.

The program scrolls the database files, each record at a time, comparing the fields that contain the bridge' structure identification number. Each time a record is found in the "New county B2R" database, the geographic coordinates (in decimal degrees format), the corresponding relational database fields (BRGOP1, BRGOP2, BRGUP1, BRGUP2) and the FLAGS fields, are updated with the information contained in the corresponding fields in the "Existing county B2R" database.

Three internal counters keep track of the initial number of bridge records, the number of bridge records updated and the final number of On-System bridges that the county will have.

Th resulting file contains the corrected coordinates updated for the replaced/rebuilt bridges and the corresponding relational database fields also updated.

Incorporate/Locate New Bridges

At this point the added bridges still have to be incorporated and located in the roads network. Subsequently, new County GIS BRINSAP files need to be generated, using the updated geographic coordinates, to map the corrected bridge locations and represent them in a point layer.

Once these files are generated, a "New Regenerated County Map" is created by superimposing a) the "New County GIS BRINSAP", and b) the "County GIS ROADS without removed and new bridges". The position of the new added bridges can be verified and corrected, if required. The procedure to verify and locate bridges is described in Chapter 4 of Reference [6].

After verifying the bridge locations, the new added bridges have to be incorporated into the roads network. This consists of writing the corresponding bridge structure numbers in the relational database fields (BRGOP1, BRGOP2, BRGUP1, and BRGUP2) of the road links. Again this is accomplished in TransCAD by using the "B2R.rsc" macro on the previously created map.

The process is similar to the one described for un-assigning the removed bridges. The macro interactively scrolls over each BRINSAP record. By clicking on the "Overpass" or "Underpass" buttons and then selecting the corresponding road links, the links will be highlighted with different colors.

To incorporate the new added bridges to the On-System, the user must review the "Added bridges" list on the CSV text file generated in Task Four.

By means of clicking on the "Save" button, the bridge can be attributed simultaneously to all road links to which it is attributed. The bridge structure numbers are automatically added to the BRGOP1-BRGOP2 fields, if the bridge was attributed to one or more road links as an overpass, and/or to the BRGUP1-BRGUP2 fields, if attributed as an underpass. The changes are saved automatically.

In addition, the relational database fields in the BRINSAP are simultaneously updated. The corresponding county road ID's are added to the CTYRDOP1-CTYRDOP2 fields if the bridge was attributed as an overpass and removed from the CTYRDUP1-CTYRDUP2 if assigned as underpass.

The resulting roads network corresponds to the "County GIS ROADS map with new bridges". This road network may still have some road links that are no longer part of the On-System network and need to be deleted, before using the routing program.

Delete Non On-System Road Links

The last step in the update process consists in eliminating the road links that are no longer part of the On-System network. By deleting the unwanted road links the routing program will avoid determining unrealistic On-System routes. The deletion process should be done with extreme care to avoid deleting other road links by mistake. The deletion process involves a series of steps that are listed below:

With the "County GIS ROADS map with new bridges" opened in TransCAD:

1) Select the ROADS layer as the working layer.
2) Carefully inspect each candidate road link to eliminate, verify that no bridges are attributed in any form. If there are one or more bridges attributed, skip the road link. Use the zoom-in, zoom-out, and pan tools to facilitate the inspection.
3) Select the road links to eliminate first, clicking on the "Select by Pointing" button in the Tools/toolbox and then click on the link. The link is then highlighted and automatically added to an internal set. Note that to deselect a link from the internal set, press Ctrl and click on the link. The link is automatically deselected.
4) After all the links to be eliminated have been selected, choose Edit/Delete set and to proceed with the deletion click "Yes". The road feature and corresponding record from the ROADS database are deleted.

The changes are automatically saved. The On-System roads network is now completely updated and the entire update process is complete.

4.7 Merge Updated GIS County Files

The end product of this update process consists of a new set of county GIS files with updated BRINSAP and ROADS geographic features and corresponding relational database BRINSAP-ROADS ("Final County GIS ROADS and BRINSAP map").

After the update process has been performed on the corresponding counties, to be able to perform the routing analysis on a district level, the "Final County GIS files" must be merged together to obtain the "Updated District GIS files". The merging of the GIS files is accomplished by the use of macros "Mergel.rsc" and "Mergep.rsc" in TransCAD. The "Final County GIS Roads" files are merged using the macro "Mergel.rsc", which merges GIS files containing line geographic features. The "Final County GIS BRINSAP" files are merged with the use of macro "Mergep.rsc", which merges GIS files containing point geographic features (see Chapter 4 of Reference [6]).

Once the "Updated District GIS" files have been obtained, these can be converted to TransCAD's compact read-only geographic format. This format not only saves disk space, it expedites the display of the maps on the computer screen. To convert the GIS files to compact read-only format, in TransCAD, the user must:

1. Choose the geographic features to export.
2. Then under Tools/Export menu option choose the following:
   a) Export: All records
   b) To: Compact Geographic file
   c) Data Field: <None>
   d) Note Data Field: <None>
   e) Options: <check> Include Built-in data.
3. Finally, choose a folder and wait a few seconds until the conversion is terminated. For more information see TransCAD's User's manual.

At this point the routing package is completely updated and ready for routing analysis. To perform a routing analysis, the "OVR.rsc" macro is used. More information on installing the program and running the application can be found in the OVR Installation Guide and the OVR User's guide included in Appendices A and B of this report.

4.8 Problems With the Update Process

During the prototyping phase of the update process, several problems associated with the County Urban maps and the databases were encountered. These problems are addressed in the following sections.

4.8.1 Problems Associated With the ROADS Database

An important step in the update process consists of incorporating, into the road network, the new added road links with its corresponding ROADS database attributed to the highways' centerlines (e.g. HIGHWAY_ID, MSLINK, etc.). The attributes, specifically the HIGHWAY_ID, are used in road management operations (e.g. maps highlighting specific highways, etc.) and also to clarify the route information in the routing program's output report.

At the time this report was written, TxDOT's ROADS database was unavailable due to incomplete information and corruption problems in the files. Therefore, the update procedure does not consider the inclusion of this information. Upon availability of the ROADS database,

the following procedure can be implemented to import, into TransCAD, the database attributes along with its corresponding road features:

a) From the "New County Urban map or New DGN", select and export the On-System road links, including centerlines of divided highways;
b) Operating under the Modular GIS Environment software (MGE), access and the ROADS database attributes corresponding to the On-System road network, as MapInfo tables; this will generate a number of table files per highway feature (e.g. State Highways (SH), Interstate Highways (IH), etc.).
c) Once all the highway tables have been exported, append all of them into a single highway feature table using MapInfo GIS software; export the resulting table into MapInfo Import Format (MIF).
d) Import the MIF table into TransCAD and generate the New Roads map (with database attributes included).

Note that this procedure differs from the one outlined in Chapter 4 of Reference [6] , where a line cleaning process consisting of deleting duplicate lines and short overshoots is implemented. This cleaning process modifies the geometry of the original drawing features, thus making the identification of new/modified links difficult and cumbersome.

To identify the new/modified road links, the "New Roads map with ROADS database attributes" and the "Old Roads map" need to be compared. The "New Roads map ..." has a database structure incorporated in the GIS files, where the "Old Roads map" does not. This incompatibility creates a problem when comparing both maps. When a new/modified link is identified in the "New Roads map ...", the line feature is copied to the "Old Roads map" without the database attribute.

Modifying the internal database structure of the "Old Roads map" solves this problem. Specifically, the ROADS database fields (MGEFCODE, HIGHWAY_ID, COUNTY_NO, MSLINK and MAPID) and the relational database fields (HEADING, CTYRDID, BRGOP1, BRGOP2, BRGUP1, and BRGUP2) need to be added. This is accomplished in TransCAD using the customized macro "adroadf.rsc".

Figure 4.7 depicts the procedure described above.

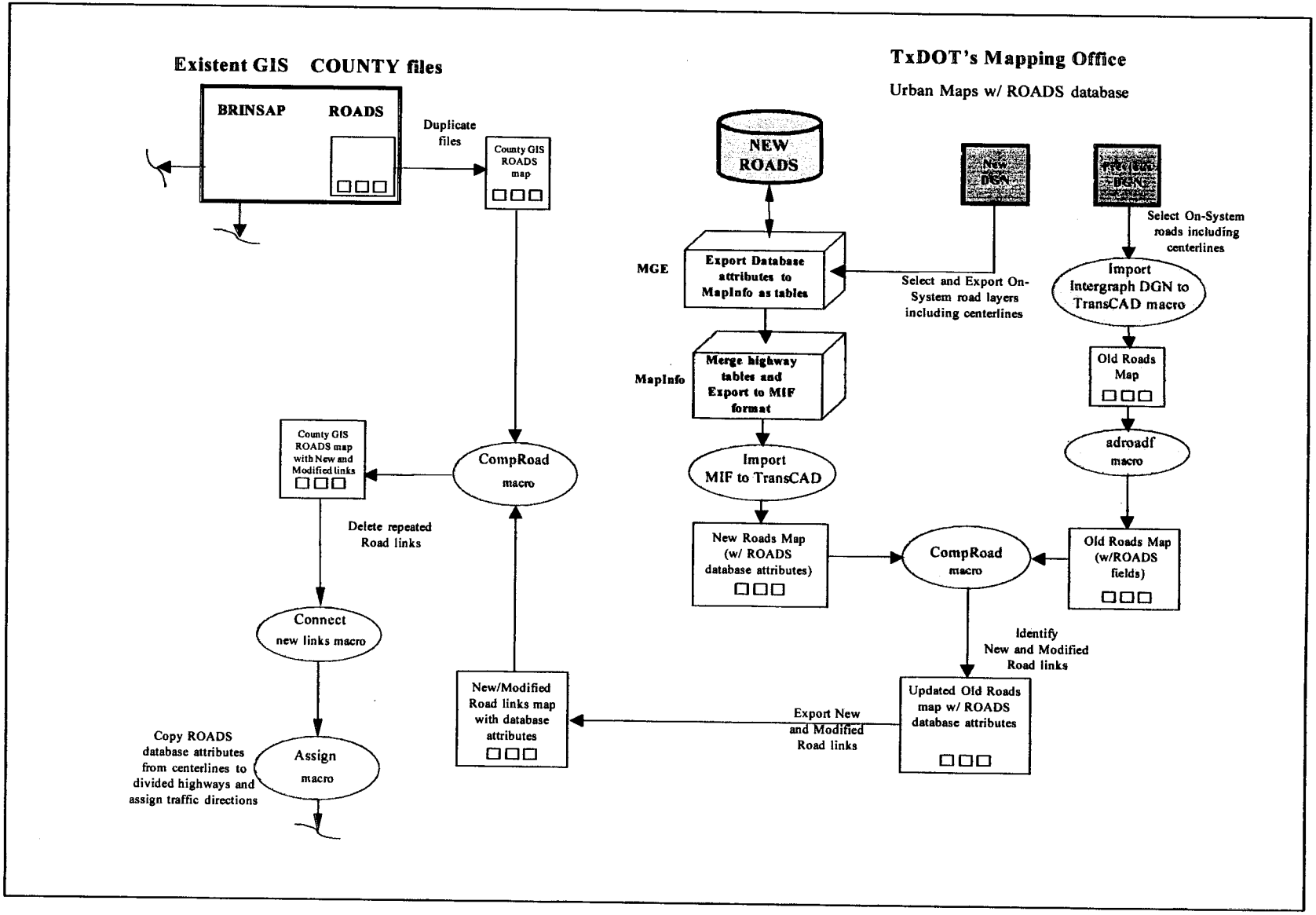


Figure 4.7 Road Network Update Process Including ROADS Database.

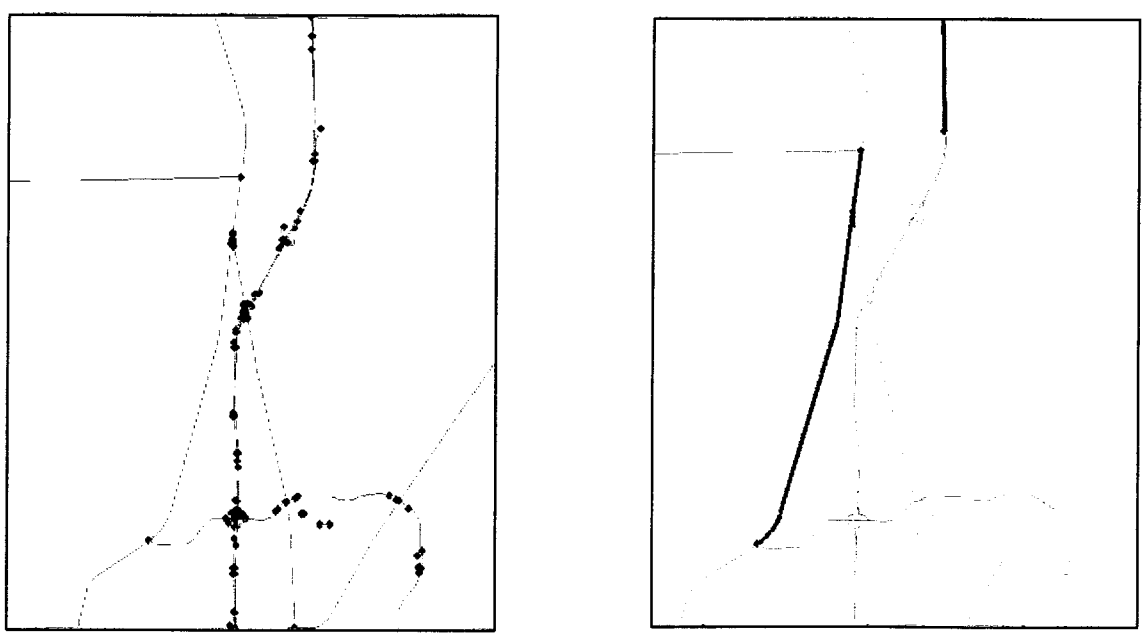
After making both GIS maps compatible, the comparison and the rest of the update process for the roads network can be made as described in Tasks Two and Three of Section B (Sections 4.6.2 and 4.6.3).

4.8.2 Problems Associated With the Urban Maps

Ideally, the identification of new and modified roads links should be done comparing the "New Roads Map" containing the On-System road links imported from the new version of the County Urban maps against the "Existing County GIS ROADS map". Nevertheless, this was neither feasible nor practical since the "Existing County GIS ROADS map" was modified during the road network preparation procedure (see Section 4.4 of Reference [6]). In summary, undershoots, overshoots, duplicate lines, short segments and other disconnectivity problems where identified and fixed, thus, modifying the drawing geometry. When making the comparison an extensive number of existent segments were repeated, defying the purpose of the comparison.

Therefore, it was decided to perform the comparison between the road links imported from the latest and previous county Urban maps ("New DGN and Previous DGN").

Although, the resulting number of new/modified road links identified was significantly reduced, some links were still repeated (see Figure 4.8). The reason for this is that the geometry and/or connectivity of the drawing elements in the new Urban map were modified (e.g. two or more contiguous segments were connected, divided highways were added, etc). The repeated links are deleted to avoid connectivity problems.



1. Old Roads map. 2. Updated Old Roads map.

Figure 4.8 Case of Repeated Links Identified between New and Previous Urban Maps.

4.8.3 Problems Associated With BRINSAP

During the comparison of the "Existing County BRINSAP" and the "New On-System County BRINSAP" described in Task Four (Section 4.6.4), new added bridge records and removed bridge records are identified. Among these bridge records, some of the new added bridge records may correspond to bridge structures that are replaced/rebuilt, and similarly, some removed bridges may correspond to bridges assigned to Off-System jurisdiction. Several problems were encountered while comparing the new and previous databases and are addressed in the sections below.

Identification of Replaced/Rebuilt Bridges: While comparing the list of removed bridges against the list of added bridge records to identify replaced/rebuilt bridges, the BRINSAP structure numbers cannot be used because the numbers are different. Therefore, it is assumed that for a replaced/rebuilt bridge, the geographic location description, the highway identification and the original geographic coordinates should simultaneously and match in the corresponding fields of both a removed record and an added record.

Occasionally the field information does not match exactly for the reasons listed in Section 4.6.4 causing the comparison process to skip possible matching records.
The problem was addressed by utilizing a "weighted optimization" procedure. The objective is to maximize the number of matching records by assigning weights to the different fields analyzed and combining the weights to determine the degree of certainty that the record corresponds to a match.

In summary the "weighted optimization" consists of:

a) Each record in the added list is compared to the corresponding fields in the records of the removed list. If there is a match in the fields between the two records, individual and/or combined weights are assigned reflecting the importance of the field(s) to consider the bridge record as replaced/rebuilt.
b) A total match value is computed by aggregating the individual weights assigned.
c) The total match value is associated to a criterion that subjectively describes the degree of certainty that the record corresponds to a replaced/rebuilt bridge record. Larger total match values suggest increasing certainty that the record corresponds to a replaced/rebuilt bridge.

Table 4.1 illustrates the individual and combined weights assigned to the fields according to the following assumptions:

a) If an added bridge record corresponds to a replaced/rebuilt bridge, the inventory route codes should match, specifically, the Control and Section numbers. These are the primary fields of importance in the matching process. The weight values are assigned according to the following pairwise scenarios:

    1. If both the Control number and the Section number of the records match, then a total combined weight of 2.25 is assigned.

2. If the Control numbers between the records match but no match is encountered in the Section numbers, then a weight of 1.25 is given to the Control number and a weight value of 0.0 is given to the Section number.
3. If the Control numbers between the records do not match and a match is found in the Section numbers, then a weight of 0.0 is given to the Control number and a weight value of 0.5 is given to the Section number.
4. If neither field matches a negative weight of –1.0 is given.

The occurrence of both numbers matching simultaneously suggests a higher possibility of a match than exclusive occurrences (one or the other), thus having a higher combination weight. Similarly, when both codes do not match, the possibility of the record corresponding to a match is lower.

b) Following in order of importance are the original geographic coordinates (in degrees-minute format) entered in BRINSAP. If a match in the records is found for either the latitude or the longitude coordinate, then an individual weight of 1.5 is assigned otherwise the weight is 0.
c) The description of the Feature Crossed and the Facility Carried are the last in order of importance. Both are also assigned the same weight if either is met, but the weight value is the least of all (0.50); if either is not met a null value is assigned (0.00).

By adding the weights a total the match value is obtained by comparing the BRINSAP records of the list of removed bridges and those of the added bridges. The total match value may vary between -1.00 and 6.25 according to the possible scenarios in Table 4.1. This match value is used to subjectively describe the degree of certainty of the record's match. The possible descriptors include a) no match (below 2.0), b) uncertain match (between 2.25 and 3.75), c) possible match (between 4 and 5.25) and d) exact match (greater that 5.5). As can be observed the total match values are classified in four ranges. As the range values increase the possibility of having an exact match also increases.

As part of the optimization process, to enhance the possibility of matching common field information, an algorithm was employed to eliminate non-alphanumeric characters (e.g. commas, colons, slashes, parenthesis, spaces, etc.) from the contents of the fields. For example, the Feature Carried Over field in a removed record could read as SH62 NB , and in the added record it might read as SH 62 (NB). This is the same information, nevertheless without the algorithm it would have not been considered as a match and a null weight value would have been assigned, decreasing the certainty of an exact match.

The weights, the total match value ranges and certainty descriptors were proposed based on the observations made on the BRINSAP databases and the understanding of maximizing the matching process. The "weighted optimization" procedure was integrated in the program CompareBRG. Appendix D shows the reports for the counties in Houston district.

Table 4.1 Weighted Optimization Table to Find Replaced/Rebuilt Bridges by Comparing the BRINSAP List of Removed Bridges to the List of Added Bridges.

INDIVIDUAL AND COMBINED WEIGHTS TO FIND REPLACED/REBUILT BRIDGES

CASE	w_1 Control	w_2 Section	w_3 Latitud	w_4 Longitud	w_5 Feature Crossed	w_6 Facility Carried	Total Match	Criterion
1		2.25	1.50	1.50	0.50	0.50	6.25	EXACT
2		2.25	1.50	1.50	0.50 - 0.00 or 0.00 - 0.50		5.75	EXACT
3		2.25	1.50	1.50			5.25	POSSIBLE
4		2.25	1.50 - 0.00 or 0.00 - 1.50		0.50	0.50	4.75	POSSIBLE
5		2.25	1.50 - 0.00 or 0.00 - 1.50		0.50 - 0.00 or 0.00 - 0.50		4.25	POSSIBLE
6		2.25	1.50 - 0.00 or 0.00 - 1.50				3.75	UNCERTAIN
7		2.25			0.50	0.50	3.25	UNCERTAIN
8		2.25			0.50 - 0.00 or 0.00 - 0.50		2.75	UNCERTAIN
9		2.25					2.25	UNCERTAIN
10	1.25		1.50	1.50	0.50	0.50	5.25	POSSIBLE
11	1.25		1.50	1.50	0.50 - 0.00 or 0.00 - 0.50		4.75	POSSIBLE
12	1.25		1.50	1.50			4.25	POSSIBLE
13	1.25		1.50 - 0.00 or 0.00 - 1.50		0.50	0.50	3.75	UNCERTAIN
14	1.25		1.50 - 0.00 or 0.00 - 1.50		0.50 - 0.00 or 0.00 - 0.50		3.25	UNCERTAIN
15	1.25		1.50 - 0.00 or 0.00 - 1.50				2.75	UNCERTAIN
16	1.25				0.50	0.50	2.25	UNCERTAIN
17	1.25				0.50 - 0.00 or 0.00 - 0.50		1.75	
18	1.25						1.25	
19		0.50	1.50	1.50	0.50	0.50	4.50	POSSIBLE
20		0.50	1.50	1.50	0.50 - 0.00 or 0.00 - 0.50		4.00	POSSIBLE
21		0.50	1.50	1.50			3.50	UNCERTAIN
22		0.50	1.50 - 0.00 or 0.00 - 1.50		0.50	0.50	3.00	UNCERTAIN
23		0.50	1.50 - 0.00 or 0.00 - 1.50		0.50 - 0.00 or 0.00 - 0.50		2.50	UNCERTAIN
24		0.50	1.50 - 0.00 or 0.00 - 1.50				2.00	
25		0.50			0.50	0.50	1.50	
26		0.50			0.50 - 0.00 or 0.00 - 0.50		1.00	
27		0.50					0.50	
28		-1.00	1.50	1.50	0.50	0.50	3.00	UNCERTAIN
29		-1.00	1.50	1.50	0.50 - 0.00 or 0.00 - 0.50		2.50	UNCERTAIN
30		-1.00	1.50	1.50			2.00	
31		-1.00	1.50 - 0.00 or 0.00 - 1.50		0.50	0.50	1.50	
32		-1.00	1.50 - 0.00 or 0.00 - 1.50		0.50 - 0.00 or 0.00 - 0.50		1.00	
33		-1.00	1.50 - 0.00 or 0.00 - 1.50				0.50	
34		-1.00			0.50	0.50	0.00	
35		-1.00			0.50 - 0.00 or 0.00 - 0.50		-0.50	
36		-1.00					-1.00	

MATCH VALUE RANGES AND ASSOCIATED DESCRIPTORS

2.00	2.25 — 3.75	4.00 — 5.25	5.50
	UNCERTAIN	POSSIBLE	EXACT

Identification of Bridges transferred from Off- to On-System and Vice Versa
The identification of bridges with jurisdiction transfer, from On- to Off-System and Off- to On-System, also presented some problems while comparing the records. The main reason for this is that Off-System bridges have Control numbers and Section numbers different to the On-System bridges. The structure numbers may sometimes be different, nevertheless it is also assumed that for a bridge assigned to the Off-System the geographic location description and the original geographic coordinates should simultaneously and exactly match in the corresponding fields of both a removed record and an added record. Therefore, the weighted optimization process was employed with a few minor differences.

Table 4.2 illustrates the individual and combined weights assigned to the fields according to the following assumptions:

a) If an added bridge record corresponds to a bridge transferred from one jurisdiction to the other, the original geographic coordinates (in degrees-minute format) entered in BRINSAP should match. A weight of 1.5 is assigned if either fields match; if either field does not match a weight of 0.0 is assigned; nevertheless if neither fields match, a total combined weight of –1.00 is assigned. In this case, these are the primary fields of importance in the matching process.
b) Following in the order of importance are the description of the Feature Crossed and the Facility Carried. The weight values are assigned according to the following scenarios:
   1. If both the Feature Crossed and the Facility Carried match, a weight value of 1.00 is assigned to each.
   2. If the Feature Crossed between records match but no match is found with the Facility Carried, then a weight of 1.00 is given to the Feature Crossed and a weight of -0.25 to the Facility Carried);
   3. In contrast, if the Feature Crossed between records do not match and the Facility Carried do, the corresponding weights assigned are -0.25 and 1.00.
   5. If neither fields match, the total combined weight is -1.00 is given.
c) The last field compared is the description of the Location. If a match is found, a value of 0.50 is assigned, otherwise, a value of 0.00 is assigned.

As with the replaced/rebuilt bridges, the individual weights are added and a total match value is determined. The total match value may vary between –2.00 and 5.50 according to the scenarios shown in Table 4.2.

Again, four descriptors are used to describe the degree of certainty of the record's match. Nevertheless, three different range scales are used to classify the total match values. The sub-classification of match values is based on three matching scenarios with respect to the original geographic coordinates:
a) when both coordinates (longitude and latitude) match simultaneously;
b) when either coordinate (longitude or latitude) matches and the other one does not; and
c) when neither coordinates match.

The subroutine to eliminate non-alphanumeric characters was again utilized to enhance the matching process. The weights, the sub-ranges were proposed as before aiming at the maximization of the matching process.

Interchanged location information:
It was also observed that sometimes only the description information corresponding to the Facility Carried Over and the Feature Crossed fields of a removed record was interchanged in the description of a bridge in the added record list. This situation suggests that the information may have been originally wrong and was corrected, meaning that the bridge record was originally considered as an overpass and may have been corrected to an underpass or vice versa. When this situation was encountered, the record was treated as one lacking matching information (refer to Appendix D, Harris county report, compare record 121020011005129 in list of added records with record 121020011005089 in list of removed records).

Table 4.2 Weighted Optimization Table to Find Bridges Transferred from On- to Off-System and Vice Versa.

INDIVIDUAL AND COMBINED WEIGHTS TO FIND BRIDGES THAT TRANSFER FROM ON-OFF AND OFF-ON JURISDICTION

CASE	w_1 Latitud	w_2 Longitud	w_3 Feature Crossed	w_4 Facility Carried	w_5 Location	Total Match	Criterion
1	1.50	1.50	1.00	1.00	0.50	5.50	EXACT
2	1.50	1.50	1.00	1.00		5.00	EXACT
3	1.50	1.50	1.00	-0.25	0.50	4.25	POSSIBLE
4	1.50	1.50	1.00	-0.25		3.75	POSSIBLE
5	1.50	1.50	-0.25	1.00	0.50	4.25	POSSIBLE
6	1.50	1.50	-0.25	1.00		3.75	POSSIBLE
7	1.50	1.50	-1.00		0.50	2.50	UNCERTAIN
8	1.50	1.50	-1.00			2.00	
9	1.50-0.00 or 0.00-1.50		1.00	1.00	0.50	4.00	EXACT
10	1.50-0.00 or 0.00-1.50		1.00	1.00		3.50	EXACT
11	1.50-0.00 or 0.00-1.50		1.00	-0.25	0.50	2.75	POSSIBLE
12	1.50-0.00 or 0.00-1.50		1.00	-0.25		2.25	POSSIBLE
13	1.50-0.00 or 0.00-1.50		-0.25	1.00	0.50	2.75	POSSIBLE
14	1.50-0.00 or 0.00-1.50		-0.25	1.00		2.25	POSSIBLE
15	1.50-0.00 or 0.00-1.50		-1.00		0.50	1.00	UNCERTAIN
16	1.50-0.00 or 0.00-1.50		-1.00			0.50	
17	-1.00		1.00	1.00	0.50	1.50	POSSIBLE
18	-1.00		1.00	1.00		1.00	POSSIBLE
19	-1.00		1.00	-0.25	0.50	0.25	UNCERTAIN
20	-1.00		1.00	-0.25		-0.25	
21	-1.00		-0.25	1.00	0.50	0.25	UNCERTAIN
22	-1.00		-0.25	1.00		-0.25	
23	-1.00		-1.00		0.50	-1.50	
24	-1.00		-1.00			-2.00	

MATCH VALUE RANGES AND ASSOCIATED DESCRIPTORS

2.00	2.25	3.50	3.75	4.50	4.75
	UNCERTAIN		POSSIBLE		EXACT

0.75	1.00	2.00	2.25	3.00	3.25
	UNCERTAIN		POSSIBLE		EXACT

0.00	0.25	0.75	1.00
	UNCERTAIN		POSSIBLE

CHAPTER 5

SUMMARY AND FUTURE WORK

5.1 Summary

This report documented the progress of activities undertaken in Texas Department of Transportation Study 0-1823 towards the development of an automated routing system for overweight and oversize vehicles on the On-System highways. Chapter 1 included an introduction to the oversize/overweight routing problem in the State of Texas and an overview of the background work.

Chapter 2 of summarized the work accomplished by correcting for the bridge locations of all the bridges located on the On-system highways. The correct bridge location on the routing software is one of the most critical elements for the functionality of the software. The BRINSAP database includes geographic longitude and latitude coordinates that have been entered into the database without a quality control procedure. As a result, some of the coordinates are incorrect and of low accuracy. The proper location for each bridge in the State of Texas was corrected and/or verified using a computer procedure that places the bridges on the proper road segments depicted in geographically accurate maps. The bridge location correction process was applied to all 25 Districts of the TxDOT. Chapter 2 includes summary tables of the observations made during the correction for the bridge locations.

Chapter 3 of this report includes a description of improvements incorporated into the GIS routing program. These improvements consist of:

a) A procedure to include turn-penalty information (the inability of large trucks to make sharp turns).
b) A procedure to select routes for heavy vehicles where the capacity of the bridges along the routes is maximized, and
c) A procedure to partition a network in order to speed-up the computation time to determine routes.

The main purpose of these improvements was to accommodate realistic situations, such as highway construction, traffic congestion, unsafe turns, unfeasibility of some turns, and other limitations frequently encountered by the user in issuing overweight/oversize vehicle routing permits.

Chapter 4 addresses the issue of updating the GIS information in the routing software to maintain the system current with the latest information of the On-System Roads and Bridges. The problem arises because TxDOT Design Division and Mapping Office periodically update and modify BRINSAP and the Roads databases as well as the digitized County Urban Maps. These changes, of course, are natural consequences of the routine growth of the highway system to satisfy new traffic demands as well as bridge inspection and management programs in the State. These changes, however, must be accounted for in the GIS routing maps and databases for a proper accountability of the actual highway system.

All the work accomplished in this project and in Project 0-1482 has resulted in operational software that can be used for the routing of overweight/oversize vehicles avoiding inadequate bridges and clearances. The TransCAD version of the software is being tested in the Motor Carrier Division and the Design Division, who are the intended customers.

Appendix A of this report includes an installation guide. Appendix B includes a User's Manual.

5.2 Future Work

During the second and last year of this project, the routing program and GIS information databases will be converted to Arc/View. This is required for the software to be compatible with TxDOT's "core" GIS technology. Independent to this research, TxDOT's GIS office adopted to exclusively use the Arc/Info and Arc/View GIS products.

REFERENCES

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[3] R.A. Osegueda, et al., "Towards the implementation of a Bridge Load Formula using BRINSAP", FHWA-TX- 1266-2, The University of Texas at El Paso, TX. (1992).

[4] R.A. Osegueda, et al., "Heavy Load Vehicle Routing using Highway Network Models and Bridge Load Formula", FHWA-TX- 1266-3, The University of Texas at El Paso, TX. (1993).

[5] P.B. Keating, "Overweight Permit Rules," Research Report 1433-IF, Texas Transportation Institute, Texas A&M University, College Station, TX. (1994).

[6] R.A. Osegueda, et al., "Development of Automated Routing of Overweight/Oversize Vehicle System for Houston District," Report TX-96-1482-1, The University of Texas at El Paso, TX, April 1997.

[7] R.A. Osegueda, et al., "Automated Route Evaluation of Overweight/Oversize Vehicles," Report TX-96-1482-2F, The University of Texas at El Paso, TX, October 1998.

APPENDIX A

OVERWEIGHT/OVERSIZE VEHICLE ROUTING SOFTWARE INSTALLATION GUIDE

This guide assumes that the user has basic knowledge about computers. This knowledge includes use of Windows95 or NT 4.0 operating systems as well as basic functions such as Copy, Paste, and the ability to create New folders [1].

NOTE: It is strongly recommended that the user become familiar with all the steps listed in each section of this guide, before actually carrying them out.

A. MINIMUM HARDWARE REQUIREMENTS

IBM PC or compatible with:

a) Pentium processor 150Mhz or greater
b) 32MB of RAM (128MB recommended)
c) 2GB Hard Disk (1GB of free space recommended)
d) VGA monitor
e) CD-ROM drive
f) 3.5" high density (1.44 MB) floppy disk drive
g) Windows 95 (recommended) or Windows NT 4.0 operating system
h) Microsoft Mouse or compatible
i) Iomega Zip drive (for 100 MB zip disks)
j) Printer (optional, recommended)

B. SOFTWARE REQUIREMENTS

k) TransCAD 3.0 Base (assumed commercial License) with hardware key
l) WordPad and Microsoft Word applications (included with Windows)
m) Installation zip disk (provided by UTEP with required files)

C. OVR PROGRAM FILES (Included in zip disk)

The following lists folders and files that contain geographic features, databases, help files and examples of the OVR program. Some of the geographic files included in this zip disk are NOT required to run the program. Files with BOUNDARIES, STREETS, SYMBOLS are examples of non-required files that should be kept for future reference, since they contain information that help identify geographic features.

The zip disk has three main folders: Macros, MergeTx and Winzip. The MergeTx folder contains eleven subfolders with zipped files and text files.

- **Macros** folder:
  Ovr.rsc : text file containing the OVR routing program code.

- **MergeTx** folder:

  Boundary folder:
  boundcdf.zip : zip file with political BOUNDARIES, NOT required

  Brinsap folder:
  brncdf.zip : zip file with BRINSAP database and geographic files

Help folder:
helpovr.txt : text file with HELP information to run the OVR program

Maps folder:
<empty> : user will create a MAP file and save here

Networks folder:
TEXAS.NET : road network file required for generating routes in TransCAD. User may have to regenerate this file once more and replace the existent one.

Readme folder:
OVR_install : Microsoft Word Document, "the file you are viewing."
OVR_user : Microsoft Word Document, OVR user's guide

Reports folder:
9 text files : sample REPORTS from OVR trials with varying results

Roads folder:
roadscdf.zip : zip file with ROAD database and geographic files

Streets folder:
streetsscdf.zip : zip file with STREETS, NOT required

Symbols folder:
symbolscdf.zip : zip file with bridge SYMBOLS, NOT required

Veh_lib folder:
<16 text files> : sample files of different VEHICLE configurations

- **Winzip** folder:
  winzip95 : application file to install WINZIP
  ReadMe : text file with HELP instructions to install winzip

The setup for the geographic files requires approximately 55MB of disk space. If you need to install Winzip, it will require an additional 2MB of disk space.

The zipped files with the cdf suffix contain the geographic files in "Compact format". This format does not allow modifications to the files. The zipped files contain the geographic files that will be used to generate the map and the network file as well as run the OVR program.
When the cdf zip files are extracted, three files with names matching the parent folder should be placed into their corresponding folders. The three files have the following extensions: bin, channel file and dcb.

D. INSTALLATION OF REQUIRED GEOGRAPHIC FILES

The computer must be turned on and logged into Windows, with the zip disk connected and properly installed to the computer. You must also have the Winzip program installed in order to unzip the required files from the zip disk. If you DO NOT have Winzip installed, refer to section **E** of this guide.

NOTE: Before attempting to install the files, it is strongly suggested that a backup copy of the zip disk is made.

The following is a step by step procedure to install the geographic files in order to run the OVR application:

1. Using Explorer, select and copy all the folders and files from the zip disk.
2. Choose a drive in your computer (C, D or any other) and paste the folders and zipped files included in the zip disk onto the selected drive. After copying, unzip them using the Winzip program.
   It is recommended that you choose the root directory of the selected drive to facilitate file selection.
   This step will take between 10 to 20 minutes to complete.
3. Once all the folders and corresponding files are copied to the chosen directory, the next step is to unzip the zipped files.
4. In this step it is assumed that the computer already has Winzip installed. Double click on the files "xxxxxcdf.zip" to extract into the corresponding folders. For example, double click on the file "boundcdf.zip", click the "I agree button", select all files, then click the "Extract" button. Choose the folder "\MergeTx\boundary\", then click the "Extract" button. Wait a few seconds until the extraction process is completed. Similarly, follow the same steps for the other "xxxxxcdf.zip" files.
5. Once all the "xxxxcdf.zip" files have been extracted, the setup of the required geographic files is complete. The additional text files and net file should have been copied automatically as described in steps 1 and 2.

E. WINZIP INSTALLATION

Refer to the Readme text file included in the Winzip folder, and follow the instructions to install Winzip.

F. TRANSCAD SOFTWARE INSTALLATION [2]

The following steps are a guide to install TransCAD GIS software, assuming it is being installed from a CD-ROM. The setup of TransCAD software requires approximately 37MB of disk space.

When installing under the Windows NT 4.0 environment, the software must be installed from the administrator account; otherwise, it will not be able to run after installation.

1. Place the "hardware block" key in the first parallel port on the back of the computer's CPU.
   Insert the "hardware block" key with care to avoid damaging the pins.
   If another device is connected to this parallel port, disconnect it, connect the "hardware block key" and connect the device back again on top of the hardware block key. This should not create any conflict whatsoever.
2. Place the TransCAD version 3.0 Program CD in the CD-ROM;
3. Go to Start/Settings/Control Panel and choose the Add-Remove Programs icon, double click on it;
4. Click the "Install" button and then the "Next" button. Windows searches for the corresponding CD drive and displays the setup executable file in the edit box.
5. Click the "Finish" button to start the installation. Windows with several options will appear on the screen and guide you through the installation.
   NOTES:
   a) Select Base TransCAD (this is the "assumed "commercial license)
   b) Select Single-User installation
   c) Choose any directory where you want to install TransCAD (the default directory is suggested)
   d) Speed-up files are optional and are not required to run the OVR program.

Wait a few seconds until TransCAD is completely installed, then re-start Windows or reboot your computer, before running TransCAD.

Go to Start\Programs\TransCAD\ and/or choose the TransCAD icon to start the application.

For more information on how to install TransCAD GIS software refer to Chapter 1, page 12 of the TransCAD User's guide.

G. OVR PROGRAM INSTALLATION

It is STRONGLY SUGGESTED that before installing and using the OVR program, the user should get familiar with TransCAD.

Customized programs or macros can be incorporated or added into TransCAD as compiled resource files to facilitate their distribution. Compiled resource files must be stored in a special database called **user interface (UI) database.** The name of the resource file containing the Overweight Vehicle Routing (OVR) macro is **ovr.rsc** (the *.rsc* extension is required), which can be found in the Macros folder.
This resource file should be copied from the Macros folder to the folder where TransCAD is installed (i.e. c:\tcw). Then the resource file **ovr.rsc** must be compiled into a separate, stand-alone UI database with the name **ovr0001.dbd**, which must also be stored in the TransCAD folder.
To install the OVR program as an Add-in macro in TransCAD, conduct the following steps for the initial time only:

1. From the **Tools** menu, choose **Add-Inns** to display the Add-Ins dialog box; then **choose GIS Developer's kit** and click OK. The GISDK toolbox will appear on the screen.
2. Click on the third button (from left to right) of the GISDK toolbox, the one with the help pop-up message "**Compile to UI**" showing just bellow the button; then the Compile to UI Database dialog box appears.
3. Choose the *ovr.rsc* file from the TransCAD folder (e.g. c:\tcw) in your computer and click OK.
4. Then the Save As dialog box displays on the screen prompting for a path to create the UI database. Choose the standard product folder (i.e. c:\tcw) or where TransCAD is installed and then enter for a name "**ovr0001.dbd**" and click OK to compile the file.
5. Again from the **Tools** menu choose **Add-Inns** to display the Add-Ins dialog box; click on **Setup** to display the Setup Add-Ins dialog box.
6. Click Add to create a new add-in, and click Macro in the radio list.
7. *Type "**Overweight Vehicle Routing**"* in the Description box.
8. Type "***ovr***" in the Name box.
9. Type *"**ovr0001**"* in the UI Database box.
10. Click OK to install the add-in and return to the Add-Ins dialog box.
11. Click Cancel to exit the Add-Ins dialog box. The OVR macro is now incorporated into TransCAD.

NOTE that "**ovr**" and "**ovr0001**" are case sensitive.
To run the OVR program see section **J** located later in this guide.

For more information on how to install Add-ins in TransCAD GIS software refer to Chapter 2, page 11 of the GISDK Programmer's Guide.

H. CREATE/LOAD A MAP FILE

TransCAD organizes geographic information in a map into layers. Each layer is a group of features of the same type, such as roads, streets, bridges, political boundaries, etc.

The OVR program requires only two layers to be included in a map, the ROADS line layer with its corresponding Endpoints layer, and the BRINSAP point layer.

The following steps will aid in the creation of a map:

1. Open TransCAD application.
2. Choose File/Open and set List Files of Type to ***Geographic File***, then find the ROADS.cdf file in the directories box (e.g. c:\MergeTx\Roads\cdf\roads.cdf) and select it. Either double click on it or click OK to load in into the workplace and view it on the screen. Wait a few seconds until the geographic features are completely loaded.
3. Then choose ***Map-Layers*** to display the Layers dialog box. Click ***Add Layer*** to display the File Open dialog box.

4. Choose ***Geographic File*** as the File Type and choose BRINSAP.cdf as in step 2. To add this layer to the map and return to it, click Close on the Layers dialog box and the map will automatically be updated with the selected layer(s).
5. To Save the map choose **File/Save As** and select from the save as dialog box the ***Map file*** type and type any name (e.g. Texas.map); save the map under the MergeTx/maps/ folder, then click the OK button.

You may add other layers such as: the boundary layer, the streets layer or bridge symbols layer using the steps mentioned above. These last layers are not required to run the OVR program.

Furthermore, the map does not need to be created every time to run the OVR program, unless different maps with different layers included are desired. Next time any existing map needs to be opened, choose File/Open and set List Files of Type to ***Map File***, then find the corresponding Maps folder and choose the map file to be loaded.

To learn more about layering features on a map refer to Chapter 4, page 65 of the TransCAD User's guide.

I. GENERATE A NETWORK FILE

To generate a shortest path between an origin and a destination from a map containing a road line layer, TransCAD requires a network file that stores important characteristics or features of the roads and/or the transportation system. To create a network file, a map file must be loaded into TransCAD and the corresponding ROADS line layer must be selected from the drop-down list on the toolbar to "activate it". Afterwards, the network can be generated following the next steps:

a. If the ***Networks/Path*** menu is not displayed, choose ***Procedures-Networks/Path***
b. Choose ***Networks/Path -Create*** to display the Create Network dialog box.
b. From the Create links drop-down list, choose **Entire line layer.**
c. From the Optional Fields-Other Link Fields scrolling list, select everything by using the ***Shift-Click*** combination.
d. Click OK to display the Save Network As dialog box.
e. Choose the MergeTx/Network folder and select the Texas.net as the file name. Click OK. Accept the number of links TransCAD will use to generate the network and wait a few seconds until it is generated. TransCAD creates the network file, and makes it the currently active network. The name of the active network is displayed in the status bar at the right bottom of the screen.

To learn more about networks refer to Chapter 9, page 167 of the TransCAD User's guide.

J. RUN THE OVR PROGRAM (MACRO)

To run the "**Overweight Vehicle Routing**" macro, TransCAD should be opened. From ***Tools*** choose ***Add Inns*** and then, choose Overweight Vehicle Routing from the list and click OK. The macro should run as expected. If a map was not previously loaded, the macro will prompt for one.

For a general overview on how to run the OVR program, see the OVR user's guide in the **Readme** folder copied to your computer. The guide is entitled "OVR_user.doc" This guide is an excerpt from Chapter 3 of Progress report 1482-2F.

For a more detailed guide on running the OVR program, see the customized help file entitled "**helpovr.txt**". This file can be accessed in two ways:
a) from explorer, find the file under the MergeTx/help/ folder, select the file and double click on it to open it with WordPad,
b) having the OVR program running in TransCAD, from the OVR main toolbox, click on the "Help" button to access it.

NOTES:

1) After running the OVR program and clicking on "Find Path" button, two outcomes are possible. One is that the program did not find a path between the selected points. The other one is that it did find a path and it was displayed on the map with a highlighted line.
   To delete a line representing the path, do the following:
   a) click on the "**Pointer tool**" button in TransCAD's Toolbox, and notice that the pointer icon changes to a cross within the scope of the map;
   b) then select the highlighted line with the mouse pointer and press the Delete key. The highlighted line should disappear from the map.
2) The map can be closed with or without saving the map. The map can be saved with different name other than the original. It is recommended that the new maps should be saved under the folder MergeTx/maps
3) To QUIT the OVR program after running it, close the OVR main toolbox by clicking the small dash icon on its upper-left hand corner and choose Close.

---

[1] For more in depth information or instructions on how to use Windows 95 or Windows NT 4.0, refer to the corresponding User's Guide, included with the software license.

[2] For more in depth information or instructions on tasks performed by TransCAD menu items or buttons, refer to the TransCAD User's Guide, included with the commercial license.

APPENDIX B

OVERWEIGHT/OVERSIZE VEHICLE ROUTING PROGRAM USER'S GUIDE

B.1 Summary

This chapter consists of a description of the current GIS-based overweight/oversize vehicle routing program. The program has been incorporated within the TransCad GIS software. It consists of a network representation of the On-system highways according to TxDOT's official base maps. The links of the network are interconnected to simulate allowable traffic flows and represent an accurate model of interchanges, overpasses and underpasses. The TxDOT's ROADS database, originally assigned to the centerlines, has been used to build the attributes of the road segments. The corrected locations of the BRINSAP's bridge geographic coordinates were used to attribute the bridge identifications to the corresponding links (representing road segment) that the bridges are located on. This permits the identification of bridges along routes and the access to the BRINSAP records as a function of the traveled route. The routing model was incorporated as a macro within the software. The user specifies the characteristics of the vehicle, to include weight and dimensions, and the program finds a shortest-path route bypassing bridges with insufficient clearances or weight capacity, according to the TAC requirements and/or TTI's Bridge Load Formulae. This chapter includes a description of the software.

B.2 Software Overview

In order to execute the routing software, the program requires (a) a commercial license of the TransCad GIS software, (b) a GIS map containing a three layers (Roads, BRINSAP, and Endpoints) and (c) an existing road network file created from the ROADS layer, including all links and endpoint information. The GIS map includes (1) the Roads layer which defines the On-system highway network with an associated roads database, (2) the BRINSAP layer providing access to the records of the On-system bridges, and (3) the Endpoints layer which define the nodes and links in the road layer. The Endpoints also correspond to the origin and destination points of travels. To properly execute the software, it is necessary first to become familiar with where the required files are located. The locations of the files are indicated below.

Type of Files	Location
GIS maps	<drive>:\mergetx\maps*.map
Network files	<drive>:\mergetx\networks*.net
Roads layer	<drive>:\mergetx\roads*.cdf
Endpoints layer	<drive>:\mergetx\roads*.pts
BRINSAP layer	<drive>:\mergetx\BRINSAP*.cdf
Vehicle Description (Input files)	<drive>:\mergetx\veh_lib*.veh
Output Routing reports	<drive>:\mergetx\reports*.out
Help file	<drive>:\macros\helpovr.txt
OVR macro program	<drive>:\tcw\ovr.rsc

B.3 Opening and Running the Routing Program

First, Open TransCad from the Desktop or the Start programs menu. Once in TransCad open the GIS map file associated with the desired Texas On-system highway network. These files have the extension of *.map. By opening the "map" file, the software automatically loads the files associated with the geographic features of the maps. That is, the roads, BRINSAP and the endpoints.

To invoke the routing program, from the software select "tools" and "Add-Ins" and then select the "Overweight Vehicle Routing" (OVR) option from the dialog window. If this step is done before a map is opened, the macro will request for a GIS map to be opened. Upon successful selection of the OVR macro, a toolbox appears in the computer screen with 10 buttons that control the execution of the routing process. This toolbox is shown in Figure B.1. The general flow of execution is from top to bottom of the toolbox.

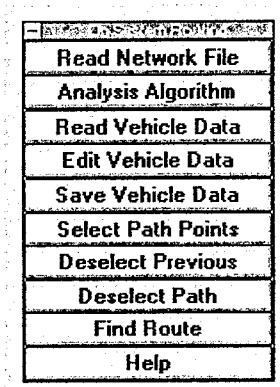

Figure B.1. OVR Macro, Main Toolbox.

B.4 Reading a Network file and Selecting an Analysis Algorithm

Once a map is selected and the OVR macro has been invoked, a Network file must be selected. This file must have been previously created and contains the description of the working network associated with the map. By clicking on "Read Network File", a dialog box appears prompting the user to select an existing road network file. A message is displayed at the bottom of the screen indicating that the file is being read. When finished, a message appears on the screen. Click "OK" to continue.

Next the analysis algorithm must be selected. Clicking on the "Analysis Algorithm" button allows displays a new dialog box. Two choices are available: "Shortest path" and the "Maximum capacity route". The shortest path algorithm finds the shortest path between any number of points (using the Select Path Points button) that satisfies the vehicle's vertical and horizontal constraints, as well as the vehicle's weight. The "Maximum Capacity route" algorithm is not yet available but will be later implemented. Figure B.2 illustrates the dialog boxes for reading the network file and selecting the algorithm.

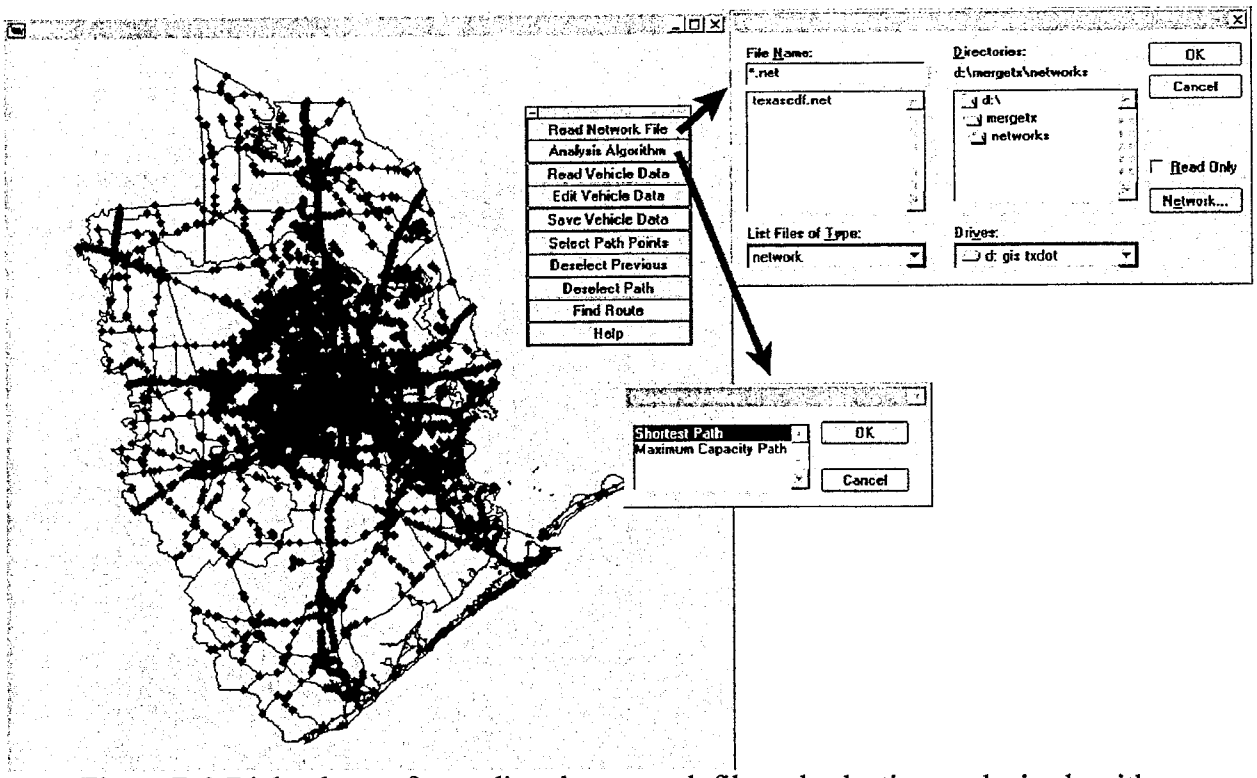

Figure B.2 Dialog boxes for reading the network file and selecting analysis algorithm.

B.5 Vehicle Information

The next step consists of entering or reading into the program the vehicle characteristics. Two options are available: (1) read the vehicle information from an existing file, or (2) enter a new vehicle description or modify an existing file. The first option is accomplished by clicking on the "Read Vehicle Data" button. A dialog box appears prompting the user to select an existing text file with the vehicle information. This existing files must have been created by pressing the "Save Vehicle Data" button. To select a file, choose the drive and subdirectory where the vehicle file is located. Then, click "OK" or double-click on the file name. When the program has finished reading the file, a message appears on the screen saying: "Finished reading vehicle information". Click "OK" to continue.

The second option permits to enter a new vehicle description or to modify an existing description. Pressing the "Edit Vehicle Data" button does this. A dialog box appears prompting the user for the "Initial data" pertaining to the vehicle description. This initial data include vehicle model, type, nominal capacity, height, width, total number of axles and an impact factor associated to the speed at which the vehicle is expected to cross the bridges. The vehicle's total number of axles includes the tractor's axles as well as the trailer's. The parameters in these boxes are initially blank when the second option is selected. The impact factor should be selected between three options 0%, 10%, or 30%. If a vehicle is assigned an escort, or if the velocity is limited, then an impact factor of 10% is recommended. If the vehicle has no monitoring or velocity restrictions, an impact factor of 30% is suggested. The default impact factor value is 10%. After entering this information, click "OK" to continue. The program is now ready for a

description of the vehicles' axle configuration and prompts the user to update the axle individual information. If "Yes" is selected, then a new set of dialog boxes appears on the screen to provide the individual axle description. The axle information consists of distance from the previous axle (zero for the first axle), total axle weight, number of tires in the axle, axle gage, and tire width (all tires per axle are assumed to have the same width). The axle gage is the distance measured between the centers of gravity of the two tire groups.

If a new vehicle description has been entered or an existing description modified, the information can be saved by clicking on the "Save Vehicle Data" button.

Figure B.3 illustrates a super-heavy vehicle for which an overload permit was requested at the MCD. The vehicle's total weight is 648 tons. Figure B.4 illustrates the dialog boxes related to the "Read Vehicle Data" and the "Edit Vehicle Data" buttons. The values in the input boxes pertain to the vehicle in Figure B.3.

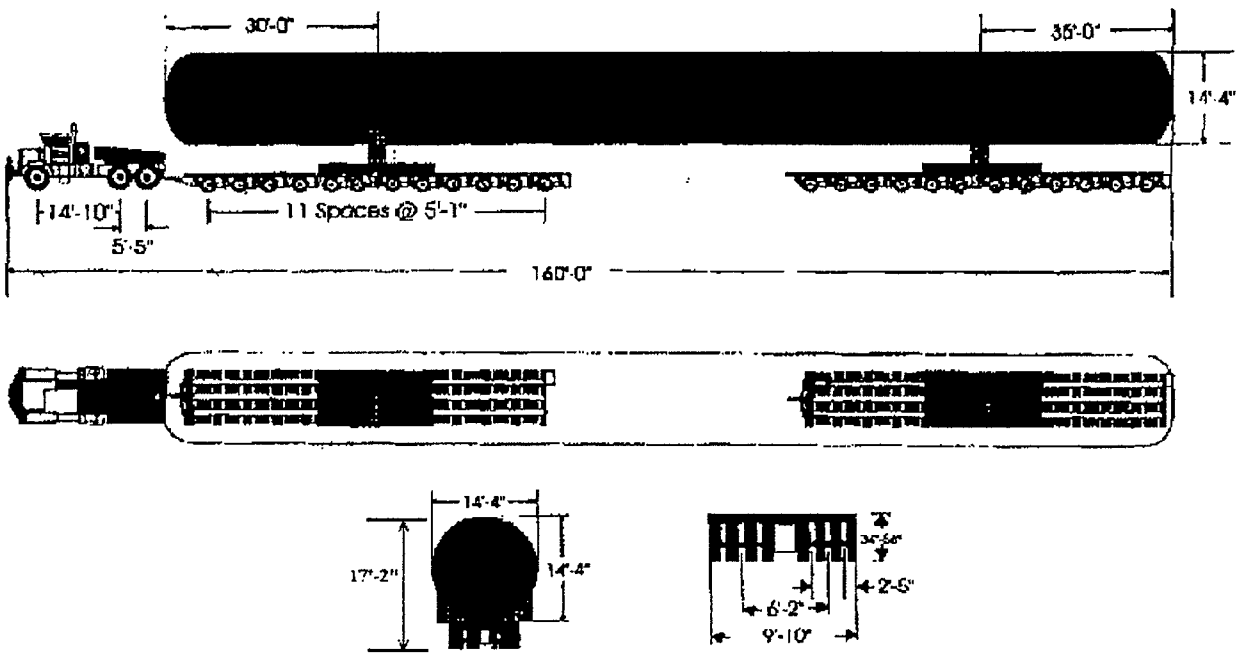

Figure B.3 A super-heavy vehicle, 648-ton capacity, 27 axles.

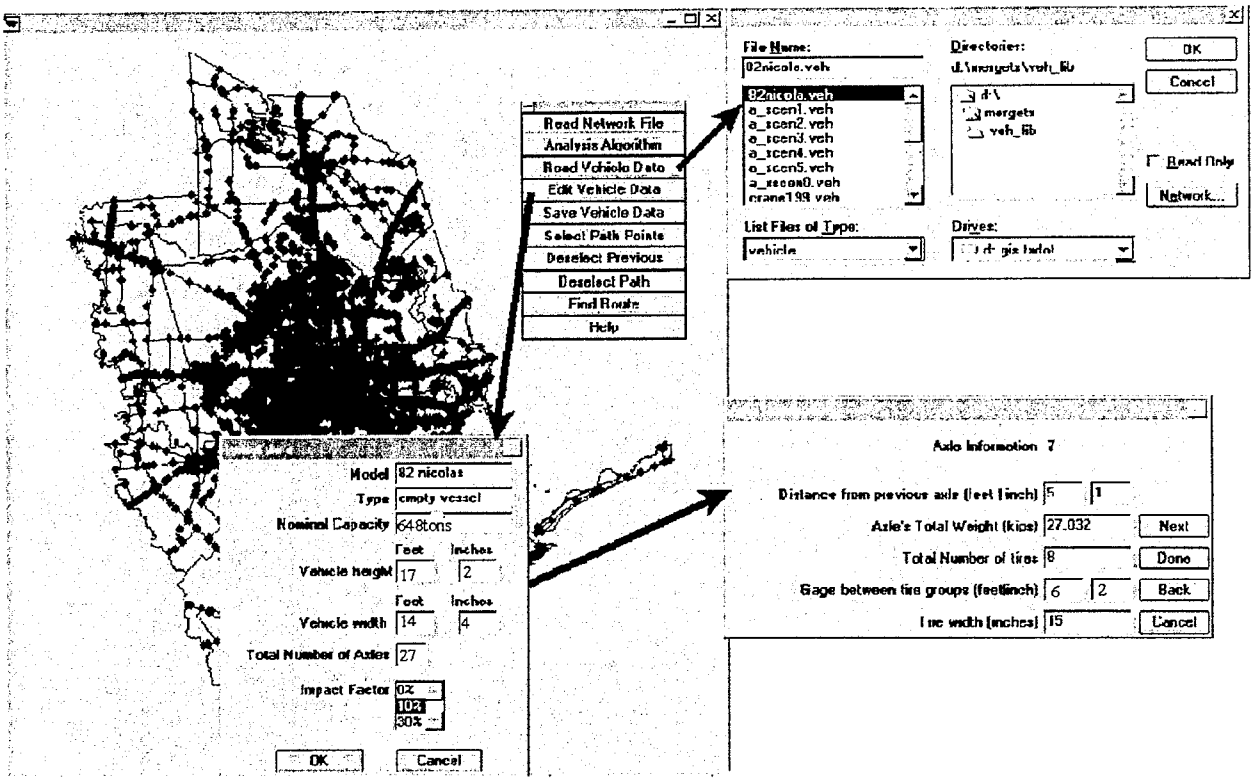

Figure B.4 Illustration of Dialog Boxes related to vehicle description.

B.6 Selection of Path Points

The route selection for the OVR macro to determine starts by the definition of the origin and destination and optional intermediate points. Clicking on the "Select Path Points" button of the main toolbox does this. When this button is pressed, the Endpoints layer is automatically activated and the user can select an unlimited number of "end" points to define the desired route. When selecting an endpoint, the user needs to use the zoom capabilities of software in congested areas. The first point selected is the origin; the last point is the destination. Any other point is considered as intermediate points (stopping points). If a mistake is made in selecting a point, the "Deselect Previous" button can be pressed to delete the previous entry. If mistakes are made in selecting various points, the user can delete the entire set of points by pressing "Deselect Path". Figure B.5 illustrates the selection of path points.

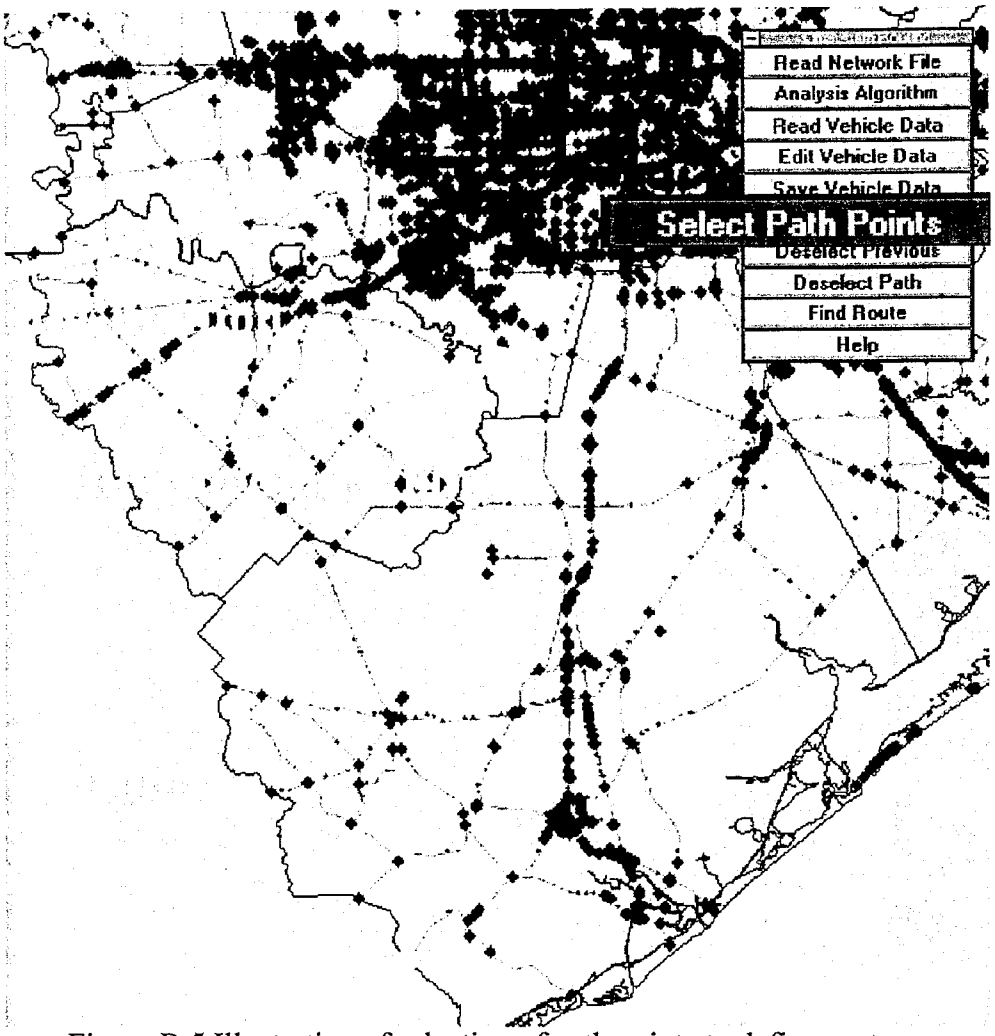

Figure B.5 Illustration of selection of path points to define routes.

B.7 Determination of Route

After selecting the path points, the user needs to press the "Find Route" button to invoke the OVR routing algorithms. This displays a dialog box prompting for the selection of an existing output file or the creation of a new output file. This file is the routing report summarizing the input, the route description, the feasible route found, and the bridges that need to be avoided due to clearances and weight restrictions. Immediately after the output file is selected or entered, the program starts running.

Several "status bars" may appear on the screen reporting two stage indicators, the possible route number being tested, and the restrictions being tested on the bridges of the current route. If an underpass bridge is encountered it checks for both vertical and horizontal restrictions. If a bridge is to be crossed over, horizontal restrictions are checked, in addition to weight capacity. The

status bars indicate the progress of the checks in terms of percentage checked for each possible route found.

In addition to the status bars, some links are highlighted with different colors. This indicates that the links have been disabled. Links disabled by vertical constraints are highlighted in pink. Those disabled by horizontal constraints are highlighted in violet. Links disabled by weight constraints are highlighted in red. Links disabled due to missing information in the BRINSAP database are highlighted in yellow.

When the routing macro finishes the route searching process, two possible outcomes can be expected: (1) A route was found that meets the clearance and weight criteria, or (2) a route was NOT found for the specified vehicle and routing points. In either case, a final report is generated. When a route is found, it is displayed in the computer screen. Figure B.6 shows a route that was determined for a vehicle using the path points shown in Figure B.5.

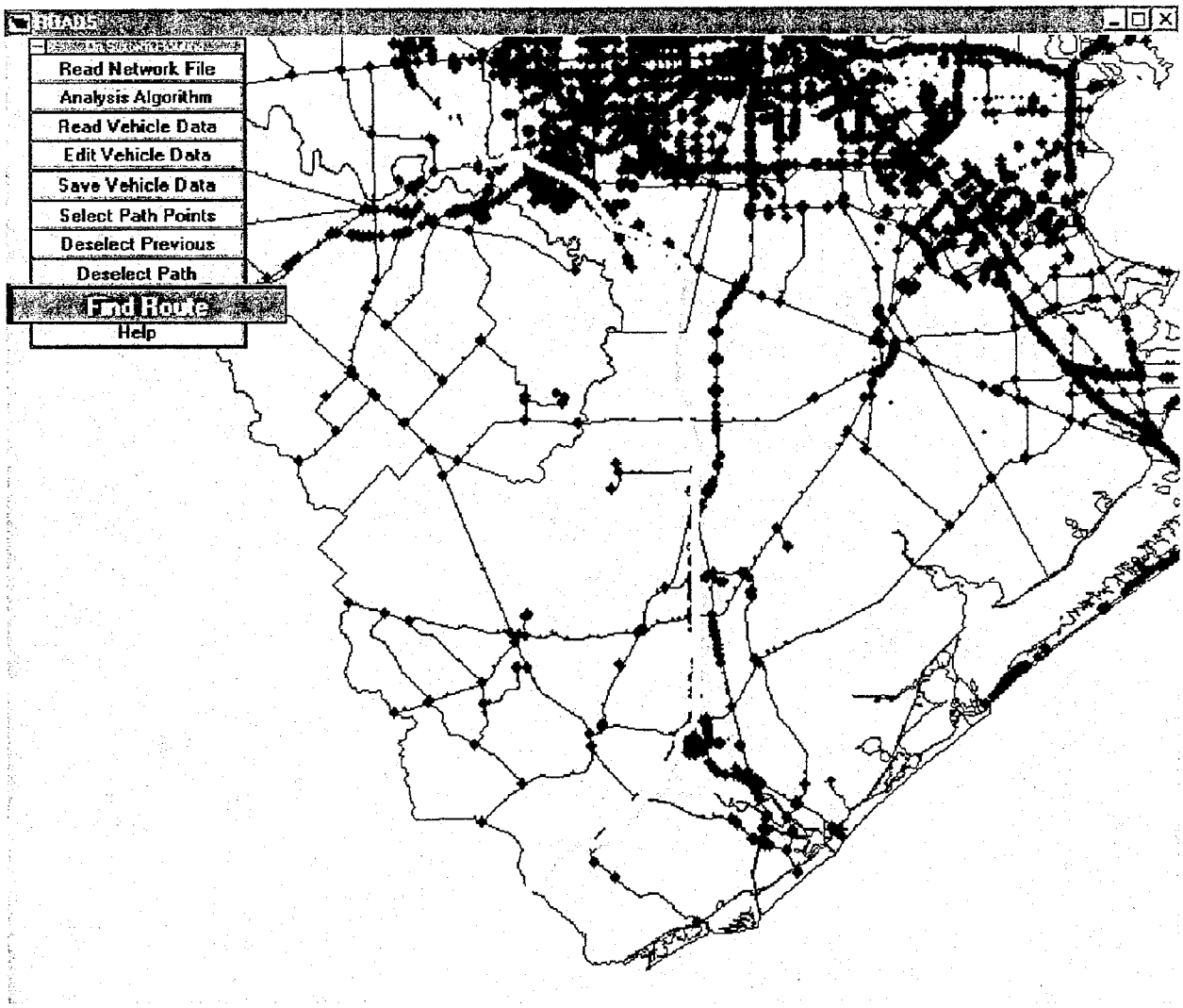

Figure B.6 Feasible route found for an overweight vehicle.

A typical report is illustrated in Figure B.7. This report is automatically launched using NOTEPAD so it can be viewed. First a "Vehicle description" section is found at the beginning of the report. In addition the computed center of gravity of the total vehicle load is also included. Then follows the selected route input consisting of the points selected on the map. In addition, the program generates a verbal description of the input points.

Next, the actual route description (if found) is reported by TransCad with headings, highway ID's, mileage, and the cumulative mileage. If a route was not found, the possible reasons are reported in the following sections. Whether a route was found or not, the report includes a list of bridges that might have been avoided due to the different restrictions encountered during the routing search. The total number of routes tested by the OVR macro, before a final result was reached, is also reported.

The following sections can be found if some bridges were avoided due to the several constraints encountered. Each section is classified according to (a) Bridges avoided due to vertical clearance constraints, (b) Bridges avoided due to horizontal width constraints, (c) Bridges avoided due to weight capacity constraints, and (d) Bridges avoided due to missing information in BRINSAP database. For all the classifications, the report includes the bridge structure number according to BRINSAP, the unique numerical link ID where bridge is located (for TransCad), Highway ID and heading (if available), and the specifics on the pertaining constraints. For example, for (a) above, the report includes the limiting vertical under-clearance in BRINSAP; for (c) information regarding axle groups, allowable vs. Actual axle group weights, axle group IDs, and bridge load formulae under which the axle groups failed, are listed. For item (d) the report list the missing BRINSAP information (i.e.: operating rating, total number of spans, total structure length, maximum span length, vertical under-clearance, or total horizontal clearance). Finally, the report lists the elapsed time that the computer took in determining a route. The report can be closed without having to save it.

File Edit Search Help

```
          Overweight/Oversize Vehicle Routing Report

*** Vehicle Description ***
Model            : 82 nicolas
Type             : empty vessel
Nominal Capacity: 364900
Heigth (ft | in): 16 | 11
Width  (ft | in): 12 | 0
Number of Axles : 15
Impact           : 10 %

AxlID  Dist.prev.axl(ft)   Weight/axl(kips)  No.Tires   Gage(ft)   Tire_Width(in)
01         00.000              000016.000         2       06.000          14
02         14.833              000024.250         4       07.000          14
03         05.417              000024.250         4       07.000          14
04         08.000              000027.032         8       08.333          15
05         05.083              000027.032         8       08.333          15
06         05.083              000027.032         8       08.333          15
07         05.083              000027.032         8       08.333          15
08         05.083              000027.032         8       08.333          15
09         05.083              000027.032         8       08.333          15
10         89.167              000023.034         8       08.333          15
11         05.083              000023.034         8       08.333          15
12         05.083              000023.034         8       08.333          15
13         05.083              000023.034         8       08.333          15
14         05.083              000023.034         8       08.333          15
15         05.083              000023.034         8       08.333          15

     Vehicle's Center of Gravity from the 1st axle is = 0079.45ft

***End of Vehicle Description***


***Route Description***
        Geographic Coordinates (Degrees)      on Road Link(s)          Highway ID
              Longitude   Latitude        (ID 1)        (ID 2)        (1)     (2)
Origin       -095.635936  028.901622     12020010142   -----NA----   FM2611--NA---
Destination  -095.476330  029.438903     12020010100   12080010101   FM0521  FM0521

No feasible route was found between selected points
   Possible reasons:
     Selected points are not connected in this network
  or See bridges avoided due to vertical clearance constraints
  or See bridges avoided due to horizontal width constraints
  or See bridges avoided due to weight    constraints
  or See bridges avoided due to missing information in BRINSAP database
```

82nicol_ - Notepad

File Edit Search Help

```
  or See bridges avoided due to vertical clearance constraints
  or See bridges avoided due to horizontal width constraints
  or See bridges avoided due to weight    constraints
  or See bridges avoided due to missing information in BRINSAP database

Total number of routes tested before final result = 4

***End of Route Description


*** Links disabled and Bridges avoided due to vertical clearance constraints ***
     Total number of bridges evaluated for vertical clearance = 3
CountyRDID    Highway   Heading      BridgeID          Under_Clearance (ft|in)
12020010984   SH0288   North Bound   120200059803107    016 | 09
12020010993   -------   North Bound   120200059803107    016 | 09
12020010024   BS0288B   -----------   120200059803099    016 | 09
     Total number of bridges avoided due to vertical clearance constraints = 3
*** End of links disabled and bridges avoided due to vertical clearance constraints ***


*** Links disabled and Bridges avoided due to horizontal width constraints ***
     Total number of bridges evaluated for horizontal width = 65
     No links were disabled and no bridges were avoided due to horizontal width
*** End of links disabled and bridges avoided due to horizontal width constraints ***


*** Links disabled and Bridges avoided due to weight capacity constraints ***

     TAC restrictions were not satisfied

     Total number of bridges evaluated for weight capacity = 3
CountyRDID    Highway   Heading      BridgeID          Allow_GW(kips)   Actual_GW(kips)   Axls/Grp   1st_Grp_Axle     BLF no
12020010145   FM2611   -----------  120200252402001    000209.269        000210.692         008          002          Gener
     Total number of bridges avoided due to BLF General = 1
     Total number of bridges avoided due to BLF Specific = 0
*** End of links disabled and bridges avoided due to weight capacity constraints ***


*** Links disabled and Bridges avoided due to missing information in BRINSAP database ***
     No links were disabled and no bridges were avoided due to missing information in BRINSAP database
*** End of links disabled and bridges avoided due to missing information in BRINSAP database ***


              -----      End of Report     -----

Time elapsed  00 h 00 m 21 s
```

Figure B.7 Typical Routing Report

APPENDIX C

OVR MACRO ROUTING REPORT ILLUSTRATING APPLICATIONS DISCUSSED IN CHAPTER 3

****

Output Report Generated from Application 1

****

```
Overweight/Oversize Vehicle Routing Report
                  **Maximal-Capacity Route**

*** Vehicle Description ***
Model           : Scenario 3 (128)
Type            : Horizontal load
Nominal Capacity: 128 kip
Height (ft | in): 15 | 4
Width  (ft | in): 15 | 4
Number of Axles : 5
Impact          : 10 %

AxlID  Dist.prev.axl(ft)   Weight/axl(kips)  No.Tires   Gage(ft)   Tire_Width(in)
01         00.000              000020.000        2       06.000          12
02         14.000              000020.000        2       06.000          12
03         04.000              000035.000        2       06.000          12
04         24.000              000035.000        2       06.000          12
05         04.000              000035.000        2       06.000          12

     Vehicle's Center of Gravity from the 1st axle is = 0027.52ft

***End of Vehicle Description***


***Route Description***
        Geographic Coordinates (Degrees)      on Road Link(s)          Highway ID
               Longitude   Latitude        (ID 1)        (ID 2)        (1)     (2)
Origin       -095.977194  029.679739     12080010053   12080010005   FM1093  FM1093
Destination  -095.989066  029.539991     12080010248   12080010140   UA0090  FM1952

Start       South on FM1093     4.77 Miles    (4.77 Miles).
Continue    East on  FM0359     3.26 Miles    (8.03 Miles).
Continue    East on  FM1093     4.22 Miles   (12.25 Miles).
Turn Right  South on SH0099    12.42 Miles   (24.67 Miles).
Continue    South on FM2759     1.94 Miles   (26.61 Miles).
Turn Right  West on  FM0762     4.07 Miles   (30.68 Miles).
Turn Left   South on FM1640     3.10 Miles   (33.78 Miles).
Turn Right  North on SH0036     0.07 Miles   (33.85 Miles).
Turn Left   West on  UA0090     0.65 Miles   (34.50 Miles).
Continue    West on  -------    9.15 Miles   (43.65 Miles).
Continue    West on  UA0090     1.16 Miles   (44.81 Miles).

Total number of unconstrained routes tested before final result = 9

***End of Route Description***


*** Links disabled and Bridges avoided due to vertical clearance constraints ***
     Total number of bridges evaluated for vertical clearance = 38
     No links were disabled and no bridges were avoided due to vertical clearance
*** End of links disabled and bridges avoided due to vertical clearance constraints ***


*** Links disabled and Bridges avoided due to horizontal width constraints ***
     Total number of bridges evaluated for horizontal width = 242
     No links were disabled and no bridges were avoided due to horizontal width
*** End of links disabled and bridges avoided due to horizontal width constraints ***


     The capacity of the resulting route = 30.201017

*** Links disabled and Bridges avoided due to weight capacity constraints ***

     TAC restrictions were not satisfied
     Total number of bridges evaluated for weight capacity = 95
CountyRDID  Highway Heading     BridgeID      Allow_GW(kips)  Actual_GW(kips)  Axls/Grp  1st_Grp_Axle  BLF not met
12080010052 FM0723  -------  120800018809027    000054.510       000145.000       002         004          General
12080010141 FM0762  -------  120800054303013    000067.426       000145.000       002         004          General
     Total number of bridges avoided due to BLF General = 2
     Total number of bridges avoided due to BLF Specific = 0

*** Links disabled and Bridges avoided during the process of finding maximal-capacity route ***
CountyRDID    Highway    Heading       BridgeID        Capacity(kips)
12020010213   SH0036   -----------  120200018803009     0023.06
12020010102   FM1462   -----------  120200141404013     0010.28
12080012378   US0059   South Bound  120800002712137     0008.14
```

```
12080012364   US0059   West  Bound  120800002712139     0010.28
12080010035   FM1489   ----------   120800141803005     0006.00
12080012420   UA0090   West  Bound  120800002708271     0027.60
*** End of links disabled and bridges avoided due to weight capacity constraints ***
*** Links disabled and Bridges avoided due to missing information in BRINSAP database ***
     No links were disabled and no bridges were avoided due to missing information in BRINSAP database
*** End of links disabled and bridges avoided due to missing information in BRINSAP database ***

              -----      End of Report     -----
Time elapsed  00 h 01 m 34 s
```

****

Output Report Generated from Application 2

****

```
Overweight/Oversize Vehicle Routing Report
                    **Shortest Route**

*** Vehicle Description ***
Model           : Scenario 3 (128)
Type            : Horizontal load
Nominal Capacity: 128 kip
Height (ft | in): 15 | 4
Width  (ft | in): 15 | 4
Number of Axles : 5
Impact          : 10 %

AxlID  Dist.prev.axl(ft)   Weight/axl(kips)  No.Tires   Gage(ft)   Tire_Width(in)
01         00.000              000020.000        2       06.000          12
02         14.000              000020.000        2       06.000          12
03         04.000              000035.000        2       06.000          12
04         24.000              000035.000        2       06.000          12
05         04.000              000035.000        2       06.000          12

     Vehicle's Center of Gravity from the 1st axle is = 0027.52ft

***End of Vehicle Description***


***Route Description***
        Geographic Coordinates (Degrees)      on Road Link(s)          Highway ID
               Longitude   Latitude        (ID 1)        (ID 2)        (1)     (2)
Origin       -095.977194  029.679739     12080010053   12080010005   FM1093  FM1093
Destination  -095.759120  029.561794     12080010122   12080010128   FM0762  FM1640

Start       South on FM1093     4.77 Miles    (4.77 Miles).
Continue    East on  FM0359     3.26 Miles    (8.03 Miles).
Continue    East on  FM1093     1.98 Miles   (10.02 Miles).
Turn Right  South on FM0723     4.55 Miles   (14.56 Miles).
Turn Left   East on  FM0359     6.34 Miles   (20.90 Miles).
Turn Right  West on  UA0090     1.35 Miles   (22.26 Miles).
Turn Left   South on FS0762     0.73 Miles   (22.99 Miles).
Turn Left   South on FM0762     1.05 Miles   (24.04 Miles).

Total number of routes tested before final result = 2

***End of Route Description***


*** Links disabled and Bridges avoided due to vertical clearance constraints ***
     Total number of bridges evaluated for vertical clearance = 0
     No links were disabled and no bridges were avoided due to vertical clearance
*** End of links disabled and bridges avoided due to vertical clearance constraints ***


*** Links disabled and Bridges avoided due to horizontal width constraints ***
     Total number of bridges evaluated for horizontal width = 16
     No links were disabled and no bridges were avoided due to horizontal width
*** End of links disabled and bridges avoided due to horizontal width constraints ***


 *** Links disabled and Bridges avoided due to weight capacity constraints ***

     TAC restrictions were not satisfied

     Total number of bridges evaluated for weight capacity = 11
CountyRDID   Highway  Heading    BridgeID     Allow_GW(kips)  Actual_GW(kips)  Axls/Grp  1st_Grp_Axle  BLF not met
12080010052  FM0723   ------- 120800018809027   000054.510      000070.000       002         004         General
     Total number of bridges avoided due to BLF General = 1
     Total number of bridges avoided due to BLF Specific = 0
*** End of links disabled and bridges avoided due to weight capacity constraints ***
*** Links disabled and Bridges avoided due to missing information in BRINSAP database ***
     No links were disabled and no bridges were avoided due to missing information in BRINSAP database
*** End of links disabled and bridges avoided due to missing information in BRINSAP database ***

              -----      End of Report     -----

Time elapsed  00 h 00 m 37 s
```

****

Output Report Generated from Application 3

****

```
Overweight/Oversize Vehicle Routing Report
                    **Shortest Route**

*** Vehicle Description ***
Model           : Scenario 3 (128)
Type            : Horizontal load
Nominal Capacity: 128 kip
Height (ft | in): 15 | 4
Width  (ft | in): 15 | 4
Number of Axles : 5
Impact          : 10 %

AxlID  Dist.prev.axl(ft)   Weight/axl(kips)  No.Tires   Gage(ft)   Tire_Width(in)
01         00.000              000020.000         2       06.000          12
02         14.000              000020.000         2       06.000          12
03         04.000              000035.000         2       06.000          12
04         24.000              000035.000         2       06.000          12
05         04.000              000035.000         2       06.000          12

     Vehicle's Center of Gravity from the 1st axle is = 0027.52ft

***End of Vehicle Description***


***Route Description***
        Geographic Coordinates (Degrees)      on Road Link(s)          Highway ID
                Longitude   Latitude        (ID 1)        (ID 2)        (1)     (2)
Origin        -095.977194  029.679739     12080010053   12080010005   FM1093  FM1093
Destination   -095.687758  029.709252     12080010065   12080010067   FM1093  FM1464

Start       South on FM1093     0.05 Miles    (0.05 Miles).
Continue    South on FM1489     5.27 Miles    (5.31 Miles).
Turn Left   East on  SH0036    10.07 Miles   (15.38 Miles).
Continue    East on  UA0090     9.18 Miles   (24.56 Miles).
Turn Left   North on SH0099     0.16 Miles   (24.71 Miles).
Turn Right  North on FM1464     7.78 Miles   (32.49 Miles).

Total number of routes tested before final result = 1

***End of Route Description***


*** Links disabled and Bridges avoided due to vertical clearance constraints ***
     Total number of bridges evaluated for vertical clearance = 4
     No links were disabled and no bridges were avoided due to vertical clearance
*** End of links disabled and bridges avoided due to vertical clearance constraints ***


*** Links disabled and Bridges avoided due to horizontal width constraints ***
     Total number of bridges evaluated for horizontal width = 20
     No links were disabled and no bridges were avoided due to horizontal width
*** End of links disabled and bridges avoided due to horizontal width constraints ***


*** Links disabled and Bridges avoided due to weight capacity constraints ***

     TAC restrictions were not satisfied

     Total number of bridges evaluated for weight capacity = 16
     No links were disabled and no bridges were avoided due to weight capacity constraints

*** End of links disabled and bridges avoided due to weight capacity constraints ***


*** Links disabled and Bridges avoided due to missing information in BRINSAP database ***
     No links were disabled and no bridges were avoided due to missing information in BRINSAP database
*** End of links disabled and bridges avoided due to missing information in BRINSAP database ***

               -----      End of Report     -----

Time elapsed  00 h 00 m 05 s
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APPENDIX D

COMPARISON REPORTS OF OLD BRINSAP

WITH NEW BRINSAP FOR HOUSTON DISTRICT

BRAZORIA COUNTY

ID	Removed bridges	Feature Crossed	Facility Carried Over	Location	Control	Section	Milepoint	Lat(DM)	Long(DM)	Yr.Built			OFF-sys bridge	OFF FLAG
170	120200084703017	BRAZOS RIVER & SH 332	FM0521	1MI.N.BRAZORIA TX.	847	3	855	29032	95334	1939	.	.	.	.
176	120200100301007	BASTROP BAYOU	FM 523	.5MI.S.OF FM523 &FM2004	1003	1	24964	29068	95225	1952	.	.	.	.
250	120200816012009	MARYS CRK	DIXIE FARM RD	2.60 MI NE OF SH 35	8160	12	2600	30000	100000	1967	.	.	120200M00750003	EXACT
251	120200816012011	COWART CRK	DIXIE FARM RD	0.90 MI NE OF SH 35	8160	12	900	30000	100000	1973	.	.	120200M00750001	EXACT
252	120200816012012	MARYS CRK BYPASS CHANNEL	DIXIE FARM RD	1.85 MI NE OF SH 35	8160	12	1850	30000	100000	1991	.	.	120200M00750002	POS
253	120200846312001	DRAINAGE D	MUSTANG RD	2.30 MI S OF SH 35	8463	12	3900	30000	100000	1958	.	.	120200D00890001	EXACT
254	120200846812001	MUSTANG BYU	SOUTH ST	0.10 MI W OF SH 35	8468	12	100	30000	100000	1986	.	.	120200D01180002	EXACT
255	120200846812003	DRAINAGE D	W SOUTH ST	0.20 MI W OF JOHNSON ST	8468	12	1700	30000	100000	1970	.	.	120200D01180003	EXACT
256	120200847312001	MUSTANG BYU	2ND ST	0.40 MI N OF SEALY PRK ST	8473	12	450	30000	100000	1961	.	.	120200D01100001	EXACT
257	120200870512005	OLD BRAZOS RI	VELASCO BLVD SB	0.20 MI N OF 2ND ST	8705	12	1300	30000	100000	1956	.	.	120200C00490002	EXACT
258	120200870512006	DRAINAGE D	S VELASCO BLVD	0.10 MI N OF SH 36	8705	12	100	30000	100000	1982	.	.	120200C00490001	EXACT
259	120200870512009	OLD BRAZOS RI	VELASCO BLVD NB	0.20 MI N OF 2ND ST	8705	12	1300	30000	100000	1956	.	.	120200C00490003	EXACT
260	120200870712001	SECOND ST	MPRR	0.35 MI E OF FM 523	8707	12	1700	30000	100000	1947	.	.	120200C00380001	EXACT
261	120200875112001	OYSTER CRK	YAUPON ST	0.10 MI N OF OYSTER CR DR	8751	12	1600	29033	95274	1977	.	.	120200B00850001	EXACT
262	120200875312001	OYSTER CRK	ANGLETON DR	0.2O MI NW OF COLLEGE BLV	8753	12	900	30000	100000	1956	.	.	120200B00265001	EXACT

Total bridges REMOVED = 15

ID	New bridges	Feature Crossed	Facility Carried Over	Location	Control	Section	Milepoint	Lat(DM)	Long(DM)	Yr.Built	Bridge Rep.	Rep. FLAG	OFF-bridge Rep.	OFF FLAG
12587	120200017803055	DRAINAGE DITCH	SH 35	0.95 MI NE OF SP 28	178	3	25791	29455	95210	1937	.	.	.	.
12631	120200019202047	DRAINAGE DITCH	SH 6	0.71 MI E OF SH 288	192	2	3673	29288	95234	1995	.	.	.	.
12632	120200019202048	DRAINAGE DITCH	SH 6	1.26 MI E OF SH 288	192	2	4218	29286	95229	1995	.	.	.	.
12633	120200019202049	DRAINAGE DITCH	SH 6	1.46 MI E OF SH 288	192	2	4420	(null)	(null)	1995	.	.	120200AA0146001	POS
12634	120200019202050	DRAINAGE DITCH	SH 6	2.22 MI E OF SH 288	192	2	5184	29283	95222	1995	.	.	.	.
12635	120200019202051	DRAINAGE DITCH	SH 6	3.30 MI E OF SH 288	192	2	6259	29280	95212	1995	.	.	.	.
12681	120200059802203	FM 1462	SH 288 SB	AT SH288 / FM1462 INTER	598	2	16977	29206	95258	1996	.	.	.	.
12682	120200059802204	FM 1462	SH 288 NB	AT SH288 / FM1462 INTER	598	2	16977	29206	95258	1996	.	.	.	.
12735	120200100301020	BASTROP BAYOU	FM 523	.6MI.SE OF FM2004	1003	1	24964	29068	95224	1995	120200100301007	POS	.	.
12766	120200152401017	BRAZOS RIVER & SH 332	FM 521	0.90 MI E OF SH 36	1524	1	855	29032	95334	1939	120200084703017	UNC	.	.

Total NEW bridges = 10
Balance = -5

FORT BEND COUNTY

ID	Removed bridges	Feature Crossed	Facility Carried Over	Location	Control	Section	Milepoint	Lat(DM)	Long(DM)	Yr.Built			OFF-sys bridge	OFF FLAG
1	120800002706007	SAN BERNARD RI	US 90A	3.90 MI W OF FM 1952	27	6	40050	29320	96032	1923	.	.	.	.
14	120800002708056	DRAINAGE D	US-90A(W.B.)	2.9 MI. SW OF SH6	27	8	23677	29361	95410	1943	.	.	.	.
78	120800008909057	SAN BERNARD RI	US 59 SB	0.60 MI SW OF FM 2919	89	9	31719	29262	96010	1939	.	.	.	.
188	120800196501001	GUY CRK	FM 1994	0.30 MI NE OF SH 36	1965	1	3577	29211	95464	1950	.	.	.	.
203	120800342201001	BIG CRK	PR 72	IN BRAZOS BEND STATE PARK	3422	1	4443	29226	95359	1930	.	.	.	.
232	120800813212001	AMERICAN CAN	DULLES AVE	1.50 MI S OF US 90A	8132	12	1800	30000	100000	1987	.	.	120800AA0412003	UNC
233	120800813212002	OYSTER CRK	DULLES RD NB	2.40 MI S OF US 90A	8132	12	900	30000	100000	1986	.	.	120800AA0412001	POS
234	120800813212003	OYSTER CRK	DULLES RD SB	2.40 MI S OF US 90A	8132	12	900	30000	100000	1986	.	.	120800AA0412002	POS
235	120800813712007	DRAINAGE D	S POST OAK RD	0.20 MI S OF COURT RD	8137	12	6500	30000	100000	1986	.	.	120800B52313009	POS
236	120800815312006	DRAINAGE D	FONDREN RD	1.20 MI S 0F CO LINE	8153	12	1200	30000	100000	1973	.	.	120800B24809010	POS
237	120800816812001	KEEGANS BYU	BELKNAP RD	0.05 MI S OF CO LINE	8168	12	1000	30000	100000	1975	.	.	120800AA0139001	POS
238	120800817212003	DRAINAGE D	W AIRPORT BLVD WB	0.75 MI E OF US 59	8172	12	2100	30000	100000	1970	.	.	120800NN0010001	POS
239	120800817212004	DRAINAGE D	W AIRPORT BLVD EB	0.75 MI E OF US 59	8172	12	2100	30000	100000	1970	.	.	120800NN0010002	POS
240	120800880612001	RABBS BYU	GOLFVIEW DR	0.30 MI NE OF THOMPSON	8806	12	800	30000	100000	1975	.	.	120800D00310001	POS
241	120800885512001	DRY CRK	AIRPORT AVE	0.30 MI E OF LOUISE	8855	12	600	30000	100000	1980	.	.	120800C00900001	POS
242	120800886112001	SEABOURNE CRK	BLUME RD	1.30 MI S OF US LP 529	8861	12	1300	30000	100000	1980	.	.	.	.
243	120800886412001	DRY CRK	4TH ST	0.65 MI SOUTH OF FM 1640	8864	12	900	30000	100000	1990	.	.	120800C00245001	POS
244	120800886612001	SEABOURNE CRK	KLAUKE RD	.1M W OF BAMORE RD	8866	12	100	0	0	1990	.	.	.	.
245	120800886812001	DRY CRK	LOUISE RD	0.10 MI N OF AIRPORT AVE	8868	12	600	30000	100000	1986	.	.	120800C00410001	POS

Total bridges REMOVED = 19

ID	New bridges	Feature Crossed	Facility Carried Over	Location	Control	Section	Milepoint	Lat(DM)	Long(DM)	Yr.Built	Bridge Rep.	Rep. FLAG	OFF-bridge Rep.	OFF FLAG
12806	120800002706282	SAN BERNARD RIVER	US 90A	0.2 MI E OF W BERNARD RD	27	6	40050	29320	96032	1996	120800002706007	EXACT	.	.
12821	120800002708280	DRAINAGE DITCH	US90A	.25MI S OF BW8	27	8	33477	(null)	(null)	1998	120800002708056	UNC	120800AA0281002	POS
12893	120800008909204	SAN BERNARD RIVER	US 59 SB	0.6 MI SW OF FM 2919	89	9	40050	29262	96010	1996	120800008909057	EXACT	.	.
13003	120800342201002	BIG CREEK	PARK RD 72	BRAZOS BEND STATE PARK	3422	1	4443	29226	95359	1996	120800342201001	POS	.	.

Total NEW bridges = 4
Balance = -15

GALVESTON COUNTY

ID	Removed bridges	Feature Crossed	Facility Carried Over	Location	Control Section	Milepoint	Lat(DM)	Long(DM)	Yr.Built			OFF-sys bridge	OFF FLAG
40	120850036706028	FERRY MAINT. BRG.	SH-87	GALVESTON FERRY	367	6	1014	29247	94428	1980	. .	.	.
41	120850036706030	FERRY MAINT.BRG.	SH-87	GALVESTON FERRY	367	6	1000	29247	94428	1980	. .	.	.
183	120850811512002	CLEAR CRK	WHISPERING PINES	0.35 MI NE OF FM 518	8115	12	500	30000	100000	1988	. .	120850PP1760001	EXACT
184	120850832512001	LAKE MADELINE	JONES DR EB	1.00 MI W OF FM 342	8325	12	1000	30000	100000	1965	. .	120850B00535001	EXACT
185	120850832512002	LAKE MADELEINE	JONES DR WB	1.00 MI W OF FM 342	8325	12	1000	30000	100000	1970	. .	120850B00535002	EXACT
186	120850832612001	PELICAN ISLAND CHANNEL	SEAWOLF PKWY	1.20 MI N OF BROADWAY AVE	8326	12	110	30000	100000	1960	. .	120850B00790001	POS
187	120850832612004	SP & ATSF RR	SEAWOLF PARKWAY	AT PORT INDUSTRIAL BLVD	8326	12	2500	30000	100000	1960	. .	120850B00720001	POS
188	120850832712002	MENBELL BYU	STEWART RD	0.30 MI E OF PABST RD	8327	12	3200	30000	100000	1910	. .	120850B00825001	EXACT
189	120850839812002	DICKINSON BYU	CEMETERY RD	1.20 MI N OF 4TH ST	8398	12	600	30000	100000	1990	. .	120850D00345001	EXACT
190	120850839912001	CLOUD BYU	28TH ST	1.10 MI E OF MOORE RD	8399	12	1700	30000	100000	1988	. .	120850AA0520001	EXACT

Total bridges REMOVED = 10

ID	New bridges	Feature Crossed	Facility Carried Over	Location	Control Section	Milepoint	Lat(DM)	Long(DM)	Yr.Built	Bridge Rep.	Rep. FLAG	OFF-bridge Rep.	OFF FLAG
13210	120850331202004	DRAINAGE DITCH	FM 270	1.50 MI N OF FM 646	3312	2	2428	29036	95042	1996	. .	.	.

Total NEW bridges = 1
Balance = -9

HARRIS COUNTY

ID	Removed bridges	Feature Crossed	Facility Carried	Location	Control	Sectio	Milepoi	Lat(DML	Long(DM	Yr.Bui			OFF-sys bridg	OFF FLA
1	121020002709032	WILLOW WATER BAYOU	LT LN US90A	.5MI.E.HARRIS-FT BEND CL.		27	9	1366	29376	95310	1928 .	.	.	.
3	121020002709051	WILLOW WATER BAYOU	EAST BOUND US90A	.5MI.W.OF HARRIS C/L.		27	9	1366	29376	95310	1942 .	.	.	.
50	121020002713128	FM 1092 O-P	US 59 SB ML	0.25MI.N.OF FORT-BEND C/L		27	13	15684	29391	95342	1969 .	.	.	.
51	121020002713129	WEST BELLFORT AVE	US 59 SB ML	.25MI.N.OF FORT BEND C/L		27	13	12911	29392	95340	1969 .	.	.	.
115	121020002713263	FM 1092	US 59 NB ML	0.25MI N OF FORT BEND C/L		27	13	15684	29391	95342	1969 .	.	.	.
116	121020002713264	WEST BELLFORT	US 59 NB ML	0.50MI N OF FORT BEND C/L		27	13	15437	29392	95340	1969 .	.	.	.
130	121020002801001	HUNTING BAYOU	US 90A	0.1 MI W OF IH 610		28	1	23907	29477	95164	1930 .	.	.	.
273	121020011005082	IH45	RICHEY RD	2MI S OF IH45 AND FM1960		110	5	41007	29597	95255	1961 .	.	.	.
274	121020011005083	IH45	AIRTEX DR	4MI S OF IH45 & FM1960		110	5	39901	29589	95254	1961 .	.	.	.
275	121020011005089	IH45 ML	CYPRESSWOOD	2MI N OF IH45 & FM1960		110	5	44804	30032	95259	1963 .	.	.	.
282	121020011006054	RANKIN RD	IH 45	1MI N OF IH45 AND IH610		110	6	38752	29579	95253	1959 .	.	.	.
284	121020011006086	GREENS ROAD	IH45 NB ML	10MI N OF IH45+IH610		110	6	37588	29569	95252	1961 .	.	.	.
305	121020011006122	LITTLE WHITE OAK BAYOU	SPUR 261	150 FT S. OF LEAGO ST.		110	6	1642	29513	95247	1990 .	.	.	.
306	121020011006127	GREENS RD	IH45 SB ML	10 MI N OF IH45&IH610		110	6	37588	29569	95252	1961 .	.	.	.
332	121020017706148	US 59	TOWNSEND BLVD	0.9 MI N OF FM 1960		177	6	2590	30012	95157	1983 .	.	.	.
348	121020017707100	GARNERS BAYOU	US59 NB	12.MI.N.OF US59&LOOP-137		177	7	1488	29587	95168	1969 .	.	.	.
350	121020017707102	REINHARD BAYOU	US59 NB	10.5MI N OF US59 & LP137		177	7	2981	29575	95173	1969 .	.	.	.
352	121020017707117	BELTWAY 8	US59 S.B.	1.5MI S OF US59 & FM1960		177	7	4327	29564	95177	1970 .	.	.	.
367	121020017711050	COLLINGSWORTH ST	US 59 SB ML	2MI.S.OF KELLY ST.		177	11	5177	29476	95204	1955 .	.	.	.
368	121020017711051	QUITMAN ST.	US 59 SB ML	1.5MI.S.OF KELLY ST		177	11	5884	29470	95204	1955 .	.	.	.
369	121020017711052	T & NO R.R.	US 59	.6MI.FROM IH-10 EAST		177	11	6255	29466	95204	1955 .	.	.	.
370	121020017711057	JEWELL ST PED CROSSING	US 59 SB	1.75MI.S.OF KELLY		177	11	5050	29474	95204	1955 .	.	.	.
373	121020017711137	TEXAS AVE	US59SB CONN F	US59SB & TEXAS AVE		177	11	8242	29454	95212	1966 .	.	.	.
374	121020017711144	CAPITAL AVE.	RAMP TO US-59 N.B.	.1MI.S.OF CAPITAL AVE.		177	11	8289	29453	95214	1966 .	.	.	.
394	121020017711250	COLLINGSWORTH ST	US 59 NB ML	2 MI S OF KELLY ST		177	11	5177	29476	95204	1955 .	.	.	.
395	121020017711251	JEWELL ST PED CROSSING	US 59 NB	1.75 MI S OF KELLY ST		177	11	5050	29474	95204	1955 .	.	.	.
396	121020017711252	QUITMAN ST	US 59 NB ML	1.5 MI S OF KELLY ST		177	11	5884	29470	95204	1955 .	.	.	.
397	121020017711390	CROSSTIMBERS	US 59 NB ML	0.75 MI S OF LAURA KOPPE		177	11	2696	29498	95202	1956 .	.	.	.
398	121020017711392	BENNINGTON ST	US 59 NB ML	0.5 MI N OF KELLY RD		177	11	3189	29493	95200	1954 .	.	.	.
566	121020027115331	IH 610	UTILITY	IH 610 AT CLINTON DR		271	15	3598	29443	95159	1970 .	.	.	.
694	121020038912034	HOUSTON SHIP CHANNEL	BAYTOWN TUNNEL	SH 146		389	12	7972	29423	95010	1953 .	.	.	.
696	121020038912036	SPUR 201	SH 146 WB	1MI.NE.OF BAYTOWN TUNNEL		389	12	6995	29429	94599	1953 .	.	.	.
697	121020038912037	BLACK DUCK BAY	SH146 EB ML	.5MI.N.OF BAYTOWN TUNNEL		389	12	7392	29427	95003	1951 .	.	.	.
698	121020038912038	SAN JACINTO BAY	SH146 WB ML	.4MI SW OF BAYTOWN TUNNEL		389	12	8808	29419	95014	1951 .	.	.	.
704	121020038912098	SAN JACINTO BAY	SH146 EB ML	.4MI SW OF BAYTOWN TUNNEL		389	12	8808	29419	95014	1951 .	.	.	.
705	121020038912099	BLACK DUCK BAY	SH146 WB ML	.5MI N OF BAYTOWN TUNNEL		389	12	7392	29427	95003	1951 .	.	.	.
742	121020050003079	TWICKENHAM DITCH	IH 45 ML & FR	.25MI N OF IH45&PARKER RD		500	3	31494	29517	95242	1959 .	.	.	.
744	121020050003081	OUTFALL DITCH	IH45 ML & SBFR	800' N OF IH45&PARKER RD		500	3	30794	29512	95238	1959 .	.	.	.
765	121020050003126	BELTWAY 8	IH 45 SB	16MI.S. OF DTWN. HOUSTON		500	3	8630	29363	95123	1965 .	.	.	.
937	121020050801047	SAN JACINTO RIVER	IH10 RT LANE	12MI E OF IH10+IH610		508	1	45927	29476	95044	1951 .	.	.	.
1010	121020050801242	MEADOW ST RAMPS O-P	RAMP C	AT IH10/US59		508	1	1000	29462	95203	1973 .	.	.	.
1012	121020050801246	WBL AND RAMPS O-P	RAMP B OVER RAMP A	AT IH10/US59		508	1	870	29462	95204	1958 .	.	.	.
1142	121020098101007	DRAW	FM 528	500' W OF IH45 & FM 528		981	1	2902	29066	95079	1995 .	.	.	.
1143	121020098101009	CLEAR CREEK	FM 528	HARRIS/GALVESTON C/L		981	1	0	29310	95107	1959 .	.	.	.
1251	121020248301096	BELTWAY 8 FRONTAGE ROAD	HARDY TOLL RD ML	0.25MI NORTH OF BLACKWOOD		2483	1	63260	29561	95228	1990 .	.	.	.
1414	121020325603054	DRAIN	BW8 SB	.5 MI N OF IH10		3256	3	6041	29460	95094	1988 .	.	.	.
1445	121020800212009	JOHN F KENNEDY BLVD SB	W CLAYTON PKWY EB	4.50 MI W OF US 59		8002	12	100	30000	100000	1970 .	.	121020B69685001	POS
1446	121020800212010	JOHN F KENNEDY BLVD NB	W CLAYTON PKWY EB	4.50 MI W OF US 59		8002	12	100	30000	100000	1970 .	.	121020B69685001	POS
1447	121020800212015	DRAINAGE D	W CLAYTON PKWY WB	1.90 MI W OF US 59		8002	12	2000	30000	100000	1967 .	.	121020B69685011	POS
1448	121020800212016	DRAINAGE D	W CLAYTON CROSSOVR	0.20 MI W OF LEE		8002	12	1500	30000	100000	1967 .	.	121020B69685010	POS
1449	121020800212017	DRAINAGE D	COLONEL FISCHER RD	1.00 MI E OF JFK BLVD		8002	12	1000	30000	100000	1967 .	.	121020B69685009	POS
1450	121020800212018	GARNERS BYU	W CLAYTON PKWY WB	0.75 MI W OF US 59		8002	12	3300	30000	100000	1966 .	.	121020B69685012	EXACT
1451	121020800212019	GARNERS BYU	W CLAYTON PKWY EB	0.75 MI W OF US 59		8002	12	3300	30000	100000	1966 .	.	121020B69685013	EXACT
1452	121020800212024	SOUTHERN PACIFIC RR	W CLAYTON PKWY	0.30 MI E OF US 59		8002	12	300	30000	100000	1976 .	.	121020T11000001	POS
1453	121020800212025	GREENS BYU	JFK BLVD NB	4.40 MI S OF W CLAYTON		8002	12	4900	30000	100000	1987 .	.	121020AA6349001	EXACT
1454	121020800212026	GREENS BYU	JFK BLVD SB	4.40 MI S OF W CLAYTON		8002	12	4900	30000	100000	1987 .	.	121020AA6349002	EXACT
1455	121020800212031	WILLIAM CLAYTON PKWY WB	SOUTH TERMINAL RD	0.50 MI E OF JFK BLVD		8002	12	500	30000	100000	1987 .	.	121020B69685031	POS
1456	121020800212032	WILLIAM CLAYTON PKWY	NORTH TERMINAL RD	0.70 MI E OF JFK BLVD		8002	12	700	30000	100000	1987 .	.	121020B69685032	POS
1457	121020800212033	WILLIAM CLAYTON PKWY	AIRPLANE TAXIWAY	0.40 MI E OF JFK BLVD		8002	12	400	30000	100000	1986 .	.	121020B69685003	POS
1458	121020800212034	WILLIAM CLAYTON PKWY	AIRPLANE TAXIWAY	0.50 MI E OF JFK BLVD		8002	12	500	30000	100000	1986 .	.	121020B69685004	POS
1459	121020800212035	DRAINAGE D	W CLAYTON PKWY	0.50 MI E OF JFK BLVD		8002	12	500	30000	100000	1986 .	.	121020B69685005	POS

HARRIS COUNTY

ID	Removed bridges	Feature Crossed	Facility Carried	Location	Control	Sectio	Milepoi	Lat(DM	Long(DM	Yr.Bui			OFF-sys bridg	OFF FLA
1460	121020800212037	WILLIAM CLAYTON PKWY WB	SOUTH TERMINAL RD	0.80 MI E OF JFK BLVD		8002	12	800	30000	100000	1987	.	121020B69685037	POS
1461	121020800212040	REINHARDT BYU	JFK BLVD SB FR	1.30 MI N OF GREENS RD		8002	12	1500	30000	100000	1979	.	121020B34977009	EXACT
1462	121020800212044	REINHARDT BYU	JFK BLVD NB FR	1.30 MI N OF GREENS RD		8002	12	1500	30000	100000	1992	.	121020B34977010	EXACT
1463	121020800212045	REINHARDT BYU	JFK BLVD	1.30 MI N OF GREENS RD		8002	12	8805	30000	100000	1994	.	121020B34977007	EXACT
1464	121020800212046	UNNAMED STREET	JFK BLVD NB	1.25 MI N OF GREENS RD		8002	12	8805	30000	100000	1994	.	121020B34977008	EXACT
1465	121020800212047	UNNAMED STREET	JFK BLVD SB	1.25 MI N OF GREENS RD		8002	12	8805	30000	100000	1994	.	121020B34977011	EXACT
1466	121020800312010	DRAINAGE D	GULF BANK RD	0.20 MI W OF HARDY RD		8003	12	12100	30000	100000	1989	.	121020B29249005	POS
1467	121020800312016	HCFCD DRAINAGE D	MT HOUSTON RD	0.50 MI W OF LOCKWOOD		8003	12	7000	30000	100000	1987	.	121020AA4351002	POS
1468	121020800312018	DRAINAGE D	W GULF BANK RD WB	0.20 MI W OF N H ROSSLYN		8003	12	4200	30000	100000	1970	.	121020B29249001	POS
1469	121020800312019	DRAINAGE D	W GULF BANK RD EB	0.20 MI W OF N H ROSSLYN		8003	12	4200	30000	100000	1970	.	121020B29249002	POS
1470	121020800312020	DRAINAGE D	W GULF BANK RD EB	0.01 MI E OF ELLA BLVD		8003	12	8700	30000	102020	1978	.	121020AA2460001	POS
1471	121020800312021	VOGEL CRK	W GULF BANK RD	0.4 MI E OF ANTOINE		8003	12	6500	30000	100000	1979	.	121020B29249004	EXACT
1472	121020800312022	DRAINAGE D	W GULF BANK RD	0.40 MI W OF ANTOINE		8003	12	5700	30000	100000	1977	.	121020B29249003	POS
1473	121020800312023	DRAINAGE D	W GULF BANK RD WB	1.20 MI W OF IH 45		8003	12	8700	30000	100000	1988	.	121020AA2460002	POS
1474	121020800412001	VOGEL CRK	VICTORY DR	0.25 MI E OF ANTOINE DR		8004	12	700	30000	100000	1940	.	121020B66825003	EXACT
1475	121020800412009	HALLS BYU	LITTLE YORK RD	0.70 MI W OF US 59		8004	12	1400	30000	102020	1983	.	121020B39913001	EXACT
1476	121020800412017	WHITE OAK BYU	VICTORY DR WB	0.10 MI W OF ANTOINE		8004	12	400	30000	100000	1988	.	121020B66825001	EXACT
1477	121020800412018	WHITE OAK BYU	VICTORY DR EB	0.10 MI W OF ANTOINE		8004	12	400	30000	100000	1988	.	121020B66825002	EXACT
1478	121020800412019	DRAINAGE D	VICTORY DR	1.30 MI E OF ANTOINE		8004	12	1600	30000	100000	1960	.	121020B66825004	EXACT
1479	121020800512004	COLE CRK	TIDWELL RD WB	0.30 MI E OF BINGLE		8005	12	1400	30000	100000	1978	.	121020B64305001	EXACT
1480	121020800512005	LITTLE WHITEOAK BYU	W TIDWELL RD	0.40 MI W OF IH 45		8005	12	6700	30000	100000	1975	.	121020B64305005	POS
1481	121020800512015	HALLS BYU TRIB	TIDWELL RD	1.80 MI W OF JOHN RALSTON		8005	12	6700	30000	100000	1956	.	121020B64289003	EXACT
1482	121020800512016	GREENS BYU	TIDWELL RD	0.25 MI W OF RALSTON RD		8005	12	1100	30000	100000	1974	.	121020AA9961001	EXACT
1483	121020800512017	COLE CRK	TIDWELL RD EB	0.30 MI E OF BINGLE		8005	12	1500	30000	100000	1978	.	121020B64305002	EXACT
1484	121020800512020	WHITE OAK BYU	TIDWELL RD EB	0.50 MI E OF ANTOINE		8005	12	3100	30000	100000	1987	.	121020B64305003	EXACT
1485	121020800512021	WHITE OAK BYU	TIDWELL RD WB	0.50 MI E OF ANTOINE		8005	12	3100	30000	100000	1987	.	121020B64305004	EXACT
1486	121020800512022	HALLS BYU	TIDWELL RD EB	2.90 MI E OF US 59		8005	12	4800	1	1	1994	.	121020B64289004	POS
1487	121020800512023	HALLS BYU	TIDWELL RD WB	2.90 MI E OF US 59		8005	12	4800	1	1	1994	.	121020B64289005	POS
1488	121020800512024	HB&T RR & MOPAC RR	TIDWELL RD EB	2.30 MI E OF US 59		8005	12	4200	1	1	1994	.	121020B64289006	POS
1489	121020800512025	HB&T RR & MOPAC RR	TIDWELL RD WB	2.30 MI E OF US 59		8005	12	4200	1	1	1994	.	121020B64289007	POS
1490	121020800612002	WHITE OAK BYU	W 43RD ST WB	0.05 MI W OF T C JESTER		8006	12	3300	30000	100000	1966	.	121020B00905002	EXACT
1491	121020800612006	WHITE OAK BYU	W 43RD ST EB	0.05 MI W OF T C JESTER		8006	12	3300	30000	100000	1966	.	121020B00905003	EXACT
1492	121020800612007	WHITEOAK BYU	CROSSTIMBERS ST	0.15 MI W OF JCT IH 45		8006	12	1600	30000	100000	1975	.	121020B17497001	EXACT
1493	121020800612016	CROSSTIMBERS ST	HB & T RR	0.05 MI E OF HARDY TOLL R		8006	12	3400	30000	100000	1988	.	121020B17497003	EXACT
1494	121020800612017	LANGHAM CRK	CLAY RD	1.25 MI W OF ADDICKS-FAIR		8006	12	13100	30000	100000	1979	.	121020B14885002	EXACT
1495	121020800612018	BRICKHOUSE GUL	CLAY RD	0.7 MI E OF GESSNER RD		8006	12	18600	30000	100000	1965	.	121020B14885004	EXACT
1496	121020800612019	TURKEY CREEK TRIB	CLAY RD	0.3 MI W OF BRITTMOORE RD		8006	12	16200	30000	100000	1989	.	121020B14885003	POS
1497	121020800612020	DRAINAGE D	W 43RD ST	0.06 MI E OF LANG RD		8006	12	1200	30000	100000	1983	.	121020B00905001	POS
1498	121020800612021	DRAINAGE D	GREEN RIVER DR	0.15 MI W OF C E KING		8006	12	1000	30000	100000	1991	.	121020AA4417001	POS
1499	121020800612023	GREENS BYU	GREEN RIVER DR	0.40 MI W OF J RALSTON RD		8006	12	1000	30000	100000	1992	.	121020B28441001	EXACT
1500	121020800612025	LEY RD	HB & T RR	0.80 MI E OF HOMESTD RD		8006	12	1000	30000	100000	1960	.	121020B39337001	EXACT
1501	121020800612026	DRAINAGE D	CLAY RD	0.05 MI E OF BLALOCK RD		8006	12	19200	30000	100000	1985	.	121020B14885005	POS
1502	121020800712054	HUNTING BYU	KELLEY ST	0.10 MI NW OF IH 610		8007	12	2800	29485	95184	1949	.	121020B35729003	POS
1503	121020800712060	KELLEY ST	T & N O RR	0.15 MI W OF US 59		8007	12	800	29488	95204	1954	.	121020B35729002	POS
1504	121020800712070	KELLEY ST	H B & T RR	0.90 MI W OF JCT US 59		8007	12	100	29488	95212	1960	.	121020B35729001	POS
1505	121020800912011	HUNTING BYU	WALLISVILLE RD EB	1.50 MI E OF IH 610		8009	12	3000	30000	100000	1987	.	121020B67417001	EXACT
1506	121020800912012	HUNTING BYU	WALLISVILLE RD WB	1.50 MI E OF IH 610		8009	12	3000	30000	100000	1987	.	121020B67417002	EXACT
1507	121020800912013	CARPENTERS BYU	WALLISVILLE RD	0.25 MI E OF BELTWAY 8		8009	12	8400	30000	100000	1982	.	121020AA4541004	EXACT
1508	121020800912014	BIG GULCH	WALLISVILLE RD	0.50 MI W OF UVALDE RD		8009	12	6500	30000	100000	1986	.	121020AA4541003	EXACT
1509	121020800912015	GREENS BYU	WALLISVILLE RD	2.00 MI W OF UVALDE RD		8009	12	5100	30000	100000	1986	.	121020AA4541001	EXACT
1510	121020800912016	WEST CAN	WALLISVILLE RD	0.20 MI E OF UVALDE RD		8009	12	7100	30000	100000	1982	.	121020AA4541002	EXACT
1511	121020801012001	DRAINAGE D	SHELDON RD	0.10 MI N OF US 90		8010	12	2000	30000	100000	1990	.	121020AA4536001	POS
1512	121020801112004	LYNCHBURG RES CAN	CROSBY-LYNCHBURG	0.10 MI N OF IH 10		8011	12	6600	30000	100000	1970	.	121020AA9962003	EXACT
1513	121020801112005	BLUFF GUL	CROSBY LYNCHBURG	2.90 MI N OF IH 10		8011	12	4600	30000	100000	1960	.	121020AA9962002	EXACT
1514	121020801112013	DRAINAGE D	CROSBY LYNCHBURG	1.30 MI S OF US 90		8011	12	4400	30000	100000	1990	.	121020AA9956001	POS
1515	121020801112014	BUFFALO BYU	CROSBY LYNCHBURG	2.40 MI SW OF IH 10		8011	12	5600	30000	100000	1930	.	121020AA9956004	EXACT
1516	121020801612008	RED BLUFF RD	PORT TERMINAL RR	0.40 MI E OF SHAVER ST		8016	12	300	30000	100000	1948	.	121020C02636009	POS
1517	121020801612009	WILLOW SPRING BYU	RED BLUFF RD NB	0.80 MI S OF FAIRMONT PKW		8016	12	8700	30000	100000	1967	.	121020C02636003	EXACT
1518	121020801612010	WILLOW SPRING BYU	RED BLUFF RD SB	0.80 MI S OF FAIRMONT PKW		8016	12	8700	30000	100000	1967	.	121020C02636004	EXACT
1519	121020801612011	SPRING GUL	RED BLUFF RD NB	1.50 MI S OF RED BLUFF		8016	12	10900	30000	100000	1967	.	121020C02636005	EXACT
1520	121020801612012	SPRING GUL	RED BLUFF RD SB	1.50 MI S OF RED BLUFF GE		8016	12	10900	30000	100000	1967	.	121020C02636006	EXACT
1521	121020801612013	BIG ISLAND SLOUGH	RED BLUFF RD NB	0.20 MI SE OF UNDERWOOD R		8016	12	11700	30000	100000	1967	.	121020C02636007	EXACT

HARRIS COUNTY

ID	Removed bridges	Feature Crossed	Facility Carried	Location	Control	Sectio	Milepoi	Lat(DM	Long(DM	Yr.Bui			OFF-sys bridg	OFF FLA
1522	121020801612014	BIG ISLAND SLOUGH	RED BLUFF RD SB	0.20 MI SE OF UNDERWOOD R		8016	12	11700	30000	100000	1967 .	.	121020C02636008	EXACT
1523	121020801612015	TAYLOR BYU	RED BLUFF RD	0.80 MI W OF FM 146		8016	12	14820	30000	100000	1981 .	.	121020P53505001	EXACT
1524	121020801612016	ARMAND BYU	RED BLUFF RD	0.50 MI S OF OASADENA BLV		8016	12	6500	30000	100000	1965 .	.	121020C02636002	EXACT
1525	121020801612017	RED BLUFF RD	UTILITY BRIDGE	0.40 MI E OF SHAVER ST		8016	12	300	30000	100000	1948 .	.	121020C02636009	EXACT
1526	121020801912006	BERRY BYU	EDGEBROOK DR	0.50 MI E OF THETA		8019	12	1200	30000	100000	1960 .	.	121020B21553001	EXACT
1527	121020801912007	DRAINAGE D	EDGEBROOK DR WB	0.10 MI E OF SH 3		8019	12	1500	30000	100000	1963 .	.	121020B21561001	POS
1528	121020801912008	DRAINAGE D	EDGEBROOK DR EB	0.10 MI E OF SH 3		8019	12	1500	30000	100000	1963 .	.	121020B21561002	POS
1529	121020801912011	DRAINAGE D	W FAIRMONT PKWY WB	50 FT W OF SP RR TRACKS		8019	12	12300	30000	100000	1960 .	.	121020L00144007	POS
1530	121020801912012	DRAINAGE D	W FAIRMONT PKWY EB	50 FT W OF SP RR TRACKS		8019	12	600	30000	100000	1960 .	.	121020L00144008	POS
1531	121020801912013	BIG ISLAND SLOUGH	FAIRMONT PKWY EB	0.70 MI E OF UNDERWOOD		8019	12	10100	30000	100000	1993 .	.	121020L00144005	POS
1532	121020801912014	BIG ISLAND SLOUGH	FAIRMONT PKWY WB	0.70 MI E OF UNDERWOOD		8019	12	10100	30000	100000	1993 .	.	121020L00144006	POS
1533	121020801912015	SPRING GUL	FAIRMONT PKWY EB	0.30 MI W OF UNDERWOOD		8019	12	9000	30000	100000	1989 .	.	121020L00144003	EXACT
1534	121020801912016	SPRING GUL	FAIRMONT PKWY WB	0.30 MI W OF UNDERWOOD		8019	12	9000	30000	100000	1989 .	.	121020L00144004	EXACT
1535	121020801912017	WILLOW SPRING BYU	FAIRMONT PKWY EB	0.70 MI E OF RED BLUFF RD		8019	12	8000	30000	100000	1959 .	.	121020L00144001	EXACT
1536	121020801912018	WILLOW SPRING BYU	FAIRMONT PKWY WB	0.70 MI E RED BLUFF RD		8019	12	8000	30000	100000	1959 .	.	121020L00144002	EXACT
1537	121020801912019	ARMAND BYU	FAIRMONT PKWY WB	0.40 MI W OF RED BLUFF RD		8019	12	6400	30000	100000	1963 .	.	121020C01076004	EXACT
1538	121020801912020	ARMAND BYU	FAIRMONT PKWY EB	0.40 MI W OF RED BLUFF RD		8019	12	6400	30000	100000	1963 .	.	121020C01076005	EXACT
1539	121020801912021	DRAINAGE D	FAIRMONT PKWY	2.60 MI E OF SHAVER		8019	12	4700	30000	100000	1975 .	.	121020C01076003	POS
1540	121020801912022	VINCE BYU	FAIRMONT PKWY WB	0.90 MI E OF S SHAVER		8019	12	3200	30000	100000	1975 .	.	121020C01076001	EXACT
1541	121020801912023	VINCE BYU	FAIRMONT PKWY EB	0.90 MI E OF SHAVER		8019	12	3200	30000	100000	1975 .	.	121020C01076002	EXACT
1542	121020801912027	DRAINAGE D	FAIRMONT PKWY	2.20 MI E OF SHAVER		8019	12	4300	30000	100000	1992 .	.	121020C01076006	POS
1543	121020802012004	BERRY BYU	SPENCER HWY	100 FT W OF 3RD ST		8020	12	300	30000	100000	1992 .	.	121020H60593001	EXACT
1544	121020802012005	VINCE BYU	SPENCER HWY	0.60 MI E OF SHAVER		8020	12	2400	30000	100000	1995 .	.	121020C02961002	EXACT
1545	121020802012006	LITTLE VINCE BYU	SPENCER HWY	3.40 MI E OF S SHAVER		8020	12	4900	30000	100000	1993 .	.	121020C02961003	POS
1546	121020802012007	ARMAND BYU	SPENCER HWY	0.40 MI W OF RED BLUFF RD		8020	12	5700	30000	100000	1993 .	.	121020C02961004	EXACT
1547	121020802012008	WILLOW SPRING BYU	SPENCER HWY	E OF FERN ROCK		8020	12	7700	30000	100000	1993 .	.	121020L60593002	EXACT
1548	121020802012009	WILLOW SPRING BYU TRIB	SPENCER HWY	E OF CANADA		8020	12	8300	30000	100000	1992 .	.	121020L60593003	EXACT
1549	121020802012010	BIG ISLAND SLOUGH	SPENCER HWY	0.50 MI E OF UNDERWOOD DR		8020	12	9400	30000	100000	1992 .	.	121020L60593004	POS
1550	121020802012011	SOUTHERN PACIFIC RR	SPENCER HWY	2.80 MI E OF UNDERWOOD DR		8020	12	1700	30000	100000	1978 .	.	121020L41705001	POS
1551	121020802012012	LITTLE CEDAR BYU	SPENCER HWY	3.10 MI E OF UNDERWOOD DR		8020	12	2300	30000	100000	1992 .	.	121020L41705002	POS
1552	121020802012018	DRAINAGE D	COLLEGE AVE	0.30 MI NE OF IH 45		8020	12	300	30000	100000	1993 .	.	121020H15577001	POS
1553	121020802112006	LITTLE VINCE BYU	PASADENA BLVD	1.70 MI W OF RED BLUFF		8021	12	700	30000	100000	1986 .	.	121020C02386001	POS
1554	121020802212080	SOUTHERN PACIFIC RR	EAST BLVD	0.02 MI S OF JCT SH 225		8022	12	1700	29424	95060	1990 .	.	121020G00070001	UNC
1555	121020802512009	VINCE BYU	W SOUTHMORE AVE	1.00 MI E OF ALLEN GENOA		8025	12	1000	30000	100000	1950 .	.	121020C02941001	EXACT
1556	121020802512010	LITTLE VINCE BYU	E SOUTHMORE AVE	1.20 MI E OF S SHAVER		8025	12	2560	30000	100000	1985 .	.	121020C02941002	POS
1557	121020802712006	LITTLE VINCE BYU	S TATAR ST	0.35 MI S OF JCT SH 225		8027	12	700	30000	100000	1977 .	.	121020C03071001	POS
1558	121020802812005	VINCE BYU	W SHAW AVE	0.50 MI E OF SHAVER ST		8028	12	200	30000	100000	1945 .	.	121020C02851001	EXACT
1559	121020802812006	LITTLE VINCE BYU	SHAW AVE	0.15 MI W OF TATAR STREET		8028	12	1000	30000	100000	1980 .	.	121020C02851002	POS
1560	121020802912003	WEST CAN	FEDERAL RD	1.25 MI S OF IH 10		8029	12	1500	30000	100000	1960 .	.	121020J23889001	EXACT
1561	121020802912005	LITTLE VINCE BYU	N SHAVER ST	0.50 MI N OF JCT SH 225		8029	12	4100	30000	100000	1965 .	.	121020C02841003	POS
1562	121020802912006	VINCE BYU	S SHAVER ST	2.55 MI S OF SH 225		8029	12	3300	30000	100000	1965 .	.	121020C02836001	EXACT
1563	121020802912007	SHAVER ST	PORT TERMINAL RR	0.40 MI N OF SH 225		8029	12	200	30000	100000	1970 .	.	121020C02841001	EXACT
1564	121020802912008	SHAVER ST	PORT TERMINAL RR	0.40 MI N OF SH 225		8029	12	200	30000	100000	1960 .	.	121020C02841001	EXACT
1565	121020802912010	DRAINAGE D	C E KING PKWY E FR	0.60 MI N OF GREEN RIVER		8029	12	3800	30000	100000	1956 .	.	121020AA4353004	POS
1566	121020802912011	DRAINAGE D	C E KING PKWY	0.60 MI N OF GREEN RIVER		8029	12	3800	30000	100000	1954 .	.	121020AA4353005	POS
1567	121020802912014	HUNTING BYU	FEDERAL RD	0.50 MI N OF CLINTON DR		8029	12	2600	30000	100000	1988 .	.	121020J23889002	EXACT
1568	121020802912026	HOUSTON SHIP CHANNEL	WASHBURN TUNNEL	FEDERAL RD S OF IH 10		8029	12	13100	30000	100000	1950 .	.	121020AA9960001	POS
1569	121020803012003	LITTLE VINCE BYU	N MAIN ST	0.30 MI N OF SH 225		8030	12	300	30000	100000	1978 .	.	121020C01966001	POS
1570	121020803112005	VINCE BYU	QUEENS RD	0.10 MI W OF S SHAVER		8031	12	400	30000	100000	1965 .	.	121020C02581001	EXACT
1571	121020803312001	BERRY BYU	SOUTH RICHEY	0.40 MI NE OF OLD GALV RD		8033	12	300	30000	100000	1966 .	.	121020B54225001	EXACT
1572	121020803312003	LITTLE VINCE BYU	N RICHEY ST	0.10 MI SW OF SHAVER ST		8033	12	100	30000	100000	1960 .	.	121020C02691001	POS
1573	121020803312004	VINCE BYU	N RICHEY ST	0.20 MI NE OF SHAW AVE		8033	12	500	30000	100000	1960 .	.	121020C01076001	POS
1574	121020803312006	RICHEY ST	PORT TERMINAL RR	0.15 MI SW OF SHAVER ST		8033	12	200	30000	100000	1966 .	.	121020C02691002	EXACT
1575	121020803312007	RICHEY ST	UTILITY BRIDGE	0.15 MI SW OF SHAVER ST		8033	12	200	30000	100000	1966 .	.	121020C02691004	EXACT
1576	121020803512004	PANTHER CRK	CLINTON DR	0.70 MILE W OF MAIN ST		8035	12	1000	30000	100000	1948 .	.	121020J15169001	EXACT
1577	121020803512006	SOUTHERN PACIFIC RR	CLINTON DR	0.20 MI W OF WAYSIDE DR		8035	12	2700	30000	100000	1988 .	.	121020B15169001	POS
1578	121020803512007	CLINTON DR	S P RR	0.10 MI E OF WAYSIDE DR		8035	12	3100	30000	100000	1927 .	.	121020B15169002	EXACT
1579	121020803512008	CLINTON DR	S P RR	0.20 MI W OF N WAYSIDE DR		8035	12	3200	30000	100000	1927 .	.	121020B15169003	EXACT
1580	121020803612002	HUNTING BYU	N WAYSIDE DR	0.60 MI S OF IH 610		8036	12	1500	30000	100000	1987 .	.	121020B68017004	EXACT
1581	121020803612003	LIBERTY RD & S P RR	N WAYSIDE DR	0.20 MI S OF IH 610		8036	12	1000	30000	100000	1988 .	.	121020B68017001	EXACT
1582	121020803612004	N WAYSIDE DR	S P RR	0.20 MI S OF IH 610		8036	12	1000	30000	100000	1950 .	.	121020B68017002	EXACT
1583	121020803612005	N WAYSIDE DR	S P RR	0.20 MI S OF IH 610		8036	12	1000	30000	100000	1950 .	.	121020B68017002	EXACT

HARRIS COUNTY

ID	Removed bridges	Feature Crossed	Facility Carried	Location	Control	Sectio	Milepoi	Lat(DM	Long(DM	Yr.Bui			OFF-sys bridg	OFF FLA
1584	121020803812001	BUFFALO BYU	HIRSCH RD/YORK ST	1.00 MI S OF IH 10		8038	12	1600	30000	100000	1957	.	121020B67161001	EXACT
1585	121020803812002	BRAYS BYU	SCOTT ST	0.60 MI N OF JCT US 90A		8038	12	2300	30000	100000	1984	.	121020B57857001	EXACT
1586	121020804112001	SIMS BYU	AIRPORT BLVD WB	0.70 MI W OF CULLEN BLVD		8041	12	1100	30000	100000	1977	.	121020B01921002	EXACT
1587	121020804112002	SIMS BYU	AIRPORT BLVD EB	0.70 MI W OF CULLEN BLVD		8041	12	1100	29387	100000	1979	.	121020B01921003	EXACT
1588	121020804112003	DRAINAGE D	AIRPORT BLVD EB	0.25 MI E OF SCOTT		8041	12	1300	29387	100000	1979	.	121020B01921004	POS
1589	121020804112004	HCFC DRAINAGE D	AIRPORT BLVD WB	E OF SOUTHVIEW		8041	12	1300	29387	100000	1979	.	121020B01921005	POS
1590	121020804112005	BERRY GUL	AIRPORT BLVD EB	E OF MONROE		8041	12	7200	29394	95158	1978	.	121020B01921007	POS
1591	121020804112006	BERRY GUL	AIRPORT BLVD WB	0.20 MI E OF MONROE		8041	12	7200	29394	95158	1978	.	121020B01921008	POS
1592	121020804112033	HCFCD DRAINAGE D	AIRPORT BLVD	0.50 MI E OF SH288		8041	12	1400	30000	100000	1977	.	121020B01921001	POS
1593	121020804112034	DRAINAGE D	AIRPORT BLVD	0.50 MI W OF MLK BLVD		8041	12	2600	30000	100000	1975	.	121020B01921006	POS
1594	121020804112035	DRAINAGE D	AIRPORT BLVD EB	0.20 MI E OF FONDREN		8041	12	4500	30000	100000	1977	.	121020B01921009	POS
1595	121020804112036	DRAINAGE D	AIRPORT BLVD WB	0.20 MI E OF FONDREN		8041	12	4500	30000	100000	1977	.	121020B01921002	POS
1596	121020804112039	DRAINAGE D	AIRPORT BLVD EB	0.20 MI E OF MLK		8041	12	3200	30000	100000	1992	.	121020B01921009	POS
1597	121020804112040	DRAINAGE D	AIRPORT BLVD WB	0.20 MI E OF MLK		8041	12	3200	30000	100000	1992	.	121020B01921010	POS
1598	121020804112041	DRAINAGE DITCH	AIRPORT BLVD EB	0.25 MI W OF MYKAWA		8041	12	4200	30000	100000	1992	.	121020B01921011	POS
1599	121020804112042	DRAINAGE DITCH	AIRPORT BLVD WB	0.25 MI W OF MYKAWA		8041	12	4200	30000	100000	1992	.	121020B01921012	POS
1600	121020804612012	BRAYS BYU	ALMEDA RD	0.20 MI W OF SH288		8046	12	2300	30000	100000	1931	.	121020B02601001	EXACT
1601	121020804712007	DRAINAGE D	S POST OAK RD SB	0.40 MI S OF W FUQUA		8047	12	4700	30000	100000	1984	.	121020B52313007	POS
1602	121020804712008	SIMS BYU	S POST OAK RD SB	JUST S OF SIMSBROOK DR		8047	12	4200	30000	100000	1984	.	121020B52313005	EXACT
1603	121020804712009	SIMS BYU	S POST OAK RD NB	JUST W OF SIMSBROOK DR		8047	12	4200	30000	100000	1984	.	121020B52313006	EXACT
1604	121020804712012	BELLFORT AVE	S POST OAK RD	0.30 MI S OF IH610		8047	12	700	30000	100000	1987	.	121020B52313002	EXACT
1605	121020804712015	DRAINAGE D	S POST OAK RD NB	0.40 MI S OF W FUQUA		8047	12	4700	30000	100000	1984	.	121020B52313008	POS
1606	121020804712016	WILLOW WATERHOLE BYU	S POST OAK RD NB	0.90 MI N OF US90A		8047	12	1400	30000	100000	1989	.	121020B52313003	EXACT
1607	121020804712017	WILLOW WATERHOLE BYU	S POST OAK RD SB	0.90 MI N OF US90A		8047	12	1400	30000	100000	1989	.	121020B52313004	EXACT
1608	121020804712444	S BRAESWOOD BLVD	NB RAMP TO S LOOP	JCT OF IH610W & IH610S		8047	12	100	29408	95273	1986	.	121020B52313001	POS
1609	121020804812001	BRAYS BYU	STELLA LINK NB	0.75 MI N OF IH610		8048	12	1300	30000	100000	1956	.	121020B61441001	EXACT
1610	121020804812002	BRAYS BYU	STELLA LINK SB	0.75 MI N OF IH610		8048	12	1300	30000	100000	1956	.	121020B61441002	EXACT
1611	121020804912002	POOR FARM D	BUFFALO SPWY	0.25 MI N OF BRAYS BYU		8049	12	3100	30000	100000	1951	.	121020B10977001	EXACT
1612	121020804912003	BRAYS BYU	BUFFALO SPWY	BUFFALO SPWY @ BRAYS BYU		8049	12	3300	30000	100000	1950	.	121020B10977002	EXACT
1613	121020804912011	SIMS BYU	BUFFALO SPWY SB	1.60 MI N OF BWY8		8049	12	8700	30000	100000	1965	.	121020B10977003	EXACT
1614	121020804912012	SIMS BYU	BUFFALO SPWY	1.60 MI N OF BWY8		8049	12	8700	30000	100000	1965	.	121020B10977004	EXACT
1615	121020805012021	MKT RR	N SHEPHERD DR	0.50 MI N OF IH 10		8050	12	2200	30000	100000	1988	.	121020B58977001	EXACT
1616	121020805012023	BUFFALO BYU	SHEPHERD DR FR RD	1.20 MI S OF IH 10		8050	12	350	30000	100000	1921	.	121020B59009002	EXACT
1617	121020805012024	ALLEN PK/MEMOR/BUFFALO B	SHEPHERD DR	1.20 MI S OF IH 10		8050	12	350	30000	100000	1958	.	121020B59009003	POS
1618	121020805012025	BRAYS BYU	GREENBRIAR	BRAYS BYU		8050	12	2600	30000	100000	1961	.	121020B28497001	EXACT
1619	121020805012062	WHITEOAK BYU	N SHEPHERD DR	0.20 MI N OF IH 10		8050	12	2400	30000	100000	1929	.	121020B58977002	EXACT
1620	121020805012067	MEMORIAL DR	SHEPHERD DR FR	1.20 MI S OF IH 10		8050	12	300	30000	100000	1958	.	121020B59009001	EXACT
1621	121020805112002	WHITE OAK BYU	DURHAM ST	0.40 MI N OF IH 10		8051	12	2300	30000	100000	1963	.	121020B20937001	POS
1622	121020805312002	BRAYS BYU	BELLAIRE BLVD (WB)	0.3 MI E OF WILCREST		8053	12	6200	30000	100000	1964	.	121020B06745001	EXACT
1623	121020805312003	BRAYS BYU	BELLAIRE BLVD EB	0.3 MI E OF WILCREST		8053	12	6200	30000	100000	1975	.	121020B06745002	EXACT
1624	121020805312004	DRAINAGE D	BELLAIRE BLVD	0.20 MI W OF GESSNER		8053	12	7500	30000	100000	1960	.	121020B06745003	POS
1625	121020805312005	DRAINAGE D	BELLAIRE BLVD	0.50 MI E OF JCT US 59		8053	12	9500	30000	100000	1958	.	121020B06745005	POS
1626	121020805312007	S MAIN ST	HOLCOMBE BLVD	HOLCOLMBE BLVD AT MAIN ST		8053	12	400	30000	100000	1962	.	121020B32209001	EXACT
1627	121020805312008	FANNIN ST	HOLCOMBE BLVD	0.15 MI E OF MAIN ST		8053	12	600	30000	100000	1962	.	121020B32209004	EXACT
1628	121020805312009	BRAYS BYU	HOLCOMBE BLVD	0.60 MI E 0F FANNIN ST		8053	12	1200	30000	100000	1958	.	121020B32209007	EXACT
1629	121020805312012	FANNIN ST	N U-TURN/HOLCOMBE	0.15 MI E OF MAIN ST		8053	12	600	30000	100000	1962	.	121020B32209005	EXACT
1630	121020805312013	FANNIN ST	S U-TURN/HOLCOMBE	0.15 MI E OF MAIN ST		8053	12	600	30000	100000	1962	.	121020B32209006	EXACT
1631	121020805312014	S MAIN ST	MAIN FR NB TO SB	HOLCOMBE S. U-TURN		8053	12	400	30000	100000	1962	.	121020B32209002	EXACT
1632	121020805312015	S MAIN ST	MAIN FR SB TO NB	HOLCOMBE N. U-TURN		8053	12	400	30000	100000	1962	.	121020B32209003	EXACT
1633	121020805312021	DRAINAGE D	BELLAIRE BLVD	0.10 MI E OF VIRGINIA ST		8053	12	14000	30000	100000	1928	.	121020FF0010001	POS
1634	121020805412001	ALLEN PKWY	W U-TURN/MONTROSE	0.10 MI W OF MONTROSE		8054	12	1100	30000	100000	1967	.	121020B02505003	EXACT
1635	121020805412002	ALLEN PKWY	MONTROSE BLVD	1.30 MI S OF IH 10		8054	12	1100	30000	100000	1967	.	121020B02505004	EXACT
1636	121020805412003	ALLEN PKWY	E U-TURN/MONTROSE	0.01 MI E OF MONTROSE		8054	12	1100	30000	100000	1967	.	121020B02505005	EXACT
1637	121020805412004	ALLEN PKWY	S P RR	0.10 MI E OF STUDEMONT		8054	12	1200	30000	100000	1964	.	121020B02505006	EXACT
1638	121020805412005	ALLEN PKWY	PEDESTRIAN X-ING	0.40 MI W OF IH 45		8054	12	1600	30000	100000	1955	.	121020B02505007	EXACT
1639	121020805412007	ALLEN PKWY	WAUGH DR	0.07 MI E OF SHEPHERD DR		8054	12	700	30000	100000	1968	.	121020B02505001	EXACT
1640	121020805412008	ALLEN PKWY	E U-TURN AT WAUGH	0.07 MI E OF SHEPHERD DR		8054	12	700	30000	100000	1968	.	121020B02505002	EXACT
1641	121020805512002	MEMORIAL DR EB	WOODWAY DR WB	0.50 MI W OF IH 610		8055	12	5300	30000	100000	1960	.	121020B71089001	EXACT
1642	121020805512003	MEMORIAL DR EB	S P RR	5.50 MI E OF IH 610		8055	12	5500	30000	100000	1937	.	121020B44185006	EXACT
1643	121020805512004	MEMORIAL DR WB	S P RR	5.50 MI E OF IH 610		8055	12	5500	30000	100000	1964	.	121020B44185007	EXACT
1644	121020805512006	MEMORIAL DR	WAUGH DR	0.75 MI E OF SHEPHERD DR		8055	12	5500	30000	100000	1955	.	121020B44185009	EXACT
1645	121020805512007	MEMORIAL DR/BUFFALO BYU	STUDEMONT ST NB	0.10 MI N OF ALLEN PARKWA		8055	12	5900	30000	100000	1967	.	121020B44185010	POS

HARRIS COUNTY

ID	Removed bridges	Feature Crossed	Facility Carried	Location	Control	Sectio	Milepoi	Lat(DM	Long(DM	Yr.Bui			OFF-sys bridg	OFF FLA
1646	121020805512008	MEMORIAL DR/BUFFALO BYU	STUDEMONT ST SB	0.40 MI E OF WAUGH DR		8055	12	5900	30000	100000	1967 .	.	121020B44185011	POS
1647	121020805512009	MEMORIAL DR	S P RR	0.10 MI E OF STUDEMONT		8055	12	5000	30000	100000	1964 .	.	121020B44185012	EXACT
1648	121020805512010	BUFFALO BYU	MEMORIAL DR	0.45 MI E OF STUDEMONT		8055	12	5400	30000	100000	1954 .	.	121020B44185013	EXACT
1649	121020805512011	BUFFALO BYU	MEMORIAL DR	0.70 MI E OF STUDEMONT		8055	12	5600	30000	100000	1955 .	.	121020B44185014	EXACT
1650	121020805512012	MEMORIAL DR	SAWYER ST	0.75 MI W OF IH 45		8055	12	5700	30000	100000	1969 .	.	121020B44185015	EXACT
1651	121020805512013	MEMORIAL DR	PEDESTRIAN X-ING	0.50 MI W OF IH 45		8055	12	10100	30000	100000	1955 .	.	121020B44185016	EXACT
1652	121020805512014	BUFFALO BYU/HOUSTON AVE	MEMORIAL DR WB	AT IH45 AND BUFFALO BYU		8055	12	10100	30000	100000	1959 .	.	121020B44185017	POS
1653	121020805512015	BUFFALO BYU/HOUSTON AVE	MEMORIAL DR EB	AT IH 45 & BUFFALO BYU		8055	12	10100	30000	100000	1959 .	.	121020B44185018	POS
1654	121020805512017	S APPROACH TO TEXAS AVE	BAGBY ST	AT MEMORIAL/BUFFALO BYU		8055	12	400	30000	100000	1959 .	.	121020B05073003	POS
1655	121020805512018	BUFFALO BYU	BAGBY ST	AT MEMORIAL DRIVE		8055	12	350	30000	100000	1959 .	.	121020B05073002	EXACT
1656	121020805512019	N APPROACH TO PRAIRIE ST	BAGBY ST	0.20 MI S OF WASHINGTON		8055	12	300	30000	100000	1966 .	.	121020B05073001	POS
1657	121020805512025	MEMORIAL DR	PEDESTRIAN X-ING	8.30 MI E OF IH 610		8055	12	5300	30000	100000	1986 .	.	121020B44185008	EXACT
1658	121020805512026	HOUSTON AVE	MEMORIAL DR FR EB	0.10 MI W OF IH 45		8055	12	10200	30000	100000	1956 .	.	121020B44185019	EXACT
1659	121020805512027	HOUSTON AVE	MEMORIAL DR FR WB	0.10 MI W OF IH 45		8055	12	10200	30000	100000	1956 .	.	121020B44185020	EXACT
1660	121020805712003	DRAINAGE D	BISSONNET ST	0.20 MI E OF FONDREN		8057	12	9700	30000	100000	1960 .	.	121020B07961003	POS
1661	121020805712006	BRAYS BYU	BISSONNET ST EB	0.80 MI E OF SW FREEWAY		8057	12	800	30000	100000	1987 .	.	121020B07961001	EXACT
1662	121020805712007	BRAYS BYU	BISSONNET ST WB	0.80 MI E OF SW FREEWAY		8057	12	800	30000	100000	1987 .	.	121020B07961002	EXACT
1663	121020805812001	BRAYS BYU	FONDREN RD	0.03 MI N OF S BRAESWOOD		8058	12	5100	29407	95295	1959 .	.	121020B24809005	POS.
1664	121020805812004	COUNTRY CLUB D	FONDREN RD SB	0.20 MI S OF BEECHNUT		8058	12	4200	30000	100000	1966 .	.	121020B24809003	EXACT
1665	121020805812005	DRAINAGE D	FONDREN RD	0.20 MI S OF W AIRPORT		8058	12	7400	30000	100000	1972 .	.	121020B66825004	POS
1666	121020805812006	SIMS BYU	FONDREN RD SB	0.40 MI S OF US 90A		8058	12	8300	30000	100000	1972 .	.	121020B01921002	POS
1667	121020805812007	SIMS BYU	FONDREN RD NB	0.40 MI S OF US 90A		8058	12	8300	30000	100000	1972 .	.	121020B01921002	POS
1668	121020805812008	COUNTRY CLUB D	FONDREN RD NB	0.20 MI S OF BEECHNUT		8058	12	4200	30000	100000	1966 .	.	121020B24809004	EXACT
1669	121020805912002	BRICKHOUSE GUL	BLALOCK RD NB	0.20 MI N OF KEMPWOOD DR		8059	12	1500	30000	100000	1973 .	.	121020B14885004	POS
1670	121020805912004	BRICKHOUSE GUL	BLALOCK RD SB	0.20 MI N OF KEMPWOOD DR		8059	12	1500	30000	100000	1973 .	.	121020B14885004	POS
1671	121020805912005	BRIAR BR	BLALOCK RD	0.30 MI N OF JCT IH 10		8059	12	4200	30000	100000	1983 .	.	121020B08129003	EXACT
1672	121020805912006	COLE CRK	FAIRBANKS N HOU NB	0.06 MI N OF JCT US 290		8059	12	5610	30000	100000	1988 .	.	121020B31281001	POS
1673	121020805912007	COLE CRK	FAIRBANKS N HOU SB	0.06 MI N OF JCT US 290		8059	12	5610	30000	100000	1988 .	.	121020B31281001	POS
1674	121020806012001	BRICKHOUSE GUL	GESSNER RD NB	0.50 MI S OF CLAY RD		8060	12	3300	29495	95327	1979 .	.	121020B26713002	POS
1675	121020806012002	BRICKHOUSE GUL	GESSNER RD SB	0.50 MI S OF CLAY RD		8060	12	3300	29495	95327	1979 .	.	121020B26713003	POS
1676	121020806012003	BRICKHOUSE GUL	GESSNER RD	0.20 MI N OF CLAY RD		8060	12	2600	30000	100000	1940 .	.	121020B26713001	EXACT
1677	121020806012005	BUFFALO BYU	GESSNER RD SB	2.35 MI S OF IH 1O		8060	12	8700	30000	100000	1970 .	.	121020B26713004	EXACT
1678	121020806012006	BUFFALO BYU	GESSNER RD NB	2.35 MI S OF IH 1O		8060	12	8700	30000	100000	1970 .	.	121020B26713005	EXACT
1679	121020806012007	DRAINAGE D	S GESSNER RD	0.20 MI N OF RICHMOND		8060	12	10300	30000	100000	1965 .	.	121020B66825004	POS
1680	121020806112003	BUFFALO BYU	DAIRY ASHFORD NB	1.50 MI S OF IH 10		8061	12	1500	30000	100000	1978 .	.	121020AA9956004	POS
1681	121020806112004	KEEGANS BYU	DAIRY ASHFORD SB	8.20 MI S OF IH 10		8061	12	8200	30000	100000	1976 .	.	121020B17911009	EXACT
1682	121020806112005	KEEGANS BYU	DAIRY ASHFORD NB	8.20 MI S OF IH 10		8061	12	8200	30000	100000	1976 .	.	121020B17911010	EXACT
1683	121020806112006	BUFFALO BYU	DAIRY ASHFORD SB	1.50 MI S OF IH 10		8061	12	1500	30000	100000	1978 .	.	121020AA9956004	POS
1684	121020806112009	BRAYS BYU	DAIRY ASHFORD NB	4.30 MI S OF IH 10		8061	12	4300	30000	100000	1983 .	.	121020B02601001	POS
1685	121020806112010	BRAYS BYU	DAIRY ASHFORD SB	4.30 MI S OF IH 10		8061	12	4300	30000	100000	1983 .	.	121020B02601001	POS
1686	121020806112011	DRAINAGE D	DAIRY ASHFORD NB	5.40 MI S OF IH 10		8061	12	5400	30000	100000	1987 .	.	121020B17911010	POS
1687	121020806112012	DRAINAGE D	DAIRY ASHFORD SB	5.40 MI S OF IH 10		8061	12	5400	30000	100000	1987 .	.	121020B17911009	POS
1688	121020806112013	DRAINAGE D	DAIRY ASHFORD	6.00 MI S OF IH 10		8061	12	6000	30000	100000	1960 .	.	121020B17911007	POS
1689	121020806112014	DRAINAGE D	DAIRY ASHFORD	6.90 MI S OF IH 10		8061	12	6900	30000	100000	1986 .	.	121020B17911008	POS
1690	121020806212003	SMITH ST AND HOLMAN ST	BRAZOS ST	1.00 MI N OF JCT US 59		8062	12	0	30000	100000	1969 .	.	121020B05073004	POS
1691	121020806412004	BUFFALO BYU	SMITH ST	0.40 MI S OF IH 10		8064	12	100	30000	100000	1962 .	.	121020B59801001	POS
1692	121020806612008	MILAM ST	S P RR	0.10 MI N OF FRANKLIN ST		8066	12	200	30000	100000	1989 .	.	121020B44745001	EXACT
1693	121020806612009	BUFFALO BYU	MILAM ST	0.15 MI S OF IH 10		8066	12	300	30000	100000	1947 .	.	121020B44745002	EXACT
1694	121020806812004	LITTLE WHITEOAK BYU	N MAIN ST	0.50 MI SE OF IH 45		8068	12	4000	30000	100000	1914 .	.	121020B41697001	POS
1695	121020806812005	BUFFALO BYU	BURNETT ST & SP RR	0.20 MI N OF IH 10		8068	12	4900	30000	100000	1923 .	.	121020B41697002	POS
1696	121020806812006	BUFFALO BYU	MAIN ST	0.20 MI S OF JCT IH 10		8068	12	4949	30000	100000	1914 .	.	121020B41697003	EXACT
1697	121020806912001	BUFFALO BYU	FANNIN ST	0.20 MI S OF IH 10		8069	12	200	29459	95214	1977 .	.	121020B23569001	POS
1698	121020806912002	NONE	ALLENS LANDING RP	AT COMMERCE AND FANNIN		8069	12	200	29459	95214	1972 .	.	121020B23569002	POS
1699	121020807012001	BUFFALO BYU	SAN JACINTO ST	AT COMMERCE ST		8070	12	300	30000	100000	1914 .	.	121020B57017001	EXACT
1700	121020807812006	BUFFALO BYU	MCKEE ST	0.35 MI S OF IH 10		8078	12	200	30000	100000	1932 .	.	121020B43593001	EXACT
1701	121020808512005	BUFFALO BYU	FRANKLIN ST	0.30 MI W OF MAIN ST		8085	12	200	30000	100000	1914 .	.	121020B25401001	EXACT
1702	121020808512006	BUFFALO BYU	FRANKLIN ST	0.35 MI W OF MAIN ST		8085	12	200	30000	100000	1931 .	.	121020B25401002	EXACT
1703	121020810212003	GARNERS BYU	RANKIN RD	0.80 MI E OF US 59		8102	12	2150	30000	100000	1977 .	.	121020T00200001	EXACT
1704	121020810312007	DRAINAGE D	WILSON RD	0.20 MI S OF FM 1960		8103	12	1150	30000	100000	1961 .	.	121020AA6581002	POS
1705	121020810312009	GARNERS BYU	WILSON RD	0.90 MI N OF BWY 8		8103	12	3400	30000	100000	1988 .	.	121020AA6581001	EXACT
1706	121020810312010	HALLS BYU	MESA DR	0.15 MI S OF TIDWELL RD		8103	12	3000	29509	95157	1953 .	.	121020B44417001	POS
1707	121020810312012	DRAIN D	MESA DR NB	0.90 MI N OF US 90		8103	12	4800	29493	95157	1966 .	.	121020B44417006	UNC

HARRIS COUNTY

ID	Removed bridges	Feature Crossed	Facility Carried	Location	Control	Sectio	Milepoi	Lat(DM	Long(DM	Yr.Bui			OFF-sys bridg	OFF FLA
1708	121020810312014	DRAIN D	MESA DR SB	0.90 MI N OF US 90		8103	12	4800	29493	95157	1982	.	121020B44417003	UNC
1709	121020810312015	MESA DR	SP RR	0.10 MI N OF US 90		8103	12	5800	29486	95157	1986	.	121020B44417004	POS
1710	121020810312016	MESA DR	LIBERTY RD	0.10 MI N OF US 90		8103	12	5800	29486	95157	1986	.	121020B44417005	POS
1711	121020810712002	LITTLE CEDAR BYU	FAIRMONT PKWY EB	0.10 MI E OF FAIRMONT PKW		8107	12	0	30000	100000	1982	.	121020L12313001	POS
1712	121020810712003	LITTLE CEDAR BYU	FAIRMONT PKWY WB	0.10 MI E OF SH 146		8107	12	100	30000	100000	1982	.	121020L12313002	POS
1713	121020810812005	DRAINAGE D	BAY AREA BLVD WB	3.00 MI E OF MIDDLEBROOK		8108	12	6300	30000	100000	1968	.	121020AA9958003	POS
1714	121020810812006	DRAINAGE D	BAY AREA BLVD EB	3.00 MI E OF MIDDLEBROOK		8108	12	6300	30000	100000	1968	.	121020AA9958004	POS
1715	121020810812007	PORT RD DRAINAGE D	BAY AREA BLVD EB	1.35 MI NE RED BLUFF BLVD		8108	12	5600	30000	100000	1970	.	121020AA9958001	POS
1716	121020810812008	PORT RD DRAINAGE D	BAY AREA BLVD WB	0.10 MI NE OF CHEMICAL RD		8108	12	5600	30000	100000	1970	.	121020AA9958002	POS
1717	121020810812012	DRAINAGE D	SENS RD	0.50 MI W OF SPRR		8108	12	1200	30000	100000	1968	.	121020L00554002	POS
1718	121020810812013	DRAINAGE D	SENS RD	0.10 MI N OF SPENCER HWY		8108	12	1500	30000	100000	1989	.	121020L00554001	POS
1719	121020810812014	ARMAND BYU	BAY AREA BLVD EB	0.90 MI E OF MIDDLEBROOK		8108	12	1900	30000	100000	1968	.	121020AA3166002	EXACT
1720	121020810812015	ARMAND BYU	BAY AREA BLVD WB	0.90 MI E OF MIDDLEBROOK		8108	12	1900	30000	100000	1968	.	121020AA3166003	EXACT
1721	121020810812016	DRAINAGE D	BAY AREA BLVD EB	E OF BAY AREA PARK		8108	12	1300	30000	100000	1968	.	121020AA3166005	POS
1722	121020810812017	DRAINAGE D	BAY AREA BLVD	0.70 MI W OF GULF		8108	12	1700	30000	100000	1978	.	121020AA3166001	POS
1723	121020810812018	DRAINAGE D	BAY AREA BLVD EB	W OF EL CAMINO REAL		8108	12	1600	30000	100000	1966	.	121020B06029001	POS
1724	121020810812019	DRAINAGE D	BAY AREA BLVD WB	W OF EL CAMINO REAL		8108	12	1600	30000	100000	1966	.	121020B06029002	POS
1725	121020810812020	HORSEPEN BYU	BAY AREA BLVD EB	NE SPACE CTR BLVD		8108	12	4000	30000	100000	1968	.	121020B06029003	EXACT
1726	121020810812021	HORSEPEN BYU	BAY AREA BLVD WB	NE SPACE CTR BLVD		8108	12	4000	30000	100000	1968	.	121020B06029004	EXACT
1727	121020811412009	TURKEY CRK	DIXIE FARM RD WB	0.10 MI W OF IH 45		8114	12	2500	30000	100000	1982	.	121020B19690001	EXACT
1728	121020811412010	TURKEY CRK	DIXIE FARM RD EB	0.10 MI SW OF GULF FWY		8114	12	2500	30000	100000	1982	.	121020B19690002	EXACT
1729	121020811412011	DRAINAGE D	DIXIE FARM RD	0.30 MI SW OF BEAMER		8114	12	1100	30000	100000	1979	.	121020AA9959002	POS
1730	121020811412012	CLEAR CREEK	DIXIE FARM RD.	1.5MI SW OF BEAMER RD		8114	12	2500	30000	100000	1978	.	121020M00750004	POS
1731	121020811912001	HCFCD DRAINAGE D	HOLLAND AVE	1.00 MI S OF IH 10		8119	12	900	30000	100000	1984	.	121020J32241001	POS
1732	121020811912002	PANTHER CRK	HOLLAND AVE	0.05 MI S OF 6TH ST		8119	12	2500	30000	100000	1953	.	121020J32241002	EXACT
1733	121020812012002	TURKEY RUN GUL	MERCURY DR	0.95 MI S OF IH 10		8120	12	900	30000	100000	1958	.	121020J44000001	EXACT
1734	121020812012007	DREDGE FILL BASIN	MERCURY DR	1.80 MI S OF JCT IH 10		8120	12	1800	30000	100000	1985	.	121020J44000005	EXACT
1735	121020812012008	DREDGE FILL BASIN	MERCURY DR	1.60 MI S OF IH 10		8120	12	1600	30000	100000	1985	.	121020J44000004	EXACT
1736	121020812012009	DREDGE FILL BASIN	MERCURY DR	1.40 MI S OF IH 10		8120	12	1400	30000	100000	1985	.	121020J44000003	EXACT
1737	121020812012010	DREDGE FILL BASIN	MERCURY DR	1.00 MI S OF IH 10		8120	12	1000	30000	100000	1985	.	121020J44000002	EXACT
1738	121020812012011	PANTHER CRK	MAIN ST	0.75 MI N OF CLINTON DR		8120	12	200	30000	100000	1965	.	121020J41689001	EXACT
1739	121020812112001	HUNTING BYU	MARKET ST EB	2.50 MI W OF FEDERAL RD		8121	12	6200	30000	100000	1948	.	121020K42473001	EXACT
1740	121020812112002	HUNTING BYU	MARKET ST WB	2.50 MI W OF FEDERAL RD		8121	12	6200	30000	100000	1943	.	121020K42473002	EXACT
1741	121020812112005	WEST CAN	MARKET ST	0.20 MI E OF NORMANDY		8121	12	6599	30000	100000	1970	.	121020AA4541007	EXACT
1742	121020812112007	GREENS BYU	MARKET ST WB	0.25 MI W OF IH 610		8121	12	8504	30000	100000	1995	.	121020B42473004	EXACT
1743	121020812112008	GREENS BYU	MARKET ST EB	4.50 MI E OF JCT IH 610		8121	12	6599	30000	100000	1995	.	121020AA4310001	POS
1744	121020812212001	BRICKHOUSE GUL	HEMPSTEAD RD	0.20 MI S OF BINGLE		8122	12	6300	30000	100000	1988	.	121020B31281002	EXACT
1745	121020812212002	COLE CRK	HEMPSTEAD RD	0.2 MI S OF LITTLE YORK		8122	12	1400	30000	100000	1980	.	121020B31281001	EXACT
1746	121020813812005	WHITE OAK BYU	WATONGA BLVD NB	0.10 MI S OF T C JESTER		8138	12	100	30000	100000	1987	.	121020B67817001	EXACT
1747	121020813812006	WHITE OAK BYU	WATONGA BLVD SB	0.10 MI S OF T C JESTER		8138	12	100	30000	100000	1987	.	121020B67817002	EXACT
1748	121020813812007	BRICKHOUSE GUL	WATONGA BLVD SB	0.90 MI S OF T C JESTER		8138	12	900	30000	100000	1988	.	121020B67817003	EXACT
1749	121020813812008	BRICKHOUSE GUL	WATONGA BLVD NB	0.90 MI S OF T C JESTER		8138	12	900	30000	100000	1988	.	121020B67817004	EXACT
1750	121020813912001	WHITE OAK BYU TRIB	T C JESTER BLVD NB	0.40 MI N OF W 43RD ST		8139	12	4500	30000	100000	1987	.	121020B62921005	EXACT
1751	121020813912002	WHITE OAK BYU TRIB	T C JESTER BLVD SB	0.40 MI N OF W 43RD ST		8139	12	4500	30000	100000	1987	.	121020B62921006	EXACT
1752	121020813912003	DRAINAGE D	W T C JESTER NB	0.10 MI NW OF JCT IH 610		8139	12	7000	30000	100000	1960	.	121020B62937001	POS
1753	121020813912004	DRAINAGE D	W T C JESTER SB	0.10 MI NW OF JCT IH 610		8139	12	7000	30000	100000	1960	.	121020B62937002	POS
1754	121020813912005	WHITE OAK BYU	W T C JESTER NB	0.10 MI N OF W 34TH ST		8139	12	6200	30000	100000	1965	.	121020B62937003	EXACT
1755	121020813912006	WHITE OAK BYU	W T C JESTER SB	0.10 MI N OF W 34TH ST		8139	12	6200	30000	100000	1965	.	121020B62937004	EXACT
1756	121020814112006	BERING D	SAN FELIPE RD EB	0.20 MI E OF JCT VOSS RD		8141	12	1300	30000	100000	1962	.	121020B57009003	POS
1757	121020814112007	BERING D	SAN FELIPE RD WB	0.20 MI E OF JCT VOSS RD		8141	12	1300	30000	100000	1962	.	121020B57009004	POS
1758	121020814112011	BUFFALO BYU	BRIAR FOREST DR WB	0.50 MI E OF GESSNER RD		8141	12	8500	30000	100000	1985	.	121020B09761001	EXACT
1759	121020814112012	BUFFALO BYU	BRIAR FOREST DR EB	0.50 MI E OF GESSNER RD		8141	12	8500	30000	100000	1985	.	121020B09761002	EXACT
1760	121020814112013	BUFFALO BYU	SAN FELIPE RD WB	0.40 MI W OF JCT VOSS RD		8141	12	500	30000	100000	1970	.	121020B57009001	EXACT
1761	121020814112014	BUFFALO BYU	SAN FELIPE RD EB	0.40 MI W OF JCT VOSS RD		8141	12	500	30000	100000	1970	.	121020B57009002	EXACT
1762	121020814412002	BRAYS BYU	S WAYSIDE DR SB	0.10 MI S OF JCT US 90A		8144	12	100	30000	100000	1986	.	121020B68025001	EXACT
1763	121020814412003	BRAYS BYU	S WAYSIDE DR NB	0.10 MI S OF JCT US 90A		8144	12	100	30000	100000	1986	.	121020B68025002	EXACT
1764	121020814412004	SIMS BYU	MYKAWA RD	0.70 MI S OF BELLFORT DR		8144	12	3300	30000	100000	1945	.	121020B68025003	EXACT
1765	121020814612012	SOUTHERN PACIFIC RR	WACP ST	0.70 MI N OF IH 10		8146	12	8600	30000	100000	1988	.	121020B32105007	POS
1766	121020814612013	HALLS BYU	HIRSCH RD NB	1.00 MI N OF TIDWELL RD		8146	12	2800	30000	100000	1988	.	121020B32105001	EXACT
1767	121020814612014	DRAIN D	HIRSCH RD	0.50 MI N OF TIDWELL RD		8146	12	3500	30000	100000	1954	.	121020B32105003	POS
1768	121020814612015	HALLS BYU	HIRSCH RD SB	1.00 MI N OF TIDWELL RD		8146	12	2800	30000	100000	1988	.	121020B32105002	EXACT
1769	121020814612016	HUNTING BYU	HIRSCH RD SB	0.10 MI S OF IH 610		8146	12	7000	30000	100000	1991	.	121020B32105005	EXACT

HARRIS COUNTY

ID	Removed bridges	Feature Crossed	Facility Carried	Location	Control	Sectio	Milepoi	Lat(DM	Long(DM	Yr.Bui			OFF-sys bridg	OFF FLA
1770	121020814612017	HUNTING BYU	HIRSCH RD NB	0.10 MI S OF IH 610		8146	12	7000	30000	100000	1991	.	121020B32105006	EXACT
1771	121020814612018	DRAIN D	HIRSCH RD	0.10 MI S OF CRESTON ST		8146	12	6300	0	0	1986	.	121020B32105004	UNC
1772	121020814712004	HALLS BYU	HOMESTEAD RD SB	0.3 MI N OF TIDWELL RD		8147	12	4900	30000	100000	1965	.	121020B32537001	EXACT
1773	121020814712005	HALLS BYU	HOMESTEAD RD NB	0.3 MI N OF TIDWELL RD		8147	12	4900	30000	100000	1965	.	121020B32537002	EXACT
1774	121020814712007	HUNTING BYU & HBT RR	HOMESTEAD RD NB	0.20 MI N OF IH 610		8147	12	8100	30000	100000	1988	.	121020B32537003	EXACT
1775	121020814712008	HUNTING BYU	HOMESTEAD TUROUND	0.20 MI N OF IH 610		8147	12	8100	30000	100000	1988	.	121020B32537004	EXACT
1776	121020814712009	HUNTING BYU	HOMESTEAD TUROUND	0.20 MI N OF IH 610		8147	12	8100	30000	100000	1988	.	121020B32537004	EXACT
1777	121020814712010	HUNTING BYU & HBT RR	HOMESTEAD RD SB	0.20 MI N OF IH 610		8147	12	8100	30000	100000	1988	.	121020B32537006	EXACT
1778	121020814712011	GREENS BYU	HOMESTEAD RD	0.45 MI S OF US 59		8147	12	4000	30000	100000	1958	.	121020AA4310001	EXACT
1779	121020815012001	SENGER GUL	LOUETTA RD	3.1 MI E OF KUYKENDAHL		8150	12	12500	30000	100000	1986	.	121020AA2111010	EXACT
1780	121020815012002	KOTHMAN GUL	LOUETTA RD	1.7 MI E OF KUYKENDAHL		8150	12	10800	30000	100000	1986	.	121020AA2111009	EXACT
1781	121020815012005	THEISS GUL	LOUETTA RD	0.06 MI E OF STUEBNER AIR		8150	12	6700	30000	100000	1976	.	121020AA2111006	EXACT
1782	121020815012006	DRY CRK	LOUETTA RD	0.15 MI W OF CHAMP FOREST		8150	12	5500	30000	100000	1978	.	121020AA2111005	EXACT
1783	121020815012009	SEALS GUL	LOUETTA RD	1.3 MI E OF KUYKENDAHL		8150	12	10400	30000	100000	1986	.	121020AA2111008	EXACT
1784	121020815012010	SPRING GUL	LOUETTA RD	1.20 MI E OF STUEBNER AIR		8150	12	7800	30000	100000	1985	.	121020AA2111007	EXACT
1785	121020815012011	S WHITE OAK BYU	LOUETTA RD	0.70 MI E OF SH 249		8150	12	1800	30000	100000	1980	.	121020AA2111002	EXACT
1786	121020815012012	FAULKNER CRK	LOUETTA RD	1.40 MI W OF SH 249		8150	12	1300	30000	100000	1979	.	121020AA2111001	EXACT
1787	121020815012013	PILLOT GUL	LOUETTA RD EB	0.70 MI E OF SH 249		8150	12	3400	30000	100000	1982	.	121020AA2111003	EXACT
1788	121020815012014	DRAINAGE D	LOUETTA RD EB	1.20 MI W OF CHAMP FOREST		8150	12	4500	30000	100000	1982	.	121020AA2111004	POS
1789	121020815012015	PILLOT GUL	LOUETTA RD WB	0.70 MI E OF SH 249		8150	12	3400	30000	100000	1990	.	121020AA2111011	EXACT
1790	121020815012016	DRAINAGE D	LOUETTA RD WB	1.20 MI W OF CHAMP FOREST		8150	12	4500	30000	100000	1990	.	121020AA2111012	POS
1791	121020815112001	GREENS BYU	W HARDY RD	0.75 MI N OF BWY 89		8151	12	11100	30000	100000	1978	.	121020B30209001	EXACT
1792	121020815112004	TURKEY CRK TRIB	E HARDY RD	0.20 MI S OF THORNE BLVD		8151	12	7700	30000	100000	1954	.	121020AA5775032	EXACT
1793	121020815112005	DRAINAGE D	E HARDY RD	1.0 MI S OF FM 1960		8151	12	6600	30000	100000	1940	.	121020AA5775030	POS
1794	121020815112009	DRAINAGE D	W HARDY RD	1.00 MI N OF ALDINE MAIL		8151	12	13500	30000	100000	1978	.	121020AA5775038	POS
1795	121020815112010	GREENS BYU	E HARDY RD	0.85 MI N OF BWY 8		8151	12	11100	29569	95231	1987	.	121020B30209002	POS
1796	121020815112011	LITTLE YORK RD	E HARDY N APPROACH	AT LITTLE YORK RD		8151	12	16800	29522	95219	1987	.	121020B30209003	POS
1797	121020815112012	LITTLE YORK RD	W HARDY S APPROACH	AT LITTLE YORK RD		8151	12	16800	29522	95219	1987	.	121020B30209004	POS
1798	121020815112013	ALDINE MAIL ROUTE RD	W HARDY N APPROACH	AT ALDINE MAIL ROUTE RD		8151	12	14600	29541	95223	1987	.	121020AA5775040	UNC
1799	121020815112014	ALDINE MAIL ROUTE RD	E HARDY N APPROACH	AT ALDINE MAIL ROUTE RD		8151	12	14600	29541	95223	1987	.	121020AA5775041	UNC
1800	121020815112015	LITTLE YORK RD	E HARDY S APPROACH	AT LITTLE YORK RD		8151	12	16800	29522	95219	1987	.	121020B30209005	POS
1801	121020815112016	LITTLE YORK RD	W HARDY N APPROACH	AT LITTLE YORK RD		8151	12	16800	29522	95219	1987	.	121020B30209006	POS
1802	121020815112017	ALDINE MAIL ROUTE RD	W HARDY S APPROACH	AT ALDINE MAIL ROUTE RD		8151	12	14600	29541	95223	1987	.	121020AA5775042	UNC
1803	121020815112018	ALDINE MAIL ROUTE RD	E HARDY S APPROACH	AT ALDINE MAIL ROUTE RD		8151	12	14600	29541	95223	1987	.	121020AA5775043	UNC
1804	121020815112019	TRIB TURKEY CRK	E HARDY RD	1.60 MI S OF FM 1960		8151	12	7700	29577	95239	1981	.	121020AA5775031	POS
1805	121020815112020	FM 525 GRADE CROSSING	E HARDY N APPROACH	AT FM 525		8151	12	12500	29559	95228	1987	.	121020AA5775033	UNC
1806	121020815112021	FM 525 GRADE CROSSING	W HARDY N APPROACH	AT FM 525		8151	12	12500	29559	95228	1987	.	121020AA5775034	UNC
1807	121020815112022	DRAINAGE D	E HARDY RD	1.10 MI S OF FM 525		8151	12	13500	29550	95226	1987	.	121020AA5775037	UNC
1808	121020815112025	FM 525 GRADE CROSSING	W HARDY S APPROACH	AT FM 525		8151	12	12500	29559	95228	1987	.	121020AA5775035	UNC
1809	121020815112026	FM 525 GRADE CROSSING	E HARDY S APPROACH	AT FM 525		8151	12	12500	29559	95228	1987	.	121020AA5775036	UNC
1810	121020815112027	HALLS BYU	W HARDY RD	0.20 MI N OF COLLINS RD		8151	12	15300	29535	95222	1987	.	121020AA5775039	POS
1811	121020815712005	DRAINAGE D	KINGWOOD DR WB	4.50 MI E OF US59		8157	12	6400	30000	100000	1970	.	121020AA8075003	POS
1812	121020815712006	DRAINAGE D	KINGWOOD DR EB	4.50 MI E OF US59		8157	12	6400	30000	100000	1970	.	121020AA8075004	POS
1813	121020815712007	BENS BR	KINGWOOD DR EB	0.20 MI W OF LAKE HOU PK		8157	12	3900	30000	100000	1977	.	121020AA8075001	EXACT
1814	121020815712008	BENS BR	KINGWOOD DR WB	0.20 MI W OF LAKE HOU PK		8157	12	3900	30000	100000	1981	.	121020AA8075002	EXACT
1815	121020815812002	W FORK GOOSE CRK	ROLLINGBROOK DR	0.85 MI W OF GARTH RD		8158	12	3000	30000	100000	1983	.	121020D02060001	EXACT
1816	121020815812003	E FORK GOOSE CRK	ROLLINGBROOK DR WB	0.40 MI E OF GARTH RD		8158	12	1600	30000	100000	1975	.	121020D02060002	EXACT
1817	121020815812004	E FORK GOOSE CRK	ROLLINGBROOK DR EB	0.40 MI E OF GARTH RD		8158	12	1600	30000	100000	1975	.	121020D02060003	EXACT
1818	121020815912005	VINCE BYU	W HARRIS AVE	0.20 MI EAST OF S RICHEY		8159	12	1200	30000	100000	1960	.	121020C01401002	EXACT
1819	121020815912006	DRAINAGE D	W HARRIS AVE	0.30 MI E OF S RICHEY RD		8159	12	1100	30000	100000	1960	.	121020C01401001	POS
1820	121020816612002	DRAINAGE D	E RICHEY RD	0.50 MI SE OF FM 1960		8166	12	13800	30000	100000	1987	.	121020AA5330005	POS
1821	121020816612003	DRAINAGE D	RICHEY RD WB	0.40 MI W OF HARDY TOLL		8166	12	10900	30000	100000	1980	.	121020AA5330003	POS
1822	121020816612004	DRAINAGE D	RICHEY RD EB	0.40 MI W OF HARDY TOLL		8166	12	10900	30000	100000	1986	.	121020AA5330004	POS
1823	121020816612005	DRAINAGE D	W RICHEY RD WB	.5 MI SW/STUEBNER AIRLINE		8166	12	4500	30000	100000	1982	.	121020AA5330001	POS
1824	121020816612006	DRAINAGE D	W RICHEY RD EB	.5 MI SW/STUEBNER AIRLINE		8166	12	4500	30000	100000	1986	.	121020AA5330002	POS
1825	121020816712005	N FORK BRAYS BYU	ELDRIDGE RD NB	0.80 MI S OF WESTHEIMER		8167	12	1800	30000	100000	1987	.	121020B21912005	POS
1826	121020816712006	N FORK BRAYS BYU	ELDRIDGE RD SB	0.80 MI S OF WESTHEIMER		8167	12	1800	30000	100000	1987	.	121020B21912006	POS
1827	121020816712007	BRAYS BYU	ELDRIDGE RD NB	1.40 MI S OF WESTHEIMER		8167	12	1400	30000	100000	1986	.	121020B02601001	POS
1828	121020816712008	BRAYS BYU	ELDRIDGE RD SB	1.40 MI S OF WESTHEIMER		8167	12	1400	30000	100000	1986	.	121020B02601001	POS
1829	121020816712009	DRAINAGE D	ELDRIDGE PKWY NB	3.10 MI S OF WESTHEIMER		8167	12	3200	30000	100000	1986	.	121020B66825004	POS
1830	121020816712010	DRAINAGE D	ELDRIDGE PKWY SB	3.10 MI S OF WESTHEIMER		8167	12	3200	30000	100000	1986	.	121020B66825004	POS
1831	121020816912003	BRAYS BYU	LAWNDALE ST	0.50 MI SE OF WAYSIDE DR		8169	12	1300	30000	100000	1958	.	121020B38473002	EXACT

HARRIS COUNTY

ID	Removed bridges	Feature Crossed	Facility Carried	Location	Control	Sectio	Milepoi	Lat(DM	Long(DM	Yr.Bui			OFF-sys bridg	OFF FLA
1832	121020817012004	HEMPSTEAD RD	MKT RR	0.10 MI N OF WASHINGTON		8170	12	1900	30000	100000	1934 .	.	121020B31281004	EXACT
1833	121020817012005	HEMPSTEAD RD	S P RR	0.10 MI N OF WASHINGTON		8170	12	1000	30000	100000	1934 .	.	121020B31281003	EXACT
1834	121020817012006	HEMPSTEAD RD	S P RR	0.10 MI N OF WASHINGTON		8170	12	1800	30000	100000	1934 .	.	121020B31281003	EXACT
1835	121020817112004	PLUM CRK	GALVESTON RD	0.05 MI NW OF JCT IH 610		8171	12	1300	30000	100000	1940 .	.	121020B26105001	EXACT
1836	121020817112005	PINE GUL	GALVESTON RD	0.80 MI SE OF IH610E		8171	12	1800	30000	100000	1945 .	.	121020B26105002	EXACT
1837	121020817112006	SIMS BYU	GALVESTON RD	1.10 MI SE OF IH610E		8171	12	1100	30000	100000	1984 .	.	121020B26105003	EXACT
1838	121020817112007	OLD SIMS BYU	OLD GALVESTON RD	1.35 MI SE OF IH610		8171	12	1300	30000	100000	1945 .	.	121020B26105004	EXACT
1839	121020817112008	BERRY CRK	GALVESTON RD	0.20 MI SE OF HOWARD DR		8171	12	2000	30000	100000	1968 .	.	121020C01184001	EXACT
1840	121020817112009	DRAINAGE D	GALVESTON RD	N OF RICHEY ST		8171	12	3000	30000	100000	1988 .	.	121020B26105005	POS
1841	121020817112010	GALVESTON RD	S PACIFIC RR	0.20 MI S OF HOWARD DR		8171	12	2100	30000	100000	1970 .	.	121020C01184002	EXACT
1842	121020817512004	CYPRESS CRK	CUTTEN RD	2.4MI N. OF FM1960		8175	12	6400	1	1	1993 .	.	121020AA2020002	POS
1843	121020817712008	BIG CYPRESS CRK	GRANT RD	1.00 MI NW OF JONES RD		8177	12	539	30000	100000	1978 .	.	121020AA0725002	EXACT
1844	121020817712009	CYPRESS CRK TRIB	GRANT RD	0.90 MI NW OF JONES RD		8177	12	539	30000	100000	1954 .	.	121020AA0725003	EXACT
1845	121020817812002	CYPRESS CRK	CHAMPION FOREST SB	0.30 MI S OF CYPRESSWOOD		8178	12	1800	30000	100000	1983 .	.	121020AA1693003	EXACT
1846	121020817812003	CYPRESS CRK	CHAMPION FOREST NB	0.30 MI S OF CYPRESSWOOD		8178	12	1800	30000	100000	1979 .	.	121020AA1693004	EXACT
1847	121020817812004	DRY CRK	CHAMPION FOREST NB	0.25 MI N OF CYPRESSWOOD		8178	12	1300	30000	100000	1980 .	.	121020AA1693001	EXACT
1848	121020817812005	DRY CRK	CHAMPION FOREST SB	0.25 MI N OF CYPRESSWOOD		8178	12	1300	30000	100000	1983 .	.	121020AA1693002	EXACT

Total bridges REMOVED = 450

HARRIS COUNTY

ID	New bridges	Feature Crossed	Facility Carried	Location	Control	Sectio	Milepoi	Lat(DM	Long(DM	Yr.Bui	Bridge Rep.	Rep. FLA	OFF-bridge Re	OFF FLA
13324	121020002713266	WILCREST DR.	US 59 NB ML	0.25MI N OF FORT BEND C/L		27	13	15684	29391	95342	1996	121020002713263	EXACT	. .
13325	121020002713267	WILCREST DR.	US 59 SB ML	.75Mi. N. OF FORT-BENDC/L		27	13	15684	29391	95342	1996	121020002713128	EXACT	. .
13326	121020002713268	WEST BELLFORT	US 59 NB ML	0.50MI N OF FORT BENDC/L		27	13	12966	29392	95340	1996	121020002713264	EXACT	. .
13327	121020002713269	WEST BELLFORT AVE	US 59 SB ML	.25MI. N. OF FORT BENDC/L		27	13	12966	29392	95340	1996	121020002713129	EXACT	. .
13351	121020002801227	HUNTING BAYOU	US 90A	0.1 MI W OF IH 610		28	1	23907	29477	95164	1996	121020002801001	EXACT	. .
13472	121020005102349	SH 3 & GH & H RR	BW 8 EB	1.10 MI NE OF IH 45		51	2	6589	29368	95113	1996	.	. .
13473	121020005102350	SH 3 & GH & H RR	BW 8 WB	1.10 MI NE OF IH 45		51	2	6588	29369	95114	1996	.	. .
13487	121020011005129	CYPRESSWOOD RD	IH45SB	2.20 MI N OF FM 1960		110	5	44804	30032	95259	1996	121020011005089	POS	. .
13491	121020011005143	AIRTEX BLVD	IH 45	4 MI S OF FM 1960		110	5	39901	29589	95254	1997	121020011005083	POS	. .
13493	121020011005163	RICHEY RD	IH45 NBML	2 MI S OF FM 1960		110	5	41007	29597	95255	1997	121020011005082	POS	. .
13494	121020011005182	CYPRESSWOOD RD	IH45NB	2.20 MI N OF FM 1960		110	5	44804	30032	95259	1996	121020011005089	POS	. .
13495	121020011005192	RICHEY RD	IH45 SBML	2 MI S OF FM 1960		110	5	41007	29597	95255	1997	121020011005082	POS	. .
13517	121020011006141	RANKIN RD	IH 45 NB	1.8 MI N OF BWY 8		110	6	38752	29579	95253	1997	121020011006054	EXACT	. .
13518	121020011006142	RANKIN RD	IH 45 SB	1.8 MI N OF BWY 8		110	6	38752	29579	95253	1997	121020011006054	EXACT	. .
13545	121020017706225	US 59	TOWNSEN BLVD	0.9 MI N OF FM 1960		177	6	2590	30012	95157	1996	121020017706148	EXACT	. .
13570	121020017707214	REINHARD BAYOU	US 59 NB FR	10.5 MI N OF LP 137		177	7	2981	29575	95173	1996	121020017707102	EXACT	. .
13571	121020017707219	GARNERS BAYOU	US 59 NB FR	12.0 MI N OF LP 137		177	7	1488	29587	95168	1996	121020017707100	EXACT	. .
13576	121020017707275	BELTWAY 8	US 59 SB	5.0 MI S OF FM 1960		177	7	4327	29564	95177	1996	121020017707117	EXACT	. .
13597	121020017711201	US59SB / KING AVE	US59 HOV	.2MI S OF BENNINGTON		177	11	3595	(null)	(null)	1996	121020017711050	UNC	. .
13601	121020017711286	LYONS ST & T&NO RR	US 59 (NB)	0.40 MI N OF IH 10		177	11	7405	29466	95204	1996	121020017711052	POS	. .
13602	121020017711289	QUITMAN ST	US 59 (SB)	0.90 MI N OF IH 10		177	11	7405	29470	95204	1997	121020017711051	EXACT	. .
13603	121020017711290	COLLINGSWORTH ST	US 59 (SB)	1.60 MI N OF IH 10		177	11	7405	29476	95204	1997	121020017711050	EXACT	. .
13604	121020017711299	LYONS ST & T&NO RR	US 59 (SB)	0.40 MI N OF IH 10		177	11	7405	29466	95204	1997	121020017711052	POS	. .
13605	121020017711300	QUITMAN ST	US 59 (NB)	0.90 MI N OF IH 10		177	11	7405	29470	95204	1997	121020017711051	EXACT	. .
13606	121020017711301	COLLINGSWORTH ST	US 59 (NB)	1.60 MI N OF IH 10		177	11	7405	29476	95204	1997	121020017711050	EXACT	. .
13611	121020017801357	SH 35	BW 8	3.40 MI W OF BEAMER RD		178	1	(null)	29446	95172	1997	.	. .
13908	121020038912089	HOUSTON SHIP CHANNEL	SH146 NB (E.LANE)	.6MI N OF SH225		389	12	7972	29422	95011	1996	121020038912034	UNC	. .
13909	121020038912090	HOUSTON SHIP CHANNEL	SH146 SB (W.LANE)	.6MI N OF SH225		389	12	7972	29422	95011	1996	121020038912034	UNC	. .
13919	121020038913106	MISSOURI ST	SH 146	0.9 MI N OF FRED HARTMAN		389	13	16110	29430	94595	1996	.	. .
13920	121020038913107	WETLAND	SH 146 NB EXIT	0.3 MI E OF SH146		389	13	23005	29428	95000	1996	.	. .
13921	121020038913108	WETLAND	LP201 WB-NB CONN	AT LP201/SH146 INTER.		389	13	16280	29428	95000	1996	.	. .
13922	121020038913109	W. TEXAS AVE.	SH 146	3.5 MI N OF FRED HARTMAN		389	13	14235	29444	94582	1996	.	. .
13923	121020038913110	SH 146 ML	LP 201 CONN	AT LP201 & SH146 INTER.		389	13	16599	29428	95000	1996	.	. .
13924	121020038913111	GOOSE CREEK & GARTH ROAD	SH 146 MAIN LANES	0.5 MI E OF MAIN STREET		389	13	13294	29449	94568	1996	.	. .
13925	121020038913112	N. MAIN ST.	LP 201	1.4 MI E OF SPUR330		389	13	12324	29450	94535	1996	.	. .
14060	121020050003305	IH 45	IH 45 HOV	0.7 MI S OF MONROE		500	3	(null)	29397	95154	1996	121020050003079	UNC	. .
14061	121020050003306	IH 45 NB FR	IH 45 HOV EXIT RP	0.7 MI S OF MONROE		500	3	(null)	29397	95155	1996	121020050003079	UNC	. .
14062	121020050003307	IH 45 SB FR	IH 45 HOV EXIT RP	0.7 MI S OF MONROE		500	3	(null)	29399	95156	1996	121020050003079	UNC	. .
14063	121020050003308	BERRY CREEK	IH 45 HOV EXIT RP	0.4 MI E OF MONROE		500	3	(null)	29397	95156	1996	121020050003079	UNC	. .
14064	121020050003309	BERRY CREEK	IH 45 HOV ENT. RP	0.4 MI E OF MONROE		500	3	(null)	29397	95156	1996	121020050003079	UNC	. .
14065	121020050003313	BELTWAY 8	IH 45 SB	0.90 MI SE OF FUQUA ST		500	3	8630	29363	95123	1996	121020050003126	EXACT	. .
14082	121020050003343	BW 8 EB FR	IH 45 NB FR	IH 45 NB CONN "D"		500	3	9167	29364	95123	1996	121020050003126		. .
14083	121020050003344	IH 45 NB ENTRANCE RAMP	IH 45 NB CONN "E"	1.80 MI NW OF FM 1959		500	3	9167	29364	95123	1996	121020050003126	UNC	. .
14084	121020050003346	IH 45	BELTWAY 8	IH 45 SB CONN "H"		500	3	9167	29364	95123	1996	121020050003126		. .
14085	121020050003347	IH 45 NB EXIT RAMP	BWY 8 EB CONN "K"	1.80 MI NW OF FM 1959		500	3	9167	(null)	(null)	1996	121020050003079	UNC	. .
14086	121020050003360	HCFCD DITCH A-119-07-00	IH 45 SB ON RAMP	0.80 MI SE OF FUQUA ST		500	3	8825	29364	95123	1992	121020050003126	UNC	. .
14087	121020050003361	HCFCD DITCH A-119-07-00	IH 45	0.80 MI SE OF FUQUA ST		500	3	8825	29364	95123	1993	121020050003126	UNC	. .
14142	121020050201081	SH 225 ML AND WB FR	MILLER CUT OFF	5.6 MI E OF BELTWAY 8		502	1	(null)	29419	95040	1996	.	. .
14143	121020050201083	SH 225 ML AND WB FR	SENS ROAD	6.8 MI E OF BELTWAY 8		502	1	(null)	29414	95028	1996	.	. .
14152	121020050201355	SH 225	BELTWAY 8 NB	1.5 MI S OF SHIP CHANNEL		502	1	(null)	29427	95092	1996	.	. .
14153	121020050201356	SH 225	BELTWAY 8 SB	1.5 MI S OF SHIP CHANNEL		502	1	(null)	29427	95092	1996	.	. .
14262	121020050801317	SAN JACINTO RIVER	IH10 RT LANE	12MI E OF IH10+IH610		508	1	45927	29476	95044	1995	121020050801047	EXACT	. .
14342	121020059801336	SH 288	BW 8 EB	JCT. OF SH 288		598	1	11062	29358	95232	1997	.	. .
14343	121020059801337	SH 288	BW 8 WB	JCT. OF SH 288		598	1	11062	29358	95232	1997	.	. .
14373	121020098101020	CLEAR CREEK	FM 528	0.85 MI NE OF FM 518		981	1	0	29310	95107	1996	121020098101009	EXACT	. .
14374	121020098101021	HCFCD DITCH A-111-00-00	FM 528	0.20 MI SW OF IH 45		981	1	2902	29066	95079	1995	121020098101007	EXACT	. .
14375	121020098101022	FUTURE DRAINAGE CHANNEL	FM 528	1.00 MI W OF IH 45		981	1	2141	29314	95089	1996	121020098101007	UNC	. .
14583	121020325602096	BELTWAY 8 FR	HARDY TOLL RD	0.25 MI N OF BLACKWOOD		3256	2	63260	29561	95228	1990	.	. .
14657	121020325603253	GENOA - RED BLUFF	BELTWAY 8 NB	3.1 MI NE OF IH 45		3256	3	(null)	29378	95103	1996	121020325603054	UNC	. .
14658	121020325603254	GENOA - RED BLUFF	BELTWAY 8 SB	3.1 MI NE OF IH 45		3256	3	(null)	29378	95103	1996	121020325603054	UNC	. .
14663	121020325603268	PRESTON AVENUE	BELTWAY 8 NB	3.7 MI NE OF IH 45		3256	3	(null)	29379	95101	1996	121020325603054	UNC	. .

HARRIS COUNTY

ID	New bridges	Feature Crossed	Facility Carried	Location	Control	Sectio	Milepoi	Lat(DM	Long(DM	Yr.Bui	Bridge Rep.	Rep. FLA	OFF-bridge Re	OFF FLA
14664	121020325603270	PRESTON AVENUE	BELTWAY 8 SB	3.7 MI NE OF IH 45		3256	3 (null)	29379	95101	1996	121020325603054	UNC	.	.
14665	121020325603289	CRENSHAW BOULEVARD	BELTWAY 8 NB	4.5 MI NE OF IH 45		3256	3 (null)	29380	95096	1996	121020325603054	UNC	.	.
14666	121020325603290	CRENSHAW BOULEVARD	BELTWAY 8 SB	4.5 MI NE OF IH 45		3256	3 (null)	(null)	(null)	1996	121020325603054	UNC	.	.
14667	121020325603304	VISTA BOULEVARD	BELTWAY 8	6.0 MI N OF IH 45 (S)		3256	3 (null)	29394	95093	1996	121020325603054	UNC	.	.
14668	121020325603310	FAIRMONT PARKWAY	BELTWAY 8	5.3 MI NE OF IH 45		3256	3 (null)	29390	95094	1996	121020325603054	UNC	.	.
14669	121020325603315	PINE STREET	BELTWAY 8	2.5 MI S OF SH 225		3256	3 (null)	29406	95094	1996	121020325603054	UNC	.	.
14670	121020325603316	SAN AUGUSTINE STREET	BELTWAY 8	1.6 MI N OF IH 45 (S)		3256	3 (null)	29414	95092	1996	121020325603054	UNC	.	.
14671	121020325603317	GREENSHADOW BOULEVARD	BELTWAY 8	0.7 MI S OF SH 225		3256	3 (null)	24421	95092	1996	121020325603054	UNC	.	.
14672	121020325603345	IH 45 NB FR	BW 8 WB FR	BWY 8 WB CONN "F"		3256	3 9167	29364	95123	1996	121020325603054	UNC		.
14673	121020325603348	IH 45	BELTWAY 8	BWY 8 WB CONN "L"		3256	3 9167	29364	95123	1996	121020325603054	UNC		.
14674	121020325603363	HUGHES & SABO RD	BW 8 WB	0.70 MI SW OF IH 45		3256	3 (null)	29360	95129	1997	121020325603054	UNC	.	.
14675	121020325603364	HUGHES & SABO RD	BW 8 EB	0.70 MI SW OF IH 45		3256	3 (null)	29360	95129	1997	121020325603054	UNC	.	.
14676	121020325603375	LITTLE VINCE BAYOU	BELTWAY 8 SB	3.1 MI S OF SH 225		3256	3 (null)	29401	95093	1995	121020325603054	UNC	.	.
14677	121020325603376	LITTLE VINCE BAYOU	BELTWAY 8 NB	3.1 MI S OF SH 225		3256	3 (null)	29401	95093	1995	121020325603054	UNC	.	.
14678	121020325603377	ARMAND RELIEF	BELTWAY 8 SB	6.2 MI N OF IH 45 (S)		3256	3 (null)	29395	95093	1995	121020325603054	UNC	.	.
14679	121020325603378	ARMAND RELIEF	BELTWAY 8 NB	6.2 MI N OF IH 45 (S)		3256	3 (null)	29395	95093	1995	121020325603054	UNC	.	.
14680	121020325603379	ARMAND BAYOU	BELTWAY 8 SB	5.5 MI N OF IH 45 (S)		3256	3 (null)	29391	95093	1995	121020325603054	UNC	.	.
14681	121020325603380	ARMAND BAYOU	BELTWAY 8 NB	5.5 MI N OF IH 45 (S)		3256	3 (null)	29391	95093	1995	121020325603054	UNC	.	.
14687	121020325604284	FM 521	BW 8 EB	JCT OF FM 521		3256	4 (null)	29358	95256	1997	.	.	.	.
14688	121020325604285	FM 521	BW 8 WB	JCT OF FM 521		3256	4 (null)	29358	95256	1997	.	.	.	.
14689	121020325604294	AT & SF RR & MYKAWA RD	BW 8 EB	0.70 MI W OF SH 35		3256	4 (null)	29359	95179	1997	.	.	.	.
14690	121020325604296	SIMS BAYOU	BW8 WBFR	.45MI S OF US90A		3256	4 8651	(null)	(null)	1998	.	.	121020B06817616	POS
14691	121020325604297	SIMS BAYOU	BW8 EBFR	.45MI S OF US90A		3256	4 8651	(null)	(null)	1998	.	.	121020B06817616	POS
14692	121020325604298	BW8 WBFR	BW8 LT U-T ACCESS	AT BW8 S-LP & US90A		3256	4 8324	(null)	(null)	1998	.	.	.	.
14693	121020325604299	BW8 EBFR	BW8 RT U-T ACCESS	AT BW8 S-LP & US90A		3256	4 8324	(null)	(null)	1998	.	.	.	.
14694	121020325604301	BW8 WBFR	SPRR	AT BW8 S-LP & US90A		3256	4 8324	(null)	(null)	1998	.	.	.	.
14695	121020325604302	BW8 EBFR	SPRR	AT BW8 S-LP & US90A		3256	4 8324	(null)	(null)	1998	.	.	.	.
14696	121020325604312	AT & SF RR & MYKAWA RD	BW 8 WB	0.70 MI W OF SH 35		3256	4 (null)	29359	95179	1997	.	.	.	.
14697	121020325604324	HILLCROFT AVE	BW 8 EB	JCT OF HILLCROFT		3256	4 (null)	29368	95297	1997	.	.	.	.
14698	121020325604325	HILLCROFT AVE	BW 8 WB	JCT OF HILLCROFT WB		3256	4 (null)	23680	95297	1997	.	.	.	.
14699	121020325604326	CHIMNEY ROCK	BW 8	JCT OF CHIMNEY ROCK		3256	4 (null)	29365	9529	1997	.	.	.	.
14700	121020325604329	W. FUQUA & DITCH	BW 8	0.9 MI. FROM S. POST OAK		3256	4 (null)	29363	95286	1997	.	.	.	.
14701	121020325604330	S. POST OAK	BW 8	JCT OF S. POST OAK		3256	4 (null)	29360	95279	1997	.	.	.	.
14702	121020325604331	DITCH	BW 8 ML	0.6 MI. E. OF S. POST OAK		3256	4 (null)	29935	809527	1997	.	.	.	.
14703	121020325604333	HIRAM CLARKE	BW 8 ML	JCT. OF HIRAM CLARK		3256	4 (null)	29358	95267	1997	.	.	.	.
14704	121020325604334	FM 521 (ALEMDA)	BELTWAY 8	JCT OF FM 521		3256	4 (null)	29358	95256	1997	.	.	.	.
14705	121020325604335	KIRBY DR	BW 8 ML	JCT. OF KIRBY DR.		3256	4 (null)	(null)	(null)	1997	.	.	.	.
14706	121020325604338	SCOTT STREET	BELTWAY 8	JCT OF SCOTT STREET		3256	4 (null)	29359	95221	1997	.	.	.	.
14707	121020325604339	FM 865	BELTWAY 8 ML	JCT OF FM 865		3256	4 (null)	29359	95212	1997	.	.	.	.
14708	121020325604341	S WAYSIDE DRIVE	BW 8	1.90 MI W OF SH 35		3256	4 (null)	29360	95191	1997	.	.	.	.
14709	121020325604358	HCFCD DITCH A-125-00-00	BW 8	0.50 MI E OF SH 35		3256	4 (null)	29360	95191	1997	.	.	.	.
14710	121020325604359	MONROE RD	BW 8	1.15 MI E OF SH 35		3256	4 (null)	29360	95191	1997	.	.	.	.
14711	121020325604360	BLACKHAWK DRIVE	BW 8	2.30 MI E OF SH 35		3256	4 (null)	29360	95149	1997	.	.	.	.
14712	121020325604361	HCFCD DITCH A-120-00-00	BW 8	3.25 MI E OF SH 35		3256	4 (null)	29360	95139	1997	.	.	.	.
14713	121020325604362	BEAMER RD	BW 8	3.40 MI E OF SH 35		3256	4 (null)	29360	95139	1997	.	.	.	.
14714	121020325604374	DRAINAGE DITCH	BW 8	0.40 MI W OF SH 35		3256	4 (null)	29360	95176	1995	.	.	.	.

Total NEW bridges = 107
Balance = -343

MONTGOMERY COUNTY

ID	Removed bridges	Feature Crossed	Facility Carried Over	Location	Control	Section	Milepoint	Lat(DM)	Long(DM)	Yr.Built			OFF-sys bridge	OFF FLAG
240	121700866112001	STEWARTS CRK	SILVERDALE RD	0.40 MI W OF FM 1314	8661	12	400	30000	100000	1989	.	.	121700C01165001	EXACT
241	121700866312002	STEWARTS CRK	FOSTER RD	1.40 MI E OF SH 75	8663	12	300	30000	100000	1960	.	.	121700C00330001	EXACT

Total bridges REMOVED = 2

ID	New bridges	Feature Crossed	Facility Carried Over	Location	Control	Section	Milepoint	Lat(DM)	Long(DM)	Yr.Built	Bridge Rep.	Rep. FLAG	OFF-bridge Rep.	OFF FLAG
14759	121700011004165	N. REL SAN JACINTO RIVER	IH 45 SBFR	0.90 MI FROM JCT. FM 1488	110	4	90	30150	95274	1997	.	.	.	.
14760	121700011004166	SAN JACINTO RIVER	IH 45 SBFR	0.75 MI FROM JCT. FM 1488	110	4	75	30145	95274	1997	.	.	.	.
14761	121700011004167	S. REL SAN JACINTO RIVER	IH 45 SBFR	0.15 MI FROM JCT. FM 1488	110	4	15	0	0	1997	.	.	.	.
14762	121700011004168	N. REL SAN JACINTO RIVER	IH 45 NBFR	0.90 MI FROM JCT. FM 1488	110	4	90	0	0	1997	.	.	.	.
14763	121700011004169	SAN JACINTO RIVER	IH 45 NBFR	0.75 MI FROM JCT. FM 1488	110	4	75	0	0	1997	.	.	.	.
14764	121700011004170	S. REL SAN JACINTO RIVER	IH 45 NBFR	0.15 MI FROM JCT. FM 1488	110	4	15	0	0	1997	.	.	.	.

Total NEW bridges = 6
Balance = 4

WALLER COUNTY

ID	Removed bridge	Feature Crossed	Facility Carried	Location	Control	Section	Milepoin	Lat(DM)	Long(DM	Yr.Built			OFF-sys bridge	OFF FLAG
6	122370005005022	CLEAR CRK	US 290 BU	0.50 MI W OF FM 359	50	5	10040	30053	96028	1930	.	.	.	.

Total bridges REMOVED = 1

ID	New bridges	Feature Crossed	Facility Carried	Location	Control	Section	Milepoin	Lat(DM)	Long(DM	Yr.Built	Bridge Rep.	Rep. FLAG	OFF-bridge Rep	OFF FLAG
14971	122370005005137	CLEAR CRK	US 290 BU	0.50 MI W OF FM 359	50	5	10040	30053	96028	1930	122370005005022	EXACT	.	.
14982	122370011411143	US290	FM359NB	6.70 MI W OF FM 362	114	11	(null)	30053	96027	1996	.	.	.	.
14983	122370011411144	US290	FM359SB	6.70 MI W OF FM 362	114	11	(null)	30053	96027	1996	.	.	.	.
14984	122370011411145	PONDS CREEK TRIB.	US 290 WB CONNECTO	R	114	11	(null)	30053	96027	1996	.	.	.	.
14985	122370011411146	PONDS CRK TRIB	FM359 TO US290EB	0.10 MI E OF FM 359	114	11	(null)	30053	96027	1996	.	.	.	.
14986	122370011411147	PONDS CRK	US290EB FR	0.90 MI E OF FM 359	114	11	(null)	30053	96027	1996	.	.	.	.
14987	122370011411148	PONDS CREEK TRIB.	US 290 WB ML	0.10 MI E OF FM 359	114	11	(null)	(null)	(null)	1996	.	.	.	.
14988	122370011411149	PONDS CRK TRIB	US290EB	0.10 MI E OF FM 359	114	11	(null)	30053	96027	1996	.	.	.	.
14989	122370011411150	PONDS CRK	US290WB	0.80 MI E OF FM 359	114	11	(null)	30051	96020	1996	.	.	.	.
14990	122370011411151	PONDS CRK	US290EB	0.80 MI E OF FM 359	114	11	(null)	30051	96020	1996	.	.	.	.
14991	122370011411152	US290	BROOKS RD.	4.3 MI W OF FM 362	114	11	(null)	30047	96004	1996	.	.	.	.
15000	122370011411162	PLANTATION PKWY	US290WB	0.5 MI W OF BROOKS RD	114	11	(null)	30050	96008	1996	.	.	.	.
15001	122370011411163	PLANTATION PKWY	US290EB	4.80 MI W OF FM 362	114	11	(null)	30050	96008	1996	.	.	.	.
15002	122370011411164	US290	FM1098	3.40 MI W OF FM 362	114	11	(null)	30046	95595	1996	.	.	.	.
15003	122370011411165	FUTURE RD	US290WB	2.00 MI W OF FM 362	114	11	(null)	30042	95581	1996	.	.	.	.
15004	122370011411166	FUTURE RD	US290EB	2.00 MI W OF FM 362	114	11	(null)	30042	5581	1996	.	.	.	.
15005	122370011411167	DRAIN D	US290	0.55 MI W OF FM 362	114	11	(null)	30040	95570	1996	.	.	.	.
15006	122370011411168	FM362	US290WB	0.40 MI W OF HARRIS C/L	114	11	(null)	30037	95560	1996	.	.	.	.
15007	122370011411169	FM362	US290EB	0.40 MI W OF HARRIS C/L	114	11	(null)	30037	95560	1996	.	.	.	.
15008	122370011411170	DRAIN D	US290	0.25 MI E OF FM 362	114	11	(null)	30037	9555	1996	.	.	.	.

Total NEW bridges = 20
Balance = 19