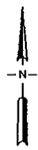


Texas Department of Transportation  
IH 635 Managed Lanes Project  
Technical Provisions

**Attachment 01-1A**

Project Limits



NOT TO SCALE

END PROJECT

SEE SHEET 5

VALWOOD PARKWAY

VALLEY VIEW LN

JOSEY LN

WEBB  
CHAPEL RD

MARSH LN

ROSER RD

MIDWAY RD

SEE SHEET 9

MATCHLINE  
SEE SHEET 2

BEGIN PROJECT

SEE SHEET 5

IH 635

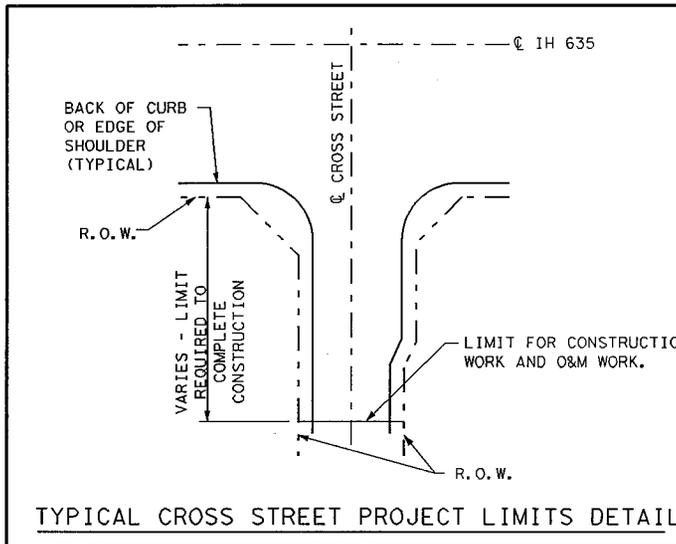
DARTON DR

SEE SHEET 7

LUNA RD

MATCHLINE  
SEE SHEET 3

IH 35E



NOTES:

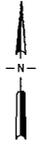
1. FOR CROSS STREET PROJECT LIMITS SEE 'TYPICAL CROSS STREET PROJECT LIMITS DETAIL'.
2. FOR FOREST LANE LIMITS SEE SHEET 7.



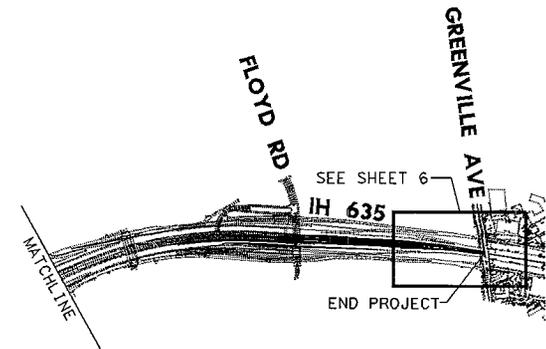
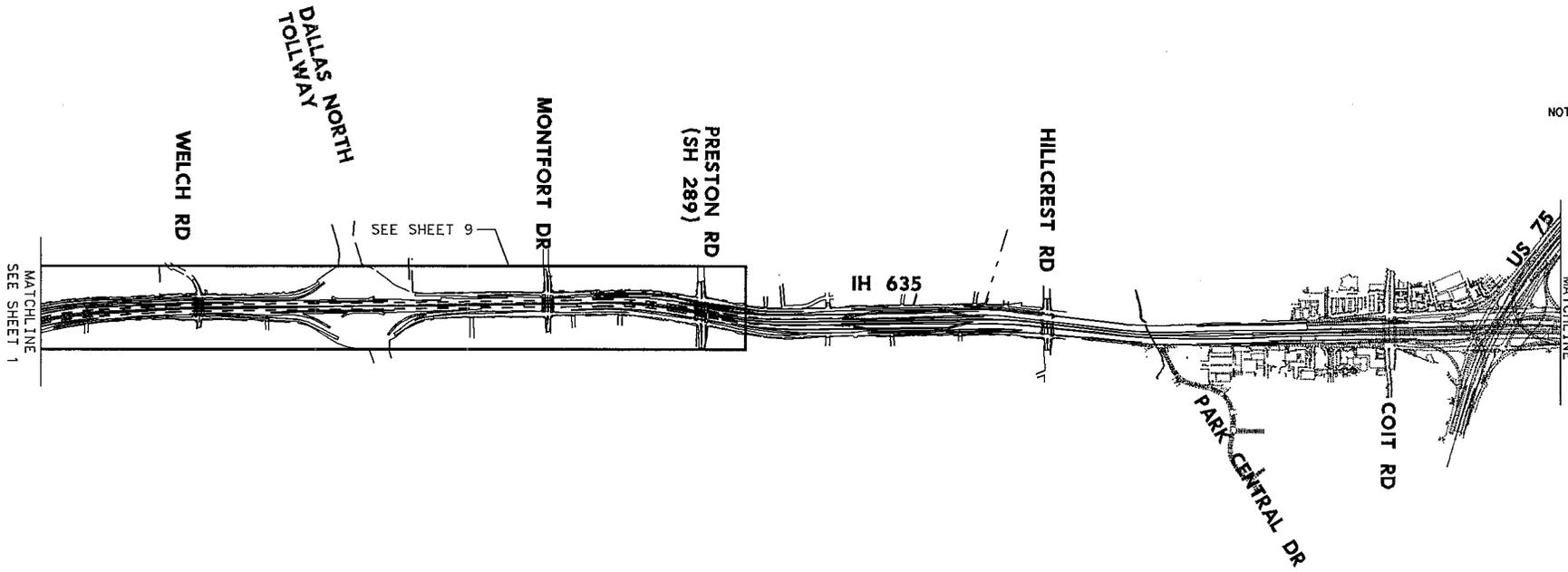
Texas Department of Transportation  
© 2008

ATTACHMENT 01-1A

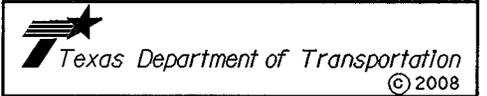
IH 635 MANAGED LANES  
PROJECT  
PROJECT LIMITS



NOT TO SCALE

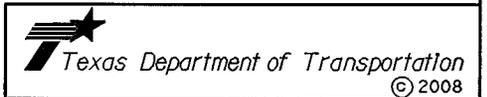
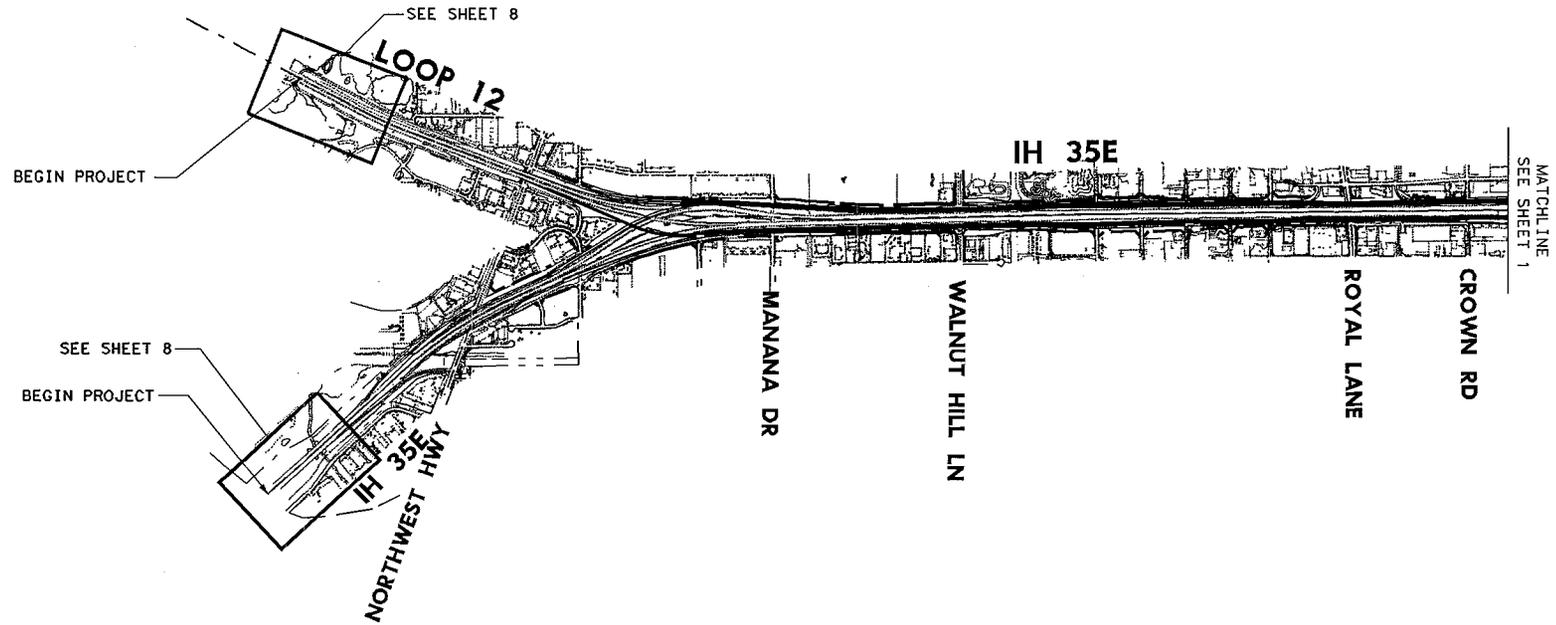
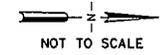


NOTE:  
FOR CROSS STREET PROJECT LIMITS SEE 'TYPICAL  
CROSS STREET DETAIL' ON SHEET 1.



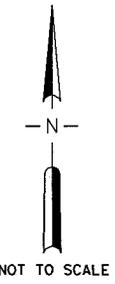
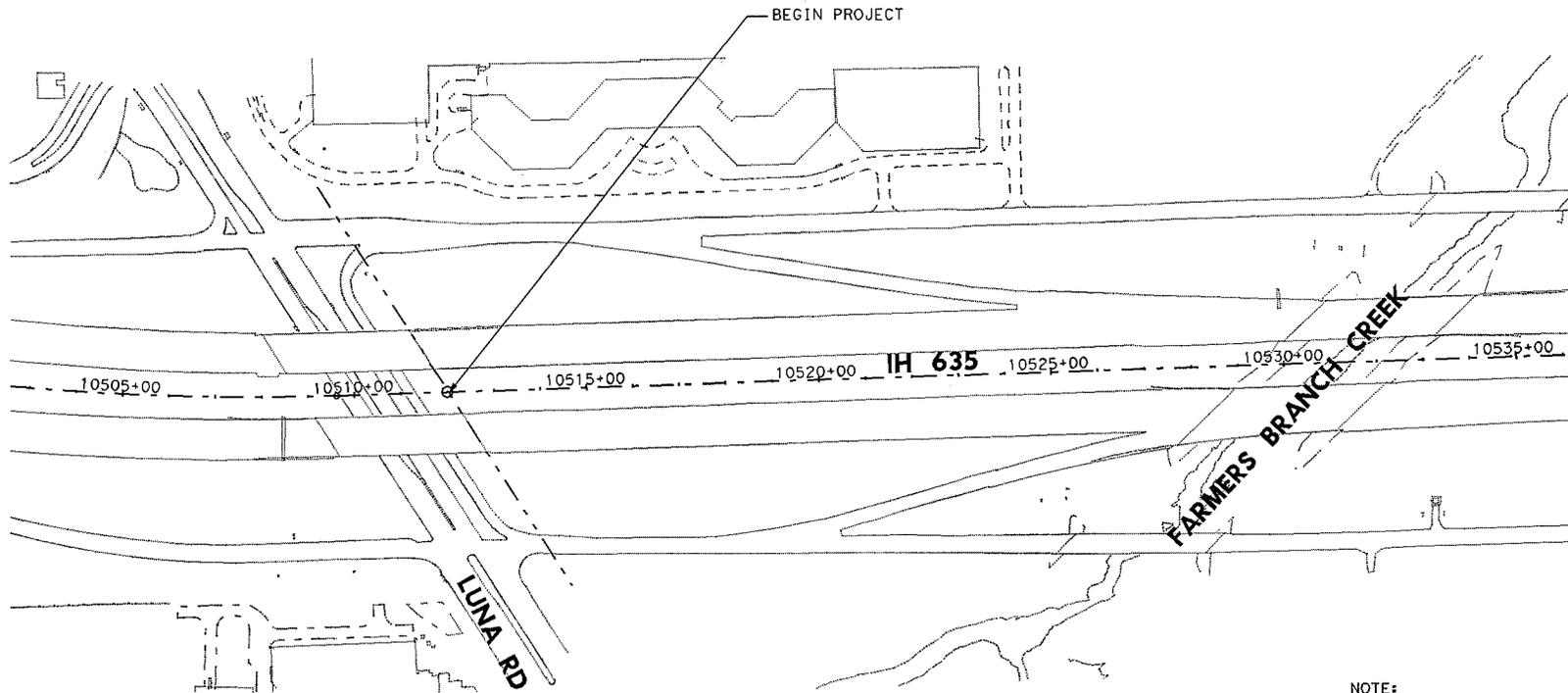
ATTACHMENT 01-1A

**IH 635 MANAGED LANES  
PROJECT  
PROJECT LIMITS**

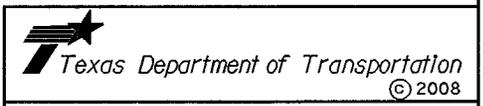


ATTACHMENT 01-1A

IH 635 MANAGED LANES  
PROJECT  
PROJECT LIMITS

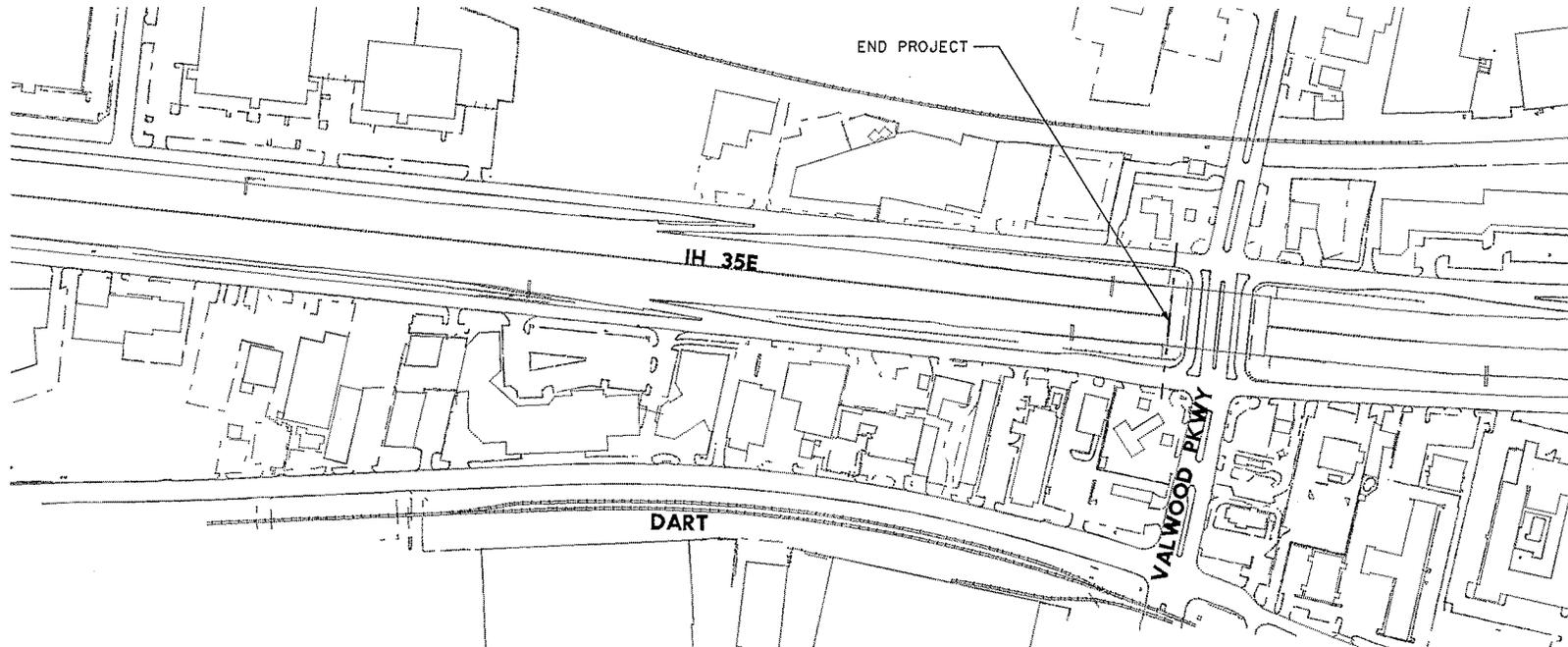
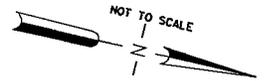


NOTE:  
PROJECT BEGINS AT EAST ABUTMENT OF  
LUNA RD OVERPASS.

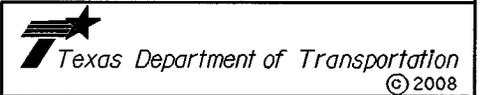


ATTACHMENT 01-1A

**IH 635 MANAGED LANES  
PROJECT  
PROJECT LIMITS**

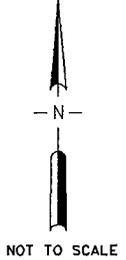
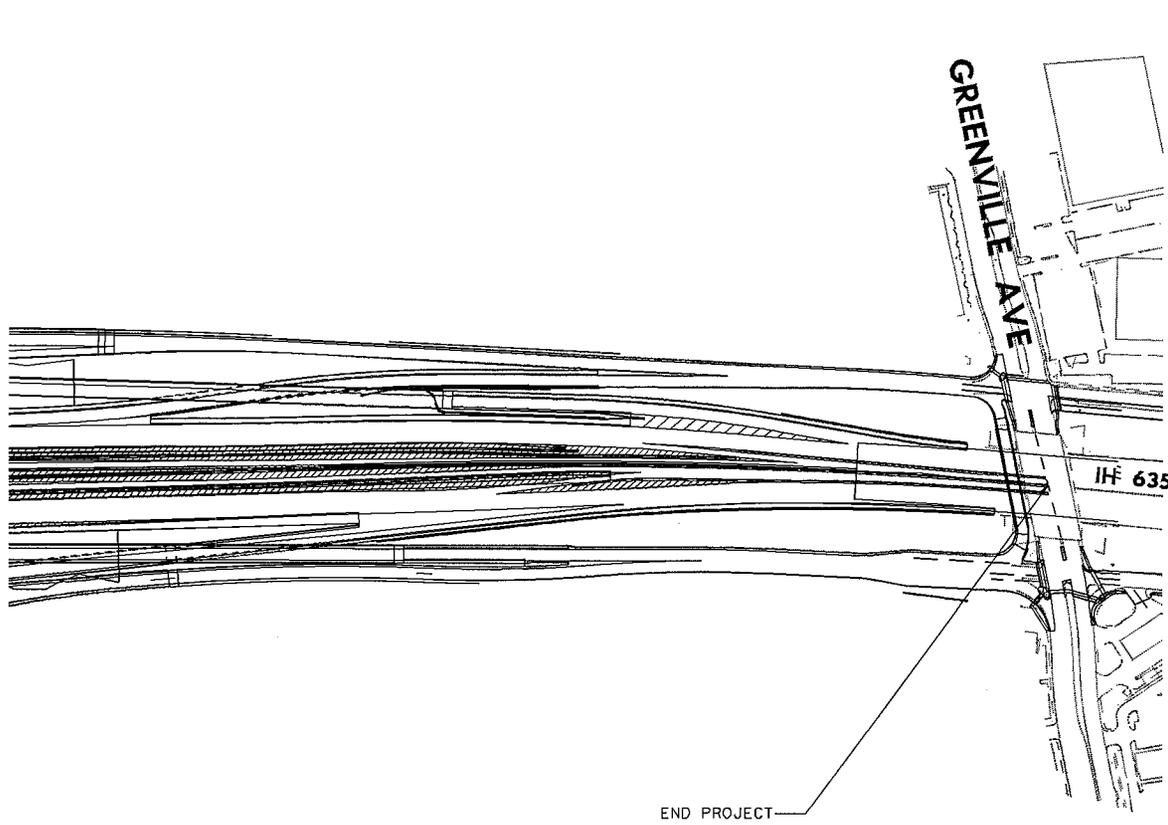


NOTE:  
PROJECT ENDS AT SOUTH ABUTMENT OF  
VALWOOD PARKWAY OVERPASS.



ATTACHMENT 01-1A

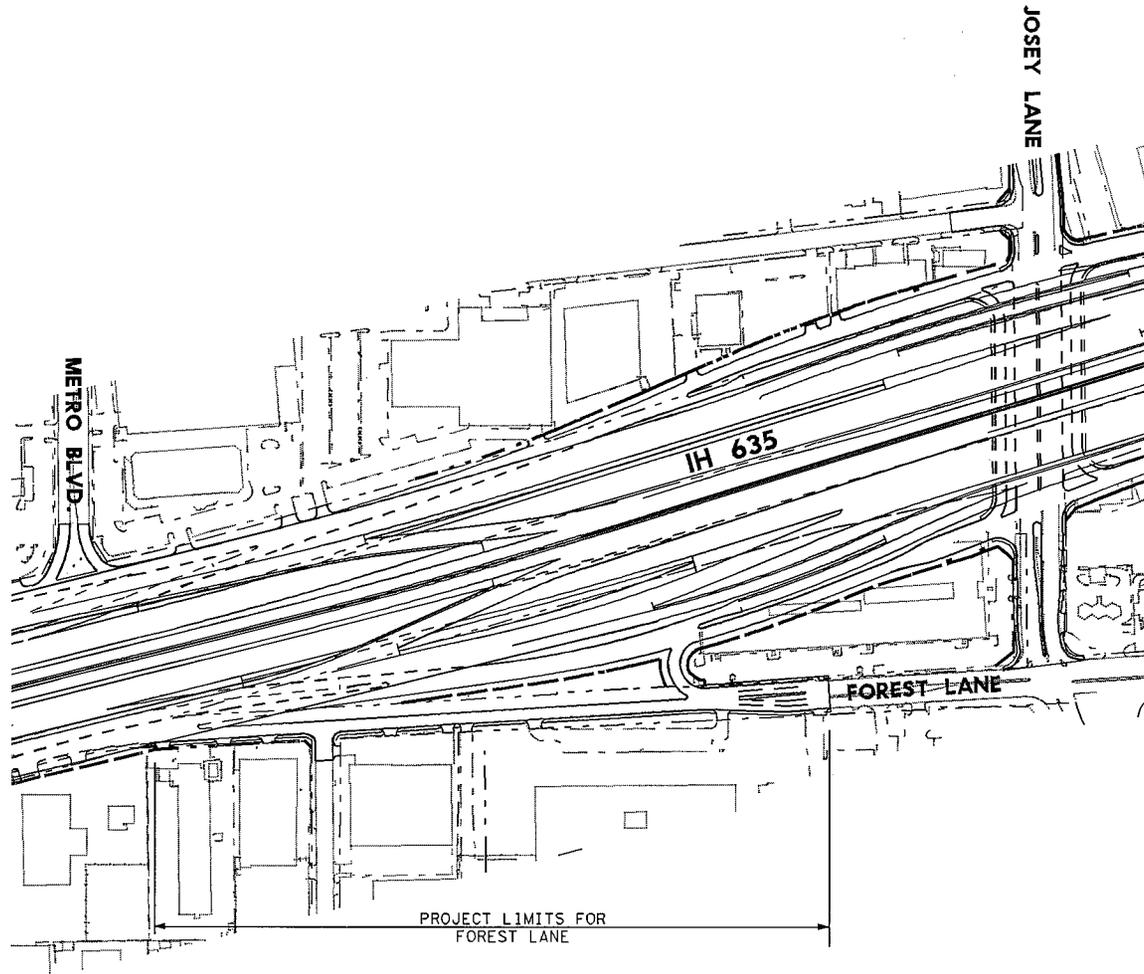
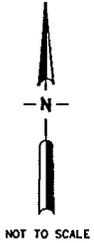
**IH 635 MANAGED LANES  
PROJECT  
PROJECT LIMITS**



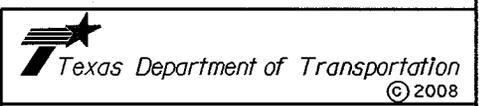
 Texas Department of Transportation  
© 2008

ATTACHMENT 01-1A

**IH 635 MANAGED LANES  
PROJECT  
PROJECT LIMITS**

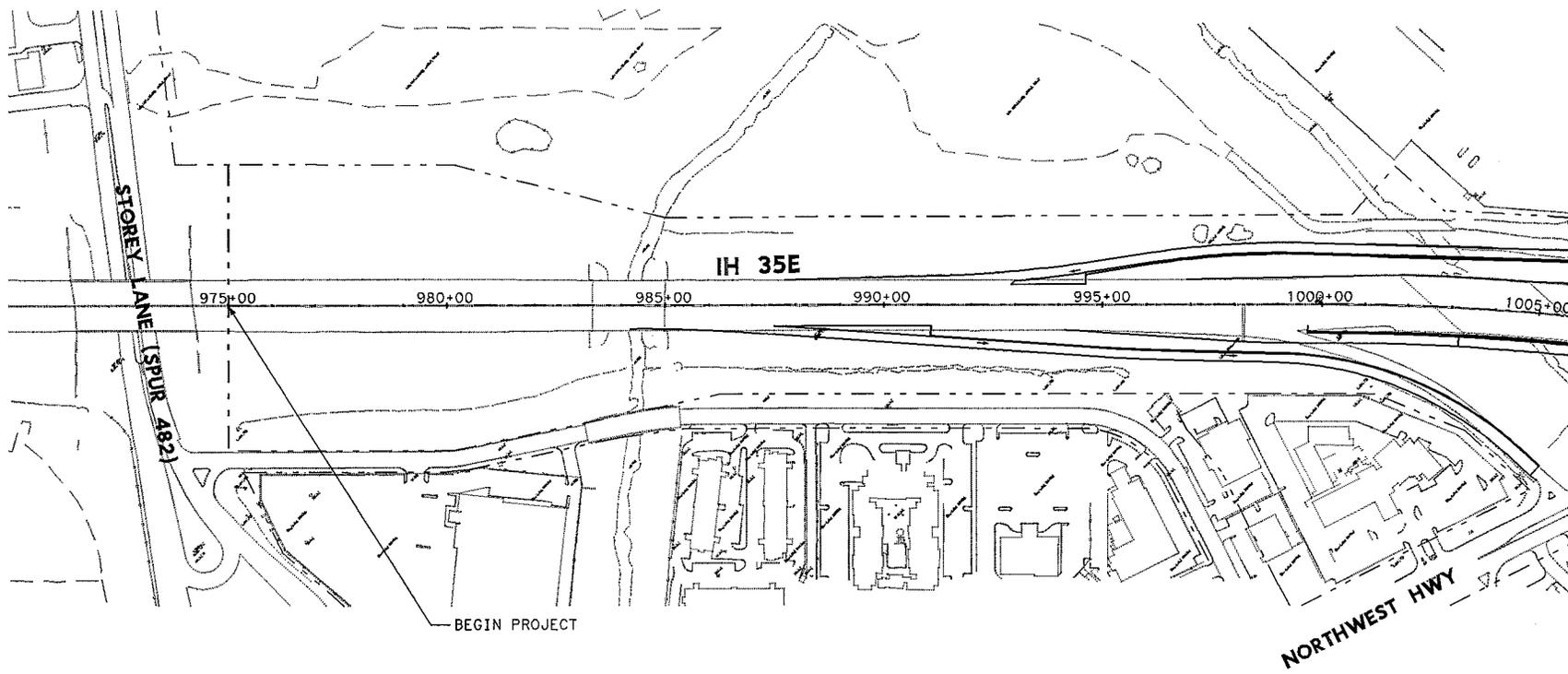
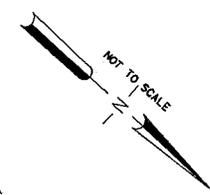


NOTE:  
PROJECT LIMITS ALONG FOREST LANE EXTEND  
FROM THE INTERSECTION OF FOREST LANE  
AND THE EB FRONTAGE ROAD UPTO 473 FT  
WEST OF CENTERLINE JOSEY LANE.

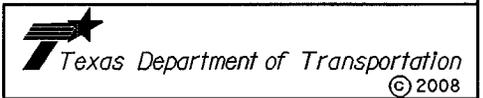


ATTACHMENT 01-1A

IH 635 MANAGED LANES  
PROJECT  
PROJECT LIMITS

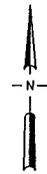
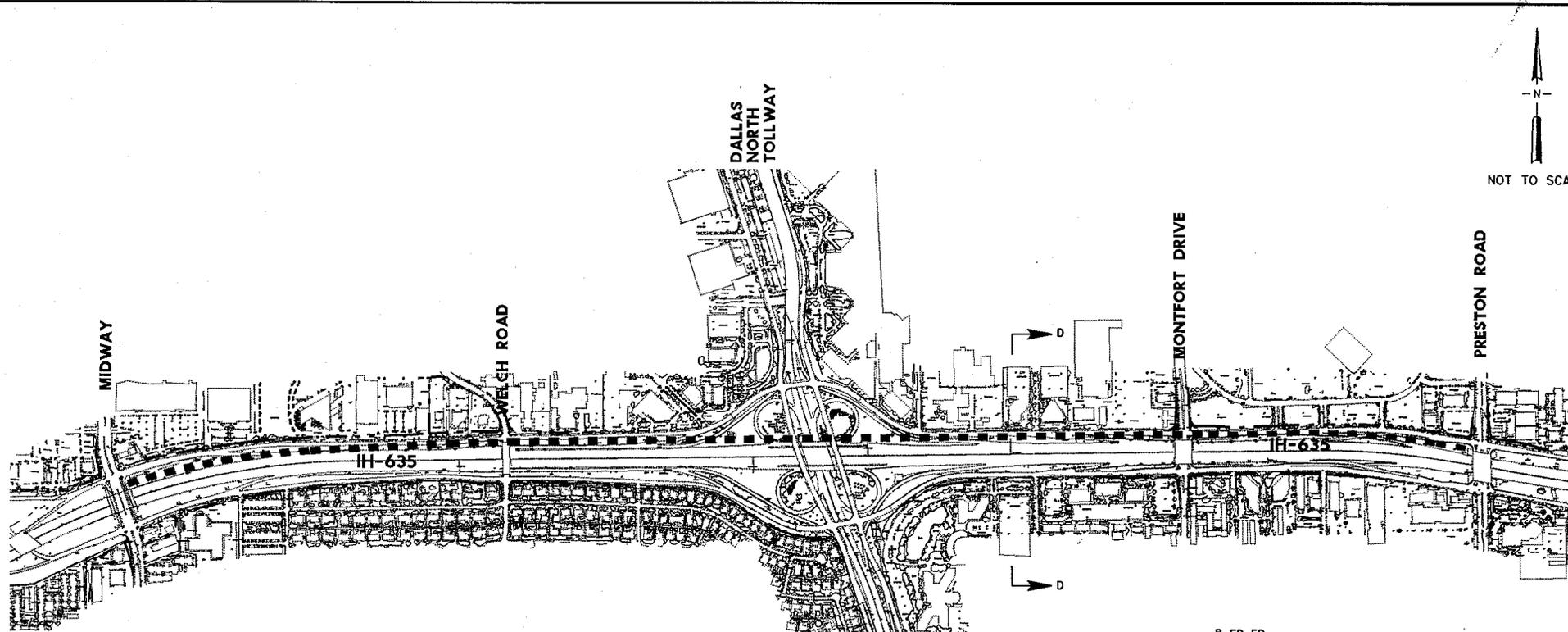


NOTE:  
PROJECT BEGINS AT THE NORTH ABUTMENT  
OF THE IH 35E BRIDGES OVER STOREY LANE.

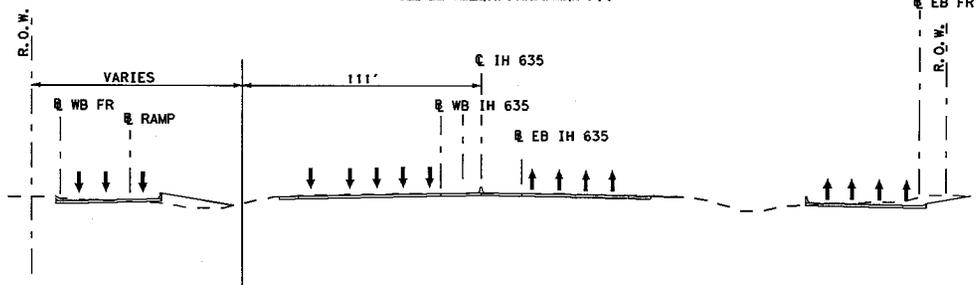


ATTACHMENT 01-1A

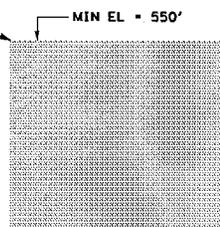
**IH 635 MANAGED LANES  
PROJECT  
PROJECTS LIMITS**



NOT TO SCALE



PRESERVED ENVELOPE FOR POSSIBLE FUTURE DART LIGHT RAIL TUNNEL CORRIDOR THAT WILL BE CONSTRUCTED BY OTHERS.



SECTION D-D  
DART TUNNEL ENVELOPE  
NOT TO SCALE

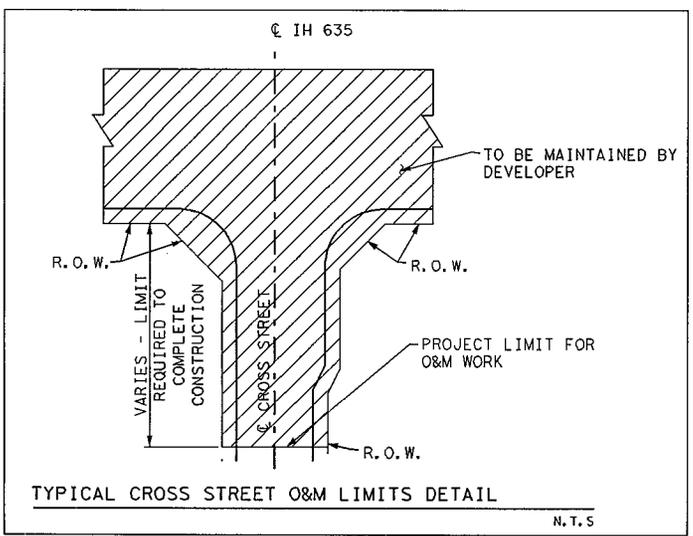
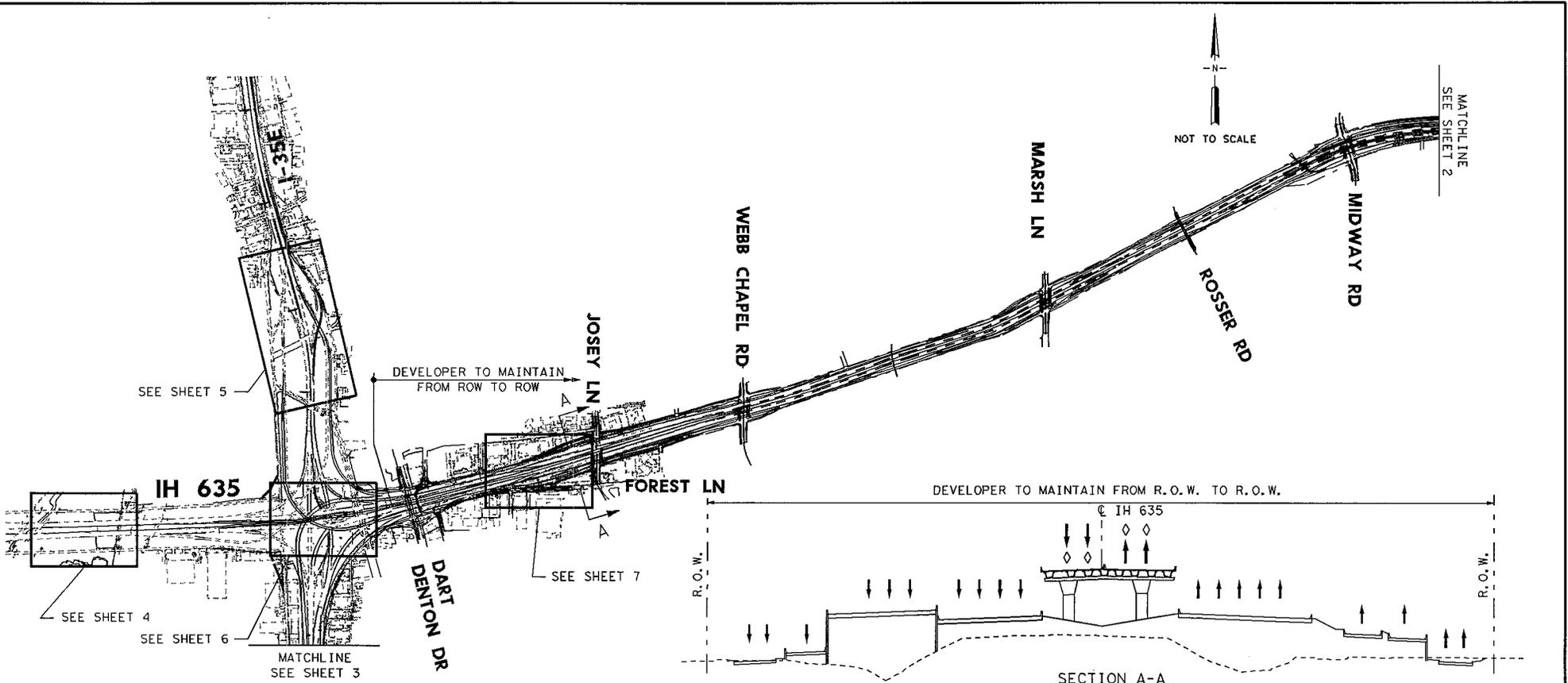
ATTACHMENT 01-1A

IH 635 MANAGED LANES  
PROJECT  
PROJECTS LIMITS

Texas Department of Transportation  
IH 635 Managed Lanes Project  
Technical Provisions

**Attachment 01-2A**

Operations and Maintenance Work Limits



- NOTES:**
- SECTION A-A DEPICTS THE LIMITS OF MAINTENANCE. THE ROADWAY CONFIGURATION IS FOR ILLUSTRATIVE PURPOSES ONLY.
  - FOR CROSS STREET O&M LIMITS, SEE 'TYPICAL CROSS STREET O&M LIMITS DETAIL'.

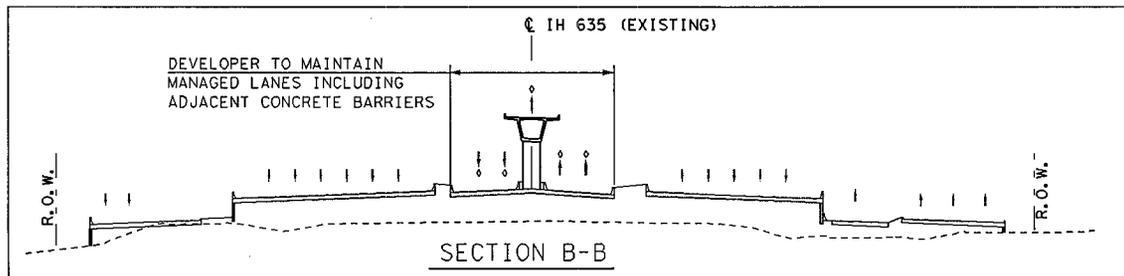
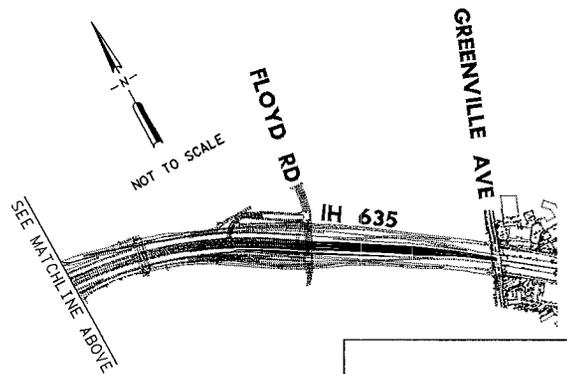
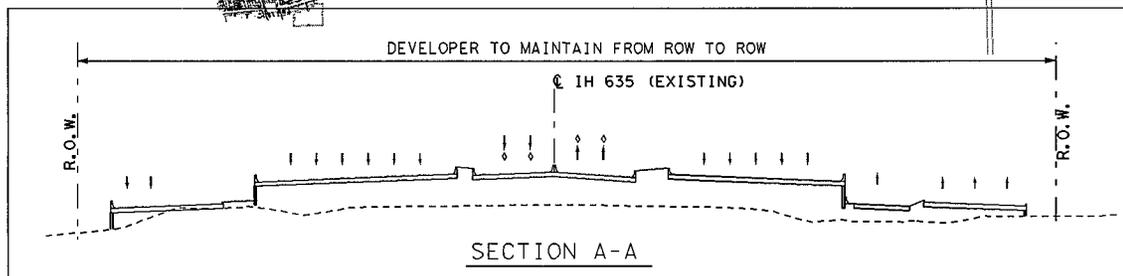
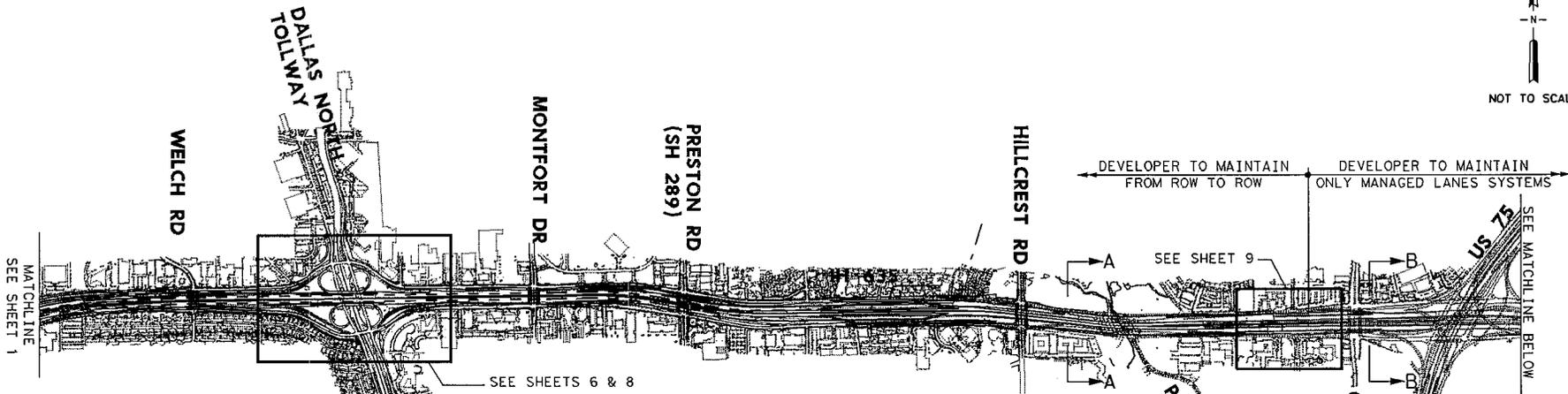


Texas Department of Transportation  
© 2008

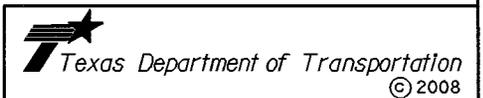
ATTACHMENT 01-2A

**IH 635 MANAGED LANES  
PROJECT  
OPERATIONS AND  
MAINTENANCE (O&M)  
WORK LIMITS**

SHEET 1 OF 12

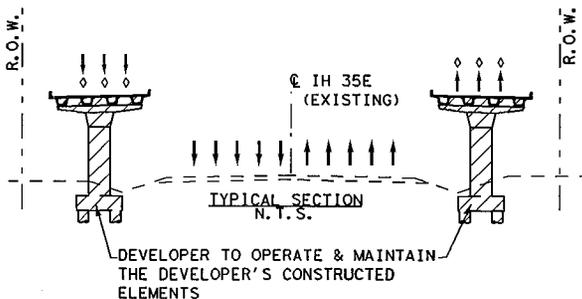
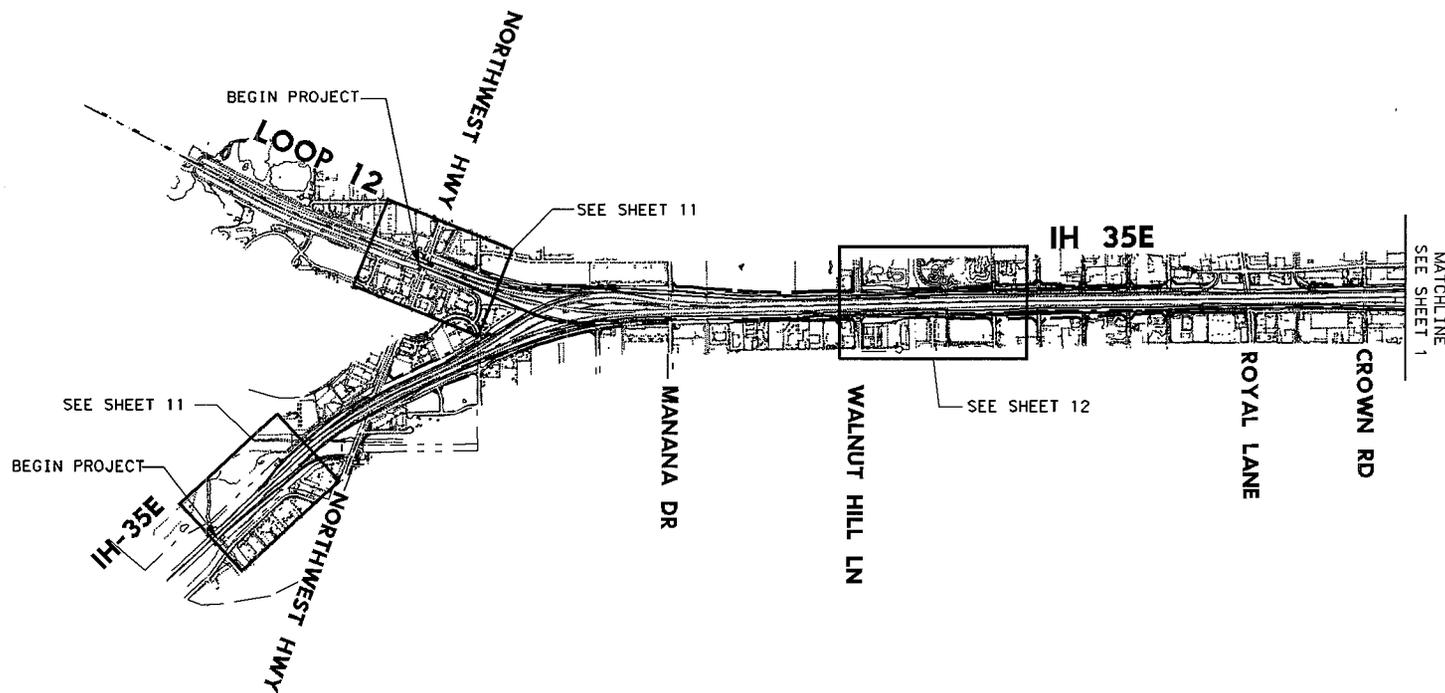
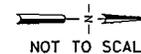


- NOTE:
1. SECTIONS A-A AND B-B DEPICT THE LIMITS OF MAINTENANCE. THE ROADWAY CONFIGURATION IS FOR ILLUSTRATIVE PURPOSES ONLY.
  2. FOR CROSS STREET MAINTENANCE LIMITS, SEE " TYPICAL CROSS STREET MAINTENANCE LIMITS DETAIL" ON SHEET 1.

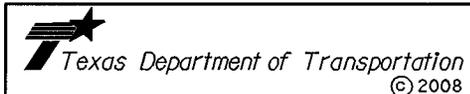


ATTACHMENT 01-2A

**IH 635 MANAGED LANES PROJECT OPERATIONS AND MAINTENANCE (O&M) WORK LIMITS**

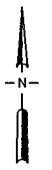


NOTE:  
 'TYPICAL SECTION' DEPICTS THE LIMITS OF MAINTENANCE. THE ROADWAY CONFIGURATION IS FOR ILLUSTRATIVE PURPOSES ONLY.

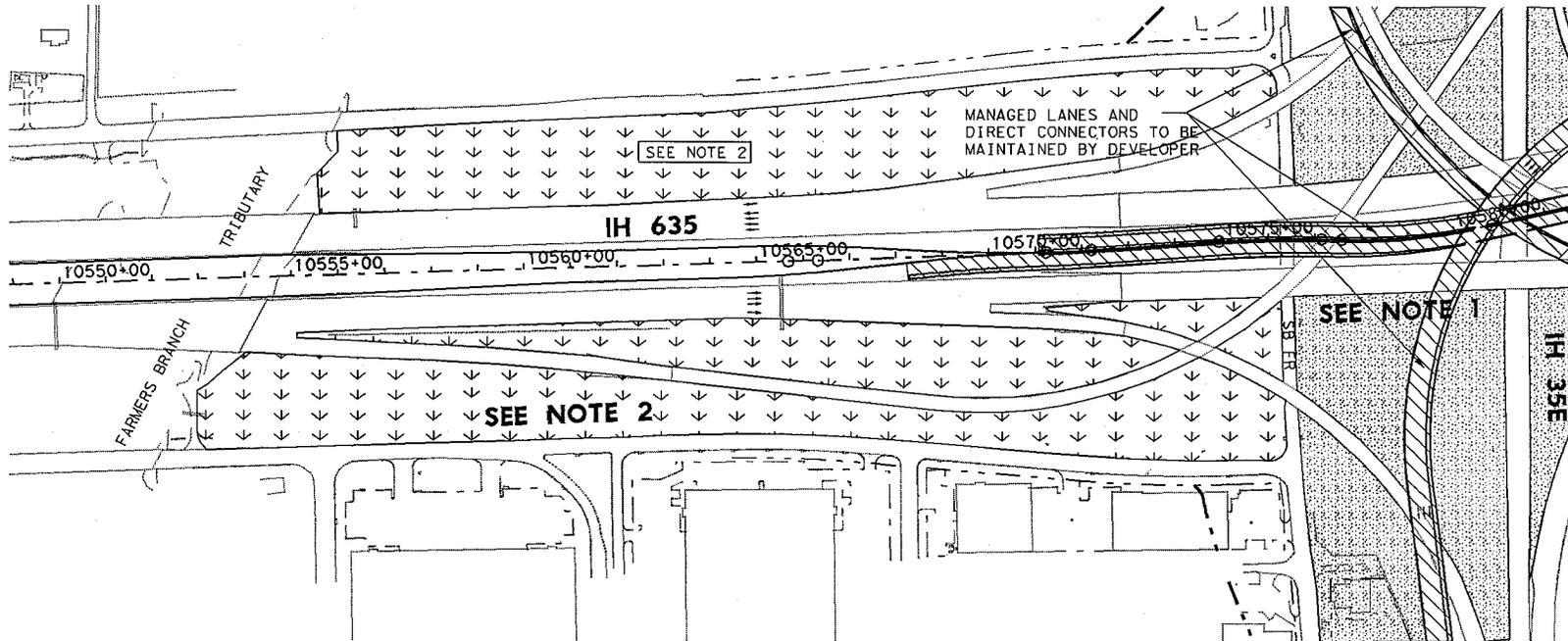


ATTACHMENT 01-2A

**IH 635 MANAGED LANES  
 PROJECT  
 OPERATIONS AND  
 MAINTENANCE (O&M)  
 WORK LIMITS**

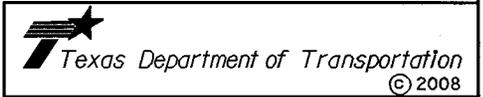


NOT TO SCALE



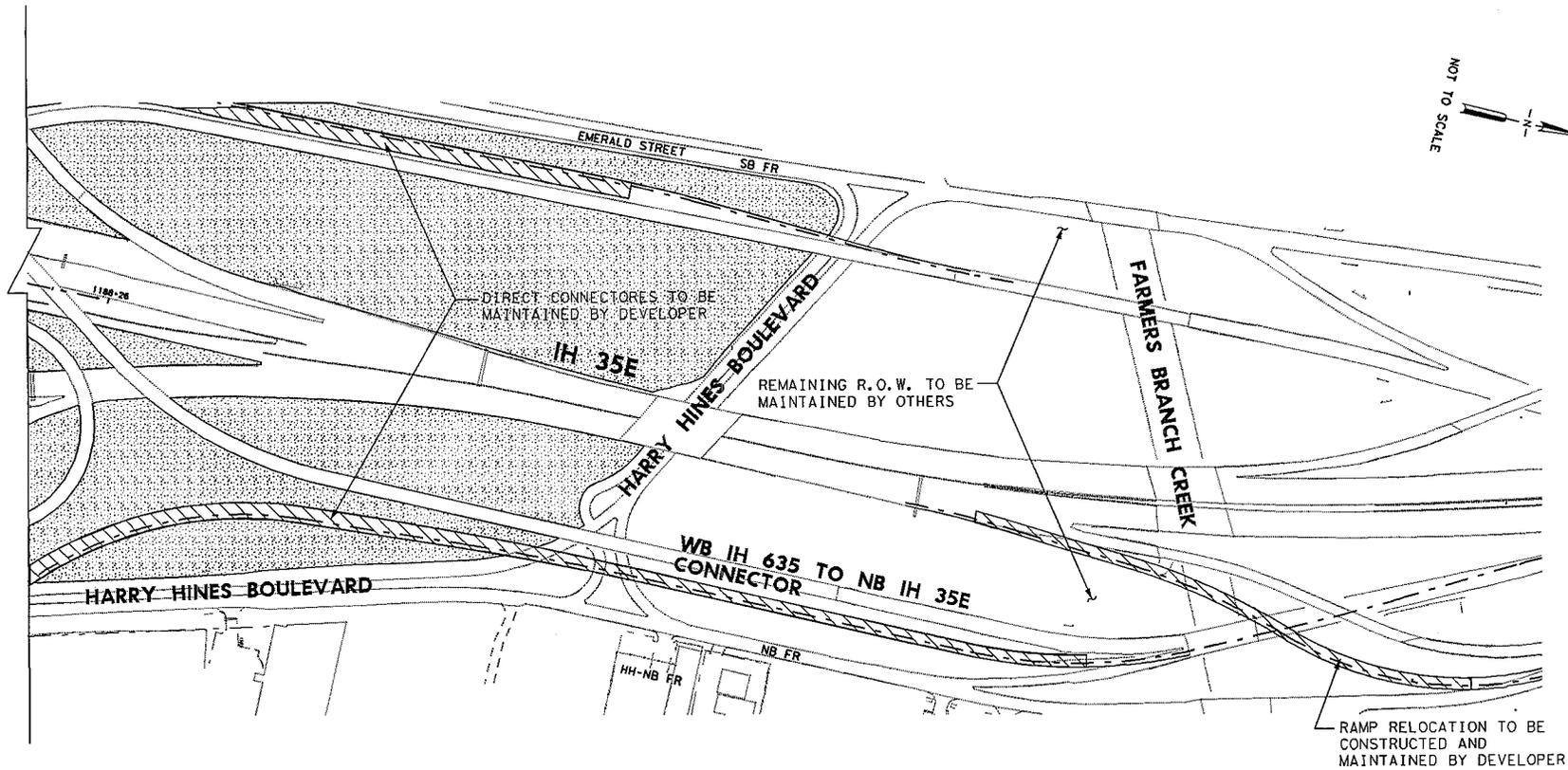
NOTES:

1. DEVELOPER SHALL MAINTAIN ALL WATER QUALITY FEATURES, OPEN CHANNELS AND DRAINAGE STRUCTURES CONSTRUCTED BY THE DEVELOPER WITHIN THE IH 35E/IH 635 INTERCHANGE. (THE AREA BOUNDED BY HARRY HINES BOULEVARD, THE IH 35E SB FRONTAGE ROAD, AND CROWN ROAD).
2. BETWEEN THE IH 35E SB FRONTAGE ROAD AND FARMERS BRANCH TRIBUTARY THE DEVELOPER SHALL MAINTAIN ALL DRAINAGE STRUCTURES CONSTRUCTED BY THE DEVELOPER INCLUDING CULVERTS, PIPES, HEADWALLS, ETC. OPEN CHANNELS SHALL BE MAINTAINED BY TxDOT.
3. REMAINING R.O.W. AND HIGHWAY TO BE OPERATED & MAINTAINED BY OTHERS.

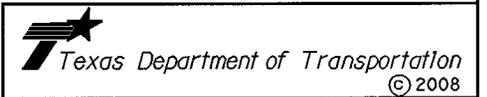


ATTACHMENT 01-2A

**IH 635 MANAGED LANES  
PROJECT  
OPERATIONS AND  
MAINTENANCE (O&M)  
WORK LIMITS**

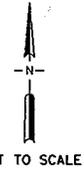
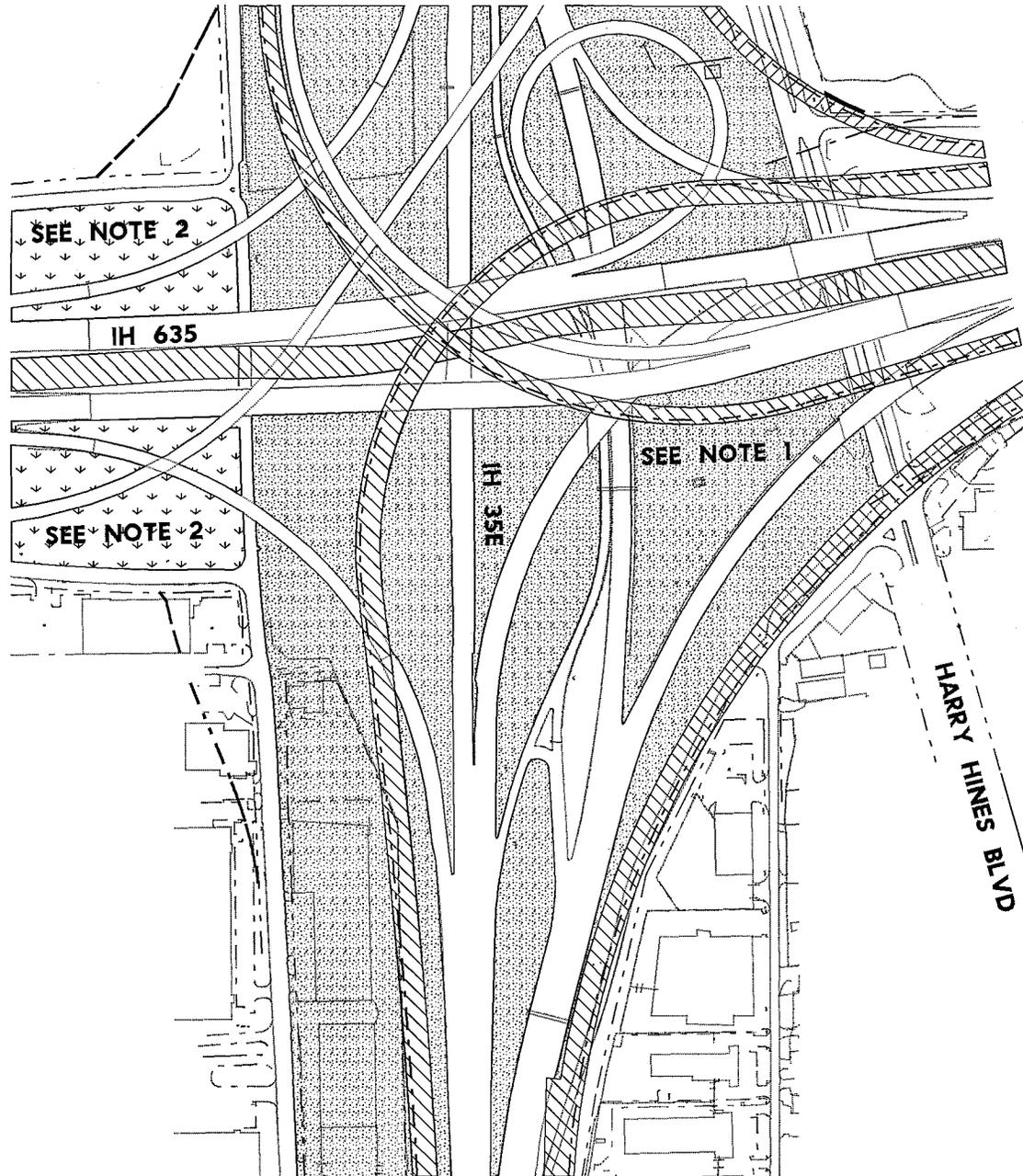


NOTE  
 DEVELOPER SHALL OPERATE AND MAINTAIN ALL WATER QUALITY  
 FEATURES, OPEN CHANNELS AND DRAINAGE STRUCTURES CONSTRUCTED  
 BY THE DEVELOPER WITHIN THE IH 35E/IH 635 INTERCHANGE  
 (THE AREA BOUNDED BY HARRY HINES BOULEVARD, THE IH 35E  
 SB FRONTAGE ROAD AND CROWN ROAD).



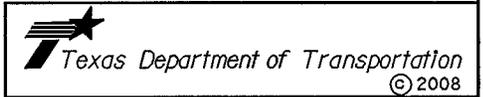
ATTACHMENT 01-2A

**IH 635 MANAGED LANES  
 PROJECT  
 OPERATIONS AND  
 MAINTENANCE (O&M)  
 WORK LIMITS**



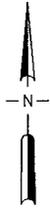
NOTES:

1. THE DEVELOPER SHALL OPERATE & MAINTAIN ALL WATER QUALITY FEATURES, OPEN CHANNELS AND DRAINAGE STRUCTURES CONSTRUCTED BY THE DEVELOPER WITHIN THE IH 35E/IH 635 INTERCHANGE (THE AREA BOUNDED FROM EAST BY HARRY HINES BOULEVARD, FROM WEST BY THE IH-35E SB FRONTAGE ROAD, FROM SOUTH BY CROWN ROAD, AND FROM THE NORTH BY HARRY HINES BOULEVARD).
2. BETWEEN THE IH 35E SB FRONTAGE ROAD AND FARMERS BRANCH TRIBUTARY THE DEVELOPER SHALL OPERATE AND MAINTAIN ANY DRAINAGE STRUCTURES INCLUDING CULVERTS, PIPES, HEADWALL, ETC. CONSTRUCTED BY THE DEVELOPER. OPEN CHANNELS SHALL BE MAINTAINED BY OTHERS.
3. THE DEVELOPER SHALL OPERATE & MAINTAIN ELEVATED DIRECT CONNECTORS FROM NORTHBOUND IH 35E TO EASTBOUND IH 635; SOUTHBOUND IH 35E TO EASTBOUND IH 635; WESTBOUND IH 635 TO SOUTHBOUND IH 35E; WESTBOUND IH 635 TO NORTHBOUND IH 35E, AND IH 635 MANAGED LANES INCLUDING ADJACENT CONCRETE BARRIERS.

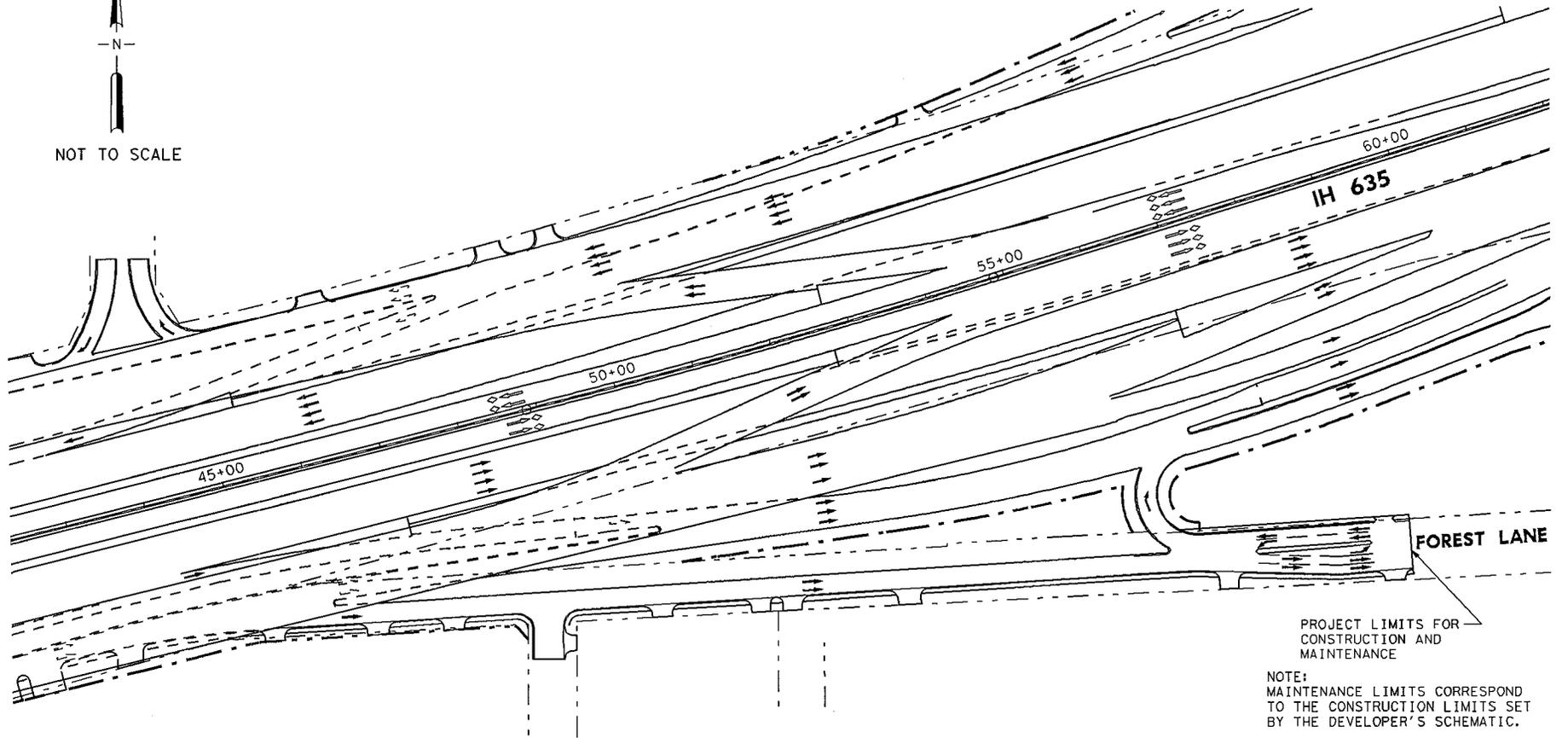


ATTACHMENT 01-2A

**IH 635 MANAGED LANES  
PROJECT  
OPERATIONS AND  
MAINTENANCE (O&M)  
WORK LIMITS**

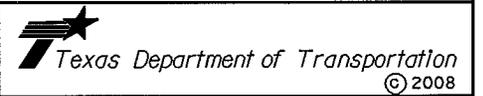


NOT TO SCALE



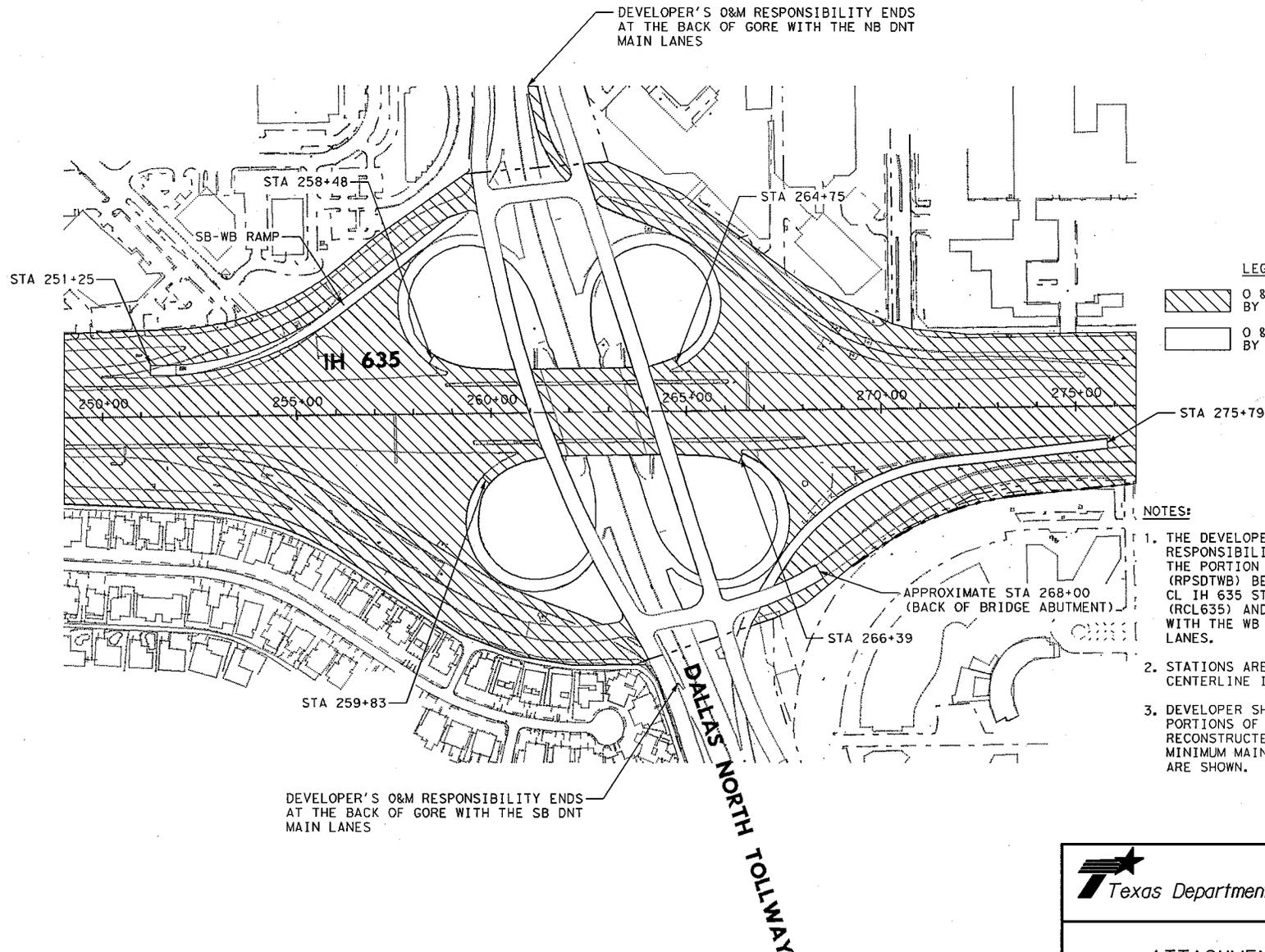
PROJECT LIMITS FOR  
CONSTRUCTION AND  
MAINTENANCE

NOTE:  
MAINTENANCE LIMITS CORRESPOND  
TO THE CONSTRUCTION LIMITS SET  
BY THE DEVELOPER'S SCHEMATIC.

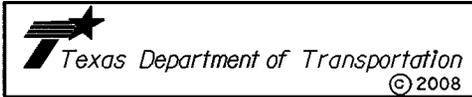


ATTACHMENT 01-2A

**IH 635 MANAGED LANES  
PROJECT  
OPERATIONS AND  
MAINTENANCE (O&M)  
WORK LIMITS**

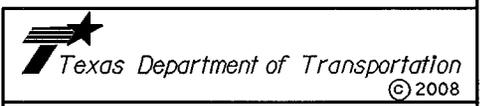
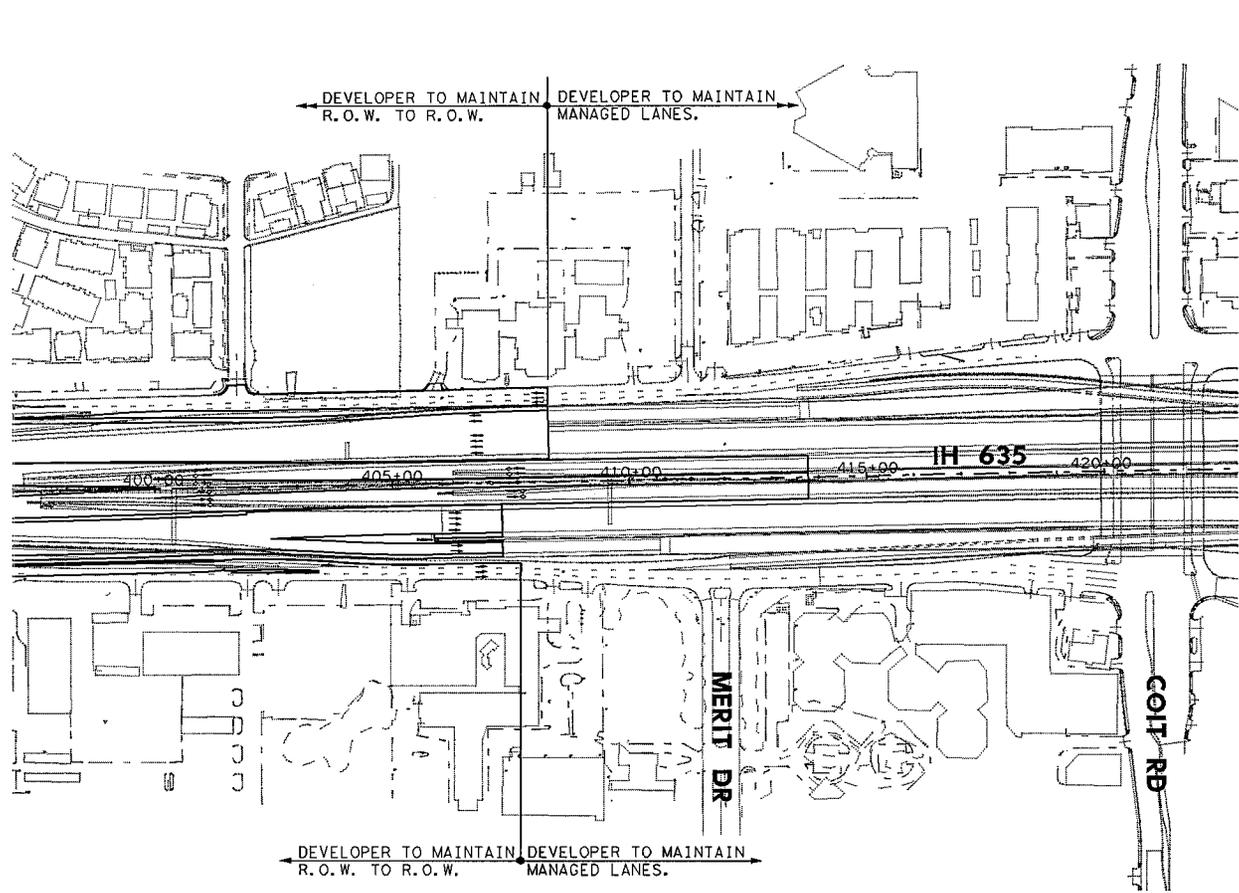


- LEGEND**
-  O & M WORK LIMITS BY DEVELOPER
  -  O & M LIMITS BY OTHERS
- NOTES:**
1. THE DEVELOPER'S O&M RESPONSIBILITY SHALL INCLUDE THE PORTION OF THE SB-WB RAMP (RPSDTWB) BETWEEN EXISTING CL IH 635 STATION 251+25 (RCL635) AND THE RAMP'S TIE-IN WITH THE WB GENERAL PURPOSE LANES.
  2. STATIONS ARE BASED ON EXISTING CENTERLINE IH 635 STATIONS.
  3. DEVELOPER SHALL MAINTAIN PORTIONS OF DNT LOOP RAMP RECONSTRUCTED BY THE WORK. MINIMUM MAINTENANCE LIMITS ARE SHOWN.



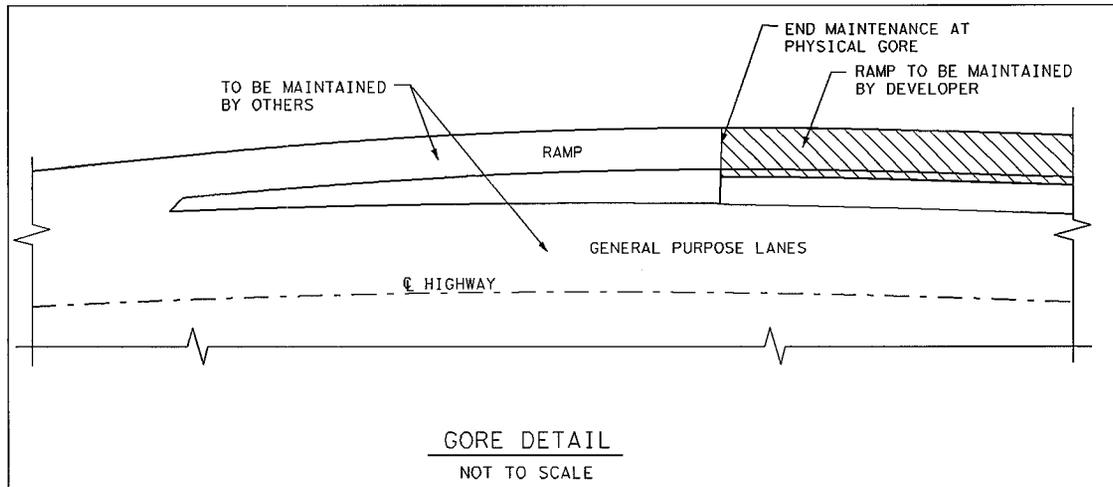
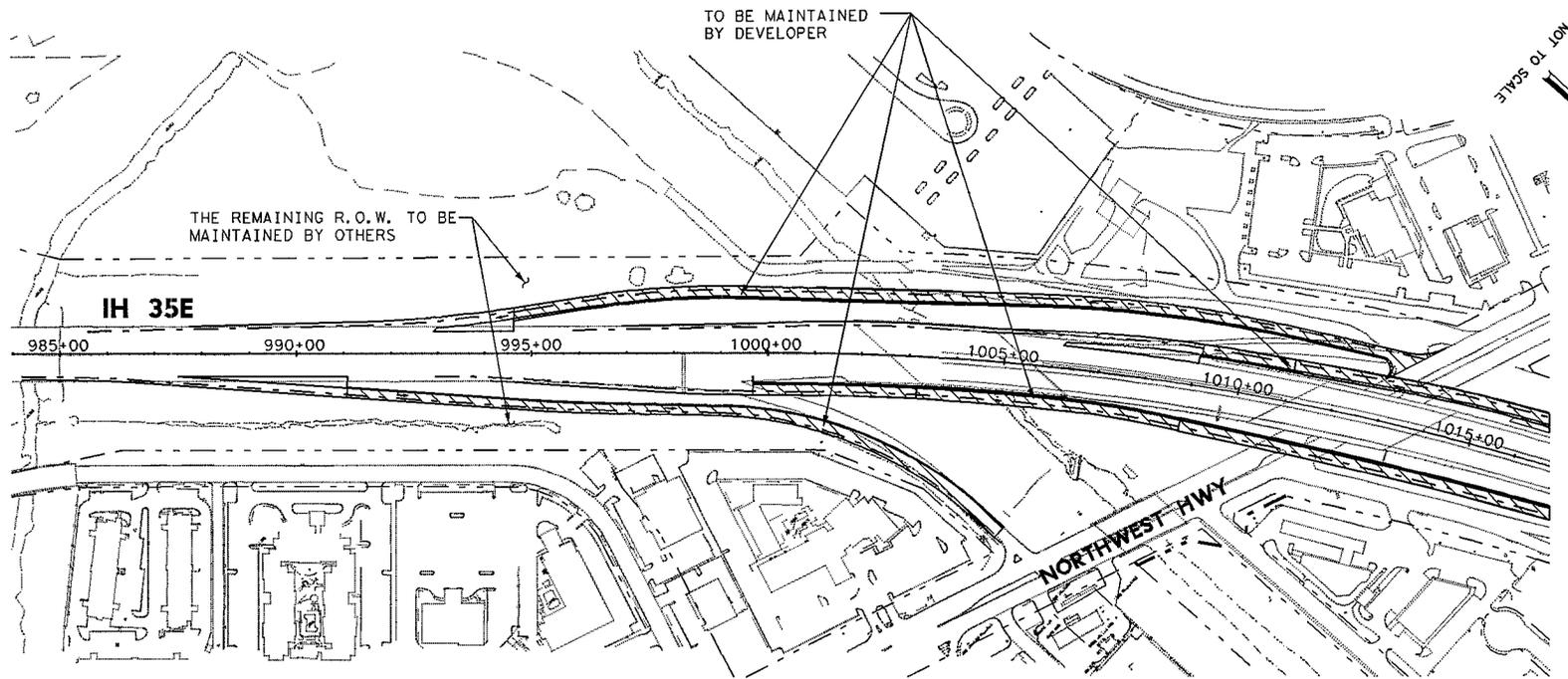
ATTACHMENT 01-2A

**IH-635 MANAGED LANES PROJECT  
OPERATIONS AND MAINTENANCE (O&M)  
WORK LIMITS**



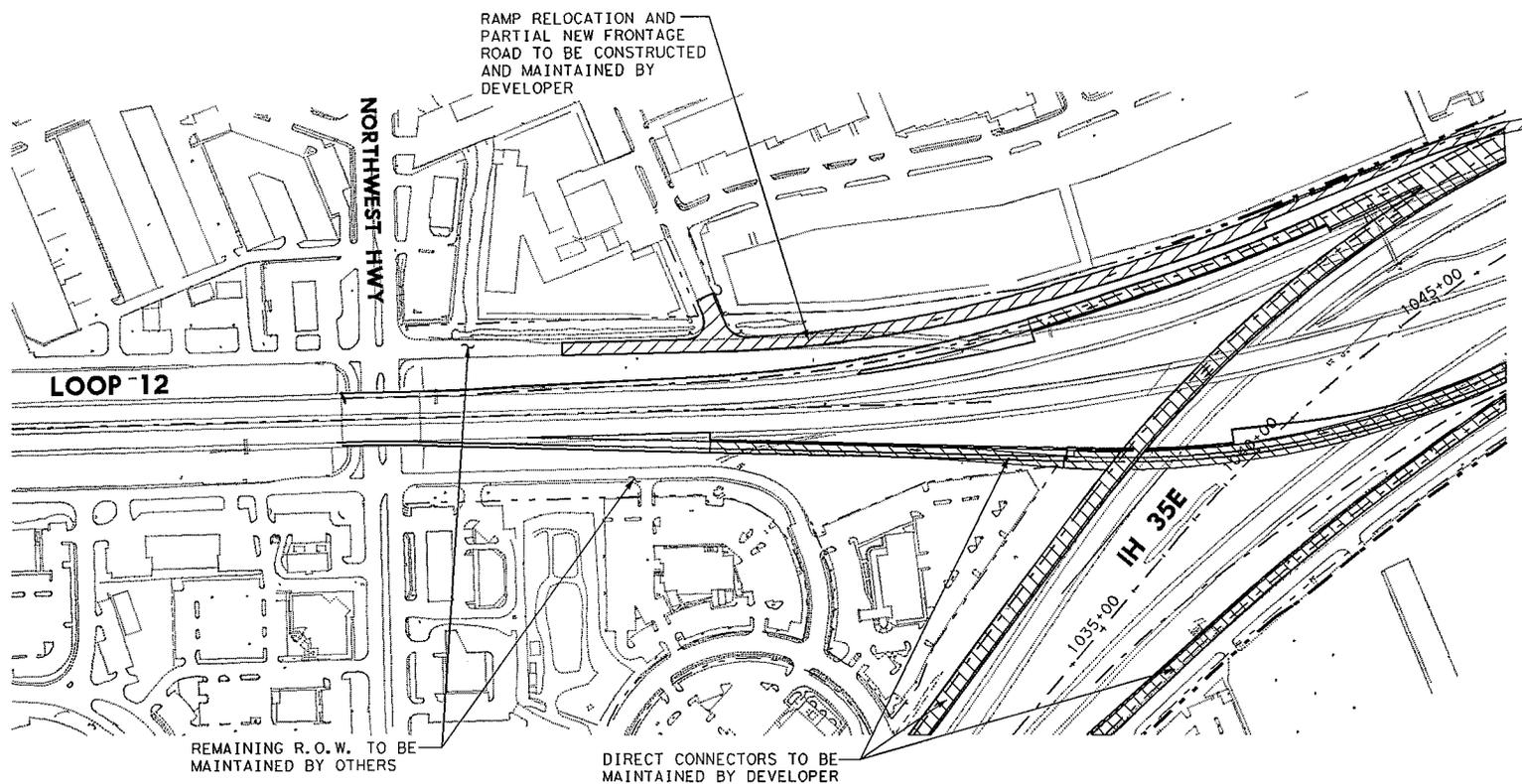
ATTACHMENT 01-2A

**IH 635 MANAGED LANES  
PROJECT  
OPERATIONS AND  
MAINTENANCE (O&M)  
WORK LIMITS**

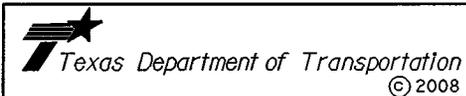


ATTACHMENT 01-2A

IH 635 MANAGED LANES  
PROJECT  
OPERATIONS AND  
MAINTENANCE (O&M)  
WORK LIMITS

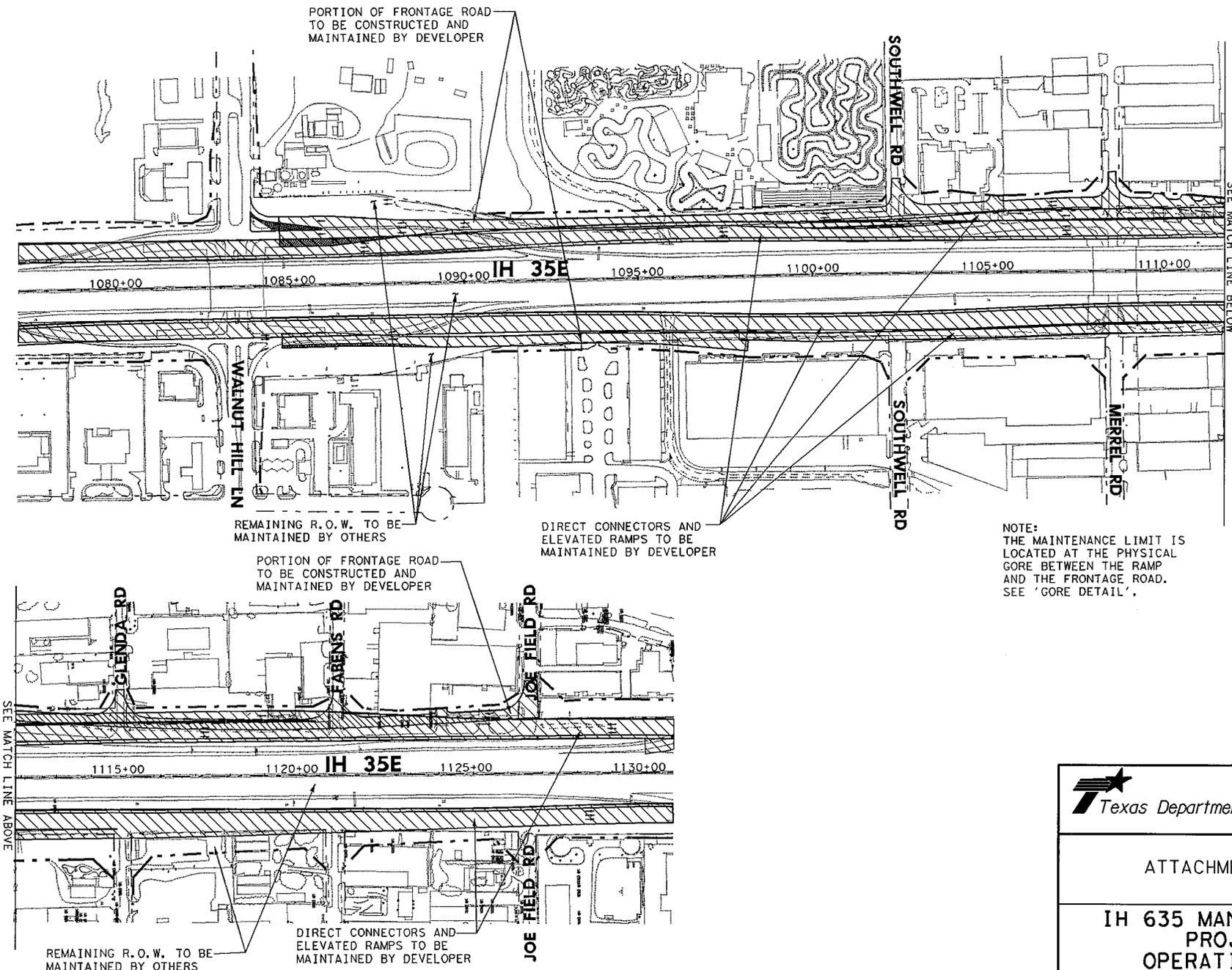


NOTE:  
 THE MAINTENANCE LIMIT IS LOCATED AT THE PHYSICAL GORE WITH GENERAL PURPOSE LANES. SEE 'GORE DETAIL'.



ATTACHMENT 01-2A

IH 635 MANAGED LANES PROJECT  
 OPERATIONS AND MAINTENANCE (O&M)  
 WORK LIMITS



PORTION OF FRONTAGE ROAD TO BE CONSTRUCTED AND MAINTAINED BY DEVELOPER

REMAINING R.O.W. TO BE MAINTAINED BY OTHERS

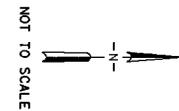
PORTION OF FRONTAGE ROAD TO BE CONSTRUCTED AND MAINTAINED BY DEVELOPER

DIRECT CONNECTORS AND ELEVATED RAMP TO BE MAINTAINED BY DEVELOPER

DIRECT CONNECTORS AND ELEVATED RAMP TO BE MAINTAINED BY DEVELOPER

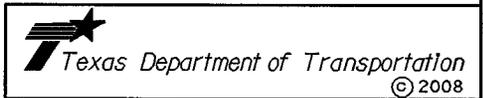
REMAINING R.O.W. TO BE MAINTAINED BY OTHERS

NOTE: THE MAINTENANCE LIMIT IS LOCATED AT THE PHYSICAL GORE BETWEEN THE RAMP AND THE FRONTAGE ROAD. SEE 'GORE DETAIL'.



SEE MATCH LINE BELOW

SEE MATCH LINE ABOVE



ATTACHMENT 01-2A

**IH 635 MANAGED LANES  
PROJECT  
OPERATIONS AND  
MAINTENANCE (O&M)  
WORK LIMITS**

Texas Department of Transportation

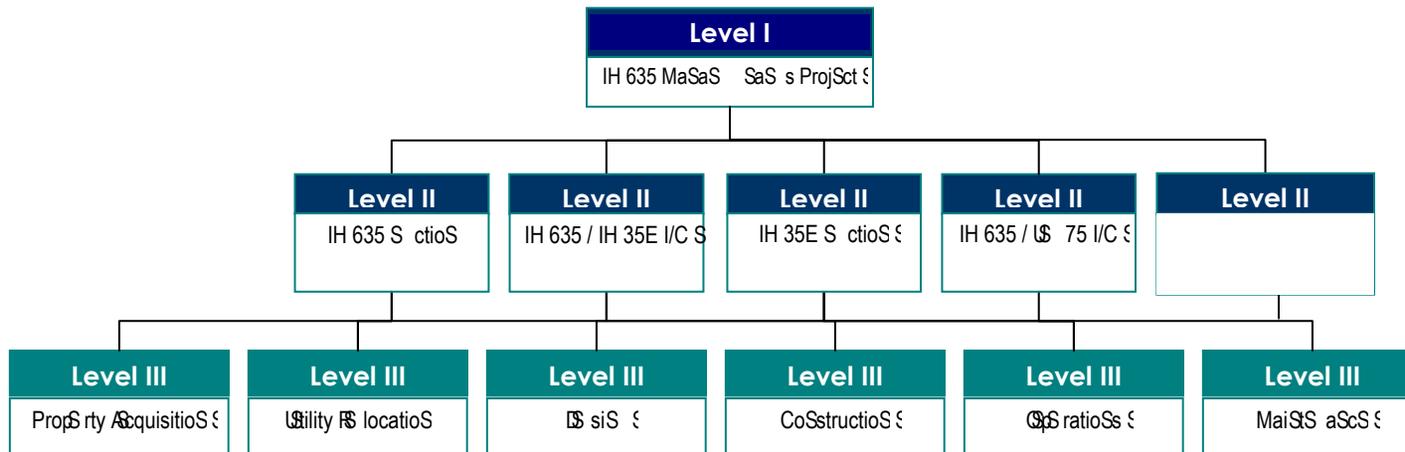
IH 635 Managed Lanes Project  
Technical Provisions

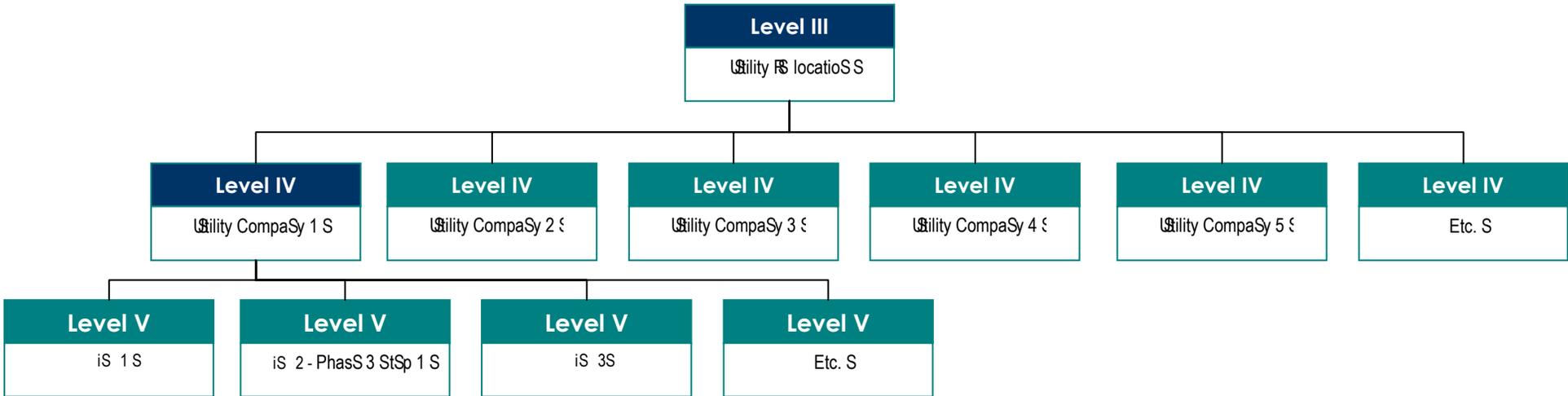
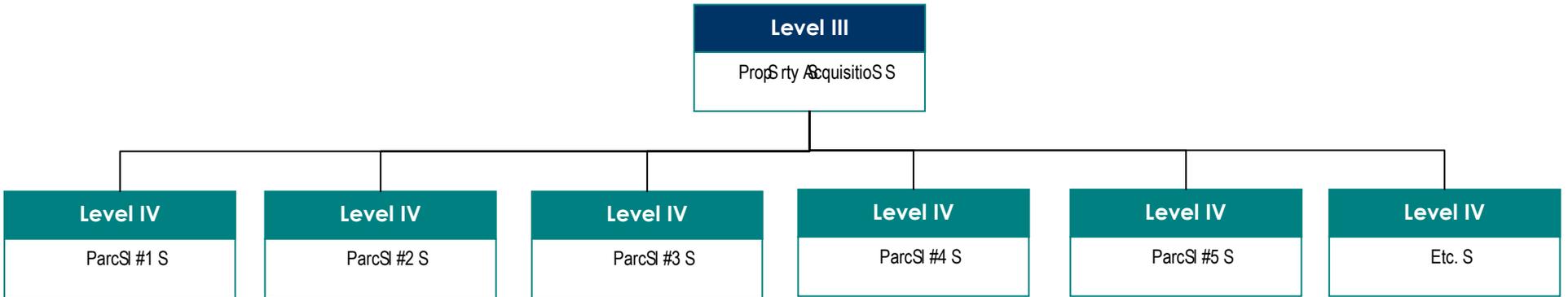
## **Attachment 02-1A**

Base Work Breakdown Structure (WBS)

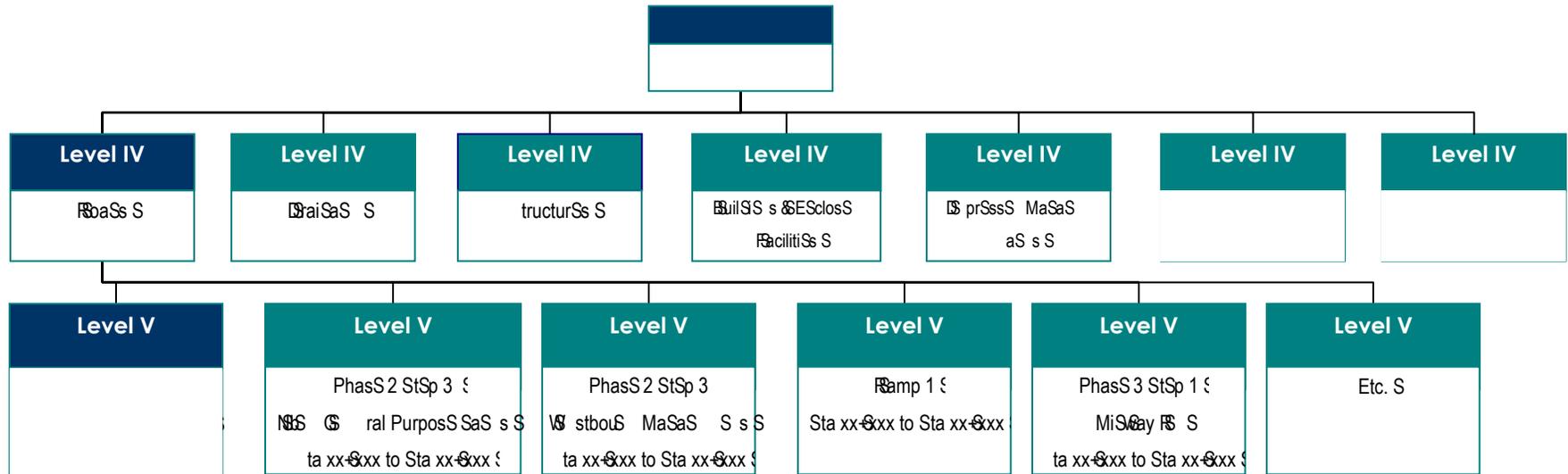
The base Work Breakdown Structure (WBS) provided to the Developer shall be the basis for organizing all Work and shall be used to structure the preliminary Project Baseline Schedule, the Project Baseline Schedule, the Schedule of Values and the Project Pay Request.

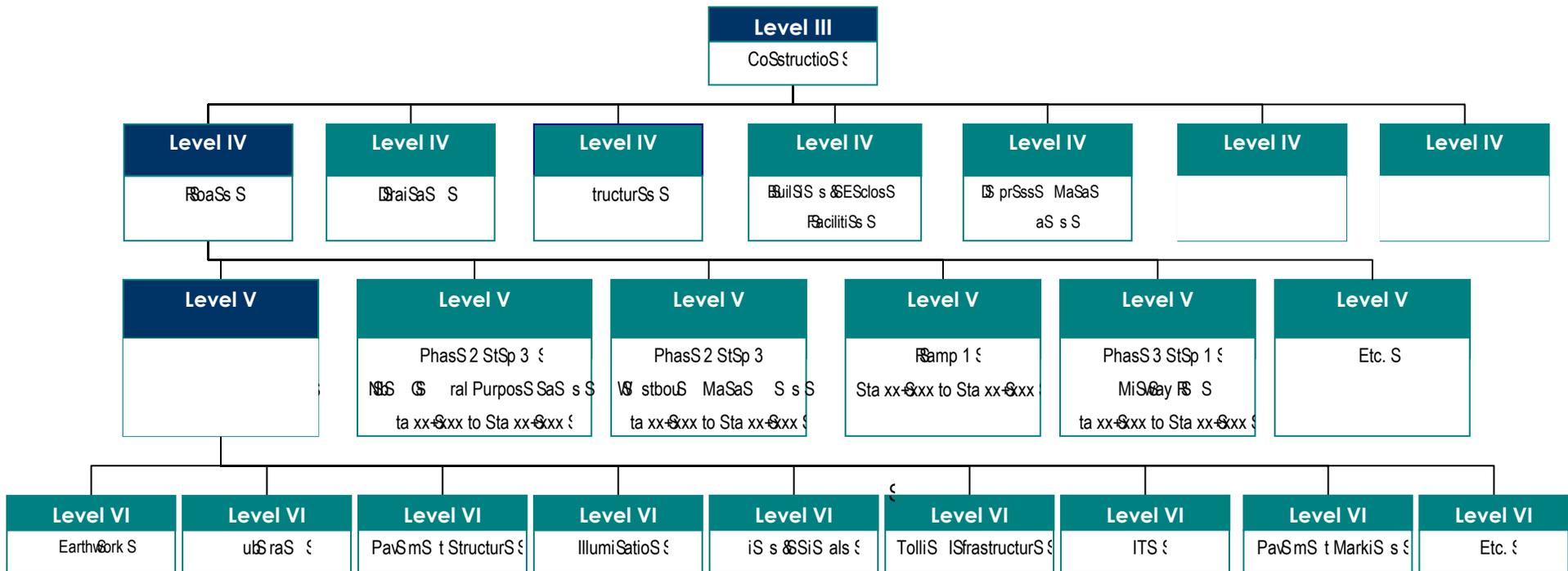
The following base WBS represents Levels I through VI. Levels I through IV shall be as provided in the following base WBS. However, the Developer may revise and / or provide further detail to Levels V and VI to provide a clear understanding of the planned Work.

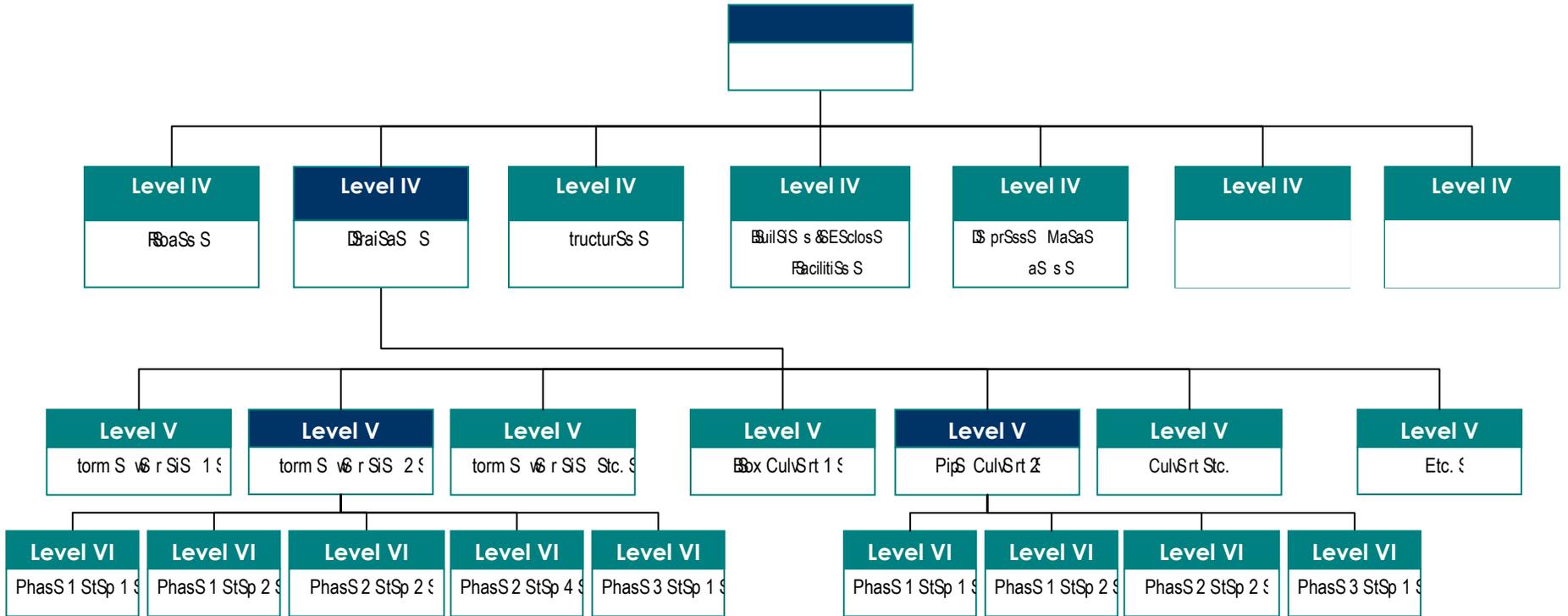




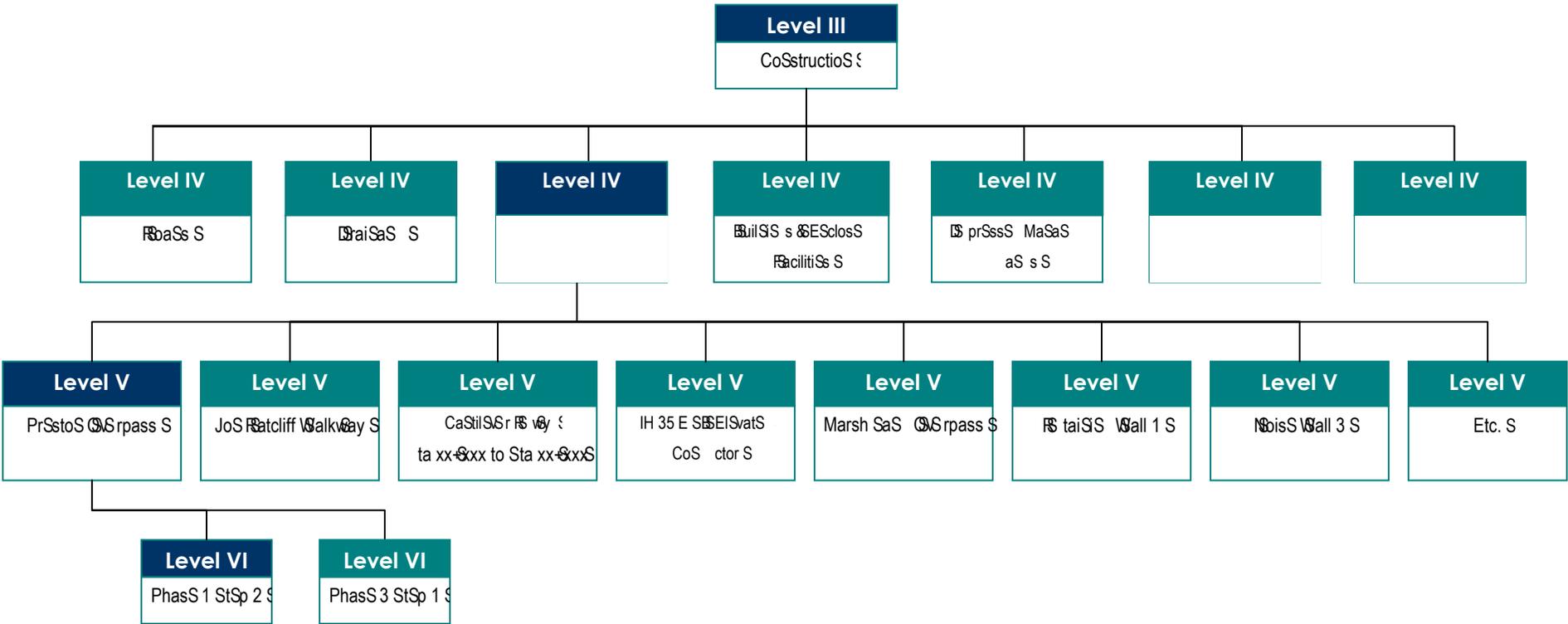
S

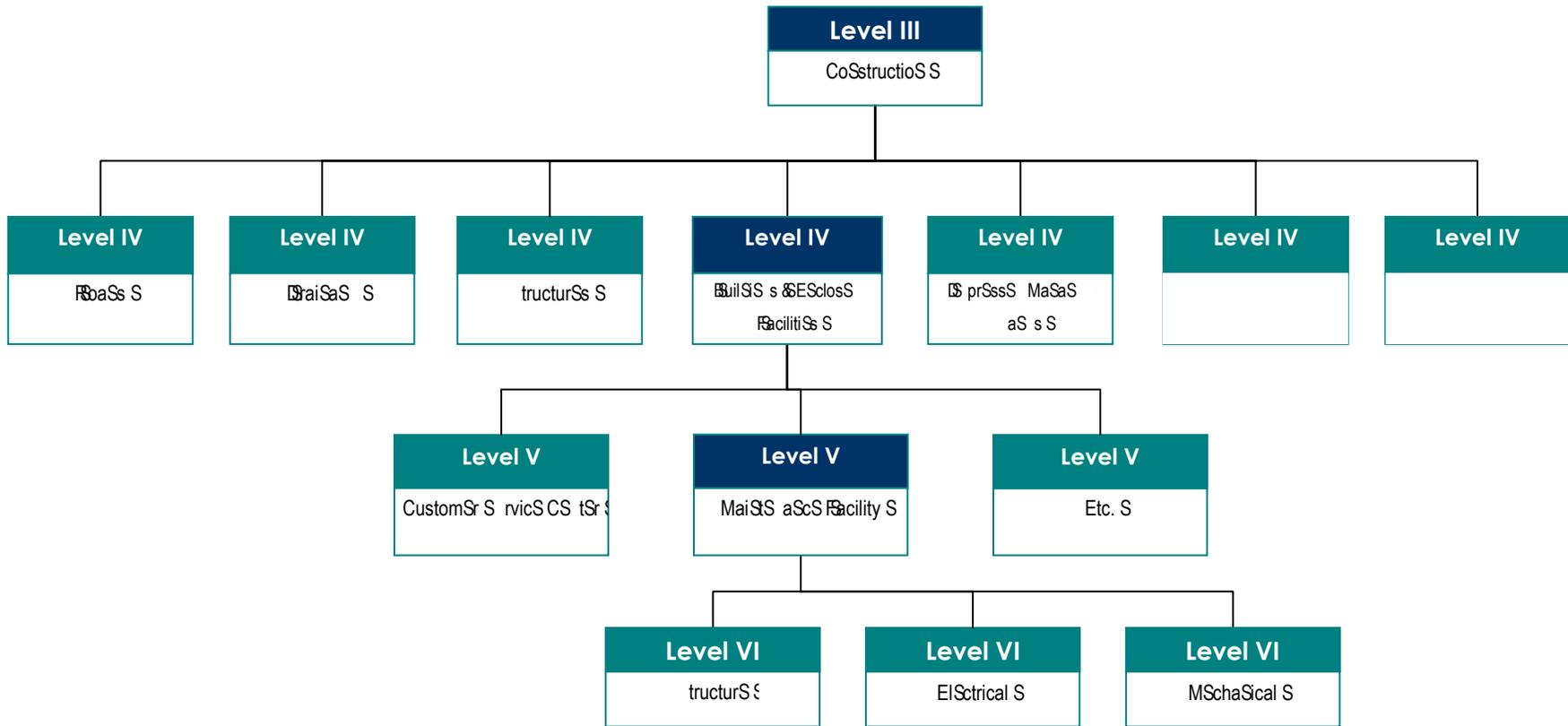


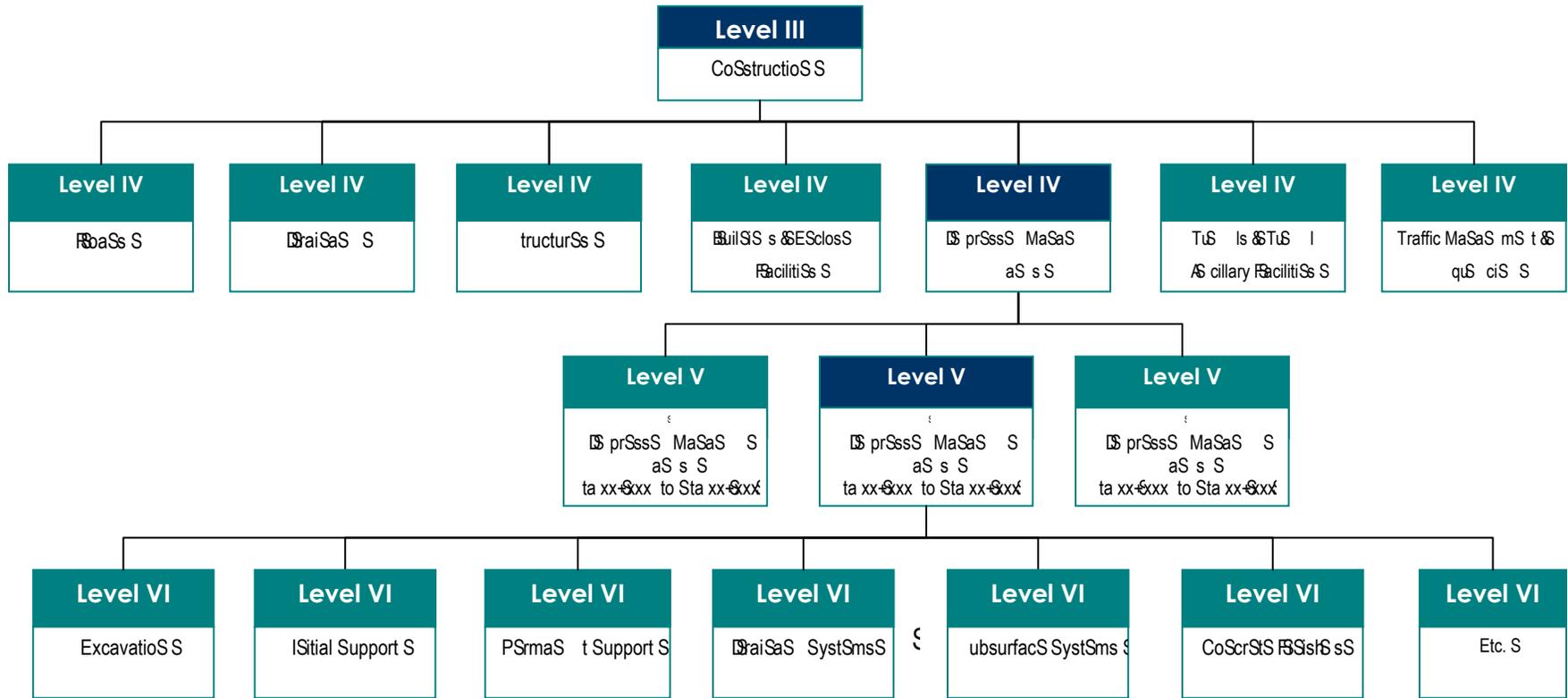


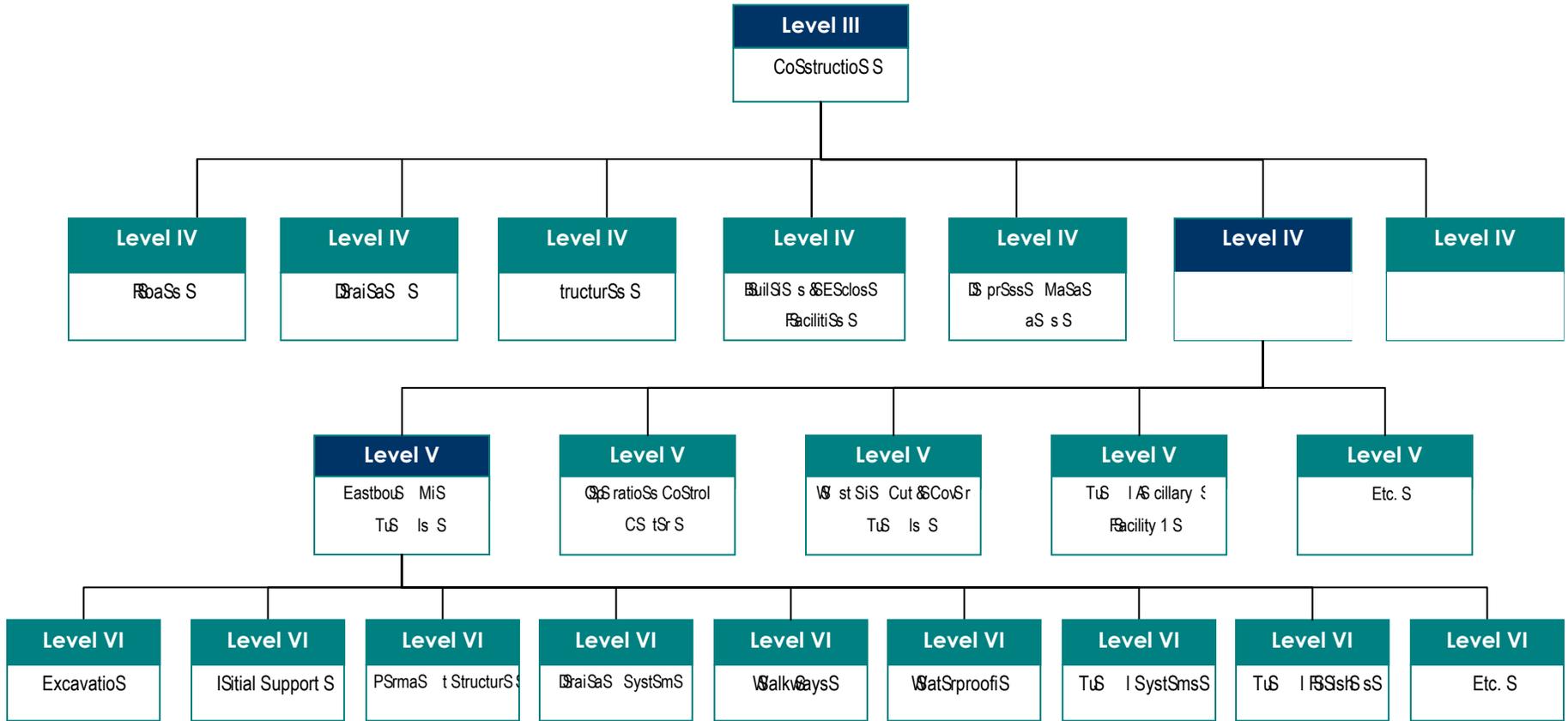


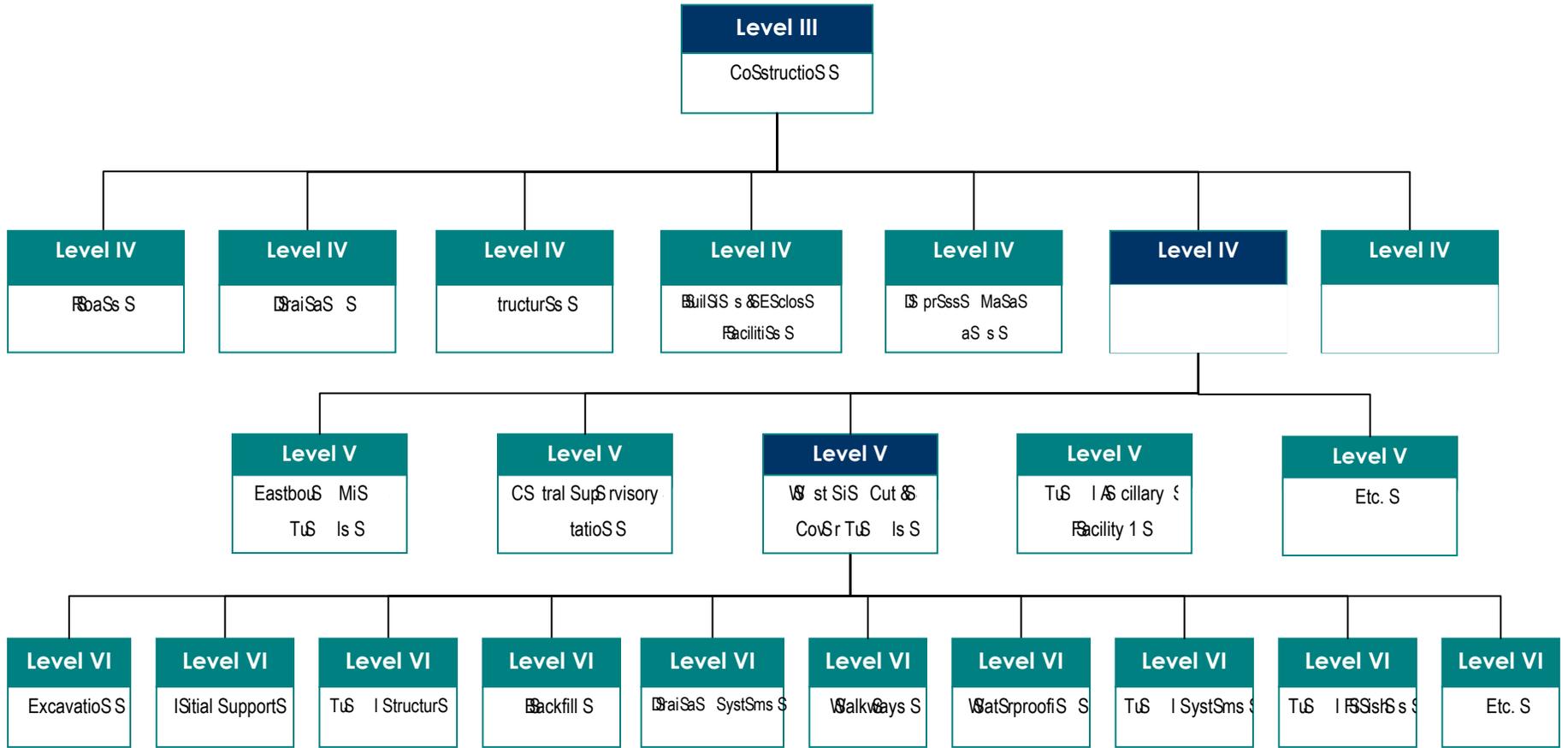
S

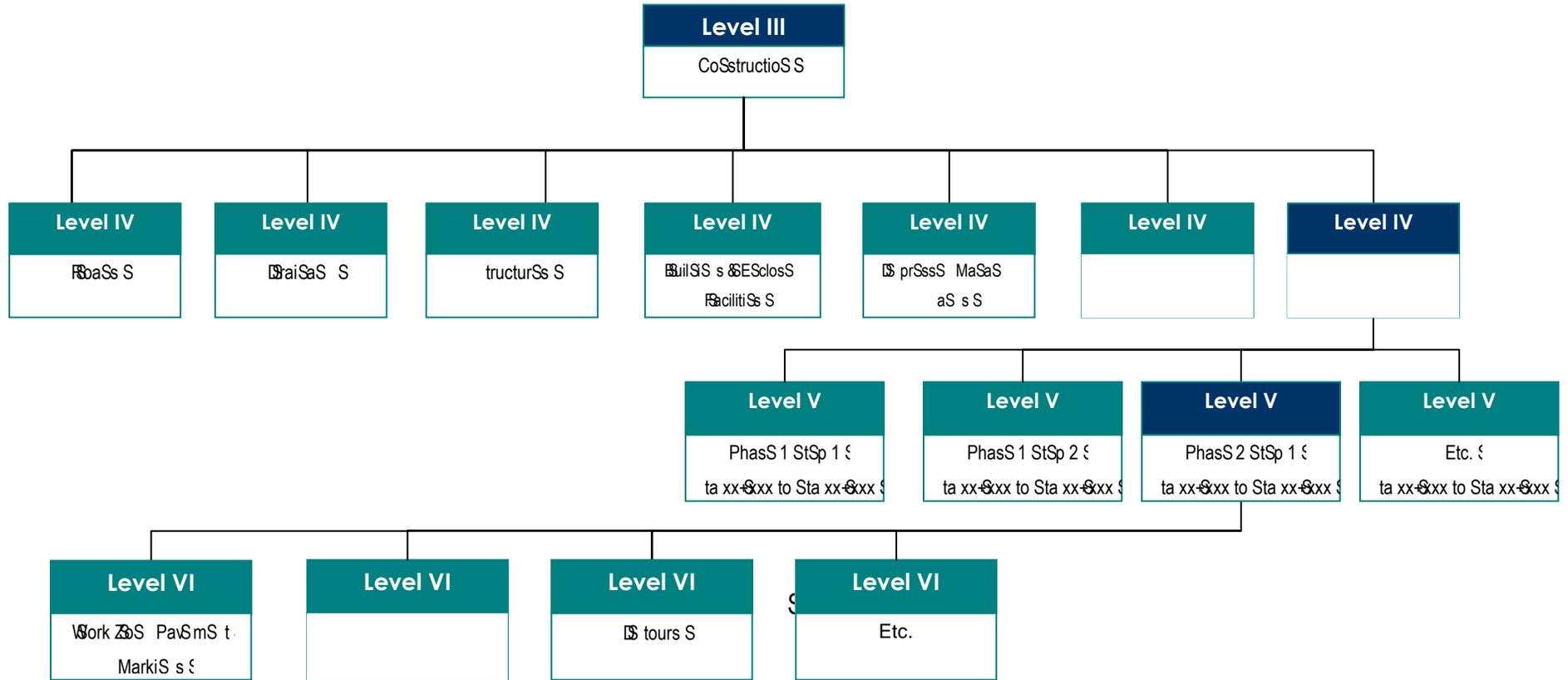






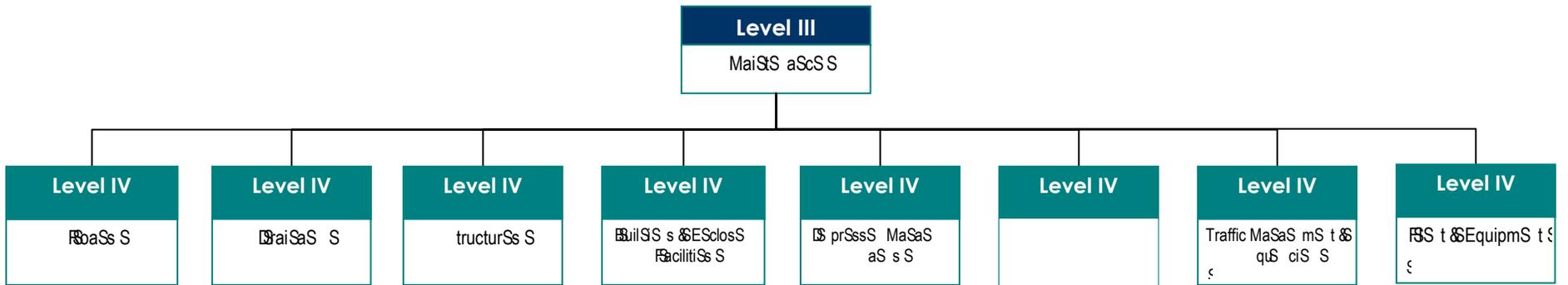
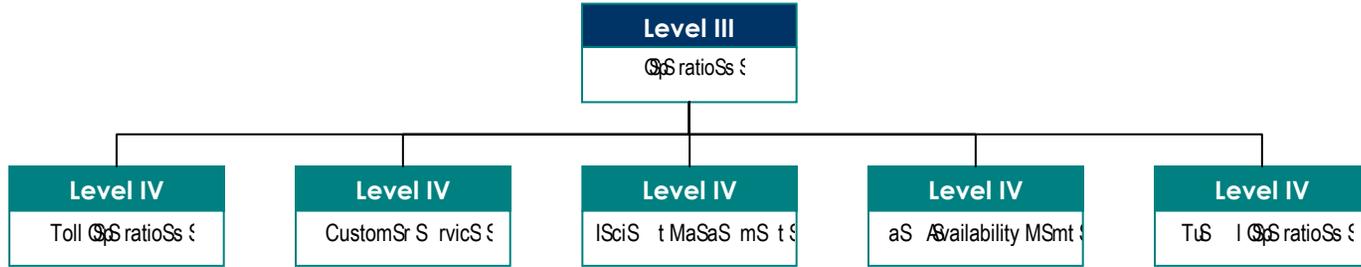






S

S



S

Texas Department of Transportation  
IH 635 Managed Lanes Project  
Technical Provisions

**Attachment 02-2A**  
Schedule of Values Example

A sample presentation of the Schedule of Values is shown below.

<u>Payment</u> <u>Activity ID No.</u>	<u>Activity Description</u>	<u>Quantity /</u> <u>Units</u>	<u>Unit Price - \$</u>	<u>Scheduled</u> <u>Value - \$</u>
<b>1.1 IH 635 Section</b> (Level II)		LS	x,xxx,xxx.00	x,xxx,xxx.00
<b>1.1.4 Construction</b> (Level III)		LS	x,xxx,xxx.00	x,xxx,xxx.00
<b>1.1.4.1 Roads</b> (Level IV)		LS	x,xxx,xxx.00	x,xxx,xxx.00
<b>1.1.4.1.01 EBFR Sta xx+xxx to Sta xx+xxx</b> (Level V)		LS	x,xxx,xxx.00	x,xxx,xxx.00
<b>1.1.4.1.01.01 Earthwork</b> (Level VI)		LS	x,xxx,xxx.00	x,xxx,xxx.00
AEBFR1245	EBnd Frtg Rd – Sta 1237+00 to Sta 1358+00 – Earthwork	12400 cy	abc / cy	xxx,xxx.00
<b>1.1.4.1.01.02 Subgrade</b> (Level VI)			xxx,xxx.00	xxx,xxx.00
AEBFR1255	EBnd Frtg Rd – Sta 1237+00 to Sta 1358+00 - Subgrade	14500 sy	def / sy	xxx,xxx.00
<b>1.1.4.6 Tunnel Systems</b> (Level IV)		LS	xxx,xxx.00	xxx,xxx.00
<b>1.1.4.6.03 West Side Cut &amp; Cover Tunnels</b> (Level V)		LS	xxx,xxx.00	xxx,xxx.00
<b>1.1.4.6.03.09 Tunnel Finishes</b> (Level VI)		LS	xxx,xxx.00	xxx,xxx.00
AEBML1245	Install Emergency Egress Tunnel Doors	20 ea	abc / ea	xx,xxx.00
AEBML1255	Build-out Emergency Egress Stairwells	20 ea	def / ea	xx,xxx.00
<b>1.2 IH 635 / IH 35E Interchange</b> (Level II)				
<b>1.2.4 Construction</b> (Level III)		LS	xxx,xxx.00	xxx,xxx.00
<b>1.2.4.1 Roads</b> (Level IV)		LS	xxx,xxx.00	xxx,xxx.00
<b>1.2.4.04Ramp 1</b> (Level V)		LS	xxx,xxx.00	xxx,xxx.00
<b>1.2.4.04.01 Earthwork</b> (Level VI)		LS	xxx,xxx.00	xxx,xxx.00
BEBR11131	DC Ramp 1 – Earthwork	500 cy	abc / cy	xx,xxx.00
<b>1.2.4.04.03</b>	<b>Pavement Structure</b>	LS	xxx,xxx.00	xxx,xxx.00
BWBR20131	DC Ramp 2 – Form & Pour 12" CRCP	1000 sy	ghi / sy	xx,xxx.00
<b>TOTAL Project Construction Costs</b>		LS	xxx,xxx,xxx.00	xxx,xxx,xxx.00

Texas Department of Transportation  
IH 635 Managed Lanes Project  
Technical Provisions

**Attachment 02-3A**  
Document Data Properties

## Attachment 02-3A – Document Data Properties

**Document Class** – Identifies the associated business discipline of the document

**Business Function** – Identifies or associates a specific business function or project subdiscipline to a file or document and is utilized only if additional classification is required within a document class.

**Document Type** – Identifies the project specific document grouping series for the document.

**Document Subtype** – Identifies the project specific document second level grouping series for the document.

**Document Name** – Identifies the project specific document name or title for the document type/subtype.

**Document Date** – Identifies the date in which a document is complete or a work action is complete.

**Received Date** - Identifies the date the document is received by the retaining organization.

**Document Status** - Identifies the 'state' of a file or document representing its document life cycle stage.

**Highway Segment** – Identifies a Highway and/or Segment identifier to each file or document.

**Component** - Identifies the corridor Components associated with the document or file.

**Document Author** - Identifies the sender (FROM) for documents such as correspondence/transmittals.

**Addressee** - Identifies the recipient (TO) for documents such as correspondence/transmittals.

**Transmittal Number** - Identifies that a document or file is transmitted to or received – identifies the date and to whom the document is going to or coming from.

**Meeting Name** - Identifies the name of a meeting.

**Meeting Date** – Identifies the calendar date of a meeting.

**Meeting Location** – Identifies the location (generally a City) where a meeting is held.

**Comment (Document)** – Identifies or further describes something unique about the document or file.

**Title** – Identifies or further defines the document or file for example subject matter or key topics.

## **Attachment 02-3A – Document Data Properties**

**Parcel Owner** – Identifies the legal owner of a ROW parcel of land or property that is being pursued for or is procured.

**Parcel Number** – Identifies the unique identification of a ROW parcel of land or piece of property that is being pursued for or is procured.

**WBS Element** – Identifies the element of the WBS.

Texas Department of Transportation  
IH 635 Managed Lanes Project  
Technical Provisions

**Attachment 02-4A**

Toll Operations Document Retention Schedule

## Toll Operations Document Retention Schedule

Document Name	Description	Retention Period	Record Retention Schedule Citation (Short Description)
<b>Bank Deposit Slips (copies)</b>	Used by the Operations/Accounting Deposit Clerk to denote the amounts, dates, and times of deposits taken to the bank (one copy goes to Mgr.)	Fiscal Year End +3 years	86ACC16--Cash Management and Deposit Records
<b>Batch Control Log</b>	Used by the Operations staff to log daily tracking forms. (10 - 2" binders for one year)	1 Year	86ADO09--Logs/Log Books
<b>Batch Tracking Form</b>	Used by the Operations Supervisors and staff to track batches as they go through the fulfillment process.	1 Year	86ADO09--Logs/Log Books
<b>Call Monitoring Form</b>	Used by Operations Supervisors	1 Year	86IRM05--Activity Monitoring
<b>Call Classification Form</b>	Used by Operations Supervisors and Managers to develop call statistics and report upon them daily. (Recommend destroying hard copies after entering into Daily Report)	1 Year	86ADM08--Operations Reports
<b>Card Testing Log</b>	Used by the Operations Supervisors and staff to track the testing of account management cards. (Recommend destroying hard copies)	1 Year	86ADO09--Logs/Log Books
<b>Card Type Summary Report</b>	Used by the Operations/Accounting Auditors to reconcile credit card totals with the Account Management System reports.	Fiscal Year End +3 years	86ACC15--Receipts/Receipts Logs/Reconciliations
<b>Change Fund Sheet</b>	Used by Operations Storefront Supervisor to track change requests for available Storefront funds	Fiscal Year End +3 years	86ACC16--Cash Management and Deposit Records
<b>Credit Card Reconciliation Worksheet (Account Management System to Credit Card Processor)</b>	Used by the Operations/Accounting Auditor to reconcile credit card payments from Account Management System to the bank.	Fiscal Year End +3 years	86ACC15--Receipts/Receipts Logs/Reconciliations
<b>Operations Daily Report</b>	Used by the Operations Management team to report call center and storefront statistics..	1 Year	86ADM08--Operations Reports
<b>Summary of Fulfilled Tag Requests Report</b>	Account Management System report used by Operations Manager to identify number of tag fulfillment requests processed for the day.	1 Year	86ADM08--Operations Reports

## Toll Operations Document Retention Schedule

Document Name	Description	Retention Period	Record Retention Schedule Citation (Short Description)
<b>Phone System (Queue) Activity Report</b>	Phone system report used by Call Center Supervisor to identify activity for each call center queue.	1 Year	86ADM08--Operations Reports
<b>Phone System Activity Report by Interval</b>	Phone system report used by Call Center Supervisor to identify activity for each call center queue in 30 minute intervals.	1 Year	86IRM05--Activity Monitoring
<b>Phone System Agent Summary Report</b>	Phone system report used by Call Center Supervisor to identify activity for each individual agent.	1 Year	86IRM05--Activity Monitoring
<b>CSR Daily Reconciliation Form</b>	Used by the Operations Storefront Supervisor and storefront staff to reconcile all walk-in transactions with their tag fulfillment and the funds taken for the transactions on a daily basis.	Fiscal Year End +3 years	86ACC15--Receipts/Receipts Logs/Reconciliations
<b>CSR Transaction Qualification Form</b>	Used by the Operations Call Center CSRs to track call type statistics and then used by the Operations Managers and Supervisors for QA procedures. (One drawer for one year)	1 Year	86IRM05--Activity Monitoring
<b>Daily Activity Report</b>	Used by Operations staff to document activity and tasks completed each day. (each supervisor maintains workgroups' logs) 10 - 12 Binders	1 Year	86ADM08--Operations Reports
<b>Daily Bank Deposit Log</b>	Used by the Operations/Accounting Clerk to denote the amounts, dates, and times of deposits taken to the bank.	Fiscal Year End +3 years	86ACC16--Cash Management and Deposit Records
<b>Daily Cash Reconciliation Worksheet</b>	Used by the Operations/Accounting Clerk to reconcile cash transactions pre-deposit on a daily basis.	Fiscal Year End +3 years	86ACC15--Receipts/Receipts Logs/Reconciliations
<b>Daily Safe Log</b>	Used by the Operations Supervisor to determine the amount of funds that should be located in the Operations center safe at any time.	Fiscal Year End +3 years	86ACC16--Cash Management and Deposit Records
<b>Deposit Reconciliation Summary</b>	Used by Deposit clerk and Auditor to reconcile daily depository funds.	Fiscal Year End +3 years	86ACC16--Cash Management and Deposit Records
<b>Deposit Reconciliation Worksheet</b>	Used by the Operations/Accounting Auditor to reconcile deposits from Account Management System to the bank on a daily basis.	Fiscal Year End +3 years	86ACC15--Receipts/Receipts Logs/Reconciliations

## Toll Operations Document Retention Schedule

Document Name	Description	Retention Period	Record Retention Schedule Citation (Short Description)
<b>Detailed Call, CSQ, Agent Report</b>	Phone System report used by Call Center Supervisor to identify activity for each individual agent, itemizing individual calls.	1 Year	86IRM05--Activity Monitoring
<b>E-Mail Tracking Log</b>	Used by Operations Storefront Supervisor to track number of incoming e-mails by type and resolution counts.	1 Year	86ADO07--Correspondence Tracking Record
<b>Enrollment Form</b>	Used by Operations CSRs to enroll new customers in the toll Account Management system. Contain credit card numbers and must be secured and destroyed accordingly.	AC (After Completion/ Account Closed)+3 years	86ACC21--Credit Card Account Record
<b>Escalation Log</b>	Used by Operations Call Center Supervisors to track escalated issues and whether or not they have been resolved.	1 Year	86ADO09--Logs/Log Books
<b>Incoming Mail Log</b>	Used by Operations Supervisors and Managers to track the collection, batching, and distribution of incoming mail.	1 Year	86ADO07--Correspondence Tracking Record
<b>Interim Bank Statement</b>	Used by the Operations/Accounting Auditor to reconcile deposits made to the bank.	Fiscal Year End +3 years	86ACC20--Bank Statements
<b>IOP Reconciliation Worksheet</b>	Used by the Operations Auditor to reconcile IOP transactions between Account Management System and the TTA IOP Module.	Fiscal Year End +3 years	86ACC15--Receipts/Receipts Logs/Reconciliations
<b>Kit Tracking Batch Transmittal</b>	Used by Operations staff to transmit a batch of kits to another Operations staff member.	Fiscal Year End +3 years	86ACC07--Inventory Records
<b>Monthly Bank Statement</b>	Used by the Operations/Accounting Auditor to verify all transactions to the bank on a monthly basis.	Fiscal Year End +3 years	86ACC20--Bank Statements
<b>Outgoing Mail Log</b>	Used by the Operations/Accounting Auditor and Management team to ensure that all outgoing mail is handled appropriately.	1 Year	86ADO07--Correspondence Tracking Record
<b>Postage Report</b>	Used by the Operations Auditor to compare to the Outgoing Mail Log and reconcile to two.	Fiscal Year End +3 years	86ADO10--Postage/Postage Expense Records

## Toll Operations Document Retention Schedule

Document Name	Description	Retention Period	Record Retention Schedule Citation (Short Description)
<b>Special Events Request Form</b>	Used by the Operations Special Events Supervisor to request equipment for a special event.	1 Year	86ADO11--Work Orders, Service Requests
<b>Tag Inventory Sheet *</b>	Used to track tag kit bins as they are received into inventory. (Recommend destroying hard copies)	Fiscal Year End +3 years	86ACC07--Inventory Records
<b>Tag Testing Log *</b>	Used by the Operations Supervisor and staff to track the testing of tags. (Recommend destroying hard copies)	1 Year	86ADO09--Logs/Log Books
<b>Transaction Detail Report</b>	Used by the Operations/Accounting Auditor to reconcile any issues (including timing issues) that result from the daily credit card reconciliation.	Fiscal Year End +3 years	86ACC09--Internal Fiscal Reports.
<b>IOP Module EFT Summary Report</b>	Used by the Operations/Accounting Auditor to track funds due to agency from away agencies and vice-versa.	Fiscal Year End +3 years	86ACC09--Internal Fiscal Reports.
<b>IOP Module Transaction Reconciliation Detail Report</b>	Used by the Operations Auditor to reconcile interop issues (including rejected, but posted tolls) that result from monthly reconciliation.	Fiscal Year End +3 years	86ACC15--Receipts/Receipts Logs/Reconciliations
<b>Tag Sales Receipts</b>	Used by Operations Storefront Supervisor as receipt for single payment to multiple accounts.	Fiscal Year End +3 years	86ACC15--Receipts/Receipts Logs/Reconciliations
<b>Tag/Card Request Form</b>	Used by the Operations Special Events Supervisor to request equipment for a special event.	1 Year	86ADO11--Work Orders, Service Requests
<b>Transaction Summary Report</b>	Used by the Operations Auditor and Operations to track all transactions in the Account Management System by all clerks for an adjustable span of time.	1 Year	86ADM08--Operations Reports
<b>Clerk Transaction Summary</b>	Used by the Operations Auditor and Supervisors to reconcile all the transaction of a specific clerk for an adjustable span of time with Account Management System.	Fiscal Year End +3 years	86ACC09--Internal Fiscal Reports.
<b>Transaction Type Detail Report</b>	Used by Operations and Auditors to reconcile transaction details in the Account Management System for a specific transaction type with their counterparts in other systems.	Fiscal Year End +3 years	86ACC09--Internal Fiscal Reports.

## Toll Operations Document Retention Schedule

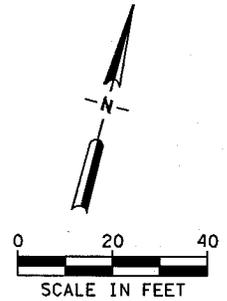
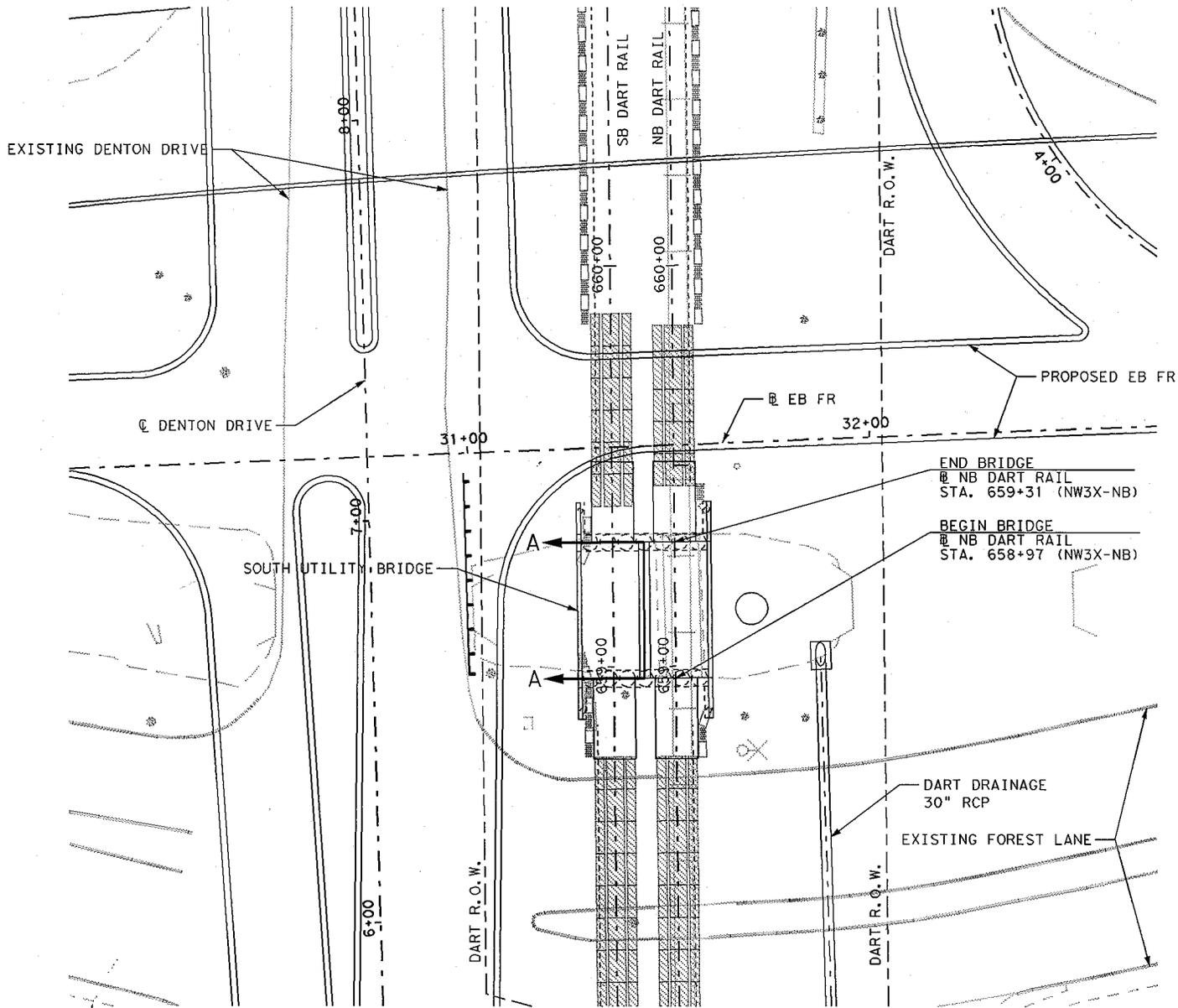
Document Name	Description	Retention Period	Record Retention Schedule Citation (Short Description)
<b>Deposit Summary</b>	Used by Walk-in Store Front Supervisor to document deposit totals in Account Management System.	Fiscal Year End +3 years	86ACC16--Cash Management and Deposit Records
<b>Credit Card Journal - Detail Report</b>	Used by the Operations Auditor to reconcile specific credit card transaction in the Account Management System for all card types to their Credit Card Processor counterparts..	Fiscal Year End +3 years	86ACC09--Internal Fiscal Reports.
<b>Transaction Control Summary by Agency</b>	Used by Auditors and Operations to deliver a big picture, large-scope review of all transactions in the Account Management System occurring for an adjustable span of time.	Fiscal Year End +3 years	86ACC09--Internal Fiscal Reports.
<b>Follow-up Notes</b>	Used by Operations Call Center Supervisors to identify escalated issues from CSRs or customers that may require follow up by the Account Management System.	AC (After Completion/ Final Resolution)+2 years	86ADM06--Complaint Files (NOTE: Issues resulting in legal action retained AC+3 per 86ADM43, Legal Case Files.
<b>New Accounts Added Report</b>	Used by the Operations Call Center Supervisors to ensure that all newly enrolled accounts were properly enrolled with the correct funds posted to all new accounts.	AC (After Completion/ Account Closed)+3 years	86ACC21--Credit Card Account Record
<b>Account Management System-IP User Productivity Report</b>	Used by Image Review Supervisor to identify images reviewed by individual clerks.	1 Year	86IRM05--Activity Monitoring
<b>Toll Management (TMS) Traffic, Operator, Status, Revenue Reports</b>	Reports on revenue and traffic	Fiscal Year End +3 years	86ACC39—Internal Fiscal Reports (Using the longest retention requirement.)

Texas Department of Transportation

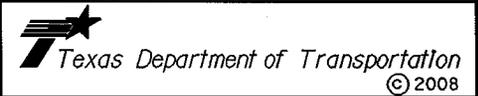
IH 635 Managed Lanes Project  
Technical Provisions

## **Attachment 05-1A**

Utility Bridge Locations for Drainage Facilities

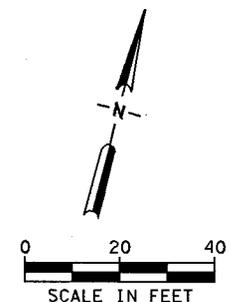
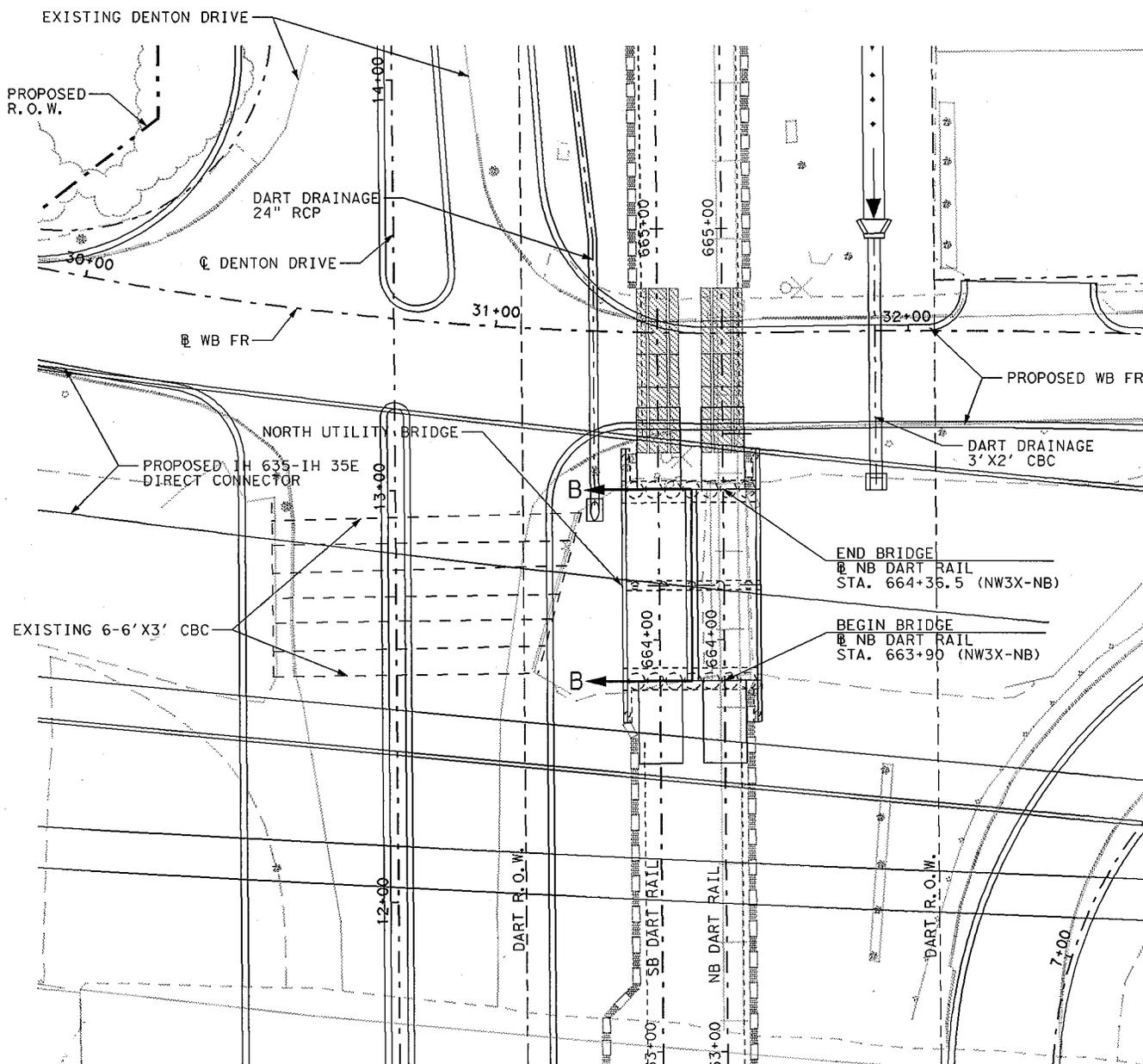


NOTE:  
 1. FOR SECTION A-A SEE SHEET 3.

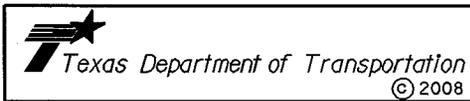


ATTACHMENT 05-1A

**IH 635 MANAGED LANES  
 PROJECT  
 UTILITY BRIDGE LOCATIONS  
 FOR DRAINAGE FACILITIES**

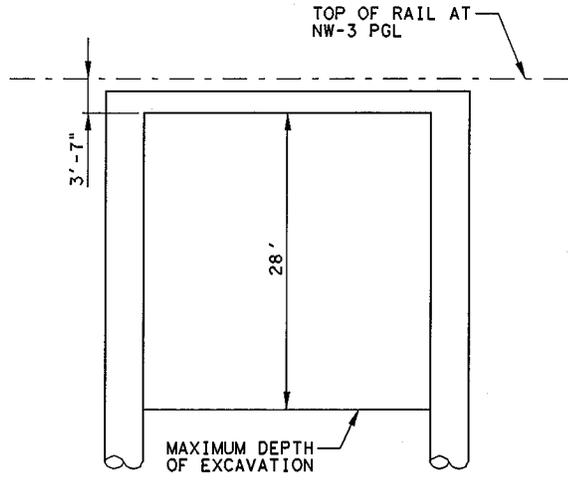


NOTE:  
 1. FOR SECTION B-B SEE SHEET 3.

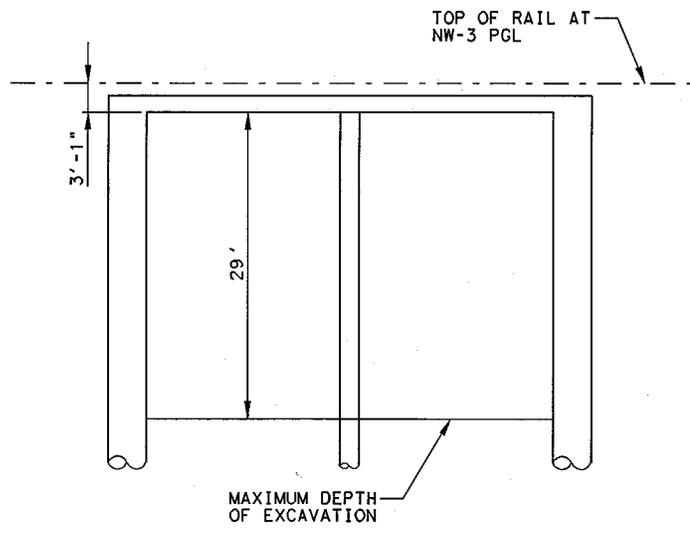


ATTACHMENT 05-1A

**IH 635 MANAGED LANES  
 PROJECT  
 UTILITY BRIDGE LOCATIONS  
 FOR DRAINAGE FACILITIES**



SOUTH UTILITY BRIDGE  
SECTION A-A  
N. T. S.



NORTH UTILITY BRIDGE  
SECTION B-B  
N. T. S.

 Texas Department of Transportation © 2008
ATTACHMENT 05-1A
IH 635 MANAGED LANES PROJECT UTILITY BRIDGE LOCATIONS FOR DRAINAGE FACILITIES
SHEET 3 OF 3

Texas Department of Transportation

IH 635 Managed Lanes Project  
Technical Provisions

**Attachment 07-1A**

ROW Parcels

## Attachment 07-1A

Parcel #	Owner
	CSJ 0196 03 231 From Spur 482 (Story Lane) to IH-635
6	City of Dallas
7	JWV Associates, Ltd.
8	PHCG Investments
9	Viacom Outdoor, Inc.
10	VCV, LLC ATTN: Gene Chupik
11	VCV, LLC ATTN: Gene Chupik
13	Sammons Realty Corporation
14	Shadows Corporation
15	Eastgroup Texas Partners, Ltd.
16	PACCAR Leasing Corporation
17	East Group Properties, LP
18	Weingarten Realty
19	Lit Industrial Texas Limited Partners
20	Summit Electric Supply Company
21	International Boating Center of Dallas, Ltd. Attention: Mr. Casey Freeman
22	Three Stemmons Land, Ltd.
23	Two Stemmons Land, Ltd. PS
24	Sarkis J. Kechejian Trust
25	KP Million
26	Composit Building, Inc., A Texas Corporation
27	Dutt Hospitality, LLC ATTN: Mr. Hemant Patel
28	ACFI Traildust, LLC
29	Clay E. Cooley
30	Million Dollar Saloon, Inc.
31	Western Properties Three, LLC
32	ACFI OSF, LLC ACFI Trail Dust, LLC
33	Van Four, Ltd.
34	Walnut Hill I35 Ent., LLC
35	Wallcon Equities 2, Ltd.
36	Paul D. Lewis No. 5, Ltd. PS
37	Mohammed Sadiq
39	Texas Utilities Electric Company
40	Texas Utilities Electric Company
41	Stemmons Park, Ltd. c/o Dentt Properties (Rick Dentt)
42 PT 1	First Industrial, LP
43	East Group Properties, LP
44	Quoin
45	F & F Stasuma PS
46	Doris S. James

Parcel #	Owner
	CSJ 0196 03 231 From Spur 482 (Story Lane) to IH-635
47	Regal Plastics Supply Company
48	Heste Trust
49	College Park Joint Venture
50	Dennis Jenkins
51	Larry Williams
52	National Advertising Company
53	Doris S. James
54	J. M. Lamb Ent., Inc.
55	Paul & Cheryl Heatherington
56	Heste Trust
57	One Fabens, Inc.
58	Khaled Chami, Trustee
59	Nasser Investments, Inc.
60	Khaled B. Chami
61	11327 Reeder Road, Inc.
62	11327 Reeder Road, Inc.
64	Larry Craig Clutter/ Robert Eric Cooper
65	Donna C. McDonald
66	Ellen Gimbel et al
67	Makhani Brothers Investments, Inc. ATTN: William Roth
68	Chun Investments, LLC ATTN: Dr. Richard B.D. Chun
69	Statewide Stations, Inc.
70	Exhaust System Spec.
71	Franchise Realty Interstate Corporation
75	US Central Plaza Investment, LP
76	Texas Utilities Electric Company
78	T J Marshal, Ltd.
79	Levering Enterprise, LP
80	Walnut Hill I35 Ent., LLC
81	Jerry Spencer, LP
82	Douglas R Ralston

Parcel #	Owner
	CSJ 2374 01 052 Luna to Webb Chapel Valwood to Royal (IH 635/35) Interchange
3AC	Principal Life Insurance Company
6	American Realty Trust, Inc.
7AC	Prologis Trust
8	Security Capital Industrial Trust
9	Multi-Plate Circuits, Inc.
10	Prologis Trust
11	Moon Ventures, Ltd.
12	Moon Acquisitions, Ltd.
13	Baldwin-Harris Company
14 PT1	2610 Forest Lane, LP
15	M6 Remainder II, LP
17	Paul Young Associates II, LP
18	M-Six VI Business Trust
19	The Army and Air Force Exchange
20	John Robert Vriesenga
21	Virginia White Bowie
22	DGSE Corporation
23	Stone-Lewis Properties
24	PWB Interests, Ltd.
25	ML & NB Ray Partners, Ltd.
26	Pit Pros #1, Inc.
27	MBC Partnership
28	Andre and Susan Mongeon
29	CSFB 1998-PI 2915 LBJ Freeway, LP
30	Josey Village, Ltd.
31	CP Plaza, LP
32	One Graystone Centre, LP
33	ARI-TRIWEST Plaza
34	Cinemark Partner II, Ltd.
35	Motiva Enterprises, LLC
36	EMKAT, Ltd.
38	BCK Properties Joint Venture
39	GH Jangda
40	11590 Emerald Street Associates
41	BJ Lancaster
42	RA Wisk
43	TXU Electric Delivery Company
44	Clinton L Watson
45	TXU Electric Delivery Company
47AC	The City of Farmers Branch Texas
48	MRP/VV, LP
49	AGF Valley View, Ltd.
50	Roy Lee and Ruby Marcom
51	Tahhan Valley Investments, LLC

Parcel #	Owner
	CSJ 2374 01 052 Luna to Webb Chapel Valwood to Royal (IH 635/35) Interchange
52	Ray Hallford
53C	The City of Farmers Branch, Texas
54	Solensen Properties, LLC

Parcel #	Owner
	CSJ 2374 01 152 Webb Chapel to DNT
1	S & S Grand, Inc.
3	Global Webb, LP
4	Millennium State Bank of Texas
5	Alejo E. Sigala and Maria Solis
9	CNLRS BEP, LP
10	State Street Bank & Trust Co. of Connecticut
11	Prescott Interest Midway Plaza, Ltd.
12	Farmers Branch/ Midway Partners
13	D & H Freed Real Estate, Ltd.
14	Dallas Texas Union, Ltd.
15	Consolidated Freed Properties, Ltd.
16	Recreation Equipment, Inc.
17	Robert & Helen Lerner Community Property, Revocable Trust
19	RM Partnership I, Ltd.
20	W.O. Bankston Nissan, Inc.
21	Katherine Ann Smith
22	Duetsche Bank National Trust Company
23	Gailya J. Johnson
24	W.O. Bankston Paint and Body, Inc.

Parcel #	Owner
	CSJ 2374 01 150 DNT to Hillcrest Rd.
1	Teachers Insurance and Annuity
3 AC	DBSI Republic, LLC
4	MEDHI Bolour Trustee, et al
5	Hollywood Plaza Associates, LLC et al
6	Montfort Corner, LP
7	McDonalds Corporation
8	Triangle Square, Ltd.
9	Primary Properties Corporation
10	Preston National Bank
11	Merit 99 Office Portfolio, LP
12	Macerich Valley View, Ltd.

Parcel #	Owner
	CSJ 2374 01 150 DNT to Hillcrest Rd.
13	CNL Retirement CRSI Valley View Dallas
14	Betty Everett Family, LP
15	Sears Roebuck and Company
16	M L Hart, TR.
17	Dallas Purling 635, Ltd.
18	Preston Valley (North) JV
19	HPD North Dallas, Ltd.
20	Motiva Enterpriser, LLC
21	V V S Properties, Ltd.
22	Tetco Store, LP
23	North Dallas Bank & Trust
24	Carol McCutchin Properties, Ltd.
25	Carol McCutchin Properties, Ltd.
26	Tuesday Morning, Inc.
28	Transwestern Concourse Office Park, LP
29	Conni Shults & I.V. Johnson
30	Anna M. Curry
31	Kah Holdings
32	Michael M & Jeanan Griffin
33	King of Glory Lutheran Church
35	David Albert & John M. Davies
36	Micheal Abtahi
37	Knoche, LP
38	Robert A. & Mirna Weathers Lynch
39	BAAR, Inc.
40	LBJ / Hillcrest Oaks, LP
41	US State Street Bank and Trust Company
43	Brinker Int'l Payroll Corporation
44	Sunrise Hillcrest Senior Living, LLC
45	David Albert and Ginette M Albert
49	Carol McCutchin Properties, Ltd.
50	VVS Properties, Ltd.

Parcel #	Owner
	CSJ 2374 01 148 Hillcrest Rd. to Merit Dr.
1	12380 Hillcrest Road Investors, LP
2	Muscovy Limited Partnership
3	Watermark Community Church
4	DA Residential Two, LP
5	Westdale LJ Partners, Ltd.
6	Houston RE Income Properties XVIII, Ltd.
7	PCRI Property, LP
8	Park Central Joint Venture

Parcel #	Owner
	CSJ 2374 01 142 IH 635 at Webb Chapel Rd.
1	Motiva Enterprises
2	Exxon Mobil Foundation
3	Metrocrest Hospital Authority

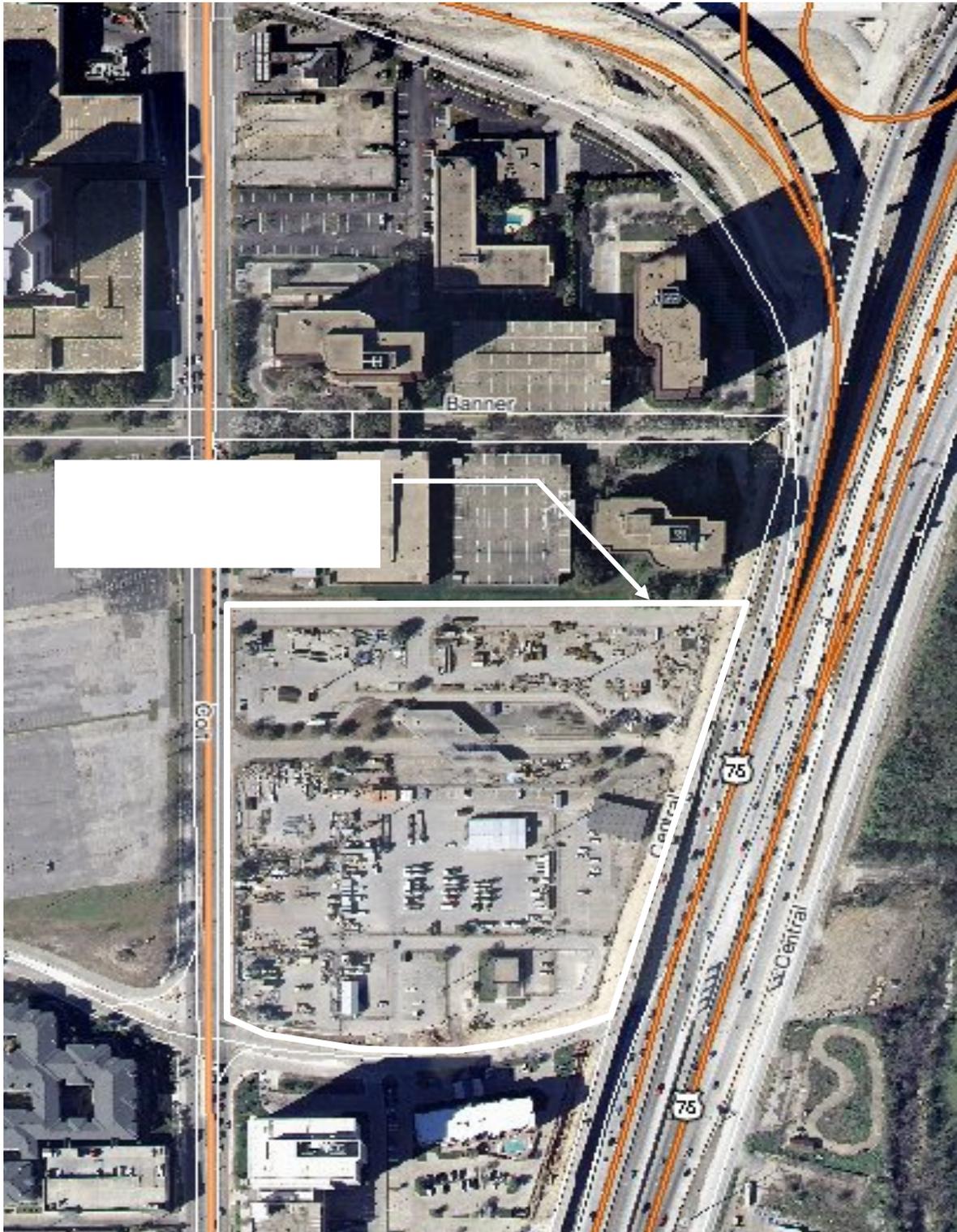
Texas Department of Transportation  
IH 635 Managed Lanes Project  
Technical Provisions

**Attachment 07-2A**

Property Descriptions and Locations







DEED  
CONTROLLED ACCESS HIGHWAY FACILITY

9018-9-18  
Parcel 1

8852

9.00 DEED  
2 03/05/79

THE STATE OF TEXAS           X  
  X  
COUNTY OF DALLAS           X

WHEREAS, the State Highway and Public Transportation Commission has been authorized under House Bill 179, Acts of the 55th Legislature, Regular Session, 1957 (Article 6674w-1, et seq., Vernon's Annotated Civil Statutes of Texas) to purchase land and such other property rights deemed necessary for the purposes of facilitating the construction, maintenance and operation of Controlled Access Highways; and,

WHEREAS, the purchase of the hereinafter described premises has been deemed necessary by the State Highway and Public Transportation Commission for the purposes of facilitating the construction, maintenance and operation of a Controlled Access Highway facility;

NOW, THEREFORE, KNOW ALL MEN BY THESE PRESENTS:

That, WDS, Inc., a Delaware Corporation, acting by and through its duly  
authorized officer,

of the County of Oklahoma, State of ~~Texas~~ <sup>Oklahoma</sup>, hereinafter referred to as Grantors, whether one or more, for and in consideration of the sum of Two Million, Five Hundred Thousand and no/100 (\$2,500,000.00) Dollars to Grantors in hand paid by the State of Texas, acting by and through the State Highway and Public Transportation Commission, receipt of which is hereby acknowledged, and for which no lien is retained, either expressed or implied, have this day Sold, and by these presents do Grant, Bargain, Sell and Convey unto the State of Texas, all that certain tract or parcel of land lying and being situated in the County of Dallas, State of Texas, more particularly described as follows, to wit:

Situated in Dallas City Block No. 7754, and in the M. J. Sanchez Survey, Abstract No. 1272, Dallas County, Texas.

BEING 485,296 square feet (11.141 acres) tract of land, more or less, and being all of the said tract of land which was conveyed to Texas Auto Warehouse, Inc., a Delaware corporation, by deed dated March 3, 1954 recorded in Volume 4187, Page 614, Deed Records of Dallas County, Texas and further conveyed by Agreement of Merger to Auto Warehouse, Inc., dated April 19, 1963 recorded in Volume 881, Page 0316, Deed Records in Dallas County, Texas, said 485,296 square feet tract of land being more particularly described as follows;

Reviewed *H.T.*  
73041 2130

**BEGINNING** at the southeast corner of said 485,296 square feet tract of land, said point being in the existing West right of way line of U. S. 75 and bears South 16°21'26" West a distance of 317.78 feet from the northeast corner of Arno Goetz tract acquired by deed dated May 28, 1975 recorded in Volume 75107, Page 2648, Deed Records of said county;

- (1) THENCE South 81°37'47" West for a distance of 642.99 feet for a corner;
- (2) THENCE North 0°20'56" East for a distance 956.47 feet for a corner;
- (3) THENCE South 89°18'13" East for a distance of 490.00 feet for a corner;
- (4) THENCE South 0°23'36" West for a distance of 675.13 feet for a corner;
- (5) THENCE North 81°14'02" East for a distance of 210.20 feet to a point in the existing West right of way line of U. S. 75;
- (6) THENCE South 16°21'26" West along the said existing right of way line a distance of 222.84 feet to the place of beginning.

SAVE and EXCEPT, HOWEVER, it is expressly understood and agreed that Grantors are retaining title to the following improvements located on the above described property, to wit:

NONE

Grantors covenant and agree to remove the above described improvements from said land by XXXXX, 19 XX, subject, however, to such extensions of time as may be granted by the State in writing; and if, for any reason, Grantors fail or refuse to remove same within said period of time prescribed, then, without any further consideration, the title to all or any part of such improvements not so removed shall pass to and vest in the State of Texas forever.

Grantors reserve all of the oil, gas and sulphur in and under the land herein conveyed but waive all rights of ingress and egress to the surface thereof for the purpose of exploring, developing, mining or drilling for same; however, nothing in this reservation shall affect the title and rights of the State to take and use all other minerals and materials thereon, therein and thereunder.

TO HAVE AND TO HOLD the above described premises herein conveyed together with all and singular the rights and appurtenances thereto in anywise beionging, unto the State of Texas and its assigns forever; and Grantors do hereby bind ourselves, our heirs, executors, administrators, successors and assigns, to Warrant and Forever Defend all and singular the said premises herein conveyed unto the State of Texas and its assigns against every person whomssoever lawfully claiming or to claim the same or any part thereof.

IN WITNESS WHEREOF, this instrument is executed on this the 20th day of February, 19 79.

ATTEST: [Signature]  
Assistant Secretary

WDS, Inc.  
By: [Signature]  
Roy E. Townsdin, President

SINGLE ACKNOWLEDGMENT

THE STATE OF TEXAS  
County of \_\_\_\_\_

Before me, \_\_\_\_\_, a notary public in and for said County and State, on this day personally appeared \_\_\_\_\_, known to me (or proved to me on the oath of \_\_\_\_\_, a credible witness) to be the person whose name \_\_\_\_\_ subscribed to the foregoing instrument and acknowledged to me that he executed the same for the purposes and consideration therein expressed.

Given under my hand and seal of office, this the \_\_\_\_\_ day of \_\_\_\_\_ 19 \_\_\_\_\_

Notary Public in and for \_\_\_\_\_ County, Texas.



BEGINNING at the southeast corner of said 26,144 square feet tract of land, said point being in the existing West right of way line of U. S. 75 and bears North 16°21'26" East a distance of 222.84 feet from the southeast corner of 3.101 acre tract which was conveyed to Texas Auto Warehouse, Inc., by Deed recorded in Volume 4187, Page 614, Deed Records of said county;

- (1) THENCE South 81°14'02" West for a distance of 210.20 feet for a corner;
- (2) THENCE North 0°23'36" East for a distance of 146.47 feet for a corner;
- (3) THENCE South 84°17'28" East for a distance of 234.64 feet to a point in the existing West right of way line of U. S. 75;
- (4) THENCE South 16°21'26" West *along* the said existing right of way line a distance of 94.94 feet to the place of beginning.

VOL PAGE  
79110 3957



Resolution of Directors

to

Terminate Lease, Adjust  
Rent and Pay Rent/Damages

WHEREAS, the State of Texas through the State Department of Highways and Public Transportation determined it is in the best interest of the public to acquire subject property located at 12505 North Central Expressway, more specifically described by attached Exhibit A; and

WHEREAS, the State of Texas public use will require existing structures be demolished and removed from the property described by Exhibit A; and

WHEREAS, the above actions required Warrex Computer Corporation to move from the property and the State is proceeding to acquire fee title interest thereto;

THEREFORE, Be It Resolved, That Warrex Computer Corporation terminate its lease of subject property, adjust the rental and other payments may be due fee owner; and, that JAMES H SMITH President of Warrex Computer Corporation be authorized to negotiate these issues and make payments to the fee owner in terms and amounts which, in his opinion, are in the best interest of Warrex Computer Corporation.

This is to certify that the Board of Directors of Warrex Computer Corporation met in a properly called session on May 14, 1979 and, after, required formality, unanimously approved the Resolution set forth above as an act of the corporation.

Certified this 30th day of May, 1979.

James H Smith  
President

attest: James H Smith  
Secretary

VC1 PAGE  
70113 3960

RETURN TO:

John G. Keller, Dist. Engr.  
State Department of Highways and Public Transportation  
P. O. Box 3067  
Dallas, Texas 75221

STATE OF TEXAS COUNTY OF DALLAS  
I hereby certify that this instrument was  
filed on this date and was stamped hereon  
by me and was duly recorded in the volume  
and page of the named records of Dallas  
County, Texas as stamped hereon in ink.

JUN 6 1979



*L. E. Murdoch*  
COUNTY CLERK, Dallas County, Texas

VOL PAGE

70119 3961

79 JUN 5 PM 2:48

ADJUTANT CLERK  
COUNTY CLERK  
*L. E. Murdoch*  
D...



BEGINNING at the southeast corner of said 34,434 square feet tract of land, said point being in the existing West right of way line of U. S. 75 and bears North 16° 21' 26" East a distance of 317.78 feet from the southeast corner of 3.101 acre tract which was conveyed to Texas Auto Warehouse Inc., by Deed recorded in Volume 4187, Page 614, Deed Records of said county;

- (1) THENCE North 84° 17' 28" West for a distance of 234.64 feet for a corner;
- (2) THENCE North 0° 23' 36" East for a distance of 124.64 feet for a corner;
- (3) THENCE South 89° 10' 03" East for a distance of 274.91 feet to a point in the existing West right of way line of U. S. 75;
- (4) THENCE South 16° 21' 26" West along the said existing right of way line a distance of 150.06 feet to the place of beginning.

80068 2105

SAVE and EXCEPT, HOWEVER, it is expressly understood and agreed that Grantors are retaining title to the following improvements located on the above described property, to wit:

None

Grantors covenant and agree to remove the above described improvements from said land by XXXXXX XXX XXX, 19 XX, subject, however, to such extensions of time as may be granted by the State in writing; and if, for any reason, Grantors fail or refuse to remove same within said period of time prescribed, then, without any further consideration, the title to all or any part of such improvements not so removed shall pass to and vest in the State of Texas forever.

Grantors reserve all of the oil, gas and sulphur in and under the land herein conveyed but waive all rights of ingress and egress to the surface thereof for the purpose of exploring, developing, mining or drilling for same; however, nothing in this reservation shall affect the title and rights of the State to take and use all other minerals and materials thereon, therein and thereunder.

TO HAVE AND TO HOLD the above described premises herein conveyed together with all and singular the rights and appurtenances thereto in anywise belonging, unto the State of Texas and its assigns forever; and Grantors do hereby bind ourselves, our heirs, executors, administrators, successors and assigns, to Warrant and Forever Defend all and singular the said premises herein conveyed unto the State of Texas and its assigns against every person whomsoever lawfully claiming or to claim the same or any part thereof.

IN WITNESS WHEREOF, this instrument is executed on this the 26th day of February, 19 80.

DALLAS CERAMIC COMPANY

By: Charles C. Nies  
Charles C. Nies  
Vice President-Finance

ATTEST:

**SINGLE ACKNOWLEDGMENT**

THE STATE OF TEXAS

County of \_\_\_\_\_ }

Before me, \_\_\_\_\_, a notary public in and for said County and State, on this day personally appeared \_\_\_\_\_

\_\_\_\_\_ known to me (or proved to me on the oath of \_\_\_\_\_, a credible witness) to be the person whose name \_\_\_\_\_

\_\_\_\_\_ subscribed to the foregoing instrument and acknowledged to me that he executed the same for the purposes and consideration therein expressed.

Given under my hand and seal of office, this the 26 day of February 19 80

Notary Public in and for Dallas County, Texas.

80068 2106

State Department of Highways  
and Public Transportation  
Form D-15-11 (Whole Taking)  
Page 1 of 4  
Rev. 7-75

9018-9-18  
Parcel 4

DEED  
CONTROLLED ACCESS HIGHWAY FACILITY

A

7201

0

7.00 DEED  
2 10/11/79

THE STATE OF TEXAS X  
X  
COUNTY OF DALLAS X

WHEREAS, the State Highway and Public Transportation Commission has been authorized under House Bill 179, Acts of the 55th Legislature, Regular Session, 1957 (Article 6674w-1, et seq., Vernon's Annotated Civil Statutes of Texas) to purchase land and such other property rights deemed necessary for the purposes of facilitating the construction, maintenance and operation of Controlled Access Highways; and,

WHEREAS, the purchase of the hereinafter described premises has been deemed necessary by the State Highway and Public Transportation Commission for the purposes of facilitating the construction, maintenance and operation of a Controlled Access Highway facility;

NOW, THEREFORE, KNOW ALL MEN BY THESE PRESENTS:

That, JOSE MILMO, not joined by my wife as this property constitutes no part of my business or residential homestead.

City of Monterrey, State of Nuevo Leon, Republic of Mexico,  
of the ~~County of~~ hereinafter referred to as  
Grantors, whether one or more, for and in consideration of the sum of Seven Hundred  
Thousand and no/100 (\$ 700,000.00)  
Dollars to Grantors in hand paid by the State of Texas, acting by and through the  
State Highway and Public Transportation Commission, receipt of which is hereby  
acknowledged, and for which no lien is retained, either expressed or implied, have  
this day Sold, and by these presents do Grant, Bargain, Sell and Convey unto the  
State of Texas, all that certain tract or parcel of land lying and being situated  
in the County of Dallas, State of Texas, more particularly described  
as follows, to wit:

Situated in Dallas City Block No. 7754, Dallas County, Texas.

BEING 134,543 square feet (3.089 acres) tract of land, more or less, and being all  
of the said tract of land which was conveyed to Jose Milmo by deed dated September 3,  
1973 recorded in Volume 73218, Page 1115, Deed Records of Dallas County, Texas,  
said 134,543 square feet tract of land being more particularly described as follows:

VOL PAGE

79199 0154

Reviewed JE  
10/7 9-7-79

BEGINNING at the southeast corner of said 134,543 square feet tract of land, said point being in the existing West right of way line of U. S. 75 and bears North 16° 21' 26" East a distance of 467.84 feet from the southeast corner of 3.101 acres tract which was conveyed to Texas Auto Warehouse, Inc., by deed recorded in Volume 4187, Page 614, Deed Records of said county;

- (1) THENCE North 89° 10' 03" West for a distance of 274.91 feet for a corner;
- (2) THENCE North 0° 23' 36" East for a distance of 404.02 feet for a corner;
- (3) THENCE South 89° 18' 13" East for a distance of 390.49 feet to a point in the existing West right of way line of U. S. 75;
- (4) THENCE South 16° 21' 26" West along the said existing right of way line a distance of 420.27 feet to the place of beginning.

SAVE and EXCEPT, HOWEVER, it is expressly understood and agreed that Grantors are retaining title to the following improvements located on the above described property, to wit:

NONE

Grantors covenant and agree to remove the above described improvements from said land by \_\_\_\_\_, 19 \_\_, subject, however, to such extensions of time as may be granted by the State in writing; and if, for any reason, Grantors fail or refuse to remove same within said period of time prescribed, then, without any further consideration, the title to all or any part of such improvements not so removed shall pass to and vest in the State of Texas forever.

Grantors reserve all of the oil, gas and sulphur in and under the land herein conveyed but waive all rights of ingress and egress to the surface thereof for the purpose of exploring, developing, mining or drilling for same; however, nothing in this reservation shall affect the title and rights of the State to take and use all other minerals and materials thereon, therein and thereunder.

TO HAVE AND TO HOLD the above described premises herein conveyed together with all and singular the rights and appurtenances thereto in anywise belonging, unto the State of Texas and its assigns forever; and Grantors do hereby bind ourselves, our heirs, executors, administrators, successors and assigns, to Warrant and Forever Defend all and singular the said premises herein conveyed unto the State of Texas and its assigns against every person whomsoever lawfully claiming or to claim the same or any part thereof.

IN WITNESS WHEREOF, this instrument is executed on this the 3 day of August, 1979.

X Jose Milmo  
Jose Milmo

SINGLE ACKNOWLEDGMENT

THE STATE OF TEXAS

County of Dallas

Before me, the undersigned authority, a notary public in and for said County and State, on this day personally appeared Jose Milmo

known to me (or proved to me as a credible witness) to be the person whose name is subscribed to the foregoing instrument and acknowledged to me that he executed the same for the purposes and consideration therein expressed.

Given under my hand and seal of office, this the 3rd day of August, 1979.

Francine C. Culenhouse

Notary Public in and for Dallas County, Texas.

79199 0156

State Department of Highways  
and Public Transportation  
Form D-15-30  
Page 1 of 4  
Rev. 7-75

DEED RECORD

QUITCLAIM

Parcel 4  
9018-9-18

STATE OF TEXAS

COUNTY OF DALLAS

7199

0

9.00 DEED  
2 10/11/79

KNOW ALL MEN BY THESE PRESENTS:

That DALLAS CERAMIC COMPANY

of the County of Dallas, State of Texas, hereinafter referred to as Grantors, whether one or more, for and in consideration of the sum of Nine Hundred Thirty and No/100 (\$ 930.00 ) Dollars, and other good and valuable consideration to Grantors in hand paid by the State of Texas, acting by and through the State Highway and Public Transportation Commission, the receipt of which is hereby acknowledged, and for which no lien is retained, either expressed or implied, have quitclaimed, and do by these presents Bargain, Sell, Release and forever Quitclaim unto the State of Texas all of Grantors' right, title, interest, claim and demand in and to that certain tract or parcel of land, situated in the County of Dallas, State of Texas, and being more particularly described as follows, to wit:

Situated in Dallas City Block No. 7754, Dallas County, Texas.

BEING 134,543 square feet (3.089 acres) tract of land, more or less, and being all of the said tract of land which was conveyed to Jose Milmo by deed dated September 3, 1973 recorded in Volume 73218, Page 1115, Deed Records of Dallas County, Texas, said 134,543 square feet tract of land being more particularly described as follows:

Reviewed MC  
10T 9-7-79

VOL PAGE

79199 0144

BEGINNING at the southeast corner of said 134,543 square feet tract of land, said point being in the existing West right of way line of U. S. 75 and bears North 16° 21' 26" East a distance of 467.84 feet from the southeast corner of 3.101 acres tract which was conveyed to Texas Auto Warehouse, Inc., by deed recorded in Volume 4187, Page 614, Deed Records of said county;

- (1) THENCE North 89° 10' 03" West for a distance of 274.91 feet for a corner;
- (2) THENCE North 0° 23' 36" East for a distance of 404.02 feet for a corner;
- (3) THENCE South 89° 18' 13" East for a distance of 390.49 feet to a point in the existing West right of way line of U. S. 75;
- (4) THENCE South 16° 21' 26" West along the said existing right of way line a distance of 420.27 feet to the place of beginning.

SAVE and EXCEPT, HOWEVER, it is expressly understood and agreed that Grantors are retaining title to the following improvements located on the above described property, to wit:

A. Advertising Sign

---

Grantors covenant and agree to remove the above described improvements from said land by October 1, 19 79, subject, however, to such extensions of time as may be granted by the State in writing; and if, for any reason, Grantors fail or refuse to remove same within said period of time prescribed, then, without any further consideration, the title to all or any part of such improvements not so removed shall pass to and vest in the State of Texas forever.

VOL. PAGE

79199 0145

2.3.11 420115

TO HAVE AND TO HOLD for said purposes together with all and singular the rights, privileges, and appurtenances thereto in any manner belonging unto the said State of Texas forever.

IN WITNESS WHEREOF, this instrument is executed on this the 3 day of August, 1979.

ATTEST \_\_\_\_\_ By: DALLAS CERAMIC COMPANY  
Charles C. Niss  
Secretary, Treasurer

**SINGLE ACKNOWLEDGMENT**

THE STATE OF TEXAS

County of Dallas }

Before me, Francis P. Culberson, a notary public in and for said County and State, on this day personally appeared Charles C. Niss, known to me (or proved to me on the oath of \_\_\_\_\_, a credible witness) to be the person whose name \_\_\_\_\_ subscribed to the foregoing instrument and acknowledged to me that he executed the same for the purposes and consideration therein expressed.

Given under my hand and seal of office, this the 3rd day of August, 1979.  
Francis P. Culberson  
Notary Public in and for Dallas County, Texas.

**SINGLE ACKNOWLEDGMENT**

THE STATE OF TEXAS

County of \_\_\_\_\_ }

Before me, \_\_\_\_\_, a notary public in and for said County and State, on this day personally appeared \_\_\_\_\_, known to me (or proved to me on the oath of \_\_\_\_\_, a credible witness) to be the person whose name \_\_\_\_\_ subscribed to the foregoing instrument and acknowledged to me that he executed the same for the purposes and consideration therein expressed.

Given under my hand and seal of office, this the \_\_\_\_\_ day of \_\_\_\_\_ 19 \_\_\_\_\_  
Notary Public in and for \_\_\_\_\_ County, Texas.

79199 0146

State Department of Highways  
and Public Transportation  
Form D-15-30  
Page 1 of 4  
Rev. 7-75

DEED RECORD

Parcel 4  
9018-9-18

QUITCLAIM

STATE OF TEXAS  
COUNTY OF DALLAS

A

7200

0

7.00 DEED  
2 10/11/79

KNOW ALL MEN BY THESE PRESENTS:

That NATIONAL ADVERTISING COMPANY

of the County of Dallas, State of Texas, hereinafter referred to as Grantors, whether one or more, for and in consideration of the sum of Eighteen Thousand, Six Hundred Ninety-Five and no/100 (\$ 18,695.00) Dollars, and other good and valuable consideration to Grantors in hand paid by the State of Texas, acting by and through the State Highway and Public Transportation Commission, the receipt of which is hereby acknowledged, and for which no lien is retained, either expressed or implied, have quitclaimed, and do by these presents Bargain, Sell, Release and forever Quitclaim unto the State of Texas all of Grantors' right, title, interest, claim and demand in and to that certain tract or parcel of land, situated in the County of Dallas, State of Texas, and being more particularly described as follows, to wit:

Situated in Dallas City Block No. 7754, Dallas County, Texas.

BEING 134,543 square feet (3.089 acres) tract of land, more or less, and being all of the said tract of land which was conveyed to Jose Milmo by deed dated September 3, 1973 recorded in Volume 73218, Page 1115, Deed Records of Dallas County, Texas, said 134,543 square feet tract of land being more particularly described as follows:

Reviewed JK  
WOT 9-7-79

PAGE

79199 0150

BEGINNING at the southeast corner of said 134,543 square feet tract of land, said point being in the existing West right of way line of U. S. 75 and bears North 16° 21' 26" East a distance of 467.84 feet from the southeast corner of 3.101 acres tract which was conveyed to Texas Auto Warehouse, Inc., by deed recorded in Volume 4187, Page 614, Deed Records of said county;

- (1) THENCE North 89° 10' 03" West for a distance of 274.91 feet for a corner;
- (2) THENCE North 0° 23' 36" East for a distance of 404.02 feet for a corner;
- (3) THENCE South 89° 18' 13" East for a distance of 390.49 feet to a point in the existing West right of way line of U. S. 75;
- (4) THENCE South 16° 21' 26" West along the said existing right of way line a distance of 420.27 feet to the place of beginning.

SAVE and EXCEPT, HOWEVER, it is expressly understood and agreed that Grantors are retaining title to the following improvements located on the above described property, to wit:

B. Advertising Sign

---

Grantors covenant and agree to remove the above described improvements from said land by October 1, 19 79, subject, however, to such extensions of time as may be granted by the State in writing; and if, for any reason, Grantors fail or refuse to remove same within said period of time prescribed, then, without any further consideration, the title to all or any part of such improvements not so removed shall pass to and vest in the State of Texas forever.

VOL PAGE  
79199 0151

TO HAVE AND TO HOLD for said purposes together with all and singular the rights, privileges, and appurtenances thereto in any manner belonging unto the said State of Texas forever.

IN WITNESS WHEREOF, this instrument is executed on this the 27<sup>th</sup> day of August, 1979.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
NATIONAL ADVERTISING COMPANY  
By David Harris

**SINGLE ACKNOWLEDGMENT**

THE STATE OF TEXAS

County of Dallas

Before me, the undersigned authority, a notary public in and for said County and State, on this day personally appeared DAVID HARRIS

known to me (or proved to me on the oath of \_\_\_\_\_, a credible witness) to be the person whose name \_\_\_\_\_

is subscribed to the foregoing instrument and acknowledged to me that he executed the same for the purposes and consideration therein expressed.

Given under my hand and seal of office, this the 27<sup>th</sup> day of August, 1979

Notary Public in and for Dallas County, Texas.

**SINGLE ACKNOWLEDGMENT**

THE STATE OF TEXAS

County of \_\_\_\_\_

Before me, \_\_\_\_\_, a notary public in and for said County and State, on this day personally appeared \_\_\_\_\_

known to me (or proved to me on the oath of \_\_\_\_\_, a credible witness) to be the person whose name \_\_\_\_\_

is subscribed to the foregoing instrument and acknowledged to me that he executed the same for the purposes and consideration therein expressed.

Given under my hand and seal of office, this the \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_

Notary Public in and for \_\_\_\_\_ County, Texas.

79199 0152



EXHIBIT "A"

County Dallas  
Parcel 33  
Highway I.H. 635  
PROJECT Limits: From: Crim Drive  
To: Pinyon Tree Road  
CSJ: 2374-01-103  
Acct: 9118-21-07

Page 1 OF 3  
D-15-11  
November 20, 2000

Legal Land Description for Parcel 33

BEING a 21.210 acre parcel of land situated in the ALEXANDER A. THOMAS SURVEY, Abstract No. 1486, in the City of Dallas, Texas, Block Numbers 7621 and 7624, being all of a called 21.2028 acre tract of land deeded to CLBJ, INC., as recorded in Volume 93012, Page 1460 of the Deed Records of Dallas County, Texas (DRDCT), and being all of Central 635 Addition, an Addition to the City of Dallas as Recorded in Volume 85008, Page 251, DRDCT. Said 21.210 acre parcel being more particularly described by metes and bounds as follows:

BEGINNING at a point, being the intersection of the west right-of-wayline of Schroeder Road ( 64.00 foot right-of-way at this point), and the south right-of-way line of Interstate 635 (variable width right-of-way), from said point a 5/8" iron rod with an aluminum cap stamped "Texas Department of Transportation" (TXDOT) bears N 86°01' 56" E, a distance of 2.52 feet;

THENCE along the west right-of-way line of said Schroeder Road (64.00foot right-of-way) the following two (2) courses and distances:

- 1.) S 04°47' 01" W, a distance of 210.42 feet to a 5/8" iron rod with yellow plastic cap stamped "CARTER BURGESS" set, and
- 2.) S 05°57' 08" W, a distance of 229.17 feet to a 5/8" iron rod with yellow plastic cap stamped "CARTER BURGESS" set, said point being the end of the 64.00 feet right-of-way width, and the beginning of variable width right-of-way for said Schroeder Road;

THENCE continuing along the west line of Said Schroeder Road (variable width right-of-way) the following three (3) courses and distances:

- 3.) S 08°09' 23" W, a distance of 548.46 feet to a point, from saidpoint a 1/2" iron rod found bears N 14°51' 32" W, a distance of 2.47 feet, and
- 4.) S 65°35' 35" E, a distance of 28.60 feet to a 5/8" iron rod found, and
- 5.) S 06°00' 58" W, a distance of 297.45 feet to a point, said point being the southeast corner of said 21.2028 acre tract and said Central 635 Addition, same being the northeast corner of Wanda Taylor Addition, an addition to the City of Dallas as recorded in Volume 88071, Page4040, DRDCT, from said point a 5/8" iron rod found bears S 65°32' 39" E, a distance of 1.42 feet;

THENCE leaving said right-of-way line along the south line of said 21.2028 acre tract and

EXHIBIT "A"

County Dallas  
Parcel 33  
Highway I.H. 635  
PROJECT Limits:

From: Crim Drive  
To: Pinyon Tree Road

Page 2 OF 3  
D-15-11  
November 20, 2000

CSJ: 2374-01-103  
Acct: 9118-21-07

Legal Land Description for Parcel 33

said Central 635 Addition, being the northline of said Wanda Taylor Addition the following two (2) courses and distances:

- 6.) N 62°21' 17" W, a distance of 482.80 feet to metal fence corner post found, and
- 7.) S 06°14 '36" W, a distance of 90.41 feet to an x-cut found in concrete, said point being a southeast corner of said 21.2028 acre tract and said Central 635 Addition, being the southwest corner of said Wanda Taylor Addition, and being in the north line of a called 1.49 acre tract of land deeded to Dallas Power and Light (DP&L), as recorded in Volume 70161, Page 1122, DRDCT;

THENCE continuing along the south line of said 21.2028 acre tract and said Central 635 Addition, being the north line of said DP&L tract the following two (2) courses and distances:

- 8.) N 62°25 04 " W, a distance of 180.80 feet to a metal fence corner post found, and
- 9.) S 21°58' 54" W, a distance of 69.43 feet to an x-cut in concrete found, said point being a southwest corner of said 21.2028 acre tract and said Central 635 Addition, same being the northeast corner of a called 0.35 acre tract of land deeded to DP&L, as recorded in Volume 70161, Page 1118, DRDCT;
- 10.) THENCE N 61°26' 23" W, along the south line of said 21.2028 acre tract and said Central 635 Addition, being the north line of said DP&L 0.35 acre tract a distance of 508.56 feet to a 5/8" iron rod with yellow plastic cap stamped "CARTER BURGESS" set;
- 11.) THENCE N 6°38' 01" E, along the west line of said 21.2028 acre tract and said Central 635 Addition, being the east line of said DP&L 0.35 acre tract, passing a northwest corner of said DP&L 0.35 acre tract, same being the southeast corner of a called 0.05 acre tract of land deeded to Restland Memorial Park of Dallas, as recorded in Volume 4026, Page 608, DRDCT, continuing along said west line, being the east line of said Restland Memorial tract a total distance of 40.13 feet to a 5/8" iron rod with an aluminum cap stamped "TXDOT" found, said point being a southwest corner of said 21.2028 acre tract and said Central 635 Addition, being the northeast corner of said Restland Memorial tract, and being the southeast corner of a called 0.1913 acre tract of land deeded to TXDOT, as recorded in Volume 99219, Page 949, DRDCT;

EXHIBIT "A"

County Dallas  
Parcel 33  
Highway I.H. 635  
PROJECT Limits:

From: Crim Drive  
To: Pinyon Tree Road

Page 3 OF 3  
D-15-11  
November 20, 2000

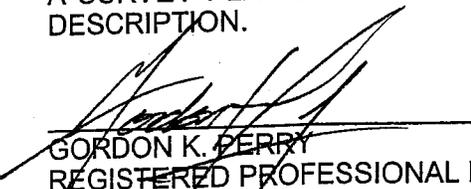
CSJ: 2374-01-103  
Acct: 9118-21-07

Legal Land Description for Parcel 33

THENCE along the west and north lines of said 21.2028 acre tract and said Central 635 Addition, being the east and south right-of-way lines for Us Highway 75 (Central Expressway variable width right-of-way) and said Interstate 635 the following seven (7) courses and distances:

- 12.) S 64°10' 23" E, a distance of 111.27 feet to a 1/2" iron rod found,
- 13.) N 11°57' 38" E, a distance of 133.29 feet to a brass highway monument found in concrete,
- 14.) N 24°14' 31" E, a distance of 224.90 feet to a brass highway monument found in concrete,
- 15.) N 40°15' 41" E, a distance of 450.27 feet to a brass highway monument found in concrete,
- 16.) N 46°20' 53" E, a distance of 260.02 feet to a brass highway monument found in concrete,
- 17.) N 82°16' 43" E, a distance of 139.82 feet to a brass highway monument found in concrete,
- 18.) N 86°17' 33" E, a distance of 352.98 feet to the point of beginning and containing 21.210 acres of land, more of less. Basis of bearing for this description is the Texas Department of Transportation Coordinate System, for US Highway 75, as expanded by Halff Associates, Based on Halff Associates Monuments 402, 403, 404, 405, and 420.

A SURVEY PLAT OF EVEN SURVEY DATE IS ATTACHED TO THIS METES AND BOUNDS DESCRIPTION.

  
GORDON K. PERRY  
REGISTERED PROFESSIONAL LAND SURVEYOR  
TEXAS REGISTRATION NO. 5185

11/21/00  
DATE

\\SUR\02044601\0008\US75-C-1\SDATA\PAR-33.FNS

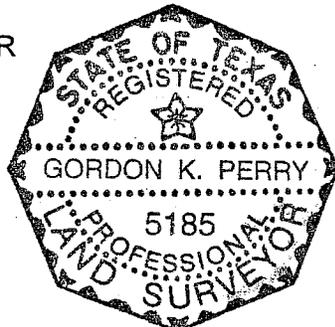


Exhibit "C"

County: Dallas

Highway: Interstate Highway No. 635

Project Limits From: Crim Drive

To: Pinyon Tree Road

CSJ: 2374-21-103

ACC: 9118-21-07

PAGE 1 of 1

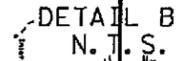
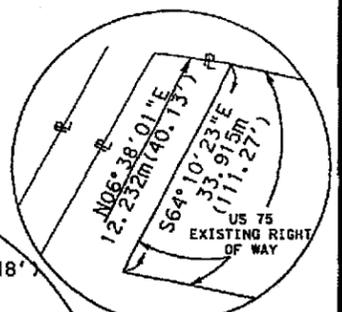
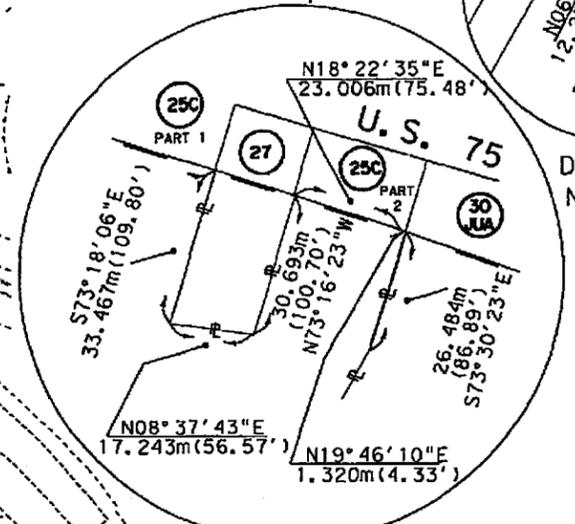
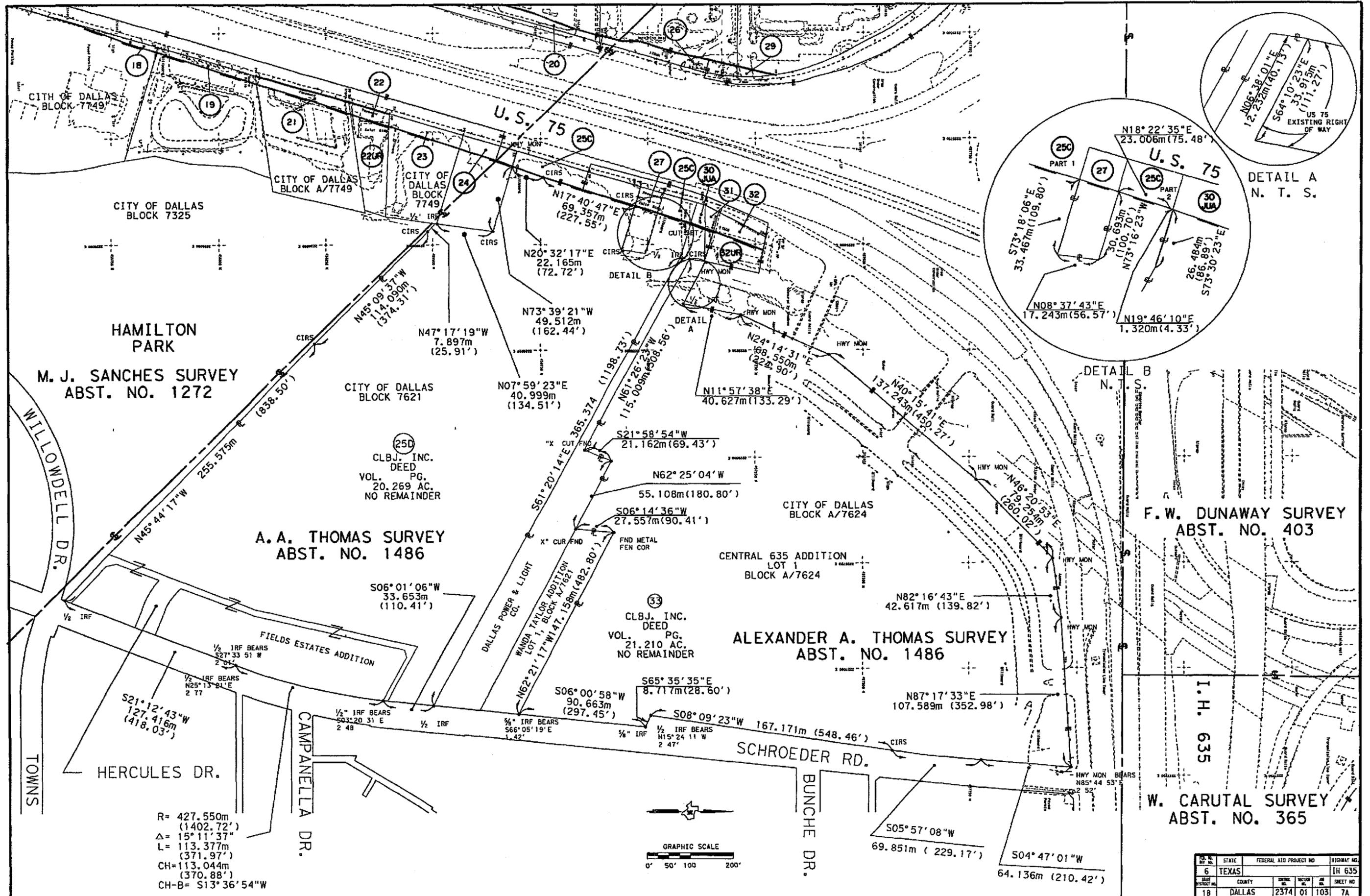
D-15-13

December 24, 1996

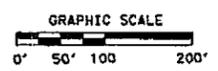
**ACCESS CLAUSE FOR PARCEL 33**

**(To be inserted under last paragraph on page 1 of 3 on D-15-13)**

the beginning of the fifteenth call and a point North 86 degrees 17 minutes 41 seconds East a distance of 32.136 meters [105.43 feet] from the beginning of the eighteenth call of the foregoing property description.



R= 427.550m  
 (1402.72')  
 Δ= 15° 11' 37"  
 L= 113.377m  
 (371.97')  
 CH= 113.044m  
 (370.88')  
 CH-B= S13° 36' 54" W



FILE NO.	STATE	FEDERAL AID PROJECT NO.	HIGHWAY NO.
6	TEXAS		18 635
DATE	COUNTY	SHEET NO.	SHEET NO.
18	DALLAS	2374	01 103 7A

Texas Department of Transportation  
IH 635 Managed Lanes Project  
Technical Provisions

**Attachment 11-1A**

Interstate Access Justification Report

# **INTERSTATE HIGHWAY (I) 635 (LBJ)**

**FROM: LUNA ROAD  
TO: MERIT DRIVE  
DALLAS COUNTY, TEXAS**

## **ACCESS JUSTIFICATION**

### **I 635 CORRIDOR WEST SECTION UPDATE**

**CSJ: 2374-07-046 & 2374-01-068**



**January, 2007**

## Table of Contents

Introduction .....	1
Existing Roadway Network .....	1
Reasonable Alternatives .....	1
Safety and Operation .....	2
Proposed Access .....	15
Consistency with Local and Regional Plans .....	15
Comprehensive Interstate Network.....	15
Coordination.....	15
Planning and Environmental Requirements.....	15
Conclusions .....	15

### Tables

Table 1: Existing, Original and Revised Schematic Access Locations .....	3
Table 2: Category 1 – Added Ramps.....	9
Table 3: Category 3 – Eliminated/Revised Ramps .....	10
Table 4: Category 1 – Added Ramps LOS .....	11
Table 5: Category 2 – Reconfigured Ramps LOS .....	12
Table 6: Category 3 – Eliminated/Reversed/Modified Ramps LOS .....	14
Table 7: Ramp analysis for I 35E - LOS .....	15

### Exhibits

Exhibit 1: TP&P - 2020 Daily Traffic Projections .....	17
Exhibit 2: Traffic & Revenue Study 2020 Daily Traffic Projections.....	21

### Appendices

- Appendix A: Original Access Justification Report (August 2003)
- Appendix B: NCTCOG Managed Lane Policy (September 2006)

**INTERSTATE HIGHWAY I 635 (LBJ)**  
**From LUNA ROAD to MERIT DRIVE**  
**(DALLAS COUNTY, TEXAS)**

**ACCESS JUSTIFICATION**  
**I 635 CORRIDOR WEST SECTION UPDATE**

**Introduction**

The Interstate 635 (LBJ) Corridor is located in north Dallas County extending from SH121 to Interstate 20. The West Section Corridor extends from Luna Road, west of I 35E to Merit Drive, west of US 75. Municipalities located along this corridor include the cities of Dallas and Farmers Branch. The west section of I 635 was completed in the 1970's and the growth in population and employment resulted in a traffic demand that greatly exceeded predictions. The roadway is also in need of substantial rehabilitation.

The intent of this report is to address and update the eight requirements of the Federal Highway Administration (FHWA) for revised access points to the existing Interstate System. The original Interstate Access Justification (IAJ) Report for the west section is dated August 22, 2003 is attached as Appendix A. This report will address the changes in access to I 635 and analyze the impact to the highway based on the revisions to the previous schematic.

It should be noted that this is a highly congested corridor. The funding of the project depends on the traffic in the congested General Purpose Lanes diverting into the Managed Lanes and paying a Toll for this swifter more dependable trip. The revisions to the approved schematic (Exhibit 3 of Attachment A) are required to allow for a more cost effective construction solution for the corridor by allowing for a no tunnel option. This study will update the 2003 IAJ Report using the same assumptions for the modifications.

**Existing Roadway Network**

The Texas Department of Transportation (TxDOT), Dallas District, has produced a schematic design to improve traffic flow and safety for the west section of I 635. The existing General Purpose Lanes (4 in each direction) will be reconstructed. The temporary High Occupancy Vehicle (HOV) Lane (1 in each direction) at grade will be replaced with Managed HOV Lanes (3 in each direction) in a below grade section. The general purpose lanes operation will improve; but it will continue to operate at a low Level-of-Service (LOS). This schematic design is currently being updated to adjust several elements. The NEPA process for this project has been completed. The west corridor received the Finding of No Significant Impact (FONSI) on April 29, 2004. The West Section is being Re-Evaluated to accommodate revised limits of open cut, cut and cover, and mined construction methods. A public meeting to receive comments on these revisions was held on November 16, 2006.

The attached diagram (Exhibit 1) shows the revisions to the Ramps for the Managed HOV Lanes (ML), General Purpose (GP) Lanes, and Frontage Roads (FR).

### **Reasonable Alternatives**

Currently, the I 635 west corridor contains a single temporary High Occupancy Vehicle (HOV) lane in each direction. The proposed managed lane improvements will replace the interim HOV lanes with three Managed HOV Lanes in each direction. Dynamic pricing will be used to influence the traffic demand in the Managed Lanes. Pricing will be adjusted to maintain free flow (50 mph) in the Managed Lanes. HOV vehicles will be given a price reduction in the peak periods. Public transportation providers traveling in the Managed HOV Lanes will not be required to pay a toll at any time. The General Purpose Lanes and Frontage Roads will allow for the traffic mix that exists in the current conditions.

Other mobility improvements are also being implemented in the I 635 corridor.

- Dallas County, Area Cities, and TxDOT are constructing intersection improvements, widening roadways, and implementing signal progression enhancements.
- Dallas Area Rapid Transit (DART) is implementing Employer Trip Reduction programs and other Transportation System Management programs.
- DART has also identified the need for a Transit Rail extension under the corridor between US 75 and the Dallas North Tollway.
- DART will also use the Managed HOV Lanes for an Express Bus Service.

The No-build alternative would not be acceptable to the community.

### **Safety and Operation**

The proposed West Section schematic has the following configuration, which is consistent with the previous schematic that was approved:

- Continuous Frontage Roads;
- 8 General Purpose Lanes;
- 4 Managed HOV Lanes (2 in each direction) from Luna Road to I 35;
- 6 Managed HOV Lanes (3 in each direction) from I 35 E to east of Preston;
- 4 Managed HOV Lanes (2 in each direction) from east of Preston through the I 635/US 75 interchange.

The previously approved IAJ Report based on the original schematic for the West Section of the LBJ corridor can be found in Appendix A. The diagrammatic representation of the revised ramp configuration of the West Section is shown in Exhibit 1. The projected Average Daily Traffic (ADT) in the year 2020 and number of lanes in the West Section of the corridor is also shown in Exhibit 1. A similar diagrammatic representation of the existing conditions is shown in Appendix A (Exhibit 2).

The proposed access locations from Luna Road to Merit Drive. are summarized in the following table (Table 1) in reference to Exhibit 1. The table also illustrates the difference in the ramp configurations between the revised schematic, the original approved schematic and the existing conditions. As the table suggests, in the revised schematic configuration, the majority of the revisions to the previous schematic involve movement of ramps upstream or downstream by a few feet to a few hundred feet.

The revised schematic also calls for minor revisions to ramps along the I 35 E corridor just north of the I 635 / I 35E interchange.

**Table 1: Existing, Original and Revised General Purpose Lane Access Locations <sup>1,2</sup>**

Existing		Approved Schematic		Revised Schematic		Comment <sup>(3)</sup>
<b>East Bound I 635 Traffic</b>						
Ramp	Type	Ramp	Type	Ramp	Type	
		Fr EB GP to FR (Ramp W-E)	Off	Fr EB GP to FR (Ramp W-E)	Off	No Change
		Fr EB GP to ML (Ramp W-ML)	Off	Fr EB GP to ML (Ramp W-ML)	Off	No Change
Fr Luna to EB GP	On	Fr Luna to EB GP (Ramp L-E (1))	On	Fr Luna to EB GP (Ramp L-E (1))	On	No Change
		Fr Luna/FR to EB GP (Ramp L-E (2))	On	Fr Luna/FR to EB GP (Ramp L-E (2))	On	No Change
<b>I 635 / I 35E Interchange</b>						
Access Point on I 635		Access Point on I 635		Access Point on I 635		
Fr EB GP to NB I 35E	Off	Fr EB GP to DC (Conn W-N/S)	Off	Fr EB GP to DC (Conn W-N/S)	Off	No Change
Fr EB GP to SB I 35E	Off					
Fr SB I 35E to EB GP	On	Fr DC to EB GP (Conn N/S-E)	On	Fr DC to EB GP (Conn N/S-E)	On	Ramp moved +90' to the West Insignificant Change
Fr NB I 35E to EB GP	On					
Fr WB GP to NB I 35E	Off	Fr WB GP to DC (Conn E-N/S)	Off	Fr WB GP to DC (Conn E-N/S)	Off	No Change
Fr WB GP to SB I 35E	Off					
Fr NB I 35E to WB GP	On	Fr DC to WB GP (Conn N/S -W)	On	Fr DC to WB GP (Conn N/S -W)	On	No Change
Fr SB I 35E to WB GP	On					
<b>Access Point on I 35E</b>						
Fr WB GP to SB I 35E	On	Fr EB/WB I 635 to SB I 35E (Conn E/W-S)	On	Fr EB/WB I 635 to SB I 35E (Conn E/W-S)	On	No Change
Fr EB GP to SB I 35E	On					
Fr NB I 35E to EB GP	Off	Fr NB I 35E to EB/WB I 635 (Conn S- E/W)	Off	Fr NB I 35E to EB/WB I 635 (Conn S- E/W)	Off	No Change
Fr NB I 35E to WB GP	Off					
Fr WB GP to NB I 35E	On	Fr EB/WB I 635 to NB I 35E (Conn E/W-N)	On	Fr EB/WB I 635 to NB I 35E (Conn E/W-N)	On	GP-Gore moved 300' to the South No impact on operation
Fr EB GP to NB I 35E	On					
Fr SB I 35E to EB GP	Off	Fr SB I 35E to EB/WB I 635 (Conn N- E/W)	Off	Fr SB I 35E to EB/WB I 635 (Conn N- E/W)	Off	No Change
Fr SB I 35E to WB GP	Off					

Existing		Approved Schematic		Revised Schematic		Comment <sup>(3)</sup>
<b>East Bound I 635 Traffic (continued)</b>						
Fr Anaheim to EB GP	On					
Fr EB GP to Josey	Off	Fr EB GP to Josey/Webb Chapel (Ramp W-J/WC)	Off	Fr EB GP to Josey/Webb Chapel (Ramp W-J/WC)	Off	GP Gore - Moved 1180' to East, FR Gore - Moved 820' East No impact on operation
Fr EB GP to Webb Chapel	Off					
Fr Josey/Webb Chapel to EB GP	On	Fr EB GP to Marsh (Ramp W-M)	Off	Fr EB GP to Marsh (Ramp W-M)	Off	GP Gore - Moved 460' to West, FR Gore- Moved 330' to West No impact on operation
		Fr EB ML to GP (Ramp ML-E(1))	On	Fr EB ML to GP (Ramp ML-E(1))	On	Ramp moved 8200' East Significant change, Reanalyzed for impact on operation <sup>a</sup>
Fr EB GP to Marsh	Off	Fr Josey/Webb Chapel to EB GP (Ramp J/WC-E)	On	Fr Josey/Webb Chapel to EB GP (Ramp J/WC-E)	On	GP Gore – Moved 20' to the West FR Gore – Moved 340' to the West No impact on operation
From Marsh to EB GP	On	Fr EB GP to Midway (Ramp W-MW)	Off	Fr EB GP to Midway (Ramp W-MW)	Off	GP Gore – Moved 1270' to the East FR Gore – Moved 1500' to the East Significant change, Analyzed as a weaving section with ramp M-E <sup>b</sup>
Fr EB GP to Midway	Off	Fr Marsh to EB GP (Ramp M-E)	On	Fr Marsh to EB GP (Ramp M-E)	On	GP Gore – Moved 3090' to the West FR Gore – Moved 3450' to the West Significant change, Analyzed as a weaving section with ramp W-MW <sup>b</sup>
From Midway to EB GP	On	Fr Midway to EB GP (Ramp MW-E)	On	Fr Midway to EB GP (Ramp MW-E)	On	GP Gore - No change FR Gore - Moved 160' to West No impact on operation
		Fr EB GP to FR (Ramp W-PKWY)	Off	Fr EB GP to FR (Ramp W-PKWY)	Off	GP Gore - Moved 30' to the East FR Gore - Moved 100' to the East No impact on operation
I 635/DNT Interchange						
Fr EB GP to SB DNT	Off	Fr EB GP to DC (Conn W-N/S DNT)	Off	Fr EB GP to DC (Conn W-N/S DNT)	Off	No Change
Fr EB GP to NB DNT	Off					
Fr SB DNT to EB GP	On	Fr SB DNT to EB GP (Ramp NDNT-E)	On	Fr SB DNT to EB GP (Ramp NDNT-E)	On	No Change
Fr NB DNT to EB GP	On	Fr NB DNT to EB GP (Conn SDNT-E)	On	Fr NB DNT to EB GP (Conn SDNT-E)	On	No Change
Fr WB GP to NB DNT	Off	Fr WB GP to NB DNT (Conn E-NDNT)	Off	Fr WB GP to NB DNT (Conn E-NDNT)	Off	No Change
Fr WB GP to SB DNT	Off	Fr WB GP to SB DNT (Conn E-SDNT)	Off	Fr WB GP to SB DNT (Conn E-SDNT)	Off	No Change
Fr NB DNT to WB GP	On	Fr NB DNT to WB GP (Conn SDNT-W)	On	Fr NB DNT to WB GP (Conn SDNT-W)	On	No Change

Existing		Approved Schematic		Revised Schematic		Comment <sup>(3)</sup>
Fr SB DNT to WB GP	On	Fr SB DNT to WB GP (Conn NDNT-W)	On	Fr SB DNT to WB GP (Conn NDNT-W)	On	No Change
<b>East Bound I 635 Traffic (continued)</b>						
Fr EB FR to EB GP	On					
Fr EB GP to Preston	Off	Fr EB GP to Preston (Ramp W-PR)	Off	Fr EB GP to Preston (Ramp W-PR)	Off	GP Gore - No Change FR Gore - Moved 230' to the East No impact on operation
Fr Montfort to EB GP	On					
Fr EB GP to Hillcrest	Off	Fr EB GP to Hillcrest (Ramp W-HC)	Off	Fr EB GP to Hillcrest (Ramp W-HC)	Off	GP Gore - No Change FR Gore - Moved +-10' to the East No impact on operation
		Fr EB ML to GP (Ramp ML-E(2))	On	Fr EB ML to GP (Ramp ML-E(2))	On	GP Gore - No Change ML Gore - Moved 270' to the East No impact on operation
Fr Preston to EB GP	On	Fr Preston to EB GP (Ramp PR-E)	On	Fr Preston to EB GP (Ramp PR-E)	On	GP Gore - No Change FR Gore - Moved 180' to the West No impact on operation
Fr Hillcrest to EB GP	On	Fr Hillcrest to EB GP (Ramp HC-E)	On	Fr Hillcrest to EB GP (Ramp HC-E)	On	
Fr EB GP to Coit	Off	Fr EB GP to Coit (Ramp W-CT)	Off	Fr EB GP to Coit (Ramp W-CT)	Off	No Change
<b>West Bound I 635 Traffic</b>						
Fr Coit to WB GP	On	Fr Coit to WB GP (Ramp CT-W)	On	Fr Coit to WB GP (Ramp CT-W)	On	No Change
Fr WB GP to Hillcrest	Off					
Fr WB GP to Preston	Off	Fr WB GP to Preston (Ramp E-PR)	Off	Fr WB GP to Preston (Ramp E-PR)	Off	GP Gore - Moved 70' to the West FR Gore - No Change No impact on operation
		Fr WB GP to ML (Ramp E-ML)	Off	Fr WB GP to ML (Ramp E-ML(1))	Off	GP Gore - No Change FR Gore - Moved 300' to the West No impact on operation
From Hillcrest to WB GP	On	Fr Hillcrest to WB GP (Ramp HC-W)	On	Fr Hillcrest to WB GP (Ramp HC-W)	On	No Change
WB Fr WB GP to Montfort	Off					
Fr Preston to WB GP	On	Fr Preston to WB GP (Ramp PR-W)	On	Fr Preston to WB GP (Ramp PR-W)	On	GP Gore - No Change FR Gore - Moved 70' to the East No impact on operation
Fr WB GP to FR	Off	Fr WB GP to FR (Conn E-PKWY)	Off	Fr WB GP to FR (Conn E-PKWY)	Off	GP Gore - Moved 40' to the West FR Gore - No Change No impact on operation
Fr WB GP to Midway	Off	Fr WB GP to Midway (Ramp E-MW)	Off	Fr WB GP to Midway (Ramp E-MW)	Off	GP Gore - No Change FR Gore - Moved 90' to the East No impact on operation

Existing		Approved Schematic		Revised Schematic		Comment <sup>(3)</sup>
Fr Midway to WB GP	On	Fr WB GP to Marsh (Ramp E-M)	Off	Fr WB GP to Marsh (Ramp E-M)	Off	GP Gore – No Change FR Gore - Moved 210' to the East No impact on operation
		Fr WB ML to GP (Ramp ML-W (1))	On			Ramp modified to WB ML to FR, No impact on GP <sup>c</sup>
				Fr WB GP to ML (Ramp E-ML(2))	Off	Ramp analysis performed based on the new location <sup>d</sup>
Fr WB GP to Marsh	Off	Fr Midway to WB GP (Ramp MW-W)	On	Fr Midway to WB GP (Ramp MW-W)	On	GP Gore – Moved 460' to the East FR Gore – Moved 820' to the East No impact on operation
Fr WB GP to Josey/ Webb Chapel	Off	Fr WB GP to Josey/Webb Chapel (Ramp E-J/WC)	Off	Fr WB GP to Josey/Webb Chapel (Ramp E-J/WC)	Off	GP Gore – No Change FR Gore - Moved 120' to the West No impact on operation
Fr Marsh to WB GP	On	Fr Marsh to WB GP (Ramp M-W)	On	Fr Marsh to WB GP (Ramp M-W)	On	Ramp moved +-40' No impact on operation
Fr Webb Chapel to WB GP	On	Fr Josey/Webb Chapel to WB GP (Ramp J/WC-W)	On	Fr Josey/Webb Chapel to WB GP (Ramp J/WC-W)	On	
Fr Josey to WB GP	On					
Fr WB GP to Luna	Off					
		Fr WB GP to FR/Luna (Ramp E-L(2))	Off	Fr WB GP to FR/Luna (Ramp E-L(2))	Off	No Change
Fr WB GP to Luna	Off	Fr WB GP to Luna (Ramp E-L(1))	Off	Fr WB GP to Luna (Ramp E-L(1))	Off	No Change
		Fr ML to WB GP (Ramp ML-W(2))	On	Fr ML to WB GP (Ramp ML-W(2))	On	No Change
		Fr WB FR to WB GP (Ramp E-W)	On	Fr WB FR to WB GP (Ramp E-W)	On	No Change
Access Point on I 35E						
				Fr Frontage Road to NB I 35E ( Ramp FR-N)	On	This ramp provides access from the frontage road to NB I 35E for traffic south of Valley View Lane in addition to the existing on ramp from Valley View Lane. This replaces ramp FR to existing WB/NB DC for Harry Hines <sup>e</sup> . Analyzed as a weaving section with Ramp S-VW.
Fr NB I 35E GP to Valwood Pkwy (Ramp S-VW)	Off	Fr NB I 35E GP to Valwood Pkwy (Ramp S-VW)	Off	Fr NB I 35E GP to Valwood Pkwy (Ramp S-VW)	Off	FR Gore – Moves 570 ' to the North GP Gore - Moves 990 ' to the South Analyzed as a weaving section with Ramp FR-N
Fr Valley View Lane to NB I 35E GP (Ramp VV-N)	On	Fr Valley View Lane to NB I 35E GP (Ramp VV-N)	On	Fr Valley View Lane to NB I 35E GP (Ramp VV-N)	On	FR Gore – Moves 780 ' to the North GP Gore - Moves 50 ' to the South No impact on operation

## Notes for Table 1:

- (1) Abbreviations:  
The following abbreviations apply to the whole document.  
Fr: From  
EB: Eastbound  
WB: Westbound  
NB: Northbound  
SB: Southbound  
PKWY: Parkway  
DNT: Dallas North Tollway  
GP: General Purpose Lanes  
ML: Managed HOV Lanes  
FR: Frontage Roads
- (2) Ramp name convention:  
For off-ramp, the first letter shows “from” what direction (West, East, South or North) and the second letter denotes “to” which cross street. For example, ramp W-MW indicates the (“from” west) EB off-ramp “to” Midway Road. For on-ramp, the first letter shows “from” which cross street and the second letter denotes “to” what direction. For example, ramp MW-E indicates “from” Midway Road “to” east (EB general purpose lanes). See Exhibit 1 and 2 for Ramp names.
- (3) The ‘Comments’ column summarizes changes in the ramp access location in the Revised Schematic in relation to the Original Schematic

The major changes in the schematic, identified in the table above with letter notes are summarized below:

- <sup>a</sup> The EB on ramp from the Managed HOV Lanes to the General Purpose Lane (W-ML(1)) east of the I 35E interchange has been moved downstream by 8200 ft in the revised schematic. The merge was analyzed based on the new schematic configuration.
- <sup>b</sup> The eastbound off ramp to Midway (W-MW) and the eastbound on ramp from Marsh (M-E) have been reversed from the approved schematic. This configuration is consistent with the existing conditions. However, in the existing condition the distance between the on-ramp and the off-ramp is approximately 3000 ft (higher than the threshold of 2500 ft prescribed by HCM for a weaving section to be analyzed), the distance is only approximately 1350 ft in the revised schematic. Therefore, this section was analyzed for weaving condition.
- <sup>c</sup> The westbound on ramp from the Managed HOV Lanes to the General Purpose Lanes (ML-W(1)), west of the off ramp to Midway (E-MW) in the approved schematic, has been eliminated. The traffic from the Managed HOV Lane, in the revised schematic will now exit to the frontage road directly. Therefore, this ramp does not have to be analyzed for the new schematic.
- <sup>d</sup> Based on the old schematic, access was provided to the Managed HOV Lanes from the frontage road in the westbound direction from Midway. This ramp has been eliminated. In the revised schematic, access is provided to the Managed HOV Lane from the General Purpose Lanes. This ramp was analyzed for operational characteristics.
- <sup>e</sup> In the revised schematic a new on ramp from the frontage road to northbound I 35E (FR-N) is added just south of Valley View Lane. This ramp provides additional access to northbound I 35E on top of the existing on ramp from Valley View Lane.

The traffic volumes were modified based on the revised schematic. But, the basic distribution of traffic across various ramps was kept consistent with the 2003 IAJ report. Based on this methodology, revised volumes were estimated on the General Purpose Lanes and reconfigured ramps.

*Eastbound traffic:* Due to the reconfiguration of the on ramp from the Managed HOV Lanes to the General Purpose Lanes (ML-E(1)), the volume on the General Purpose Lanes was estimated to increase by a small amount between the beginning of the Managed HOV Lanes west of I 35E interchange and to the relocated on ramp from the Managed HOV Lanes. Analysis was performed at all the ramp merge and diverge locations based on the revised volumes.

*Westbound traffic:* Using the methodology described above, the westbound traffic was determined for the revised schematic. It was found that the General Purpose Lane volumes will not change except at the locations where ramp gores have significantly moved or the functionality of a ramp has changed.

The projected year 2020 average daily traffic volumes on I 635 General Purpose Lanes, Managed Lanes and ramps are from TxDOT's Transportation Planning and Programming (TP&P) Division are shown in Exhibit 1. The projected average daily traffic volumes have been converted to the peak hour traffic volume by applying a "K" factor to it. A K-Factor of 0.08 was used for this study. The 2003 IAJ report on the I 635 corridor have indicated a K-factor of 0.078 (refer to Appendix A).

The I 635 corridor is located in a highly urbanized area and is the major east-west thoroughfare serving the North Dallas Metropolitan Area. In highly urbanized areas, the peak hour is spread out to most of the day. Therefore, heavy traffic is not restricted to one "peak hour", but rather for a longer "peak period". Past studies have indicated a K-factor of around 0.06 for the peak period (refer to 'Operational Analysis' section of Appendix A) which represents around a 15-hour period in a day.

In the previous study, the operational analysis was first performed using a K-Factor of 0.08, which represents the absolute worst case hour of the day. At locations where there is a breakdown (LOS=F) during the "peak hour", further analysis was performed for the "peak period" using a K-Factor of 0.06 as an alternative analysis. And if the traffic will continue to show failure, then the 2020 traffic numbers developed by the 'LBJ Traffic & Revenue Study' were applied to the level of service check calculation and capacity check. This same methodology was used in the 2003 report.

For weaving analysis, the assumptions made in the 2003 IAJ report have been adopted for this study too. It is assumed that a small volume of traffic would take the on ramp followed by off ramp (ramp to ramp weaving traffic). This percentage is assumed to be half the percentage of exiting traffic in the weaving area. Since HCM procedures are specified for only a maximum of five lane weaving sections, for six-lane weaving (5 upstream lanes plus 1 auxiliary lane) scenarios a factor of 4/5 was applied to the General Purpose Lanes upstream of the weaving segment to reduce the volume to the equivalent of a five-lane section in the weaving area.

In the original study, the ingress and egress locations were classified into 3 categories (See Appendix A, Pg.8).

- Category 1: Ramps that provide access to the General Purpose Lane (including General Purpose Lane/Managed Lane access) that do not exist today. Table 2 lists all the ramps that belong to this category based on the original schematic and the revised schematic.
- Category 2: Access at reconfigured interchanges. The I 635/I 35E and I 635/DNT interchanges fall into this category. The ramps that belong to Category 2 can be found in Appendix A (Table 3, Pg. 8). The configuration of these ramps does not change in the revised schematic.
- Category 3: Eliminated or reversed ramp access. In the revised analysis, this category will include ramps whose gores have moved significantly to warrant further analysis. Table 3 lists the ramps in this category.

**Table 2: Category 1 – Added Ramps**

<b>Ramps</b>		<b>Notes</b>
<b>Revised Schematic</b>	<b>Original Schematic</b>	
1. EB W-E	1. EB W-E	GP/FR Access
2. EB L-E (2)	2. EB L-E (2)	GP/FR Access
3. EB W-PKWY	3. EB W-PKWY	GP/FR Access
4. WB E-L(2)	4. EB E-L(2)	GP/FR Access
5. WB E-W	5. EB E-W	GP/FR Access
6. EB W-ML	6. EB W-ML	GP/ML Access
7. EB ML-E(1)	7. EB ML-E(1)	GP/ML Access
8. EB ML-E(2)	8. EB ML-E(2)	GP/ML Access
9. WB E-ML(1)	9. WB E-ML	GP/ML Access
10. WB E-ML(2)	10. WB ML-W(1)	GP/ML Access
11. WB ML-W(1)	11. WB ML-W(2)	GP/ML Access

**Table 3: Category 3 – Eliminated/Revised Ramps**

Ramps		Notes <sup>1</sup>
Revised Schematic	Original Schematic	
1. EB from Anaheim to GP	1. EB from Anaheim to GP	No change
2. EB from GP to Webb Chapel	2. EB from GP to Webb Chapel	No change
3. EB from Montfort to GP	3. EB from Montfort to GP	No change
4. WB from GP to Hillcrest	4. WB from GP to Hillcrest	No change
5. WB from GP to Montfort	5. WB from GP to Montfort	No change
6. WB from Webb Chapel to GP	6. WB from Webb Chapel to GP	No change
7. WB from GP to FR	7. WB from GP to FR	No change
8a. EB W-M	8a. EB W-M	No change
8b. EB J/WC-E	8b. EB J/WC-E	
9a. EB M-E	9a. EB W-MW	Pair reversed order (on-ramp followed by off-ramp) Consistent with existing configuration.
9b. EB W-MW	9b. EB M-E	
10. WB E-M	10. WB E-M	No change
11. WB MW-W	11. WB MW-W	

<sup>1</sup> Summarizes the change in the revised schematic in relation to the original schematic. Details of the change in comparison to the existing configuration can be found in Appendix A (Table 4, Pg.9).

*Operational Analysis*

Category 1: The operation analyses of General Purpose Lanes that are affected because of the revised schematic configuration have been performed in accordance with the procedures outlined in the 2000 Highway Capacity Manual (HCM), using Highway Capacity Software (HCS). The level of service of Category 1 ramps are shown in Table 4. The freeway analysis evaluates the LOS of freeway segments due to the addition of traffic volume by proposed access ramps. The operational LOS of ramp-freeway junctions was studied in the ramp analysis. The weaving analysis considers the weaving operation between proposed on ramps followed by off ramps.

**Table 4: Category 1 – Added Ramps LOS**

Ramp	Level of Service			Notes
	Freeway	Weaving	Ramp	
W-E	Appendix A			-
L-E (2)	C	No Weaving	B	The operation of this ramp is not affected adversely because of the revised schematic design.
W-PKWY	Appendix A			-
E-L(2)	Appendix A			-
E-W	Appendix A			-
W-ML	D	No Weaving	F E <sup>(i)</sup>	The operation of this ramp is not affected adversely due to the revised schematic.
ML-E(1)	F E <sup>(ii)</sup>	No Weaving	F C <sup>(ii)</sup>	
ML -E(2)	Appendix A			-
E- ML	Appendix A			-
ML -W(1)	Ramp access to Frontage from ML			
ML -W(2)	Appendix A			-
E- ML(2) <sup>(iii)</sup>	F D <sup>(iii)</sup>	No Weaving	F D <sup>(iii)</sup>	This is a modified ramp that provides access to the ML from the General Purpose Lane. This ramp previously provided access from the Frontage Road to the ML.

<sup>i</sup> By using the 2020 Traffic & Revenue Study traffic volume and applying the “peak period” K-Factor of 0.06, the LOS of the ramp diverge condition will improve.

<sup>ii</sup> The peak hour LOS=F is because of insufficient capacity on 4 General Purpose Lanes to handle the 2020 peak hour flow of 12,496vph that is converted from the 156,200vpd by a factor of K=0.08. But, by using the 2020 Traffic & Revenue Study traffic number and applying the “peak period” K-Factor of 0.06, the LOS will improve.

Notes for table 4 continued:

<sup>iii</sup> This is a reconfigured ramp. In the original schematic, the ramp provided connection from the Frontage Road to the Managed HOV Lanes. In the revised schematic the ramp connects the General Purpose Lane to the Managed HOV Lane. The peak hour LOS=F is because of insufficient capacity of 4 General Purpose Lanes for the 2020 peak hour flow of 9,248vph that was converted from the 115,600vpd by a factor of K=0.08. But, by using the 2020 Traffic & Revenue Study traffic number and applying the “peak period” K-Factor of 0.06, the LOS will improve to “D”.

Category 2: The level of service of Category 2 ramps are shown in Table 5. The revised schematic is consistent with the configuration of the I 635/I 35E interchange and the I 635/DNT interchange in the original schematic. There is insignificant movement of some of the ramp locations (Table 1). The projected volume on I 635 General Purpose Lanes at certain locations have changed due to the reconfiguration of ramp access at other locations. New analyses at affected General Purpose Lanes, taking the revised volumes into account, are summarized in Table 5. Table 5 shows that the proposed changes to the schematic have minimal to no impact on Category 2 ramps.

**Table 5: Category 2 – Reconfigured Ramps LOS**

Revised Schematic	Original Schematic	Notes
<b>I 635/I 35 Interchange</b>		
1. Conn W-N/S a) Weaving with ramp L-E(1) Major Diverge Area $88900\text{vpd} \times 0.08 = 7112\text{vph}$ $7112\text{vph} / (\text{PHF}0.9 \times \text{Fhv}0.96)$ $= 8231 \text{ pc/h}$ Average Density $D = 0.0109 \times 8231/6$ $= 14.9 \text{ Eq. 25-12}$ LOS = B Exhibit (25-4)  Depart leg-4 LN Freeway $53400\text{vpd} \times 0.08 = 4272\text{vph}$ $4272\text{vph} / (\text{PHF}0.90 \times \text{Fhv}0.96)$ $= 4944 \text{ pc/h} < 9000 \text{ pc/h}$ from Exhibit 25-14 b) Consolidated one exit point	Refer to Appendix A (Page 14)	The LOS does not change from the previous Study
2. Conn N/S-E a) Major Merge Area Approach leg-3 LN Freeway $46400\text{vpd} \times 0.08 = 3712\text{vph}$ $3712\text{vph} / (\text{PHF}0.90 \times \text{Fhv}0.96)$ $= 4296 \text{ pc/h} < 6750 \text{ pc/h}$ from Exhibit 25-7 Approach Leg-3 LN Conn b) Same as Original Schematic Consolidated one exit point	Refer to Appendix A (Page 15)	Operation of the ramp is not affected by the changes.

3. Conn E-N/S Same as Original Schematic	Refer to Appendix A (Page 15)	--
4. Conn N/S-W Same as Original Schematic	Refer to Appendix A (Page 16)	--
5. Conn S-E/W Same as Original Schematic	Refer to Appendix A (Page 16)	--
6. Conn E/W-N Same as Original Schematic	Refer to Appendix A (Page 17)	--
7. Conn N-E/W Same as Original Schematic	Refer to Appendix A (Page 17)	--
8. Conn E/W-N Same as Original Schematic	Refer to Appendix A (Page 18)	--
<b>Revised Schematic</b>	<b>Original Schematic</b>	<b>Notes</b>
<b>I 635/DNT Interchange</b>		
1. Conn W-N/S DNT Same as Original Schematic	Refer to Appendix A (Page 19)	--
2. Conn NDNT-E Same as Original Schematic	Refer to Appendix A (Page 19)	--
3. Conn SDNT-E Same as Original Schematic	Refer to Appendix A (Page 19)	--
4. Conn E-NDNT Same as Original Schematic	Refer to Appendix A (Page 19)	--
5. Conn E-SDNT Same as Original Schematic	Refer to Appendix A (Page 19)	--
6. Conn SDNT-W Same as Original Schematic	Refer to Appendix A (Page 20)	--
7. Conn NDNT-W Same as Original Schematic	Refer to Appendix A (Page 20)	--

Category 3: The revised schematic maintains the functionality of most of the ramps in the original schematic. In addition the changes that have been addressed in the previous sections, two other major changes include the following: a).The eastbound off ramp to Midway (W-MW) and the eastbound on ramp from Marsh (M-E) are reversed. This will result in the new configuration being consistent with the existing configuration. The distance between the ramps is 1350 ft and falls within the 2500 ft threshold distance for weaving analysis as prescribed by HCM. In the 2003 IAJ report, weaving analysis was conducted for the section between the on ramp from Josey Lane/Webb Chapel (J/WC-E)

and the off ramp to Midway Road (W-MW). The Ramp reversal eliminated the weaving section that occurred in the original schematic as can be seen from Exhibit 1. b) The distance of the weaving section between the WB on ramp from Midway (MW-W) and WB off ramp to Josey/Webb Chapel increases from 2200 ft to 2600 ft (approx.).

The results of the analysis for the above conditions are shown below in Table 6. The original analysis still applies for the other ramps and details of those analyses can be found in Appendix A (Pg. 22-23).

**Table 6: Category 3 – Eliminated/Reversed/Modified Ramps LOS**

Revised Schematic	Original Schematic	Notes
8a and 8b. EB off-ramp to Marsh (Ramp W-M) followed by EB on-ramp from Webb Chapel (Ramp J/WC-E). No weaving between J/WC-E and W-MW.	8a and 8b. EB off-ramp to Marsh (Ramp W-M) followed by EB on-ramp from Webb Chapel (Ramp J/WC-E). Weaving between J/WC-E and W-MW.	No analysis required for the new configuration since there is no weaving section.
9a and 9b. EB on-ramp from Marsh (Ramp M-E) followed by EB off-ramp to Midway (W-MW). Weaving Analysis LOS = F (E <sup>1</sup> )	9a and 9b. Reversed ramps EB off-ramp to Midway (Ramp W-MW) followed by EB on-ramp from Marsh (Ramp M-E)	Weaving between M-E and W-MW with a weaving distance of 1350 ft.
10a and 10b. Reversed ramps WB off-ramp to Marsh (Ramp E-M) followed by WB on-ramp from Midway (Ramp MW-W). Weaving between WB on-ramp from Midway (MW-W) and WB off-ramp to Josey/Webb Chapel (E-J/WC).	10a and 10b. Reversed ramps WB off-ramp to Marsh (Ramp E-M) followed by WB on-ramp from Midway (Ramp MW-W). Weaving between WB on-ramp from Midway (MW-W) and WB off-ramp to Josey/Webb Chapel (E-J/WC).	The weaving distance between the ingress/egress ramps is 2650 ft in the revised schematic compared to 2200 ft in the original schematic. 2500 ft is the maximum distance for which weaving analysis needs to be conducted according to the HCM. Therefore, no analysis was considered necessary for the operation between the ramps in the revised schematic.

<sup>1</sup>By using the 2020 Traffic & Revenue Study traffic volume, applying the “peak period” K-Factor of 0.06 and Peak Hour Factor of 0.95 the LOS of the weaving operation will improve to acceptable condition.

**I 35 E**

A new on ramp from the Frontage Road to northbound I 35E General Purpose Lanes is added in the revised schematic. This ramp forms a weaving segment with the off ramp to Valwood Parkway (Ramp S-VW). Therefore, it was analyzed for weaving operation and freeway capacity. The results are shown in Table 7.

**Table 7: Ramp analysis for I 35E - LOS**

Ramp	Level of Service			Notes
	Freeway	Weaving	Ramp	
FR-N	D	E	-	This ramp was analyzed for weaving operation with Ramp S-VW. This is a five lane weaving segment of 2010 ft length.

**Proposed Access**

The proposed design provides for traffic movement onto corridor and connects only with public roadways and the frontage road system. The proposed access additions are required to support the Managed HOV Lane system, tolling of the managed lanes and the rebuilding of the Interstate System as part of this project. A continuous frontage road system will increase capacity and improve mobility.

**Consistency with Local and Regional Land Use**

A Major Investment Study (MIS) was completed for the entire corridor in 1996. The Metropolitan Planning Organization (MPO) for this region is the North Central Texas Council of Governments (NCTCOG). This proposal considered and is consistent with local and regional land use and transportation plans. The revised corridor is also consistent with the policies and goals set forth by the North Central Texas Council of Governments in the Mobility 2025 Plan. The proposal is also consistent with NCTCOG 2030 plan adopted January 2007. The NCTCOG approved a Managed Lane policy on Sept. 14, 2006 specifically for this corridor (see Appendix B).

The City of Dallas Bond Plan and DART programs include funding and support of this project.

**Comprehensive Interstate Network**

This project will reconstruct the Interstate and Frontage Road network in the process of constructing the Managed HOV Lanes to create a seamless roadway network.

**Coordination**

This request is not generated by new or expanded development. This request is being generated by the Texas Department of Transportation's intent to reconstruct and improve the efficiency and safety of the corridor. The additional Managed HOV Lanes are also critical to maintain the capacity required in the corridor.

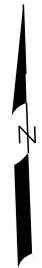
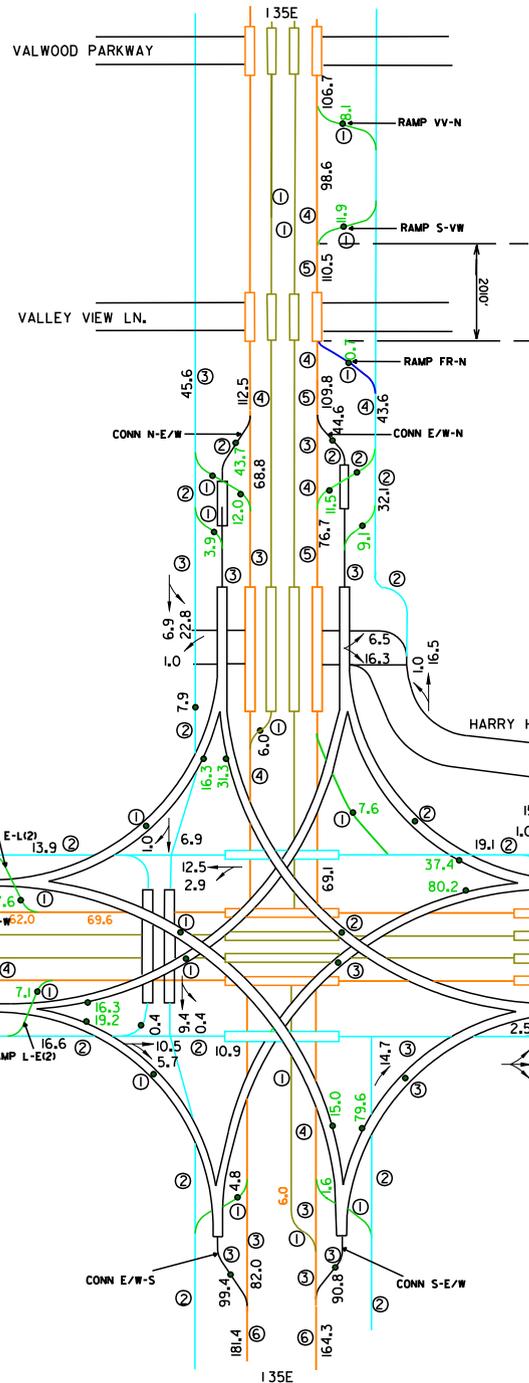
**Planning and Environmental Requirements**

The FONSI Re-Evaluation process for this project is being conducted and the revised design schematic is currently under review by the Austin office of TxDOT.

**Conclusions**

The North Dallas Metropolitan Area will benefit from the additional capacity the Managed HOV Lanes provide for the I 635 area. The additional access is required to rebuild the Interstate System and add the Managed HOV Lanes. This improvement will provide for congestion relief on the existing main lanes. The Managed HOV Lanes will provide for a dependable time saving trip for those willing to use them. Those remaining in the

General Purpose Lanes they will benefit from reduced congestion compared to the current conditions, however some congestion must remain for the Managed HOV Lanes to be economically viable. The revisions to the project will provide for a more cost effective solution to the rebuilding of the corridor.



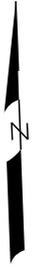
Not to Scale

- LEGEND:**
- GENERAL PURPOSE LANES (GP) ———
  - MANAGED HOV LANES (ML) ———
  - FRONTAGE ROADS (FR) ———
  - BYPASS FRONTAGE ROADS ———
  - RAMPS ———
  - DIRECT CONNECT RAMPS (DC) ———
  - ELIMINATED/RELOCATED RAMPS ———
  - REVISED RAMP LOCATION ———

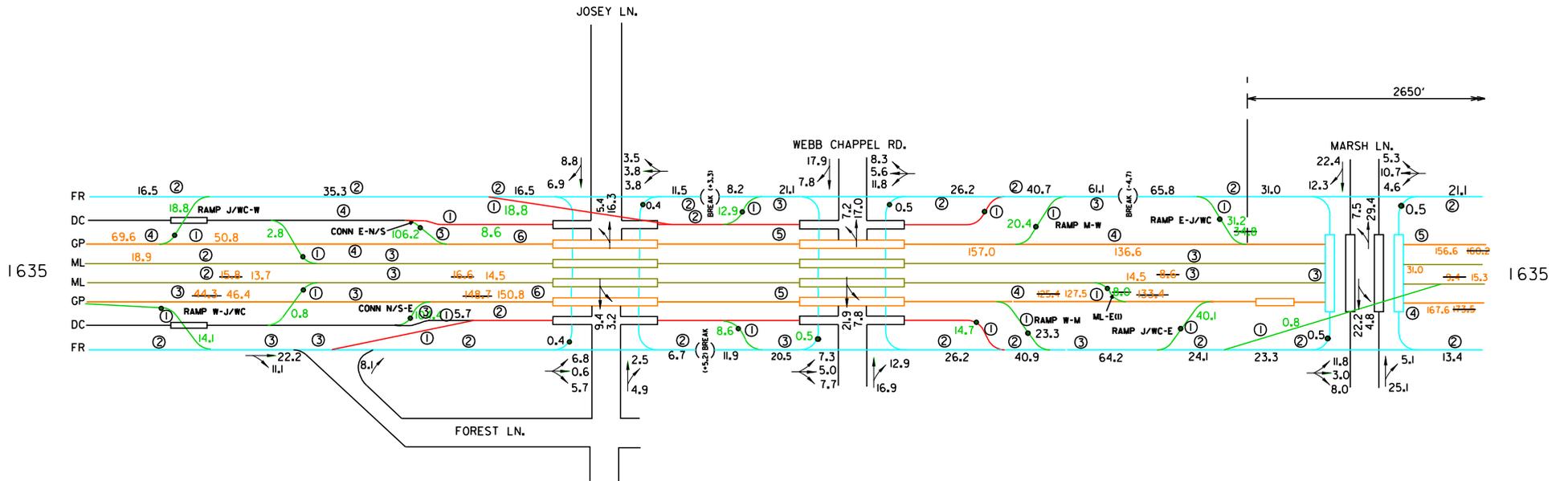
- NOTES:**
1. CROSS STREET ARE SHOWN PERPENDICULAR
  2. MANAGED LANES ARE DIAGRAMMATICALLY LOCATED FOR ACCESS/ EGRESS PURPOSES
  3. TRAFFIC NUMBER (ADT) = \*1000
  4. (N) NUMBER OF LANES
  5. XXX.X ORIGINAL VOLUME (LATER REVISED)
  6. XXX.X REVISED VOLUME
  7. FOR RAMP NAMES REFER TO REPORT

EXHIBIT I

**2020 DAILY TRAFFIC PROJECTIONS**  
**TP&P PROJECTIONS**  
**SHEET 1 OF 4**  
**1635 (LBJ) CORRIDOR WEST SECTION**



Not to Scale



**LEGEND:**

- GENERAL PURPOSE LANES (GP) ———
- MANAGED HOV LANES (ML) ———
- FRONTAGE ROADS (FR) ———
- BYPASS FRONTAGE ROADS ———
- RAMPS ———
- DIRECT CONNECT RAMPS (DC) ———
- ELIMINATED/RELOCATED RAMPS ———
- REVISED RAMP LOCATION ———

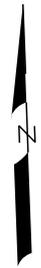
**NOTES:**

1. CROSS STREET ARE SHOWN PERPENDICULAR
2. MANAGED LANES ARE DIAGRAMMATICALLY LOCATED FOR ACCESS/ EGRESS PURPOSES
3. TRAFFIC NUMBER (ADT) = \*1000
4. (C) NUMBER OF LANES
5. XXX.X ORIGINAL VOLUME (LATER REVISED)
6. XXX.X REVISED VOLUME
7. FOR RAMP NAMES REFER TO REPORT

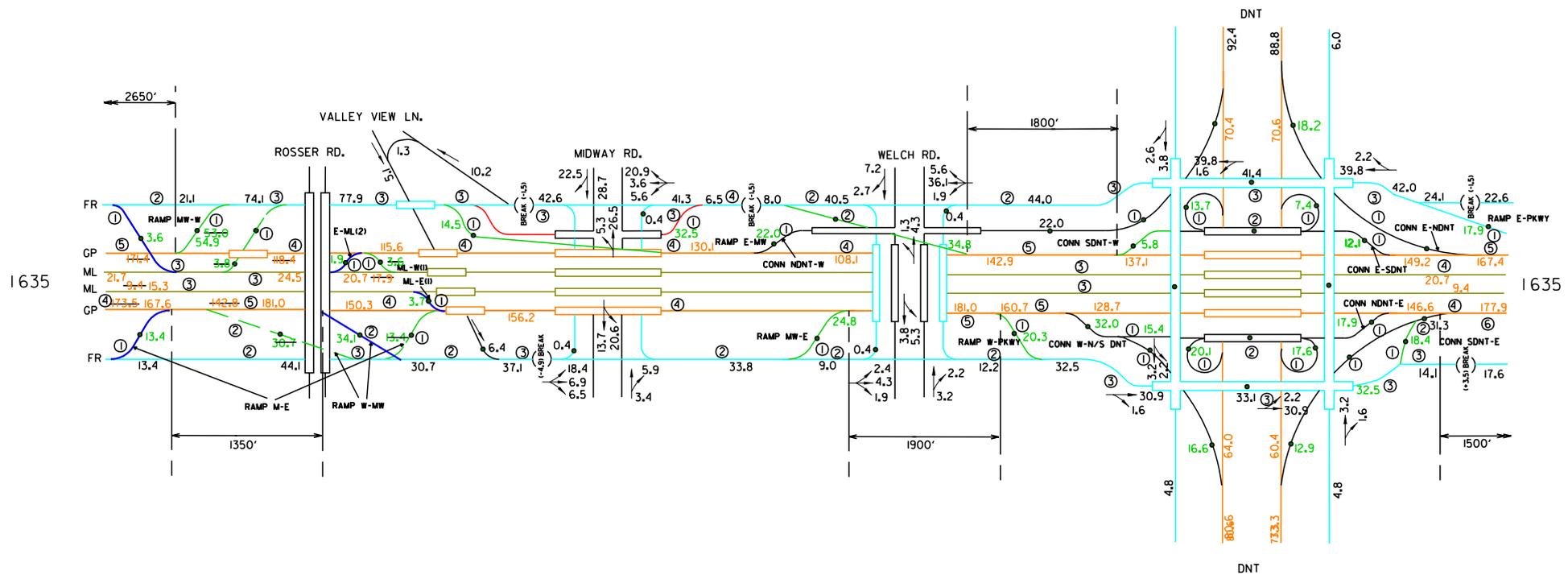
**EXHIBIT 1**



2020 DAILY TRAFFIC PROJECTIONS  
 TP&P PROJECTIONS  
 SHEET 2 OF 4  
 1635 (LBJ) CORRIDOR WEST SECTION



Not to Scale



**LEGEND:**

- GENERAL PURPOSE LANES (GP) ———
- MANAGED HOV LANES (ML) ———
- FRONTAGE ROADS (FR) ———
- BYPASS FRONTAGE ROADS ———
- RAMPS ———
- DIRECT CONNECT RAMPS (DC) ———
- ELIMINATED/RELOCATED RAMPS ———
- REVISED RAMP LOCATION ———

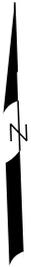
**NOTES:**

1. CROSS STREET ARE SHOWN PERPENDICULAR
2. MANAGED LANES ARE DIAGRAMMATICALLY LOCATED FOR ACCESS/ EGRESS PURPOSES
3. TRAFFIC NUMBER (ADT) = \*1000
4. ( ) NUMBER OF LANES
5. XXX.X ORIGINAL VOLUME (LATER REVISED)
6. XXX.X REVISED VOLUME
7. FOR RAMP NAMES REFER TO REPORT

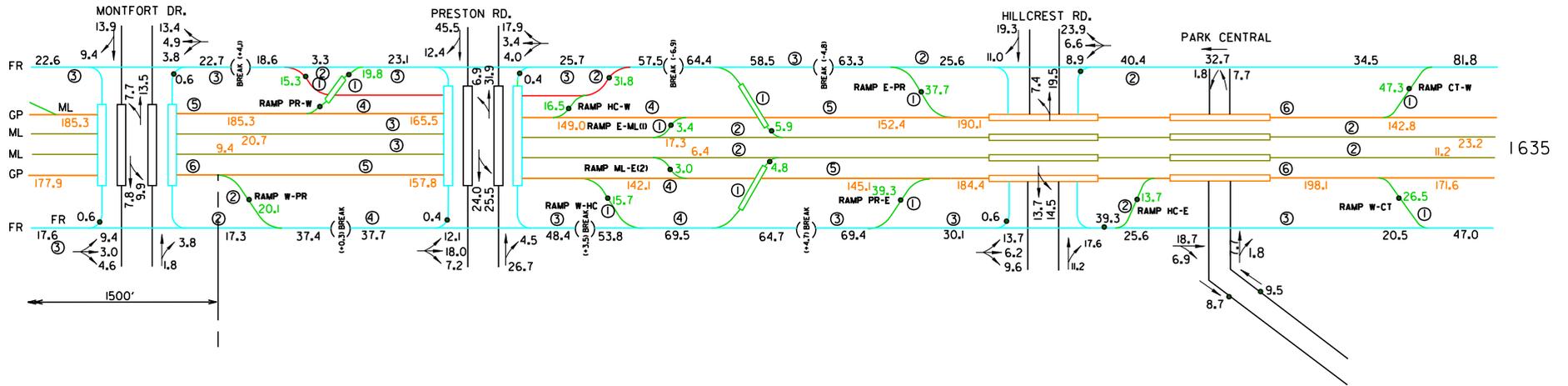
**EXHIBIT I**




2020 DAILY TRAFFIC PROJECTIONS  
TP&P PROJECTIONS  
SHEET 3 OF 4  
1635 (LBJ) CORRIDOR WEST SECTION



Not to Scale



**LEGEND:**

- GENERAL PURPOSE LANES (GP) ———
- MANAGED HOV LANES (ML) ———
- FRONTAGE ROADS (FR) ———
- BYPASS FRONTAGE ROADS ———
- RAMPS ———
- DIRECT CONNECT RAMPS (DC) ———
- ELIMINATED/RELOCATED RAMPS ———
- REVISED RAMP LOCATION ———

**NOTES:**

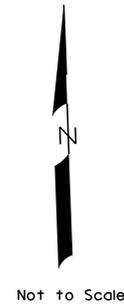
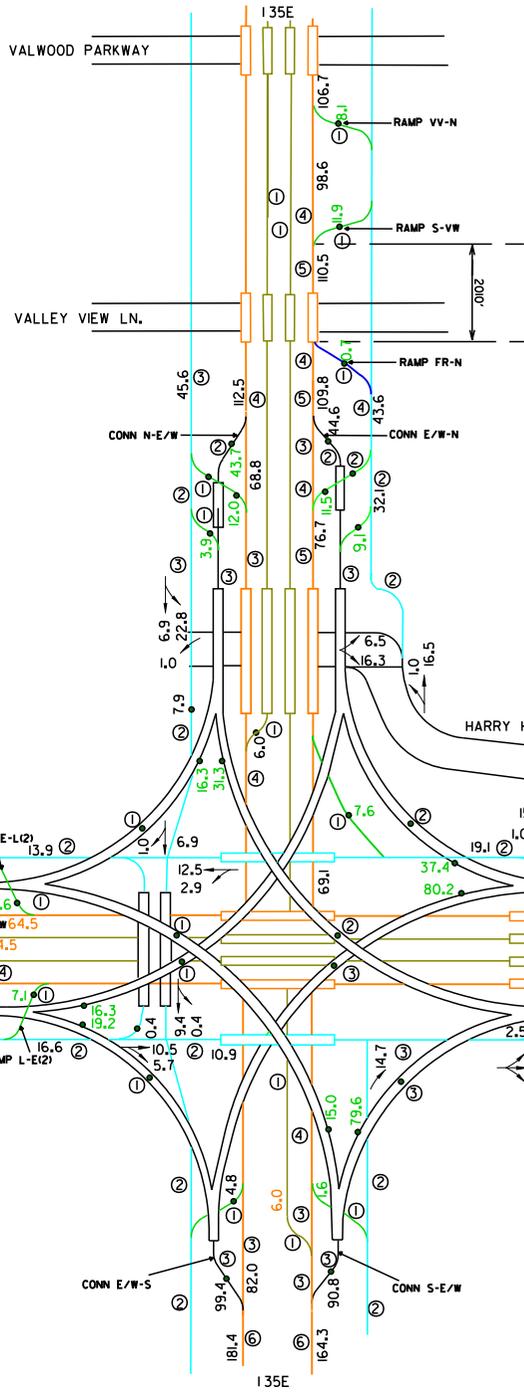
1. CROSS STREET ARE SHOWN PERPENDICULAR
2. MANAGED LANES ARE DIAGRAMMATICALLY LOCATED FOR ACCESS/ EGRESS PURPOSES
3. TRAFFIC NUMBER (ADT) = \*1000
4. ( ) NUMBER OF LANES
5. XXX.X ORIGINAL VOLUME (LATER REVISED)
6. XXX.X REVISED VOLUME
7. FOR RAMP NAMES REFER TO REPORT

**EXHIBIT I**



2020 DAILY TRAFFIC PROJECTIONS  
 TP&P PROJECTIONS  
 SHEET 4 OF 4

1635 (LBJ) CORRIDOR WEST SECTION



- LEGEND:**
- GENERAL PURPOSE LANES (GP) ———
  - MANAGED HOV LANES (ML) ———
  - FRONTAGE ROADS (FR) ———
  - BYPASS FRONTAGE ROADS ———
  - RAMPS ———
  - DIRECT CONNECT RAMPS (DC) ———
  - ELIMINATED/RELOCATED RAMPS ———
  - REVISED RAMP LOCATION ———

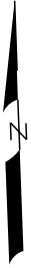
- NOTES:**
1. CROSS STREET ARE SHOWN PERPENDICULAR
  2. MANAGED LANES ARE DIAGRAMMATICALLY LOCATED FOR ACCESS/ EGRESS PURPOSES
  3. TRAFFIC NUMBER (ADT) = \*1000
  4. (⊙) NUMBER OF LANES
  5. ~~XXXX~~ ORIGINAL VOLUME (LATER REVISED)
  6. XXX.X REVISED VOLUME
  7. FOR RAMP NAMES REFER TO REPORT

EXHIBIT 2

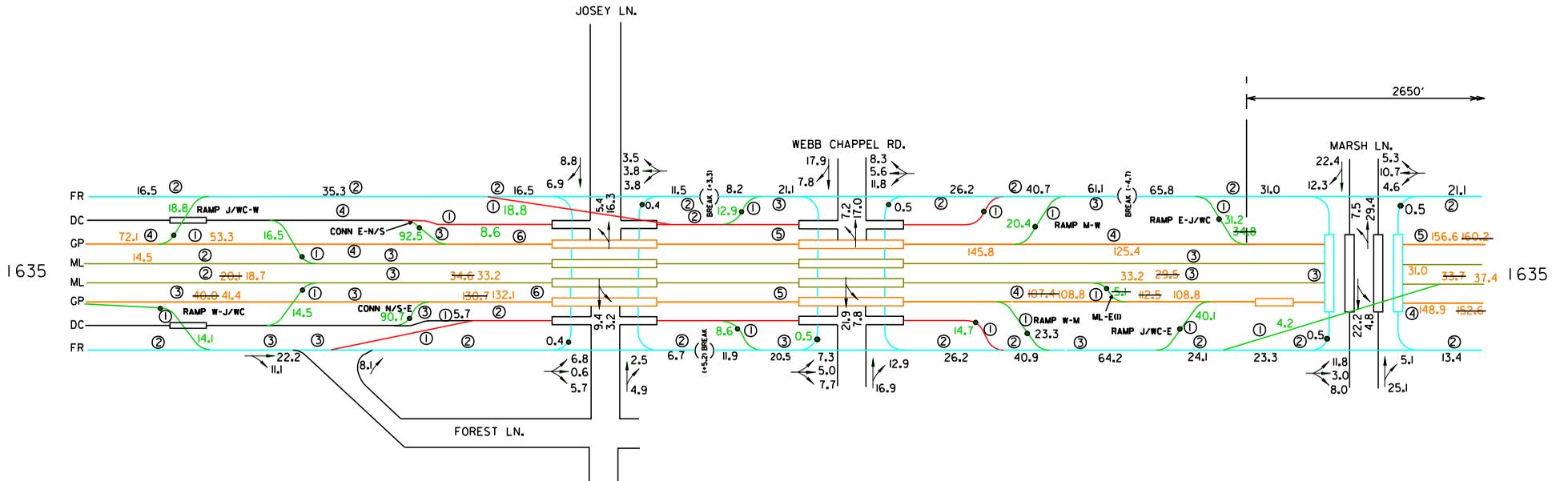


2020 DAILY TRAFFIC PROJECTIONS  
 TRAFFIC AND REVENUE STUDY-WSA  
 SHEET 1 OF 4

1635 (LBJ) CORRIDOR WEST SECTION



Not to Scale



**LEGEND:**

- GENERAL PURPOSE LANES (GP) —
- MANAGED HOV LANES (ML) —
- FRONTAGE ROADS (FR) —
- BYPASS FRONTAGE ROADS —
- RAMPS —
- DIRECT CONNECT RAMPS (DC) —
- ELIMINATED/RELOCATED RAMPS —
- REVISED RAMP LOCATION —

**NOTES:**

1. CROSS STREET ARE SHOWN PERPENDICULAR
2. MANAGED LANES ARE DIAGRAMMATICALLY LOCATED FOR ACCESS/ EGRESS PURPOSES
3. TRAFFIC NUMBER (ADT) = \*1000
4. (Ⓞ) NUMBER OF LANES
5. \*\*\* ORIGINAL VOLUME (LATER REVISED)
6. XXX.X REVISED VOLUME
7. FOR RAMP NAMES REFER TO REPORT

**EXHIBIT 2**

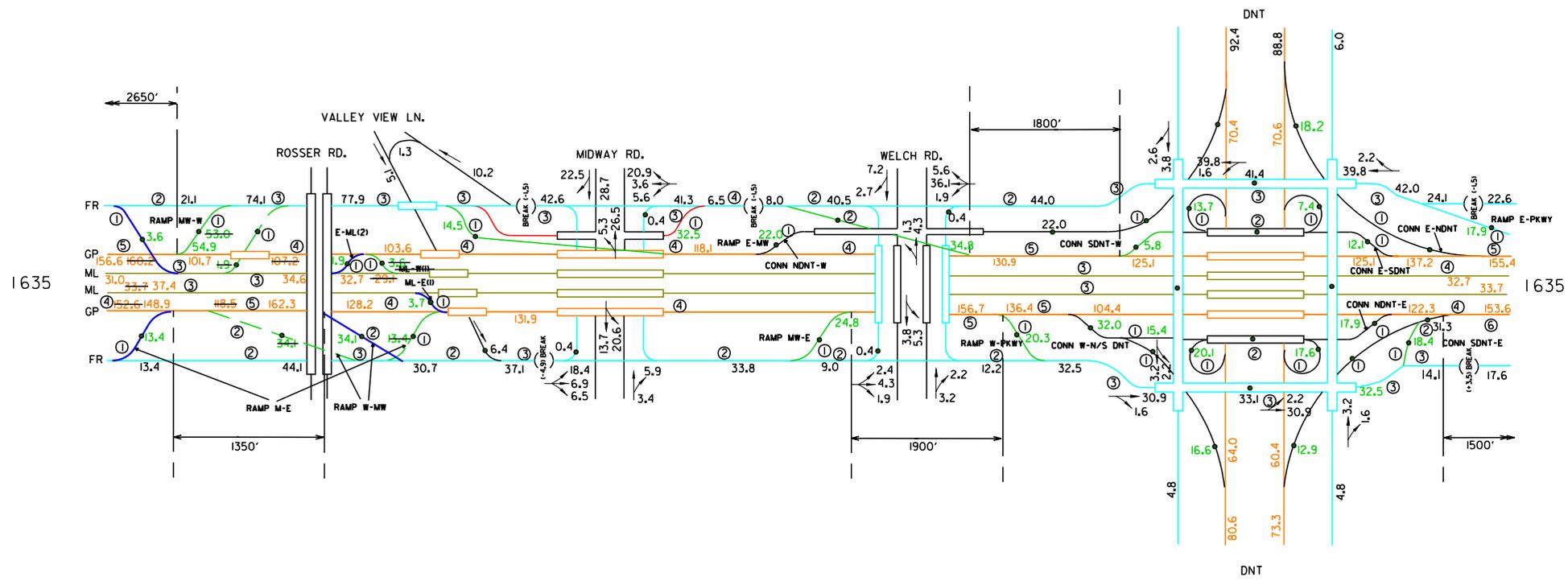



2020 DAILY TRAFFIC PROJECTIONS  
TRAFFIC AND REVENUE STUDY-WSA  
SHEET 2 OF 4

1635 (LBJ) CORRIDOR WEST SECTION



Not to Scale



- LEGEND:**
- GENERAL PURPOSE LANES (GP) ———
  - MANAGED HOV LANES (ML) ———
  - FRONTAGE ROADS (FR) ———
  - BYPASS FRONTAGE ROADS ———
  - RAMPS ———
  - DIRECT CONNECT RAMPS (DC) ———
  - ELIMINATED/RELOCATED RAMPS ———
  - REVISED RAMP LOCATION ———

- NOTES:**
1. CROSS STREET ARE SHOWN PERPENDICULAR
  2. MANAGED LANES ARE DIAGRAMMATICALLY LOCATED FOR ACCESS/ EGRESS PURPOSES
  3. TRAFFIC NUMBER (ADT) = \*1000
  4. (Ⓜ) NUMBER OF LANES
  5. \*\*\* ORIGINAL VOLUME (LATER REVISED)
  6. XXX.X REVISED VOLUME
  7. FOR RAMP NAMES REFER TO REPORT

EXHIBIT 2




2020 DAILY TRAFFIC PROJECTIONS  
TRAFFIC AND REVENUE STUDY-WSA  
SHEET 3 OF 4  
1635 (LBJ) CORRIDOR WEST SECTION



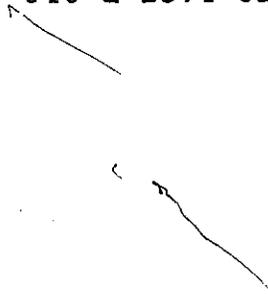
# Appendix

**Appendix A**  
**ACCESS JUSTIFICATION**  
**I 635 CORRIDOR WEST SECTION**  
**(August 22, 2003)**

INTERSTATE HIGHWAY (IH) 635

FROM: LUNA ROAD  
TO: PARK CENTRAL BLVD  
DALLAS COUNTY

CSJ: 2374-07-046 & 2374-01-068



ACCESS JUSTIFICATION  
IH 635 CORRIDOR WEST SECTION

August 22, 2003

Texas Department of Transportation  
Dallas District LBJ Project Office

## Table of Contents

Introduction.....	1
Existing Roadway Network.....	2
Transportation and Land Use Plans.....	2
Regional Traffic Needs.....	3
Reasonable Alternatives.....	3
Connections and Design.....	4
Operational Analysis.....	10
Conclusion.....	27

### Tables

Table 1: Existing and Proposed Mainlane Access Locations.....	5
Table 2: Category 1 - Added Ramps.....	9
Table 3: Category 2 - Reconfigured Ramps.....	9
Table 4: Category 3 - Eliminated/Revised Ramps.....	10
Table 5: Category 1 Ramp LOS.....	13
Table 6: Category 2 Ramp LOS.....	15
Table 7: Category 3 Ramp LOS.....	23

### Exhibits

Exhibit 1: IH 635 Corridor Layout.....	30
Exhibit 2: Existing West Section.....	32
Exhibit 3: LBJ Freeway Corridor Recommended Design Schematic.....	37
Exhibit 4: Proposed West Section.....	38
Exhibit 5: Proposed West Section (Traffic # by WSA).....	42
Exhibit 6: CORSIM Simulation.....	46

## ACCESS JUSTIFICATION LBJ Corridor West Section

### Introduction

The IH 635 (LBJ Freeway) corridor is located in the Dallas/Fort Worth metropolitan area. The corridor is approximately 21 miles in length extending from Luna Road, west of IH 35E, to US 80, in the City of Mesquite. Its width extends from Beltline Road to the North and Loop 12 to the south. Municipalities located along this corridor include the cities of Farmers Branch, Dallas, Garland and Mesquite.

The LBJ freeway corridor encompasses one of the most highly developed commercial and residential areas in North Texas. The completion of LBJ freeway in the 1970's resulted in significant population and employment growth in the region. This growth in conjunction with the opening of DFW International Airport led to traffic demand that greatly exceeded predictions.

The LBJ freeway serves a variety of trip purposes. It serves long distance trips accessing other regional facilities such as IH 35E, Dallas North Tollway (DNT), US 75, IH 30 and US 80. The residential and commercial developments within the region serve as origins and destinations for shorter and local trips. The combination of these users has resulted in significant congestion for many hours each day. Predicted development and travel demand growth for the area indicate that the problem will continue to worsen.

The corridor is divided into 4 sections. The West section is from Luna Road to Park Central Boulevard. The Dallas High Five section is from Park Central Boulevard to West of Greenville Ave. The East section is from East of Greenville Ave including the Greenville Ave underpass to North of Town East Boulevard. The Mesquite section is from North of Town East Boulevard to US 80. Exhibit 1 depicts the general area.

The Dallas High Five is currently under construction. The Mesquite section access justification has been separately performed and approved by the FHWA and TxDOT's Design Division. The Public Hearing for Mesquite Section was held on May 7, 2002 and a Category Exclusion (CatEx) was obtained on September 6, 2002. The NEPA process for the Mesquite Section has been completed. In addition, the Mesquite Section phase I construction has started and the phase II PS&E is in process.

The Public Hearing for the East Section was held on October 10, 2002 and a Finding of No Significant Impact (FONSI) was obtained on January 30, 2003. The NEPA process for the East Section has also been completed. In addition, the East Section access justification had been submitted to FHWA as separate report and

was approved on December 24, 2002.

The West Section is in its final stages of the NEPA process. The design schematic has been approved. The Environmental Assessment (EA) has obtained a "Satisfaction for Further Processing" status from FHWA. The West Section Public Hearing was held in June 5, 2003. The final "IH 635 West Section Public Hearing Documentation Package" has been submitted to FHWA via TxDOT Environmental Affairs Division to seek FONSI.

This report covers the access justification for the West Section of LBJ freeway corridor. It describes the existing facility, its relation to the regional transportation and land use plan, other alternatives evaluated, and the design and operational characteristics of the proposed ramps.

### **Existing Roadway Network**

The LBJ Freeway generally consists of eight mainlanes except at interchanges. One-way service roads are generally two and three lanes wide and are not continuous. Right-of-way (ROW) width varies from 330' to 450' depending on the existence of service roads, interchange design and drainage requirements.

Within the West section, there are two major crossing facilities, IH 35E and the Dallas North Tollway (DNT). In addition, there are 15 cross street intersections. Access situations vary from full access to no access from the LBJ freeway. Interim HOV lanes also exist in the West Section. Exhibit 2 demonstrates the detailed access situation at each cross street, and the IH 35E and DNT interchanges. The average daily traffic (ADT) in the year 1997 and number of lanes on the West Section existing roadway network are also shown in the Exhibit 2.

### **Transportation and Land Use Plans**

The North Central Texas Council of Government (NCTCOG), the metropolitan planning organization (MPO) for this region, is responsible for preparing financially constrained regional transportation plans. A Major Investment Study (MIS) was completed for the entire corridor in 1996. The LBJ freeway has been a major factor in commercial development. In 1995, total employment for Dallas County was approximately 1.44 million. The LBJ corridor study boundaries contained nearly 80% of the total employment in Dallas County. The results of this study have been included in each of the region's Mobility plans since that time.

The proposed action is consistent with the area's financially constrained Metropolitan Transportation Plan, Mobility 2025 Plan Update.

## Regional Traffic Needs

The dramatic population growth and the variety of trip purposes served within the LBJ corridor led to travel demands that far exceeded original projections for the freeway. The average daily traffic for LBJ freeway has continued to increase each year from 100,000 vehicle per day (vpd) in 1976 to 230,000 vpd in 1994 to a projected volume of over 400,000 vpd in 2020. The extremely high traffic volumes result in significant congestion for many hours each day. The high travel demand for the freeway has forced traffic to spread out beyond the normal peak hours and creating congested conditions for most of the day. For example, the Texas Transportation Institute (TTI) of Texas A&M University made traffic counts at two EB IH 635 mainlane locations east of IH 35E on February 1, 2001 (Friday). The 15-hour (6AM to 9PM) traffic volumes are 59,087 vehicles with the highest hourly volume of 5,310 (4PM to 5PM) and lowest hourly volume of 2,838 (10AM to 11AM).

Transportation improvements implemented on and near LBJ freeway have not been able to satisfy the ever-increasing travel demand in the area or reduce congestion on the facility. Predicted development and travel demand growth for the area indicate that the problem will continue to worsen in the foreseeable future. The current and projected travel demand clearly warrants a need for improvements.

## Reasonable Alternatives

The following reasonable alternatives were evaluated to determine if they meet the traffic demand in the corridor.

- Programmed Improvements (no-build)
- Transportation System Management (TSM)
- Transportation Demand Management (TDM)

It was concluded after the evaluation that these alternatives could not help much in meeting the traffic demand. The following is a discussion of each alternative.

Programmed Improvements (no-build): Programmed improvements are projects that are included in the regional transportation plan, Mobility 2025 plan, and have funding programmed for their construction. The local parallel streets that can be used as partial relief routes are Forest Lane to the south and Spring Valley to the north. These streets are currently serving at full capacities with their own congestion problems during peak hours. In addition, the President George Bush Turnpike (PGBT) is a toll road and is more than 4 miles to the north of LBJ freeway. Although the PGBT is offering a reasonable alternative to some current LBJ travelers, it is already experiencing peaking conditions that would not encourage greater diversion from LBJ.

Thus, without the extensive reconstruction and improvements of the LBJ freeway, the future traffic demand cannot be adequately accommodated.

**TSM Strategies:** TSM strategies improve the flow of traffic through improvements to the transportation network and include traffic signal timing improvements, signing improvements and intersection geometry improvements. NCTCOG, TxDOT and the surrounding cities have identified and been working on various intersection improvement projects. These improvements will mostly benefit and smoothen the local/off-system traffic flow. Their impacts on the LBJ freeway mainlanes are negligible.

**TDM Strategies:** TDM strategies reduce or manage traffic demand. They include strategies such as Employer Trip Reduction (ETR) program, telecommuting, flexible work hours and ride sharing. The private corporations and public entities along the LBJ corridor have already implemented various such programs. In addition, non-work related trips such as dropping children off at daycare or school, shopping, lunch, along with the geographic diversification of land uses create the dependency on the private automobile. The Dallas Area Rapid Transit (DART) lines are basically radial lines in relation to IH 635, see Exhibit 3. DART will relieve radial traffic congestion such as congestion on US 75, DNT and IH 35E, rather than the congestion on IH 635. It is evident that TDM strategies alone cannot help much to improve the congestion significantly.

### **Connections and Design**

The proposed West Section schematic calls for

- continuous frontage roads;
- 8 mainlanes with wider inside shoulders for the future flexibility to expand to 10 mainlanes;
- 4 HOV/HOT lanes (2 in each direction) from Luna Road to west of Josey;
- 6 HOV/HOT lanes (3 in each direction) from west of Josey to east of Preston; and
- 4 HOV/HOT lanes (2 in each direction) from east of Preston through the IH 635/US 75 interchange.

The diagrammatic representation of the West Section is shown in Exhibit 4. The projected average daily traffic (ADT) in the year 2020 and number of lanes on the West Section proposed roadway network are also shown in the Exhibit 4.

The existing and proposed mainlane access locations from Luna Road to Park Central Blvd are summarized in the following table in reference to the Exhibits 2 and 4.

**TABLE 1: Existing and Proposed Mainlane Access Locations**

Proposed		Existing	
East Bound Traffic			
Ramp	Type	Ramp	Type
Fr EB ML to FR (Ramp W-E)	Off		
Fr EB ML to HOV (Ramp W-HOV)	Off		
Fr Luna to EB ML (Ramp L-E(1))	On	Fr Luna to EB ML	On
Fr Luna/FR to EB ML (Ramp L-E(2))	On		
IH 635/IH 35E Interchange			
Access Point on IH 635		Access Point on IH 635	
Fr EB ML to DC (Conn W-N/S)	Off	Fr EB ML to NB IH 35E	Off
		Fr EB ML to SB IH35E	Off
Fr DC to EB ML (Conn N/S-E)	On	Fr SB IH 35E to EB ML	On
		Fr NB IH 35E to EB ML	On
Fr WB ML to DC (Conn E-N/S)	Off	Fr WB ML to NB IH 35E	Off
		Fr WB ML to SB IH 35E	Off
Fr DC to WB ML (Conn N/S-W)	On	Fr NB IH 35E to WB ML	On
		Fr SB IH 35E to WB ML	On
Access Point on IH 35E		Access Point on IH 35E	
Fr EB/WB IH 635 to SB IH 35E (Conn E/W-S)	On	Fr WB ML to SB IH 35E	On
		Fr EB ML to SB IH 35E	On
Fr NB IH 35E to EB/WB IH 635 (Conn S-E/W)	Off	Fr NB IH 35E to EB ML	Off
		Fr NB IH 35E to WB ML	Off
Fr EB/WB IH 635 to NB IH 35E (Conn E/W-N)	On	Fr WB ML to NB IH 35E	On
		Fr EB ML to NB IH 35E	On
Fr SB IH 35E to EB/WB IH 635 (Conn N-E/W)	Off	Fr SB IH 35E to EB ML	Off
		Fr SB IH 35E to WB ML	Off

Table 1 Continue

East Bound Traffic (continue)			
		Fr Anaheim to EB ML	On
Fr EB ML to Josey/Webb Chapel (Ramp W-J/WC)	Off	Fr EB ML to Josey	Off
		Fr EB ML to Webb Chapel	Off
Fr EB ML to Marsh (Ramp W-M)	Off	Fr Josey/Webb Chapel to EB ML	On
Fr EB HOV to ML (Ramp HOV-E(1))	On		
Fr Josey/Webb Chapel to EB ML (Ramp J/WC-E)	On	Fr EB ML to Marsh	Off
Fr EB ML to Midway (Ramp W-MW)	Off	Fr Marsh to EB ML	On
Fr Marsh to EB ML (Ramp M-E)	On	Fr EB ML to Midway	Off
Fr Midway to EB ML (Ramp MW-E)	On	Fr Midway to EB ML	On

Fr EB ML to FR (Ramp W-PKWY)	Off		
IH 635/DNT Interchange			
Fr EB ML to DC (Conn W-N/S DNT)	Off	Fr EB ML to SB DNT	Off
		Fr EB ML to NB DNT	Off
Fr SB DNT to EB ML (Ramp NDNT-E)	On	Fr SB DNT to EB ML	On
Fr NB DNT to EB ML (Conn SDNT-E)	On	Fr NB DNT to EB ML	On
Fr WB ML to NB DNT (Conn E-NDNT)	Off	Fr WB ML to NB DNT	Off
Fr WB ML to SB DNT (Conn E-SDNT)	Off	Fr WB ML to SB DNT	Off
Fr NB DNT to WB ML (Conn SDNT-W)	On	Fr NB DNT to WB ML	On
Fr SB DNT to WB ML (Conn NDNT-W)	On	Fr SB DNT to WB ML	On
East Bound Traffic (continue)			
		Fr EB FR to EB ML	On
Fr EB ML to Preston (Ramp W-PR)	Off	Fr EB ML to Preston	Off
		Fr Montfort to EB ML	On
Fr EB ML to Hillcrest (Ramp W-HC)	Off	Fr EB ML to Hillcrest	Off
Fr EB HOV to ML (Ramp HOV-E(2))	On		
Fr Preston to EB ML (Ramp PR-E)	On	Fr Preston to EB ML	On
Fr Hillcrest to EB ML (Ramp HC-E)	On	Fr Hillcrest to EB ML	On

Table 1 Continue

Fr EB ML to Coit (Ramp W-CT)	Off	Fr EB ML to Coit	Off
West Bound Traffic			
Fr Coit to WB ML (Ramp CT-W)	On	Fr Coit to WB ML	On
		Fr WB ML to Hillcrest	Off
Fr WB ML to Preston (Ramp E-PR)	Off	Fr WB ML to Preston	Off
Fr WB ML to HOV (Ramp E-HOV)	Off		
Fr Hillcrest to WB ML (Ramp HC-W)	On	Fr Hillcrest to WB ML	On
		WB Fr WB ML to Montfort	Off
Fr Preston to WB ML (Ramp PR-W)	On	Fr Preston to WB ML	On
Fr WB ML to FR (Conn E-PKWY)	Off	Fr WB ML to FR	Off
Fr WB ML to Midway (Ramp E-MW)	Off	Fr WB ML to Midway	Off

Fr WB ML to Marsh (Ramp E-M)	Off	Fr Midway to WB ML	On
Fr WB HOV to ML (Ramp HOV-W(1))	On		
Fr Midway to WB ML (Ramp MW-W)	On	Fr WB ML to Marsh	Off
Fr WB ML to Josey/Webb Chapel (Ramp E-J/WC)	Off	Fr WB ML to Josey/Webb Chapel	Off
Fr Marsh to WB ML (Ramp M-W)	On	Fr Marsh to WB ML	On
Fr Josey/Webb Chapel to WB ML (Ramp J/WC-W)	On	Fr Webb Chapel to WB ML	On
		Fr Josey to WB ML	On
		Fr WB ML to FR	Off
Fr WB ML to FR/Luna (Ramp E-L(2))	Off		
Fr WB ML to Luna (Ramp E-L(1))	Off	Fr WB ML to Luna	Off
Fr HOV to WB ML (Ramp HOV-W(2))	On		
Fr WB FR to WB ML (Ramp E-W)	On		
Summary			
# of EB ML/Cross Street On Ramps	7		9
# of EB ML/Cross Street Off Ramps	8		7
# of EB ML/HOV Access	3		0

Table 1 Continue

# of IH 635/IH 35E Interchange Access	8		16
# of IH 635/DNT Interchange Access	7		8
# of WB ML/Cross Street On Ramps	7		7
# of WB ML/Cross Street Off Ramps	7		9
# of WB ML/HOV Access	3		0

Notes:

- (1) Ramp name convention: For off-ramp, the first letter shows "from" what direction (west, east, south or north) and the second letter denotes "to" which cross street. For example, ramp W-MW indicates the ("from" west) EB off-ramp "to" Midway Road. For on-ramp, the first letter shows "from" which cross street and the second letter denotes "to" what direction. For example, ramp MW-E indicates "from" Midway Road "to" east (EB mainlane).
- (2) The existing interim HOV lane in the West Section is not a barrier separated HOV lane from the mainlanes. The access between the mainlane and the HOV is not connected by conventional ramps and thus, the existing mainlane and HOV

access locations are not listed in the above table.

There are three categories of access included in the proposed schematics that need to be justified.

- Category 1: Category 1 access is for any ramps that will provide mainlane on/off access that does not exist today (including mainlane/HOV access).
- Category 2: Category 2 access is for reconfigured interchanges. The proposed IH 635/IH 35E and IH 635/DNT interchanges in the West Section fall into this category, according to the FHWA guidance.
- Category 3: Category 3 access is for eliminated ramp access and reversed ramp access that will be investigated case by case to ensure that no adverse effect exists.

In reference to the Exhibits 2, 4 and Table 1, Table 2 lists ramps that are classified as Category 1 access.

**Table 2: Category 1 - Added Ramps**

Ramps	Note
1. EB W-E	Mainlanes/FR Access
2. EB L-E(2)	Mainlanes/FR Access
3. EB W-PKWY	Mainlanes/FR Access
4. WB E-L(2)	Mainlanes/FR Access
5. WB E-W	Mainlanes/FR Access
6. EB W-HOV	Mainlanes/HOV Access
7. EB HOV-E(1)	Mainlanes/HOV Access
8. EB HOV-E(2)	Mainlanes/HOV Access
9. WB E-HOV	Mainlanes/HOV Access
10. WB HOV-W(1)	Mainlanes/HOV Access
11. WB HOV-W(2)	Mainlanes/HOV Access

Table 3 shows the reconfigured IH 635/IH 35E interchange connectors and revised access locations on IH 635 of IH 635/DNT interchange. These connectors and access locations are defined as Category 2 access. The access locations on DNT of IH 635/DNT interchange will remain the same and thus, are not listed in the Table 3.

**Table 3: Category 2 - Reconfigured Ramps**

Direct Connectors	Note
IH 635/IH 35E Interchange	
1. Conn W-N/S	EB IH 635 Exit to NB/SB IH 35E

2. Conn N/S-E	Entrance from NB/SB IH 35E to EB IH 635
3. Conn E-N/S	WB IH 635 Exit to NB/SB IH 35E
4. Conn N/S-W	Entrance from NB/SB IH 35E to WB IH 635
5. Conn S-E/W	NB IH 35E Exit to EB/WB IH 635
6. Conn E/W-S	Entrance from EB/WB IH 635 to SB IH 35E
7. Conn N-E/W	SB IH 35E Exit to EB/WB IH 635
8. Conn E/W-N	Entrance from EB/WB IH 635 to NB IH 35E
IH 635/DNT Interchange	
1. Conn W-N/S DNT	EB IH 635 Exit to NB/SB DNT
2. Conn NDNT-E	Entrance from SB DNT to EB IH 635
3. Conn SDNT-E	Entrance from NB DNT to EB IH 635
4. Conn E-NDNT	WB IH 635 Exit to NB DNT
5. Conn E-SDNT	WB IH 635 Exit to SB DNT
6. Conn SDNT-W	Entrance from NB DNT to WB IH 635
7. Conn NDNT-W	Entrance from SB DNT to WB IH 635

Due to the proposed continuous frontage roads, widened mainlanes, added HOV lanes and reconstruction of all cross street overpasses/underpasses, all the cross street access ramps will be revised from their existing conditions. Table 4 lists all eliminated access and on/off reversed ramps (Category 3 access).

**Table 4: Category 3 - Eliminated/Revised Ramps**

Ramps	Note
1. EB from Anaheim to ML	Eliminated Access
2. EB from ML to Webb Chapel	Eliminated Access
3. EB from Montfort to ML	Eliminated Access
4. WB from ML to Hillcrest	Eliminated Access
5. WB from ML to Montfort	Eliminated Access
6. WB from Webb Chapel to ML	Eliminated Access
7. WB from ML to FR	Eliminated Access
8a. EB W-M	Pair Reversed on/off Order (off-ramp followed by on-ramp)
8b. EB J/WC-E	
9a. EB W-MW	Pair Reversed on/off Order (off-ramp followed by on-ramp)
9b. EB M-E	
10a. WB E-M	Pair Reversed on/off Order (off-ramp followed by on-ramp)
10b. WB MW-W	

### Operational Analysis

The operational analyses of mainlanes that are affected by the above three (3) categories of access ramps have been performed in accordance with the procedures outlined in the 2000 Highway Capacity Manual (HCM), using Highway Capacity Software (HCS). The analysis consists of freeway analysis, weaving analysis, ramp analysis and major merge/diverge analysis, whenever applicable. The projected year 2020 daily traffic volumes on IH 635 mainlanes, HOV/HOT and ramps are from TxDOT Transportation

Planning and Programming (TP&P) Division and shown in Exhibit 4. The average daily traffics (ADTs) have been converted to the busiest one hour (peak hour) traffic volume by a factor of "K" for calculation of the year 2020 peak hour level of service (LOS) to have a general understanding of the "worst" traffic operation conditions during a day. The factor "K" ranges from 0.08 to 0.12 for general urban facilities based on the TxDOT's Roadway Design Manual Chapter 2 Section 2. For IH 635 that serves a highly urbanized and fully developed area, the factor "K" is close to 0.8 (for example,  $K=0.078$  as computed from TTI February 1, 2001 traffic count at east of IH 35E). In addition, the year 1997 daily traffic volumes on IH 635 mainlanes and ramps are also from TxDOT TP&P Division and shown in Exhibit 2. They are used for the computation of the peak hour level of service in the existing conditions.

As discussed in the "Regional Traffic Needs" section, the LBJ corridor is located in and serves a highly urbanized region. The heavy traffic is not limited to only one "peak hour" defined above. It actually spreads out to most of the day. For instance, the average hourly EB two lane traffic volume at east of IH 35E was 3,939vph in a 15-hour span (6AM to 9PM) according to the February 1, 2001 traffic count by TTI. This 15-hour span is defined as "peak period" on the LBJ corridor in this report. The "K" factor used to compute the "peak period" hourly traffic volume from the ADT was calculated as 0.058 in this example. Further detailed data analysis has indicated that there were only 5 hours' K greater than 0.06 (1 hour  $K=0.08$  and 4 hours'  $K=0.07$ ) within our defined 15-hour "peak period" at this location. From the available field data, we concluded that using a factor of " $K=0.08$ " to compute the LOS would be helpful to have a first glance of the traffic operation conditions in the LBJ corridor. But the results represented the worst scenario - the level of service at the real "peak hour" during the day. In this report, each LOS will first be computed using  $K=0.08$ . Special attention will then be given to those LOS=F where further analysis for the "peak period" ( $K=0.06$ ) is performed by considering the above traffic characteristics on LBJ corridor. The majority actual hour by hour LOS will be equal or better than the calculated LOS using  $K=0.06$  within the defined 15-hour "peak period".

The term "Value Pricing Strategy" would appear in the report extensively and used to analyze the traffic operation. The basic idea of the "Value Pricing Strategy" is to manage the HOV lanes in such a manner that will not either under-use or over-use the HOV lane capacity. The managed HOV lanes are defined as HOV/HOT lanes, i.e., High-Occupancy-Vehicle (Toll) lanes, in this report. The mechanism of the "Value Pricing Strategy" can be simply explained as to encourage the single-occupancy-vehicle (SOV) to use the HOV/HOT lanes when traffic volume on HOV/HOT lanes is below the capacity by lowering the toll price. On the other hand, the SOV will be limited to use the HOV/HOT lanes when traffic flow on HOV/HOT lanes is at capacity by raising the toll price.

The ultimate purpose of the "Value Pricing Strategy" is to balance the traffic demands and capacities on the general mainlanes and HOV/HOT lanes. For example, when the LOS=A or B on the HOV/HOT lanes and LOS=F on the general mainlanes are observed, the toll price would be lowered to divert some traffic to the HOV/HOT lanes. The level of services would probably be "C" on the HOV/HOT lanes and "E" on the general mainlanes in this case. The fundamental difference between the common concept of "toll" road and "Value Pricing Strategy" is that "toll" road concept is to maximize revenue while "Value Pricing Strategy" is to optimize traffic operation. The "Value Pricing Strategy" is a separate research project and is currently under study. The "Value Pricing Strategy" is currently planned to be adopted for the entire LBJ corridor. TxDOT TP&P Division projected year 2020 traffic volumes in the network of IH 635 corridor (Exhibit 4) did not take into consideration of the "Value Pricing Strategy". In order to introduce the "Value Pricing Strategy" into traffic operation analysis in this report, Wilbur Smith Associates had provided the year 2020 HOV/HOT lane traffic demand projection (see Exhibit 5), per TxDOT request, from its existing ongoing Traffic Revenue Study contract with TxDOT.

The operational analysis in this report will use TxDOT TP&P Division projected year 2020 traffic volume (Exhibit 4) as the foundation. The peak hour ( $K=0.08$ ) level of service or capacity will first be calculated or checked. If the computed level of service would be "F" or capacity check would fail, the traffic operation during a broader "peak period" ( $K=0.06$ ) defined above would then be investigated. Finally, when all the above fail to show an acceptable traffic condition (LOS=E or better), the year 2020 traffic number by Wilbur Smith Associates, Exhibit 5, will be applied to the level of service calculation and capacity check.

Although the HCS forms the foundation of operational analysis in this report, the traffic at a few mainlane locations have also been "spot checked" by the micro-simulation software CORSIM, with the assistance of Wilbur Smith Associates, to understand the operational characteristics, see Exhibit 6.

For weaving analysis, there would be a small volume of traffic that would take the entrance ramp followed by the exit ramp (ramp to ramp weaving traffic). This percentage is assumed to be half the percentage of exiting traffic in the weaving area. For example, if 20% of the vehicles in the weaving area will exit the freeway, then 10% of the entrance ramp traffic would be exiting the freeway. The HCS can only analyze weaving sections with a maximum of five lanes. For six-lane weaving area (5 upstream lanes plus 1 auxiliary lane) analysis, a factor of 4/5 is applied to the mainlane volume upstream from the weaving area to proportionally project volume to a five lane weaving section.

The level of service of Category 1 ramps is shown in Table 5. The

freeway analysis evaluates the LOS of freeway segment due to the addition of traffic volume by proposed access ramps. The ramp analysis studies the LOS of ramp-freeway junctions due to the addition of the proposed access ramps. The weaving analysis investigates the potential weaving between the proposed access ramp and adjacent ramps.

**Table 5: Category 1 Ramp LOS**

Ramp	Level of Service			Note
	Freeway	Weaving	Ramp	
W-E	D	No Weaving	E	Due to continuous FR, the ramp provides access to Harry Hines Blvd, Denton Dr. and Ford Rd. where no direct access from EB ML has been provided.
L-E(2)	C	No Weaving	B	This ramp relieves ramp L-E(1) whose major function is to provide access to IH 35E DC.
W-PKWY	F D <sup>(I)</sup>	F E <sup>(I)</sup>	F E <sup>(I)</sup>	This is a revised access to FR and Montfort compared with the existing condition.
E-L(2)	C	No Weaving	C	This ramp relieves ramp E-L(1) whose major function is to provide access from NB&SB IH 35E to FR and Luna Road.
E-W	D	No Weaving	C	Due to continuous FR, the ramp provides access for Harry Hines Blvd., Denton Dr. and Ford Rd. where no direct access to WB ML has been provided.
W-HOV	D	No Weaving	E	This is the EB beginning of HOV.
HOV-E(1)	F E <sup>(II)</sup>	NO Weaving	F C <sup>(II)</sup>	This ramp provides HOV access to Midway, Welch, DNT, Montfort and Preston.
HOV-E(2)	E	No Weaving	N/A	One lane addition. Analyze as freeway segment with one more lane. This ramp provides access to Coit and US 75 from EB HOV.

E-HOV	F D <sup>(III)</sup>	No Weaving	Capa- city Check  OK	One lane drop, analyze as Ramp roadway 3400vpd x 0.08 = 272vph 272vph/(PHF0.90xFhv0.96) =315pc/h < 2200 pc/h from Exhibit 25-3
HOV-W(1)	F D <sup>(IV)</sup>	No Weaving	F C <sup>(IV)</sup>	Provide access to Josey/Webb Chapel from WB HOV.
HOV-W(2)	D	No Weaving	C	End of HOV.

<sup>(I)</sup>The peak hour LOS=F is simply because the 5 general mainlanes cannot handle the projected year 2020 peak hour flow of 14,480vph that is converted from the 181,000vpd by a factor of K=0.08. It is noted that the originally projected year 2020 daily traffic of 9,400vpd on the 3-lane HOV/HOT is well below the capacity. Based on the study and modeling by Wilbur Smith Associates, 33,700vpd is projected on the HOV/HOT lanes by the "Value Pricing Strategy". Thus, the LOS would be improved to an acceptable level on the general mainlanes for the "peak period".

<sup>(II)</sup>The 4 general mainlanes in this area cannot provide the needed capacity for the projected year 2020 peak hour flow of 10,672vph and thus, the peak hour level of service would be "F". The level of service would be improved for the freeway segment and ramp when the "peak period" traffic is analyzed.

<sup>(III)</sup>The projected peak hour volume of 12,192vph exceeds the capacity of 5 general mainlanes. However, the level of service would be "D" for the "peak period".

<sup>(IV)</sup>The 9,472vph of the projected year 2020 peak hourly flow cannot be absorbed appropriately by the 4 general mainlanes in the area. But, the LOS would be at a comfortable level for the "peak period".

Based on the level of service calculations, the peak hour traffic would experience "break down" at four (4) newly added ramps/access locations. One (1) is for mainlane/FR access and three (3) are at mainlane/HOV access locations. The sole reason for the "break down" is that the projected year 2020 peak hour traffic volumes in these areas exceed the capacity. However, by successfully applying the "Value Pricing Strategy" and/or looking at a big picture of "peak period" traffic, the LOS would generally be improved to an acceptable level. The benefit of adding these ramps listed in Table 2 far outweighs the disadvantages of not providing these access locations. The proposed access points all connect to public roads and provide for all traffic movements. By providing these ramps, the LBJ corridor network traffic time will be saved, mobility will be improved, and the traffic burden on frontage roads and cross

street intersections will be significantly relieved.

Category 2 access characteristics are summarized in Table 6. IH 635/IH 35E interchange will be totally reconstructed and these access locations must be provided. The operational analysis shows the improvements from the proposed intersection access configuration (sheet 1 of Exhibit 4) over the existing interchange access locations (sheet 1 of Exhibit 2). The IH 635/DNT interchange will only be partially reconstructed. While all the access points on IH 635 will be revised, all the access locations on DNT will remain as is. Therefore, only the access locations on IH 635 will be analyzed in this report.

**Table 6: Category 2 Ramp LOS**

Proposed	Existing	Note
IH 635/IH 35E Interchange		
Access Points on IH 635		
<p>1. Conn W-N/S  a) Weaving with ramp  L-E(1)  LOS = C  Major Diverge Area  <math>86800\text{vpd} \times 0.08 = 6944\text{vph}</math>  <math>6944\text{vph} / (\text{PHF}0.9 \times \text{Fhv}0.96)</math>  <math>= 8037 \text{ pc/h}</math>  Average Density  <math>D = 0.0109 \times 8037/6</math>  <math>= 14.6 \text{ Eq. (25-12)}</math>  LOS = B Exhibit (25-4)</p> <p>Depart leg-4 LN Freeway  <math>51300\text{vpd} \times 0.08 = 4104\text{vph}</math>  <math>4104\text{vph} / (\text{PHF}0.90 \times \text{Fhv}0.96)</math>  <math>= 4750 \text{ pc/h} &lt; 9000 \text{ pc/h}</math>  from Exhibit 25-14</p> <p>Depart leg-2 LN Conn  <math>35500\text{vpd} \times 0.08 = 2840\text{vph}</math>  <math>2840\text{vph} / (\text{PHF}0.90 \times \text{Fhv}0.96)</math>  <math>= 3287 \text{ pc/h} &lt; 4500 \text{ pc/h}</math>  from Exhibit 25-14</p> <p>b) Consolidated one exit point</p>	<p>a) Freeway Analysis  LOS = C  One lane drop, analyze as ramp roadway  <math>10200\text{vpd} \times 0.08 = 816\text{vph}</math>  <math>816\text{vph} / (\text{PHF}0.90 \times \text{Fhv}0.96)</math>  <math>= 944\text{pc/h} &lt; 2200 \text{ pc/h}</math>  from Exhibit 25-3</p> <p>b) Two consecutive exit points 1,500' apart</p>	<p>EB IH 635  Access NB/SB  IH 35E  Location.</p>

Table 6 Continue

<p>2. Conn N/S-E  a) Major Merge Area  Approach leg-3 LN Freeway  44300vpd x 0.08 = 3544vph  3544vph/(PHF0.95xFhv0.96)  = 3886 pc/h &lt; 6750 pc/h  from Exhibit 25-7</p> <p>(i) Approach leg-3 LN Conn  104400vpd x .08 = 8352vph  8352vph/(PHF0.95xFhv0.96)  =9158 pc/h &gt; 6750 pc/h  from Exhibit 25-7</p> <p>Depart leg - 6 LN Freeway  148700vpd x .08 =11896vph  11896vph/(PHF0.95xFhv.96)  =13043 pc/h &lt; 13500 pc/h  from Exhibit 25-7</p> <p>b) Consolidated one  entrance point</p>	<p>a) Two lanes are added  consecutively from SB IH  35E and NB IH 35E to EB  IH 635. Analyze as  freeway segment.</p> <p style="text-align: center;">LOS = F</p> <p>b) Two consecutive  entrance (right and  left) points 800' apart</p>	<p>NB/SB IH 35E  access EB IH  635  location.</p>
<p>3. Conn E-N/S  a) Major Diverge Area  157000vpd x 0.08=12560vph  12560vph/(PHF0.9xFhv0.96)  = 14537 pc/h  Average Density  D = 0.0109 x 14537/6  = 26.4 Eq. (25-12)  LOS = C Exhibit (25-4)</p> <p>Depart leg-4 LN Freeway  50800vpd x 0.08 = 4064vph  4064vph/(PHF0.90xFhv0.96)  = 4704 pc/h &lt; 9000 pc/h  from Exhibit 25-14</p> <p>(ii) Depart leg-3 LN Conn  106200vpd x .08 = 8496vph</p>	<p>a) WB ML to NB IH 35E  Ramp Analysis  LOS = F  WB ML to SB IH 35E  Major Diverge Area  101000vpd x 0.08=8080vph  8080vph/(PHF0.9xFhv0.96)  = 9352 pc/h  Average Density  D = 0.0109 x 9352/4  = 25.5 Eq. (25-12)  LOS = C Exhibit (25-4)</p> <p>Depart leg-3 LN Freeway  50800vpd x 0.08=4064vph  4064vph/(PHF.90xFhv0.96)  = 4703 pc/h &lt; 6750 pc/h  from Exhibit 25-14</p>	<p>WB IH 635  Access NB/SB  IH 35E  Location.</p>

<p>8496vph/ (PHF0.90xFhv0.96) = 9833 pc/h &gt; 6750 pc/h from Exhibit 25-14</p> <p>b) Consolidated one exit Point</p>	<p>Depart leg-2 LN Conn 50200vpd x 0.08=4016vph 4016vph/ (PHF.90xFhv0.96) = 4648 pc/h &gt; 4500 pc/h from Exhibit 25-14</p> <p>b) Two consecutive exit (right and left) points 500' apart</p>	
---	---	--

Table 6 Continue

<p>4. Conn N/S-W</p> <p>a) Weaving with ramp E-L(1)</p> <p>LOS = C</p> <p>Major Merge Area Approach leg-4 LN Freeway 62000vpd x 0.08 = 4960vph 4960vph/ (PHF0.95xFhv0.96) = 5439 pc/h &lt; 9000 pc/h from Exhibit 25-7</p> <p>Approach leg-2 LN Conn 31300vpd x .08 = 2504vph 2504vph/ (PHF0.95xFhv0.96) =2746 pc/h &lt; 4500 pc/h from Exhibit 25-7</p> <p>Depart leg - 6 LN Freeway 93300vpd x .08 =7464vph 7464vph/ (PHF0.95xFhv.96) =8184 pc/h &lt; 13500 pc/h from Exhibit 25-7</p> <p>b) Consolidated one entrance point</p>	<p>a) Two lanes are added consecutively from NB IH 35E and SB IH 35E to WB IH 635. Analyze as freeway segment.</p> <p>LOS = C</p> <p>b) Two consecutive entrance points 1,300' apart</p>	<p>NB/SB IH 35E access WB IH635 Location.</p>
--	--	---

Access Points on IH 35E

<p>5. Conn S-E/W</p> <p>a) Major Diverge Area 164300vpd x 0.08=13144vph 13144vph/ (PHF.95xFhv0.96) = 14412 pc/h</p> <p>Average Density D = 0.0109 x 14412/6 = 26.2 Eq. (25-12) LOS = C Exhibit (25-4)</p> <p>Depart leg-3 LN Freeway 73500vpd x 0.08 = 5880vph 5880vph/ (PHF0.95xFhv0.96) = 6447 pc/h &lt; 6750 pc/h from Exhibit 25-14</p> <p>(iii) Depart leg-3 LN Conn</p>	<p>a) Major Diverge Area 105200vpd x 0.08=8416vph 8416vph/ (PHF.95xFhv0.96) = 9228 pc/h</p> <p>Average Density D = 0.0109 x 9741/5 = 20.1 Eq. (25-12) LOS = C Exhibit (25-4)</p> <p>Depart leg-3 LN Freeway 55400vpd x 0.08=4432vph 4432vph/ (PHF.95xFhv0.96) = 4860 pc/h &lt; 6750 pc/h from Exhibit 25-14</p> <p>Depart leg-2 LN Conn 49800vpd x 0.08=3984vph</p>	<p>NB IH 35E Access EB/WB IH 635 Location.</p>
---	---	--

<p>90800vpd x .08 = 7264vph  7264vph/(PHF0.95xFhv0.96)  = 7965 pc/h &gt; 6750 pc/h  from Exhibit 25-14  b) Consolidated one exit  Point</p>	<p>3984vph/(PHF.95xFhv0.96)  = 4368 pc/h &lt; 4500 pc/h  from Exhibit 25-14  b) Two consecutive exit  (right and left) point  1,100' apart</p>	
---	--	--

Table 6 Continue

<p>6. Conn E/W-N  a) Major Merge Area  Approach leg-3 LN Freeway  65200vpd x 0.08 = 5216vph  5216vph/(PHF0.95xFhv0.96)  = 5719 pc/h &lt; 6750 pc/h  from Exhibit 25-7   Approach leg-2 LN Conn  44600vpd x .08 = 3568vph  3568vph/(PHF0.95xFhv0.96)  =3912 pc/h &lt; 4500 pc/h  from Exhibit 25-7   Depart leg - 5 LN Freeway  109800vpd x .08 = 8784vph  8784vph/(PHF0.95xFhv.96)  =9632 pc/h &lt; 11250 pc/h  from Exhibit 25-7   b) Consolidated one  entrance point</p>	<p>WB IH 635 to NB IH 35E  Ramp Analysis  LOS = F   EB IH 635 to NB IH 35E  Ramp Analysis  LOS = F</p>	<p>EB/WB IH 635  access NB IH  35E  Location.</p>
<p>7. Conn N-E/W  a) Major Diverge Area  112500vpd x 0.08=9000vph  9000vph/(PHF0.9xFhv0.96)  = 10417 pc/h  Average Density  D = 0.0109 x 10417/4  = 28.4 Eq. (25-12)  LOS = D Exhibit (25-4)   Depart leg-3 LN Freeway  68800vpd x 0.08 = 5504vph  5504vph/(PHF0.90xFhv0.96)  = 6370 pc/h &lt; 6750 pc/h  from Exhibit 25-14   Depart leg-2 LN Conn  43700vpd x 0.08 = 3496vph  3496vph/(PHF0.90xFhv0.96)  = 4046 pc/h &lt; 4500 pc/h  from Exhibit 25-14   b) Consolidated one exit  Point</p>	<p>SB IH 35E to EB IH 635  Ramp Analysis  LOS = F   SB IH 35E to WB IH 635  Ramp Analysis  LOS = F</p>	<p>SB IH 35E  Access EB/WB  IH 635  Location.</p>

Table 6 Continue

<p>8. Conn E/W-S</p> <p>a) Major Merge Area <sup>(rv)</sup></p> <p>Approach leg-3 LN Freeway  <math>82000\text{vpd} \times 0.08 = 6560\text{vph}</math>  <math>6560\text{vph} / (\text{PHF}0.95 \times \text{Fhv}0.96)</math>  <math>= 7193 \text{ pc/h} &gt; 6750 \text{ pc/h}</math>  from Exhibit 25-7</p> <p>Approach leg-3 LN Conn  <math>99400\text{vpd} \times 0.08 = 7952\text{vph}</math>  <math>7952\text{vph} / (\text{PHF}0.95 \times \text{Fhv}0.96)</math>  <math>= 8719 \text{ pc/h} &gt; 6750 \text{ pc/h}</math>  from Exhibit 25-7</p> <p>Depart leg - 6 LN Freeway  <math>181400\text{vpd} \times .08 = 14512\text{vph}</math>  <math>14512\text{vph} / (\text{PHF}0.95 \times \text{Fhv}0.96)</math>  <math>= 15912 \text{ pc/h} &gt; 13500 \text{ pc/h}</math>  from Exhibit 25-7</p> <p>b) Consolidated one  entrance Point</p>	<p>a) Major Merge Area  (SB IH 35E and entrance  ramp from WB ML to SB IH  35E)</p> <p>Approach leg-3 LN IH 35E  <math>48100\text{vpd} \times 0.08 = 3848\text{vph}</math>  <math>3848 / (\text{PHF}0.95 \times \text{Fhv}0.96)</math>  <math>= 4219 \text{ pc/h} &lt; 6750 \text{ pc/h}</math>  from Exhibit 25-7</p> <p>Approach leg-2 LN ramp  <math>50200\text{vpd} \times 0.08 = 4016\text{vph}</math>  <math>4016 / (\text{PHF}0.95 \times \text{Fhv}0.96)</math>  <math>= 4404 \text{ pc/h} &lt; 4500 \text{ pc/h}</math>  from Exhibit 25-7</p> <p>Depart leg - 5 LN IH 35E  <math>98300\text{vpd} \times .08 = 7864\text{vph}</math>  <math>7864\text{vph} / (\text{PHF}0.95 \times \text{Fhv}0.96)</math>  <math>= 8623 \text{ pc/h} &lt; 11250 \text{ pc/h}</math>  from Exhibit 25-7</p> <p>b) Weaving Area  (between entrance ramp  from EB ML to SB IH 35E  and IH 35E exit ramp to  Royal Lane)  LOS = C</p> <p>Note: Only 250' between  the Major Merge Area and  Weaving Area.</p>	<p>EB/WB IH 635  access SB  IH 35E  Location.</p>
---	---	---

Table 6 Continue

IH635/DNT Interchange		
<p>1. Conn W-N/S DNT a) Major Diverge Area 160700vpd x 0.08=12856vph 12856vph/(PHF.97xFhv0.96) = 13806 pc/h Average Density D = 0.0109 x 13806/5 = 30.1 Eq. (25-12) LOS = D Exhibit (25-4)</p> <p>(v) Depart leg-4 LN Freeway 128700vpd x 0.08=10296vph 10296vph/(PHF.97xFhv0.96) = 11057 pc/h &gt; 9000 pc/h from Exhibit 25-14</p> <p>Depart leg-2 LN Conn 32000vpd x 0.08 = 2560vph 2560vph/(PHF0.97xFhv0.96) = 2749 pc/h &lt; 4500 pc/h from Exhibit 25-14</p> <p>b) Consolidated one exit point, provide room for new ramp W-PKWY</p>	<p>Weaving between entrance ramp from Midway and exit ramp to SB DNT</p> <p>Weaving Analysis LOS = F</p>	<p>EB IH 635 Access NB/SB DNT location.</p>
<p>2. Conn NDNT-E Same configuration as existing. Ramp Analysis LOS = F (C<sup>(VI)</sup>)</p>	<p>Ramp Analysis LOS = F</p>	<p>SB DNT access EB IH 635 Location.</p>
<p>3. Conn SDNT-E Reconfigured entrance ramp to EB ML from FR such that it merged with Conn SDNT-E first to reduce one access location on the ML. Weaving with ramp W-PR LOS = F (D<sup>(VII)</sup>)</p>	<p>Ramp Analysis LOS = F</p> <p>Three consecutive entrance ramps within 1,800'. Weaving between entrance ramp from FR and exit ramp to Preston LOS = F</p>	<p>NB DNT access EB IH 635 Location.</p>
<p>4. Conn E-NDNT One land drop, analyzed as ramp roadway. 17900vpd x 0.08 =1432vph 1432vph/(PHF0.90xFhv0.96) =1657pc/h &lt; 2200 pc/h from Exhibit 25-3</p>	<p>Ramp Analysis LOS = D</p>	<p>WB IH 635 access NB DNT Location.</p>

Table 6 Continue

5. Conn E-SDNT	Ramp Analysis	WB IH 635
----------------	---------------	-----------

Same configuration as existing Ramp Analysis LOS = F (E <sup>(VIII)</sup> )	LOS = E	access SB DNT Location.
6. Conn SDNT-W Weaving with ramp E-MW LOS = F (D <sup>(IX)</sup> )	Ramp Analysis LOS = C	NB DNT access WB IH 635 Location.
7. Conn NDNT-W Removed entrance point further west and eliminated existing weaving. Ramp Analysis LOS = F (C <sup>(X)</sup> )	Weaving between entrance ramp from SB DNT and exit ramp to Midway LOS = F	SB DNT access WB IH 635 Location.

<sup>(I)</sup> The projected year 2020 peak hourly flow of 8,352vph would simply be too heavy a burden on the 500' long 3-lane final leg of the 5-lane connector. However, the "Value Pricing Strategy" would put 14,500vpd (not 800vpd as shown in the page 2 of Exhibit 4) to the HOV/HOT lanes from the connector via the HOV/HOT access ramp 500' upstream. The capacity check process would show the "peak period" demand of 5,967 pc/h that is less than the capacity of 6,750 pc/h. It is important to note that for the majority of the connector that is 5-lane and 2000' long, the projected year 2020 peak hour demand of 9,728 pc/h is less than the capacity of 11,250 pc/h.

<sup>(II)</sup> Similar to the footnote (I) above, the projected year 2020 peak hourly flow of 8,496vph would exceed the capacity of the 1,200' long 3-lane beginning leg of the 5-lane connector. The traffic demand on the connector would be reduced to 92,500vpd from 106,200vpd by the "Value Pricing Strategy". The capacity check would indicate the "peak period" demand of 6,423 pc/h that is less than the capacity of 6,750 pc/h from Exhibit 25-14. It is worth noting that for the 2000' long 5-lane connector downstream, the projected year 2020 peak hour demand of 10,888 pc/h is less than the capacity of 11,250 pc/h.

<sup>(III)</sup> The projected year 2020 peak hour volume of 7,264vph exceeds the capacity of the 3-lane connector. However, the 6,750 pc/h capacity meets the "peak period" demand of 5,974 pc/h.

<sup>(IV)</sup> The projected year 2020 peak hour demands of 6,560vph, 7,952vph and 14,512vph on the 3-lane upstream freeway, 3-lane upstream connector and 6-lane downstream freeway exceed the capacity of the major merge area. The "peak period" demands were calculated as 5,395 pc/h, 6,539 pc/h and 11,934 pc/h for the upstream freeway, connector and downstream freeway, respectively. The proposed improvements would be able to handle the demand during "peak period".

<sup>(V)</sup> The projected year 2020 peak hour volume of 10,296vph exceeds the capacity of the 4-lane mainlane section. The traffic volume in this location would become 104,400vpd down from 128,700vpd

when the "Value Pricing Strategy" was considered. Therefore, the peak hour traffic demand on the mainlane would be reduced to 8,969 pc/h that is less than the capacity of 9,000 pc/h.

<sup>(VI)</sup> Same as footnote (V) above, the level of service of this ramp would be improved to "C" for the "peak period" if 104,400vpd on the mainlane was used in the HCS computation due to the "Value Pricing Strategy".

<sup>(VII)</sup> Same logic applies to this ramp. The LOS would be improved to "D" for the "peak period" when 33,700vpd (not 9,400vpd shown in the page 3 of Exhibit 4) was projected to HOV/HOT lanes by the "Value Pricing Strategy".

<sup>(VIII)</sup> The LOS would be improved to "E" for the "peak period" when the mainlane demand is reduced from 149,200vpd shown in page 3 of Exhibit 4 to 137,200vpd under the "Value Pricing Strategy".

<sup>(IX)</sup> This connector is immediate downstream to the connector in footnote (VIII) above. The LOS would be improved to "D" for the "peak period" when 32,700vpd (not 20,700vpd in the page 3 of Exhibit 4) could be diverted to HOV/HOT lanes by the "Value Pricing Strategy".

<sup>(X)</sup> Although the LOS=F for the peak hour, the LOS would be generally "C" for the "peak period".

Consolidating the existing dual points access situation into the proposed single point access for the IH 635/IH 35E interchange will eliminate the existing two closely spaced consecutive exit and entrance access locations. Although the traffic conditions at the interchange area would be generally improved as the Table 6 shows, the peak hour traffic demand in the year 2020 will still exceed the capacity for those traveling between the downtown Dallas business district and LBJ business corridor (from WB IH 635 to SB IH 35E and from NB IH 35E to EB IH 635). In order to improve the traffic operation in general during the "peak period", it will be very critical to correctly apply the "Value Pricing Strategy" to maximize the HOV/HOT usage.

For IH 635/DNT interchange, no dramatic access location revisions have been called for as that for IH 635/IH 35E interchange. The access ramps on DNT would remain the same, and only the access points on IH 635 to/from DNT are revised and analyzed in this report. The existing EB two exit ramps to SB & NB DNT have been consolidated into one exit ramp. In addition, an existing entrance ramp from FR to EB mainlane has been merged with the NB DNT to EB mainlane ramp to reduce another access point on IH 635 mainlane. Finally, the existing entrance ramp from SB DNT to WB IH 635 mainlane has been extended further west. This eliminates the heavy weaving between the entrance ramp and the exit ramp to Midway that exists today. As the Table 6 demonstrates, the

traffic operations at the DNT area would be enhanced. Considering the projected year 2020 near 350,000vpd demand on the IH 635 mainlanes in the IH 635/DNT interchange area, the fundamental solution to improve the level of service will be to use the 6-lane HOV/HOT efficiently by the "Value Pricing Strategy".

Category 3 access is summarized in the table 7. Seven ramps that exist today have been eliminated in the proposed schematic.

Table 7: Category 3 Ramp LOS

Proposed	Existing
1. Eliminate direct entrance Ramp from Anaheim to EB IH 635 Freeway Analysis LOS = C	Direct entrance from Anaheim. Ramp Analysis LOS = F
2. Eliminate direct exit ramp From EB IH 635 to Webb Chapel Freeway Analysis LOS = E Heavy weaving with IH 35E DC if this ramp is not eliminated.	Direct exit ramp to Webb Chapel. Ramp Analysis LOS = F
3. Eliminate direct entrance Ramp from Montfort to EB IH 635 Freeway Analysis LOS = F (E, D) <sup>(II)</sup>	Direct entrance ramp from Montfort. Ramp Analysis LOS = F

Table 7 Continue

4. Eliminate direct exit ramp From WB IH 635 to Hillcrest Access to Hillcrest has been moved further east and has been constructed with Dallas High Five project. Freeway Analysis LOS = F (E <sup>(II)</sup> )	Weaving between on-ramp from Coit to WB IH 635 and off-ramp From WB IH 635 to Hillcrest. LOS = F
5. Eliminate direct exit ramp From WB IH 635 to Montfort Freeway Analysis LOS = F (E <sup>(III)</sup> )	Direct exit to Montfort Ramp Analysis LOS = F
6. Eliminate direct entrance Ramp from Webb Chapel to WB IH 635 Freeway Analysis	Direct entrance ramp from Webb Chapel Ramp Analysis LOS = F

<p>LOS = F (E<sup>(iv)</sup>)  Heavy weaving with DC to IH 35E if this ramp is not eliminated.</p>	
<p>7. Eliminate direct exit ramp from WB IH 635 to FR  Eliminate weaving with the on ramp from Josey/Webb Chaple to WB IH 635  Freeway Analysis  LOS = C</p>	<p>Weaving between on-ramp from Josey to WB IH 635 and off-ramp from WB IH 635 to FR.   LOS = F</p>
<p>8a &amp; 8b. Reversed ramps  EB off-ramp to Marsh (Ramp W-M) followed by EB on-ramp from Webb Chapel (Ramp J/WC-E).  Weaving between J/WC-E and W-MW  LOS = F (E<sup>(v)</sup>)</p>	<p>EB on-ramp from Webb Chapel followed by EB off-ramp to Marsh.  Freeway Analysis  LOS = F</p>
<p>9a &amp; 9b. Reversed ramps  EB off-ramp to Midway (Ramp W-MW) followed by EB on-ramp from Marsh (Ramp M-E).  Weaving analysis as (8a &amp; 8b) above.</p>	<p>EB on-ramp from Marsh followed by EB off-ramp to Midway.  Freeway Analysis  LOS = F</p>
<p>10a &amp; 10b. Reversed ramps  WB off-ramp to Marsh (Ramp E-M) followed by WB on-ramp from Midway (Ramp MW-W).  Weaving between WB on ramp from Midway (MW-W) and WB off ramp to Josey/Webb Chapel (E-J/WC).  LOS = F (E<sup>(vi)</sup>)</p>	<p>WB on-ramp from Midway followed by WB off-ramp to Marsh.  Freeway Analysis  LOS = F</p>

<sup>(i)</sup> LOF=F is simply because the 5 general mainlanes cannot handle the projected year 2020 peak hour flow, 12,624vph, in this area. The level of service would be improved to "E" for the general "peak period". Furthermore, the level of service would be enhanced to "D" if "Value Pricing Strategy" was considered and LOS was computed using revised HOV/HOT traffic numbers by Wilbur Smith Associates.

<sup>(ii)</sup> The 6 general mainlanes cannot provide the needed capacity for the projected year 2020 peak hour traffic volume of 15,208vph. The level of service would be improved to "E" for the general "peak period".

<sup>(iii)</sup> The projected year 2020 peak hour demand of 14,824vph exceeds the capacity of 5 general mainlanes. The level of service would be improved to "E" for the general "peak period".

<sup>(iv)</sup> The 5 general mainlanes cannot absorb the projected year 2020 peak hour flow of 12,560vph. The level of service would be improved to "E" for the general "peak period".

<sup>(v)</sup>Based on the study and modeling by Wilbur Smith Associates, 29,500vpd, not firstly assumed 8,600vpd, is projected on the HOV/HOT lanes by the "Value Pricing Strategy". The level of service would be improved to "E" for the general "peak period".

<sup>(vi)</sup>The projected year 2020 daily traffic volume of 53,000vpd is too heavy a burden for a 1-lane entrance ramp (Ramp MW-W). The level of service would be "F" no matter what "strategy" is adopted under the current schematic. The following schematic revision is proposed to improve the traffic operation.

Schematic Revision:

1. Revise the 1-lane entrance ramp (Ramp MW-W) into a 2-lane ramp.
2. Add one WB general mainlane between the Ramp MW-W and Ramp M-W. This will make it a 6-lane section between Ramp MW-W and Ramp E-J/WC and a 5-lane section between Ramp E-J/WC and Ramp M-W.

Therefore, the level of service was calculated as "E" for the general "peak period" using 31,000vpd on the HOV/HOT lanes projected by the Wilbur Smith Associates with the "Value Pricing Strategy". It is understood that it is not easy to carry out the proposed schematic revision due to the unknown ROW and displacement impact. This particular issue should be kept in mind for the future designers.

By eliminating access locations on the IH 635 mainlanes, the proposed schematic would generally improve the traffic operation conditions over the existing configurations, as Table 7 indicated. These improvements were obtained even without considering the potential benefit of the "Value Pricing Strategy". Once the "Value Pricing Strategy" is used to encourage more traffic to the HOV/HOT lanes and balance the traffic demands and capacities on the general mainlanes and HOV/HOT lanes, such as footnote (I) of Table 7 showed, the level of service would be further improved.

There are three pairs (6 ramps) of mainlane on/off ramp configurations that have been revised from an existing "Diamond" type to the proposed "X" type design, i.e., revising the existing "on" ramp followed by "off" ramp configuration to the proposed "off" ramp followed by "on" ramp configuration. For example, the existing EB mainlane between Webb Chapel Road and Marsh Lane showed the "on" ramp from Webb Chapel Road followed by the "off" ramp to Marsh Lane (see sheet 2 of Exhibit 2). The proposed design calls for the "off" ramp to Marsh Lane followed by the "on" ramp from Webb Chapel Road (see sheet 2 of Exhibit 4). The general design concepts to support the reconfigurations are listed below.

1. The traffic on the proposed "X" type "off" ramp will have a higher speed (e.g., 55 MPH, since it is farther away from the destined intersection) than that on the existing "Diamond"

type "off" ramp (e.g., 35 MPH, since it is closer to the destined intersection). Therefore, the proposed "X" type design will remove traffic from the mainlane to the frontage road more efficiently than the existing "Diamond" type design. In addition, the proposed "X" type design will provide better queuing at the intersection signal, preventing traffic from queuing onto the exit ramp during peak traffic conditions.

2. The proposed "X" type design forces the local traffic to stay on the frontage road longer (entering the mainlane further downstream) and removes traffic from the mainlane to frontage road earlier than that of the existing "Diamond" type design, and thus, improve the mainlane traffic flow.
3. For the five-lane mainlane portions of the LBJ West Section, the weaving created by the proposed "X" type design for upstream and downstream ramps is limited to the outside two lanes. By removing traffic from the mainlane to frontage road earlier and injecting traffic from frontage road to mainlane later, the inside three mainlanes will have a better traffic operation condition.

Finally, real-time traffic operation has been simulated by CORSIM at selected IH 635 west section mainlane locations for  $K=0.08$  (peak hour),  $K=0.07$  and  $K=0.06$  (peak period). The speed, level of service, traffic demanded and processed are tabulated in Exhibit 6. Although the CORSIM simulation and HCS computation lead to similar results, the peak hour LOS simulated by CORSIM is generally better than those listed in the IH 635 West Section Environmental Assessment document and those calculated in this report. This is because the LOS computation in the EA document did not take into consideration of the "Value Pricing Strategy" and the CORSIM only "processed" part of the traffic "demand" while the "full" traffic volume was used in the LOS calculation by HCS in this report. In addition, both the CORSIM simulation and HCS computation revealed the worst area in the IH 635 west section, i.e., in the vicinity of Ramp E-J/WC. The LOS would be "F" and schematic revision is discussed in this report, see footnote (VI) of Table 7.

## Conclusion

Both sides of IH 635 west section have been fully developed. The Right of Way (ROW) is severely constrained and it is impractical to provide more general mainlanes. This is the compelling reason that a majority of the proposed HOV/HOT lanes will be in the tunnel or in a cut-and-cover box underneath the frontage road. A Value Engineering Study that was held in 1999 thoroughly investigated all avenues (moving, eliminating or braiding ramps, adding auxiliary lanes, etc.) to balance the traffic operation and demand, and to geometrically fit the area and satisfy the adjacent property/home owner's request (such as no elevated roadway in LBJ corridor). The study and other planning process

had resulted in the current schematic layout that had been approved by both TxDOT and FHWA. There is only limited leverage in this report to recommend any revisions of the approved schematic.

Although adding an additional general mainlane is practically not feasible at this time, a wider than usual concrete inside shoulder has been proposed in the schematic. It has provided the potential in the future that the mainlanes would be re-stripped with one more lanes in each direction with reduced inside shoulder. As a result, the level of services computed in this report would be further improved. A design exception will be needed for such re-striping.

"Peak period" is an important concept introduced in this report. Considering the reality that the existing and future peak hour level of service would be "F" almost in the entire IH 635 west section, the level of service in "peak period" provides us a different angle to see a broader "picture" of traffic operation. However, It should be clearly understood that by showing a better "peak period" ( $K=0.06$ ) LOS does not mean the worst peak hour ( $K=0.08$ ) LOS not exist. Furthermore, a deeper investigation by a sample data analysis of TTI February 1, 2001 traffic count at east of IH 35E indicated that there were only 5 hours'  $K$  greater than 0.06 (1 hour  $K=0.08$  and 4 hours'  $K=0.07$ ) within the defined 15-hour "peak period". The "peak period" broader "picture" demonstrated that the majority actual hour by hour LOS would be equal or better than the calculated LOS using  $K=0.06$  within the defined 15-hour "peak period".

In addition to the "peak period" concept, the "Value Pricing Strategy" is another tool introduced in this report to analyze the traffic operation. For such a highly congested (today and future), full commercially developed IH 635 west section with adding more general mainlanes almost impossible, the calculated level of service cannot be improved from "F" to "E" or better in numerous sections without considering the "Value Pricing Strategy" as a factor in the access justification analysis. The TxDOT ongoing Traffic Revenue Study with the Wilbur Smith Associates clearly indicates that the "Value Pricing Strategy" would certainly divert more vehicles from the general mainlanes to the HOV/HOT lanes. The operational analysis demonstrated the importance of the "Value Pricing Strategy".

HCS is an efficient tool to study the traffic operation characteristics in a big corridor. The micro-simulation model such as CORSIM would provide more detailed information and let the planners "visualize" the congestion. However, to establish and fine-tune the model would need a huge amount of effort for a big corridor.

The proposed new ramp access points (Category 1 Access) provide direct connections to the IH 635 mainlanes from major local cross streets and HOV/HOT lanes, and relieve the traffic on adjacent ramps. There are a few cases where the projected year 2020 mainlane peak hour LOS would be "F". But this is not due to the addition of these new ramps. It is because the projected year 2020 peak hour traffic volume exceeds the mainlane capacity in the area. On the other hand without these ramps, vehicles will have to use the next or previous ramps to get to and leave from the cross streets. This will increase the congestion at these intersections that already exists today.

For the reconfigured IH 635/IH 35E interchange (Category 2 Access), the existing 16 dual-point "on" and "off" access connectors have been revised to an 8 single-point "on" and "off" access connectors. The LOS has been significantly improved at the interchange area.

For the revised access locations on IH 635 mainlanes of IH 635/DNT interchange (Category 2 Access), the traffic operation for both EB and WB IH 635 mainlanes has been enhanced, as discussed in the "Operational Analysis" section.

Seven existing ramps have been eliminated in the proposed schematic, so do the seven LOS=F ramp-freeway junctions for the LBJ freeway at peak hour. However, due to the projected heavy mainlane traffic volume in the year 2020, further eliminating a few more ramps would not help the peak hour mainlane level of service much. In addition, there is so much congestion in the parallel facilities and latent demand along the corridor.

Three pairs of ramps (six ramps) have been reversed. They have been converted from the existing "Diamond" configuration to proposed "X" configuration. In addition to the advantages discussed in the "Operational Analysis" section for Category 3 access, a specific schematic revision has been recommended for the future designer to consider to improve the traffic operation conditions in WB IH 635 mainlanes at Midway, Webb Chapel area.

The proposed new access ramps and revised access points meet the current standards for Federal-aid projects on the Interstate System as required in the revision of the FHWA policy statement issued in the Federal Register on February 11, 1998.

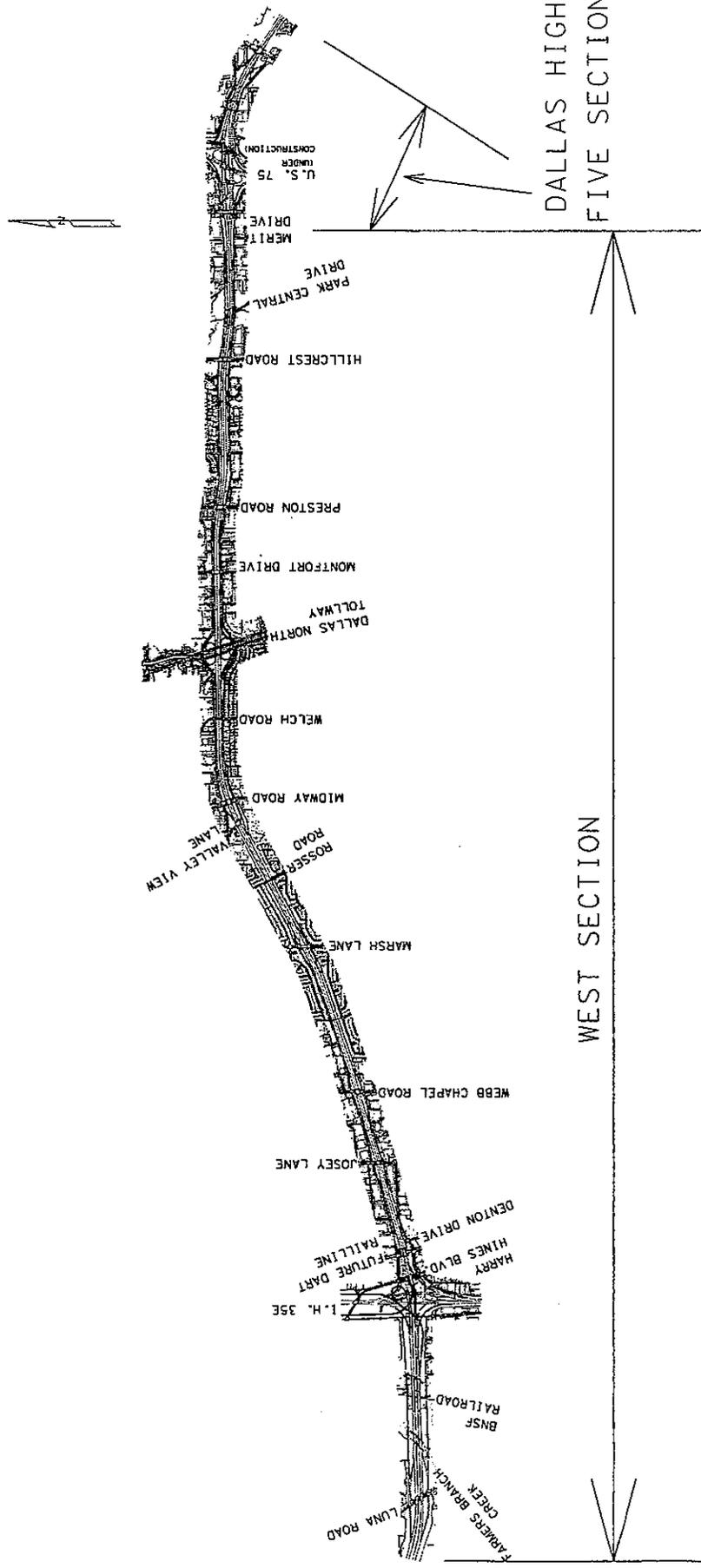


EXHIBIT 1

6	1/2
TEXAS	10
IH 635	

IH 635 CORRIDOR LAYOUT

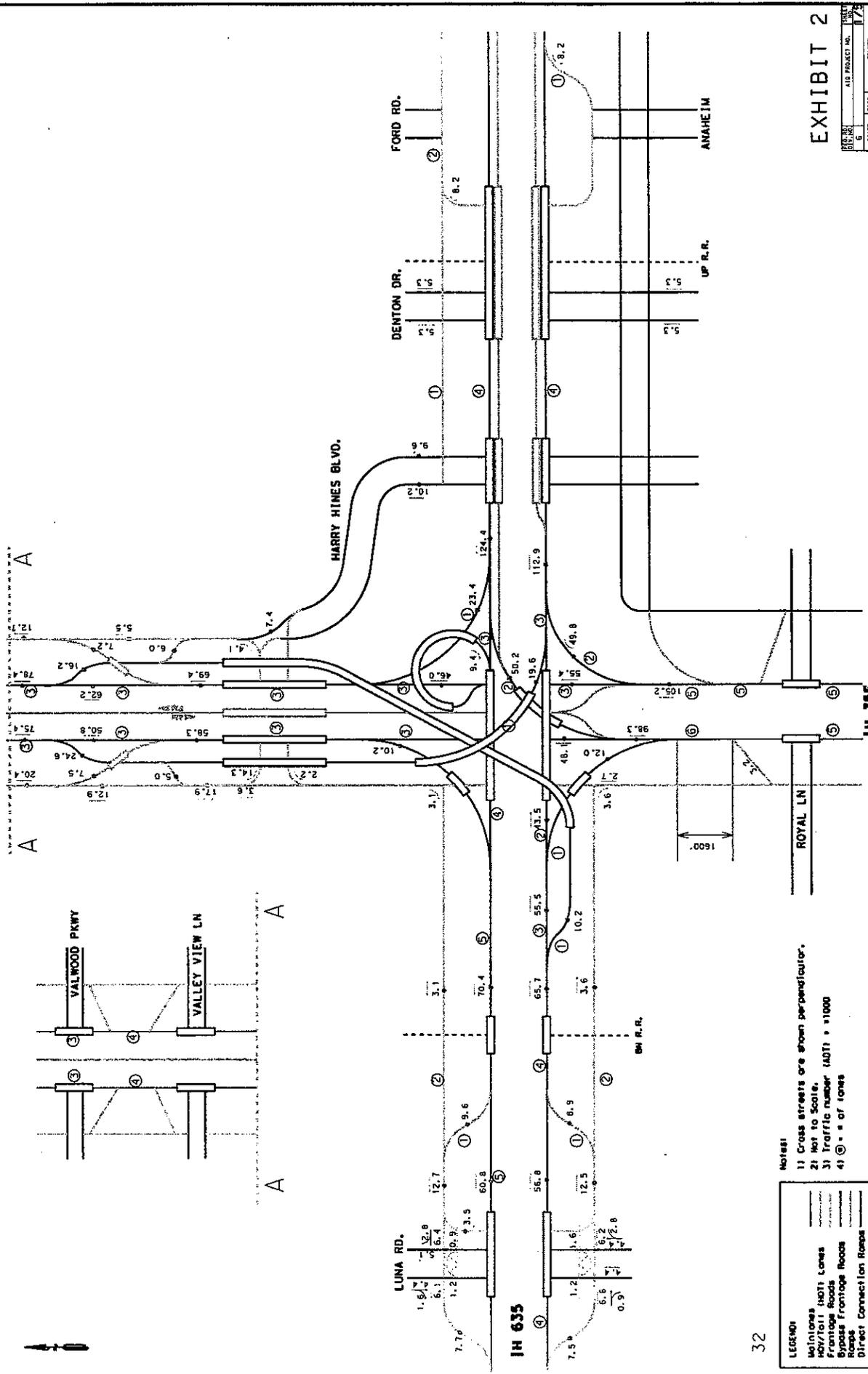


EXHIBIT 2

STATE	TEXAS	PROJECT NO.	117
COUNTY	DADE	SECTION	003
DATE	08/10/04	REVISION NO.	117 635

EXISTING WEST SECTION

**LEGEND:**

- 1) Mainlines
- 2) HOV/Toll Lanes
- 3) Frontage Roads
- 4) Bypass Frontage Roads
- 5) Ramps
- 6) Direct Connection Ramps

**Notes:**

- 1) Cross streets are shown perpendicular.
- 2) Not to Scale.
- 3) Traffic number (DOT) = 1000
- 4) ① = 1 of lanes



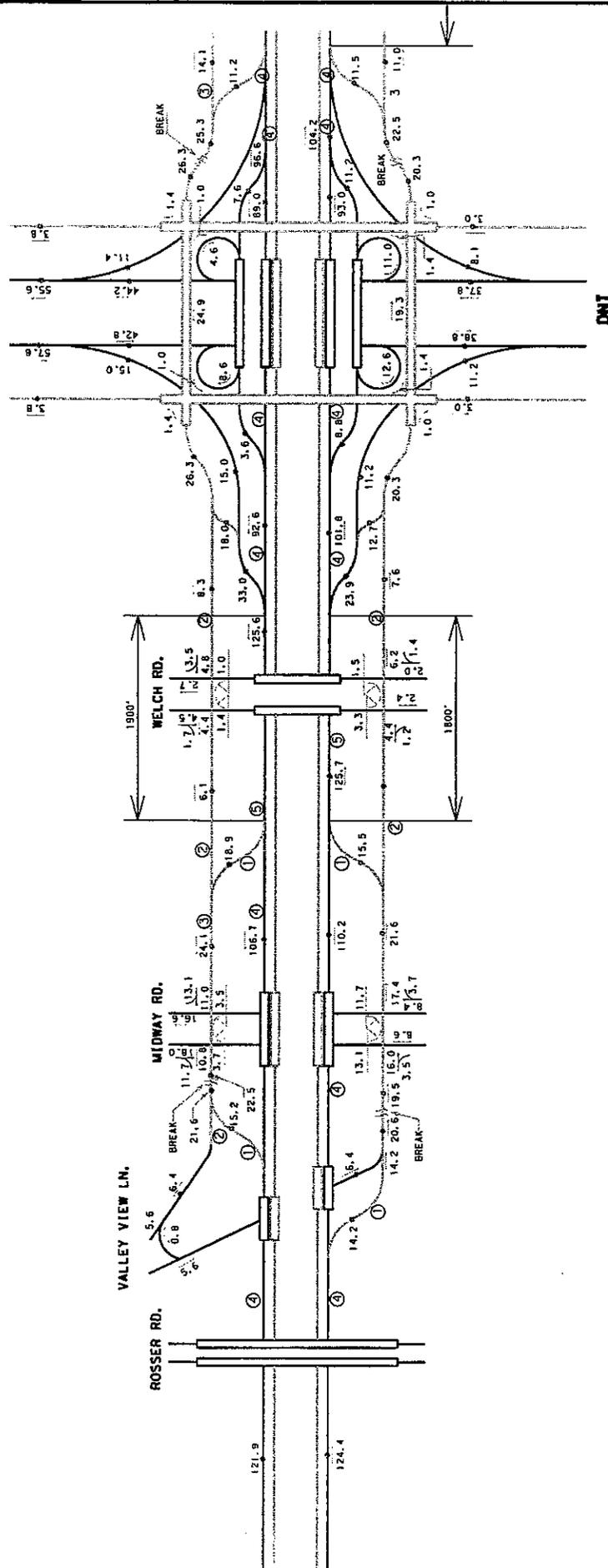


EXHIBIT 2

PROJECT NO.	1500
SHEET NO.	34
DATE	7/10/04
DESIGNED BY	...
CHECKED BY	...
APPROVED BY	...

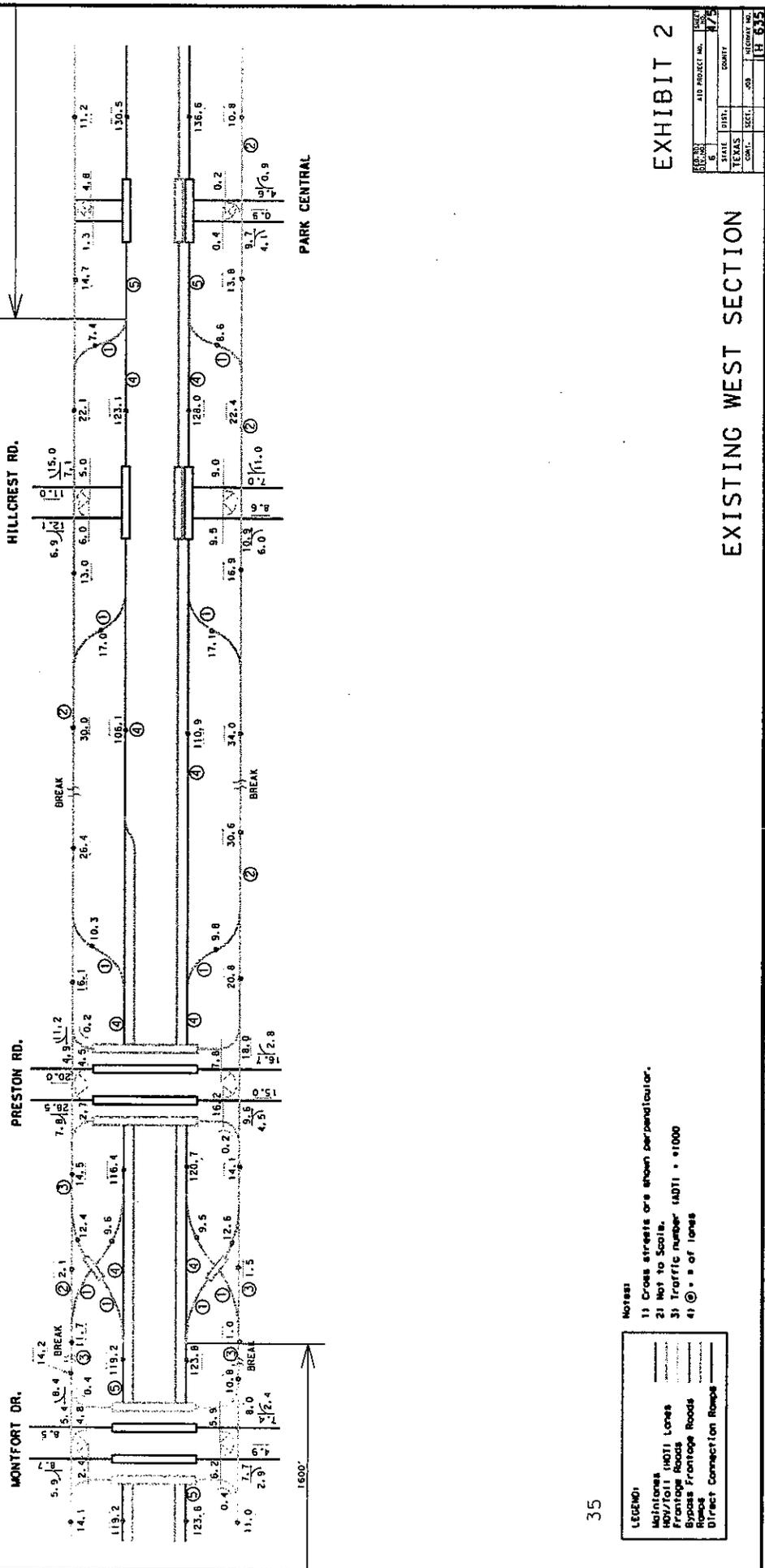
EXISTING WEST SECTION

34

- Notes:
- 1) Cross streets are shown perpendicular.
  - 2) Not to Scale.
  - 3) Traffic number (ADT) = 11000
  - 4) @ = # of lanes

LEGEND:

—	Mainlines
—	HOV/Toll (HOT) Lanes
—	Frontage Roads
—	Bridge Frontage Roads
—	Break
—	Direct Connection Roads



35

**LEGEND:**

—	Mainlines
—	HOV/Toil Lanes
—	Frontage Roads
—	Bypass Frontage Roads
—	Ramps
—	Direct Connection Ramps

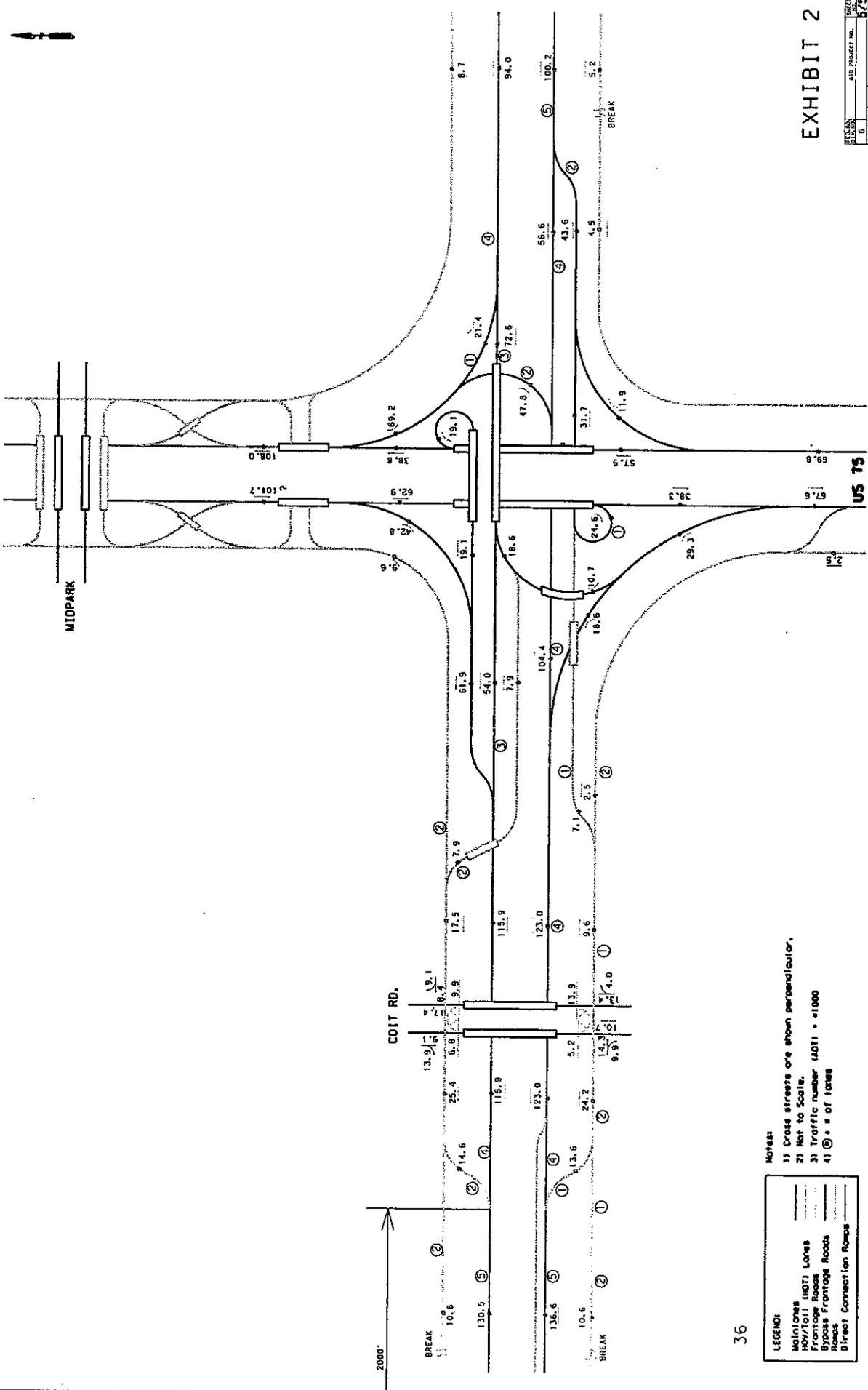
**Notes:**

- 1) Cross streets are shown perpendicular.
- 2) Not to Scale.
- 3) Traffic number (ADT) • •1000
- 4) • • • of lanes

**EXHIBIT 2**

PROJECT NO.	AID PROJECT NO.	DATE	DIST.	COUNTY
10000000	10000000	11/15	10	10
CONTRACT NO.	SECTION	SHEET	TOTAL SHEETS	DATE PLOTTED
10000000	10000000	10	10	11/15

**EXISTING WEST SECTION**



EXISTING WEST SECTION

US 75

36

- Notes:
- 1) Cross streets are shown perpendicular.
  - 2) Not to Scale.
  - 3) Traffic number (ADTI) = 1000
  - 4) 0 = 0 of lanes

LEGEND:

---	Median
---	Right-of-Way (ROW) Line
---	Frontage Road
---	Right-of-Way (ROW) Line
---	Direct Connection Ramp

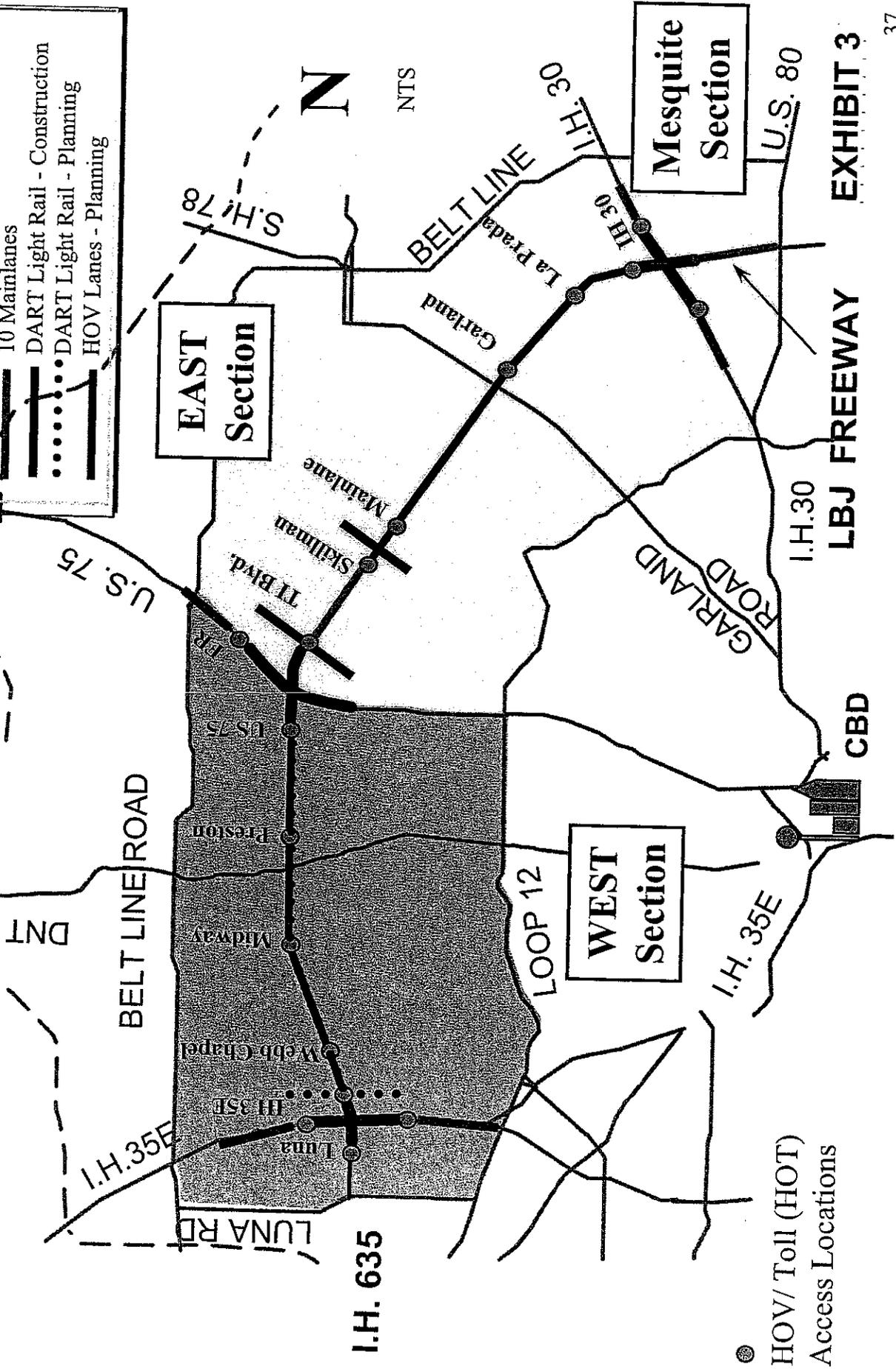
36

PROJECT NO.	1000
DATE	07/2
COUNTY	TEXAS
SECTION	1001
JOB	1001
SCALE	1" = 100'

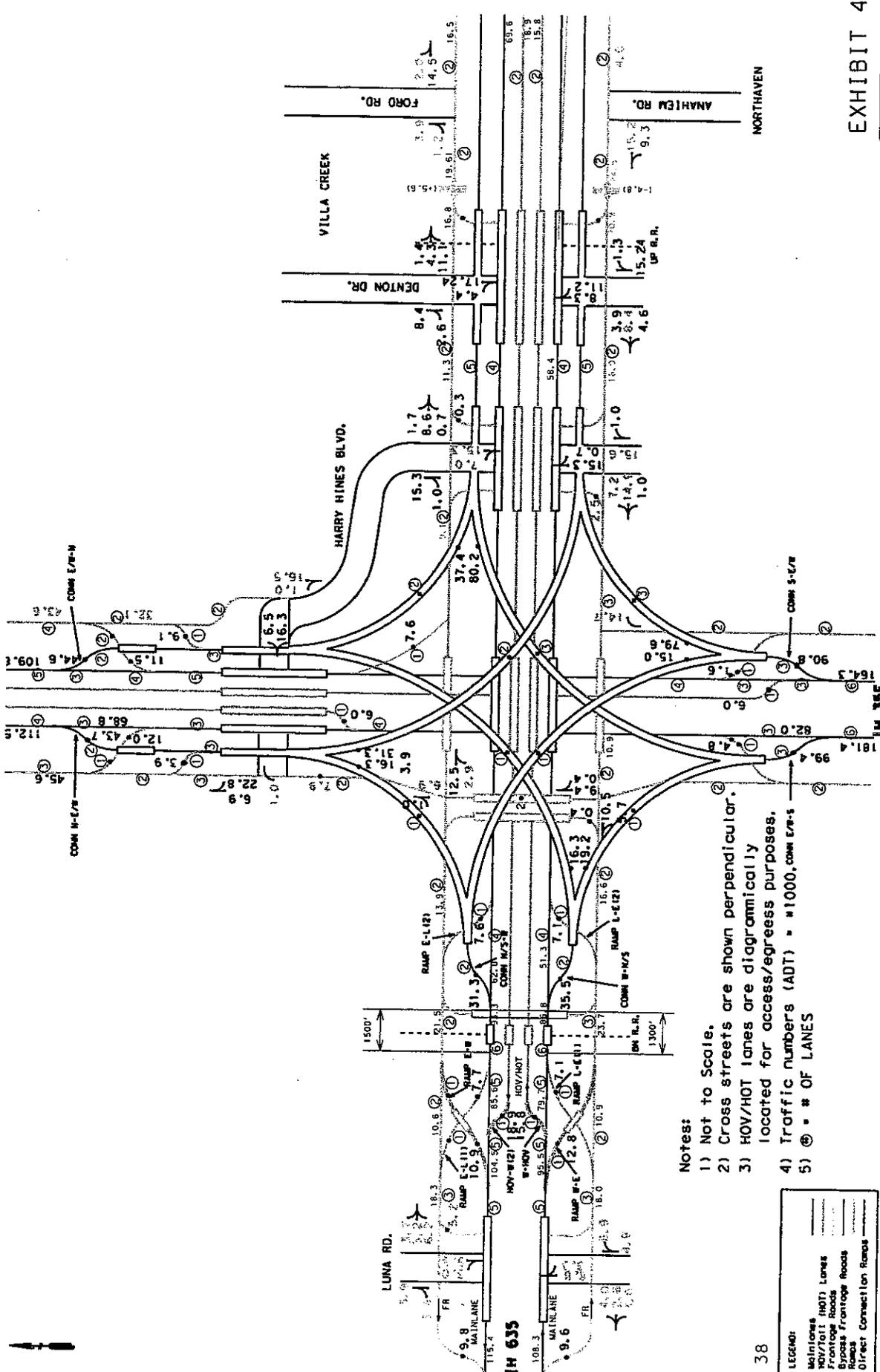
# LBJ Freeway Corridor Recommended Design Schematic

**Legend**

- 8 Mainlanes + 4/6 HOV/ Toll Lanes
- 10 Mainlanes + 4 HOV/Toll Lanes
- 10 Mainlanes + 2 Rev. HOV/Toll
- 10 Mainlanes
- DART Light Rail - Construction
- DART Light Rail - Planning
- HOV Lanes - Planning



**EXHIBIT 3**



- Notes:
- 1) Not to Scale.
  - 2) Cross streets are shown perpendicular.
  - 3) HOV/HOT lanes are diagrammatically located for access/egress purposes.
  - 4) Traffic numbers (ADT) = \*1000, comm. crvs =
  - 5) ⊕ = # OF LANES

38

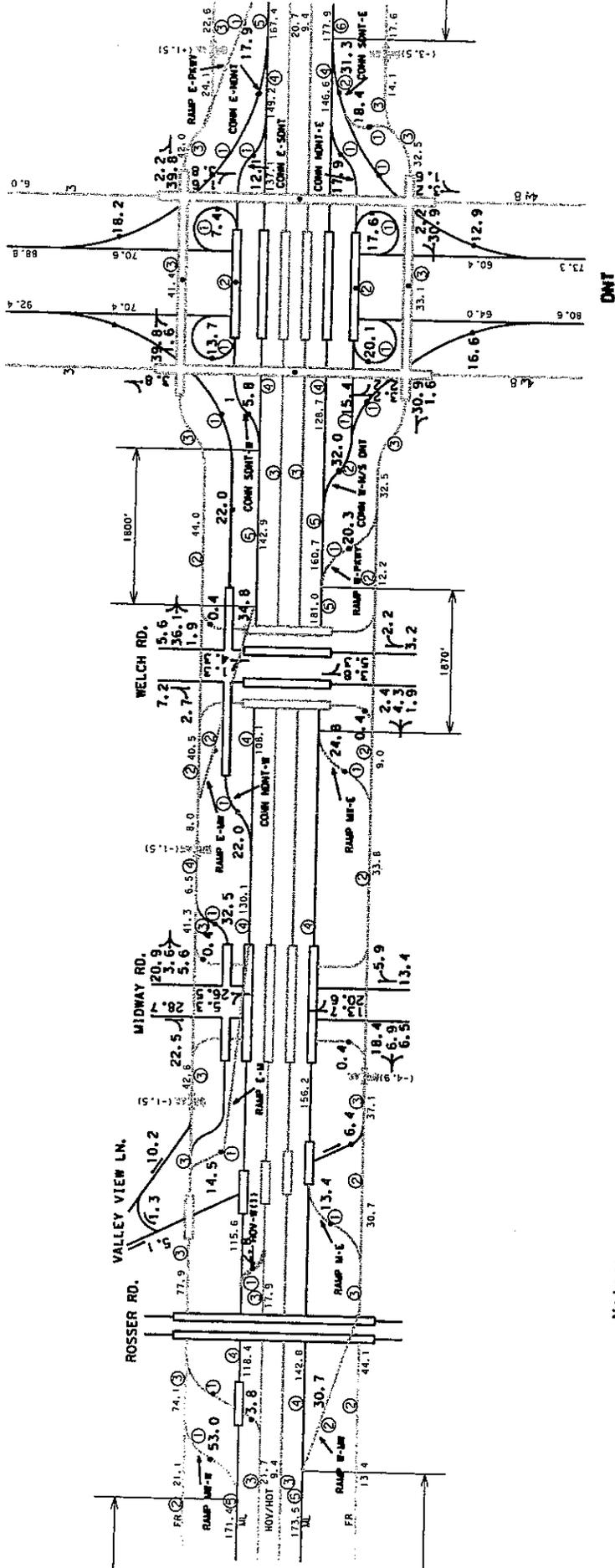
LEGEND:
— Mainlines
— HOV/Hot Lanes
— Frontage Roads
— Bypass Frontage Roads
— Ramps
— Direct Connection Ramps

PROPOSED WEST SECTION

EXHIBIT 4

PROJECT NO.	174
SHEET NO.	174
COUNTY	TEXAS
DATE	11/15/04
SCALE	AS SHOWN
DESIGNER	CH2M HILL
CHECKER	CH2M HILL
APPROVED BY	CH2M HILL





Notes:

- 1) Not to Scale.
- 2) Cross streets are shown perpendicular.
- 3) HOV/HOT lanes are diagrammatically located for access/egress purposes.
- 4) Traffic numbers (ADT) = #1000.
- 5) Ⓢ = # OF LANES

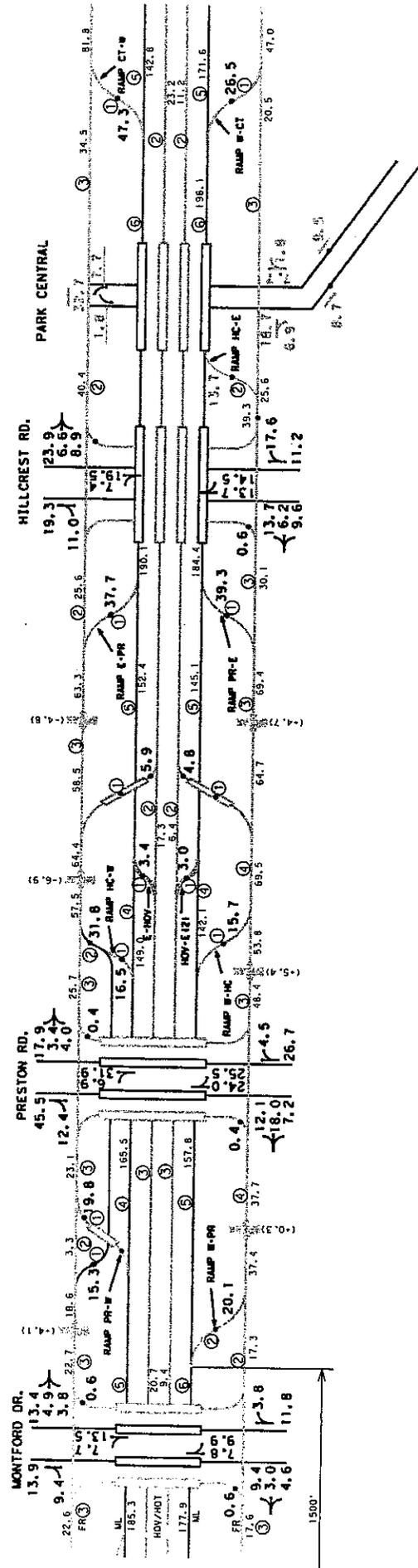
40

LEGEND:	
	Mainline Interchanges
	HOV/HOT Lanes
	Frontage Roads
	Bypass Frontage Roads
	Ramps
	Direct Connection Ramps

PROPOSED WEST SECTION

EXHIBIT 4

PROJECT NO.	440
DATE	11/10/04
SCALE	AS SHOWN
DESIGNER	CH
CHECKER	CH
DATE	11/10/04
PROJECT NO.	440
DATE	11/10/04
SCALE	AS SHOWN
DESIGNER	CH
CHECKER	CH
DATE	11/10/04



Notes:

- 1) Not to Scale.
- 2) Cross streets are shown perpendicular.
- 3) HOV/HOT lanes are diagrammatically located for access/egress purposes.
- 4) Traffic numbers (ADT) \* \*1000.
- 5) Ⓞ \* \* OF LANES

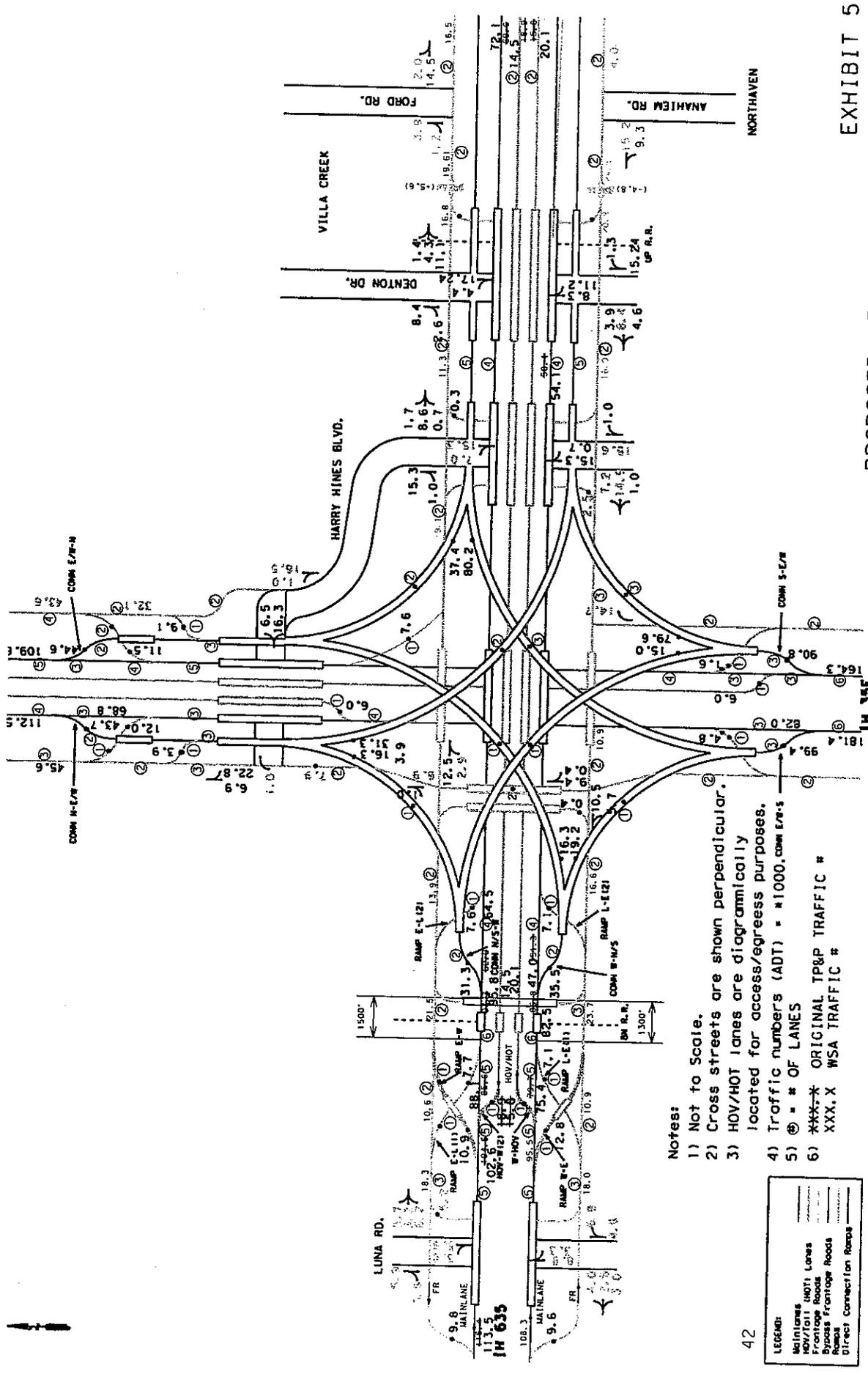
41

LEGEND	
—	Mainlines
—	HOV/HOT Lanes
—	Frontage Roads
—	Ramps
—	Frontage Roads
—	Direct Connection Ramps

EXHIBIT 4

DATE	10/20/04
PROJECT NO.	1074
NO.	6
DATE	10/20/04
DESIGN	1074
SCALE	AS SHOWN
DATE	10/20/04
NO.	6
DATE	10/20/04
NO.	6

PROPOSED WEST SECTION



- Notes:
- 1) Not to Scale.
  - 2) Cross streets are shown perpendicular.
  - 3) HOV/HOT lanes are diagrammatically located for access/egress purposes.
  - 4) Traffic numbers (ADT) = \*1000, COMB LANE
  - 5) ⊙ = # OF LANES
  - 6) \*\*\*-X ORIGINAL TRAFFIC #
  - XXX-X WSA TRAFFIC #

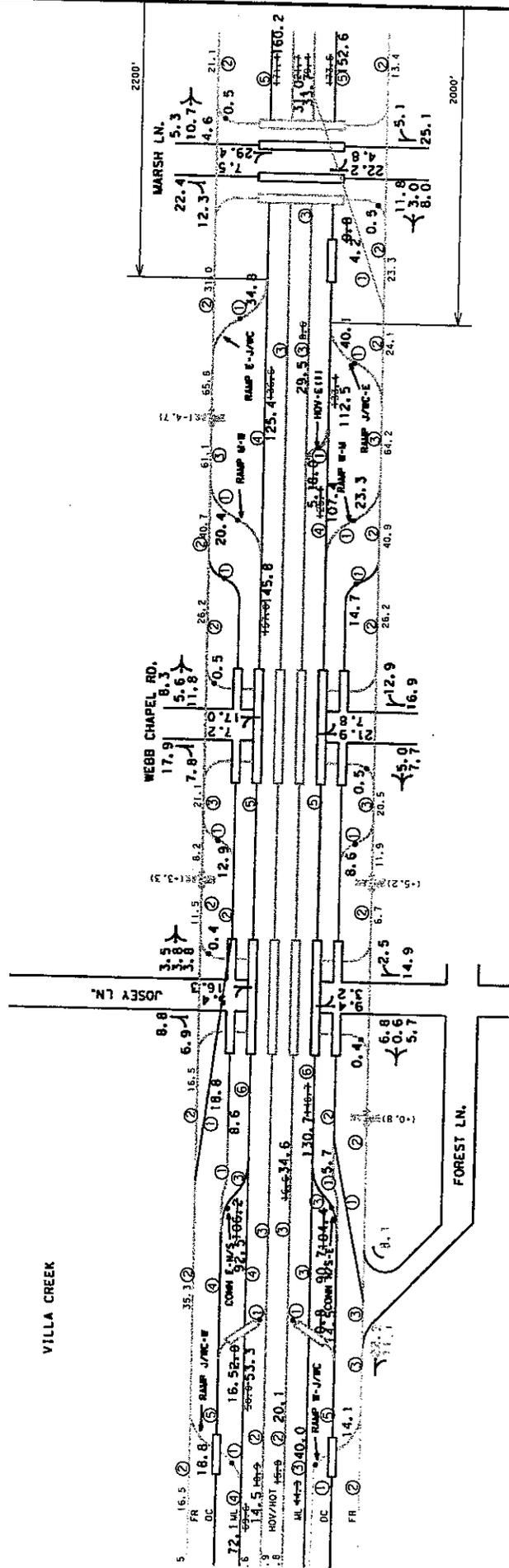
42

LEGEND:
Mainline
HOV/HOT Lanes
Frontage Roads
Ramp Frontage Roads
Direct Connection Ramps

EXHIBIT 5

PROPOSED WEST SECTION  
(TRAFFIC # BY WSA)

DATE	DIST.	COUNTY	PROJECT NO.
TEXAS			172
COMT.	SECT.	JOB	WSP NO.
			IH 635



Notes:

- 1) Not to Scale.
- 2) Cross streets are shown perpendicular.
- 3) HOV/HOT lanes are diagrammatically located for access/egress purposes.
- 4) Traffic numbers (ADT) = #1000.
- 5) (C) = # OF LANES
- 6) \*\*\*X\* ORIGINAL TP&P TRAFFIC #  
XXX, X WSA TRAFFIC #

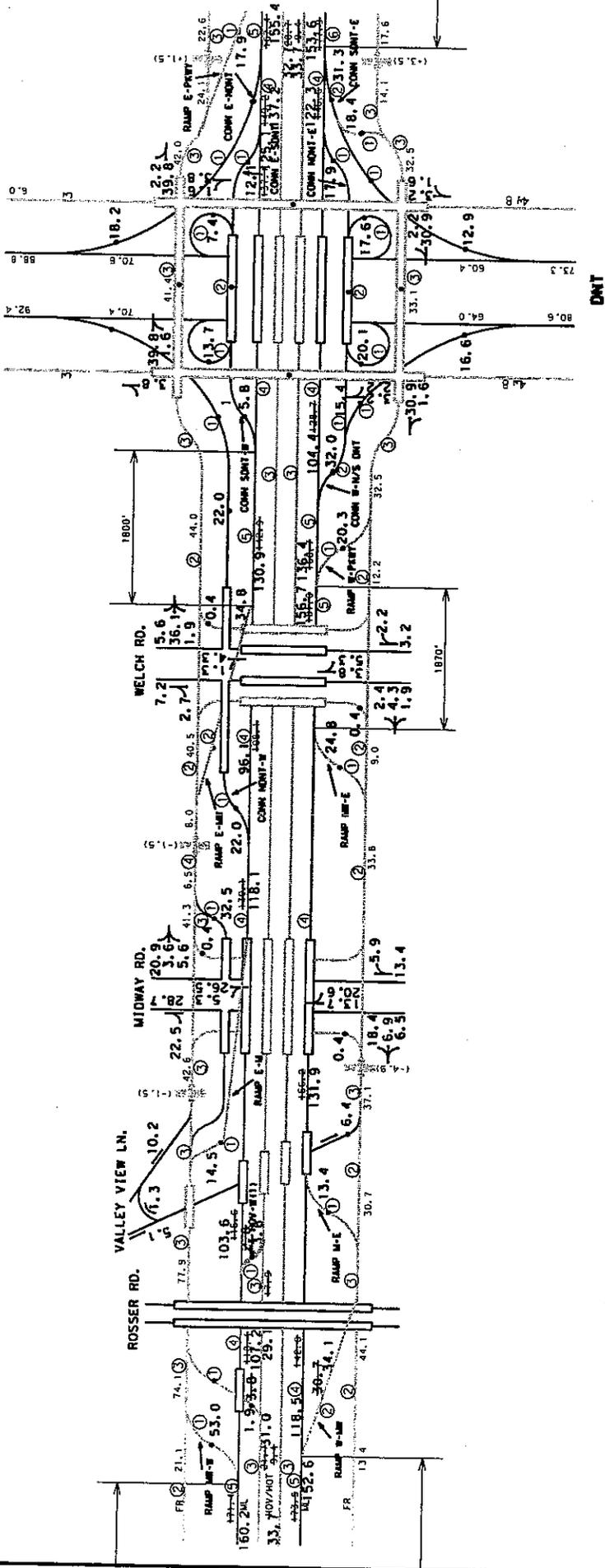
LEGEND:	
—	Mainlines
—	HOV/TOI (HOT) Lanes
—	Frontage Roads
—	Bypass Frontage Roads
—	Ramps
—	Direct Connection Ramps

43

EXHIBIT 5

PROPOSED WEST SECTION  
(TRAFFIC # BY WSA)

PROJECT NO.	1000
DATE	10/10/04
STATE	TEXAS
COUNTY	274
DIST.	
SECT.	
JOB	
INVOICE NO.	111 6.5



- Notes:
- 1) Not to Scale.
  - 2) Cross streets are shown perpendicular.
  - 3) HOV/HOT lanes are diagrammatically located for access/egress purposes.
  - 4) Traffic numbers (ADT) = \*1000.
  - 5) @ = # OF LANES
  - 6) \*\*\*-X ORIGINAL TP&P TRAFFIC #  
XXX.X WSA TRAFFIC #

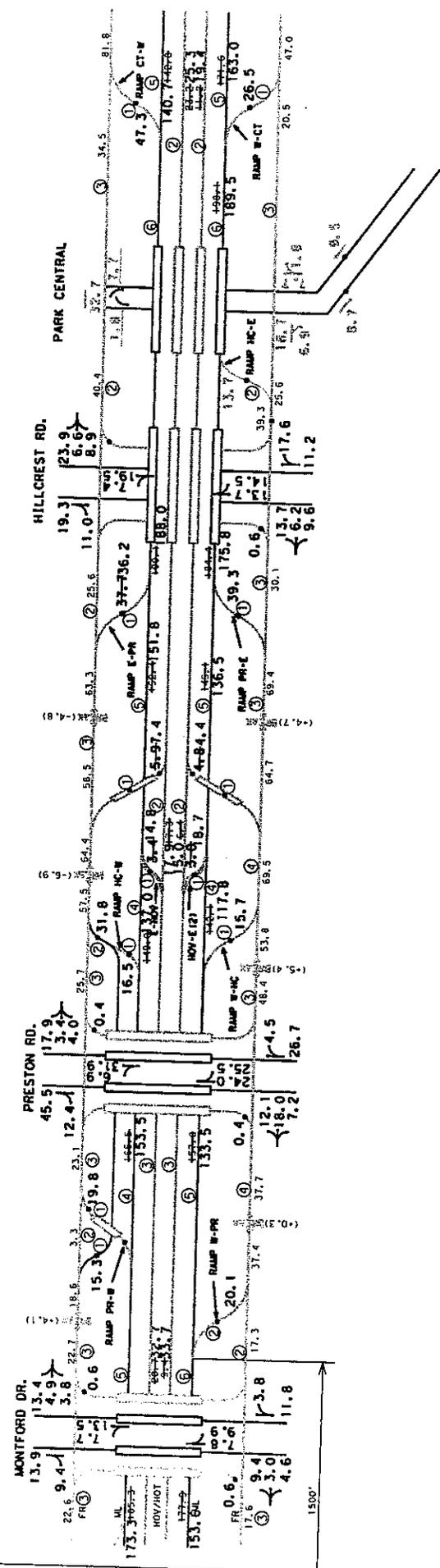
44

LEGEND:	
-----	Mainline Right-of-Way
-----	Interchange Right-of-Way
-----	HOV/HOT Lanes
-----	Access/Egress Roads
-----	Bypass Frontage Roads
-----	Ramps
-----	Direct Connection Ramps

EXHIBIT 5

PROPOSED WEST SECTION  
(TRAFFIC # BY WSA)

DATE	BY	DATE	BY
10/10/04	AD PROJECT NO.	10/10/04	AD PROJECT NO.
10/10/04	AD PROJECT NO.	10/10/04	AD PROJECT NO.
10/10/04	AD PROJECT NO.	10/10/04	AD PROJECT NO.
10/10/04	AD PROJECT NO.	10/10/04	AD PROJECT NO.



# **Appendix B**

**NCTCOG**  
**MANAGED LANE POLICY**

# MANAGED LANE POLICIES

1. A fixed-fee schedule will be applied during the first six months of operation; dynamic pricing will be applied thereafter.
2. The toll rate will be set up to \$0.75 per mile during the fixed-schedule phase. The established rate will be evaluated and adjusted, if warranted, with Regional Transportation Council (RTC) approval.
3. Toll rates will be updated monthly during the fixed-schedule phase.
4. Market-based tolls will be applied during the dynamic-pricing phase.
5. Transit vehicles will not be charged a toll.
6. Single-occupant vehicles will pay the full rate.
7. Trucks will pay a higher rate, and no trucks will be permitted in the LBJ tunnel.





## MANAGED LANE POLICIES (continued)

8. High-occupancy vehicles of two or more occupant and vanpools will pay the full rate in the off-peak period.
9. High-occupancy vehicles of two or more occupants will receive a 50 percent discount during the peak period.\* This discount will phase out after the air quality attainment maintenance period. RTC-sponsored public vanpools are permitted to add peak-period tolls as eligible expenses. Therefore, the Comprehensive Development Agreement (CDA) firm will be responsible for the high-occupancy vehicle discount and the Regional Transportation Council will be responsible for the vanpool discount.
10. The toll rate will be established to maintain a minimum average corridor speed of 50 miles per hour.

\*6 hours per weekday: 6:30 a.m. - 9:00 a.m. and 3:00 p.m. - 6:30 p.m.



# MANAGED LANE POLICIES (continued)

11. During the dynamic-pricing phase, travelers will receive rebates if the average speed drops below 35 mph. Rebates will not apply if speed reduction is out of the control of the operator.
12. Motorcycles qualify as high-occupancy vehicles.
13. No discounts will be given for "Green Vehicles."
14. No scheduled inflation adjustments will be applied over time.
15. Every managed lane corridor will operate under the same policy.
16. There will be no change to the Regional Transportation Council Excess Revenue Policy.



# MANAGED LANE POLICIES (continued)

17. The Regional Transportation Council requests that local governments and transportation authorities assign representatives to the Comprehensive Development Agreement procurement process.
18. The duration of the Comprehensive Development Agreement should maximize potential revenue.
19. Tolls will remain on the managed lanes after the Comprehensive Development Agreement duration.

Texas Department of Transportation  
IH 635 Managed Lanes Project  
Technical Provisions

**Attachment 12-1A**  
Drainage Criteria Manual



---

## Table of Contents

CHAPTER 1 - INTRODUCTION .....	1-1
1.1    PURPOSE .....	1-1
1.2    SCOPE .....	1-1
1.3    DESIGN CRITERIA SUMMARY .....	1-2
CHAPTER 2 - POLICY AND GUIDELINES .....	2-1
CHAPTER 3 - DATA COLLECTION, EVALUATION, AND DOCUMENTATION .....	3-1
3.1    GENERAL .....	3-1
3.2    HYDRAULIC REPORTS .....	3-1
3.3    DRAINAGE PLANS PREPARATION .....	3-3
3.4    SUBMITTALS .....	3-6
CHAPTER 4 - HYDROLOGY .....	4-1
4.1    GENERAL .....	4-1
4.2    DESIGN FREQUENCY .....	4-1
4.3    FREQUENCIES OF COINCIDENTAL OCCURRENCES .....	4-2
4.4    TIME OF CONCENTRATION .....	4-2
4.5    RATIONAL METHOD .....	4-3
4.6    NRCS RUNOFF CURVE NUMBER METHOD .....	4-5
4.7    FLOOD HYDROGRAPH ROUTING METHODS .....	4-6
CHAPTER 5 - HYDRAULIC CROSSINGS .....	5-1
5.1    GENERAL .....	5-1
5.2    SURVEY .....	5-1
5.3    ROUGHNESS COEFFICIENTS .....	5-1
5.4    REQUIREMENTS .....	5-4
5.5    CHANNELS .....	5-4
5.6    STREAM ANALYSIS .....	5-5
CHAPTER 6 - STORM DRAINAGE SYSTEMS .....	6-1
6.1    GENERAL .....	6-1
6.2    DESIGN FREQUENCIES .....	6-1
6.3    RUNOFF CALCULATIONS .....	6-6
6.4    PAVEMENT DRAINAGE .....	6-6
6.5    STORM DRAIN INLETS .....	6-7
6.6    LOCATION OF STORM DRAIN APPURTENANCES / CONDUIT RUNS .....	6-11



---

6.7	CONDUIT SYSTEMS .....	6-11
6.8	ROADSIDE CHANNELS .....	6-12
6.9	HEAD LOSSES .....	6-13
6.10	OUTPUT .....	6-14
CHAPTER 7 - CULVERTS .....		7-1
7.1	GENERAL .....	7-1
7.2	RUNOFF CALCULATIONS .....	7-1
7.3	TAILWATER DETERMINATION .....	7-1
7.3.1	Culverts That Tie Into a Downstream Channel .....	7-1
7.3.2	Culverts That Tie Into a Closed System.....	7-1
7.4	HYDRAULIC COEFFICIENTS .....	7-1
7.5	HEADWATER.....	7-1
7.6	CULVERT SECTIONS .....	7-2
7.7	CULVERT VELOCITY .....	7-2
7.8	OUTPUT .....	7-3
CHAPTER 8 - BRIDGES .....		8-1
8.1	GENERAL .....	8-1
8.2	RUNOFF CALCULATIONS .....	8-1
8.3	BRIDGE SECTIONS .....	8-1
8.4	HYDRAULIC OPERATION.....	8-1
8.5	BRIDGE SCOUR .....	8-2
8.6	OUTPUT .....	8-3



---

## List of Tables

Table 1.3.1	Design Criteria .....	1-2
Table 4.2.1	Design Frequencies .....	4-1
Table 4.3.1	Frequency Combinations .....	4-2
Table 4.5.1	Runoff Coefficients (C) for Urban Watersheds .....	4-3
Table 4.5.2	Runoff Coefficient Adjustment Factors for Rational Method .....	4-4
Table 4.5.3	Intensity Coefficients for Dallas County .....	4-5
Table 4.6.1	Runoff Curve Numbers for Urban Areas .....	4-6
Table 5.3.1	Manning's "n" Values .....	5-3
Table 5.5.1	Types of Channel Lining .....	5-5
Table 6.4.1	Allowable Ponding Widths .....	6-6
Table 6.5.1	Inlet Types .....	6-7
Table 6.5.2	Curb Inlet Input .....	6-8
Table 6.5.3	Grate Inlet Input .....	6-9
Table 6.7.1	Conduit System Design Criteria .....	6-12
Table 6.8.1	Roadway Channel Design Criteria .....	6-13
Table 6.9.1	Headloss Coefficients .....	6-14
Table 6.10.1	Example Drainage Area Output .....	6-15
Table 6.10.2	Example Inlet Configuration Output .....	6-15
Table 6.10.3	Example Inlet Hydraulics Output .....	6-16
Table 6.10.4	Hydraulic Data: Proposed Storm Sewer (50-Year Frequency) .....	6-16
Table 6.10.5	Hydraulic Data: Proposed Storm Sewer (50-Year Frequency) .....	6-17
Table 7.4.1	Entrance Loss Coefficients .....	7-1
Table 8.6.1	Sample Scour Calculations .....	8-4
Table 8.6.2	Scour Results .....	8-5

---

## List of Figures

Figure 5.2.1	Typical Surveyed Cross Section with Five Points in the Channel.....	5-2
Figure 6.2.1	Depressed and Non-Depressed Frequencies .....	6-4
Figure 6.2.2	Depressed Sections.....	6-5
Figure 6.5.1	Parallel Grate Inlet .....	6-10
Figure 6.8.1	Roadside Channels .....	6-13
Figure 7.6.1	Multiple Box Culvert Placement.....	7-2



## **CHAPTER 1 - INTRODUCTION**

### **1.1 PURPOSE**

The purpose of this drainage manual is to establish design procedures necessary for the control of storm water runoff for the IH 635 Freeway improvements from Luna Road to US 80 (referred to in this manual as IH 635 corridor). Also included is IH 35E from Royal Lane to Valwood Parkway. The design factors, formulas, graphs, and procedures are intended for use as engineering guides in the solution of drainage problems involving determination of the quantity, rate of flow and conveyance of storm water. The procedures defined herein should be applied by experienced professional drainage Engineers who are ultimately responsible for the design of drainage systems within the IH 635 corridor.

### **1.2 SCOPE**

This manual presents various applications of accepted principles of surface drainage engineering and is a working supplement to the information obtained from standard drainage handbooks and other publications on drainage.

The design criteria presented herein for the IH 635 corridor drainage systems are primarily based on the Texas Department of Transportation's (TxDOT) Hydraulic Design Manual, March 2004. However, additional drainage design guidelines from the cities of Dallas, Farmer's Branch, Garland, and Mesquite were referenced during the development of this manual.

The intent of this manual is to provide clear, concise and uniform principles, guidelines and criteria for use by drainage Engineers designing the storm drainage systems along the IH 635 corridor from Luna Road to US 80. The information provided in this manual has been adjusted to reflect the conditions that generally exist along the Project corridor and is meant to clarify and supplement the TxDOT Hydraulic Design Manual.

Methods of design other than indicated herein may be considered in special cases where experience clearly indicates they are preferable. However, there should be no extensive variations from the practices established herein without express approval from TxDOT.



### 1.3 DESIGN CRITERIA SUMMARY

A brief summary of the drainage design criteria is provided in Table 1.3.1. For detailed discussions and additional criteria refer to the following chapters.

**Table 1.3.1 Design Criteria**

Description	General Purpose Lanes	Managed Lanes	Direct Connectors
<b>Method for Determining Peak Runoff</b>			
Less than 200 acres	Rational Method	Rational Method	Rational Method
Greater than 200 acres	Natural Resources Conservation Service Runoff Curve Number Method	Natural Resources Conservation Service Runoff Curve Number Method	Natural Resources Conservation Service Runoff Curve Number Method
<b>Culvert Crossings</b>			
Design Storm	Minor: 50-year	Minor: 50-year	Minor: 50-year
	Major: 100-year	Major: 100-year	Major: 100-year
Check Storm	100-year	100-year	100-year
Headwater Control <sup>[1]</sup>	< Or = Existing Headwater Elevation	< Or = Existing Headwater Elevation	< Or = Existing Headwater Elevation
Maximum Outlet Velocity	Lined: 12 fps	Lined - 12 fps	Lined - 12 fps
	Vegetated clay: 8 fps	Vegetated clay: 8 fps	Vegetated clay: 8 fps
	Vegetated sand: 6 fps	Vegetated sand: 6 fps	Vegetated sand: 6 fps
Minimum Outlet Velocity	Lined: 2.5 fps	Lined: 2.5 fps	Lined: 2.5 fps
	Vegetated: 2 fps	Vegetated: 2 fps	Vegetated: 2 fps
<b>Storm Sewers and Inlets</b>			
Design Storm	50-year	50-year	50-year
Check Storm	100-year	100-year	100-year
Design Storm Allowable Ponding Width	No encroachment into the travel lanes	2 feet of encroachment into the travel lanes	2 feet of encroachment into the travel lanes
Check Storm Allowable Ponding Width	One lane free of encroachment	One lane free of encroachment	One lane free of encroachment
Pipe Material	Concrete	Concrete	Concrete
Minimum Pipe Size	Laterals: 18 inch	Laterals: 18 inch	Laterals: 18 inch
	Trunklines: 24 inch	Trunklines: 24 inch	Trunklines: 24 inch
Minimum Pipe Velocity	2 fps	2 fps	2 fps
Maximum Pipe Velocity	12 fps	12 fps	12 fps

**Table 1.3.1 Cont.**

Description	Ramps	By-Passes	Elevated Collectors
<b>Method for Determining Peak Runoff</b>			
Less than 200 acres	Rational Method	Rational Method	Rational Method
Greater than 200 acres	Natural Resources Conservation Service Runoff Curve Number Method	Natural Resources Conservation Service Runoff Curve Number Method	Natural Resources Conservation Service Runoff Curve Number Method
<b>Culvert Crossings</b>			
Design Storm	Minor: 50-year	Minor: 50-year	Minor: 50-year
	Major: 100-year	Major: 100-year	Major: 100-year
Check Storm	100-year	100-year	100-year
Headwater Control <sup>[1]</sup>	< Or = Existing Headwater Elevation	< Or = Existing Headwater Elevation	< Or = Existing Headwater Elevation
Maximum Outlet Velocity	Lined: 12 fps	Lined - 12 fps	Lined - 12 fps
	Vegetated clay: 8 fps	Vegetated clay: 8 fps	Vegetated clay: 8 fps
	Vegetated sand: 6 fps	Vegetated sand: 6 fps	Vegetated sand: 6 fps
Minimum Outlet Velocity	Lined: 2.5 fps	Lined: 2.5 fps	Lined: 2.5 fps
	Vegetated: 2 fps	Vegetated: 2 fps	Vegetated: 2 fps
<b>Storm Sewers and Inlets</b>			
Design Storm	50-year	50-year	50-year
Check Storm	100-year	100-year	100-year
Design Storm Allowable Ponding Width	2 feet of encroachment into the travel lanes	2 feet of encroachment into the travel lanes	2 feet of encroachment into the travel lanes
Check Storm Allowable Ponding Width	One lane free of encroachment	One lane free of encroachment	One lane free of encroachment
Pipe Material	Concrete	Concrete	Concrete
Minimum Pipe Size	Laterals: 18 inch	Laterals: 18 inch	Laterals: 18 inch
	Trunklines: 24 inch	Trunklines: 24 inch	Trunklines: 24 inch
Minimum Pipe Velocity	2 fps	2 fps	2 fps
Maximum Pipe Velocity	12 fps	12 fps	12 fps

**Table 1.3.1 Cont.**

Description	Frontage Roads	Cross Streets
<b>Method for Determining Peak Runoff</b>		
Less than 200 ac	Rational Method	Rational Method
Greater than 200 ac	Natural Resources Conservation Service Runoff Curve Number Method	Natural Resources Conservation Service Runoff Curve Number Method
<b>Culvert Crossings</b>		
Design Storm	Minor: 50-year	Minor: 50-year
	Major: 100-year	Major: 100-year
Check Storm	100-year	100-year
Headwater Control <sup>[1]</sup>	< Or = Existing Headwater Elevation	< Or = Existing Headwater Elevation
Maximum Outlet Velocity	Lined - 12 fps	Lined - 12 fps
	Vegetated clay: 8 fps	Vegetated clay: 8 fps
	Vegetated sandy: 6 fps	Vegetated sandy: 6 fps
Minimum Outlet Velocity	Lined: 2.5 fps	Lined: 2.5 fps
	Vegetated: 2 fps	Vegetated: 2 fps
<b>Storm Sewers and Inlets</b>		
Design Storm <sup>[2]</sup>	25-year	25-year
	Depressed: 50-year	Depressed: 50-year
Check Storm	50-year	50-year
	Depressed: 100-year	Depressed: 100-year
Design Storm Allowable Ponding Width	One-lane for a 2-lane frontage road One-and-a-half lanes for a 3-lane frontage road	One lane open to traffic in each direction
Check Storm Allowable Ponding Width	50-year – no overtopping of curb	50-year – no overtopping of curb
Pipe Material	Concrete	Concrete
Minimum Pipe Size	Laterals: 18 inch	Laterals: 18 inch
	Trunklines: 24 inch	Trunklines: 24 inch
Minimum Pipe Velocity	2 fps	2 fps
Maximum Pipe Velocity	12 fps	12 fps

Notes:

1. This applies to cross structures. Refer to Chapter 7. The same headwater controls that apply to storm sewer apply to internal culverts. For internal drainage hydraulic grade line requirements, refer to Chapter 6.
2. For frontage roads and side streets along IH-35E south of Royal Lane, the 10-year design frequency applies. In all cases for depressed sections, design will be for the 50-year event. For further discussion, refer to Chapter 6.2.



## **CHAPTER 2 - POLICY AND GUIDELINES**

An objective of TxDOT is to construct and maintain facilities that minimize the potential for flooding impacts to the surrounding area. The TxDOT Drainage Policy as stated in Chapter 2 of the TxDOT Hydraulic Design Manual shall govern the design of drainage facilities within the IH 635 corridor. All criteria in this manual have been developed to support this policy.

Variances from any of the criteria or policy in this manual must receive prior approval from TxDOT.

TxDOT and the design Engineer shall work together in the preparation of the construction plans for projects within the IH 635 corridor. Throughout the preparation process TxDOT shall review the progress of the design in pre-determined intervals as defined in this manual. Submittals shall be made to TxDOT in the form of half-size sets of construction plans that are eleven inches tall by seventeen inches wide. For all but the final submittal, the construction plans shall have the preliminary seal of the project Engineer that is licensed in the state of Texas. An Engineer licensed in the state of Texas shall seal the final set of construction plans and any bound reports.

The review process is subdivided into four distinct steps, representing levels of completeness. They are: 35 percent complete, 65 percent complete, 95 percent complete, and 100 percent complete. A description of major drainage-related elements required at each step is explained in Chapter 3, Section 4. Refer to TxDOT's PS&E Preparation Manual for additional information.

For improvements at crossings that affect Federal Emergency Management Agency (FEMA) flood hazard areas, the guidelines explained in Chapter 2 of TxDOT's Hydraulic Design Manual should be followed. No rise in water surface for the 100-year storm will be permitted; therefore, Conditional Letters of Map Revision (CLOMR's) will not be necessary. It will be left up to the local community to submit to the FEMA a Letter of Map Revision (LOMR) request. TxDOT will provide the cities with the certified as-built plans for the proposed Project.

Improvements along the IH 635 corridor may impact jurisdictional waters of the United States. The agency responsible for regulating such impacts is the U.S. Army Corps of Engineers (USACE). Applications shall be submitted to the USACE detailing impacts to the waters of the United States and adjacent wetlands, according to the guidelines prescribed by the USACE.



The Engineer shall prepare exhibits that clearly demonstrate proposed work in waters of the U.S. and adjacent wetlands. Any measures to mitigate the impacts to the waters of the United States shall be reviewed and approved by TxDOT. The design Engineer shall prepare other permits or applications that may apply along the IH 635 corridor.



## CHAPTER 3 - DATA COLLECTION, EVALUATION, AND DOCUMENTATION

### 3.1 GENERAL

The purpose of this chapter is to clarify documentation and data collection procedures for the IH 635 corridor. Because drainage improvements along the IH 635 corridor may be designed by several Engineers, it is imperative that a clear procedure for documentation is followed. This will ensure that information is adequately relayed and a uniform design within the corridor is achieved. Chapters 3 and 4 of TxDOT's Hydraulic Design Manual discuss the standard documentation and data collection procedures. The following chapter clarifies specific aspects of those procedures as they apply to the IH 635 corridor for the following design elements:

1. Hydraulic reports
2. Drainage plans preparation
3. Submittals

### 3.2 HYDRAULIC REPORTS

All data gathered and used in analysis and design should be included in hydraulic reports. For each major hydraulic crossing as defined in Table 4.2.1 the following information shall be included when available:

1. Stream/Structure location
2. Site description
3. Maps
  - a. Local zoning maps
  - b. Flood insurance studies
  - c. USGS quadrangle maps
  - d. Aerial photos
  - e. Soil maps
4. Field survey information
  - a. Existing hydraulic facilities
  - b. Existing controls
  - c. Profiles of existing roadway
5. Ground level photographs
6. Flood history
7. Flood insurance studies (FIS by FEMA)



8. Geotechnical information
  - a. Soil properties
  - b. Stream stability
  - c. Existing erosion/scour problems
  - d. Historic scour data from bridge inspection records for existing bridges and other crossings on the same and nearby streams.
  - e. Boring logs where available
9. Drainage area maps
  - a. Scale
  - b. North arrow
  - c. Delineated areas and size
  - d. Runoff coefficients/Runoff Curve Numbers (RCN)
  - e. Slopes
  - f. Contours
10. Hydrologic methods and programs
11. Hydrologic calculations
12. Flood frequency analysis
  - a. Peak discharges for design and check events
  - b. Runoff hydrographs for design and check events
13. Hydraulic method or program used
14. Channel data
  - a. Cross sections
    - i. Location
    - ii. Subdivisions and “n” values
  - b. Thalweg profiles
  - c. Flow controls
  - d. Design criteria and assumptions
15. Structure data
  - a. Size and configuration
  - b. Abutment protection for bridges
  - c. Stream bank stabilization
  - d. Allowable headwater and outlet velocities for design and check events
  - e. Magnitude and frequency of overtopping event



- f. Scour calculations and estimated scour envelope for bridges
- 16. Hydraulic computations including stage-discharge data
- 17. Water surface elevations for the design and check events including headwater elevations at structures
- 18. Average velocities for design and check events
- 19. Analysis of existing conditions for comparison
  - a. Velocities through existing structures
  - b. Water surface elevations
  - c. Erosion and sedimentation problems
- 20. Channel improvements/easements
- 21. Outlet protection/control

### **3.3 DRAINAGE PLANS PREPARATION**

The drainage construction plans for the IH 635 corridor shall include the following sheets and information:

- 1. Drainage Area Maps
  - a. Overall/Offsite drainage area maps
    - i. Scale
    - ii. North arrow
    - iii. Centerline of IH 635
    - iv. Cross structure drainage designation and size
    - v. Drainage boundary for major divides
    - vi. Contours with elevation label at a readable increment (when available)
    - vii. Runoff direction arrows
    - viii. Drainage area sizes
    - ix. Design flows
  - b. Roadway/Onsite drainage area maps
    - i. Scale
    - ii. North arrow
    - iii. Centerline of IH 635
    - iv. Existing topography
    - v. Inlets and cross structures visible



- vi. Runoff direction arrows
- vii. Drainage area label/identification
- 2. Major culvert hydraulic computation sheets
  - a. Culvert size and length
  - b. Method of hydraulic analysis
  - c. Design and check storm flow
  - d. Design and check storm headwater and tailwater elevations
  - e. Design and check storm velocities
    - i. Through proposed structure
    - ii. Through existing structure
  - f. Culvert flowlines upstream and downstream
  - g. Allowable and existing headwater elevations
- 3. Storm sewer hydraulic calculation sheets (refer to Tables 6.10.1 through 6.10.5) for required information
  - a. Runoff computations
  - b. Inlet configuration
  - c. Inlet computations
  - d. Storm sewer configuration
  - e. Storm sewer computations
- 4. Culvert layout sheets
  - a. North arrow
  - b. Vertical and horizontal scales
  - c. Plan view
    - i. Proposed contours and grading
    - ii. Existing contours, grading, or features to match at R.O.W.
    - iii. Proposed roadway linework
    - iv. Roadway centerline/baseline callouts and stationing
    - v. Right-of-way and drainage easement linework and callouts
    - vi. Culvert size and length (normal length and skew length, if applicable)
    - vii. Culvert, headwall, inlet, storm sewer linework
    - viii. Culvert stationing
    - ix. Callouts for headwalls and junctions on culvert
  - d. Profile view



- i. Culvert profile facing the direction of increasing roadway stationing
  - ii. Culvert stationing
  - iii. Culvert elevation callouts at grade breaks and junctions
  - iv. Linework and callouts for pipes/culverts tying to cross structure
  - v. Centerline slopes upstream and downstream of structure
  - vi. Proposed flows for the design and check events
  - vii. Proposed headwater and tailwater elevations for the design and check events
  - viii. Proposed velocities for the design and check events
  - ix. Proposed and existing ground along the centerline of the culvert
  - x. Applicable culvert and end treatment/headwall standard details reference
5. Storm sewer plan and profile sheets
- a. Plan view
    - i. Scale
    - ii. North arrow
    - iii. Topography
    - iv. Proposed roadway linework
    - v. Callouts for the reference roadway centerlines/baselines
    - vi. Culvert, storm sewer trunk line and lateral, inlet, and ditch centerline linework
    - vii. Node identification - headwall, inlet, bend, and junction designations
    - viii. Pipe/link designations, pay lengths, and diameter/size
    - ix. Utilities in critical locations
  - b. Profile view
    - i. Scale
    - ii. Link profile linework
    - iii. Callouts for headwalls, inlets, junctions, bends, and grade breaks
      - 1. Flowline elevations
      - 2. Type of node
      - 3. Reference roadway station/offset
      - 4. Top of pavement/grade or lip of gutter where applicable
      - 5. Depth of inlet/manhole
    - iv. Callouts for pipe/link pay length, diameter/size, and slope



- v. Trench excavation protection limits and length
  - vi. Hydraulic grade line for design event
  - vii. Existing ground and proposed (finished) grade along centerline of link
6. Special ditch grading
- a. Ditch designation – shown on storm sewer plan view
  - b. Table summarizing ditch design – on separate special ditch grading summary sheet
    - i. Reference roadway station, offset and elevation for beginning, end, grade breaks, and shape changes
    - ii. Ditch flowline elevations
    - iii. Ditch bottom width
  - c. Ditch typical sections shown on roadway typical sections or on special ditch grading summary sheets
7. Drainage details and standard details

### 3.4 SUBMITTALS

Documentation review stages shall be as follows:

1. 35 Percent Submittal – Preliminary Design
  - a. 11" x 17" half-size bond with preliminary seal
  - b. Preliminary hydraulic report for effective review
  - c. Overall drainage area maps essentially complete for final review
  - d. Major creek crossings
    - i. Final hydrologic and hydraulic calculations
    - ii. Water surface elevations
    - iii. Bridge layouts essentially complete for final review
    - iv. Culvert plan and profile sheets with final layouts and sizes
    - v. Utility locations in critical locations
  - e. Minor culvert crossings – design substantially complete for effective review
    - i. Final hydrologic calculations
    - ii. Preliminary hydraulic calculations
    - iii. Culvert layout
    - iv. Preliminary size and profile



- v. Preliminary water surface elevations
    - f. Preliminary box culvert supplement sheet if applicable
  - 2. 65 Percent Submittal – Plans Adequate
    - a. 11" x 17" half-size bond with preliminary seal
    - b. Incorporated TxDOT comments from 35% submittal
    - c. Preliminary storm sewer design
      - i. Trunk line layout and preliminary size
      - ii. Preliminary trunk line profile
      - iii. Known inlet locations
      - iv. Sample inlet drainage area map
      - v. Outfall location, description, and tailwater information
      - vi. Utility locations in critical locations
    - d. Minor culvert design complete
      - i. Final hydraulic calculations
      - ii. Final culvert plan and profile sheets
    - e. Provide plans and reports for review by adjacent cities
    - f. Provide plans adequate for utility adjustments
  - 3. 95 Percent Submittal – District Review
    - a. 11" x 17" half-size bond with preliminary seal
    - b. Incorporated TxDOT comments from 65% submittal
    - c. Final storm sewer design
      - i. Final inlet locations and inlet drainage area maps
      - ii. Final hydrologic and hydraulic calculations
      - iii. Final storm sewer plan and profiles sheets – trunk lines and laterals
    - d. Final bridge design and construction plans
  - 4. 100 Percent Submittal – Final Mylars
    - a. 11" x 17 " half-size sealed mylar
    - b. Incorporated TxDOT comments from 95% submittal
    - c. Final drainage construction plans and detail sheets
    - d. TxDOT standard details
  - 5. As-Built Plans
    - a. 11" x 17" half-size sealed mylar
    - b. Incorporated TxDOT approved field changes of 100% submittal

## CHAPTER 4 - HYDROLOGY

### 4.1 GENERAL

The requirements regarding the computations of runoff from the watersheds located along the IH 635 corridor are based primarily on the TxDOT's Hydraulic Design Manual, Chapter 5. The information contained herein offers clarification to that manual and specifies some site-specific requirements related to the IH 635 corridor.

For the purposes of the IH 635 corridor, all computed existing and design discharges will be based on the assumption that the offsite contributing watershed is completely developed. In other words, only fully-urbanized discharges will be used to size proposed improvements. Sufficient documentation such as zoning maps, as-builts, site plans, etc., must be provided to support the computation of both the existing and fully-developed runoff discharges.

### 4.2 DESIGN FREQUENCY

The frequency of a storm refers to the probability that, in any given year, a certain magnitude of rainfall event will occur or be exceeded. Table 4.2.1 summarizes the frequencies that are to be used for the various drainage structures within the IH 635 corridor. Table 4.2.1 also specifies the criteria that are to be used for both design storms and check storms. The design and check storm conditions as they relate to the roadway facilities are given in Chapter 6, 7 and 8.

**Table 4.2.1 Design Frequencies**

Hydraulic Crossings	Design Storm	Check Storm
<b>Major Bridge Crossings</b>		
- Farmers Branch	100-year	
- Farmers Branch Tributary	100-year	
<b>Major Culvert Crossings</b>		
- Cooks Branch	100-year	
- Long Branch	100-year	
- Audelia	100-year	
- Jackson	100-year	
- Dixon	100-year	
Other major culverts (DA > 200 ac)	100-year	
Minor culvert crossings (DA < 200 ac)	50-year	100-year
<b>Storm Drainage</b>		
Frontage road and cross streets	25- and 50*-Year	50- and 100-Year
Mainlanes/General Purpose, ramps, collector/distributor and Managed HOV	50-Year	100-Year

\*Depressed Section

### 4.3 FREQUENCIES OF COINCIDENTAL OCCURRENCES

Coincidental Occurrence was applied in the hydrologic design for the IH 635 corridor. Coincidental Occurrences refer to the varying amount of time it takes for different size drainage basins to reach peak flow. A smaller basin with a relatively quick time of concentration is going to achieve its peak discharge before a larger basin with a longer time of concentration. Therefore, when the smaller basin's peak flow is achieved the larger basin has only reached a fraction of its peak flow. The percent of the larger basin's peak flow that is reached depends on the ratio of drainage areas for the two basins. Table 4.3.1 lists the possible frequency combinations in the IH 635 corridor. Refer to Section 6.2 for further guidance involving coincidental occurrences.

**Table 4.3.1 Frequency Combinations**

Area Ratio  Receiving Stream Area to Storm Drain Area	Storm Drain Frequency		
	25-Year	50-Year	100-Year
1,000:1	5	5	10
100:1	10	10	25
10:1	10	25	50
1:1	25	50	100

### 4.4 TIME OF CONCENTRATION

The computation of the time of concentration will be based on TxDOT's Hydraulic Design Manual for urbanized areas which subdivides the flow path into three categories: overland flow (sheet flow), shallow concentrated flow (gutter flow), and conduit and/or open channel flow. Typically, the overland or sheet flow consists of water flow over plane surfaces before it collects as shallow concentrated flow. Because only fully urbanized conditions will be considered for the IH 635 corridor, the shallow concentrated flow is most often carried through the gutter to an inlet and then into a storm sewer pipe or to a discharge point at a creek or channel. The runoff continues in the pipe and/or creek until it reaches IH 635 corridor or the design point.

The overland flow and shallow concentrated flow can be computed by using Figure 5-4 of the TxDOT Hydraulic Design Manual. The overland flow length shall not be greater than 200 feet for urban watersheds and 400 feet for all other watersheds.

Conduit flow and open channel flow can be computed from basic hydraulic principles. The velocity for open channels shall be computed using full bank flow conditions (channel full with no flow in the overbanks) for a typical stream cross-section. If no detailed information or as-built plans are available, the United States Geographical Maps (USGS) may be used. Conduit flow velocity shall be computed at uniform depth based on the computed discharge.

Actual time of concentration shall be computed, input into storm drain analysis, and accumulated along system, even if less than 10 minutes. Actual time is not used until accumulated total exceeds 10 minutes.

If the computed discharge is unknown, the velocity shall be computed using the full capacity of the pipe. The minimum time of concentration shall be 10 minutes.

#### 4.5 RATIONAL METHOD

The Rational Method shall be used for drainage areas that are less than 200 acres. The TxDOT Hydraulic Design Manual provides a specific description of the theory and assumptions for the Rational Method. Table 4.5.1 summarizes various runoff coefficients that are to be used for the IH 635 corridor.

**Table 4.5.1 Runoff Coefficients (C) for Urban Watersheds for 2-year, 5-year, and 10-year Frequencies**

Type of Drainage Area	Runoff Coefficients (C)
Business	
• Downtown areas	0.90
• Neighborhood areas	0.80
Residential	
• Single-family development	0.60
• Multi-family development	0.85
Industrial	0.90
Parks, cemeteries, open grass areas	0.35
Yards	0.40
Streets	
• Asphalt	0.95
• Concrete	0.95

The runoff coefficients listed in Table 4.5.1 apply to storm events of 2, 5, and 10-year frequencies. Higher frequency storms require modifying the runoff coefficient because infiltration and other abstractions have a proportionally smaller effect on runoff. In order to

adjust the runoff coefficients in Table 4.5.1 to represent higher frequency events, multiply them by the factor  $C_f$  as indicated in Table 4.5.2. In no cases should the product of  $C$  and  $C_f$  exceed 1.00.

**Table 4.5.2 Runoff Coefficient Adjustment Factors for Rational Method**

Recurrence Intervals (years)	$C_f$
25	1.10
50	1.20
100	1.25

The Rational formula then becomes:

$$Q = CC_f IA$$

Where,

- Q = Design frequency discharge (cfs)
- C = Runoff coefficient from Table 4.5.1
- $C_f$  = Correction factor for 25, 50, and 100-year frequencies from Table 4.5.2
- I = Design Storm Rainfall Intensity (in/hr)
- A = Drainage Area (acres)

Each city within the IH 635 corridor has determined the rainfall intensity for various storm events. The values determined by the Cities are published in their respective drainage manuals. A comparison made between the intensities published in these manuals and those computed using TxDOT's criteria revealed that the Cities' 100-year intensities were generally lower than the 25-year intensities computed by TxDOT's criteria for times of concentration less than 20 minutes. Therefore, the rainfall intensity to be used for the IH 635 corridor is based on the following equation from the TxDOT manual:

$$I = \frac{b}{(t_c + d)^e}$$

Where,

- I = Rainfall intensity (in/hr)
- $t_c$  = Time of concentration (min)
- e, b, d = coefficients for specific frequencies that are based on rainfall frequency-duration data contained in the National Weather Service Technical Paper 40 (TP 40) for each county in Texas. See Table 4.5.3.

**Table 4.5.3 Intensity Coefficients for Dallas County**

Design Storm	Coefficients		
	e	b	d
2-Year	0.791	54	8.3
5-Year	0.782	68	8.7
10-Year	0.777	78	8.7
25-Year	0.774	90	8.7
50-Year	0.771	101	8.7
100-Year	0.762	106	8.3

#### 4.6 NRCS RUNOFF CURVE NUMBER METHOD

The Natural Resources Conservation Services Runoff Curve Number Method (NRCS RCN Method) with a TY II 15-minute rainfall distribution shall be used to compute runoff for drainage areas greater than 200 acres. A detailed discussion of the NRCS RCN methodology can be found in Chapter 5, Section 7 of the TxDOT Hydraulic Design Manual. Within the IH 635 corridor, HEC-1, HEC-HMS, or other TxDOT approved software may be used to compute the runoff and a dimensionless unit hydrograph. With any modeling software, the computational interval shall not exceed one-third of the shortest lag time of any basin in the model. Refer to Chapter 5, Section 8 of the TxDOT Hydraulic Design Manual for a detailed discussion of the NRCS Type II unit hydrograph.

Table 4.6.1 summarizes the curve numbers that are to be used for the IH 635 corridor. This table is based on values from the TxDOT Hydraulic Design Manual, and includes only those categories that represent development within the IH 635 corridor.

**Table 4.6.1 Runoff Curve Numbers for Urban Areas**

Cover Type and Hydrologic Condition	Average Percent Impervious Area	A	B	C	D
		Open space (lawns, parks, golf courses, cemeteries, etc.)	68	79	86
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
• Paved; curbs and storm drains (excluding right-of-way)		98	98	98	98
• Paved; open ditches (including right-of-way)		83	89	92	93
• Gravel (including right-of-way)		76	85	89	91
• Dirt (including right-of-way)		72	82	87	89
Urban districts:					
• Commercial and business	85	89	92	94	95
• Industrial	72	81	88	91	93
Residential districts:					
• Town houses and apartments	65	77	85	90	92
• Residential lots	38	61	75	83	87
<b>Notes:</b> Values are for average runoff condition, and $I_a = 0.2S$ . The average percent impervious area shown was used to develop the composite RCNs. Other assumptions are: impervious areas are directly connected to the drainage system, impervious areas have a RCN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition.					

#### 4.7 FLOOD HYDROGRAPH ROUTING METHODS

A detailed description of Flood Hydrograph Routing techniques can be found in Chapter 5, Section 9 of the TxDOT Hydraulic Design Manual. Along streams that have detailed studies, the routing techniques should not be modified. However, for watersheds that have no existing study, HEC-1, HEC-HMS, or other TxDOT approved software may be used for flood hydrograph routing computation. The Modified Puls Method is to be used for channel routing. This will require development of a storage-discharge relationship from the hydraulic model (HEC-2 or HEC-RAS). Where there are detention ponds, a storage-elevation-discharge relationship is to be determined.



## **CHAPTER 5 - HYDRAULIC CROSSINGS**

### **5.1 GENERAL**

A detailed discussion of hydraulic principles and theory can be found in Chapter 6 of the TxDOT Hydraulic Design Manual. The following guidelines apply to open channels, including creeks, ditches, and channels along the IH 635 corridor. The analysis for these open channels within the IH 635 corridor shall be performed using HEC-RAS. See Section 6.8 for additional Roadside Ditch Criteria.

### **5.2 SURVEY**

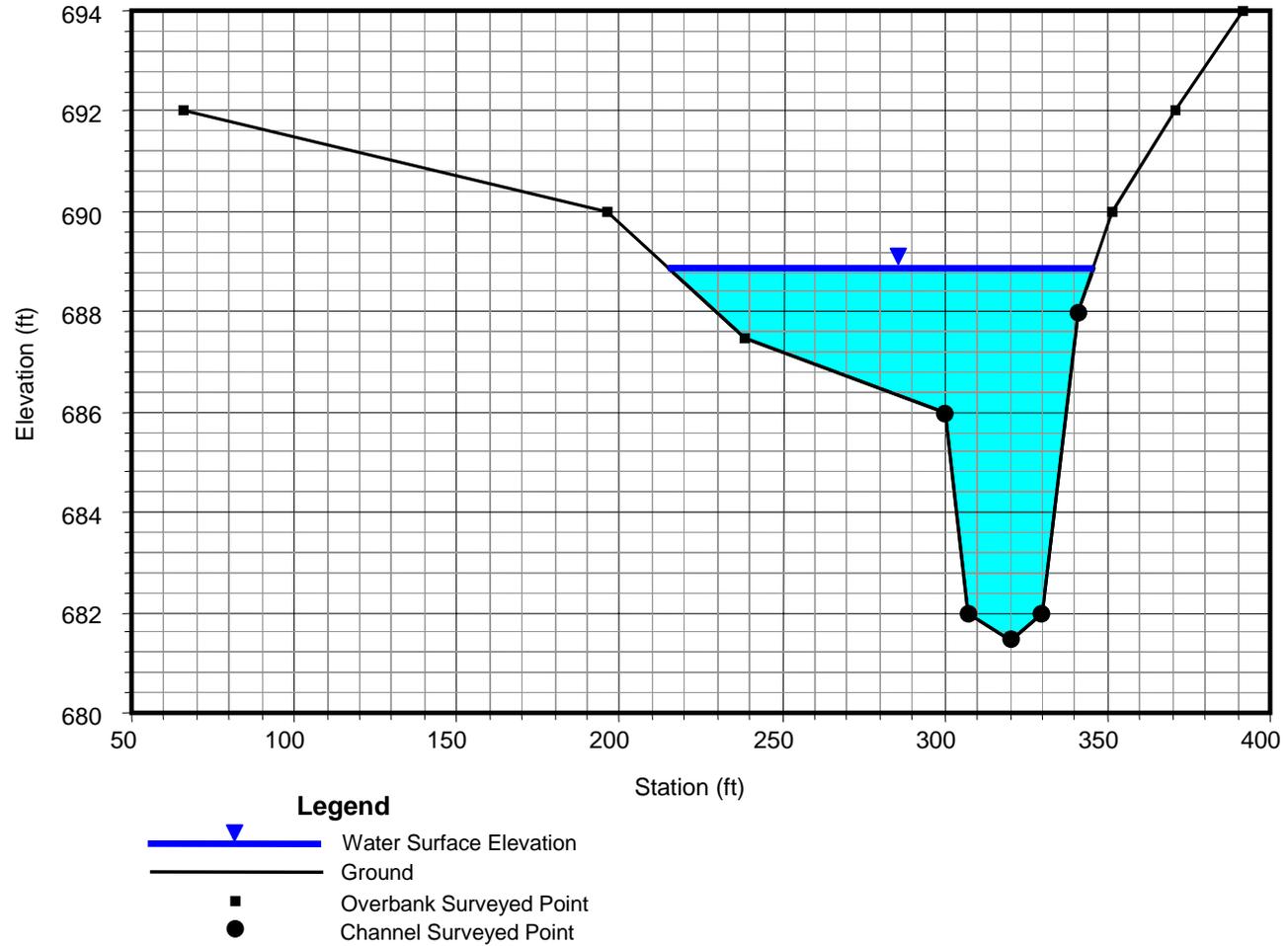
Cross-section information used in the hydraulic modeling of open channels shall be based on surveyed information. The cross sections shall be spaced no greater than 500 feet apart, and shall provide enough detail to sufficiently define the channel geometry as illustrated by Figure 5.2.1.

Existing bridges and culverts shall be modeled using the field survey information. The upstream and downstream limits of the hydraulic model for a culvert or bridge crossing shall extend 1,000-feet or to the nearest hydraulic control point which may include structure crossings or any point in the channel that controls the water surface elevation.

### **5.3 ROUGHNESS COEFFICIENTS**

The roughness coefficients used for the hydraulic models shall be defined so that they vary horizontally along the cross section depending on the type of land cover. Table 5.3.1 lists typical values of roughness coefficients. Cross-sections should be subdivided to have a minimum 3 subsections, left overbank, channel, and right overbank. Typically, these 3 subsections will be adequate to define the section.

Figure 5.2.1 Typical Surveyed Cross Section with Five Points in the Channel



**Table 5.3.1 Manning's "n" Values**

<u>Channel Description</u>	<u>"n" value</u>
<b>Channel Roughness Coefficients:</b>	
Well Defined Natural Channel	
Rock bottom	0.035
Dirt lined with light vegetation	0.040
Moderate vegetation on banks	0.060
Heavy vegetation on banks	0.070
<u>Channel Description</u>	<u>"n" value</u>
Irregular Channel with Meanders and Pools	
Rock bottom	0.047
Dirt lined with light vegetation	0.052
Moderate vegetation on banks	0.072
Heavy vegetation on banks	0.080
Lined Channel	
Concrete-lined channel	0.020
Grouted riprap	0.035
Ungouted riprap	0.040
Gabion mattress	0.033
Geotextile fabric with established vegetation	0.043
Maintained grass-lined channel	0.035
Non-maintained grass-lined channel	0.060
<b>Overbank Roughness Coefficients:</b>	
Undeveloped Overbank	
Short grass, no brush	0.050
Tall grass, no brush	0.060
Grass with moderate tree cover	0.080
Grass with heavy tree cover	0.120
Developed Overbanks	
Residential	0.150
Developed commercial or industrial	0.100
Parks, manicured open space	0.035

## 5.4 REQUIREMENTS

The study of existing open channels within the IH 635 corridor involves the study of both existing and proposed improvements using fully-developed conditions. In addition to complying with the USACE's requirements and TxDOT's requirements, the following guidelines must be met:

- There shall be no rise in water surface elevation between the existing conditions and the proposed conditions for the design storm. Existing conditions are defined as fully-developed offsite design flows and existing onsite (within existing right-of-way) through the existing structure and over the road, if applicable. Proposed conditions are based on fully-developed design flows through the proposed structure.
- The proposed conditions shall not increase the design storm channel velocity above the amount specified in Table 5.5.1.
- The study limits for major crossings shall extend either 1,000 feet upstream and downstream or to the next control structure, whichever is closer.

Valley storage shall be considered on those streams that are part of the Certificate Development Corridor (CDC) program.

## 5.5 CHANNELS

Chapter 7 of the TxDOT Hydraulic Design Manual discusses in detail the analysis and design of proposed channel improvements. In addition to the guidelines listed here, other requirements that involve state and federal agencies must be met for permits as they apply to any proposed improvements. This includes, but is not limited to, the following:

- Federal Emergency Management Agency National Flood Insurance Program (FEMA NFIP)
- U.S. Corps of Engineers (USACE) Section 404 permit
- Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System permit requirements
- TPDES permit for industrial activity (construction)
- EPA Endangered Species Act provisions
- Texas Commission of Environmental Quality (TCEQ) 401 Permit

**Table 5.5.1 Types of Channel Lining**

Type of Channel Lining	Maximum Velocity	Minimum Side Slopes (Hor.: Vert.)	Desired Shape	Minimum Velocity
Grouted riprap	12 feet/sec	3:1	Trapezoidal	2.5 feet/sec
Rock riprap	12 feet/sec	3:1	Trapezoidal	2.5 feet/sec
Gabion	12 feet/sec	N/A	N/A	2.5 feet/sec
Vegetated clay channels	8 feet/sec	3:1	Trapezoidal	2 feet/sec *
Vegetated sandy channels	6 feet/sec	3:1	Trapezoidal	2 feet/sec *

\* The minimum velocities apply to proposed channels. Any modifications to existing channels shall match the existing channel as close as possible.

Proposed channel improvements shall be lined with native material such as grasses, crushed rock, and earth where possible. In such a case, the side slopes shall be no steeper than 3 to 1. Other lining material may be necessary to accommodate hydraulic, aesthetic, economics, safety, and environment. Table 5.5.1 summarizes the requirements for various types of channel lining that are to be used in the IH 635 corridor.

## 5.6 STREAM ANALYSIS

For a detailed discussion of stream morphology and channel analysis refer to Chapter 7 of the TxDOT Hydraulic Design Manual. This manual also discusses environmental mitigation alternatives and stream stabilization measures that should be reviewed during the design of any channel improvements in the IH 635 corridor.



## CHAPTER 6 - STORM DRAINAGE SYSTEMS

### 6.1 GENERAL

The drainage systems shall include all drainage and erosion control appurtenances such as:

- curb inlets
- grate inlets
- manholes
- junction boxes
- headwalls
- ditches
- underdrains
- safety end treatments
- storm sewer pipes
- box or pipe culverts
- lined channels

Drainage shall be designed to:

- Ensure the proper collection and disposal of storm runoff disrupted or generated by the Project and its associated construction.
- Ensure the continuing service of all drainage systems during Project construction.
- Provide protection from erosion of all slopes and ditches in the IH 635 corridor and on adjacent property.
- Maintain clear roadways for the design storm.
- Provide subgrade drainage, where required.

### 6.2 DESIGN FREQUENCIES

All inlet and storm drain design and check frequencies are listed in Table 4.2.1.

Depressed and at-grade mainlane/general purpose lane, ramp, and Managed HOV lane storm inlets and conduit shall be designed as given here and Table 4.2.1. These criteria with the ponding and the Hydraulic Grade Line (HGL) requirements given in Sections 6.4 through 6.7 meet the Federal Highway Administration (FHWA) and TxDOT's criteria for depressed sections.

The FHWA defines depressed sections as pavement areas on interstate highways where ponded water can only be removed through the storm conduit. The TxDOT Dallas district's policy adds mainlanes/general purpose lanes, direct connectors, ramps, Managed HOV lanes and frontage roads bounded by barrier or retaining wall to the "depressed" category. Because the majority of the IH 635 corridor falls within these two descriptions, all mainlane/general purpose lane, direct connector, ramp, and Managed HOV lane storm drain will be designed at the same frequency.

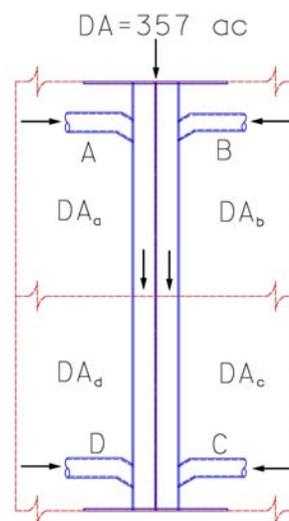
When a depressed frontage road section ties to a non-depressed frontage road section trunk line, the trunk line downstream of the junction shall be designed to maintain the 50-year HGL at critical elevations. All laterals that tie to this trunk line will be designed for full flow at the 25-year storm event. Figures 6.2.1 and 6.2.2 show examples of the proper design event for various locations. Critical elevations are given in Sections 6.5 and 6.7.

When a storm drain system ties to a cross structure of a larger drainage basin, coincidental occurrence may be applied to determine the storm drain's beginning HGL. The following example references the Table 4.3.1 in Chapter 4, Section 3.

Trunk line design for the 25-year event tying to a cross culvert.

Cross Structure Drainage A = 357 acres  
 Total Storm Drain Area =  $(DA_a + DA_b + DA_c + DA_d) = 18.7$  acres  
 Ratio  $357/18.7 = 19.1$

Go to Table 4.3.1  
 Ratio 10:1 (round to the nearest ratio in table)  
 25-year design  
 Main stream = 10 year



Use the cross structure's 10-year water surface elevation as the starting tailwater elevation for each trunk line.



## *Storm Drainage Systems*

---

An acceptable alternative to the above method would be to evaluate the flood hydrograph in the outfall channel and base the tailwater elevation on the water level in the outfall at the time of the peak discharge from the trunk line.

Figure 6.2.1 Depressed and Non-Depressed Frequencies

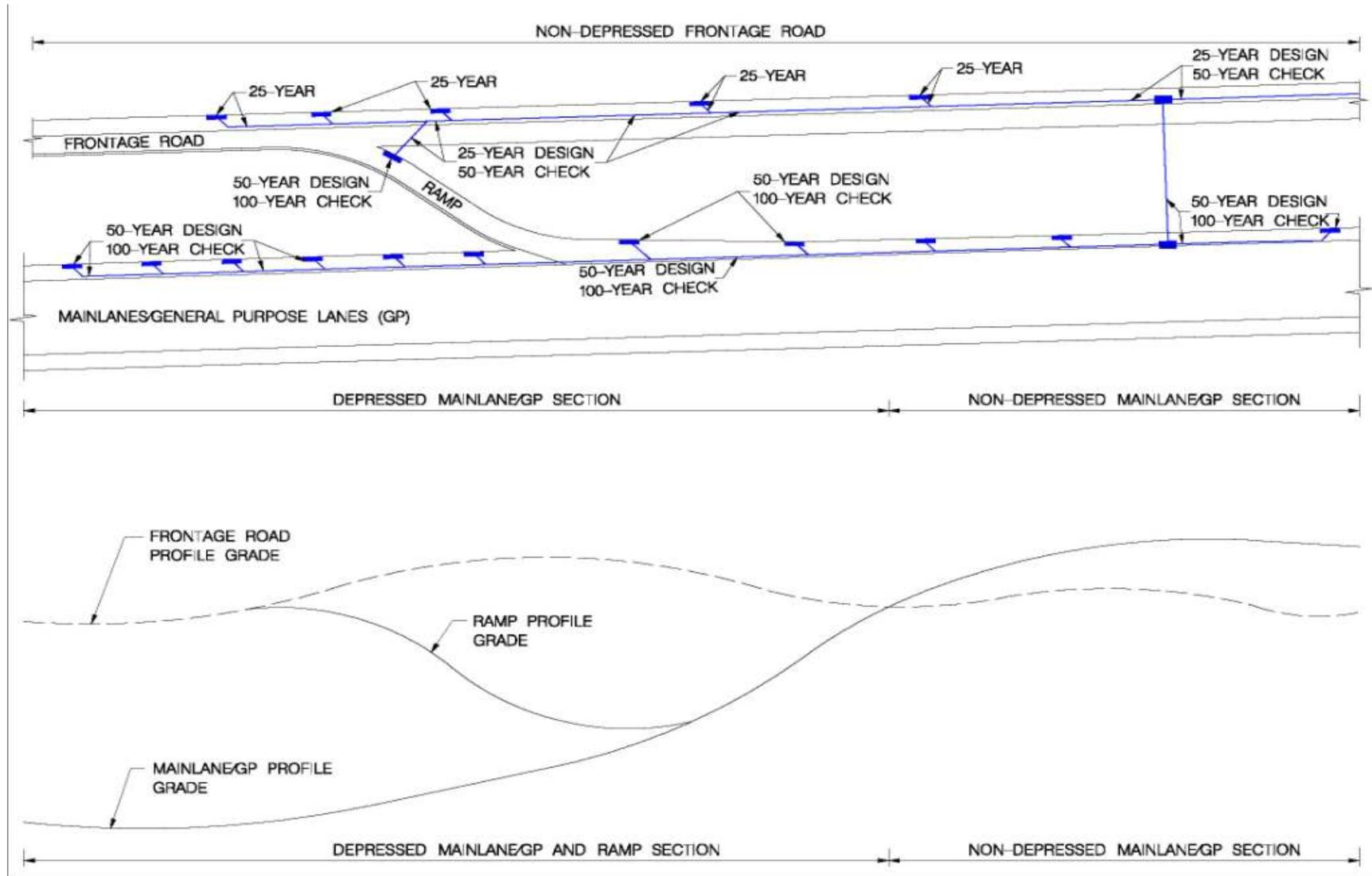
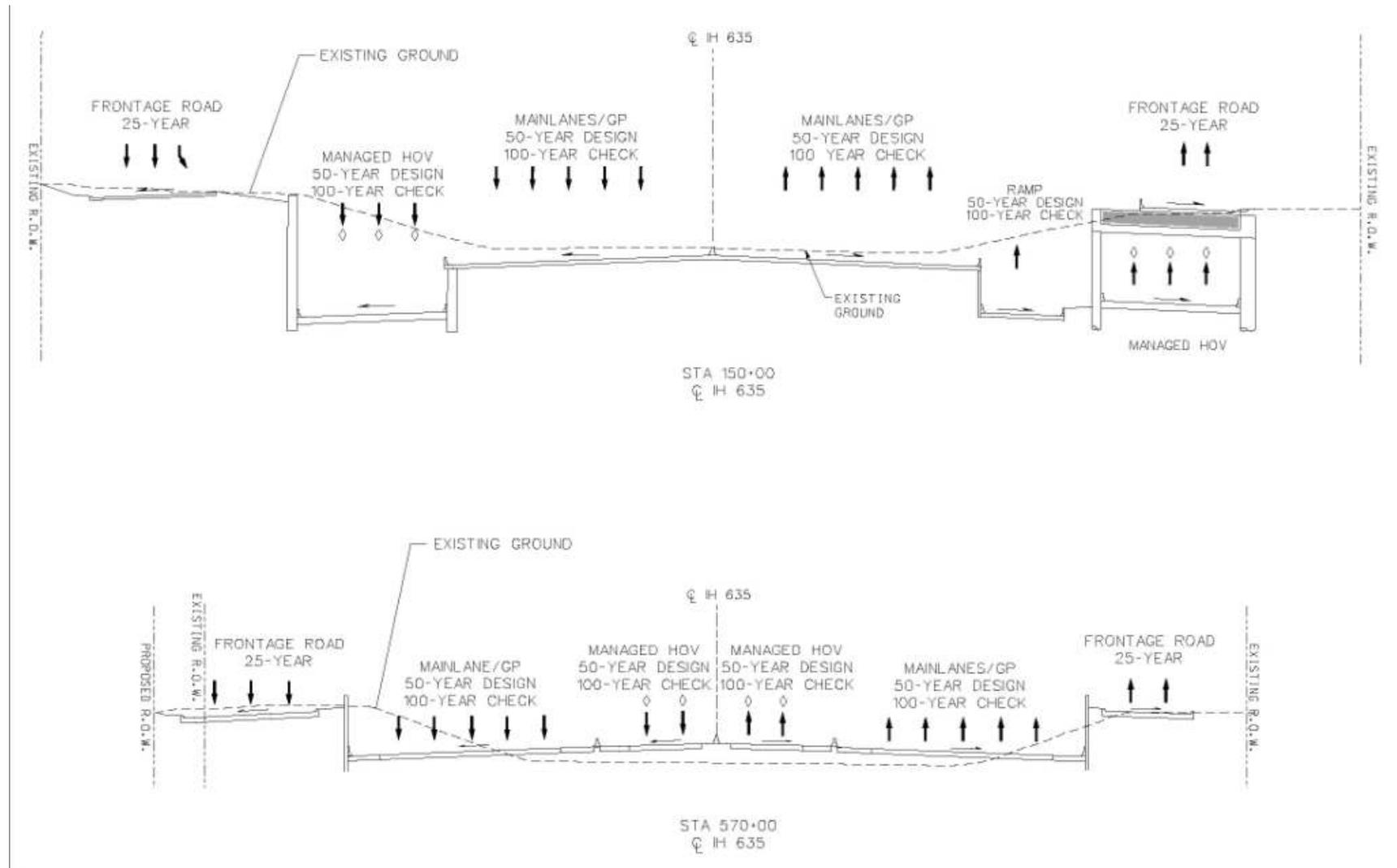


Figure 6.2.2 Depressed Sections



### 6.3 RUNOFF CALCULATIONS

Storm drain design should maintain the pre-project drainage boundaries when possible to avoid diverting runoff flows from one major watershed to another.

The time of concentration in storm drainage design consists of the time required for water to flow from the most distant point of the drainage area to the inlet and the travel time of the flow within the storm drain pipe. For the IH 635 corridor, the minimum time of concentration shall be 10-minutes. (Refer to Chapter 4, Section 5 for additional information.)

Refer to Chapter 4, Sections 5 and 6 for appropriate runoff calculation methods.

### 6.4 PAVEMENT DRAINAGE

Table 6.4.1 summarizes the allowable ponding widths.

**Table 6.4.1 Allowable Ponding Widths**

Location	Design Events	Check Event
Mainlanes/General Purpose Lanes	No encroachment into the travel lanes.	One lane free of encroachment
Managed HOV lanes, ramps, direct connectors and collector distributors	2-foot encroachment into the travel lanes.	One lane free of encroachment
Frontage roads	One-lane for a 2-lane frontage road.	50-year – no overtopping of curb
	One-and-a-half lanes for a 3-lane frontage road.	50-year – no overtopping of curb
Cross streets	One lane open to traffic in each direction.	50-year – no overtopping of curb
Note: Isolated instances of ponding width greater than those shown in the table may be allowed based on the Engineer's judgment and approval of TxDOT.		

For the design frequency, the allowable ponding width shall not be exceeded, nor shall the depth of flow exceed the curb height on curbed roadways. During the 100-year flood event, one-lane should be free of encroachment on the mainlanes/general purpose lanes, direct connectors and ramps to allow for emergency vehicle access.

Gutter flow and ponding spread should be calculated using the methods given in Chapter 10 Section 4 of the TxDOT Hydraulic Design Manual. Appropriate Manning's "n" values are 0.015 for concrete gutter with asphalt pavement and 0.016 for concrete pavement. For ponding at



approaches to sag locations, the longitudinal slopes used to evaluate ponding widths should be one-half of the tangent grades.

### 6.5 STORM DRAIN INLETS

Inlet types to be used in the IH 635 corridor are listed in Table 6.5.1. These refer to TxDOT Dallas District Standard Details.

Inlet runoff interception calculations should be based on equations and methods listed in Chapter 10, Section 5 of the TxDOT Hydraulic Design Manual.

Inlet input information for inlet capacity calculations are listed in Table 6.5.2 and Table 6.5.3.

**Table 6.5.1 Inlet Types**

Inlet Type	Standard Detail Sheet Name	General Location
Curb inlet	Curb Inlet TY I	Frontage roads, cross streets
Grate inlet	Drop Inlet TY C, Drop Inlet TY C & G	Gore areas, separation ditches, swales behind retaining walls
	Drop Inlet TY E & F	Mainlanes/General Purpose lanes, gore areas
Combination inlet	Curb and Grate Inlet TY II	Frontage roads, cross streets (where needed) <sup>a</sup>
Barrier inlet	Curb & Grate Inlet TY III Curb & Grate Inlet TY V	Mainlanes/General Purpose Lanes, Managed HOV lanes, ramps
Slotted drain <sup>b</sup>	Roadway Drain Details <sup>c</sup> (Slotted Drain) SD	Mainlanes/General Purpose Lanes against median barrier (where needed) <sup>d</sup> , at entrances to tunnel sections

<sup>a</sup> If a Curb Inlet TY I is not sufficient to meet ponding and interception requirements

<sup>b</sup> Statewide Standard

<sup>c</sup> If other inlet types are not sufficient to meet ponding and interception requirements

<sup>d</sup> Not to be used at sag points and at locations where there are flexible joints in the roadway structure

**Table 6.5.2 Curb Inlet Input**

Dallas District Standard Detail Sheet Name	Curb Length	Gutter Depression	Depression Width	Inlet Opening Height	Critical Elevation	Maximum Ponded Depth
Curb Inlet TY I <sup>a</sup>	5', 10', 15'	3"	2'	4"	1.0' below gutter depression	Satisfies ponding requirements & < curb height
Curb & Grate Inlet TY II <sup>a</sup>	5', 10', 15' <sup>b</sup>	3"	3'	4"	1.0' below gutter depression	Satisfies ponding requirements & < curb height
Curb & Grate Inlet TY III	5' <sup>b</sup>	3"	3'	4"	1.0' below gutter depression	Satisfies ponding requirements
Curb & Grate Inlet TY V <sup>a</sup>	5', 10', 15' <sup>b</sup>	3"	3'	3"	1.0' below gutter depression	Satisfies ponding requirements

<sup>a</sup> Starting Curb length is 5' and larger lengths increase in 5' increments.

<sup>b</sup> Where the grate and curb opening overlap, the capacity of the greater of the two will be used.

Grate inlets should be aligned so that grate bars are parallel to the gutter flow except on side streets where bicycle safety is concerned and as stated above. Figure 6.5.1 shows typical grate inlet orientation.

All on-grade inlets, slotted drains excluded, shall be designed to intercept a minimum of 65% of the approaching flow of the design event, but inlets shall be designed to be cost effective. Carryover shall be limited upstream of intersections, driveways, superelevation transitions, bridges, and downstream of exit and entrance ramps so that no more than 0.10 cfs shall be allowed to concentrate and flow across travel lanes. If this is not possible, the potential for hydroplaning shall be checked based on guidelines listed in Chapter 10, Section 4 of the TxDOT Hydraulic Design Manual. At Dallas Area Rapid Transit (DART) light rail crossings, inlets shall be coordinated with the street profile so that no runoff enters the trackway.



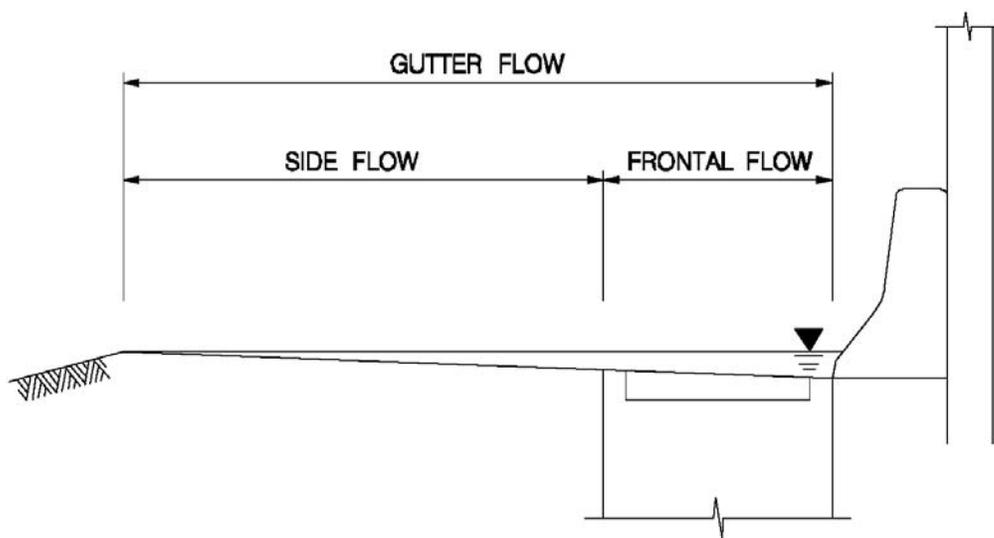
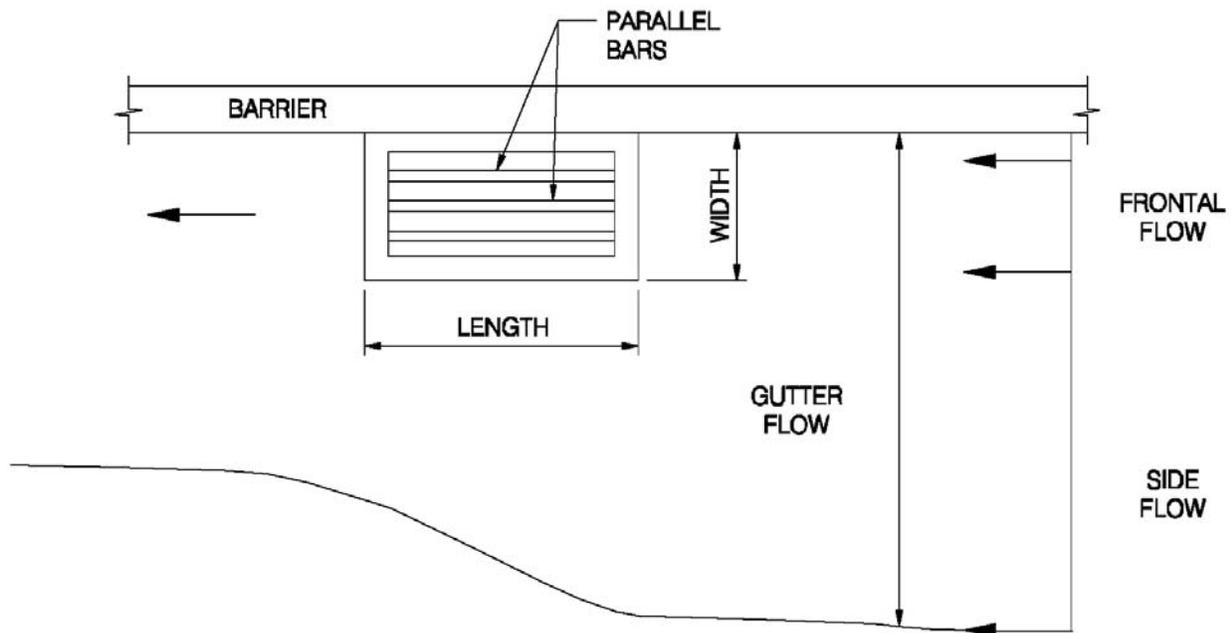
**Table 6.5.3 Grate Inlet Input**

Dallas District Standard Detail Sheet Name	Critical Elevation	Grate Type	Maximum Poned Depth	Number of Grates	Grate Width	Grate Length	Effective Grate Area In Sag	Effective Grate Perimeter in Sag - 3-sided	Effective Grate Perimeter in Sag - 4-sided	Safety Reduction Factor in Sag
Drop Inlet TY C	1.0' below top of grate	Parallel	1' of freeboard <sup>a</sup>	1	2'	2.38'	3.14 ft <sup>2</sup>	3.14'	8.25'	50%
				2	2'	4.73'	6.38 ft <sup>2</sup>	6.38'	13.04'	50%
				3	2'	7.08'	9.59 ft <sup>2</sup>	9.59'	17.75'	50%
Drop Inlet TY C & G*	b	b	b	b	b	b	b	b	b	
Drop Inlet TY E & F	1.0' below top of grate	Parallel	1' of freeboard <sup>a</sup>	1	2.5'	1.22'	3.36 ft <sup>2</sup>		7.54'	50%
				2	5.43'	1.22'	6.72 ft <sup>2</sup>		11.54'	50%
				3	8.35'	1.22'	10.07 ft <sup>2</sup>		15.54'	50%
Curb & Grate Inlet TY II	1.0' below gutter depression	Transverse	Satisfies ponding requirements & < curb height	1	1.52'	2.49'	3.09 ft <sup>2</sup>	4.97'	NA	NA
Curb & Grate Inlet TY III	1.0' below gutter depression	Transverse	Satisfies ponding requirements	1	1.52'	2.49'	3.09 ft <sup>2</sup>	4.97'	NA	NA
Curb & Grate Inlet TY V	1.0' below gutter depression	Transverse	Satisfies ponding requirements	1	1.52'	2.49'	3.09 ft <sup>2</sup>	4.97'	NA	NA
Roadway Drain Details (Slotted Drain) SD	1.0' below drain guide opening	NA	NA	NA	NA	20'	NA	NA	NA	NA

<sup>a</sup> Refer to Figure 6.8.1

<sup>b</sup> Grate used in this detail is the same as the on used in the Drop Inlet TY C standard detail sheet so input is the same.

Figure 6.5.1 Parallel Gate Inlet





## **6.6 LOCATION OF STORM DRAIN APPURTENANCES / CONDUIT RUNS**

Storm conduit and inlets shall be designed so that conflicts with major utilities are avoided.

Geometric controls may determine inlet location in addition to the ponding requirements given in Section 6.4. Examples of such locations are as follows:

- Low points in the gutter grade.
- Immediately upstream of entrance/exit ramp gores, cross walks and street intersection.
- Immediately upgrade of bridges (to prevent pavement runoff from flowing onto bridge decks).
- Immediately downstream of bridges (to intercept bridge deck drainage).
- Immediately upgrade of cross slope reversals.

## **6.7 CONDUIT SYSTEMS**

Table 6.7.1 lists all storm drainage conduit criteria.



**Table 6.7.1 Conduit System Design Criteria**

Component	Design Criteria
Pipe class	Class III or greater, D-loads calculated according to Chapter 14 in the TxDOT Hydraulic Design Manual
Diameters	Laterals - minimum of 18" reinforced concrete pipe (RCP) Trunk lines - minimum of 24" RCP Standard sizes - 18", 24", 36", etc. in 6" increments Maximum pipe size - 60" then use reinforced concrete box Minimum box culvert height - 3'
Cover	Pavement - top of pipe clears pavement base structure Non-Pavement - a minimum of 1-ft from top of pipe to finished grade
Roughness coefficient "n"	Concrete pipe - 0.013 Concrete box - 0.012
Manhole spacing	24" - 300' 36" - 375' 42"-54" - 450' 60" - 900'
Bends	15, 30, 45, and 60 degree angles 90 degree angle if unavoidable
Lateral tie-ins	One lateral junction - 45 and 60 degree wyes Two or more lateral junction - A manhole or junction box unless the trunkline is more than twice the diameter of the largest adjoining lateral
Velocities	Minimum - 2 fps Maximum - 12 fps
Conduit flow	Design event - non-pressure flow Check event - see Hydraulic Grade Line
Hydraulic grade line	Design: Inlets - meet critical elevation requirements listed in Tables 6.5.2 and 6.5.3 Mahholes - a minimum of 1.0' below the top of the manhole cover Check: Frontage road and side streets - 50-year HGL below top of curb. Mainlanes, ramps, HOV, collector/distributor, depressed frontage roads - 100-year HGL allows for one travel lane to be free of encroachment

**6.8 ROADSIDE CHANNELS**

For the IH 635 corridor, roadside channels are those open channels, which convey runoff within the proposed right-of-way. Design shall meet criteria given in Section 5.5 and in Chapter 7, Section 3 of the TxDOT Hydraulic Design Manual. A summary of additional design requirements is listed in Table 6.8.1. Where possible, ditches parallel to DART light rail shall meet DART drainage design criteria.

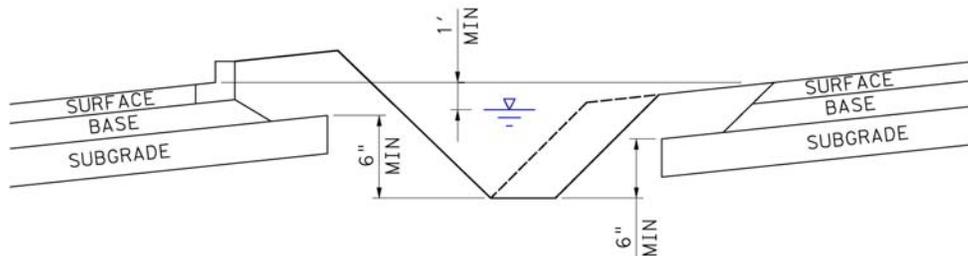
**Table 6.8.1 Roadway Channel Design Criteria**

Component	Design Criteria
Minimum longitudinal slope	0.50%
Maximum side slope	Within clear zone <sup>a</sup> Mainlanes/General Purpose and Ramps – 6:1 Frontage Roads – 4:1 Outside of clear zone Mainlanes/General Purpose and Ramps – 4:1 Frontage Roads – 3:1 Backslope Trapezoidal bottom – 4:1 V-shaped bottom – 3:1
Water surface elevation	Design event – 1-foot below pavement surface <sup>b</sup>
Depth	Minimum of 6 inches below subgrade crown <sup>b</sup>

<sup>a</sup> Maximum side slopes without positive protection.

<sup>b</sup> Refer to Figure 6.8.1 for further explanation.

**Figure 6.8.1 Roadside Channels**



## 6.9 HEAD LOSSES

Hydraulic grade line losses associated with junctions, manholes, wyes, bends and pipe size changes will be calculated as shown in Table 6.9.1.



**Table 6.9.1 Headloss Coefficients**

Inlet on mainline		0.50	$(V_2^2/2g) - (K*V_1^2/2g)$
Inlet on mainline with branch lateral		0.25	$(V_2^2/2g) - (K*V_1^2/2g)$
Manhole on mainline with:	90°	0.25	$(V_2^2/2g) - (K*V_1^2/2g)$
	60°	0.35	
	45°	0.50	
	30°	0.60	
	15°	0.90	
Wye connection or cut in:	60°	0.60	$(V_2^2/2g) - (K*V_1^2/2g)$
	45°	0.75	
Inlet or manhole at beginning of line		1.25	$K*V_2^2/2g$
Bends:	90°	0.70	$K*V_2^2/2g$
	60°	0.56	
	45°	0.47	
	30°	0.35	
	15°	0.19	
Conduit connection to cross culvert		N/A	Headloss negligible

$V_1$  is upstream velocity and  $V_2$  is downstream velocity.

### 6.10 OUTPUT

Drainage design calculations may be done with Winstorm, Geopak Drainage or other TxDOT approved methods. Required output is shown in Tables 6.9.1 through 6.9.5.

**Table 6.10.1 Example Drainage Area Output**

DRAINAGE AREA	PAVEMENT C = 0.95 (AC)	COMMERCIAL		INDUSTRIAL C = 0.85 (AC)	RESIDENTIAL		OPEN AREA		TOTAL AREA (AC)	COMPOSITE C VALUE	Tc ACTUAL (MIN)	Tc USED (MIN)	INTENSITY 25 yr (IN/HR)	DISCHARGE 25 yr (CFS)	INTENSITY 50 yr (IN/HR)	DISCHARGE 50 yr (CFS)	INTENSITY 100 yr (IN/HR)	DISCHARGE 100 yr (CFS)
		DOWNTOWN C = 0.90 (AC)	NEIGHBRHD. C = 0.70 (AC)		MULTI C = 0.75 (AC)	SINGLE C = 0.50 (AC)	GRASS C = 0.40 (AC)	PARKS C = 0.30 (AC)										
1-A1	0.24	0.12	0.00	0.62	0.00	0.00	0.05	0.00	1.03	0.86	7.15	10.00	9.33	9.09	10.56	11.22	11.57	12.81
1-A3	0.16	0.45	0.00	0.00	0.00	0.00	0.08	0.00	0.69	0.85	5.27	10.00	9.33	6.02	10.56	7.43	11.57	8.48
2-A1	0.06	0.00	0.23	0.00	0.45	0.70	0.04	0.10	1.58	0.60	9.62	10.00	9.33	9.73	10.56	12.01	11.57	13.71
2-B1	1.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.39	0.95	7.06	10.00	9.33	13.55	10.56	16.73	11.57	19.10

**Table 6.10.2 Example Inlet Configuration Output**

Inlet ID	Inlet Description	Inlet Station	Inlet Offset (ft)	Inlet Ref Chain	Inlet Elev (ft)	Inlet Type	Profile Type	Spread X-sect Slope 1 (%)	Spread X-sect Width 1 (ft)	Curb Length (ft)	Curb Depression (ft)	Curb Height (ft)	Curb Depression Width (%)	Grate Type	Grate Length (ft)	Grate Width (ft)	Grate Area (sf)	Grate Perimeter (sf)	Grate Area Reduction	Grate Perimeter Reduction	Remarks
1-A1	Curb Inlet Ty C w/ 1 ext (10')	910+00	0.00	EBFR	658.54	Curb	On Grade	3.06	38.00	10	0.33	0.50	2.00	n/a	n/a	n/a	n/a	n/a	n/a	n/a	CURB INLET
1-A3	Curb Inlet Ty C w/ 1 ext (10')	912+00	0.00	EBFR	653.51	Curb	On Grade	2.77	40.00	10	0.33	0.50	2.00	n/a	n/a	n/a	n/a	n/a	n/a	n/a	CURB INLET
2-A1	Inlet Ty C-1	913+15	5' RT	EBFR	642.21	Grate	Sag	16.61	6.00	n/a	n/a	n/a	n/a	Parallel 1 1/8	2.48	4.96	4.87	9.44	0.5	0.5	DITCH GRATE INLET
2-B1	Inlet Ty C-1	915+00	69.17 LT	CL-IH635	635.54	Grate	On Grade	2.54	52.00	n/a	n/a	n/a	n/a	Parallel 1 1/8	2.48	4.96	4.87	6.95	n/a	n/a	GRATE INLET

**Table 6.10.3 Example Inlet Hydraulics Output**

Link/Run No.	From Node	To Node	Drainage Area No.	Total DA	Weighted C-Value	Cumulative Tc (min)	Intensity (in/hr)	Design Q (cfs)	Conduit Size	Number of Barrels	Flowline U.S. (ft)	Flowline D.S. (ft)	Hydraulic Length (ft)	Slope (%)	Manning's n-value		
1-A1	Curb	On Grade	910+00	EBFR	9.09	2.33	0.00	0.00	10.00	9.60	6.51	0.17	3.45	6.51	0.06	0.015	
1-A3	Curb	On Grade	912+00	EBFR	6.02	3.20	0.00	1-A1	0.00	10.00	9.95	8.26	0.22	1.83	8.26	0.10	0.015
2-A1	Grate	Sag	913+15	EBFR	9.73	23.01	0.00		0.00	n/a	n/a	0.00	0.01	n/a	0.00	0.016	
2-B1	Grate	On Grade	915+00	CL-IH635	13.55	9.45	0.00		0.00	n/a	n/a	0.77	0.18	n/a	0.77	0.00	0.016

**Table 6.10.4 Example Link Configuration Output**  
**Hydraulic Data: Proposed Storm Sewer (50-Year Frequency)**

Link/Run No.	From Node	To Node	Drainage Area No.	Total DA	Weighted C-Value	Cumulative Tc (min)	Intensity (in/hr)	Design Q (cfs)	Conduit Size	Number of Barrels	Flowline U.S. (ft)	Flowline D.S. (ft)	Hydraulic Length (ft)	Slope (%)	Manning's n-value
<b>IH 635 Eastbound Frontage Road Trunk Line (West of DNT)</b>															
1	DP1	DP2	EF DP 1	2.45	0.915	10.00	10.56	23.72	30" RCP	1	626.35	623.02	664.73	0.50	0.013
2	DP2	DP3	EF DP 1-2	5.76	0.842	10.00	10.56	51.20	36" RCP	1	622.52	615.33	1037.64	0.69	0.013
3	DP3	DP4	EF DP 1-3	6.92	0.868	10.00	10.56	63.46	36" RCP	1	615.33	606.42	810.48	1.10	0.013
4	DP4	DP5	EF DP 1-4	17.88	0.845	10.00	10.56	159.62	4'X4' BC	1	605.42	600.56	441.36	1.10	0.012
5	DP5	DP6	EF DP 1-5	45.41	0.939	12.88	9.46	403.29	6'X6' BC	1	598.56	593.11	1010.63	0.54	0.012
6	DP6	DP6A	EF DP 1-6	60.85	0.951	14.22	9.03	522.27	6'X6' BC	1	593.11	589.75	589.63	0.57	0.012

**Table 6.10.5. Example Link Hydraulics Output**

**Hydraulic Data: Proposed Storm Sewer (50-Year Frequency)**

Link/Run No.	From Node	To Node	Critical Elevation (ft)	HGL U.S. (ft)	HGL D.S. (ft)	Friction Slope (%)	Depth		Velocity		Q (cfs)	Capacity (cfs)	Junction Loss (ft)	Remarks
							Uniform (ft)	Actual (ft/s)	Uniform (ft)	Actual (ft/s)				
1	DP1	DP2	631.40	629.22	627.00	0.334	1.72	2.50	6.59	4.83	23.72	29.01	0.000	
2	DP2	DP3	629.80	627.00	620.48	0.589	2.27	3.00	8.91	7.24	51.19	55.52	0.408	
3	DP3	DP4	627.10	620.48	612.52	0.905	2.24	3.00	11.22	8.98	63.46	69.96	0.626	
4	DP4	DP5	616.60	612.52	608.88	0.649	2.78	4.00	14.35	9.98	159.61	207.81	0.773	
5	DP5	DP6	611.70	608.88	603.09	0.477	4.88	6.00	13.79	11.20	403.29	429.26	0.975	
6	DP6	DP6A	619.60	603.09	596.74	0.799	5.91	6.00	14.74	14.51	522.27	441.04	1.635	



## **CHAPTER 7 - CULVERTS**

### **7.1 GENERAL**

Culvert design shall be based on procedures outlined in Chapter 8 of TxDOT's Hydraulic Design Manual. The guidelines included here are intended to supplement that manual. Downstream tailwater shall be calculated as stated in Chapter 7 of TxDOT's Hydraulic Design Manual. Refer to Table 5.3.1 for Channel roughness coefficients to be used in IH 635 corridor.

Chapter 8, Section 2 of the TxDOT Hydraulic Manual discusses design considerations for culverts and Chapter 8, Section 3 discusses design procedure. The following discussion clarifies these sections as they relate specifically to the IH 635 corridor.

### **7.2 RUNOFF CALCULATIONS**

Refer to Chapter 6 for appropriate runoff calculation methodology.

Major crossings or crossings with an upstream drainage area greater than 200 acres shall be designed based on the 100-year storm frequency. Minor crossings with upstream contributing drainage areas less than 200 acres shall be designed based on the 50-year storm frequency. For minor culvert crossings, the 100-year storm frequency shall be used as a check of the performance of the culvert. See section 7.5 for check criteria.

### **7.3 TAILWATER DETERMINATION**

The tailwater refers to the water surface elevation downstream of the culvert crossing. The tailwater is used as starting conditions for the computation of the hydraulic grade line through the culvert. Within the IH 635 corridor there are two types of tailwater conditions and they include culverts that tie into a downstream channel and culverts that tie into a closed storm drain system.

#### **7.3.1 Culverts That Tie Into a Downstream Channel**

The tailwater for instances where the culvert discharges into a channel shall be computed based on standard backwater procedures as prescribed in Chapter 7 of the TxDOT Hydraulic Design Manual. Cross sections shall be obtained downstream to the first downstream control point or 1000-feet whichever is shorter. The procedure for obtaining

cross sections and creating hydraulic models is discussed in Chapter 5. Where the culvert is located along a major creek crossing, HEC-RAS or HEC-2 hydraulic models shall be used to determine the tailwater and to design the culvert. When two culverts along the same channel are separated by 1,000-foot or less, the downstream culvert must be included in the backwater computations.

### 7.3.2 Culverts That Tie Into a Closed System

The hydraulic grade line of the appropriate design frequency for the downstream drainage system shall be used as a tailwater for the proposed culvert. The frequency for the hydraulic grade line shall be the same frequency that is being used to size the culvert.

## 7.4 HYDRAULIC COEFFICIENTS

The Manning's roughness coefficient that is to be used for concrete boxes is 0.012. For concrete pipe the roughness coefficient is 0.013. Metal or plastic culverts shall not be used for culvert crossings within the IH 635 corridor.

The entrance loss coefficient is based on the culvert entrance geometry. Table 7.4.1 defines the entrance loss coefficients to be used for the various entrance types allowed within the IH 635 corridor. The exit loss coefficient shall be 1.0.

**Table 7.4.1 Entrance Loss Coefficients**

Type of Structure/Design of Entrance	Coefficient $C_e$
<b>Pipe, Concrete</b>	
Headwall or headwall and wingwalls	0.5
Straight wingwalls or pipe cut (mitered) to match embankment side slope	0.7
<b>Box, Reinforced Concrete</b>	
Beveled edges on three sides	0.20
45° flared wingwalls	0.40
180° parallel wingalls	0.50
Straight wingwalls (extension of sides)	0.70

## 7.5 HEADWATER

The headwater is the depth of the upstream water surface measured from the invert at the culvert entrance. Refer to Chapter 8 of TxDOT's Hydraulic Design Manual for headwater computation procedure. The design of the culvert shall begin by establishing the headwater and the upstream water surface elevations resulting from the existing culvert passing the

fully-urbanized discharges as defined in Sections 4.1 and 5.4. The flow used for culvert design shall include the runoff from all drainage areas contributing flow to the culvert. For culverts within the IH 635 corridor, the total flow will be assumed to enter the upstream culvert entrance.

Once the existing water surface elevations are set, the proposed culvert must be designed so that the design storm's headwater is no greater than the existing water surface elevation at the location of the proposed culvert entrance. The check storm shall be used to ensure the headwater does not encroach onto the IH 635 mainlanes/general purpose lanes. In addition, the headwater elevation for the check storm must not be greater than the elevation of the culverts drainage divides.

The hydraulic grade line for the culverts will be a straight line interpolation between the proposed headwater and tailwater unless a hydraulic jump or hydraulic drop occurs inside the box.

## **7.6 CULVERT SECTIONS**

For the IH 635 corridor only concrete box culverts or concrete pipe culverts will be allowed for cross drainage. The smallest pipe diameter allowed is 24-inches. The shortest concrete box culvert height that is allowed is three-feet. The culverts span to height ratio must be no less than 1:1/2 as site conditions allow. When multiple box culverts are necessary they may be placed at various elevations to best match the natural or pipe channel section as shown in Figure 7.6.1.

For the IH 635 corridor, all culverts not tying to closed systems must have headwalls. Wingwalls shall project from the headwall at angles allowed by TxDOT standard details for headwalls and wingwalls. The edges of the culvert entrance shall be beveled as shown in TxDOT standard details for box culverts.

## **7.7 CULVERT VELOCITY**

Modifications to the existing culvert shall not raise the velocities greater than the erosive limits for either the design storm or the check storm. The erosive limits are specified in Table 5.5.1 of this manual. If the proposed design causes a rise in the channel velocity

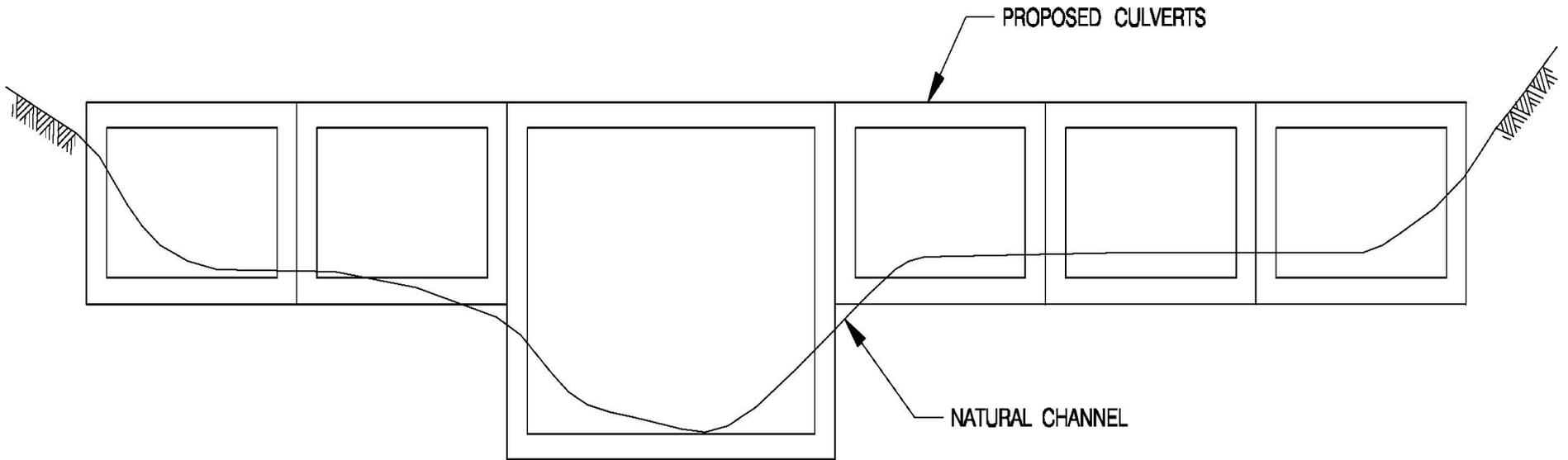


## *Culverts*

---

greater than erosive limits, the proposed design must be modified to lower the velocity or the channel must be armored.

Figure 7.6.1 Multiple Box Culvert Placement



Armoring the channel experiencing high velocities may consist of materials shown in Table 5.5.1 such as gabions or rock rip-rap. The armoring shall be extended downstream or upstream to a point where the channel velocities are not erosive. Methods of reducing the proposed velocities are discussed in Chapter 8, Section 5 of TxDOT's Hydraulic Design Manual.

## **7.8 OUTPUT**

There are a number of different tools to analyze culvert systems including: HEC-RAS, HY8, Culvert Master, etc. For the IH 635 corridor, regardless of the analytical tool used to design the culvert, the following data must be provided:

- Number and size of culvert structure
- Lowest top of curb above the culvert
- Upstream and downstream flowline (for each barrel, if necessary)
- Tailwater used for the design and check storm
- Headwater calculated for the design and check storms
- Length of box
- Slope of box
- Discharge for the design storm and check storm

## **CHAPTER 8 - BRIDGES**

### **8.1 GENERAL**

There are four hydraulically designed bridges in the IH 635 corridor. They are the crossings over Farmer's Branch Creek, its tributary, Cooks Branch, and the Lower Long Branch Creek of Duck Creek. These bridge crossings shall be designed based on methods provided in Chapter 9 of TxDOT's Hydraulic Design Manual. Chapter 9, Section 3 covers design considerations and Sections 4 through 6 cover design procedures. The information provided here supplements these sections as they apply to the IH 635 corridor.

### **8.2 RUNOFF CALCULATIONS**

Refer to Chapter 4 for the appropriate runoff calculation methods. All bridge crossings are considered major creek crossings and shall be designed for the ultimate 100-year storm frequency as described in Section 5.4.

### **8.3 BRIDGE SECTIONS**

Bridges shall span the creek so that no bents are located within the main channel when possible. Bents and headers shall be oriented so that they are parallel to the stream lines at the 100-year flow with standard skew angles to the floodplain such as 15°, 30°, 45°, etc. where possible. For skewed stream crossings where the skew angle is greater than 20°, the effective area of opening shall be reduced. Documentation shall be provided in the hydraulic report in the event that bridge or culvert skew is considered.

### **8.4 HYDRAULIC OPERATION**

Because all hydraulically designed bridges are located at major creek crossings, HEC-2 or HEC-RAS hydraulic models shall be used to design the openings and determine tailwater and headwater. Farmer's Branch Creek and its tributary are in HEC-RAS, while Cooks Branch and Upper Long Branch will remain in HEC-2. The limits of analysis and cross section update requirements are given in Section 5.2. Manning's "n" values are given in Table 5.3.1.

Headwater shall be determined with methods listed in Chapter 9 Section 4 of TxDOT's Hydraulic Design Manual. The design storm headwater elevation must not be greater than the bridge's drainage divide elevation. Bridge low chord elevations shall be designed for a minimum of 2-feet above the 50-year water surface elevation and a desirable freeboard of 1-foot above the 100-year water surface elevation. The 100-year headwater shall not encroach onto

the IH 635 mainlanes/general purpose lanes. Bridges shall be designed to maintain their integrity during a 500-year event.

Maximum velocities for various types of channel lining are given in Section 5.5 in Table 5.5.1. Where velocities greater than these exist, the channel shall be protected.

### 8.5 BRIDGE SCOUR

Refer to “Evaluating Scour at Bridges” (HEC 18, 2001) for detailed scour discussion and analysis procedures.

Refer to FHWA IH-97-030, “Bridge Scour and Stream Instability Countermeasures” (HEC-23) for discussion on selection of scour protection measures.

To prevent scour from impacting the stability of the proposed bridges in non-lined channels, the following two methods shall be used to protect the columns and foundations:

- Design the bridge columns and foundations to withstand the maximum total potential scour for the structure. This includes the assumption that all of the material down to the maximum potential scour limit has been removed when determining the point of rigidity. It is also advisable in areas where a layer of highly erosion resistant bedrock, such as shale or limestone, is relatively shallow, to design these foundations as if the soil above the bedrock is removed completely by the scour process.
- Provide scour protection at the base of columns by installing an apron of rock riprap. Rock riprap is preferred over the use of gabions for scour protection. Riprap protection must be combined with a regular maintenance program to repair any scour that does occur at the base of the columns and regular inspection program of columns subject to scour, especially after major flood events. Guidelines based on HEC-23 for use of rock riprap are as follows:
  - The individual rocks should be sized to withstand the expected velocities.
  - The top of the apron should be at the streambed elevation.
  - The thickness of the apron should be a minimum of 3 times the  $D_{50}$ , and no shallower than the  $D_{100}$ .
  - The maximum size rock should be no greater than 2 times the  $D_{50}$ .



- The extent of the riprap apron around the column should be at least 2 times the column dimension measured perpendicular to the flow, measured from the column face. However, the extent of the apron downstream of the column should be no less than 10 feet.

## 8.6 OUTPUT

In the IH 635 corridor, HEC-RAS will be used for hydraulic modeling, except where an existing HEC-2 hydraulic model is available. With either software, the design models will be provided in the hydraulic report, and a summary of that documentation shall be incorporated into the construction plans as given in Chapter 3.

Scour calculations shall be performed in accordance with HEC-18. The required scour analysis output is shown in Table 8.6.1. An example of the required scour analysis results is shown in Table 8.6.2.

**Table 8.6.1 Sample Scour Calculations**

IH 635 LBJ FREEWAY  
HYDRAULIC ANALYSIS

**SCOUR ANALYSIS**

NOTES AND SOURCES OF DATA:

**MAXIMUM ALLOWABLE SCOUR:**

Original Embedment (ft):	-
Existing Scour (ft):	-
Diameter / Section (inches):	-
Total column length (ft):	-
Column length above bracing (ft):	-
Based on bearing stability = 0.5 * Embedment (ft) - Exist. Scour:	-
Based on allowable unsupported length (ft):	-
Column/Drill Shaft = 1.5 x diameter (inches) - Exposed length:	-
Trestle Pile = 2.0 x diameter (inches) - Exposed length:	-
H or Square Pile = 2.0 x section depth (inches) - Exposed length:	-
Timber Pile = 1.0 x diameter (inches) - Exposed length:	-

**PIER SCOUR:**  $Y_s = 2 * Y_1 * K_1 * K_2 * K_3 * K_4 * (a/Y_1)^{0.65} * Fr^{0.43}$

where:	angle of attack:	-
L = pier length	L (ft):	-
a = pier width	a (ft):	-
K <sub>1</sub> = pier shape correction (chp 4, table 2 in HEC -18)	K <sub>1</sub> :	-
K <sub>2</sub> = correction for angle of attack (chp 4, table 3 in HEC-18)	K <sub>2</sub> :	-
K <sub>3</sub> = correction for bed condition (chapter 4, table 4 in HEC-18)		
K <sub>4</sub> = correction for armoring by bed material size (chp 4, eqn 24 and table 5 in HEC-18)		
Y <sub>1</sub> = depth of flow directly upstream of the pier	Y <sub>1</sub> (ft):	-
V <sub>1</sub> = velocity upstream of pier	V <sub>1</sub> (fps):	-
Fr = V <sub>1</sub> / (gy) <sup>0.5</sup>	Fr:	-
Y <sub>s</sub> = pier scour depth	Y <sub>s</sub> (ft):	-

**CHECK FOR LIVE BED SCOUR:**  $V > V_{cr} ? , V_{cr} = 11.52 Y^{1/3} d_{50}^{1/3}$

where:		
V = avg. through bridge velocity for subarea	V (fps):	-
Y = avg. flow depth in subarea	Y (ft):	-
d <sub>50</sub> = median particle size diameter	d <sub>50</sub> (ft):	-
V <sub>cr</sub> = critical velocity for incipient motion	V <sub>cr</sub> (ft):	-

**LIVE BED CONTRACTION SCOUR:**  $Y_2 / Y_1 = (Q_1 / Q_c)^{0.857} (W_1 / W_2)^{0.69}$

where:		
Y <sub>1</sub> = avg. depth of flow in upstream channel	Y <sub>1</sub> (ft):	-
W <sub>1</sub> = bottom width of the upstream main channel	W <sub>1</sub> (ft):	-
W <sub>2</sub> = bottom width of contracted channel	W <sub>2</sub> (ft):	-
Q <sub>c</sub> = main channel flow upstream of contraction	Q <sub>c</sub> (cfs):	-
Q <sub>1</sub> = main channel flow in contracted section	Q <sub>1</sub> (cfs):	-
Y <sub>2</sub> = avg. flow depth in contracted section	Y <sub>2</sub> (ft):	-
Y <sub>s</sub> = contraction scour = Y <sub>2</sub> - Y <sub>1</sub>	Y <sub>s</sub> (ft):	-

**CLEAR WATER CONTRACTION SCOUR:**  $Y_2 = (Q^2 / 120 d_{50}^{2/3} W^2)^{3/7}$

where:		
Q = flow in the clear water section	Q (cfs):	-
W = width in clear water section less pier widths	W (ft):	-
Y <sub>2</sub> = avg. flow depth in section + c/w scour	Y <sub>2</sub> (ft):	-
Y <sub>s</sub> = contraction scour = Y <sub>2</sub> - Y	Y <sub>s</sub> (ft):	-

**SUMMARY OF SCOUR DEPTHS:**

Pier scour (ft):	-
Contraction scour (ft):	-
Total (pier + contraction) scour (ft):	-
Maximum allowable scour depth (ft):	-



**Table 8.6.2 Scour Results**

Contraction Scour Variables and Depths							
Proposed Structure	Y <sub>1</sub>	W <sub>1</sub>	W <sub>2</sub>	Q <sub>c</sub>	Q <sub>t</sub>	Y <sub>2</sub>	Maximum Computed Potential Contraction Scour (ft)
	U/S Depth of Flow (ft)	Bottom Width of Main Channel (ft)	Bottom Width of Contracted Channel (ft)	Main Channel Flow U/S of Contraction (cfs)	Main Channel Flow Contracted Section (cfs)	Avg. Flow Depth Contracted Section (ft)	

Pier Scour Variables and Depths									
Proposed Structure	a	K <sub>1</sub>	K <sub>2</sub>	K <sub>3</sub>	K <sub>4</sub>	Y <sub>1</sub>	V <sub>1</sub>	Fr	Maximum Computed Potential Pier Scour (ft)
	Pier Width (ft)	Pier Shape Factor	Attack Angle Factor	Bed Condition Factor	Amoring Factor	Hydraulic Depth (ft)	Velocity (fps)	Froude Number	

Texas Department of Transportation  
IH 635 Managed Lanes Project  
Technical Provisions

**Attachment 12-2A**

Amendment For The  
IH-635 Drainage Criteria Manual, October 2006  
(Revised February 2008)

## Chapter 1 – Introduction

Section	Subheading	Modification
1.1	Purpose	Retain
1.2	Scope	Delete
1.3	Design Criteria Summary	Retain all text except criteria for pipe material, minimum pipe velocity, and maximum pipe velocity for all roadway types presented in Table 1.3.1.

## Chapter 2 – Policy and Guidelines

Delete all text except: “No rise in water surface of the 100-year storm will be permitted, therefore Conditional Letters of Map Revision (CLOMR’s) will not be necessary.”

## Chapter 3 – Data Collection, Evaluation, and Documentation

Section	Subheading	Modification
3.1	General	Delete
3.2	Hydraulic Reports	Retain
3.3	Drainage Plans Preparation	Delete
3.4	Submittals	Delete

## Chapter 4 – Hydrology

Section	Subheading	Modification
4.1	General	Delete text in first paragraph. Retain text in second paragraph.
4.2	Design Frequency	Retain
4.3	Frequencies of Coincidental Occurrences	Retain
4.4	Time of Concentration	Replace first sentence in first paragraph with: “The computation of the time of concentration will be based on subdividing the flow path into three categories: overland flow (sheet flow), shallow concentrated flow (gutter flow), and conduit and/or open channel flow. Delete the first sentence in the second paragraph.
4.5	Rational Method	Retain Table 4.5.1, Table 4.5.2, Table 4.5.3 and all text except: “The TxDOT Hydraulic Design Manual provides a specific description of the theory and assumptions for the Rational Method.” Replace “ Each city within the IH 635 corridor has determined the rainfall intensity for various storm events. The values determined by the Cities are published in their respective drainage manuals. A comparison made between the intensities published in these manuals and those computed using TxDOT’s criteria revealed that the Cities’ 100-year intensities were generally lower than the 25-year intensities computed by TxDOT’s criteria for times of concentration less than 20 minutes. Therefore, the rainfall intensity to be used for the IH 635 corridor is based on the following equation from the TxDOT manual:” with “The rainfall intensity to be used for the IH 635 corridor is based on the following equation:”
4.6	NRCS Runoff Curve Number Method	Retain Table 4.6.1 and replace text with the following: “The Natural Resources Conservation Services Runoff Curve Number Method (NRCS RCN Method) with a TY II 15-minute rainfall distribution shall be used to compute runoff for drainage areas greater than 200 acres. With any modeling software, the computational interval shall not exceed one-third of the shortest lag time of any basin in the model. Table 4.6.1 summarizes the

Section	Subheading	Modification
		curve numbers that are to be used for the IH 635 corridor.”
4.7	Flood Hydrograph Routing Methods	Retain all text except: “A detailed description of Flood Hydrograph Routing techniques can be found in Chapter 5, Section 9 of the TxDOT Hydraulic Design Manual and “TxDOT approved.”

### Chapter 5 – Hydraulic Crossing

Section	Subheading	Modification
5.1	General	Retain all text except: “A detailed discussion of hydraulic principles and theory can be found in Chapter 6 of the TxDOT Hydraulic Design Manual.”
5.2	Survey	Retain
5.3	Roughness Coefficients	Retain
5.4	Requirements	Retain all text except: “In addition to complying with the USACE’s requirements and TxDOT’s requirements”.
5.5	Channels	Delete all except Table 5.5.1.
5.6	Stream Analysis	Delete

### Chapter 6 – Storm Drainage Systems

Section	Subheading	Modification
6.1	General	Delete
6.2	Design Frequencies	Retain all text except: “Critical elevations are given in Sections 6.5 and 6.7.”
6.3	Runoff Calculations	Delete all text except: “Storm drain design should maintain the pre-project drainage boundaries when possible to avoid diverting runoff flows from one major watershed to another.”
6.4	Pavement Drainage	Retain Table 6.4.1 and all text except: “Gutter flow and ponding spread should be calculated using the method’s given in Chapter 10 Section 4 of the TxDOT Hydraulic Design Manual.”
6.5	Storm Drain Inlets	Delete all text except: “Dallas Area Rapid Transit (DART) light rail crossings, inlets shall be coordinated with the street profile so that no runoff enters the trackway.”
6.6	Location of Storm Drain Appurtenances / Conduit Runs	Delete
6.7	Conduit Systems	Retain all except delete the text in Table 6.7.1: “Minimum – 2 fps,” “Maximum – 12 fps,” and “D-loads calculated according to Chapter 14 in the TxDOT Hydraulic Design Manual” and replace the text in Table 6.7.1: “Inlets – meet critical elevation requirements listed in Table 6.5.2 and 6.5.3” with the text: “Curb inlets and combination curb & grate inlets – a minimum of 1.0’ below gutter depression. Grate inlets – a minimum of 1.0’ below top of grate. Slotted drain – a minimum of 1.0’ below guide opening.”
6.8	Roadside Channels	Retain Table 6.8.1, Figure 6.8.1, and all text except: “and in Chapter 7, Section 3 of the TxDOT Hydraulic Design Manual.”
6.9	Head Losses	Retain
6.10	Output	Delete

## Chapter 7 – Culverts

Section	Subheading	Modification
7.1	General	Delete all text except: “Refer to Table 5.3.1 for Channel roughness coefficients to be used in IH 635 corridor.” And “The following discussion clarifies these sections as they relate specifically to the IH 635 corridor.”
7.2	Runoff Calculations	Retain
7.3	Tailwater Determination	Retain
7.3.1	Culverts That Tie Into a Downstream Channel	Retain all text except first sentence.
7.3.2	Culverts That Tie Into a Closed System	Retain
7.4	Hydraulic Coefficients	Retain
7.5	Headwater	Retain all text except: “Refer to Chapter 8 of TxDOT’s Hydraulic Design Manual for headwater computation procedure.”
7.6	Culvert Sections	Retain all text except the last 2 sentences in the second paragraph.
7.7	Culvert Velocity	Retain all text except: “Methods of reducing the proposed velocities are discussed in Chapter 8, Section 5 of TxDOT’s Hydraulic Design Manual.”
7.8	Output	Delete

## Chapter 8 – Bridges

Section	Subheading	Modification
8.1	General	Delete all text except the first and second sentence.
8.2	Runoff Calculations	Retain
8.3	Bridge Sections	Retain
8.4	Hydraulic Operation	Retain all text except: “Headwater shall be determined with methods listed in Chapter 9 Section 4 of TxDOT’s Hydraulic Design Manual.”
8.5	Bridge Scour	Delete
8.6	Output	Replace all text with the following: “In the IH 635 corridor, HEC-RAS will be used for hydraulic modeling, except where an existing HEC-2 hydraulic model is available.”

Texas Department of Transportation  
IH 635 Managed Lanes Project  
Technical Provisions

**Attachment 14-1A**

Amendment for the TxDOT Traffic Operations  
Manual, Railroad Operations Volume

## AMENDMENTS FOR THE:

### *TxDOT Traffic Operations Manual – Railroad Operations Volume, February 2000*

#### Manual Notices

Delete

#### Chapter 1 – Introduction

Section	Subheading	Modification
3	Operations Involving Railroads	Replace text with “The Developer and TxDOT will jointly enter into agreements with railroad companies. The Developer shall be responsible for all costs related to force account work for construction or maintenance requirements during the term of project. Where the Manual refers to actions the state normally takes, Developer shall perform those actions.”

#### Chapter 2 – Railroad Agreements – General

Section	Subheading	Modification
1	Overview	Replace text with “Developer shall be responsible for all costs normally assigned to TxDOT.”
2	Railroad Force Account Work	Replace text with “Developer and TxDOT will jointly enter into agreements with railroad companies. The Developer shall be responsible for all costs related to force account work for construction or maintenance requirements during the term of project. Where the Manual refers to actions the state normally takes, Developer shall perform those actions.”
3	District Responsibilities	For reference only
3	District Responsibilities	In all subsequent subheadings, where the text includes work to be performed by the District or TRF, Developer shall perform.
4	TRF Responsibilities	Replace all text with the following: “The Developer shall provide all documents, estimates, and other information required by the TxDOT Traffic Operations Division (TRF) to prepare railroad agreements for the project.”

#### Chapter 3 – Highway-Rail Grade Crossing Surfaces (Construction and Reconstruction)

Section	Subheading	Modification
1	Overview	Delete
2	Plan Layout	Replace “District” and “TxDOT” with “Developer”. Under <b>Instruction</b> , delete “to be performed by TxDOT, TxDOT’s contractor”.
3	Agreement and Negotiating	Replace references to “Traffic Operations Division”, “TRF”, and “TxDOT” with the word “Developer”. Delete <b>Construction and Maintenance</b> except for the 1 <sup>st</sup> sentence. Under <b>Insurance Claims</b> delete all except the 1 <sup>st</sup> sentence. Replace the word “contractor with the word “Developer”. Delete “Payment Clause”, “Solicitations of Bids” clause and “Conditions”. Delete “Negotiating” and “After Execution”.
4	Project Execution	Replace the words “District”, “TxDOT’s Contractor” and “TxDOT” with the word “Developer”. Delete the section <b>Completion Letter</b> .

#### Chapter 4 – Grade Crossing Replanking Program

Delete

**Chapter 5 – Spur Tracks**

Delete

**Chapter 6 – Warning Signals and Devices**

Delete

**Chapter 7 – Traffic Signal Preemption**

Delete

**Chapter 8 – Grade Separation**

Delete

**Chapter 9 – Drainage Structures and Common Ditches**

Delete this Chapter, except for Page 9-2; Overview Policy and Practice.

**Chapter 10 – Other Railroad Agreements**

Delete this Chapter except for Page 10-2, Letter Agreements, Policy and Practices.

**Chapter 11 – Crossing Closure, Relocation, and Consolidation**

Delete

**Appendix A – Forms**

Delete

Texas Department of Transportation  
IH 635 Managed Lanes Project  
Technical Provisions

**Attachment 19-1AA**

Performance and Measurement Table Baseline

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
<b>1) ROADWAY</b>									
							<b>Unless otherwise stated, measurements shall be conducted using procedures, techniques and measuring equipment consistent with TxDOT's Pavement Management Information System Rater's Manual. Unless otherwise stated pavement performance measurement records relate to 0.5 mile sections as described in the PMIS Rater's Manual</b>		
	1.1	Obstructions and debris	Roadway and clear zone free from obstructions and debris	2 hrs	N/A	N/A	Visual Inspection	Auditable Sections with roadway and clear zone free from obstructions and debris	100%
	1.2	Pavement	All roadways have a smooth and quiet surface course (including bridge decks, covers, gratings, frames and boxes) with adequate skid resistance and free from Defects.	24 hrs	28 days	6 months	<b>a) Pavement Condition Score</b> Measurements and inspections necessary to derive Pavement Condition Score	Pavement Condition Score for 80% of Auditable Sections exceeding:  Mainlanes and ramps – 90  Frontage roads – 80	100%  100%
	1.2	Pavement	All roadways have a smooth and quiet surface course (including bridge decks, covers, gratings, frames and boxes) with adequate skid resistance and free from Defects.	24 hrs	28 days	6 months	<b>b) Ruts – Mainlanes, shoulders &amp; ramps</b> Depth as measured using an automated device in compliance with TxDOT Standards  10ft straight edge used to	Auditable Sections with percentage of wheel path length with ruts less than ¼" in depth:  Mainlanes, shoulders and ramps – 97%  Frontage roads – 90%	100%  100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
							measure rut depth for localized areas.	Auditable Sections free of ruts greater than 1/2" in depth	100%
	1.2	Pavement	All roadways have a smooth and quiet surface course (including bridge decks, covers, gratings, frames and boxes) with adequate skid resistance and free from Defects.	24 hrs	28 days	6 months	<b>c) Ride quality</b> Measurement of International Roughness Index (IRI) according to TxDOT standard Tex-1001-S, Operating Inertial Profilers and Evaluating Pavement Profiles	For 80% of all Auditable Sections measured, IRI throughout 98% of each Auditable Section is less than or equal to:  Mainlanes, ramps – 95** inches per mile  Frontage roads – 120** inches per mile	100%  100%
	1.2	Pavement	All roadways have a smooth and quiet surface course (including bridge decks, covers, gratings, frames and boxes) with adequate skid resistance and free from Defects.	24 hrs	28 days	6 months	** To allow for measurement bias, an adjustment of -10 (minus ten) is made to IRI measurements for concrete pavements before assessing threshold compliance  (Renewal Work and new construction subject to construction quality standards)  3ft straight edge used to measure discontinuities	IRI measured throughout 98% of Auditable Section of less than or equal to:  Mainlanes, ramps 120** inches per mile  Frontage roads – 150** inches per mile  Mainlanes, ramps 0.1 mile average – 150** inches per mile  Frontage roads, 0.1 mile average – 180** inches per mile  IRI measured throughout 98% of each lane containing a bridge deck in any Auditable Section, 0.1 mile average – 200** inches per mile  Auditable Sections free of individual discontinuities greater than 0.75"	100%  100%  100%  100%  100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
	1.2	Pavement	All roadways have a smooth and quiet surface course (including bridge decks, covers, gratings, frames and boxes) with adequate skid resistance and free from Defects.	24 hrs	28 days	6 months	<b>d) Failures</b> Instances of failures exceeding the failure criteria set forth in the TxDOT PMIS Rater's Manual, including potholes, base failures, punchouts and jointed concrete pavement failures	Auditable Sections free from instances of failure exceeding the failure criteria set forth in the TxDOT PMIS Rater's Manual, including potholes, base failures, punchouts and jointed concrete pavement failures	100%
	1.2	Pavement	All roadways have a smooth and quiet surface course (including bridge decks, covers, gratings, frames and boxes) with adequate skid resistance and free from Defects.	24 hrs	28 days	6 months	<b>e) Edge drop-offs</b> Physical measurement of edge drop-off level compared to adjacent surface	Auditable Sections free from instances of edge drop-off exceeding 2"	100%
	1.2	Pavement	All roadways have a smooth and quiet surface course (including bridge decks, covers, gratings, frames and boxes) with adequate skid resistance and free from Defects.	24 hrs	28 days	6 months	<b>f) Skid resistance</b> ASTM E 274 Standard Test Method for Skid Resistance Testing of Paved Surfaces at 50 MPH using a full scale smooth tire meeting the requirements of ASTM E 524	Auditable Sections with Skid Numbers for mainlanes, shoulders and ramps exceeding 30 and for which investigations as to potential risk of skidding accidents and appropriate remedial actions have been taken.	100%
	1.2	Pavement	All roadways have a smooth and quiet surface course (including bridge decks, covers, gratings, frames and boxes) with adequate skid resistance and free from Defects.	24 hrs	28 days	6 months	<b>f) Skid resistance</b> ASTM E 274 Standard Test Method for Skid Resistance Testing of Paved Surfaces at 50 MPH using a full scale smooth tire meeting the requirements of ASTM E 524	Auditable Sections with Skid Numbers for frontage roads exceeding 30 and for which investigations as to potential risk of skidding accidents and appropriate remedial actions have been taken.	100%
	1.2	Pavement	All roadways have a smooth and quiet surface course (including bridge decks, covers, gratings, frames and boxes) with adequate skid resistance and free from Defects.	24 hrs	28 days	6 months	<b>f) Skid resistance</b> ASTM E 274 Standard Test Method for Skid Resistance Testing of Paved Surfaces at 50 MPH using a full scale smooth tire meeting the requirements of ASTM E 524	Auditable Sections with Skid Numbers that comply with Federal requirements and / or classified as high risk by the Wet Weather Accident Reduction Program, for which the Concessionaire has performed a site investigation and any required corrective action.	100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
	1.2	Pavement	Road users warned of potential skidding hazards	24 hrs	7 days	N/A	<b>Skid resistance</b> (as above)	Auditable Sections with potential skidding hazards for which road user warnings are provided	100%
	1.3	Crossovers and other paved areas	Crossovers and other paved areas are free of Defects	24 hrs	28 days	6 months	<b>a) Potholes</b>  <b>b) Base failures</b>	Auditable Sections free from potholes  Auditable Sections free from base failures	100%  100%
	1.4	Joints in concrete	Joints in concrete paving are sealed and watertight  Longitudinal joint separation	24 hrs	28 days	6 months	Visual inspection of joints  Measurement of joint width and level difference of two sides of joints	Auditable Sections free from unsealed joints greater than 1/4"  Auditable Sections free from joint widths more than 1" or faulting more than 1/4"	100%  100%
	1.5	Curbs	Curbs are free of defects	24 hrs	28 days	6 months	Visual inspection	Auditable Sections with 95% of curbs free of defects	100%
<b>2) DRAINAGE</b>									
	2.1	Culverts, Pipes and Channels	Each element of the drainage system is maintained in its proper function by cleaning, clearing and/or emptying as appropriate including vegetation and debris and silt from the point at which water drains from the travel way to the outfall or drainage way.	24 hrs	28 days	6 months	Visual inspection supplemented by CCTV where required to inspect buried pipe work	Auditable Sections with culverts, pipes and channels with a minimum of 90% clear cross-sectional area, calculated as the arithmetic mean of the clear cross-sectional areas of individual 10 feet lengths of culverts, pipes and channels in each Auditable Section.	100%
	2.2	Drainage treatment devices	Drainage treatment and balancing systems, flow and spillage control devices function correctly and their location and means of operation is recorded adequately to permit their correct operation in Emergency.	24 hrs	28 days	6 months	Visual inspection	Auditable Sections with drainage treatment devices functioning correctly and with means of operation displayed	100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
	2.3	Travel Way	The travel way is free from water to the extent that such water would represent a hazard by virtue of its position and depth.	24 hrs	28 days	6 months	Visual inspection of water on surface	Auditable Sections with travel way free from instances of hazardous water build-up	100%
	2.4	Discharge systems	Surface water discharge systems perform their proper function and discharge to groundwater and waterways complies with the relevant legislation and permits.	24 hrs	28 days	6 months	Visual inspection and records	Auditable Sections with surface water discharge systems performing their proper function and discharging in compliance with the relevant legislation and permits.	100%
	2.5	Protected Species	Named species and habitats are protected	24 hrs	28 days	6 months	Visual inspection	Auditable Sections with named species and habitats with protection of these named species and habitats	100%

**3) STRUCTURES**

	3.1	Structures having an opening measured along the centre of the roadway of more than 20 feet between undercopings of abutments or springlines of arches or extreme ends of openings or multiple boxes	<p>Substructures and superstructures are free of:</p> <ul style="list-style-type: none"> <li>Graffiti</li> <li>Undesirable vegetation</li> <li>Debris and bird droppings</li> <li>Blocked drains, weep pipes manholes and chambers</li> <li>Blocked drainage holes in structural components</li> <li>Defects in joint sealants</li> <li>Defects in pedestrian protection measure</li> <li>Scour damage</li> <li>Corrosion of rebar</li> <li>Paint system failures</li> </ul>	24 hrs	28 days	6 months	Inspection and assessment in accordance with the requirements of federal National Bridge Inspection Standards (NBIS) of the Code of Federal Regulations, 23 Highways – Part 650, the TxDOT Bridge inspection Manual, and the Federal Administration's Bridge Inspector's Reference Manual.	<p>Records as required in the TxDOT Bridge Inspection Manual</p> <p>Auditable Sections with superstructures and substructures with condition ratings of seven or higher</p> <p>Auditable Sections with structure components with condition states of one</p>	<p>100%</p> <p>100%</p>
--	-----	---	--	--------	---------	----------	--	--	-------------------------



Performance and Measurement Table Baseline									
ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
			vi) All non-structural items such as hoists and electrical fixings, operate correctly, are clean and lubricated as appropriate, in accordance with the manufacturer's recommendation and certification of lifting devices is maintained.						
	3.3	Non-bridge class culverts	Non-bridge-class culverts are free of:  Defects in sealant to movement joints Scour damage	24 hrs	28 days	6 months	Visual inspection	Auditable Sections with non-bridge-class culverts free from defects in sealant and movement joints and no scour damage	100%
	3.4	Gantries and high masts	Sign signal gantries, high masts are structurally sound and free of:  Loose nuts and bolts Defects in surface protection systems Graffiti	24 hrs	28 days	6 months	Visual inspection	Auditable Sections with gantries and high masts free of loose assemblies  Auditable Sections with gantries and high masts free from defects in surface protection systems  Auditable Sections with gantries and high masts free from graffiti	100%  100%  100%
	3.5	Load ratings	All structures maintain the design load capacity.	24 hrs	28 days	6 months	Inspection and assessment in accordance with the requirements of AASHTO's Guide Manual for Condition Evaluation and Load and Resistance Factor Rating (LRF) of Highway Bridges, the TxDOT Bridge inspection Manual, and the Federal Administration's Bridge Inspector's Reference Manual.	Auditable Sections with structures that do not require load restrictions for Texas legal loads	100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
	3.6	Surface coating	Include a re-coating schedule in the MMP.	N/A	N/A	1 year	Visual Inspection of gloss and color	Auditable Sections with surface coating compliant with the standards referenced in the MMP	100%
	3.7	Graffiti	Graffiti is removed in a manner and using materials that restore the surface to a like appearance similar to adjoining surfaces.	N/A	N/A	24 hours	Visual inspection	Auditable Sections with structures that have suffered graffiti and for which graffiti removal and surface restoration have been carried out.	100%
	3.8	Retaining walls	Integrity and structural condition of the retaining walls is maintained	24 hrs	28 days	6 months	Structural assessment if visual inspection warrants	Auditable Sections with inspection records showing compliance	100%
	3.8	Retaining walls	Integrity and structural condition of the retaining walls is maintained	24 hrs	28 days	6 months	Structural assessment if visual inspection warrants	Auditable Sections with inspection records showing compliance with the following:  No joint with exposed filter fabric or backfill material No concrete to concrete contact No loss of joint seal material No settlement of backfill material	100%
<b>4) PAVEMENT MARKINGS, OBJECT MARKERS, BARRIER MARKIERS AND DELINEATORS</b>									
	4.1	Pavement markings	Pavement markings are: clean and visible during the day and at night whole and complete and of the correct color, type, width and length placed to meet the TMUTCD and TxDOT's Pavement Marking Standard Sheets	24 hrs	28 days	6 months	a) Markings – General Portable retroflectometer, which uses 30 meter geometry meeting the requirements described in ASTM E 1710	Auditable Sections with white thermoplastic pavement markings meeting a minimum retroreflectivity of 250 mcd/sqm/lx  Auditable Sections with white paint and beads pavement markings meeting a minimum retroreflectivity of 175 mcd/sqm/lx	100%  100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
							Physical measurement  b) Profile Markings Visual inspection	Auditable Sections with yellow thermoplastic pavement markings meeting a minimum retroreflectivity of 175 mcd/sqm/lx  Auditable Sections with yellow paint and beads pavement markings meeting a minimum retroreflectivity of 125/mcd/sqm/lx  Auditable Sections with pavement markings with more than 95% of original specified pavement marking area  Auditable Sections with pavement marking dimensions compliant with the relevant specified dimensions.  Auditable Sections with pavement markings performing their intended function and compliant with relevant regulations	100%  100%  100%  100%  100%
	4.2	Raised reflective markings	Raised reflective pavement markers, object markers and delineators are: clean and clearly visible of the correct color and type reflective or	24 hrs	28 days	6 months	Visual inspection	Auditable Sections free from occurrences of 6 consecutive ineffective markers (ineffective includes missing, damaged, settled or sunk).  (A minimum of four markers should be visible at 80' spacing when viewed under	100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
			retroreflective as TxDOT standard correctly located, aligned and the correct level are firmly fixed are in a condition that will ensure that they remain at the correct level				low beam headlights) Auditable Sections free from occurrences of 6 consecutive markers failing to provide equivalent performance characteristics to adjacent markers	100%	
	4.3	Delineators & Markers	Object markers, mail box markers and delineators are: clean and visible of the correct color and type legible and reflective Straight and Vertical	24 hrs	28 days	6 months	Visual inspection	Auditable Sections free from defective or missing object markers or delineators	100%

**5) GUARDRAILS, SAFETY BARRIERS AND IMPACT ATTENUATORS**

	5.1	Guard rails and safety barriers	All guardrails, safety barriers, concrete barriers, etc. are maintained free of Defects. They are appropriately placed and correctly installed at the correct height and distance from roadway or obstacles.	24 hrs	7 days	N/A	Visual inspection	Auditable Sections with guard rails and safety barriers appropriately placed and correctly installed	100%
								Auditable Sections with guard rails and safety barriers free from defects	100%
								Auditable Sections with guard rails and safety barriers at correct heights	100%
								Auditable Sections with guard rails and safety barriers at correct distance from roadway obstacle	100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
	5.2	Impact attenuators	All impact attenuators are appropriately placed and correctly installed	24 hrs	7 days	6 months	Visual inspection	Auditable Sections with impact attenuators appropriately placed and correctly installed	100%

**6) TRAFFIC SIGNS**

	6.1	General – All Signs	<ul style="list-style-type: none"> <li>i. Signs are clean, correctly located, clearly visible, legible, reflective, at the correct height and free from structural and electrical defects</li> <li>ii. Identification numbers are provided, correctly located, visible, clean and legible</li> <li>iii. Sign mounting posts are vertical, structurally sound and rust free</li> <li>iv. All break-away sign mounts are clear of silt or other debris that could impede break-away features and shall have correct stub heights</li> <li>v. Obsolete and redundant signs are removed or replaced as appropriate</li> <li>vi. Visibility distances meet the stated requirements</li> </ul>	24 hrs	28 days	6 months	<ul style="list-style-type: none"> <li><b>a) Retroreflectivity</b> Coefficient of retro reflectivity</li> <li><b>b) Face damage</b> Visual inspection</li> <li><b>c) Placement</b> Visual inspection</li> <li><b>d) Obsolete signs</b> Visual inspection</li> <li><b>e) Sign Information</b> Visual inspection</li> <li><b>f) Dynamic Message Signs</b> Visual inspection</li> </ul>	<ul style="list-style-type: none"> <li>Auditable Sections with signs with reflectivity meeting or exceeding the requirements of TxDOT's TMUTCD</li> <li>Auditable Sections with signs with face damage less than 5% of face area</li> <li>Auditable Sections with signs placed in accordance with TxDOT's Sign Crew Field Book including not twisted or leaning</li> <li>Auditable Sections free from obsolete signs</li> <li>Auditable Sections with sign information of the correct size, location, type and wording to meet its intended purpose</li> <li>Auditable Sections with fully functioning dynamic message signs</li> </ul>	<ul style="list-style-type: none"> <li>100%</li> <li>100%</li> <li>100%</li> <li>100%</li> <li>100%</li> <li>100%</li> </ul>
--	-----	---------------------	--	--------	---------	----------	--	---	--

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
			vii. Sign information is of the correct size, location, type and wording to meet its intended purpose and any statutory requirements  viii. All structures and elements of the signing system are kept clean and free from debris and have clear access provided  ix. All replacement and repair materials and equipment are in accordance with the requirements of the TMUTCD  x. Dynamic message signs are in an operational condition						
	6.2	General – Safety critical signs	Requirements as 6.1, Plus:  “Stop,” “Yield,” “Do Not Enter,” “One Way” and “Wrong Way” signs are clean legible and undamaged	2 hrs	1 week	6 months	Visual inspection	Auditable Sections with safety critical signs that are clean legible and undamaged	100%
<b>7) TRAFFIC SIGNALS</b>									
	7.1	General	i. Traffic Signals and their associated equipment are: clean and visible	2 hrs	24 hrs	6 months	<b>a) General condition</b> Visual inspection  <b>b) Damage</b>	Auditable Sections with clean and visible traffic signals  Auditable Sections free of	100%  100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
			correctly aligned and operational free from damage caused by accident or vandalism correctly aligned and operational  ii. Signal timing and operation is correct  iii. Contingency plans are in place to rectify Category 1 defects not immediately repairable to assure alternative traffic control is provided during a period of failure				Visual inspection  <b>c) Signal timing</b> Timed measurement  <b>d) Contingency plans</b> Records Review	damaged traffic signals  Auditable Sections with installations with correct traffic signals timing  Auditable Sections with contingency plans in place	100%  100%
	7.2	Soundness	Traffic Signals are structurally and electronically sound	24 hrs	28 days	6 months	<b>a) Structural soundness</b> Visual inspection  <b>b) Electrical soundness</b> Testing to meet NEC regulations	Auditable Sections with inspection records showing safe installation and maintenance	100%
	7.3	Identification marking	Signals have identification markers and the telephone number for reporting faults are correctly located, clearly visible, clean and legible	N/A	28 days	6 months	Visual inspection	Auditable Sections with inspection records showing identification markers and other information are easily readable	100%
	7.4	Pedestrian Elements and Vehicle Detectors	All pedestrian elements and vehicle detectors are correctly positioned and fully functional at all times	24 hrs	28 days	6 months	Visual inspection	Auditable Sections with inspection records showing compliance	100%



**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
			ii. All obstruction lights are present and working (if required)  iii. Compartment door is secure with all bolts in place  iv. All winch and safety equipment is correctly functioning and maintained without rusting or corrosion  (for structural requirements refer to Element Category 3)					Auditable Sections with no identified other defects	100%

**9) FENCES, WALLS AND SOUND ABATEMENT**

	9.1	Design and Location	Fences and walls act as designed and serve the purpose for which they were intended	24 hrs	28 days	6 months	Visual Inspection	Auditable Sections with inspection records showing compliance	100%
	9.2	Construction	Integrity and structural condition of the fence is maintained.	24 hrs	28 days	6 months	Structural assessment if visual inspection warrants	Auditable Sections with inspection records showing compliance	100%
			Integrity and structural condition of the walls are maintained.	24 hrs	28 days	6 months	Structural assessment if visual inspection warrants	Auditable Sections with inspection records showing compliance with the following:  Vertical tolerance of wall 1/2" per 10' of wall height Wall panel offset of 3/4" or less	100%

**10) ROADSIDE MANAGEMENT**

	10.1	Vegetated Areas – Except landscaped areas –	Vegetation is maintained so that:	24 hrs	7 days	28 days	a) Urban areas Physical measurements of	Auditable Sections having 95% of height of grass and	100%
--	------	---	-----------------------------------	--------	--------	---------	--	--	------

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
		General	i. Height of grass and weeds is kept within the limits described for urban and rural areas. Mowing begins before vegetation reaches maximum height  ii. Spot mowing at intersections, ramps or other areas maintains visibility of appurtenances and sight distance  iii. Grass or vegetation does not encroach into or on paved shoulders, main lanes, sidewalks, islands, riprap, traffic barrier or curbs  iv. A herbicide program is undertaken in accordance with the TxDOT Herbicide Manual to control noxious weeds and to eliminate grass in pavement or concrete  v. A full width mowing cycle is completed after the first frost  vi. Wildflowers are preserved utilizing the guidelines in the mowing specifications and TxDOT <i>Roadside</i>				height of grass and weeds  <b>b) Rural areas</b> Physical measurement of height of grass and weeds  <b>c) Encroachment</b> Visual inspection of instances of encroachment of vegetation  <b>d) Wildflowers</b> Visual inspection with audit of process  <b>e) Sight lines</b> Visual inspection	weeds between 5 in and 18 in  Auditable Sections having 95% of height of grass and weeds between 5 in and 30 in  Auditable Sections free of vegetation encroachment  Auditable Sections that adhere to vegetation management manuals  Auditable Sections free from instances of impairment of sight lines or sight distance to signs	100%  100%  100%  100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
			<i>Vegetation Manual.</i>						
	10.2	Landscaped Areas	i. All landscaped areas are maintained to their originally constructed condition. Landscaped areas are as designated in the plans.  ii. Mowing, litter pickup, irrigation system maintenance and operation, plant maintenance, pruning, insect, disease and pest control, fertilization, mulching, bed maintenance, watering is undertaken as per FMP.  iii. The height of grass and weeds is kept between 2" and 8"  iv. Damaged or dead vegetation is replaced	24 hrs	7 days	28 days	Visual inspection	Auditable Sections with inspection records showing compliance	100%
	10.3	Fire Hazards	Fire hazards are controlled	24 hrs	7 days	28 days	Visual inspection	Auditable Sections free from instances of dry brush or vegetation forming fire hazard	100%
	10.4	Trees, brush and ornamentals	i. Trees, brush and ornamentals on the right of way, except in established no mow areas, are trimmed in accordance with TxDOT standards  ii. Trees, brush and ornamentals are trimmed to insure they	24 hrs	7 days	28 days	Visual inspection	Auditable Sections with inspection records showing compliance	100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
			do not interfere with vehicles or sight distance, or inhibit the visibility of signs.  iii. Dead trees, brush, ornamentals and branches are removed. Potentially dangerous trees or limbs are removed.  iv. All undesirable trees and vegetation are moved. Diseased trees or limbs are treated or removed by licensed contractors.						
	10.5	Wetlands	Wetlands are managed in accordance with the permit requirements	24 hrs	7 days	28 days	Visual inspection, assessment of permit issuers	Auditable Sections free from instances where permit requirements not met	100%
<b>11) REST AREAS AND PICNIC AREAS</b>									
	11.1	Rest areas and picnic areas	i. Picnic areas are clean and neat in appearance  ii. Trash barrels are painted and attached to their supports to prevent stealing  iii. Site free of any visible litter, all litter properly disposed. Litter removed from the picnic grounds and barrels before being allowed to accumulate outside of the barrels	24 hrs	28 days	6 months	Inspection records showing compliance	Auditable Sections having 90% of grass and weeds height between 2 in and 8 in.  Mowing shall begin before vegetation reaches 8 in  Auditable Sections free from bare ground areas larger than 5 square feet  Auditable Sections free from prohibited, invasive or noxious weeds	100%  100%  100%  100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
			iv. All vehicles used in transporting litter are equipped to prevent the accumulated litter from being strewn along the roadway  v. Vegetation damaged due to improper or careless mowing and trimming operations or any other reason is replaced  vi. Weeds, grass and other undesirable growth are removed from beds of plants and shrubs as needed. Trees and shrubs are trimmed neatly. All curbs and sidewalks are edged and repaired.  vii. All picnic tables are clean, free of stains and free of any defect  viii. All directional, informational, safety and any other sign is properly installed, contains accurate information and is visible from a reasonable distance				Auditable Sections free from occurrences of encroachment of vegetation or debris for more than two (2) inches onto any curb or sidewalk located throughout the rest area.  Auditable Sections free from occurrences of deviation of soil or mulch above or below the top of the curb  Auditable Sections with paved surfaces maintained clean and safe with minimal obstruction  Auditable Sections free from occurrences of pavement undermining greater than 2"  Auditable Sections free from unsealed cracks greater than ½ inch at rest areas and picnic areas	100%  100%  100%  100%	

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
			ix. All striping is intact and all parking and travel areas are clearly marked  x. All curbs are in place and intact					Auditable Sections with fully functional lights at rest areas and picnic areas	100%

**12) EARTHWORKS, EMBANKMENTS AND CUTTINGS**

	12.1	Slope Failure	All structural or natural failures of the embankment and cut slopes of the Facility are repaired	24 hrs	28 days	6 months	Visual inspection by geotechnical specialist and further tests as recommended by the specialist	Auditable Sections with repaired structural or natural failures of the embankment and cut slopes	100%
	12.2	Slopes – General	Slopes are maintained in general conformance to the original graded cross-sections, the replacement of landscaping materials, reseeding and re-vegetation for erosion control purposes and removal and disposal of all eroded materials from the roadway and shoulders.	24 hrs	28 days	6 months		Auditable Sections with inspection records showing compliance	100%

**13) ITS AND ETCS EQUIPMENT**

	13.1	ETCS Equipment – Maintenance	All ITS and ETCS equipment is fully functional and housing is functioning and free of defects.  i. All equipment and cabinet identification numbers are visible, sites are well drained and access is clear ii. Steps, handrails and	24 hours	14 days	1 month	Visual Inspection	Auditable Sections with inspection records showing compliance	100%
--	------	------------------------------	---	----------	---------	---------	-------------------	---	------

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
			accesses are kept in good condition iii. Access to all communication hubs, ground boxes, cabinets and sites is clear iv. All drainage is operational and all external fixtures and fittings are in a satisfactory condition v. All communications cable markers, cable joint markers and duct markers are visible and missing markers are replaced. vi. Backup power supply system is available at all times.						
	13.2	VES Equipment – Maintenance	All VES equipment is kept clean, the identification numbers are visible.	24 hrs	14 days	1 month	Visual Inspection	Auditable Sections with inspection records showing compliance	100%
	13.3	Dynamic Message Sign Equipment	Dynamic Message Signs are free from faults such as: i. Any signal displaying a message which is deemed to be a safety hazard ii. Failure of system to clear sign settings when appropriate iii. 2 or more contiguous sign failures that prevent control office setting strategic diversions iv. Signs displaying an	2 hrs	24 hrs	14 days	Defect measurement dependent on equipment	Auditable Sections with inspection records showing compliance	100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
			incorrect message						
	13.4	CCTV Equipment	CCTV Systems are free from serious faults that significantly limit the availability of the operators to monitor the area network, such as: <ul style="list-style-type: none"> <li>i. Failure of CCTV Systems to provide control offices with access and control of CCTV images</li> <li>ii. Failure of a CCTV camera or its video transmission system</li> <li>iii. Failure of a Pan / Tilt unit or its control system</li> <li>iv. Moisture ingress onto CCTV camera lens</li> <li>v. Faults that result in significant degradation of CCTV images</li> </ul>	2 hrs	24 hrs	14 days	Defect measurement dependent on equipment	Auditable Sections with inspection records showing compliance	100%
	13.5	Vehicle Detection Equipment	All equipment free of defects and operational problems such as: <ul style="list-style-type: none"> <li>i. Inoperable loops.</li> <li>ii. Malfunctioning camera controllers</li> </ul>	2 hrs	24 hrs	1 month	Defect measurement dependent on equipment  Traffic Detector Loops: Loop circuit's inductance to be > 50 and < 1,000 micro henries Insulation resistance to be > 50 meg ohms	Auditable Sections with inspection records showing compliance  Auditable Sections free from instances where loops are out of compliance	100%  100%

**14) TOLLING FACILITIES AND BUILDINGS (Not Used)**

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
<b>15) AMENITY</b>									
	15.1	Graffiti	Graffiti is removed in a manner and using materials that restore the surface to a like appearance similar to adjoining surfaces	24 hrs	N/A	N/A	All graffiti is considered a Category 1 defect	Auditable Sections with inspection records showing compliance	100%
<b>16) SNOW AND ICE CONTROL</b>									
	16.1	Travel Lanes	Maintain travel way free from snow and ice.	1hr or 2hrs as noted.	N/A	N/A	Maximum 1hr response time to complete manning and loading of spreading vehicles  Maximum 2hrs from departure from loading point to complete treatment and return to loading point  Maximum 1hr response time for snow and ice clearance vehicles to depart from base	Auditable Sections with inspection records showing compliance	100%
	16.2	Weather Forecasting	weather information is obtained and assessed and appropriate precautionary treatment is carried out to prevent ice forming on the travel way	2 hrs	N/A	N/A	Operations plan details the process and procedures in place and followed	Auditable Sections with inspection records showing compliance	100%
	16.3	Operational Plans	Operate snow and ice clearance plans to maintain traffic flows during and after snowfall and restore the travel way to a clear condition as soon as possible.	2 hrs	N/A	N/A	Operations plan details the process and procedures in place and followed	Auditable Sections with inspection records showing compliance	100%

Performance and Measurement Table Baseline									
ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
<b>17) INCIDENT RESPONSE</b>									
	17.1	General	Respond to Incidents and Emergencies in accordance with Sections 22 and 24 of the Technical Provisions	15 min	N/A	N/A	Response times met for 98% of Incidents measured on a 1 year rolling basis. No complaints from Emergency responders.	Auditable Sections with inspection records showing compliance	100%
	17.2	Hazardous Materials	For any hazardous materials spills, comply with the requirements of Section 22 of the Technical Provisions.	1 hr	N/A	N/A	FMP details the process and procedures in place and followed	Auditable Sections with inspection records showing compliance	100%
	17.3	Structural assessment	Evaluate structural damage to structures and liaise with emergency services to ensure safe working in clearing the incident	24 hrs	28 days	6 months	Inspections and surveys as required by incident	Auditable Sections with structures that have suffered damage and for which liaison with emergency services and safe clearance of the damage incident have been carried out.	100%
	17.4	Temporary and permanent remedy	Propose and implement temporary measures or permanent repairs to Defects arising from the Incident. Ensure the structural safety of any structures affected by the incident.	24 hrs	28 days	N/A	Review and inspection of the incident site	Auditable Sections with inspection records showing compliance	100%
<b>18) CUSTOMER RESPONSE</b>									
	18.1	Response to inquiries	Timely and effective response to customer inquiries and complaints	48 hrs	28 days	N/A	Contact the customer within 48 hours following initial customer inquiry.  All work resulting from customer requests is scheduled within 48 hours of customer contact.  Follow-up contact with the customer within 72 hours of initial inquiry.	Auditable Sections with responses within specified times	100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
							All customer concerns / requests are resolved to TxDOT's satisfaction within 2 weeks of the initial inquiry.		
	18.2	Customer contact line	Telephone line manned during business hours and 24 hour availability of messaging system. Faults to telephone line or message system rectified	24 hrs	28 days	N/A	Instances of line out of action or unmanned	Auditable Sections with operations records showing line availability, including complaints from public.	100%

**19) SWEEPING AND CLEANING**

	19.1	Sweeping	<ul style="list-style-type: none"> <li>i. Keep all channels, shoulders, gore areas, ramps, intersections, islands and frontage roads swept clean</li> <li>ii. Clear and remove debris from traffic lanes, shoulders, verges and central reservations, footways and cycle ways</li> <li>iii. Remove all sweeping without stockpiling in the right of way and dispose of at approved tip</li> </ul>	24 hrs	28 days	6 months	Buildup of dirt, ice rock, debris, etc. on roadways and bridges not to accumulate greater than 24 in. wide or ½ in. deep.	Auditable Sections with inspection records showing compliance.	100%
--	------	----------	---	--------	---------	----------	---	--	------

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
	19.2	Litter	i. Keep the right of way in a neat condition, remove litter regularly ii. Pick up large litter items before mowing operations iii. Dispose of all litter and debris collected at an approved solid waste site	24 hrs	28 days	6 months	No more than 20 pieces of litter per roadside mile shall be visible when traveling at highway speed.	Auditable Sections with inspection records showing compliance.	100%

**20) BUILDINGS AND ENCLOSED FACILITIES**

	20.1	Buildings and Enclosed Facilities	All structural features of buildings and enclosed facilities (walls, roof, fenestrations, etc.) are safe functional and operational.	24 hrs	7 days	6 months	Perform visual inspection by a Texas Real Estate Commission (TREC) certified Professional Inspector that meets the National Academy of Building Inspection Engineers (NABIE) Standards of Practice for building inspection.	Auditable Sections with all Elements safe, functional and operational.  Auditable Sections with inspection and maintenance records showing compliance.	100%  100%
	20.2.1	Electrical Systems, Normal, Electrical & Security Lighting	Lighting system fixtures, lamps and control functioning to provide the intended illumination level, lighting quality, duration, availability of sources and energy efficiency for the task.	8 hrs	7 days	6 months	Regularly scheduled visual inspection(s) of a frequency to determine adequate function for the particular system, both daytime and nighttime, as determined by the Developer. Nighttime lighting level readings of all exterior lighting quarterly. Preventative maintenance of lighting components, circuiting, re-lamping and testing per NFPA 70B, 101, 110 & 111	Auditable Sections with illumination levels of all lighting systems meeting intended levels, quality and duration.  Auditable Sections with all inspections conducted and documented.  Auditable Sections with all preventative maintenance performed and documented in accordance with the referenced standards.  Auditable Sections with original energy efficiency requirements maintained.	100%  100%  100%  100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
	20.2.2	Electrical Systems, Fire Detection & Alarm	Fire detection and alarm systems provide the intended detection and notification functions.	4 hrs	7 days	6 months	<p>Visual and demonstration testing monthly to meet the requirements of NFPA 70B and 72.</p> <p>Preventative maintenance of fire alarm components, circuiting, sources and testing per NFPA 70B, 72, 101, 110 &amp; 111.</p> <p>Follow manufacturer's recommendations for maintenance and testing where requirements are more demanding.</p>	<p>Auditable Sections with all fire alarm systems perform as designed and providing the intended level of protection.</p> <p>Auditable Sections with all detectors operating within manufacturer's tolerance for sensitivity and cleanliness.</p> <p>Auditable Sections with all inspections conducted and documented.</p> <p>Auditable Sections with all preventative maintenance performed and documented in accordance with the referenced standards.</p>	<p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p>
	20.2.3	Electrical Systems, Communications to include telephone, Network and CCTV	Communications systems serving their intended functions.	4 hrs	4 days	6 months	<p>Visual and demonstration testing monthly to meet the requirements of NFPA 70B.</p> <p>Preventative maintenance of communication system components, circuiting, sources and testing per NFPA 70B</p> <p>Follow manufacturer's recommendations for maintenance and testing where requirements are more stringent.</p> <p>Continuous monitoring through self-system diagnostics and failure detection.</p>	<p>Auditable Sections with all equipment operating in accordance with manufacturer's recommendations for actual conditions of use.</p> <p>Auditable Sections with all inspections conducted and documented.</p> <p>Auditable Sections with all preventative maintenance performed and documented in accordance with the referenced standards.</p> <p>Auditable Sections free from database and communication system security breaches.</p>	<p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p>

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
							Auditable Sections with electronic retention of database files, back-ups and other stored media.	100%	
	20.2.4	Electrical Systems, Distribution – normal, essential & emergency	Electrical system serving connected loads with intended capacity, voltage regulation, protection, control and monitoring.	2 hrs	3 days	6 months	<p>Regularly scheduled visual and operational testing of electrical equipment, circuits, protection devices, control and monitoring of a frequency to determine adequate function for the particular system.</p> <p>Preventative maintenance and testing per NFPA 70B, 110, 111, manufacturer's recommendations and NETA MTS.</p> <p>Exercising of back-up generators under load where used as Emergency source, monthly.</p> <p>Exercising of ATS switches, semi-annually.</p> <p>Load testing of UPS systems where used as Emergency source, monthly.</p> <p>Monitoring and Testing of individual battery cell condition, annually.</p>	<p>Auditable Sections with all equipment operating in accordance with manufacturer's recommendations for actual conditions of use.</p> <p>Auditable Sections with electrical systems and components serving the intended loads with proper capacity, voltage and frequency.</p> <p>Auditable Sections with protection devices calibrated and set properly for selective coordination.</p> <p>Auditable Sections with all preventative maintenance in accordance with the referenced standards.</p> <p>Auditable Sections where serving as a redundant source, availability of 100%.</p> <p>Auditable Sections with all electrical outages within Developer control documented as to time, duration, loads affected, cause and resulting corrective measures taken.</p> <p>Auditable Sections with adequate on-site storage of</p>	<p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p>

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
							fuel supply sufficient to meet the intended standby essential operating time.	100%	
							Auditable Sections with continuous monitoring of essential & Emergency sources when consisting of a non-utility source.	100%	
	20.2.5	Electrical Systems, SCADA	SCADA system provides intended function of control, monitoring, communication and visual display of all connected systems including integration with other systems.	2 hrs	3 days	6 months	<p>Visual and demonstration testing monthly to meet the requirements of NFPA 70B. Preventative maintenance of SCADA components, wiring, communications, power supplies, sensors and visual displays per NFPA 70B. Follow manufacturer's recommendations for maintenance and testing where requirements are more demanding.</p> <p>Continuous monitoring through self-system diagnostics and failure detection.</p> <p>Like Safety preventative maintenance performed and reported bi-annually.</p>	<p>Auditable Sections with all SCADA systems performing as designed and providing the intended level of control and monitoring.</p> <p>Auditable Sections with all sensors and monitoring devices operating within manufacturer's tolerance for sensitivity.</p> <p>Auditable Sections free from loss of critical or life safety functions due to equipment or system malfunction.</p> <p>Auditable Sections with software and system integration with other systems including ITS and ETCS, debugged, vendor supported and updated to latest release.</p> <p>Auditable Sections with all inspections conducted and documented.</p> <p>Auditable Sections with all preventative maintenance performed and documented in accordance with the referenced standards.</p>	<p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p>

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
							Auditable Sections free from loss of redundancy due to SCADA system malfunction where the controlled function is in support of other redundant systems.	100%	
	20.2.6	Electrical Systems, Grounding & LP	Grounding and lightning protection systems provide intended function and level of protection for equipment, structure and personnel protection.	24 hours	7 days	3 months	<p>Regularly scheduled visual inspection(s) of a frequency to determine adequate function for the particular system, as a minimum annually.</p> <p>Perform preventative maintenance and testing in accordance with NFPA 70B, 780, manufacturer's recommendations and NETA MTS. The fall of potential method shall be used to test the resistance to earth of all grounding electrode systems serving electrical services, lightning protection and alternate energy sources, every 5 years. The continuity of ground connections to remote earth shall be tested during replacement of equipment served or any major change of system configuration.</p>	<p>Auditable Sections with all bonding, grounding and lightning protection connections passing visual inspection and not showing signs of corrosion.</p> <p>Auditable Sections with all fall of potential tests demonstrating proper resistance to earth.</p> <p>Auditable Sections with all continuity tests showing proper resistance.</p> <p>Auditable Sections with inspection &amp; maintenance records showing compliance</p>	<p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p>

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
	20.3.1	Plumbing Systems	All plumbing systems (domestic water, gas, drains, sewerage) operational and functioning properly.	24 hrs	7 days	1 month	An inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, and manufacturer's recommendations.	Auditable Sections with maintenance performed and documented in accordance with the Maintenance Management Plan.  Auditable Sections with all equipment in satisfactory physical condition and systems/equipment operating per design	100%  100%
	20.3.2	HVAC Systems	All heating, ventilating and air conditioning systems (chillers, air handling units, heating systems, etc.) operational and functioning properly.	8 hrs (2 hrs if serving critical space(s) or equipment).	7 days	1 month	An inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, and manufacturer's recommendations.	Auditable Sections with maintenance performed and documented in accordance with the Maintenance Management Plan.  Auditable Sections with all equipment in satisfactory condition and systems/equipment operating per design	100%  100%
	20.3.4	Fire Suppression Systems	All fire suppression systems (sprinkler, standpipe, clean agent, fire extinguishers, etc.) operational and functioning properly.	2 hrs	7 days	1 month	Inspection, maintenance, and rehabilitation plans shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, and applicable NFPA standards.	Auditable Sections with maintenance performed and documented in accordance with the applicable NFPA code.  Auditable Sections for which the physical condition and configuration of fire protection equipment is satisfactory and proper, respectively, based on visual inspection.  Auditable Sections free from alarms, supervisory or trouble	100%  100%  100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
							signals on fire alarm control panels.		
<b>21) SUBSURFACE MANAGED LANE ELEMENTS</b>									
	21.1	Subsurface Structures including but not limited to tunnels and tunnel ancillary facilities and spaces  (General Purpose lane cantilever structure and supports – see Element Category 3)	All subsurface structures shall be free of Defects.	24 hrs	28 days	6 months	An inspection, maintenance, and rehabilitation plan shall be developed, documented as part of the Maintenance Management Plan, and adhered to. The plan shall be based on the FHWA "Highway and Rail Transit Tunnel Inspection Manual, 2005" and the FHWA "Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, 2005".	Auditable Sections free of moderate or severe Defects  Auditable Sections free of any conditions exposing rebar	100%  100%
	21.2	Structural Supports & Connections for all miscellaneous structural attachments or supports. Specific items may include but not limited to include support for signage, ventilation equipment, fire detection and protection items, safety items, and any item attached to a larger structural element.	Structural Supports & Connections for all miscellaneous structural attachments or supports shall be free of defects.	24 hrs	7 days	3 months	An inspection, maintenance, and rehabilitation plan shall be developed, documented as part of the Maintenance Management Plan, and adhered to. The plan shall be based on the FHWA "Highway and Rail Transit Tunnel Inspection Manual, 2005" and the FHWA "Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, 2005".	Auditable Sections with full capacity connections in accordance with the design and manufacturer's requirements  Auditable Sections free of loss of connection material due to impact, corrosion, or wear.  Auditable Sections: Free of loose connections or bolts. Free of deterioration or damage of base structure material Free of movement of supported item. Free of excessive vibration of supported item.	100%  100%  100% 100% 100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
	21.3	Retaining Walls	As a minimum the items listed as defects in the FHWA "Highway and Rail Transit Tunnel Inspection Manual, 2005" Chapter 4, Section A.	2 hrs	7 days	3 months	A subsurface retaining wall inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual and the FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual.	Auditable Sections: Free from moderate or severe conditions of concrete as defined by FHWA With vertical tolerance of wall 1/2" per 10' of wall height With wall panel offset of 3/4" or less With no joint with exposed filter fabric or backfill material With no concrete to concrete contact With no loss of joint seal material With no settlement of structures or backfill material resulting with non compliance of pavement criteria	100% 100% 100% 100% 100% 100%
	21.4	Waterproofing	The Subsurface Managed Lanes Structures shall be free of leaks.	24 hrs	28 days	6 months	An inspection, maintenance, and rehabilitation plan shall be developed, documented as part of the Maintenance Management Plan, and adhered to. The plan shall be based on the FHWA "Highway and Rail Transit Tunnel Inspection Manual, 2005" and the FHWA "Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, 2005".	Auditable Sections: That adhere to maximum allowable water infiltration rate defined in Technical Provision. Free of dripping water on travel lanes In full compliance with additional requirements in the referenced FHWA Inspection Manual Free of water infiltration causing unsafe conditions	100% 100% 100% 100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
	21.5	Finishes	All finishes shall be free of Defects.	24 hrs	28 days	6 months	An inspection, maintenance, and rehabilitation plan shall be developed, documented as part of the Maintenance Management Plan, and adhered to. The plan shall be based on the FHWA "Highway and Rail Transit Tunnel Inspection Manual, 2005" and the FHWA "Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, 2005".	Auditable Sections:  Maintaining level of reflectivity and brightness consistent with lighting level criteria. Free of loose or damaged finish materials With fully functional emergency equipment such as exit signage, lights, hose cabinets, fire alarm boxes and communications equipment. With maintained colors and design characteristics consistent with aesthetic requirements.	100%  100%  100%  100%
	21.6	Drainage	Subsurface drainage and pumping systems fully operational and clear of debris.	2 hrs	7 days	6 months	An inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, and manufacturer's recommendations.	Auditable Sections:  With maintenance performed and documented per the Maintenance Management Plan. With flow rates established per design Free from blockage due to sedimentation or calcification With fully functional pumping components and systems, screeds, and control and monitoring equipment.	100%  100%  100%  100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
	21.7	Fire Protection	Fire protection systems (e.g., fire detection, alarm, notification and suppression systems) fully functional and operational.	2 hrs	7 days	3 months	<p>Inspection, maintenance, and rehabilitation plans shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, and applicable NFPA standards.</p> <p>Life Safety preventative maintenance performed and reported bi-annually.</p>	<p>Auditable Sections:</p> <p>With maintenance performed and documented in accordance with the Maintenance Management Plan and applicable NFPA code.</p> <p>For which the physical condition and configuration of fire protection equipment is satisfactory and proper, respectively, based on visual inspection.</p> <p>Free from alarms, supervisory or trouble signals on fire alarm control panels.</p>	<p>100%</p> <p>100%</p> <p>100%</p>
	21.8.1	Electrical Systems, Normal & Emergency Lighting	Lighting system fixtures, lamps and control functioning to provide the intended illumination level, light output, lighting quality, duration and energy efficiency, for the location.	8 hrs	7 days	6 months	<p>An inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, and manufacturer's recommendations.</p> <p>Daytime and nighttime lighting level readings of all lighting levels, quarterly.</p> <p>Calibration of luminance meter, every 3 years.</p> <p>Walk tests of emergency lighting equipment to demonstrate proper function.</p>	<p>Auditable Sections:</p> <p>For which illumination levels of all lighting systems meet intended levels, quality and duration.</p> <p>With all inspections conducted and documented.</p> <p>With all preventative maintenance performed and documented in accordance with the referenced standards.</p> <p>With original energy efficiency requirements maintained.</p> <p>With luminance meter calibrated.</p>	<p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p>

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
							Life Safety preventative maintenance performed and reported bi-annually.  Preventative maintenance of lighting circuiting and sources per NFPA 70B, 101, 110 & 111.		
	21.8.2	Electrical Systems, Fire Detection & Alarm	Fire detection and alarm systems provide the intended detection and notification functions.	2 hrs	4 days	6 months	An inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, manufacturer's recommendations, NFPA 70B and 72. Preventative maintenance of fire alarm sources and testing per NFPA 70B, 72, 101, 110 & 111. Follow manufacturer's recommendations for maintenance and testing where requirements are more demanding. Continuous monitoring through self-system diagnostics and failure detection.	Auditable Sections:  For which all fire alarm systems perform as designed and provide the intended level of protection. With all detectors operating within manufacturer's tolerance for sensitivity and cleanliness. With all inspections conducted and documented. With all preventative maintenance performed and documented in accordance with the referenced standards.	100%  100%  100%  100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
	21.8.3	Electrical Systems, Communications to include AM/FM Rebroadcast, 2-way Radio, Telephone and CCTV	Communications systems serving their intended functions	4 hrs	4 days	6 months	An inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, and manufacturer's recommendations. Operational tests using 2-way radio equipment and frequencies to match outside agencies served, weekly. Continuous monitoring through self-system diagnostics and failure detection. CCTV system compliance with NFPA 72 inspection and maintenance requirements for fire detection, where used.	Auditable Sections:  With all equipment operating in accordance with manufacturer's recommendations for actual conditions of use. With 2-way radio system performance conforming with up-to-date using agency specifications With CCTV system complying with all requirements required to function as second means of fire detection. With all inspections conducted and documented. With all preventative maintenance performed and documented in accordance with the referenced standards. Free from database and communication system security breaches. With electronic retention of database files, back-ups and other stored media.	100%  100%  100%  100%  100%  100%
	21.8.4	Electrical Systems, Distribution – Normal, Essential & Emergency	Electrical system serving connected loads with intended capacity, voltage regulation, protection, control and monitoring.	2 hrs	3 days	6 months	An inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, and manufacturer's recommendations.	Auditable Sections:  With all equipment operating in accordance with manufacturer's recommendations. Free from loss of electrical source to connected loads due to electrical system component or installation failure. With protection devices	100%  100%  100%

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
							<p>Preventative maintenance and testing of essential &amp; Emergency sources per NFPA 110 and 111.</p> <p>Exercising of back-up generators under load where used as essential &amp; Emergency sources, monthly.</p> <p>Exercising of ATS switches, semi-annually.</p> <p>Load testing of UPS systems where used as essential &amp; Emergency source, monthly.</p> <p>Monitoring and Testing of individual battery cell condition, annually.</p>	<p>calibrated &amp; set properly.</p> <p>With preventative maintenance in accordance with the referenced standards.</p> <p>That, where serving as a redundant source, availability of 100%.</p> <p>For which all electrical outages within Developers control documented as to time, duration, loads affected, cause and corrective measures taken.</p> <p>For which the capacity, duration and availability of non-utility essential or emergency sources meet the design requirements.</p> <p>With adequate on-site storage of fuel supply sufficient to meet the intended standby essential operating time.</p> <p>With continuous monitoring of essential Emergency sources when consisting of a non-utility source.</p>	<p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p>
	21.8.5	Electrical Systems, SCADA	SCADA system provides intended function of control, monitoring, communication and visual display of all connected systems including integration with other systems.	2 hrs	3 days	6 months	<p>An inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, and manufacturer's recommendations. Follow manufacturer's</p> <p>Auditable Sections:</p> <p>With SCADA systems providing the intended level of control and monitoring.</p> <p>For which trouble conditions are corrected and cleared within 72 hours.</p> <p>With all sensors and monitoring devices operating within manufacturer's tolerance for sensitivity.</p> <p>Free from loss of critical or</p>	<p>100%</p> <p>100%</p> <p>100%</p>	

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
							recommendations for maintenance and testing where requirements are more demanding. Continuous monitoring through self-system diagnostics and failure detection.  life safety functions due to equipment or system malfunction. With software and system integration with other systems including ITS and ETCS, debugged, vendor supported and updated to latest release. With inspections and preventative maintenance in accordance with the referenced standards. With availability on-site or within 2 hours of spares for all critical components serving critical or life safety functions. Free from loss of redundancy due to SCADA system malfunction where the controlled function is in support of other redundant systems.	100%  100%  100%  100%  100%	
21.8.6	Electrical Systems, Grounding & LP	Grounding and lightning protection systems provide intended function and level of protection for equipment, structure and personnel protection.	24 hours	7 days	3 months	An inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, manufacturer's recommendations and NFPA 780. The fall of potential method shall be used to test the resistance to earth of all grounding electrode systems	Auditable Sections:  For which all bonding, grounding and lightning protection connections pass visual inspection and do not show signs of corrosion. For which all fall of potential tests demonstrate proper resistance to earth. For which all continuity tests show proper resistance. With inspection & maintenance records showing compliance	100%  100%  100%  100%	

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
							<p>serving electrical services, lightning protection and alternate energy sources, every 5 years.</p> <p>The continuity of ground connections to remote earth shall be tested during replacement of equipment served or any major change of system configuration.</p>		
	21.9	Ventilation System	Ventilation System fully functional and operational.	2 hrs	7 days	1 month	<p>An inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway, Rail Transit Tunnel Maintenance and Rehabilitation Manual, and manufacturer's recommendations.</p> <p>Life Safety preventative maintenance performed and reported bi-annually.</p> <p>Life safety components of the tunnel ventilation system tested annually,</p> <p>Verification of OCC activation and separately, local activation of tunnel ventilation life safety response, annually.</p>	<p>Auditable Sections:</p> <p>With maintenance performed and documented per the Maintenance Management Plan.</p> <p>For which the physical condition and configuration of fire protection equipment is satisfactory and proper, respectively, based on visual inspection.</p> <p>For which Supervisory Control and Data Acquisition system operates and monitors system properly.</p>	<p>100%</p> <p>100%</p> <p>100%</p>

\* Items in these columns shall be reviewed annually by Developer as part of the MMP to comply with Technical Documents and/or Good Industry Practice

Texas Department of Transportation  
IH 635 Managed Lanes Project  
Technical Provisions

**Attachment 19-2A**

Amendment for the Texas Reference Marker System  
Users Manual, TxDOT Maintenance and Operations  
Manual, TxDOT Pavement Design Manual, TxDOT  
Maintenance Management Manual, NCHRP 350, and  
TxDOT Bridge Inspection Manual

**AMENDMENTS FOR THE:**  
***Texas Reference Marker (TRM) System User's Manual, January 2005 General***

**General**

Access to the TPP Database shall be coordinated through TxDOT. All input and supplemental data entry shall be the responsibility of Developer.

**Manual Notices**

Delete

**Chapter 1**

<b>Section</b>	<b>Subheading</b>	<b>Modification</b>
1	Introduction to TRM	Retain
2	Key Points to Know	Delete except for subsection "Official TRM Location Key"
3	Data Maintenance Responsibility	Replace with "Developer shall provide with TPP all information necessary to enter and maintain facility in TRM."
4	Establishing a Route	Replace with "Developer shall coordinate with TPP to establish a reference marker system on the facility."

**Chapter 2**

Retain

**Chapter 3**

Retain

**Chapter 4**

Retain

**Chapter 5**

Retain

**Chapter 6**

Retain

**Chapter 7**

Retain

**Chapter 8**

Retain

**Chapter 9**

Retain

**Chapter 10**

Retain

**Chapter 11**

Retain

**Chapter 12**

Retain

**Chapter 13**

Retain

**Chapter 14**

Retain

**Chapter 15**

Retain

**Appendix A**

Retain

**AMENDMENTS FOR THE  
TxDOT Maintenance and Operations Manual (MOM)**

**Manual Notices**

Delete

**Chapter 1 – Pavement**

Delete

**Chapter 2 – Roadside**

Section	Subheading	Modification
1	Overview	Delete
2	Litter	Replace TxDOT with Developer. Replace Department with Developer
3	Vegetation Management	Replace TxDOT with Developer. Replace Department with Developer
4	Roadside Drainage	Replace TxDOT with Developer.
5	Culverts and Storm Drains	
6	Safety Rest Areas and Picnic Areas	Delete
7	Guardrail, Barriers and Attenuators	
8	Stockpiles on Right of Way	Delete
9	Fire Control and Prevention	Delete

**Chapter 3 – Bridges**

Delete

**Chapter 4 – Traffic Operations**

Section	Subheading	Modification
1	Overview	Delete
2	Signs	
3	Signals and Illumination	Delete
4	Pavement Markings and Delineators	

**Chapter 5 – Emergency Operations**

Delete

**Chapter 6 – Work For or By Others**

Delete

# AMENDMENTS FOR THE *TxDOT Pavement Design Manual*

## Manual Notices

Delete

## Chapter 1 – Introduction

Delete

## Chapter 2 – Flexible Pavement Design

Delete

## Chapter 3 – Rigid Pavement Design

Delete

## Chapter 4 – Load Zoning

Delete

## Chapter 5 – Wet Weather Accident Reduction Program (WWARP)

Section	Subheading	Modification
1	Overview	Delete
2	Wet Weather Accident Analysis (Phase I)	Replace Traffic Operations Division with Developer Delete sentence beginning with “Each year the Traffic Operations Division...” Replace TxDOT with Developer Replace CST/M&P with Developer
3	Aggregate Selection (Phase II)	Delete
4	Skid Testing (Phase III)	Replace CST/M&P with Developer Pavement Management Information System (PMIS) is to be provided by the Developer for organizing the skid data.

## Chapter 6 – Other Pavement-Related Activities

Delete

**AMENDMENTS FOR THE  
TxDOT Maintenance Management Manual (MMM)**

**Manual Notices**

Delete

**Chapter 1 – Definitions and Planning**

Delete

**Chapter 2 – Budgeting**

Delete

**Chapter 3 – Level of Service**

Delete

**Chapter 4 – Contracting and Purchasing**

Delete

**Chapter 5 – Agreements, Permits and Reports**

Section	Subheading	Modification
1	Overview	Delete
2	Municipal Maintenance Agreements	Delete
3	Personal Injury and Property Damage Claims	Delete
4	River Water Use Certification	Delete
5	Wetlands/Streambed Permits	Delete
6	Storm Water Management	Delete
7	Major Accident or Unusual Incident Reporting	Delete
8	Highway Condition Reporting System	Replace TxDOT with Developer Replace Department with Developer
9	Storage Site Agreements	Delete

**Chapter 6 – Management Information Systems**

Section	Subheading	Modification
1	Overview of Maintenance Management Information System	Delete second paragraph under Maintenance Management Information System
2	Maintenance Management Information System	Retain
3	Pavement Management Information System	Retain

**Chapter 7 – Emergency Management**

Delete

**AMENDMENTS FOR THE  
NCHRP Report 350, Recommended Procedures for the Safety Performance  
Evaluation of Highway Features**

**Foreword**

Delete

**Summary**

Delete

**Chapter 1 - Introduction**

Delete

**Chapter 2 – Test Parameters**

Retain

**Chapter 3 – Test Conditions**

Section	Subheading	Modification
All		Retain with the following modifications: Delete Section 3.1 – General Revise footnote “a” in Table 3.1 to read “Test is optional.”

**Chapter 4 – Data Acquisition**

Retain

**Chapter 5 – Evaluation Criteria**

Retain

**Chapter 6 – Test Documentation**

Retain

**Chapter 7 – Implementation and In-Service Evaluation**

Delete

**Appendix A-J**

Delete

# AMENDMENTS FOR THE *TxDOT Bridge Inspection Manual*

## Manual Notices

Delete

### Chapter 1 – Introduction

Section	Subheading	Modification
1	About this Manual	Delete
2	Style of Manual Text	Retain

### Chapter 2 – History of Bridge Inspection

Section	Subheading	Modification
1	Initial Reasons for Bridge Inspection	Delete
2	Primary References	Retain
3	AASHTO Inspection Manuals	Delete
4	Federal and State Inspection Procedures	Retain

### Chapter 3 – Qualifications, Responsibilities and Duties of Bridge Inspection Personnel

Section	Subheading	Modification
1	Requirements	Delete paragraph entitled TxDOT Requirements
2	TxDOT Bridge Inspection Personnel	Delete
3	Bridge Inspection by Consultants	Replace “TxDOT” with “Developer” Delete “on- and off-system” Delete the sentence starting with “Bridge inspection contracts are developed...”
4	Use of Consultant Pool	Retain only the section entitled “Managing Consultant Bridge Inspection”, first paragraph and bullets 1, 2, and 3. Replace in the retained section “Bridge Inspection Branch” with “Developer” Delete “Bridge Division” Delete “district”

### Chapter 4 – Field Inspection Requirements

Replace all reference to “Bridge Division”, “District”, “District Bridge Inspector” with “Developer”

Section	Subheading	Modification
1	Types of Bridge Inspection	Retain
2	Initial Inspections	Applicable only to the new bridges. Existing bridges have prior inspection records available from TxDOT. Delete second main bullet Delete “, particularly an off-system bridge,” Delete final bullet
3	Routine Inspections	In the paragraph “Inspection Equipment” delete the last two sentences of the last paragraph. Delete the paragraph “Interim Inspections.
4	Damage Inspections	Retain
5	In-Depth Inspections	Retain
6	Special Inspections	Retain

### Chapter 5 – Ratings and Load Postings

Section	Subheading	Modification
1	Overview	Retain
2	Condition Ratings	Retain
3	Appraisal Ratings	Retain
4	Load Ratings	Delete
5	Legal Loads and Load Posting	Delete

### Chapter 6 – Routine and Permits

Delete

### Chapter 7 – Bridge Programming

Section	Subheading	Modification
1	Basis for Bridge Rehabilitation	Retain
2	Federal Bridge Program	Delete Section “Funding Classifications” Delete Section “Qualification for Rehabilitation or Replacement” Delete Section “Texas Eligible Bridge Selection System
3	Sufficiency Ratings	Retain
4	Bridge Management System	Delete entire section. Refer to MMIS in TP19

### Chapter 8 – Bridge Records

Section	Subheading	Modification
1	Overview	Replace "TxDOT" with "Developer"
2	Definition of Terms	Delete "Bridge Folder" paragraph and all reference to "Bridge Folder" Replace "off-system" with "bridge" Replace "on-system" with "bridge" Replace "Bridge Inventory File" and all reference to "Bridge Inventory File" with "MMIS" Delete "Control-Section Job (CSJ) Numbers" paragraph and all reference to "Control-Section Job (CSJ) Numbers" or "CSJ" Delete "Elements Data" paragraph and all reference to "Elements Data" Delete all but the first sentence in the paragraph "Engineer" Delete "Forms" paragraph and all reference to "Forms" Delete "...and TxDOT policy." In the "Signing and Sealing" paragraph Delete "Work Authorization" paragraph and all reference to "Work Authorization"
3	Consultant Requirement	Replace "TxDOT" with "Developer" Replace "District Bridge Inspection Coordinator" with "Developer" Delete paragraph "E-Mail and Correspondence"
4	Coding Guidelines	Delete "on- and off-system" Delete paragraph "Summary of Instructions" Delete paragraph "Multiple Pipe Culverts" Replace wording in paragraph "Data Quality" with "Data updates reflecting changes to any bridge structure must be made within 90 days of the inspection. New, rebuilt or rehabilitated structures must be reported within 90 days of completion." Delete paragraph "Elements Data"
5	Forms	Delete
6	Calculations	Delete
7	Data Submittal	Replace "TxDOT" with "Developer" In paragraph "General Data Submittal Requirements" delete the first two paragraphs. Replace "Bridge Folder" with "MMIS" Replace the text of paragraph "Electronic Media" with "All applicable data entered into the MMIS must be available to TxDOT on-line or on a CD with files compatible with Microsoft Office applications." In the paragraph "Presentation of Documents" replace the first two paragraphs with "The Developer must provide the required information in electronic format compatible with Microsoft Office applications to TxDOT" Delete the paragraph "Original and Duplicate Files" Delete the paragraph "Additional Files" Delete the paragraph "Summary Reports" Delete the paragraph "Summary of New Load Posting Materials"
8	The Bridge Folder	Delete

### Appendix A – State and Federal Regulations

Retain. This section provides a quick reference to national and state codes and identifies the responsible party for enforcing the codes.

**Appendix B – Bridge Inspection Data**

Delete and replace with “Bridge inspection data is to be entered into the MMIS. The MMIS must be capable of tracking all of the bridge elements, ratings, deficiencies and repairs identified.”

**Appendix C – Links to Coding Guidelines**

Retain

Texas Department of Transportation  
IH 635 Managed Lanes Project  
Technical Provisions

**Attachment 26-1A**  
Amendments to NFPA 502

**AMENDMENTS TO NFPA 502 (2008 EDITION) FOR  
THE IH 635 MANAGED LANES PROJECT**

**Chapter 1 - Administration**

<b>Section</b>	<b>Subheading</b>	<b>Amendment</b>
1.1.1		This standard provides fire protection and fire life safety requirements for road tunnels in the IH 635 Managed Lanes Project.
1.1.4		Delete
1.3.2		Delete
1.3.3		The portion of this standard that covers emergency procedures applies to new facilities in the IH 635 Managed Lanes Project.
1.4	Retroactivity	Delete
1.4.1		Delete
1.4.2		Delete
1.4.3		Delete

**Chapter 2 - Referenced Publications**

Not amended

**Chapter 3 - Definitions**

<b>Section</b>	<b>Subheading</b>	<b>Amendment</b>
3.2.1	Approved	Delete
3.2.2	Authority Having Jurisdiction (AHJ)	TxDOT or it's designee.
3.2.3	Labeled	Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
3.2.4	Listed	Equipment, materials, or services included in a list published by an organization that is concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.
3.3.2	Alteration	Delete
3.3.6	Bridge	Delete
3.3.10	Communications	Radio, telephone, and messenger services throughout the facility and particularly at the operations control center.
3.3.17	Facility	A road tunnel.
3.3.25.2	Elevated Highway	Delete
3.3.34	Point of Safety	An exit enclosure that leads to a public way or safe location outside the structure, or an at-grade point beyond any enclosing structure, or another area that affords adequate protection for motorists.

**Chapter 4 - General Requirements**

<b>Section</b>	<b>Subheading</b>	<b>Amendment</b>
4.3.2	Limited Access Highways	Delete
4.3.3	Bridges and	Delete

	Elevated Highways	
4.3.4	Depressed Highways	Delete
4.3.6	Roadway Beneath Air-Right Structures	Delete
4.3.7	Ancillary Facilities	All related ancillary facilities that support the operation of road tunnels shall be protected as required by all applicable NFPA standards and applicable building codes except as modified in this standard.
4.4.1		The Developer for the IH 635 Managed Lanes Project shall carry out a complete and coordinated program of fire protection that shall include written preplanned emergency response procedures and standard operating procedures.
4.4.3		Emergency response procedures and the development of an emergency response plan shall comply with the requirements of Chapter 12 and the Book 2A Technical Provision.
4.5	Emergency Communications	Delete "by the authority having jurisdiction".

#### Chapter 5 - Limited Access Highways

Delete		
--------	--	--

#### Chapter 6 - Bridges and Elevated Highways

Delete		
--------	--	--

#### Chapter 7 - Road Tunnels

Section	Subheading	Amendment
7.3.2		Delete "or other curve that is acceptable to the AHJ".
7.4.1.2.3		For the IH 635 Managed Lanes Project, each manual fire alarm box shall be securely mounted, with the operable part of each manual fire alarm box not less than 3½ ft and not more than 4½ ft above floor level. Where located at cross passageways or exits, the operable part of the manual fire alarm box shall be within 5 ft of the exit doorway.
7.4.2	Fire Alarm Control Panel	A listed fire alarm control panel (FACP) shall be installed, inspected, and maintained in accordance with <i>NFPA 72</i> .
7.5.1		Communications systems in tunnels and ancillary structures shall be in accordance with IH 635 Managed Lanes Project, Book 2A Technical Provisions.
7.8.1		Portable fire extinguishers, with a rating of 2-A:20-B:C, shall be located along the roadway in listed wall cabinets at intervals of not more than 300 ft.
7.14.1.1		The means of egress requirements for all road tunnels in the IH 635 Managed Lanes Project shall be in accordance with NFPA 101, Chapter 7, except as modified by this standard, and the Book 2A Technical Provisions.

#### Chapter 8 - Roadways Beneath Air-Right Structures

Delete		
--------	--	--

### Chapter 9 - Standpipe and Water Supply

Section	Subheading	Amendment
9.1.1		Standpipe systems in the IH 635 Managed Lanes Project shall be designed, installed, inspected, and maintained as Class I systems in accordance with NFPA 14, except as modified by this standard.
9.1.2		Standpipe systems in the IH 635 Managed Lane Project shall be inspected and maintained in accordance with NFPA 25.
9.1.3		For the IH 635 Managed Lanes Project, standpipe systems shall be either wet or dry, depending on the climatic conditions, the fill times, and shall be established in coordination with the Participating Agencies and meet the requirements of the Book 2A Technical Provisions, or any combination thereof.
9.2.2		For the IH 635 Managed Lanes Project, dry standpipe systems shall have water supply in accordance with 9.2.3 that is capable of supplying the system demand for a minimum of 1 hour.
9.2.3		(1) Dallas Water Utilities. (2) Automatic or manually controlled fire pumps that are connected to a Dallas Water Utilities water source. (3) Delete
9.3.3		For the IH 635 Managed Lanes Project, fire department connections shall be protected from vehicular damage.
9.3.4		Fire department connections shall be in accordance with IH 635 Managed Lanes Project, the Book 2A Technical Provisions, and shall be coordinated with emergency access and response locations.
9.4.4		For the IH 635 Managed Lanes Project, hose connections shall have 2-1/2 in. external threads in accordance with NFPA 1963, and meet the requirements of the Participating Agency having responsibility for resolving fire-related emergency incidents.
9.6.1		For the IH 635 Managed Lanes Project, identification signage for standpipe systems and components shall be developed with input from the Participating Agency having responsibility for resolving fire-related emergency incidents.

### Chapter 10 - Emergency Ventilation

Section	Subheading	Amendment
10.1.1		Delete "and shall be permitted only where approved by the authority having jurisdiction."
10.6.7		For the IH 635 Managed Lanes Project, where separation is not possible, intake openings shall be protected by other proven means or devices, which have a documented operating history of previous and/or current usage, or devices that are listed, to prevent smoke from re-entering the system.

### Chapter 11 – Electrical Systems

Section	Subheading	Amendment
11.4.2		Emergency circuit wiring shall remain functioning for a period of not less than 1 hour when exposed to fire conditions in accordance with the RWS Fire Test Procedure or shall be protected by other equivalent means.
11.5.1		Delete "and dual level bridges"

## Chapter 12 - Emergency Response

Section	Subheading	Amendment
12.1	General	The Developer for the IH 635 Managed Lanes Project shall anticipate and plan for emergencies. Participating Agencies shall assist with the preparation of the Emergency Response Plan in accordance with the Book 2A Technical Provisions.
12.3	Emergency Response Plan	The emergency response plan shall be prepared, reviewed, updated, and maintained in accordance with IH 635 Managed Lanes Project, Book 2A Technical Provisions, and shall include, as a minimum, the following:
12.4	Participating Agencies	Participating Agencies and organizations that shall be considered to coordinate and assist, depending on the nature of the emergency, shall be in accordance with IH 635 Managed Lanes Project, Book 2A Technical Provisions.
12.5.6		Delete "by the operating agency".
12.6.1		An up-to-date list of all liaison personnel from Participating Agencies shall be maintained by the Developer and shall be part of the emergency procedure plan.
12.8.1		The Developer and Participating Agency personnel shall be trained to function efficiently during an emergency.
12.8.3		To optimize the emergency response plan, comprehensive training programs shall be organized and conducted by the Developer for all personnel and agencies that are expected to participate in emergencies.
12.8.5		Exercises and drills shall be conducted at least twice a year to prepare the Developer and participating personnel for emergencies.
12.8.5.1		The scope and content of the drills for meeting the intent of 12.8.5 shall be in accordance with IH 635 Managed Lanes Project, Book 2A Technical Provisions.

## Chapter 13 - Regulated and Unregulated Cargoes

Section	Subheading	Amendment
13.1.1		The facility Developer shall develop procedures regarding the transportation of regulated and unregulated cargoes in accordance with Section 24.3.5 of Book 2A.

## Annex A - Explanatory Material

Section	Subheading	Amendment
A.3.2.1	Approved	The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, acceptance may be based on compliance with NFPA or other appropriate standards. In the absence of such standards, evidence of proper installation, procedure, or use shall be required. Reference shall also be made to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.
A.3.2.2	Authority Having Jurisdiction (AHJ)	Delete
A.3.2.4	Listed	The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The system employed by the listing organization shall be utilized to identify a listed product.

A.3.3.16	Engineering Analysis	A written report of the analysis that recommends the fire protection method(s) that provides a level of fire safety commensurate with this standard shall be submitted as a part of the Developer's release for construction documentation.
A.3.3.41.1	Air-Right Structure	Delete
A.4.1		Fire protection for road tunnels can be achieved through a combination of facility design, operating equipment, hardware, software, subsystems, and procedures that are integrated to provide requirements for the protection of life and property from the effects of fire.
A.5.2		Delete
A.5.3		Delete
A.6.1		Delete
A.6.3		Delete
A.6.6		Delete
A.7.1		Delete
A.8.1		Delete
A.8.4.1.1		Delete
A.9.1.5		Calculations, including transit and fill times, shall be submitted as a part of the Developer's release for construction documentation.
A.12.4		The Participating Agencies for the IH-635 Managed Lanes Project are as listed in Book 2A, Technical Provisions, Section 24.

#### **Annex B - Tenable Environment**

<b>Section</b>	<b>Subheading</b>	<b>Amendment</b>
B.4	Time Considerations	Delete "with the approval of the authority having jurisdiction".

#### **Annex C - Temperature and Velocity Criteria**

Not amended

#### **Annex D - Critical Velocity Calculations**

Not amended

#### **Annex E – Water-Based Fixed Fire-Fighting Systems in Road Tunnels**

<b>Section</b>	<b>Subheading</b>	<b>Amendment</b>
E.4.1	Application	The installation of water-based fixed fire fighting systems should be considered applicable only where the passage of hazardous cargo is considered. However, even in these cases, the Developer and the local fire department should consider the advantages and disadvantages of such systems as they apply to a particular tunnel installation.
E.4.3.1		An integrated graphic display of the fixed fire-fighting system zones, fire detection system zones, tunnel ventilation system limits, and emergency access and egress locations should be provided at the control room to allow the Developer and responding emergency personnel to make initial response decisions.

#### **Annex F - Emergency Response Plan Outline**

Not amended

#### **Annex G - Alternative Fuels**

Not amended

#### **Annex H – The Memorial Tunnel Fire Ventilation Test Program**

Not amended

**Annex I - Tunnel Ventilation System Concepts**

Not amended

**Annex J - Fire Apparatus**

<b>Section</b>	<b>Subheading</b>	<b>Amendment</b>
J.4	Bridges and Elevated Highways.	Delete

---

**Annex K – Motorist Education**

Not Amended

---

**Annex L - Informational References**

Not amended