Task A.5.b.6
Location Hydraulic Report

TAMPA INTERSTATE STUDY

State Project No. 99007-1402, WPI No. 7140004, FAP No. IR-9999(43)

Interstate 275 (I-275) from Dale Mabry Highway Interchange north to Dr. Martin Luther King Jr. Boulevard (formerly Buffalo Avenue), Interstate 4 (I-4) from I-275 (including interchange) to east of 50th Street (U.S. 41), and the Crosstown Connector from I-4 southward to the existing Tampa South Crosstown Expressway, Hillsborough County.

Prepared For The

FLORIDA DEPARTMENT OF TRANSPORTATION

Prepared By

GREINER, INC.

In Association With

KNIGHT APPRAISAL SERVICES, INC.
PIPER ARCHAEOLOGICAL SERVICES

MAY 1991

EXECUTIVE SUMMARY

This report documents the evaluation of existing and proposed cross-drain structures within the Tampa Interstate Study (TIS) Environmental Impact Statement (EIS) project limits. The project limits include I-275 (from east of Dale Mabry Highway to north of Dr. Martin Luther King, Jr. Boulevard), I-4 (from the I-4/I-275 junction to 50th Street), and the proposed Crosstown Connector (from I-4 near 30th Street extending southward to the Crosstown Expressway near McKay Bay) in the City of Tampa. The methodology used in this evaluation was established in Executive Order 11988 "Floodplain Management" and Federal-Aid Highway Program Manual (FHPM) 6-7-3(2), Paragraph 7.

Currently, I-275 provides a six-lane facility from east of Dale Mabry Highway to Howard Avenue and eight lanes from Howard Avenue to the Ashley Street ramps. From Ashley Street eastward through the Central Business District (CBD), six mainline lanes, with various auxiliary lane segments, are provided to the I-275/I-4 interchange. On I-275 between the I-4 junction and Dr. Martin Luther King, Jr. Boulevard, the facility has eight lanes and six lanes north of Dr. Martin Luther King, Jr. Boulevard. On I-4, six lanes are provided from the I-4/I-275 junction to 21st Street. From 21st Street eastward beyond 50th Street, I-4 is a four-lane facility.

The recommended concept for I-275 consists of a four-roadway system from east of Dale Mabry Highway to north of Dr. Martin Luther King, Jr. Boulevard. High Occupancy Vehicle (HOV)/Transitway lanes will be included within the interstate alignment. Interchange improvements include new interchange ramps at Himes Avenue to and from the east on I-275, split interchange ramps remaining at Howard

and Armenia Avenues, modification of ramps at Scott and Kay Streets to and from the west on I-275 to provide a west side CBD distributor interchange at Ashley/Tampa Streets serving all movements and a new west bank CBD interchange with ramps to and from the west on I-275 at North Boulevard.

I-4 improvements include a four-roadway system throughout the recommended concept segment transitioning to a two-roadway system at 50th Street. HOV lanes will be included within the interstate alignment. A new Ybor City/east side CBD split interchange will be included on I-4 at 14th and 15th Streets with the extension of the ramps at 14th and 15th Streets as parallel frontage roads to 21st and 22nd Streets to replace the existing access from I-4 to these streets, removal of the 19th Street overpass while maintaining the 26th Street overpass. Other interchange improvements will include the reconfiguration of the split interchange at Columbus Avenue and 50th Street, the removal of the interchange ramps at 40th Street and a new directional freeway-to-freeway interchange with the Crosstown Expressway Connector on I-4 at 30th Street.

Within the project limits, the existing roadway traverses the Federal Emergency Management Agency (FEMA) flood zones A, B and C. No longitudinal encroachments are within the project corridor. A bridge on I-275 crosses the Hillsborough River. A Bridge Hydraulic Report should be prepared separately to address this crossing. Due to the effects of the USACOE/SWFWMD Tampa Bypass Canal flood-control project on the Hillsborough River, encroachment up to the natural channel banks will not increase the flood elevation. Although the Hillsborough River serves as a floodway for the City of Tampa, the floodway data or delineations are not presented in the

FEMA Flood Insurance Study. All encroachments to the 100-year floodplain (Zone A) will be mitigated according to local and regional regulations.

The project corridor extends through areas which are characterized as heavily urbanized. The existing stormwater drainage systems within the project corridor outfall to Old Tampa Bay, Hillsborough River, and McKay Bay. Thirty cross-drain structures have been identified within the project corridor. These cross-drain structures include 23 reinforced concrete pipes (RCP), with sizes ranging from 18 inches to 84 inches and concrete box culverts (CBC), with sizes ranging from 3 feet by 3 feet to 10 feet by 6 feet. Four existing cross-drain structures were analyzed within the project corridor. Three of the four structures will be lengthened without increasing the headloss significantly. These three structures, along with the bridge crossing of the Hillsborough River, are considered Category 3 structures in accordance with the requirements set forth in FHPM 6-7-3(2), Paragraph 7. One of the four structures, rated as Category 5, will require upgrading to minimize adverse upstream flood impacts.

Modification and replacement of existing structures are needed due to the proposed improvements. The proposed roadway project should not significantly contribute to an increase in flood elevations and will not cause incompatible floodplain development. The proposed project should improve the use of the facility for emergency services and evacuation purposes.

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INTRODUCTION

Purpose

The majority of the Tampa interstate system was designed and constructed in the late 1950's and early 1960's. Realizing the need to upgrade the antiquated interstate system, the Florida Department of Transportation (FDOT) began a study in 1983 to evaluate reconstruction and High Occupancy Vehicle (HOV) improvements on the urban interstate system in Hillsborough County. The study established year 2010 traffic for the interstate system design and described some potential short-term safety and geometric solutions for the existing interstate. Additionally, the study identified long-term, HOV-related improvements to accommodate year 2010 traffic volumes.

A significant conclusion from the completed study was that efforts must be expanded to consider all transportation needs within the corridor, including any concurrent highway, rail, or transit improvements to the area which may impact the corridor, and to recommend improvements to the interstate system to accommodate those needs.

Utilizing the 1983 justification as a documented base, the Tampa Interstate Study (TIS) began in late 1987. Generally, the purpose of TIS was to produce a Master Plan, conceptual design, and an environmental impact data base for improvements to I-4, I-75, and I-275. Those recommended improvements are intended to serve traffic and transportation needs through the year 2010. Specifically, the objectives of the TIS are to prepare a series of reports documenting the requirements for conceptual design,

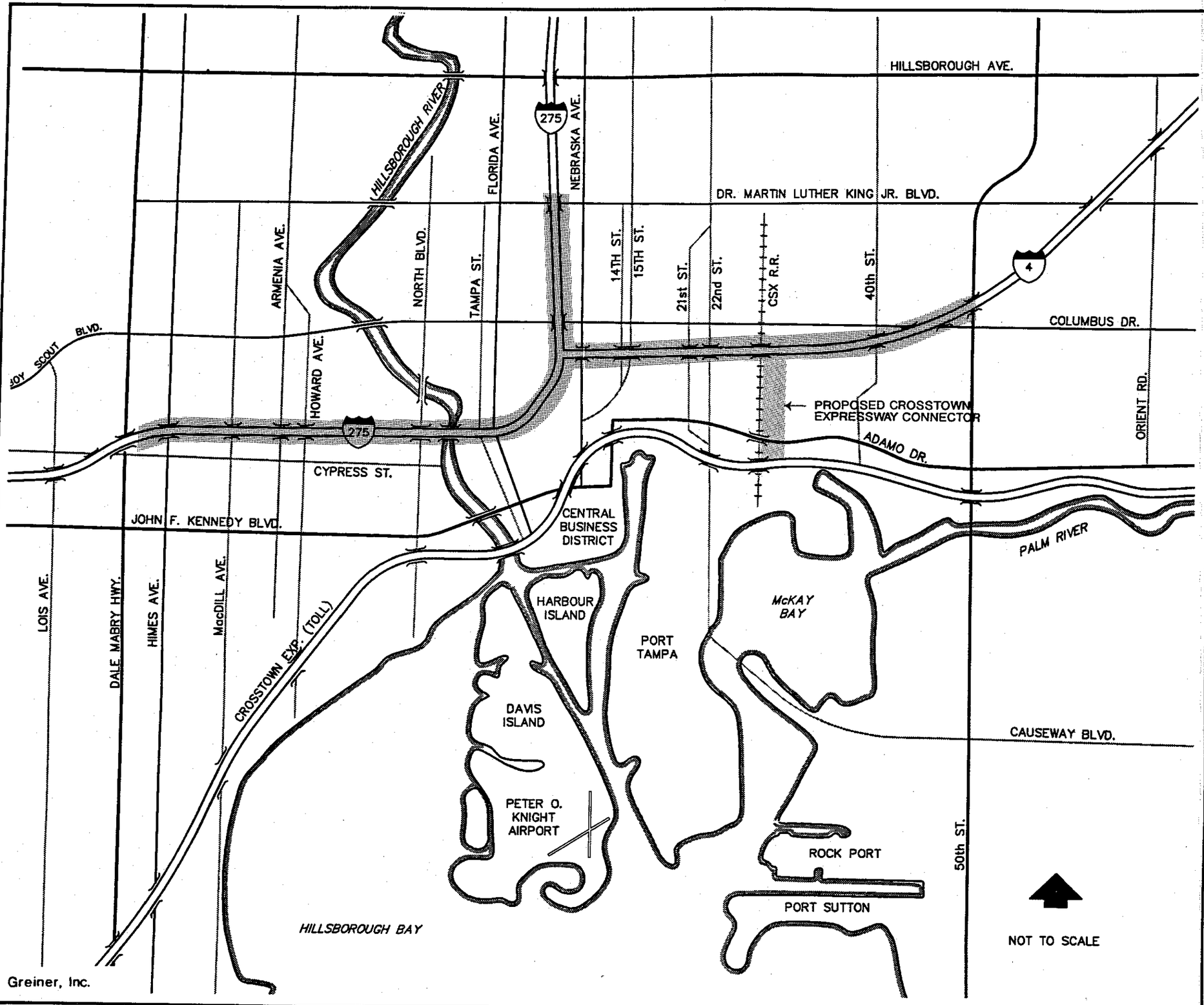
including existing and predicted conditions, typical sections, right-of-way requirements, environmental constraints, and costs of the recommended alternatives.

Following acceptance of the Master Plan, provisions were set forth by the FDOT to implement Phase II of the TIS. Phase II of TIS is intended to satisfy those requirements necessary to fully complete the environmental documentation for the recommended Master Plan. Completion of Phase II activities will enable the FDOT to proceed with final design and construction of the Tampa interstate system.

This Location Hydraulic Report (LHR) was completed in accordance with the requirements set forth in Executive Order 11988 "Floodplain Management" and FHPM 6-7-3(2), Paragraph 7. It provides supporting data, calculations and discussions of potential floodplain impacts due to the TIS proposed improvements along I-275 (from east of Dale Mabry Highway to north of Dr. Martin Luther King, Jr. Boulevard), I-4 (from the I-4/I-275 junction to 50th Street), and the Crosstown Connector (from I-4 near 30th Street southward to the Crosstown Expressway) in the City of Tampa, Florida.

Project Description

The project corridor extends through areas which are characterized as heavily urbanized. The project limits are I-275 from east of Dale Mabry Highway to north of Dr. Martin Luther King, Jr. Boulevard, I-4 from the I-4/I-275 junction east to 50th Street, and the Crosstown Connector in the vicinity of 30th Street on I-4 southward to the Crosstown Expressway. The project limits are shown on Exhibit 1.



LEGEND

Study Limits

FLORIDA DEPARTMENT OF TRANSPORTATION

LOCATION HYDRAULIC REPORT

TAMPA INTERSTATE STUDY
PHASE II

Hillsborough County, Florida

LOCATION MAP

EXHIBIT 1

Currently, I-275 provides a six-lane facility from east of Dale Mabry Highway to Howard Avenue and eight lanes from Howard Avenue to the Ashley Street ramps. From Ashley Street eastward through the Central Business District (CBD), six mainline lanes, with various auxiliary lane segments, are provided to the I-275/I-4 interchange. On I-275 between the I-4 junction and Dr. Martin Luther King, Jr. Boulevard, the facility has eight lanes and six lanes north of Dr. Martin Luther King, Jr. Boulevard. On I-4, six lanes are provided from the I-4/I-275 junction to 21st Street. From 21st Street eastward beyond 50th Street, I-4 is a four-lane facility.

The recommended Master Plan concept on I-275 consists of a four-roadway system from east of Dale Mabry Highway to north of Dr. Martin Luther King, Jr. Boulevard. HOV/Transitway lanes will be included within the interstate alignment. Interchange improvements include new interchange ramps at Himes Avenue to and from the east on I-275, split interchange ramps remaining at Howard and Armenia Avenues, modification of ramps at Scott and Kay Streets to and from the west on I-275 to provide a west side CBD distributor interchange at Ashley/Tampa Streets serving all movements and a new west bank CBD interchange with ramps to and from the west on I-275 at North Boulevard.

I-4 improvements include a four-roadway system throughout the recommended concept segment transitioning to a two-roadway system at 50th Street. HOV lanes will be included within the interstate alignment. A new Ybor City/east side CBD split interchange will be included on I-4 at the 14th and 15th Streets with the extension of 14th and 15th Street ramps as parallel frontage roads to 21st and 22nd Streets to replace the existing access from I-4 to these streets, removal of the 19th Street overpass and maintain the 26th Street overpass. Other interchange improvements will

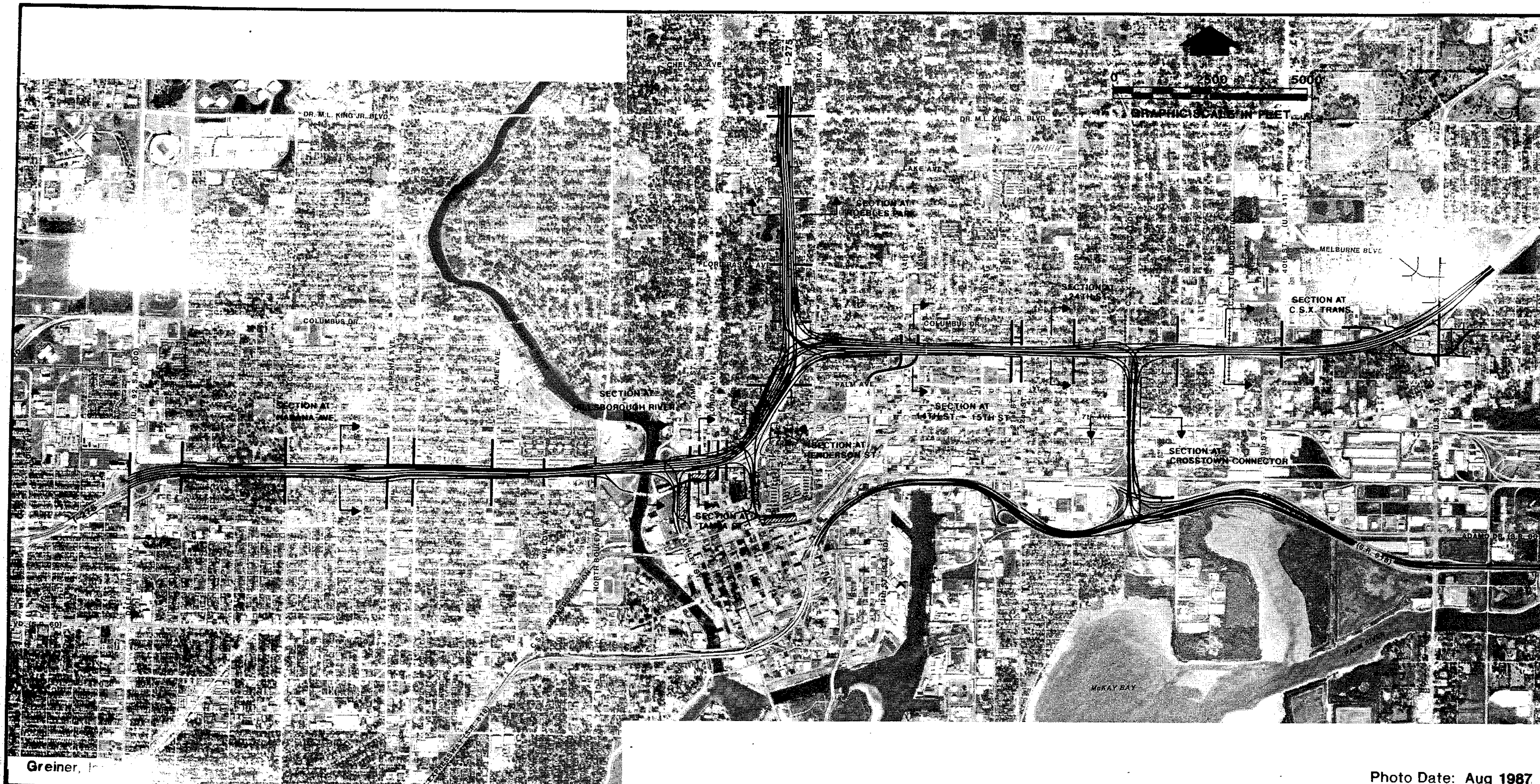
include the reconfiguration of the split interchange at Columbus Avenue and 50th Street, the removal of the interchange ramps at 40th Street and a new directional freeway-to-freeway interchange with the Crosstown Expressway Connector on I-4 at 30th Street. Exhibits 2-1 through 2-10 show the typical cross-section locations and cross-sections of the proposed improvements on I-275, I-4, and the Crosstown Connector within the project corridor.

The existing roadway within the project corridor serves the community as an evacuation route. The roadway within the project corridor is an elevated highway; therefore, the roadway overtopping and the traffic interruption due to flooding will be minimized.

The sources of information used in the preparation of this LHR include the following:

* USGS Quadrangle Maps
* Southwest Florida Water Management District's (SWFWMD) Contoured Aerials
* City of Tampa Drainage Atlas
* FEMA Flood Insurance Rate Maps and Flood Insurance Studies for the City of Tampa, Florida.
* USGS Soil Conservation Service, Soil Survey of Hillsborough County.
* Ybor City Stormwater Management Study - Phases 1 and 2, City of Tampa (1985).
* 29th Street Outfall Drainage System - Preliminary Report Phase II, City of Tampa (1973).
* FDOT plans for existing roadway within the study area.

Existing structures data were obtained from the City of Tampa Drainage Atlas (Ref. 1) and FDOT as-built plans (Ref. 6) of the project corridor, as well as other sources.



Greiner, Inc.

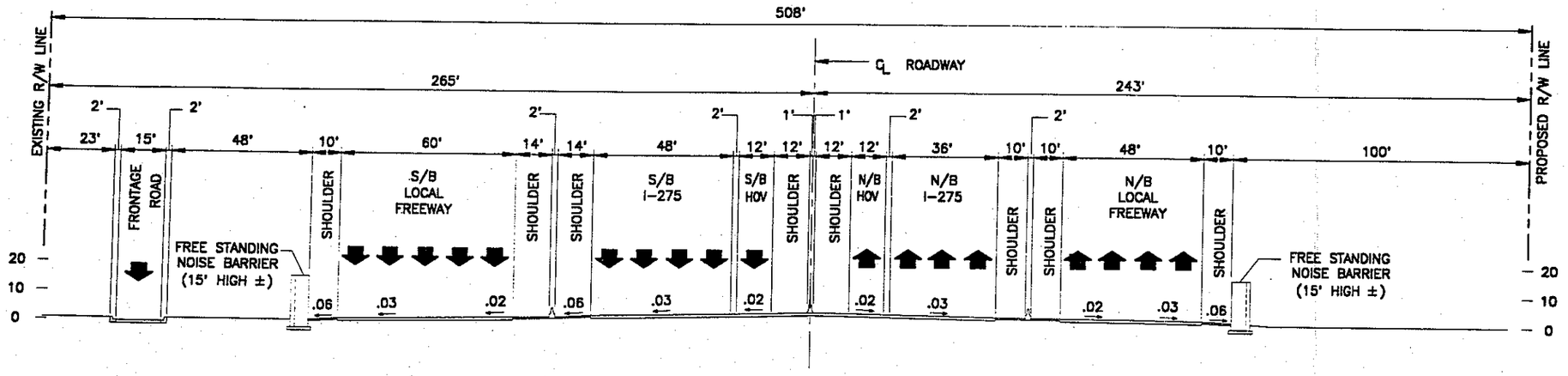
Photo Date: Aug 1987

FLORIDA DEPARTMENT OF TRANSPORTATION
LOCATION HYDRAULIC REPORT

TAMPA INTERSTATE STUDY
PHASE II
Hillsborough County, Florida

TYPICAL SECTION LOCATION MAP

EXHIBIT 2-1



STATION 300+00

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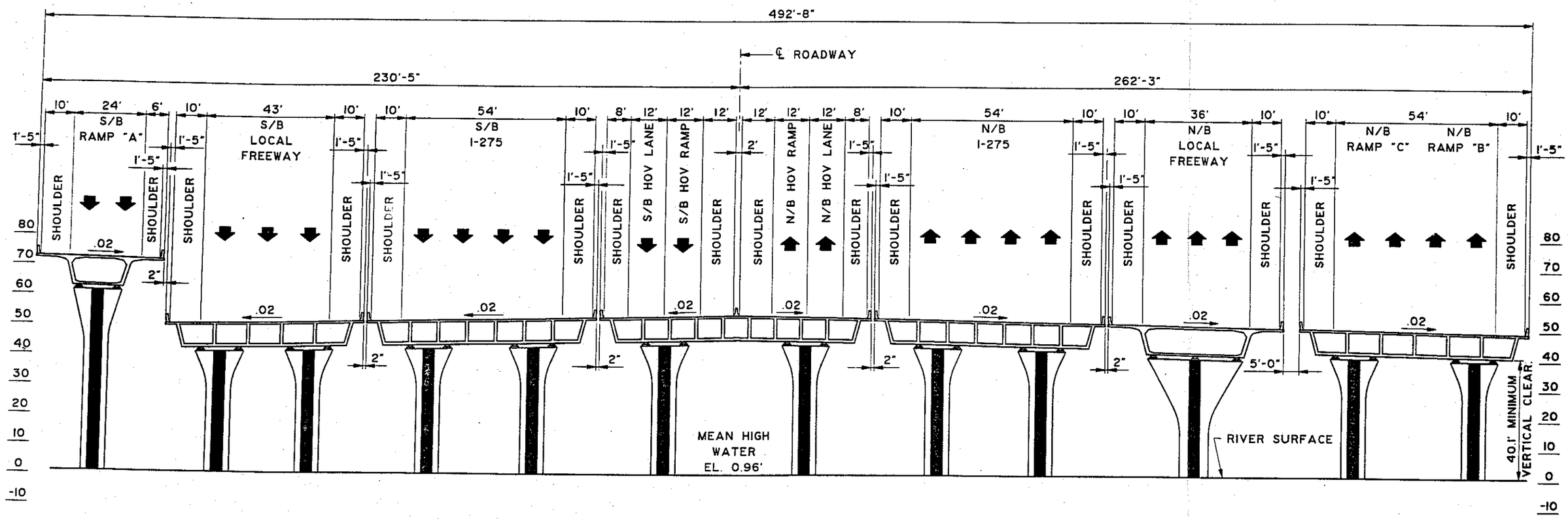
LOCATION HYDRAULIC REPORT

TAMPA INTERSTATE STUDY
PHASE II

Hillsborough County, Florida

TYPICAL SECTION
I-275 AT HABANA AVENUE

EXHIBIT 2- 2



STATION 421+00

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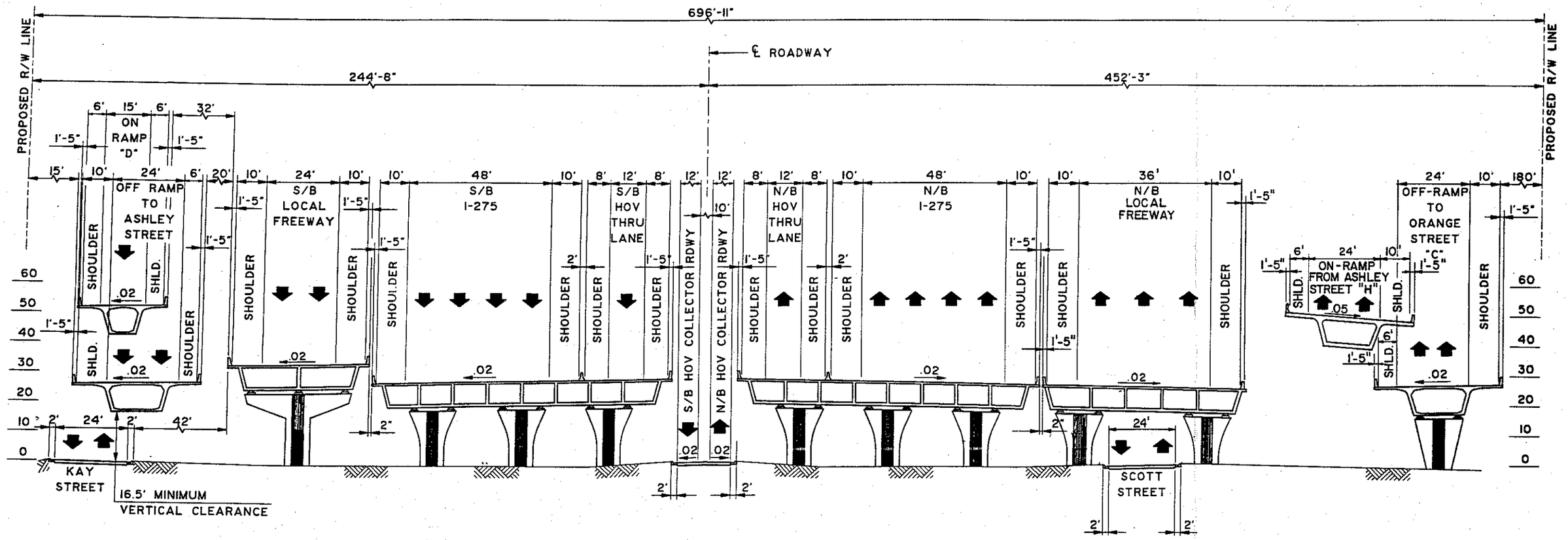
LOCATION HYDRAULIC REPORT

TAMPA INTERSTATE STUDY
PHASE II

Hillsborough County, Florida

TYPICAL SECTION
I-275 AT HILLSBOROUGH RIVER

EXHIBIT 2-3



STATION 432 + 00

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LOCATION HYDRAULIC REPORT

TAMPA INTERSTATE STUDY
PHASE II

Hillsborough County, Florida

TYPICAL SECTION
I-275 AT TAMPA STREET

EXHIBIT 2- 4

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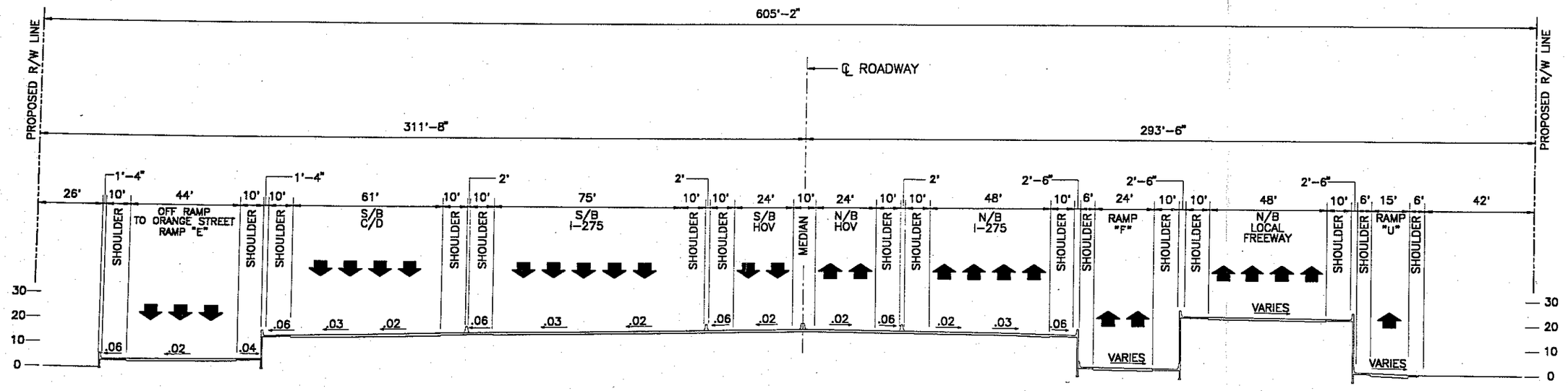

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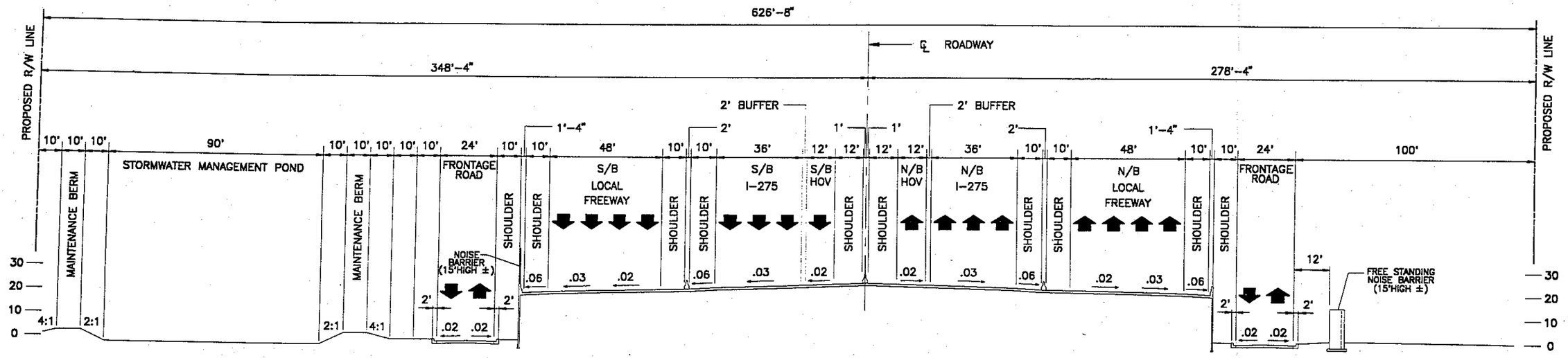
LOCATION HYDRAULIC REPORT

TAMPA INTERSTATE STUDY
PHASE II

Hillsborough County, Florida

TYPICAL SECTION
I-275 AT HENDERSON STREET

EXHIBIT 2- 5



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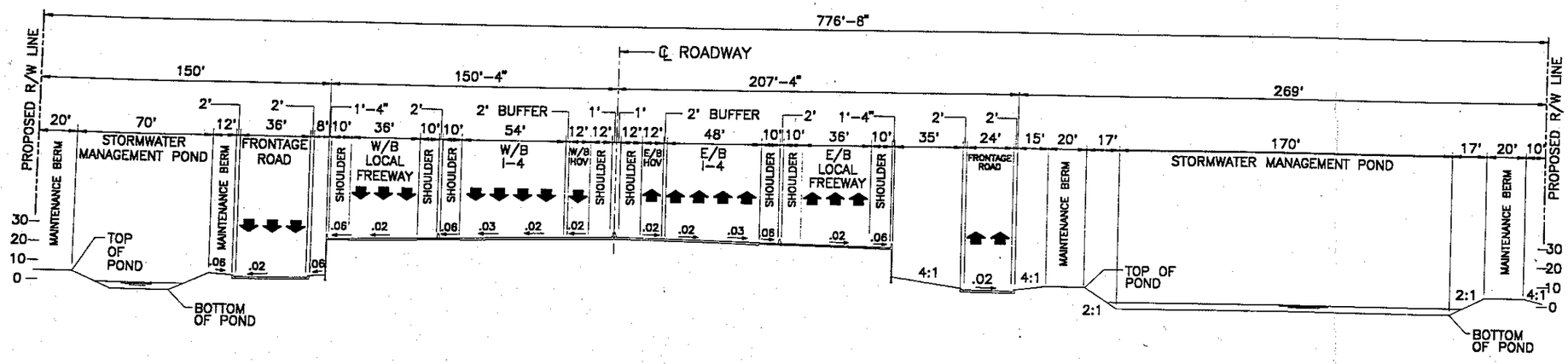
LOCATION HYDRAULIC REPORT

TAMPA INTERSTATE STUDY
PHASE II

Hillsborough County, Florida

TYPICAL SECTION
I-275 AT ROBLES PARK

EXHIBIT 2- 6



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LOCATION HYDRAULIC REPORT

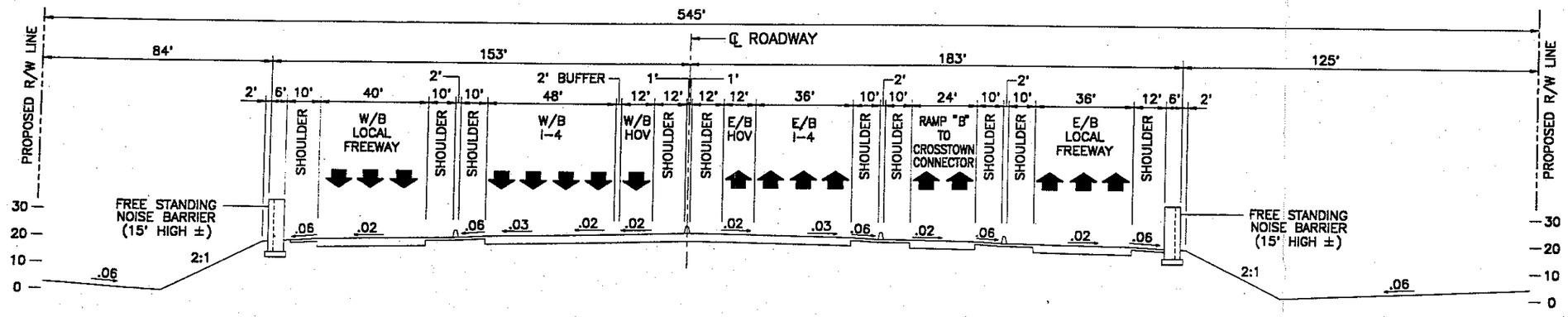
TAMPA INTERSTATE STUDY

PHASE II

Hillsborough County, Florida

TYPICAL SECTION
I-4 AT 14TH AND 15TH STREETS

EXHIBIT 2- 7



STATION 508+00

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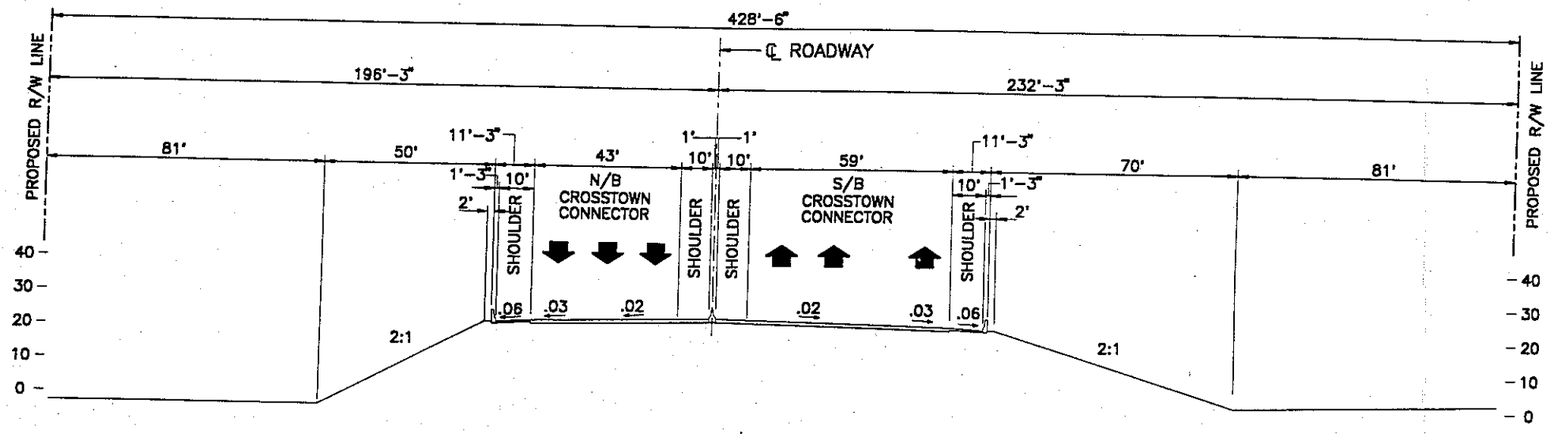
TAMPA INTERSTATE STUDY
PHASE II
Hillsborough County, Florida

TYPICAL SECTION
I-4 AT 24TH STREET

EXHIBIT 2- 8



STATION 348+00

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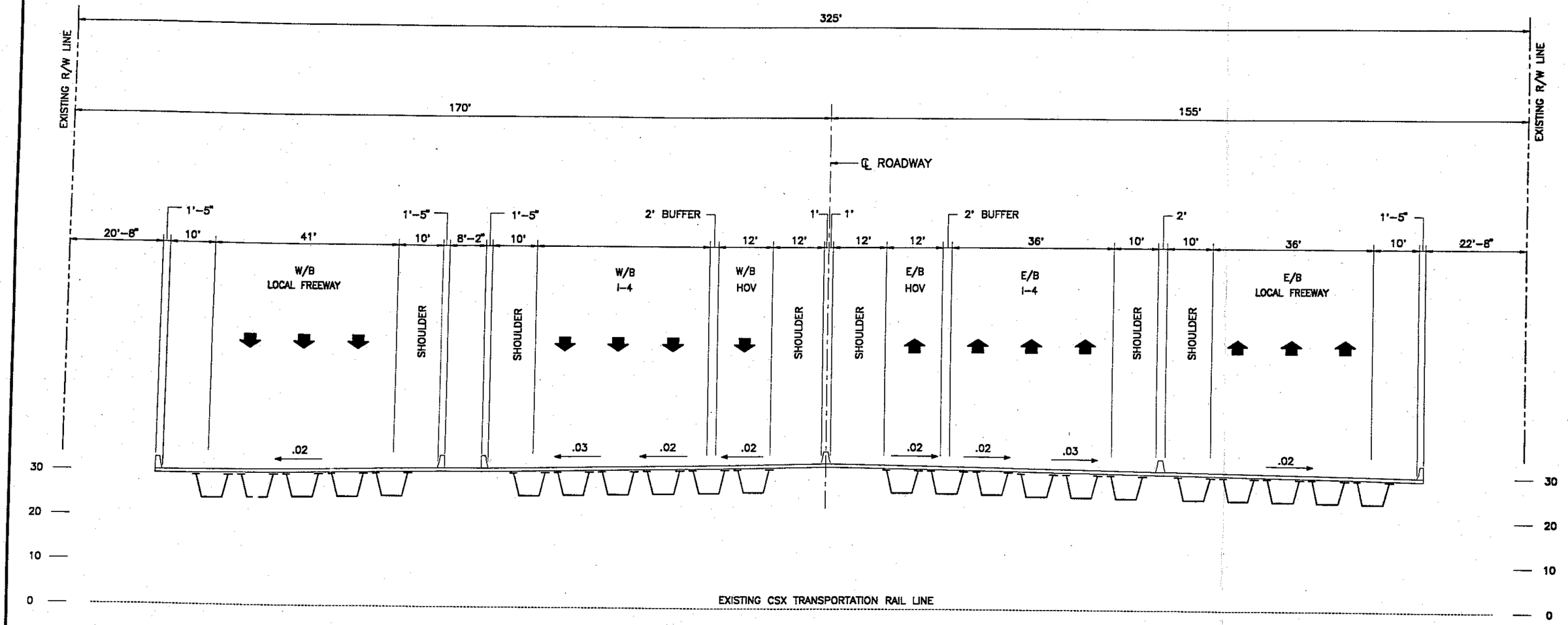
LOCATION HYDRAULIC REPORT

TAMPA INTERSTATE STUDY
PHASE II

Hillsborough County, Florida

TYPICAL SECTION
CROSSTOWN EXPRESSWAY CONNECTOR

EXHIBIT 2- 9



STATION 555+00

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LOCATION HYDRAULIC REPORT

TAMPA INTERSTATE STUDY
PHASE II

Hillsborough County, Florida

TYPICAL SECTION
I-4 AT C.S.X. TRANSPORTATION CORRIDOR

EXHIBIT 2-10

This report contains general information and is intended for planning purposes only. Specific, detailed studies will be required for each cross-drain structure before construction of any improvements.

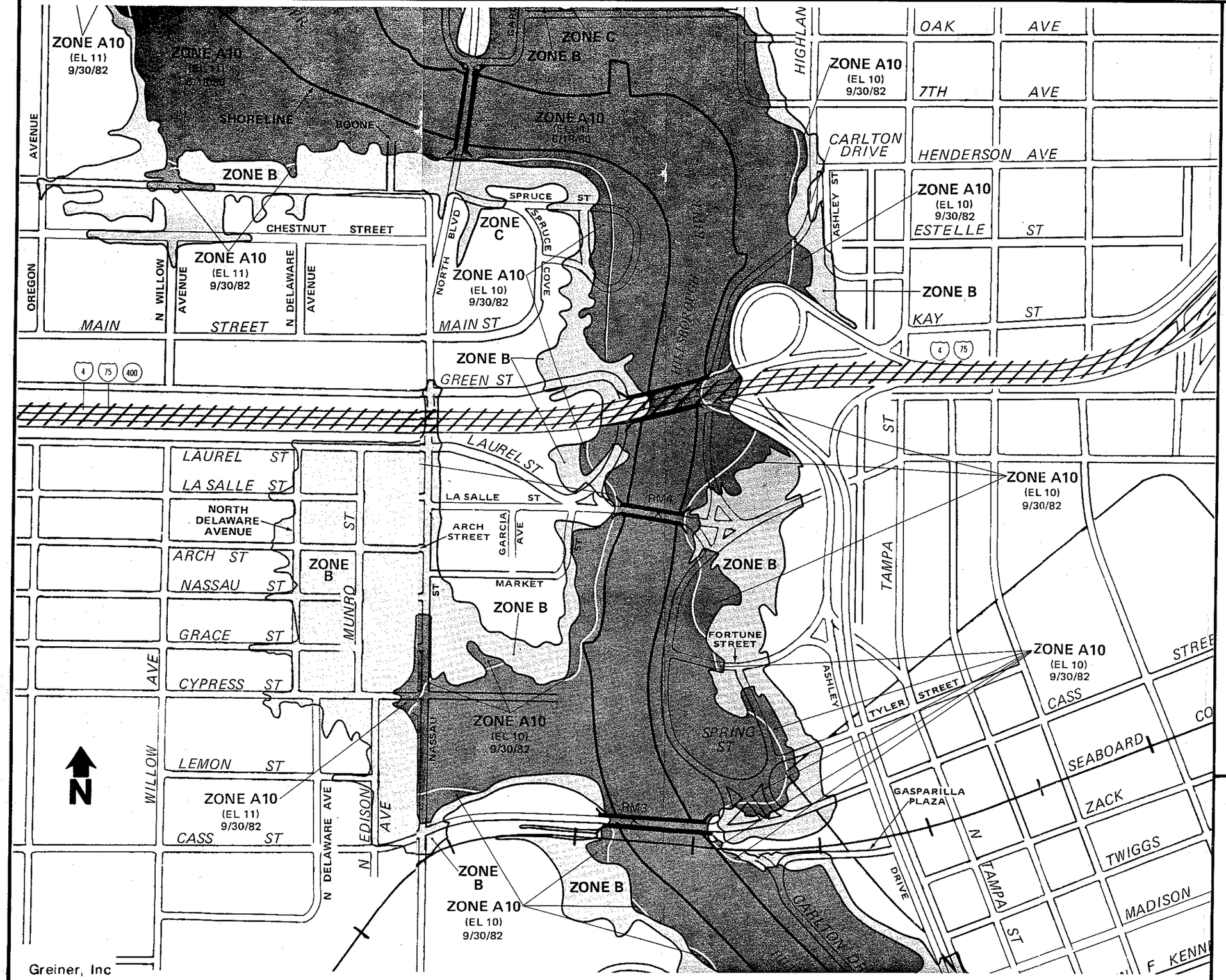
Flood Zone Designations

A floodplain map, prepared for the project corridor from the FEMA Flood Insurance Rate Maps (FIRM, Ref. 2) and Flood Insurance Studies (FIS, Ref. 3), is illustrated in Exhibits 3-1, 3-2, and 3-3. This information was taken from the City of Tampa FIRM Community Panel Numbers 120114 0022C, 120114 0023C, 120114 0024C, 120114 0025C, 120114 0026C, and 120114 0015C, dated September 30, 1982. Exhibits 3-1, 3-2, and 3-3 show the three locations with floodplain (Zones A and B) encroachments within the project corridor. The remaining areas within the project corridor are located in the area of minimal flooding (Zone C). Explanations of the flood zone designations are listed in Table 1.

TABLE 1

FEMA FLOOD ZONE DESIGNATIONS

Zone	Explanation
A	Area of 100-year flood; base flood elevations and flood hazard factors not determined.
A1-A30	Area of 100-year flood; base flood elevations and flood hazard factors determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood.
C	Area of minimal flooding.



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LEGEND

EXPLANATION OF ZONE DESIGNATIONS

Zone	
A	Area of 100-year flood; base flood elevations and flood hazard factors not determined.
A1-A30	Area of 100-year flood; base flood elevations and flood hazard factors determined
B	100-500 year floodplain
C	Area of minimal flooding (No Shading)
///	Project Corridor

FLORIDA DEPARTMENT OF TRANSPORTATION

LOCATION HYDRAULIC REPORT

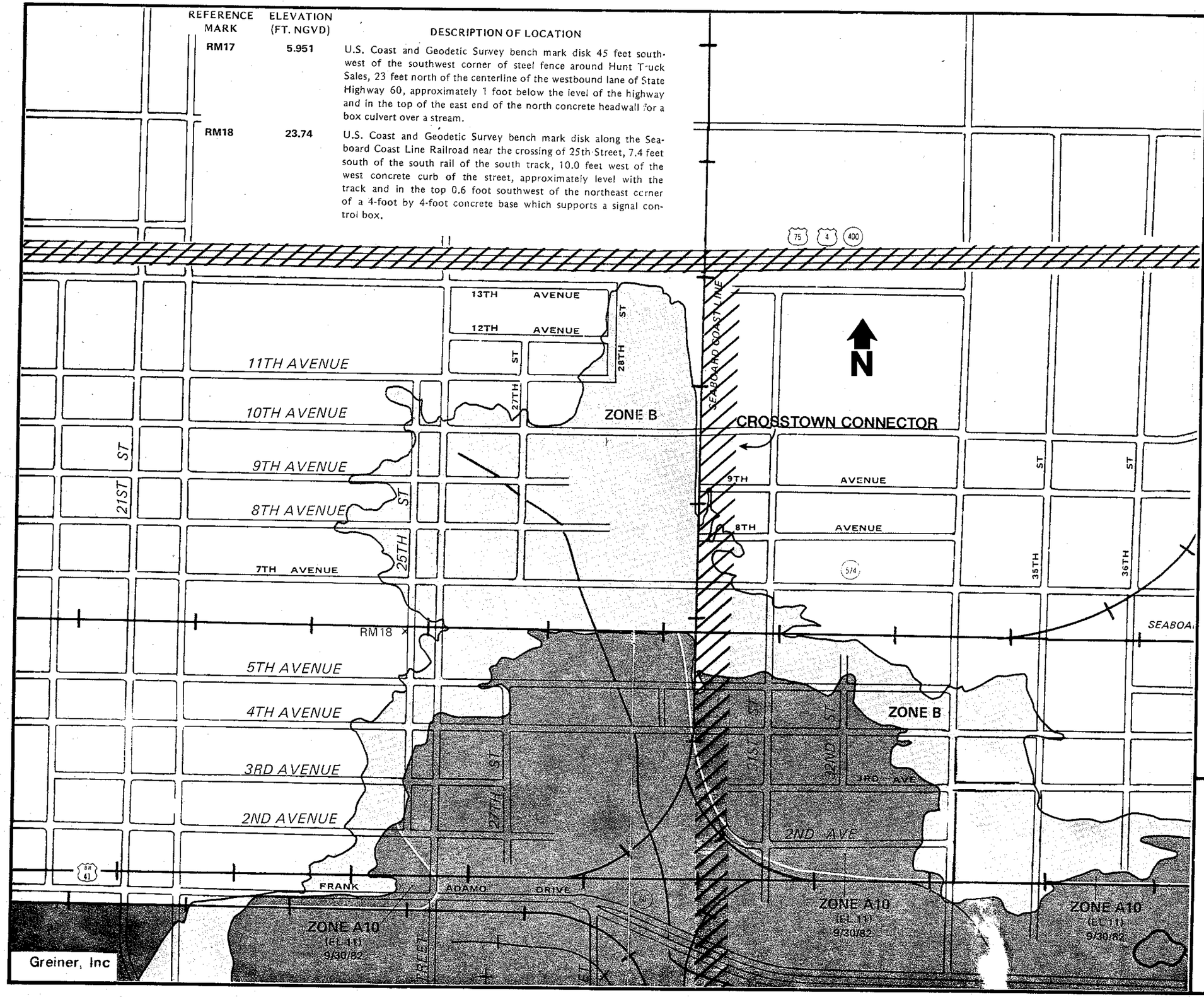
TAMPA INTERSTATE STUDY
PHASE II

Hillsborough County, Florida

FLOODPLAINS

EXHIBIT 3-1

REFERENCE MARK	ELEVATION (FT. NGVD)	DESCRIPTION OF LOCATION
RM17	5.951	U.S. Coast and Geodetic Survey bench mark disk 45 feet southwest of the southwest corner of steel fence around Hunt Truck Sales, 23 feet north of the centerline of the westbound lane of State Highway 60, approximately 1 foot below the level of the highway and in the top of the east end of the north concrete headwall for a box culvert over a stream.
RM18	23.74	U.S. Coast and Geodetic Survey bench mark disk along the Seaboard Coast Line Railroad near the crossing of 25th Street, 7.4 feet south of the south rail of the south track, 10.0 feet west of the west concrete curb of the street, approximately level with the track and in the top 0.6 foot southwest of the northeast corner of a 4-foot by 4-foot concrete base which supports a signal control box.



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LEGEND

EXPLANATION OF ZONE DESIGNATIONS

Zone	
A	Area of 100-year flood; base flood elevations and flood hazard factors not determined.
A1-A30	Area of 100-year flood; base flood elevations and flood hazard factors determined.
B	100-500 year floodplain
C	Area of minimal flooding (No Shading)
////	Project Corridor

FLORIDA DEPARTMENT OF TRANSPORTATION

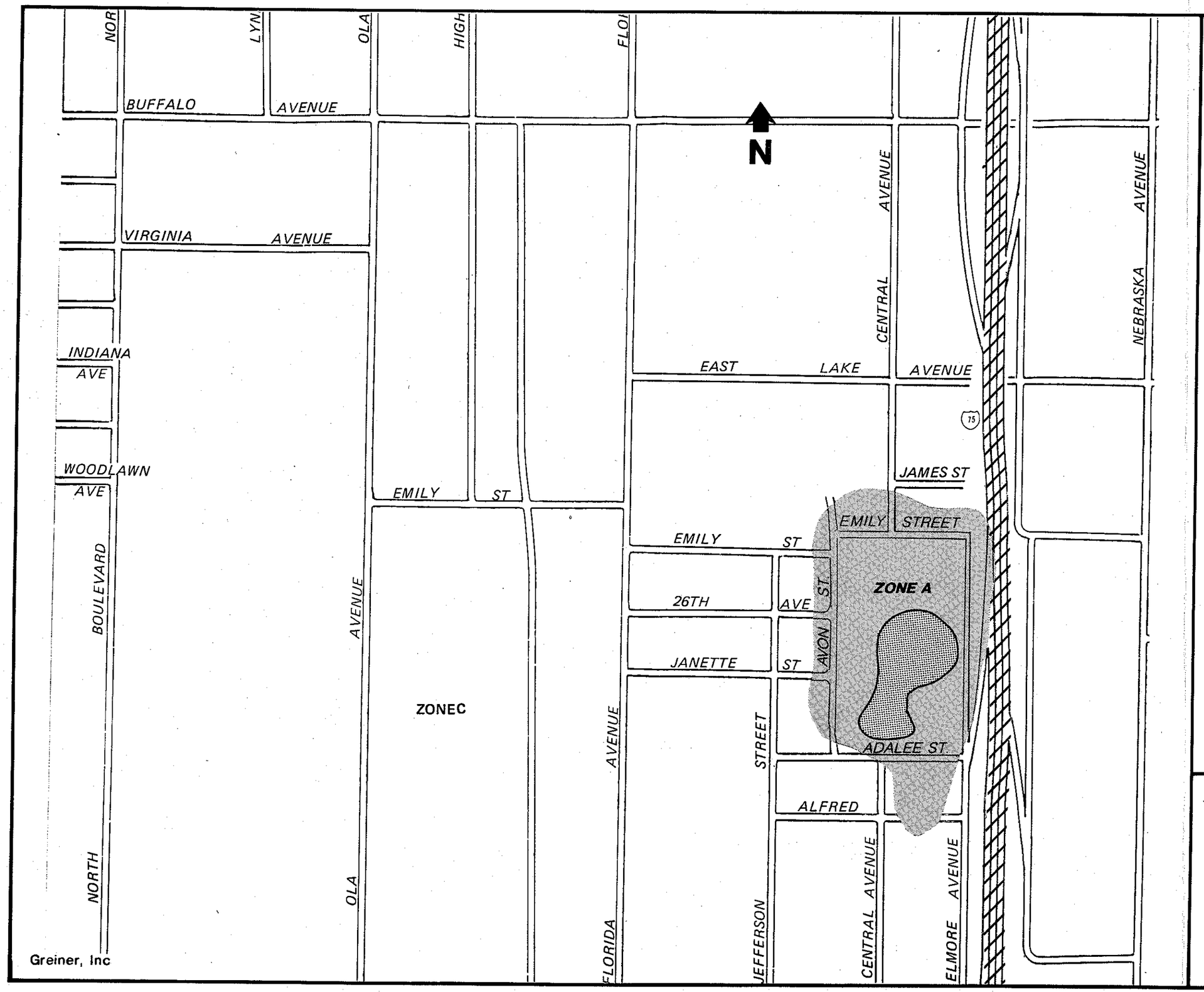
LOCATION HYDRAULIC REPORT

TAMPA INTERSTATE STUDY
PHASE II

Hillsborough County, Florida

FLOODPLAINS

EXHIBIT 3-2



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LEGEND

EXPLANATION OF ZONE DESIGNATIONS

Zone

A	Area of 100-year flood; base flood elevations and flood hazard factors not determined.
C	Area of minimal flooding (No Shading)
//	Project Corridor

FLORIDA DEPARTMENT OF TRANSPORTATION

LOCATION HYDRAULIC REPORT

TAMPA INTERSTATE STUDY
PHASE II

Hillsborough County, Florida

FLOODPLAINS

EXHIBIT 3-3

The base floodplain (Zone A10) within this area results from a storm surge associated with a tropical storm or hurricane. The project corridor has three transverse floodplain encroachments. The first area of the base floodplain encroachment is located at the I-275 crossing of the Hillsborough River between North Boulevard and Tampa Street as shown in Exhibit 3-1. The second area of the base floodplain encroachment is located at the proposed Crosstown Connector near 30th Street from 6th Avenue to the Crosstown Expressway (near McKay Bay) as shown in Exhibit 3-2. Finally, a segment of I-275 from Alfred Street to Emily Street is adjacent to the area of the 100-year floodplain (Zone A) in the Robles Park Pond as shown in Exhibit 3-3. Due to the degree of existing development within the project area, the proposed roadway improvements should not cause an incompatible floodplain development.

The Hillsborough River serves as a floodway for the City of Tampa as defined in the National Flood Insurance Program, City of Tampa Flood Insurance Study (Ref. 3). The Lower Hillsborough River is regulated by the Tampa Bypass Canal flood-control project which was constructed by the U.S. Army Corps of Engineers and is owned and operated by the Southwest Florida Water Management District (SWFWMD) (Ref. 14). The Tampa Bypass Canal (TBC) facilities provide flood protection to the urban development area along the Lower Hillsborough River. The Hillsborough River has a total drainage area of 690 square miles. However, flood waters from the 644 square miles of the Uupper Hillsborough River Basin will be diverted to the TBC during major storm events. Due to the effects of the flood-control project, encroachment up to the natural channel banks in the Lower Hillsborough River will not increase the flood elevation. Therefore, the natural channel of the Hillsborough River serves as a floodway in Tampa, with flood control provided by the TBC. No floodway data or

delineations were presented in the City of Tampa FEMA Flood Study due to the control of TBC. The I-275 bridge crossing of the Hillsborough River should be analyzed in a separate Bridge Hydraulic Report.

Existing Drainage Problems

The maintenance and drainage staff of the Florida Department of Transportation (FDOT), Hillsborough County, and the City of Tampa were contacted regarding existing drainage problems within the project corridor. The following areas were reported as having drainage problems:

Location and Problems	Sources
I-275 curb inlet - westbound on north side just east of Morgan Street, curb inlet cannot handle water, slope washes out and Morgan Street floods.	FDOT
I-4, I-275 intersection, barrier walls - Inlets continually fill up with trash, and during heavy rains lanes of I-275 flood.	FDOT
I-4 "off ramp" westbound at 40th Street - Ditches and ramp flood during heavy rains. Apparently no outlet for water to drain through private property.	FDOT
I-4, 10th Street - north side of I-4, inadequate storm sewer drainage system.	City of Tampa
I-4, 44th Street - north side of I-4, inadequate storm sewer drainage system.	City of Tampa
I-275, Robles Park Pond - west side of I-275, inadequate capacity of pump station and drainage system to Hillsborough River.	City of Tampa

In addition, historical flooding has occurred in the 13th Street and 28th Street areas north of I-4, as referenced in the City of Tampa, Ybor City and 29th Street Outfall Drainage Studies (Ref. 7 and 8). The primary cause of flooding in these areas is the overtaxing of the existing storm sewer drainage system.

DESCRIPTION OF DRAINAGE STRUCTURES

The project corridor crosses eight small sub-basins which include the Cypress Memorial Basin, west Hillsborough River Basin, east Hillsborough River Basin, Nuccio Parkway Basin, Ybor City Basin, 29th Street Basin, McKay Bay Outfall Basin, and Robles Park Pond Basin. Generally, areas near the Hillsborough River (west and east Hillsborough River Basins, Robles Park Pond Basin) drain toward the Hillsborough River. The basins which cross I-4 (Nuccio Parkway, Ybor City, 29th Street, and McKay Bay Outfall) drain southward and outfall to McKay Bay. Small portions of the Cypress Memorial Basin within the project corridor drain westward to the Lemon Street Canal and outfall to Old Tampa Bay.

Drainage structures within the study area have been identified utilizing information from the City of Tampa Drainage Atlas, Ybor City Stormwater Management Study, 29th Street Outfall Drainage System Study, site inspections and FDOT as-built plans (Ref. 6). The drainage structures along I-275 and I-4 within the project corridor are listed in Table 2 and shown in Exhibit 4. A total of 30 existing cross-drain structures and one bridge crossing of the Hillsborough River is located within the project limits. The information listed in Table 2 contains cross-drain structure location, type, size, invert elevations, length, drainage basin, and rating category. These cross-drain

TABLE 2

DRAINAGE STRUCTURES

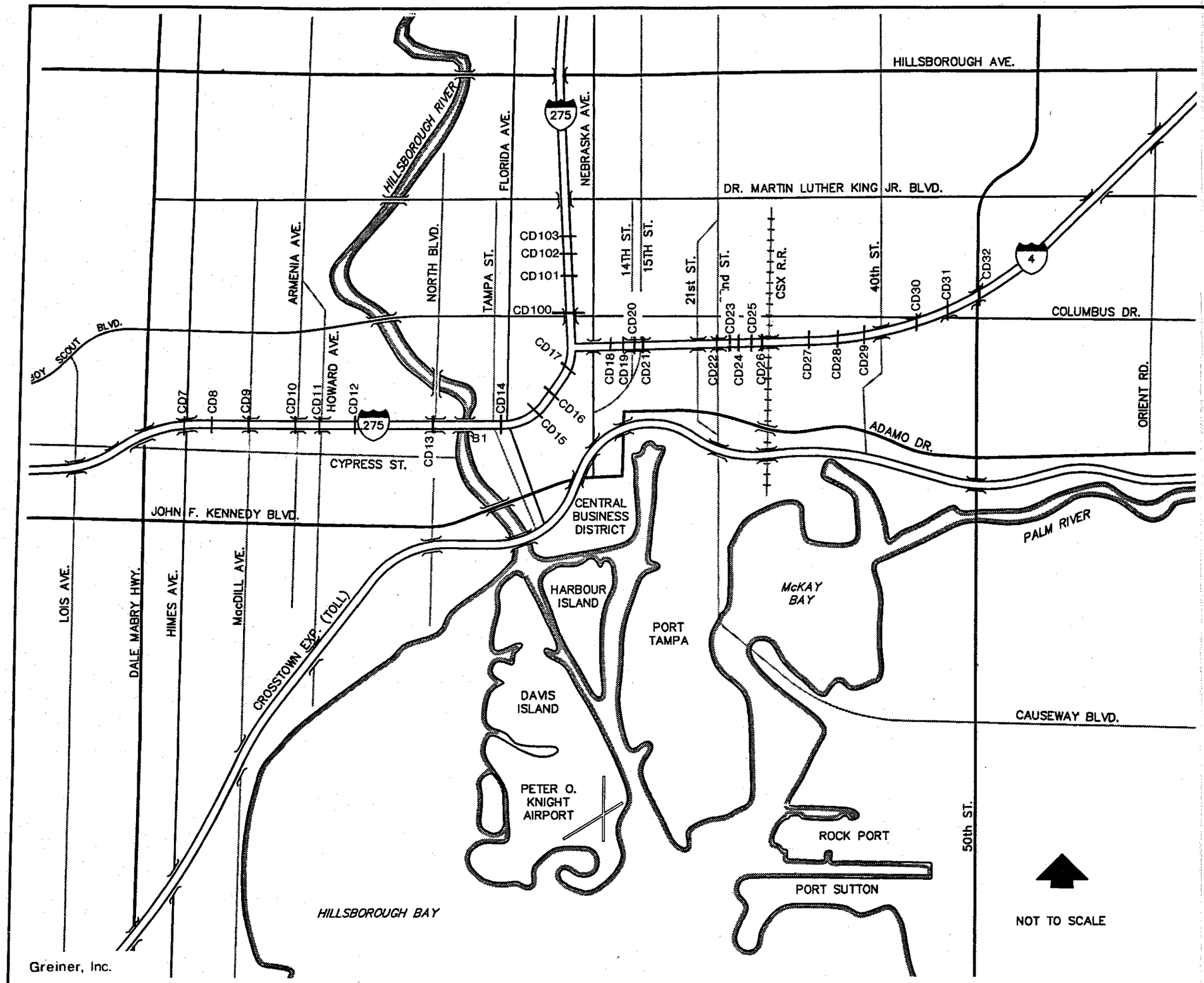
Structure I.D.	Location	Size/Type	Length	Invert (HW) (ft.NGVD)	Invert (TW) (ft.NGVD)	Drainage Basin	Rating*
CD7	Himes Avenue	21" RCP	225'	25.32	24.35	Cypress/Memorial	C
CD8	Glen Avenue	30" RCP	240'	29.97	28.65	Cypress/Memorial	B
CD9	MacDill Avenue	42" RCP	200'	N/A	N/A	Cypress/Memorial	C
CD10	Armenia Avenue	24" RCP	203'	25.20	24.00	East Hillsborough River	B
CD11	Howard Avenue	24" RCP	212'	23.50	23.00	East Hillsborough River	B
CD12	Albany Avenue	24" RCP	N/A	21.43	20.40	East Hillsborough River	B
CD13	North Boulevard	24" RCP	N/A	N/A	N/A	East Hillsborough River	C
CD14	Franklin Street	36" RCP	300'	12.49	7.10	West Hillsborough River	C
CD15	Morgan Street	60" RCP	200'	10.60	10.32	West Hillsborough River	C
CD16	Henderson Avenue	18" RCP	270'	43.40	37.00	West Hillsborough River	C
CD17	Palm Street	24" RCP	440'	40.06	36.08	Nuccio Parkway	C
CD18	10th Street	5'x5' CBC	232'	28.61	28.05	Nuccio Parkway	D
CD19	13th Street	7'x5' CBC	1000'	38.5	N/A	Ybor City	D
CD20	14th Street	18" RCP	250'	35.74	31.25	Ybor City	C
CD21	15th Street	42" RCP	200'	N/A	29.09	Ybor City	B
CD22	22nd Street	30" RCP	N/A	N/A	17.49	29th Street	C
CD23	23rd Street	9'x6' CBC	230'	16.9	15.8	29th Street	D

TABLE 2

DRAINAGE STRUCTURES
(Continued)

Structure I.D.	Location	Size/Type	Length	Invert (HW) (ft.NGVD)	Invert (TW) (ft.NGVD)	Drainage Basin	Rating*
CD24	24th Street	3'x3' CBC	260'	16.9	14.8	29th Street	B
CD25	26th Street	84" RCP	N/A	N/A	N/A	29th Street	C
CD26	28th Street	10'x6' CBC	225'	12.6	11.9	29th Street	D
CD27	34th Street	18" RCP	N/A	N/A	N/A	McKay Bay	C
CD28	35th Street	6'x5' CBC	231'	16.6	16.0	McKay Bay	D
CD29	37th Street	30" RCP	N/A	N/A	N/A	McKay Bay	C
CD30	42nd Street	36" RCP	288'	26.9	26.59	McKay Bay	A
CD31	44th Street	12'x4' CBC	244'	23.40	22.90	McKay Bay	A
CD32	50th Street	42" RCP	N/A	N/A	N/A	McKay Bay	C
CD100	Columbus Drive	18" RCP	260'	N/A	N/A	Nuccio Parkway	C
CD101	Floribraska Avenue	24" RCP	N/A	N/A	N/A	Robles Park Pond/Hillsborough River	B
CD102	Plymouth Street	36" RCP	276'	31.0	21.5	Robles Park Pond/Hillsborough River	A
CD103	26th Avenue	36" RCP	339'	26.2	21.2	Robles Park Pond/Hillsborough River	A
B1	I-275 Bridge Crossing of Hillsborough River between North Boulevard and Tampa Street						

RCP = Reinforced Concrete Pipe
CBC = Concrete Box Culvert
N/A = Not Available
* See Table 3



Greiner, Inc.

LEGEND

CD	Cross Drain
B	Bridge

FLORIDA DEPARTMENT OF TRANSPORTATION

LOCATION HYDRAULIC REPORT

TAMPA INTERSTATE STUDY

PHASE II

Hillsborough County, Florida

DRAINAGE STRUCTURES LOCATIONS MAP

EXHIBIT 4

structures include 23 reinforced concrete pipes (RCP), with sizes ranging from 18 inches to 84 inches and 7 concrete box culverts (CBC), with sizes ranging from 3' x 3' to 10' x 6'.

A rating system was developed to categorize all identified structures. This rating system separates structures within the project corridor into four levels: Levels A through D. A complete description of the rating system is provided in Table 3. Level A structures will be analyzed, while no analysis is required for Level B, Level C, and Level D structures. For Level B structures, the proposed roadway will cover the entire existing drainage basin. Stormwater from these areas will be collected and drained into the proposed TIS stormwater ponds. Level D structures are those cross-drains which are included with enclosed systems both upstream and downstream of the interstate. Level D structures are considered as part of the City of Tampa storm sewer system per discussion with the drainage staff of FDOT District 7. Level D structures will not be evaluated because they will not be considered as cross-drain structures by the staff of FDOT District 7.

TABLE 3

STRUCTURE RATING STANDARD

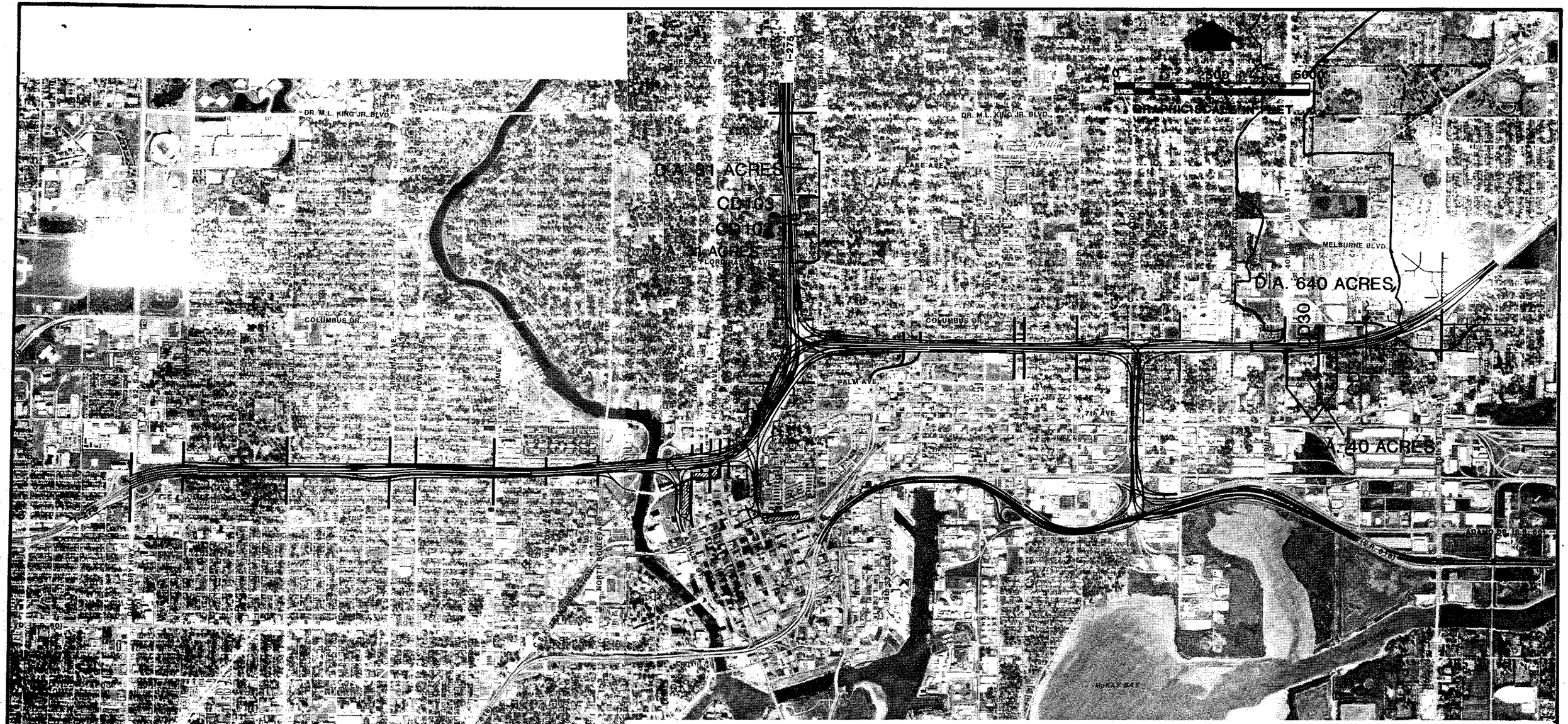
Rating Level	Rating Standard
A	The structure should be lengthened or replaced due to the roadway improvements.
B	Proposed roadway will cover the entire existing drainage basin area; therefore, it is no longer a cross-drain.
C	Cross-drain is part of a storm sewer network and is placed along the central line of a road which is spanned by I-275 for the existing and proposed roadway improvements. Therefore the storm sewer system below the existing road will not be affected by the widening of I-275.
D	Cross-drain is included with enclosed systems both upstream and downstream of the interstate. It will not be considered as a cross-drain and will not be affected by the roadway improvements.

Thirty drainage structures identified within the project corridor include 4 Level A, 6 Level B, 15 Level C, and 5 Level D structures based on the Table 3 rating standard.

Level A structures (CD30, CD31, CD102 and CD103) were analyzed in this report. The drainage basins associated with the analyzed structures (Level A), as shown in Exhibit 5, were determined using the best available information and on-site inspections.

STRUCTURE ANALYSIS

The analysis of cross-drain structures included a determination of 50-year and 100-year peak runoff rates and associated headwater elevations at the structures for the calculated peak flows. Peak runoff rates were determined using the regression



Greiner, Inc.

Photo Date: Aug 1987

LEGEND

- Basin Boundries
- CD Structures I.D.
- D.A. Drainage Area (acres)
- Flow Direction

FLORIDA DEPARTMENT OF TRANSPORTATION

LOCATION HYDRAULIC REPORT

TAMPA INTERSTATE STUDY
PHASE II
Hillsborough County, Florida

DRAINAGE BASIN MAP

EXHIBIT 5

equations for the Tampa Bay area from the FDOT Drainage Manual (Ref. 4). Basin characteristics such as basin area, basin channel slope, and basin development factor and structure information were determined from the City of Tampa Drainage Atlas, SWFWMD contour aerials (Ref. 9), USGS Quadrangle Maps (Ref. 10), USGS Soil Survey Maps (Ref. 12) as well as other available information. Headwater elevations were calculated by the FHWA HY-8 culvert analysis program (Ref. 15) based on the peak runoff rate obtained from the Tampa Bay Area Regression Method. These computations are contained in the Appendix.

The four Level A structures and the I-275 bridge crossing over the Hillsborough River are described below. The lengths of the proposed structures were estimated from the TIS Master Plan Report (Ref. 5). The normal depth of the downstream channel (CD31, CD32) and the water surface elevation of Robles Park Pond (CD102, CD103) were used as the tailwater condition in the analysis.

CD30 (Structure at 42nd Street Crossing I-4)

This 36-inch pipe drains a 40-acre basin located south of I-4. The runoff from the basin flows north through the pipe and outfalls to a ditch connecting to CD31 at 44th Street. Both existing and proposed lengthened pipes were analyzed with the 50-year and 100-year peak discharges (29 and 35 cfs, respectively). In the proposed condition, the pipe will be lengthened from 288 feet to 300 feet. The calculations indicate that both the existing and proposed lengthened cross-drains are sufficient to convey the design 50-year and 100-year peak flows without impacting the upstream areas.

CD31 (Structure at 44th Street Crossing I-4)

This structure (12-foot by 4-foot CBC) drains approximately 680 acres total. It includes 640 acres north of I-4 and 40 acres coming from CD30. The basin extends east to 46th Street, west to 37th Street, north to Hillsborough Avenue, south to I-4 and includes a 40-acre area which drains through CD30. The structure will be extended from the existing 244 feet to a proposed 375 feet. Flooding is predicted for the 50-year peak discharge with the existing cross-drain (12-foot by 4-foot CBC). Preliminary sizing of the structure improvements indicates that an additional 12-foot by 4-foot CBC will be necessary to convey the calculated 50-year(Q_{50}) and 100-year (Q_{100}) peak flows. The calculations, based on existing downstream channel conditions, also indicate that the proposed structures (two 12-foot by 4-foot CBC's) will not impact downstream areas.

CD102 (Structure near Plymouth Street Crossing I-275)

Cross-drain CD102, located near Plymouth Street, is a 36-inch RCP which drains a 31-acre basin east of I-275 and outfalls to the Robles Park Pond. The water in the Robles Park Pond is then pumped via the City of Tampa pump station westward to the Hillsborough River. A constant tailwater based on a pump-on design condition (Ref. 1) is used to analyze the structure's capacity. Although the cross-drain will be extended from the existing 276 feet to a proposed 400 feet, calculations indicate the existing pipe size (36 inches) is adequate for Q_{50} (20 cfs) and Q_{100} (23 cfs) conveyance without impacting upstream areas.

CD103 (Structures Near 26th Avenue Crossing I-275)

This cross-drain situation is similar to CD102. It drains approximately 31 acres through a 36-inch pipe which also outfalls to the Robles Park Pond. The same tailwater condition as CD102 is used for analysis. The computations indicate the existing structure (36-inch RCP) will be sufficient to convey the design 50-year (20 cfs) and 100-year (23 cfs) peak discharges without impacting upstream areas in the existing and proposed conditions.

B1 (I-275 Bridge Crossing of the Hillsborough River)

The I-275 bridge crossing of the Hillsborough River near North Boulevard and Tampa Street can be treated as a cross-drain structure. This bridge will be widened from the existing 175 feet to the proposed 493 feet. As previously mentioned, this reach of the Hillsborough River is regulated by the Lower Hillsborough Flood Detention Area and the Tampa Bypass Canal. The existing bridge and the proposed bridges are designed to meet U.S. Coast Guard requirements for navigation clearance. Detailed analysis of structure B1 should be addressed in a separate Bridge Hydraulic Report. The bridge widening will not adversely impact the floodplain or floodway of the Hillsborough River.

CROSSTOWN CONNECTOR

The proposed Crosstown Connector is located between 30th and 31st Streets and extends from I-4 south to the Crosstown Expressway. This connector is transversely encroaching into the 100-year base floodplain in the region near its south end. The

entire segment of the proposed connector does not cross any existing drainage structures. Although there is a concrete paved ditch under the elevated Crosstown Expressway near McKay Bay, the proposed Crosstown Connector is also elevated to connect to the Crosstown Expressway above the ditch, which will not affect the drainage capacity of the existing ditch.

DRAINAGE STRUCTURE CATEGORIZATION

In accordance with the requirements set forth in FHPM 6-7-3(2), Paragraph 7, the project corridor was evaluated to determine the impact of the proposed roadway improvements. Required hydraulic improvements as a result of the roadway improvements are categorized into seven categories based on the type of the hydraulic improvements and estimated floodplain impacts. Within the project corridor, I-275 represents a transverse encroachment on the floodplains associated with the cross-drain structures. This encroachment should remain at existing levels or be reduced to an insignificant level if the proposed hydraulic improvements are implemented.

As analyzed above, the hydraulic structures in the project corridor were divided into two categories depending on hydraulic performance: Category 3 and Category 5. These categories describe the type of individual modification or replacement required for each structure.

Category 3: Projects Involving Modification to Existing Drainage Structures

Category 3 projects include activities which will not involve the replacement of any existing drainage structures or the construction of any new drainage structures. This category applies only to projects which involve modification to existing structures (i.e.,

extending cross-drains, adding headwalls, relocating manholes and inlets). In regards to the TIS project corridor, the following cross-drains fall within this category: CD30, CD102, CD103, and B1.

The following statement applies to Category 3 projects:

> "Drainage structure modifications included in this project will result in an insignificant change in their capacity to carry floodwater. This change will cause minimal increases in flood heights and flood limits. These minimal increases will not result in any significant adverse impacts on the natural and beneficial floodplain volumes or any significant change in flood risks or damage. There will not be a significant change in the potential for interruption or termination of emergency service or emergency evacuation routes. Therefore, it has been determined that this encroachment is not significant." (FDOT Drainage Manual, 1987).

Category 5: Projects on Existing Alignment Involving Replacement of Drainage Structures in Heavily Urbanized Floodplains

Category 5 addresses those replacement projects in flood sensitive, heavily urbanized floodplains, where the conditions of flooding are largely attributable to the low-lying terrain. Other secondary flood-contributing considerations could be density of floodplain development, and degree and amount of downstream flow constrictions.

Replacement drainage structures in this category are limited to hydraulically equivalent structures in most instances. Conveyance increases due to the improved structures may impact downstream tailwater levels. As a result, downstream channel improvements have been proposed when applicable. In regards to the TIS project area, the following structure falls in this category: CD31.

The following statement applies to Category 5 projects:

> "Replacement drainage structures for this project are limited to hydraulically equivalent structures. The limitations to the hydraulic equivalency being proposed are basically due to restrictions imposed by the geometrics of design, existing development, cost feasibility, or practicability. An alternative encroachment location is not considered in this category since it defeats the project purpose or is economically unfeasible. Since flooding conditions in the project area are inherent in the topography or are a result of other outside contributing sources, and there is no practical alternative to totally eradicate flood impacts or even reduce them in any significant amount, existing flooding will continue, but not be increased. The proposed structure will be hydraulically equivalent to or greater than the existing structure, and backwater surface elevations are not expected to increase. As a result, the project will not affect existing flood heights or floodplain limits. This project will not result in any new or increased adverse environmental impacts. There will be

no significant change in the potential for interruption or termination of emergency service or emergency evacuation routes. Therefore, it has been determined that this encroachment is not significant."

REGULATORY AGENCY COORDINATION

Local Agencies

The City of Tampa is the only local agency with jurisdiction for the proposed improvements to I-275, I-4 and the proposed Crosstown Connector. The City of Tampa Drainage Atlas and related basin studies (Ref. 8) were utilized extensively in determining basin areas and characteristics. The two basin studies were conducted by a private consulting firm for the City of Tampa during the years 1973 and 1985. Coordination with the City of Tampa will be required during preliminary and final design to address floodplain and stormwater quality impacts as well as proposed modifications to the existing drainage system.

State Agencies

State agencies that have permitting responsibilities relevant to the proposed I-275 and Memorial Highway drainage facility improvements include the Florida Department of Environmental Regulation (FDER), Florida Department of Natural Resources (FDNR), and the Southwest Florida Water Management District (SWFWMD).

FDER requires permits for all dredge and fill activities conducted in areas either in or connected to waters of the State, pursuant to Chapter 17-4.28, F.A.C.

FDNR requires easements for any crossing of state-owned lands. Coordination for easements should be accomplished during final design.

SWFWMD requires surface water management permits for the construction or alteration of any surface water system pursuant to Chapter 40D-40, F.A.C. This permit considers the impacts on floodplains, stormwater quantity, and wetlands from public roadway projects. In addition, pursuant to Chapter 17-25, F.A.C., SWFWMD regulates the discharge of untreated stormwater runoff which could be a potential source of pollution of the state. All new stormwater discharge facilities must comply with the design and performance standards set forth in Chapter 17-25.025, F.A.C.

Federal Agencies

The Federal agency which could require permits for the proposed I-275 improvements is the U.S. Army Corps of Engineers (COE).

The COE also issues permits relevant to dredge and fill activities in waters of the United States based on COE, Section 404. To simplify the dredge and fill permitting procedures, the FDER and COE have developed a joint application form.

Preliminary meetings were held with representatives of the regulatory agencies having jurisdiction within the EIS study limits. General discussions were held related to the type of long-term commitments available from the agencies. The agencies stated that some agreement mechanism could be reached for long-term commitments between the agencies and FDOT.

Due to the length of the anticipated construction schedule for the TIS project, Greiner recommends that long-term commitments should be pursued which would set drainage-related design criteria and minimize future changes to the TIS design created by changing regulatory agency rules or policies.

CONCLUSIONS

With the roadway improvements proposed for the I-275 and I-4 project corridor, the modification and replacement of existing cross-drain structures will be required. The proposed improvements to the project corridor will require one cross-drain structure (CD31) to be replaced, three culvert drainage structures (CD30, CD102 and CD103) to be lengthened, and one bridge (B1) to be widened. The remaining structures described as Levels B, C, or D were not evaluated because either the roadway spans the drainage structures or the roadway improvements will engulf the entire cross-drain basin.

The existing roadway transverses the FEMA flood zone A in three locations. The first flood zone is located at the I-275 crossing of the Hillsborough River, the second flood zone is located at the south end of the proposed Crosstown Connector, and the third flood zone is located at Robles Park Pond. No longitudinal floodplain encroachments are within the proposed project corridor.

A separate Bridge Hydraulic Report is needed to address the I-275 bridge crossing of the Hillsborough River. Due to the effects of the USACOE/SWFWMD flood-control project on the Hillsborough River (Tampa Bypass Canal), encroachment up to the natural channel banks will not increase the flood elevations.

The proposed roadway project should not significantly contribute to an increase in flood elevations. Due to the degree of existing urbanization within the project corridor, the proposed project should not increase the potential for development within the floodplain. The entire project corridor is an elevated highway; therefore, the roadway overtopping and traffic interruption due to the flooding will not occur or will be insignificant for both existing and proposed facilities.

The roadway within the project corridor serves the community as an evacuation route. Modifications to the roadway width and drainage structures should improve the use of the facility for emergency services and evacuation purposes.

REFERENCES

1. Drainage Atlas; City of Tampa.

2. Flood Insurance Rate Maps for the following community panel numbers in the City of Tampa, Hillsborough County, Florida: 120114 0022C, 120114 0023C, 120114 0024C, 120114 0025C, 120114 0026C, and 120114 0015C, Federal Emergency Management Agency; September 30, 1982.

3. Flood Insurance Study; Federal Emergency Management Agency; for the City of Tampa, Florida; Community Number 120114; March 1980.

4. Drainage Manual, Volume II; Florida Department of Transportation; 1987.

5. Master Plan Report; Florida Department of Transportation; Tampa Interstate Study; 1989.

6. Plan of Proposed State Highway; Florida Department of Transportation, I-4-1(39)-14, I-4-1(42)18, I-4-1(34)19, I-4-1(22)20, I-75-1(17)0 and I-75-1(33)0.

7. Ybor City Stormwater Management Study Phase I and Phase II; Stormwater Management Division, Department of Public Works, City of Tampa, Florida; March and October 1985.

8. Preliminary Report Phase II: 29th Street Outfall Drainage System; City of Tampa, Florida; July 1973.

9. Aerial Photography with Contours; Southwest Florida Water Management District.

10. Management and Storage of Surface Waters Permit Information Manual, Volume I; Southwest Florida Water Management District; March 1988.

11. Quadrangle Maps; USGS; Revised 1981.

12. Soil Survey Hillsborough County, Florida; USGS Soil Conservation Service; 1989.

13. Stormwater Management Technical Standards; City of Tampa; October 1988.

14. Regulation Manual for Lower Hillsborough Flood Detention Area and Tampa Bypass Canal; Department of the Army; April 1983.

15. HY-8 Culvert Analysis Program; Federal Highway Administration; 1987.

APPENDIX

CALCULATIONS

APPENDIX

There are thirty (30) cross-drain structures and one bridge crossing of the Hillsborough River within the project corridor. Twenty-six (26) structures rated as Levels B, C and D were not analyzed while four (4) structures rated as Level A were analyzed in this report. A preliminary hydraulic analysis was performed to categorize each structure. Each analyzed structure's headwater and tailwater elevations were evaluated by determining basin characteristics and peak runoff rates. After computations and classification, the cross-drain Level A structures were determined to be associated with two categories: Category 3 and Category 5. This report contains general information and is intended for planning purposes only. Specific, detailed studies will be required for each cross-drain before construction of any improvements.

The hydraulic data for each structure as listed in Table A-1 were obtained from the best available information. For peak discharge computations, basin areas were determined using FDOT as-built roadway plans, City of Tampa Drainage Atlas, Ybor City Stormwater Management Study - Phases 1 and 2, Preliminary Report of 29th Street Outfall Drainage System, quad maps, field reviews, and SWFWMD contour aerials. Basin characteristics such as slope and basin development factor (BDF) were estimated from the Drainage Atlas, contour aerials and USGS Soil Survey maps. Basin peak runoff rates were evaluated using the Tampa Bay Area Regression Method equations from the FDOT Design Manual Volume 2, Chapter 5. The EPA Stormwater Management Model, Version 3.0 (SWMM III) was used in the Ybor City Stormwater Management Study - Phases 1 and 2 (1985). The studies were based on the 5-year, 4-hour and 25-year, 24-hour design storm rainfall from FDOT Itensity-Duration-Frequency (IDF) curves. In the other report, Phase II of 29th Street Outfall Drainage

System (Western Branch only, 1973), the storm sewer design was performed on a Storm Sewer Tabulation Form based on rational method and 5-year frequency rainfall. The proposed crossing (10' x 6.25' CBC) of I-4 at 26th Street had been installed as 84-inch concrete pipe (CD25). All drainage structures included in both reports (City of Tampa) within the project corridor were enclosed systems both upstream and downstream of I-4. They were not considered as cross-drain structures by the staff of FDOT District 7 and were not analyzed in this Location Hydraulic Report (LHR). For the structures analyzed in this LHR, the peak discharges (Q_{50} and Q_{100}) resulting from the regression equations are listed in Table A-2.

TABLE A-1

DRAINAGE STRUCTURES INFORMATION

Structures ID	Location	Size & Type	Invert Elevation Upstream/Downstream (NGVD Feet)	Existing/Proposed Length (Feet)	U/S & D/S Street EL. (NGVD Feet)	U/S & D/S Connection
CD30	42nd St./I-4	36" RCP	26.9/26.5	288/300	32.4/32.8	Ditch/Ditch
CD31	44th St./I-4	12'x4' CBC	23.4/22.9	244/375	31.1/30.0	Ditch/Ditch
CD102	Plymouth St./I-275	36" RCP	31.0/21.5	295/400	38.0/33.4	Ditch/Pond
CD103	26th Ave./I-275	36" RCP	26.2/21.1	339/400	38.0/33.4	Pipe/Pond

TABLE A-2

PEAK RUNOFF COMPUTED FROM TAMPA BAY AREA

(REGRESSION METHOD)

Outfall Structure ID	Basin Area Acres/Mile^2	BDF*	Channel Slope (feet/mile)	Regression Method Peak Discharge (cfs) Q_{50}	Q_{100}
CD30	40/0.0625	9	11	29	35
CD31	680/1.0625	9	11	722	923
CD102	31/0.0484	10	8	20	23
CD103	31/0.0484	10	8	20	23

* Basin Development Factor

For the culvert/pipe analysis (using HY-8), a tailwater elevation is needed in addition to the information provided in Table A-1. There are two types of tailwater elevations used in this report's hydraulic analysis. When an open channel/ditch is available downstream of the analyzed cross-drain (CD30, CD31), the normal depth of the downstream channel will be assumed with correspondent discharge. Cross-drains CD102 and CD103 outfall to the Robles Park Pond and discharge to the Hillsborough River by the stormwater pump station. The pond elevation associated with pump-on conditions (Drainage Atlas, City of Tampa) was used as the downstream boundary condition.

Based on the available cross-drain information and boundary conditions, each structure was evaluated using HY-8 for the peak flows for the 50-year and 100-year floods. The FDOT requires a design standing headwater (more than 24 hours) to be 2 feet below the roadway base for the design storm. The allowable headwater for the design storm (50-year) is the edge of pavement. The allowable headwater for the 100-

year flood must leave at least one lane dry. If the culvert failed to meet this criterion, then a replacement structure was sized using HY-8. Culverts which did meet the requirements for the existing conditions were evaluated as a group to determine the effects of lengthening the structures to accommodate the additional lanes of traffic.

The street elevations at the upstream end of each cross-drain structure (from the City of Tampa Drainage Atlas and SWFWMD aerials) are compared with existing upstream water surface elevations and listed in Table A-3.

TABLE A-3

UPSTREAM STREET AND WATER SURFACE (Q_{100}) ELEVATION

Structure ID	CD30	CD31	CD102	CD103
Upstream water surface elevation (ft.NGVD) (Q_{100})	30.2	43.3	33.4	33.4
Upstream street elevation (ft.NGVD)	32.4	31.1	38.0	38.0
CONDITION	adequate	flooding	adequate	adequate

After the analysis of the proposed conditions, the cross-drains can be grouped into two categories:

Category 3 Structures

Category 3 structures are those which require only modification of the existing culvert (including lengthening and relocation of manholes and inlets). This group of structures includes CD30, CD102, CD103, and the bridge crossing (B1) of the

Hillsborough River. The headwater and tailwater conditions for each structure were evaluated for the existing and proposed conditions. All of these structures performed satisfactorily to carry the runoff generated from the 50-year and 100-year floods. The headloss increase due to lengthening of structures in this category is listed in Table A-4 (B1 excluded). The worst-case headloss increase occurred in structure CD30 for both the Q_{50} and Q_{100} flows. However, the increase of 0.02 feet can be considered insignificant.

TABLE A-4

HEADLOSS INCREASE DUE TO STRUCTURE LENGTHENING

	Structure ID		
	CD18	CD19	CD23
Headloss Increase for Q_{50} (ft)	0.02	0.02	0.0
Headloss Increase for Q_{100} (ft)	0.02	0.01	0.01

Category 5 Structures

Category 5 structures are those pipes which exhibit a tendency to flood during the design event and which will require replacement. These culverts are analyzed individually to determine a replacement structure. One Category 5 structure was identified within the project limits (CD31). The HY-8 analysis of structure CD31 for the pre- and post-conditions is summarized in Table A-5.

TABLE A-5

SUMMARY OF HY-8 ANALYSIS OF CATEGORY 5 STRUCTURES

			EXISTING CONDITION (Q_{100})				PROPOSED (Q_{100})			
Structure ID	Q_{50} (cfs)	Q_{100} (cfs)	Pipe Size	Length (ft)	Headwater (ft. NGVD)	Upstream Street Elevation (ft. NGVD)	Pipe Size	Length (ft)	Headwater (ft. NGVD)	Upstream Street Elevation (ft. NGVD)
CD31	722	923	12'x4' CBC	244	43.31	31.1	2(12'x4' CBC)	375	31.03	31.1

From the above computed results, the proposed additional 12-foot by 4-foot box culvert in addition to the existing cross-drain CD31 should prevent the upstream area from flooding. The calculations, based on existing downstream channel conditions, also indicate that the proposed structures (two 12-foot by 4-foot CBCs) will not impact downstream areas.

The detailed results of the cross-drain structure analysis from HY-8 the computation are provided in the following pages.

CONCLUSIONS

With the proposed I-275 improvements, modification and replacement of existing drainage structures will be required. The proposed improvements to the project corridor will require one cross-drain structure replacement, the lengthening of three cross-drains and the widening of one bridge. The remaining structures rated as Levels B, C, and D will not be analyzed because the roadway improvements will either engulf the entire cross-drain basin or span the existing and proposed cross-drains.

CD30 EXISTING

CULVERT ANALYSIS 1.1
CULVERT FILE NAME: S30.DAT

DATE: 1-11-90
SUMMARY TABLE

CULV NO.	A - SITE DATA: INLET ELEV. (FT)	OUTLET ELEV. (FT)	CULVERT LENGTH (FT)	B - CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (IN)	RISE (IN)	MANN. N	INLET TYPE
1	26.90	26.50	288	1 -RCP	36	36	0.012	CONVENTIONA
2								
3								
4								
5								
6								

TO EDIT DATA PRESS (A) FOR SITE DATA
(B) FOR CULVERT SHAPE, MATERIAL, OR INLET DATA,
(C) FOR DISCHARGE RANGE,
(D) FOR TAILWATER DATA,
(E) FOR OVERTOPPING DATA,
(F) TO ADD OR DELETE CULVERTS,
(RET) TO CONTINUE ANALYSIS.

CULVERT # 1 PERFORMANCE CURVE
FOR 1 BARRELS

	Q (cfs)	HW (ft)	TWE (ft)	ICH (ft)	OCH (ft)	TWH (ft)	VO (fps)
	0.00	26.90	26.50	0.00	-0.40	0.00	0.00
	4.00	27.83	26.81	0.85	0.93	0.62	3.78
	8.00	28.27	26.95	1.23	1.37	0.89	4.55
	12.00	28.59	27.06	1.53	1.69	1.09	5.15
	16.00	28.90	27.16	1.83	2.00	1.27	5.62
	20.00	29.18	27.24	2.10	2.28	1.42	6.05
	24.00	29.42	27.31	2.35	2.52	1.57	6.42
Q50 →	28.00	29.70	27.37	2.58	2.80	1.70	6.76
	32.00	29.97	27.43	2.82	3.07	1.83	7.08
Q100 →	36.00	30.24	27.49	3.05	3.34	1.94	7.44
	40.00	30.54	27.54	3.30	3.64	2.06	7.75

PRESS <V> TO PLOT PRESS <ENTER> TO CONTINUE

CD30PROPOSED

CULVERT ANALYSIS 1.1
CULVERT FILE NAME: P30.DAT

DATE: 1-13-91
SUMMARY TABLE

CULV NO.	A - SITE DATA: INLET ELEV. (FT)	OUTLET ELEV. (FT)	CULVERT LENGTH (FT)	B - CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (IN)	RISE (IN)	MANN. N	INLET TYPE
1	26.92	26.50	300	1 -RCP	36	36	0.012	CONVENTIONA
2								
3								
4								
5								
6								

TO EDIT DATA PRESS (A) FOR SITE DATA
(B) FOR CULVERT SHAPE, MATERIAL, OR INLET DATA,
(C) FOR DISCHARGE RANGE,
(D) FOR TAILWATER DATA,
(E) FOR OVERTOPPING DATA,
(F) TO ADD OR DELETE CULVERTS,
(RET) TO CONTINUE ANALYSIS.

CULVERT # 1 PERFORMANCE CURVE
FOR 1 BARRELS

	Q (cfs)	HW (ft)	TWE (ft)	ICH (ft)	OCH (ft)	TWH (ft)	VO (fps)
	0.00	26.92	26.50	0.00	-0.42	0.00	0.00
	4.00	27.85	26.81	0.85	0.93	0.62	3.78
	8.00	28.29	26.95	1.23	1.37	0.89	4.55
	12.00	28.64	27.06	1.53	1.72	1.09	5.15
	16.00	28.92	27.16	1.83	2.00	1.27	5.62
	20.00	29.20	27.24	2.10	2.28	1.42	6.05
	24.00	29.44	27.31	2.35	2.52	1.57	6.42
Q50 →	28.00	29.72	27.37	2.58	2.80	1.70	6.76
	32.00	29.99	27.43	2.82	3.07	1.83	7.08
Q100 →	36.00	30.26	27.49	3.05	3.34	1.94	7.44
	40.00	30.63	27.54	3.30	3.71	2.06	7.75

PRESS <V> TO PLOT PRESS <ENTER> TO CONTINUE

CD31 EXISTING

CULVERT ANALYSIS 1.1
CULVERT FILE NAME: S31.DAT

DATE: 1-11-90
SUMMARY TABLE

CULV NO.	A - SITE DATA: INLET ELEV. (FT)	OUTLET ELEV. (FT)	CULVERT LENGTH (FT)	B - CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (IN)	RISE (IN)	MANN. N	INLET TYPE
1	23.40	22.90	244	1 -RCB	144	48	0.012	CONVENTIONA
2								
3								
4								
5								
6								

TO EDIT DATA PRESS (A) FOR SITE DATA
(B) FOR CULVERT SHAPE, MATERIAL, OR INLET DATA,
(C) FOR DISCHARGE RANGE,
(D) FOR TAILWATER DATA,
(E) FOR OVERTOPPING DATA,
(F) TO ADD OR DELETE CULVERTS,
(RET) TO CONTINUE ANALYSIS.

CULVERT # 1 PERFORMANCE CURVE
FOR 1 BARRELS

	Q (cfs)	HW (ft)	TWE (ft)	ICH (ft)	OCH (ft)	TWH (ft)	VO (fps)
	0.00	23.40	22.90	0.00	-0.50	0.00	0.00
	95.00	25.55	24.14	2.14	2.15	1.25	6.33
	190.00	26.83	24.75	3.35	3.43	1.99	7.97
	285.00	27.88	25.22	4.44	4.48	2.60	9.13
	380.00	29.03	25.62	5.63	5.43	3.15	10.04
	475.00	30.46	25.98	7.06	6.31	3.66	10.82
	570.00	32.20	26.30	8.80	8.10	4.00	11.88
	665.00	34.29	26.59	10.89	9.75	4.00	13.85
Q50 →	760.00	36.86	26.86	13.46	11.66	4.00	15.83
	855.00	39.91	27.11	16.51	14.04	4.21	17.81
Q100 →	950.00	43.31	27.35	19.91	16.70	4.45	19.79

PRESS <V> TO PLOT PRESS <ENTER> TO CONTINUE

CD31 PROPOSED

CULVERT ANALYSIS 1.1
CULVERT FILE NAME: P31.DAT

DATE: 1-13-91
SUMMARY TABLE

CULV NO.	A - SITE DATA: INLET ELEV. (FT)	OUTLET ELEV. (FT)	CULVERT LENGTH (FT)	B - CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (IN)	RISE (IN)	MANN. N	INLET TYPE
1	23.70	22.90	375	1 -RCB	144	48	0.012	CONVENTIONA
2	23.70	22.90	375	1 -RCB	144	48	0.012	CONVENTIONA
3								
4								
5								
6								

TO EDIT DATA PRESS (A) FOR SITE DATA
(B) FOR CULVERT SHAPE, MATERIAL, OR INLET DATA,
(C) FOR DISCHARGE RANGE,
(D) FOR TAILWATER DATA,
(E) FOR OVERTOPPING DATA,
(F) TO ADD OR DELETE CULVERTS,
(RET) TO CONTINUE ANALYSIS.

SUMMARY OF CULVERT FLOWS (CFS) file: P31.DAT date:1-13-91

	ELEV (FT)	TOTAL	1	2	3	4	5	6	OVERTOP
	23.70	0	0	0	0	0	0	0	0
	25.05	95	48	48	0	0	0	0	0
	25.85	190	95	95	0	0	0	0	0
	26.52	285	143	142	0	0	0	0	0
	27.11	380	190	190	0	0	0	0	0
	27.66	475	237	238	0	0	0	0	0
	28.17	570	285	285	0	0	0	0	0
	28.71	665	333	333	0	0	0	0	0
Q50 →	29.33	760	380	380	0	0	0	0	0
	30.10	855	428	428	0	0	0	0	0
Q100 →	31.03	950	475	475	0	0	0	0	0

PRESS:
(1) TO PLOT TOTAL RATING CURVE
(2) TO DETERMINE SPECIFIC INFORMATION ABOUT EACH CULVERT
(3) TO SEE MULTIPLE CULVERT COMPUTATIONAL ERROR TABLE
(ENTER) TO RETURN FOR NEW RUN OR EXIT

CD102 EXISTING

CULVERT ANALYSIS 1.1
CULVERT FILE NAME: S102.DAT

DATE: 1-11-91
SUMMARY TABLE

CULV NO.	A - SITE DATA: INLET ELEV. (FT)	A - SITE DATA: OUTLET ELEV. (FT)	A - SITE DATA: CULVERT LENGTH (FT)	B - CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (IN)	RISE (IN)	MANN. N	INLET TYPE
1	31.00	21.50	295	1 -RCP	36	36	0.012	CONVENTIONA
2								
3								
4								
5								
6								

TO EDIT DATA PRESS (A) FOR SITE DATA
(B) FOR CULVERT SHAPE, MATERIAL, OR INLET DATA,
(C) FOR DISCHARGE RANGE,
(D) FOR TAILWATER DATA,
(E) FOR OVERTOPPING DATA,
(F) TO ADD OR DELETE CULVERTS,
(RET) TO CONTINUE ANALYSIS.

CULVERT # 1 PERFORMANCE CURVE
FOR 1 BARRELS

	Q (cfs)	HW (ft)	TWE (ft)	ICH (ft)	OCH (ft)	TWH (ft)	VO (fps)
	0.00	31.00	27.00	0.00	-4.00	5.50	0.00
	2.50	31.64	27.00	0.64	-4.00	5.50	0.35
	5.00	31.93	27.00	0.93	-3.98	5.50	0.71
	7.50	32.15	27.00	1.15	-3.95	5.50	1.06
	10.00	32.35	27.00	1.35	-3.90	5.50	1.41
	12.50	32.52	27.00	1.52	-3.84	5.50	1.77
	15.00	32.71	27.00	1.71	-3.77	5.50	2.12
	17.50	32.89	27.00	1.89	-3.69	5.50	2.48
Q50 →	20.00	33.05	27.00	2.05	-3.59	5.50	2.83
Q100 →	22.50	33.21	27.00	2.21	-3.48	5.50	3.18
	25.00	33.36	27.00	2.36	-3.36	5.50	3.54

PRESS (V) TO PLOT PRESS (ENTER) TO CONTINUE

CD102 PROPOSED

CULVERT ANALYSIS 1.1
CULVERT FILE NAME: P102.DAT

DATE: 1-13-91
SUMMARY TABLE

CULV NO.	A - SITE DATA: INLET ELEV. (FT)	OUTLET ELEV. (FT)	CULVERT LENGTH (FT)	B - CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (IN)	RISE (IN)	MANN. N	INLET TYPE
1	31.00	21.50	400	1 -RCP	36	36	0.012	CONVENTIONA
2								
3								
4								
5								
6								

TO EDIT DATA PRESS (A) FOR SITE DATA
(B) FOR CULVERT SHAPE, MATERIAL, OR INLET DATA,
(C) FOR DISCHARGE RANGE,
(D) FOR TAILWATER DATA,
(E) FOR OVERTOPPING DATA,
(F) TO ADD OR DELETE CULVERTS,
(RET) TO CONTINUE ANALYSIS.

CULVERT # 1 PERFORMANCE CURVE
FOR 1 BARRELS

	Q (cfs)	HW (ft)	TWE (ft)	ICH (ft)	OCH (ft)	TWH (ft)	VO (fps)
	0.00	31.00	27.00	0.00	-4.00	5.50	0.00
	2.50	31.65	27.00	0.65	-3.98	5.50	0.35
	5.00	31.94	27.00	0.94	-3.95	5.50	0.71
	7.50	32.16	27.00	1.16	-3.91	5.50	1.06
	10.00	32.35	27.00	1.35	-3.86	5.50	1.41
	12.50	32.53	27.00	1.53	-3.79	5.50	1.77
	15.00	32.72	27.00	1.72	-3.71	5.50	2.12
	17.50	32.90	27.00	1.90	-3.61	5.50	2.48
Q50 →	20.00	33.07	27.00	2.07	-3.49	5.50	2.83
Q100 →	22.50	33.22	27.00	2.22	-3.36	5.50	3.18
	25.00	33.37	27.00	2.37	-3.22	5.50	3.54

PRESS <V> TO PLOT PRESS <ENTER> TO CONTINUE

CD103 EXISTING

CULVERT ANALYSIS 1.1
CULVERT FILE NAME: S103.DAT

DATE: 1-11-90
SUMMARY TABLE

CULV NO.	A - SITE DATA: INLET ELEV. (FT)	A - SITE DATA: OUTLET ELEV. (FT)	A - SITE DATA: CULVERT LENGTH (FT)	B - CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (IN)	RISE (IN)	MANN. N	INLET TYPE
1	26.20	21.10	339	1 -RCP	36	36	0.012	CONVENTIONA
2								
3								
4								
5								
6								

TO EDIT DATA PRESS (A) FOR SITE DATA
(B) FOR CULVERT SHAPE, MATERIAL, OR INLET DATA,
(C) FOR DISCHARGE RANGE,
(D) FOR TAILWATER DATA,
(E) FOR OVERTOPPING DATA,
(F) TO ADD OR DELETE CULVERTS,
(RET) TO CONTINUE ANALYSIS.

CULVERT # 1 PERFORMANCE CURVE
FOR 1 BARRELS

	Q (cfs)	HW (ft)	TWE (ft)	ICH (ft)	OCH (ft)	TWH (ft)	VO (fps)
	0.00	27.00	27.00	0.00	0.80	5.90	0.00
	2.50	27.20	27.00	0.65	1.00	5.90	0.35
	5.00	27.15	27.00	0.94	0.95	5.90	0.71
	7.50	27.37	27.00	1.17	0.88	5.90	1.06
	10.00	27.56	27.00	1.36	0.93	5.90	1.41
	12.50	27.75	27.00	1.55	0.99	5.90	1.77
	15.00	27.94	27.00	1.74	1.06	5.90	2.12
Q50 →	17.50	28.11	27.00	1.91	1.15	5.90	2.48
Q100 →	20.00	28.28	27.00	2.08	1.26	5.90	2.83
	22.50	28.44	27.00	2.24	1.38	5.90	3.18
	25.00	28.59	27.00	2.39	1.51	5.90	3.54

PRESS <V> TO PLOT PRESS <ENTER> TO CONTINUE

CD103 PROPOSED

CULVERT ANALYSIS 1.1
CULVERT FILE NAME: P103.DAT

DATE: 1-13-91
SUMMARY TABLE

CULV NO.	A - SITE DATA: INLET ELEV. (FT)	OUTLET ELEV. (FT)	CULVERT LENGTH (FT)	B - CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (IN)	RISE (IN)	MANN. N	INLET TYPE
1	26.20	21.10	400	1 -RCP	36	36	0.012	CONVENTIONA
2								
3								
4								
5								
6								

TO EDIT DATA PRESS (A) FOR SITE DATA
(B) FOR CULVERT SHAPE, MATERIAL, OR INLET DATA,
(C) FOR DISCHARGE RANGE,
(D) FOR TAILWATER DATA,
(E) FOR OVERTOPPING DATA,
(F) TO ADD OR DELETE CULVERTS,
(RET) TO CONTINUE ANALYSIS.

CULVERT # 1 PERFORMANCE CURVE
FOR 1 BARRELS

	Q (cfs)	HW (ft)	TWE (ft)	ICH (ft)	OCH (ft)	TWH (ft)	VO (fps)
	0.00	27.00	27.00	0.00	0.80	5.90	0.00
	2.50	27.11	27.00	0.65	0.91	5.90	0.35
	5.00	27.15	27.00	0.95	0.93	5.90	0.71
	7.50	27.37	27.00	1.17	0.85	5.90	1.06
	10.00	27.57	27.00	1.37	0.90	5.90	1.41
	12.50	27.75	27.00	1.55	0.97	5.90	1.77
	15.00	27.94	27.00	1.74	1.06	5.90	2.12
	17.50	28.12	27.00	1.92	1.16	5.90	2.48
Q50 →	20.00	28.28	27.00	2.08	1.27	5.90	2.83
Q100 →	22.50	28.44	27.00	2.24	1.40	5.90	3.18
	25.00	28.59	27.00	2.39	1.55	5.90	3.54

PRESS <V> TO PLOT PRESS <ENTER> TO CONTINUE