I-4 / Crosstown Connector Interchange Justification Report

TAMPA INTERSTATE STUDY

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

Prepared For

FLORIDA DEPARTMENT OF TRANSPORTATION

Prepared By

GREINER, INC.

In Association With

GANNETT FLEMING TRANSPORTATION ENGINEERS
TEXAS TRANSPORTATION INSTITUTE
KNIGHT APPRAISAL SERVICES, INC.

REVISED
NOVEMBER 1992

Greiner, Inc. - Tampa, Florida

Contract Number C2380 Project I-4

The attached Final IJR has received quality control review and I recommend this to be submitted to the client as: ☐ Draft ☐ Preliminary ☒ Final ☐ _____

Gregory S. Rust 11-30-92
Signature Date

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INTRODUCTION

The Tampa Interstate Study (TIS) provides for the reconstruction of Interstate 275 (I-275) and Interstate 4 (I-4) in Hillsborough County. In conjunction with TIS and previous studies conducted by the Tampa Hillsborough County Expressway Authority (THCEA), the need for a freeway to freeway connection between I-4 and the South Crosstown Expressway has been identified (the Crosstown Connector). The proposed interchange on I-4 with the Crosstown Connector, the Crosstown Connector interchange, has been included in the TIS study and is in the year 2010 Long Range Transportation Plan for Hillsborough County.

Greiner Inc. has been requested by the Florida Department of Transportation (FDOT) to analyze the impact of this new interchange on the operation and safety of I-4 and the South Crosstown Expressway, as well as justify the need for the new interchange.

The purpose of this report is to present the FDOT and the Federal Highway Administration (FHWA) with the documentation to justify the new interchange. To accomplish this, the report discusses the need for the project and the project's relationship to the area transportation system as well as the traffic operations, safety and capacity impacts of the interchange. The cost effectiveness of the proposed interchange is also addressed.

The appendices of this document contain support documentation for the traffic operations calculations.

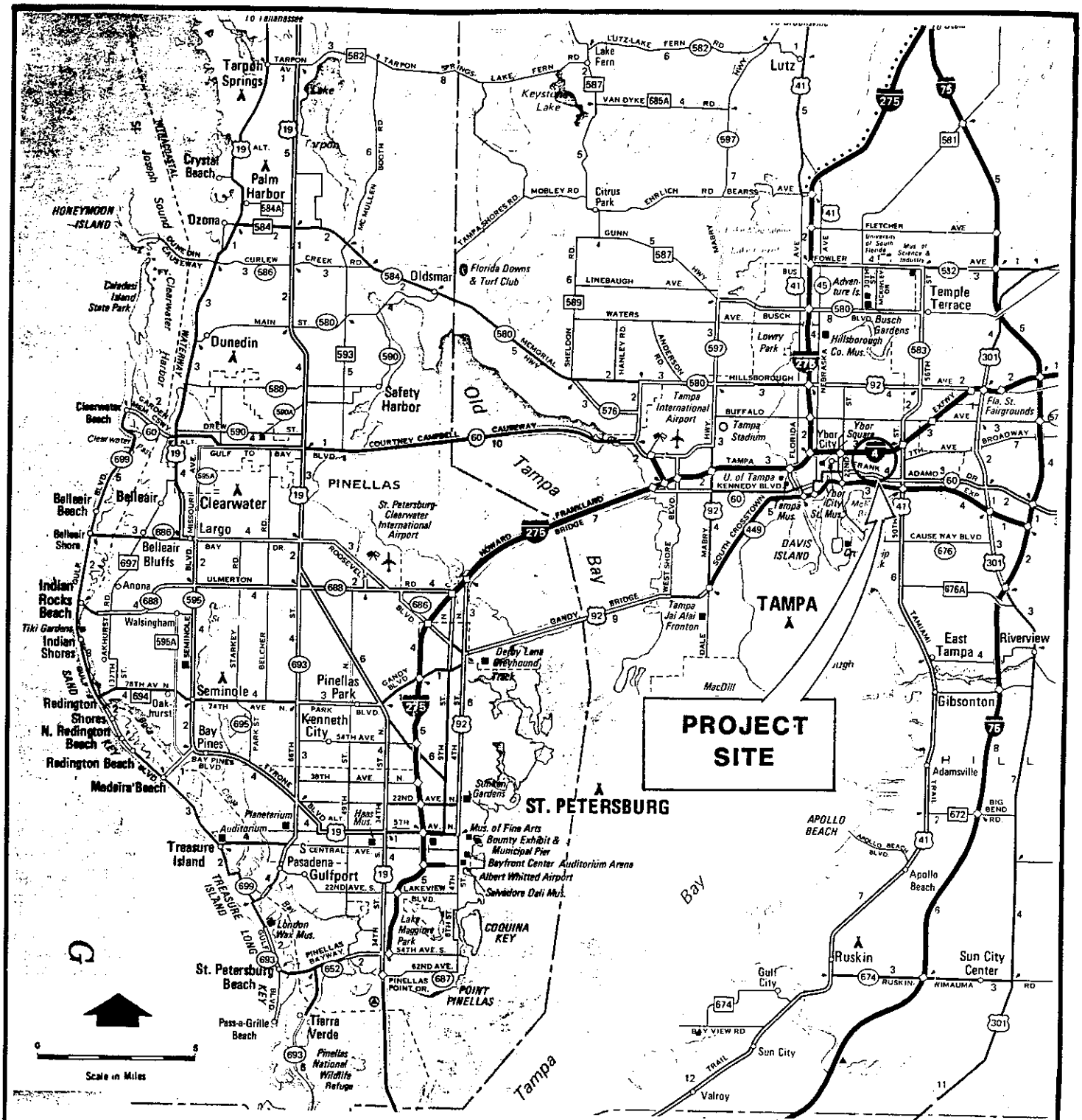
DESCRIPTION OF THE PROPOSED ACTION

The proposed project site for the Crosstown Connector is located east of the Tampa Central Business District (CBD) and the I-4/I-275 interchange. The proposed Crosstown Connector is located east of the C.S.X. Transportation railroad corridor and west of 31st Street between the existing I-4 interchanges at 21st/22nd Streets and 40th Street. The proposed Crosstown Connector extends from I-4 southward to the South Crosstown Expressway. The connector interchanges with the South Crosstown Expressway between the existing interchanges at 22nd Street and 39th Street. Exhibit 1 illustrates the project location.

The location of the Crosstown Connector, including the interchanges, was the subject of a separate study conducted for THCEA. The initial investigations to locate the Connector examined the area from the Howard/Armenia Avenue corridor east through 50th Street and involved using existing street alignments and interchanges as well as new alignments and interchanges. The initial evaluation of alternative locations and feasibility of the Connector are documented in the following reports:

* Proposed I-275/I-4 Crosstown Expressway Connector-Technical Memorandum; Howard, Needles, Tammen and Bergendoff; April, 1986.
* Feasibility Study of Extensions to the Tampa South Crosstown Expressway; Parsons, Brinckerhoff, Quade and Douglas; August, 1987.

Further documentation of the Connector location will be included in the environmental document and engineering reports currently being prepared by THCEA under their ongoing Project Development and Environmental (PD&E) Study for the Connector. For purposes of this evaluation and TIS, the location of the Connector is assumed to be fixed.



FLORIDA DEPARTMENT OF TRANSPORTATION

INTERCHANGE JUSTIFICATION REPORT

I-4/CROSSTOWN CONNECTOR

Hillsborough County, Florida

LOCATION MAP

EXHIBIT 1

The proposed Crosstown Connector interchange with I-4 has been developed in conjunction with the proposed improvements to I-4 and I-275 developed under TIS. The TIS Master Plan in the project area includes a basic eight-lane express freeway system comprised of six general use freeway lanes and two High Occupancy Vehicle (HOV) lanes on I-4. In addition, there is a two- to three-lane local access freeway system paralleling the express freeway lanes. The proposed Crosstown Connector is a six-lane freeway section. The Connector provides access to/from the local access freeway lanes to/from the east and to/from the express and local access freeway lanes to and from the west. The Crosstown Connector provides a toll-free exit and entrance ramp to and from Adamo Drive (S.R. 60) and provides direct connections to and from an eight-lane freeway section on the South Crosstown Expressway. The concept is illustrated in the appended plan set on 100 scale aerial photography.

The proposed Crosstown Connector will provide direct freeway to freeway access between I-4 and the South Crosstown Expressway. This connection will improve traffic operations on the north-south local streets in the project area as well as along the two freeway corridors. In addition, as a result of the direct connection between I-4 and the South Crosstown Expressway, the growing suburban communities are provided improved access to and from area business districts.

An additional function of the proposed Crosstown Connector is its role as a system maintenance of traffic route during the reconstruction of the Interstate. The Crosstown Connector will provide an alternative route for traffic to access the CBD during the reconstruction of the downtown and I-4/I-275 interchanges. Without the Connector, during the reconstruction traffic accessing the CBD would likely be diverted to the arterial street system including 21st, 22nd, 40th and 50th Streets. Due

to the limited available capacity on these arterials, severe congestion would result. Therefore, the Connector is a vital link for both the ultimate freeway system in Tampa as well as a system maintenance of traffic route during the reconstruction of the freeway system.

JUSTIFICATION OF THE PROPOSED ACTION

Hillsborough County is located in one of the fastest growing metropolitan areas in the country. In 1985, Hillsborough County had an established population of 748,507. Population projections indicate that approximately 546,000 additional people will live and work in Hillsborough County over the next 25 years (Year 2010).

The population growth projected for Hillsborough County and the Tampa Bay urban area will increase the travel demand on the area's roadway system. Traffic projections for the year 2010 indicate that improvements to the I-275 and I-4 corridors are needed to meet this travel demand. The TIS Master Plan to upgrade I-4 and I-275 will improve these major east-west and north-south transportation corridors. The South Crosstown Expressway, with the proposed western extension to the Gandy Bridge, the proposed eastern extension through Brandon to S.R. 60 and overall upgrading and widening in high volume areas, will provide additional capacity for east-west travel south of the I-275/I-4 corridor. In conjunction with these improvements, the proposed Crosstown Connector interchange provides a vital freeway to freeway link between these two major transportation corridors. Traffic projections for the design year 2010 indicate that with the TIS Master Plan improvements in place the Connector will carry approximately 90,000 vehicles per day.

The following sections of this report provide the engineering justification of the proposed project. The issues addressed include the existing (1988), opening year (1995), and design year (2010) traffic volumes, traffic operations, safety, cost-effectiveness and implementation of the proposed action. Due to the nature of the Interstate's function to carry interregional traffic, particular attention has been focused on the impacts that the proposed interchange will have on the I-4 traffic operations. Also of importance, and addressed herein, is the impact on the adjacent street system.

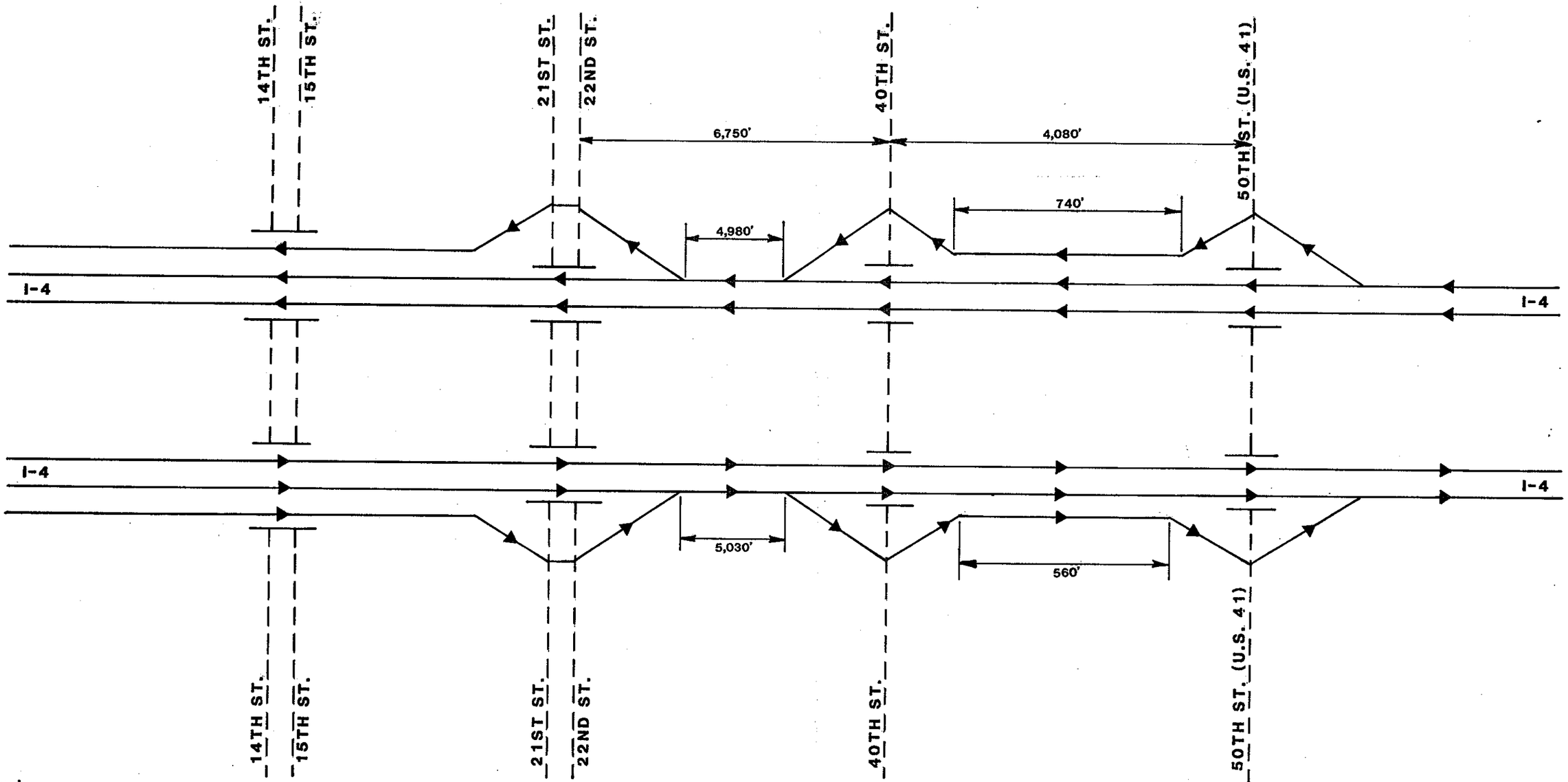
AREA STREET SYSTEM

As previously shown in Exhibit 1, I-4 and the South Crosstown Expressway run primarily east and west in the vicinity of the proposed Crosstown Connector. The Connector is proposed to run north-south, connecting the two roadways. The following briefly describes the existing facilities and planned improvements.

Interstate 4 - runs primarily east-west in the vicinity of the proposed project. East of 40th Street, I-4 takes a northeasterly route through Hillsborough County and continues in a northeasterly direction through Orlando and continuing to Daytona Beach on Florida's east coast. I-4 terminates west of the proposed project area at an interchange with I-275. I-4 is generally a four-lane divided, limited access freeway with the exception of the section west of 21st/22nd Streets, which is a six-lane divided section. A lane drop eastbound and a lane add westbound occurs on the west side of the existing 21st/22nd Street interchange. The existing laneage on I-4 and the configuration of the ramps is illustrated schematically on Exhibit 2.

The segment of I-4 between I-275 and 50th Street (U.S. 41) covers a distance of approximately 3.2 miles. There are three existing freeway interchanges within the study area. Split-diamond interchanges are currently provided at 21st/22nd Streets and 50th Street/Columbus Drive. A diamond interchange is located at 40th Street.

The South Crosstown Expressway - is a four-lane divided, limited access east-west toll road. Currently, the South Crosstown Expressway extends from Gandy Boulevard/Dale Mabry Highway north and eastward, through south Tampa and the southern portion of the Tampa Central Business District (CBD). It continues eastward from the CBD to I-75. The long range plans for the South Crosstown Expressway



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FLORIDA DEPARTMENT OF TRANSPORTATION

INTERCHANGE JUSTIFICATION REPORT

I-4/CROSSTOWN CONNECTOR

Hillsborough County, Florida

EXISTING MAINLINE AND RAMP LANEAGE

EXHIBIT 2

include a western extension to the Gandy Bridge, providing a limited access connection to Pinellas County and an eastern extension through or around Brandon to S.R. 60. The South Crosstown Expressway improvement plan includes upgrading to a six-lane facility from 39th Street east to 78th Street. An eight-lane facility is currently proposed from Kennedy Boulevard east to 39th Street.

Adamo Drive (S.R. 60) - is an east-west principal arterial that traverses all of Hillsborough County. Between 13th Street and 50th Street, Adamo Drive is located approximately two-thirds of a mile south of I-4 and one-sixteenth of a mile north of the South Crosstown Expressway. In this area, Adamo Drive is currently a four-lane divided facility. The Long Range Highway Plan for Hillsborough County includes improving Adamo Drive to a six-lane divided facility.

14th/15th Streets - are a north-south one-way pair located east of I-275. Fourteenth Street is a two-lane one-way southbound facility and 15th Street is a three-lane one-way northbound facility. South of the I-4 overpass these roads merge and connect with the Nick Nuccio Parkway (a four-lane divided facility) south of 7th Avenue. Along with the South Crosstown Expressway and Adamo Drive, Nick Nuccio Parkway provides access to the east side of the Tampa CBD.

21st/22nd Streets - are a north-south one-way pair located east of 14th/15th Streets. Twenty-first Street is a three-lane one-way southbound facility. North of I-4, 22nd Street is a two-lane one-way northbound facility while south of I-4 it is a three-lane one-way northbound facility. Just north of the interchange with the South Crosstown Expressway, 22nd Street becomes a four-lane two-way facility. This facility serves as the primary access to/from the Port of Tampa.

40th Street - is a six-lane north-south arterial that has its southern terminus at 7th Avenue (S.R. 574), approximately one-third of a mile south of I-4. Approximately one-tenth of a mile south of the I-4 interchange, at 11th Avenue, 39th Street merges with 40th Street. Thirty-ninth Street extends south of 7th Avenue as a four-lane arterial and terminates at its interchange with the South Crosstown Expressway.

50th Street (U.S. 41) - is a north-south arterial paralleling 39th/40th Street to the east. North of the I-4 interchange, 50th Street is a four-lane arterial that diverges to form Melburne Boulevard (Business U.S. 41) which runs in a northwesterly direction and connects with 40th Street. South of the I-4 interchange, 50th Street is a six-lane arterial that extends south of the interchange with the Crosstown Expressway and continues southward through the remaining portion of Hillsborough County.

EXISTING CONDITIONS

To provide a baseline condition, the existing conditions on I-4 were evaluated. This involved an inventory of existing geometric and traffic conditions, an evaluation of peak hour traffic operations and an assessment of traffic safety. The following discusses each of these.

Existing Traffic Volumes

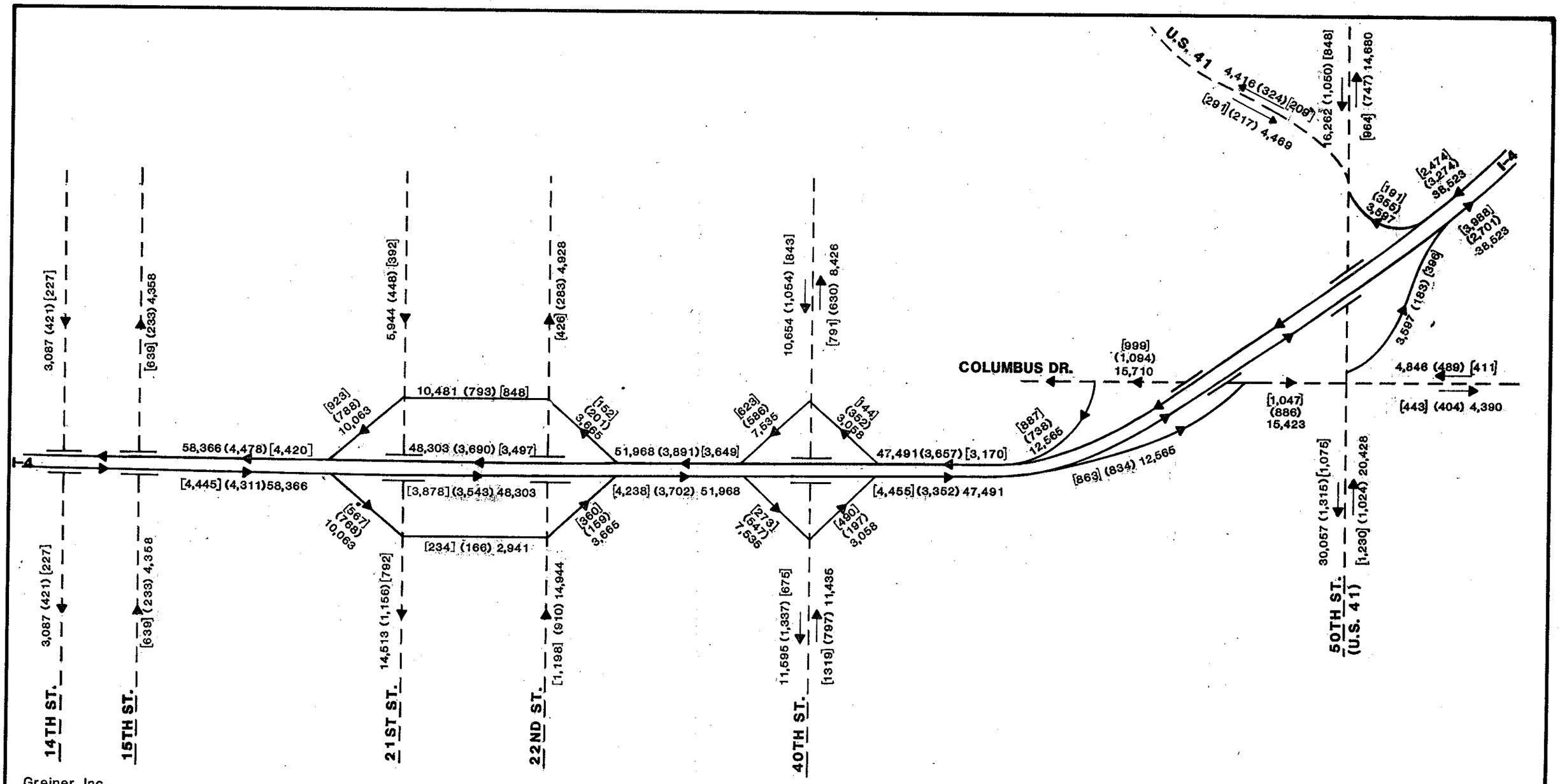
Existing average daily traffic (ADT) and peak hour (a.m. and p.m.) volumes were obtained from traffic counts conducted in the project area by Greiner, Inc. At selected locations, 24-hour machine traffic counts (directional volumes in 15-minute increments) were conducted on I-4 and adjacent arterials. The daily traffic counts were collected at the following locations:

I-4 Mainline west of 21st Street
I-4 Mainline west of 50th Street
Eastbound I-4 off-ramp to 21st Street
Eastbound I-4 on-ramp from 22nd Street
Eastbound I-4 on- and off-ramps at 40th Street
Eastbound I-4 off-ramp to Columbus Drive
Eastbound I-4 on-ramp from 50th Street
Westbound I-4 off-ramp to 50th Street
Westbound I-4 on-ramp from Columbus Drive
Westbound I-4 on- and off-ramps at 40th Street
Westbound I-4 off-ramp to 22nd Street
Westbound I-4 on-ramp from 21st Street
14th Street (at I-4 overpass)
15th Street (at I-4 overpass)
21st Street (north and south of I-4 ramps)
22nd Street (north and south of I-4 ramps)
40th Street (north and south of I-4 ramps)
50th Street (north and south of I-4 ramps)

Peak hour turning movement counts were conducted from 7 to 9 a.m. and 4 to 6 p.m. at the ramp terminals at the following interchanges:

I-4 and 21st/22nd Streets
I-4 and 40th Street
I-4 and 50th Street/Columbus Drive

The existing ADT's and peak hour (a.m. and p.m.) traffic volumes on I-4 are illustrated on Exhibit 3. The existing a.m. and p.m. peak hour turning movements at the I-4 ramp terminals are illustrated on Exhibit 4.



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LEGEND

51,968 Average Daily Traffic Volume
(3,891) A.M. Peak Hour Volume
[3,649] P.M. Peak Hour Volume

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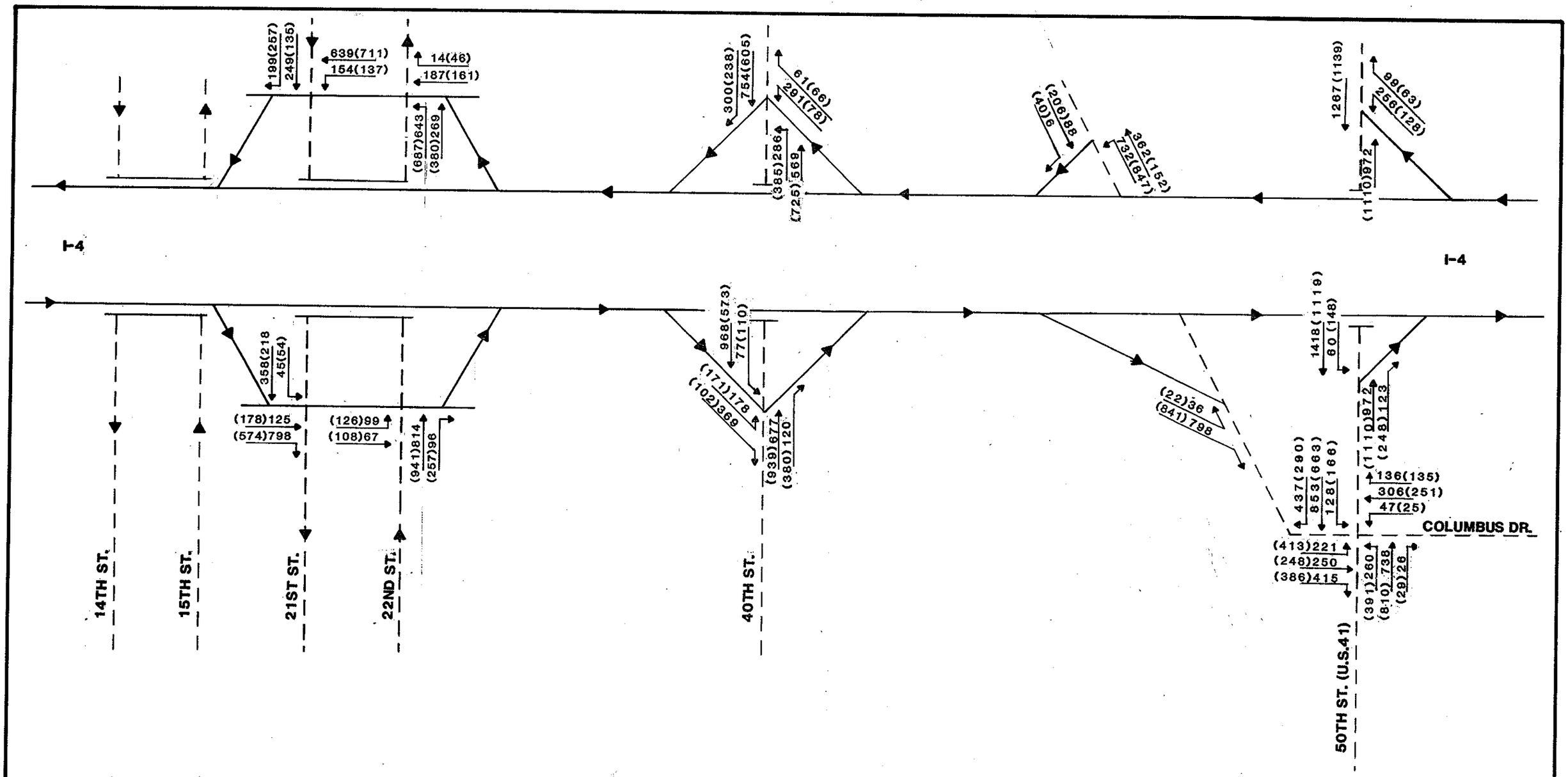
INTERCHANGE JUSTIFICATION REPORT
I-4/CROSSTOWN CONNECTOR
Hillsborough County, Florida

EXISTING (1988) TRAFFIC VOLUMES

EXHIBIT 3



Greiner, Inc.

LEGEND

798 A.M. Peak Hour

(863) P.M. Peak Hour

FLORIDA DEPARTMENT OF TRANSPORTATION

INTERCHANGE JUSTIFICATION REPORT

I-4/CROSSTOWN CONNECTOR

Hillsborough County, Florida

EXISTING (1988) PEAK HOUR TURNING MOVEMENTS

EXHIBIT 4

Existing Traffic Operations

Using the existing peak hour volumes, traffic operations analyses were conducted for the mainline of I-4 from west of 21st Street to east of 50th Street.

The weaving section speeds and the ramp junction merge and diverge volumes were estimated using the methodologies described in Chapter 4, Weaving Areas, and Chapter 5, Ramps and Ramp Junctions, of the 1985 Highway Capacity Manual (HCM). To be consistent with the operations analyses conducted for TIS, the levels of service for the merge and diverge areas in this study were determined using the values developed for TIS and previously approved by FHWA. In addition, the levels of service for weaving and non-weaving speeds in weaving sections that were used for TIS were also used in this study. Table 1 lists the merge, diverge and weaving section levels of service used in the operations analyses.

The capacity calculations for the ramp junctions are contained in Appendix A.

Tables 2 and 3 summarize the level of service for existing conditions on I-4 in the a.m. and p.m. peak hours, respectively. As seen in the tables, the existing operating conditions on I-4 include several merge/diverge areas and weaving areas operating at unacceptable levels of service.

In the a.m. peak hour the westbound on-ramp from 40th Street operates at Level of Service E (LOS E). This is primarily due to the high volume (3,305 vehicles per hour) on the freeway upstream of the on-ramp. In addition, the weaving sections between the 40th Street and Columbus Drive/50th Street interchanges operate at LOS F in both the eastbound and westbound directions. This is due to the short lengths of the

TABLE 1

LEVELS OF SERVICE FOR MERGE/DIVERGE VOLUMES AND SPEEDS IN WEAVING SECTIONS
I-4/Crosstown Connector

MERGE/DIVERGE AREAS

LOS	Merge Volume (in pcph)	Diverge Volume (in pcph)
A	≤ 660	≤ 715
B	≤ 1,100	≤ 1,155
C	≤ 1,595	≤ 1,650
D	≤ 1,925	≤ 1,980
E	≤ 2,200	≤ 2,200

WEAVING SECTIONS

	50 mph Design Speed		60 mph Design Speed	
LOS	Weaving Speed Sw (in mph)	Non-Weaving Speed Snw (in mph)	Weaving Speed Sw (in mph)	Non-Weaving Speed Snw (in mph)
A	≥ 50.0	≥ 54.0	≥ 55.0	≥ 60.0
B	≥ 45.0	≥ 48.0	≥ 50.0	≥ 54.0
C	≥ 40.0	≥ 42.0	≥ 45.0	≥ 48.0
D	≥ 35.0	≥ 35.0	≥ 40.0	≥ 42.0
E	≥ 30.0	≥ 30.0	≥ 35.0	≥ 35.0
F	< 30.0	< 30.0	< 35.0	< 35.0

TABLE 2

EXISTING I-4 FREEWAY OPERATIONS ANALYSIS SUMMARY - AM PEAK HOUR
I-4/Crosstown Connector

Location	Freeway Volume (in vph)[1]	Merge Area			Diverge Area			Weaving Area				
		Ramp Volume (in vph)	Merge Volume (in pcph)	Merge Level of Service	Ramp Volume (in vph)	Diverge Volume (in pcph)	Diverge Level of Service	Type of Weave	Weaving Speed (in mph)	Weaving Level of Service	Non-Weaving Speed (in mph)	Non-Weaving Level of Service
EB I-4 off-ramp to 21st Street	4,311				768	825	B					
EB I-4 on-ramp from 22nd Street	3,543	159	1,646	D								
EB I-4 off-ramp to 40th Street	3,702				547	1,886	D					
EB I-4 between 40th Street and Columbus Drive/50th Street	3,352							A	31.6	F	45.1	D
EB I-4 on-ramp from Columbus Drive/50th Street	2,518	183	1,270	C								
WB I-4 off-ramp to Columbus Drive/50th Street	3,274				355	1,615	C					
WB I-4 between Columbus Drive/ 50th Street and 40th Street	3,657							A	33.7	F	46.7	D
WB I-4 on-ramp from 40th Street	3,305	586	1,962	E								
WB I-4 off-ramp to 22nd Street	3,891				201	1,768	D					
WB I-4 on-ramp from 21st Street	3,690	788	846	B								

1 Refers to the freeway volume that occurs before merge or diverge.
vph = Vehicles per hour
pcph = Passenger cars per hour
mph = Miles per hour

TABLE 3

EXISTING I-4 FREEWAY OPERATIONS ANALYSIS SUMMARY - PM PEAK HOUR
I-4/Crosstown Connector

Location	Freeway Volume (in vph)[1]	Merge Area			Diverge Area			Weaving Area				
		Ramp Volume (in vph)	Merge Volume (in pcph)	Merge Level of Service	Ramp Volume (in vph)	Diverge Volume (in pcph)	Diverge Level of Service	Type of Weave	Weaving Speed (in mph)	Weaving Level of Service	Non-Weaving Speed (in mph)	Non-Weaving Level of Service
EB I-4 off-ramp to 21st Street	4,445				567	609	A					
EB I-4 on-ramp from 22nd Street	3,878	360	1,965	E								
EB I-4 off-ramp to 40th Street	4,238				273	1,940	D					
EB I-4 between 40th Street and Columbus Drive/50th Street	4,455							A	28.7	F	42.4	D
EB I-4 on-ramp from Columbus Drive/50th Street	3,592	396	1,889	D								
WB I-4 off-ramp to Columbus Drive/50th Street	2,474				191	1,214	C					
WB I-4 between Columbus Drive/ 50th Street and 40th Street	3,170							A	34.8	F	47.0	D
WB I-4 on-ramp from 40th Street	3,026	623	1,889	D								
WB I-4 off-ramp to 22nd Street	3,649				152	1,648	C					
WB I-4 on-ramp from 21st Street	3,497	923	991	B								

[1] Refers to the freeway volume that occurs before merge or diverge.
vph = Vehicles per hour
pcph = Passenger cars per hour
mph = Miles per hour

weaving sections (560 feet and 740 feet in the eastbound and westbound directions, respectively). The analyses also indicate that in the westbound direction, the lane adjacent to the merge/diverge locations from east of 50th Street to west of 21st Street is operating at unacceptable levels of service. In the eastbound direction, unacceptable levels of service are occurring in the lane adjacent to the merge/diverge areas from west of 21st Street to east of 40th Street.

In the p.m. peak hour, the eastbound on-ramp from 22nd Street operates at LOS E. In addition, the weaving sections between the 40th Street and Columbus Drive/50th Street interchanges operate at LOS F in both the eastbound and westbound directions. As was the case in the a.m. peak hour, the lane adjacent to the merge/diverge areas operates at unacceptable levels of service in the p.m. peak hour. In the eastbound direction, this lane operates at an unacceptable level of service from west of 21st Street to east of Columbus Drive/50th Street. In the westbound direction, this lane operates at an unacceptable level of service from east of 40th Street to west of 21st Street. The volume to capacity ratios of the adjacent lanes are also included in Appendix A.

In addition to the mainline I-4 analyses, signalized intersection analyses were conducted for the I-4 interchange ramp terminals for the a.m. and p.m. peak hours using the methodology described in Chapter 9 - Signalized Intersections, of the HCM. The results of these ramp terminal operations analyses are listed in Table 4. The table indicates that all I-4 ramp terminals are operating at LOS D in both the a.m. and p.m. peak hours. The capacity calculations for the freeway ramp terminals are also included in Appendix A.

TABLE 4

EXISTING I-4 RAMP TERMINAL OPERATIONS ANALYSIS SUMMARY
I-4/Crosstown Connector

AM PEAK HOUR

Location	Delay (in sec/veh)	V/C Ratio	Level of Service
I-4 @ 21st/22nd Street	34.1	0.85	D
I-4 @ 40th Street	38.4	0.84	D
Columbus @ 50th Street	25.8	0.70	D

PM PEAK HOUR

I-4 @ 21st/22nd Street	36.5	0.97	D
I-4 @ 40th Street	32.5	0.75	D
Columbus @ 50th Street	27.5	0.71	D

Traffic Safety

Accident data was obtained from FDOT for a five-year period (1983-1987). Both detailed and summary accident data were reviewed. The accident data for I-4 from east of 14th Street to east of 50th Street (U.S. 41) are summarized in Tables 5 through 9.

The tables provide a listing, by year, of the number of accidents (total accidents as well as fatalities, injuries, and property damage), average daily traffic volumes, actual accident rate, critical accident rate, safety ratio, economic loss and property loss. The safety ratio, the ratio of the actual accident rate to the critical accident rate, is the criteria used to identify safety problems and/or high accident locations. The critical accident rate is the statewide average accident rate for a similar facility. Thus, a safety ratio greater than 1.00 indicates that the facility is experiencing more accidents than would typically be anticipated on this type of facility.

As shown in Tables 5 and 6, the section of I-4 from east of 14th Street to east of 26th Street has experienced safety ratios greater than 1.00. On the section of I-4 between 19th Street and 26th Street (Table 6), the safety ratio has exceeded 1.10 for each of the five years from 1983 to 1987 with a maximum value of 1.581 in 1987. The high safety ratios in this area are primarily due to the large amount of lane changing (weaving) that occurs. In the eastbound direction, a single lane from southbound I-275 merges as a left side lane add with two lanes from eastbound I-275 to form I-4. Approximately 3,800 feet east of this merge, there is a drop lane to 21st Street with the other two lanes continuing eastward. This configuration requires all vehicles from southbound I-275 that exit at 21st Street to change two lanes. In the westbound

TABLE 5

ACCIDENT SUMMARY
I-4 FROM EAST OF 14TH STREET TO EAST OF 19TH STREET
I-4/Crosstown Connector

Year	Roadway Type	ADT[a]	Accidents	Actual[b] Accident Rate	Critical[b] Accident Rate	Safety Ratio	Number of Fatalities	Number of Injuries	Number of Property Damage Accidents	Economic Loss	Property Loss
1983	6LD	87,839	51	2.651	2.677	0.990	0	8	43	$160,400	-
1984	6LD	100,246	46	2.095	1.731	1.210	1	41	21	643,300	-
1985	6LD	109,947	41	1.702	1.768	0.962	1	20	22	450,000	-
1986	6LD	109,156	45	1.882	1.547	1.216	0	41	25	579,300	$2,200
1987	6LD	112,627	34	1.378	1.582	0.871	1	24	17	606,200	1,275
TOTAL	-	-	217	-	-	-	3	134	128	$2,439,200	$3,475

Mile Post Marker 7.65 To 8.25

Source: Data supplied by the Florida Department of Transportation.
[a] Average Daily Traffic Volume.
[b] Accidents per million vehicle miles.

TABLE 6

ACCIDENT SUMMARY
I-4 FROM EAST OF 19TH STREET TO EAST OF 26TH STREET
I-4/Crosstown Connector

Year	Roadway Type	ADT[a]	Accidents	Actual[b] Accident Rate	Critical[b] Accident Rate	Safety Ratio	Number of Fatalities	Number of Injuries	Number of Property Damage Accidents	Economic Loss	Property Loss
1983	6LD/4LD	87,960	49	3.052	2.766	1.103	0	12	38	$187,600	-
1984	6LD/4LD	100,246	44	2.405	1.792	1.342	0	38	19	139,140	-
1985	6LD/4LD	98,047	40	2.235	1.869	1.195	0	24	24	271,200	-
1986	6LD/4LD	104,042	39	2.056	1.620	1.269	0	33	22	471,900	$2,900
1987	6LD/4LD	106,126	48	2.664	1.684	1.581	1	29	31	709,700	3,425
TOTAL	-	-	220	-	-	-	1	136	134	$1,778,640	$6,325

Mile Post Marker 8.25 To 8.75

Source: Data supplied by the Florida Department of Transportation.
[a] Average Daily Traffic Volume.
[b] Accidents per million vehicle miles.

TABLE 7

ACCIDENT SUMMARY
I-4 FROM EAST OF 26TH STREET TO EAST OF 34TH STREET
I-4/Crosstown Connector

Year	Roadway Type	ADT[a]	Accidents	Actual[b] Accident Rate	Critical[b] Accident Rate	Safety Ratio	Number of Fatalities	Number of Injuries	Number of Property Damage Accidents	Economic Loss	Property Loss
1983	4LD	88,067	35	1.451	2.577	0.563	0	15	25	$189,500	$109,190
1984	4LD	100,246	25	0.911	1.655	0.550	0	17	12	182,100	-
1985	4LD	81,948	32	1.426	1.789	0.797	1	17	16	410,100	-
1986	4LD	97,424	15	0.562	1.515	0.370	0	4	11	82,200	800
1987	4LD	102,225	23	0.821	1.545	0.531	0	14	13	211,200	550
TOTAL	-	-	130	-	-	-	1	67	77	$1,075,100	$110,540

Mile Post Marker 8.75 To 9.50

Source: Data supplied by the Florida Department of Transportation.
[a] Average Daily Traffic Volume.
[b] Accidents per million vehicle miles.

TABLE 8

ACCIDENT SUMMARY
I-4 FROM EAST OF 34TH STREET TO EAST OF 40TH STREET
I-4/Crosstown Connector

Year	Roadway Type	ADT[a]	Accidents	Actual[b] Accident Rate	Critical[b] Accident Rate	Safety Ratio	Number of Fatalities	Number of Injuries	Number of Property Damage Accidents	Economic Loss	Property Loss
1983	4LD	83,512	33	2.165	2.789	0.776	0	9	26	$135,700	-
1984	4LD	85,554	21	1.344	1.853	0.725	1	7	15	315,100	-
1985	4LD	76,780	16	1.141	1.968	0.579	0	3	13	53,900	-
1986	4LD	91,702	15	0.896	1.664	0.538	0	9	9	137,700	$ 400
1987	4LD	97,343	24	1.350	1.689	0.799	0	10	15	168,000	1,125
TOTAL	-	-	109	-	-	-	1	38	78	$810,400	$1,525

Mile Post Marker 9.50 To 10.00

Source: Data supplied by the Florida Department of Transportation.
[a] Average Daily Traffic Volume.
[b] Accidents per million vehicle miles.

TABLE 9

ACCIDENT SUMMARY
I-4 FROM EAST OF 40TH STREET TO EAST OF 50TH STREET
I-4/Crosstown Connector

Year	Roadway Type	ADT[a]	Accidents	Actual[b] Accident Rate	Critical[b] Accident Rate	Safety Ratio	Number of Fatalities	Number of Injuries	Number of Property Damage Accidents	Economic Loss	Property Loss
1983	4LD	62,405	41	2.249	2.702	0.832	0	7	34	$133,100	-
1984	4LD	63,482	33	1.780	1.793	0.992	0	25	14	260,500	-
1985	4LD	68,518	36	1.799	1.831	0.982	0	22	19	242,600	-
1986	4LD	77,565	19	0.838	1.563	0.536	0	15	7	205,500	$4,100
1987	4LD	80,320	27	1.151	1.597	0.720	0	13	20	219,900	3,690
TOTAL	-	-	156	-	-	-	0	82	94	$1,061,600	$7,790

Mile Post Marker 10.00 To 10.80

Source: Data supplied by the Florida Department of Transportation.
[a] Average Daily Traffic Volume.
[b] Accidents per million vehicle miles.

direction, a single lane on-ramp from 21st Street merges with two through lanes on I-4 as a lane add. These three lanes then split into southbound I-275 (two lanes) and northbound I-275 (one lane). All vehicles destined for southbound I-275 that enter at 21st Street must weave with all vehicles on I-4 east of 21st that are destined for northbound I-275. The sections of I-4 from east of 26th Street to east of 40th Street (Tables 7 and 8) have safety ratios less than 1.00, ranging from a low of 0.370 to a high of 0.799. The section from east of 40th Street to east of 50th Street (U.S. 41) has experienced safety ratios approaching 1.00 in three of the five years (Table 9).

TRAFFIC PROJECTIONS

The TIS Master Plan concept includes a four-roadway system on I-4 in the vicinity of the proposed project. The four-roadway system consists of an eight-lane express freeway system with two High Occupancy Vehicle (HOV) lanes in the center of the roadway and a two- to three-lane local access freeway system on the outside of the express lanes. This four-roadway system is to be implemented in two phases. Phase I of the Master Plan concept includes the I-4 local access freeway system and the Crosstown Connector interchange, while Phase II includes the I-4 express freeway system and the HOV lanes, additional direct connections to/from the Crosstown Connector interchange and slip ramps to/from the local access freeway system.

To assess the impact of the proposed project, both 1995 (opening year) and 2010 (design year) traffic projections were estimated. These projections were estimated using the Florida Standard Urban Transportation Model Structure (FSUTMS) for

Hillsborough County, as supplied by FDOT and refined as part of TIS. Computer simulations were run for four alternatives:

* Alternative A - Opening Year (1995)
* Alternative B - No-Build (1995)
* Alternative C - Design Year (2010)
* Alternative D - No-Build (2010)

The Crosstown Connector interchange is included in both Alternatives A and C and the existing 40th Street interchange is eliminated. Alternative A includes "braided" ramps at 15th Street (to and from the east) and 21st Street (to and from the west) while Alternative C includes a split-diamond interchange at 14th Street (to and from the west) and 15th Street (to and from the east). The existing 21st/22nd Street interchange is replaced by the 14th/15th Street interchange in Alternative C. Alternative B (the 1995 No-Build Alternative) contains the existing laneage and interchange locations/configurations. Alternative D does not include the Crosstown Connector interchange but does include the split-diamond interchange at 14th/15th Streets and a modified 40th Street interchange. Alternatives A, C, and D all include a reconfigured 50th Street/Columbus Drive split-diamond interchange.

TRAFFIC OPERATIONS ANALYSES

Evaluation of opening year (1995) and design year (2010) operating conditions were based on directional design hour traffic volumes (DDHV's). The 1995 and 2010 ADT's were converted to DDHV's using a "K" factor of 8 percent and a "D" factor of 55 percent. These K and D factors are the same factors used in TIS. The analyses were conducted based upon the following assumptions:

Peak Hour Factor (PHF)	= 0.95
Design Hour Truck Percentage	= 3%
Design Hour Buses/RV Percentage	= 0%
Population Factor	= 1.0
Terrain	= Level
Design Speed	= 60 mph Express Freeway Lanes 50 mph Local Access Freeway Lanes

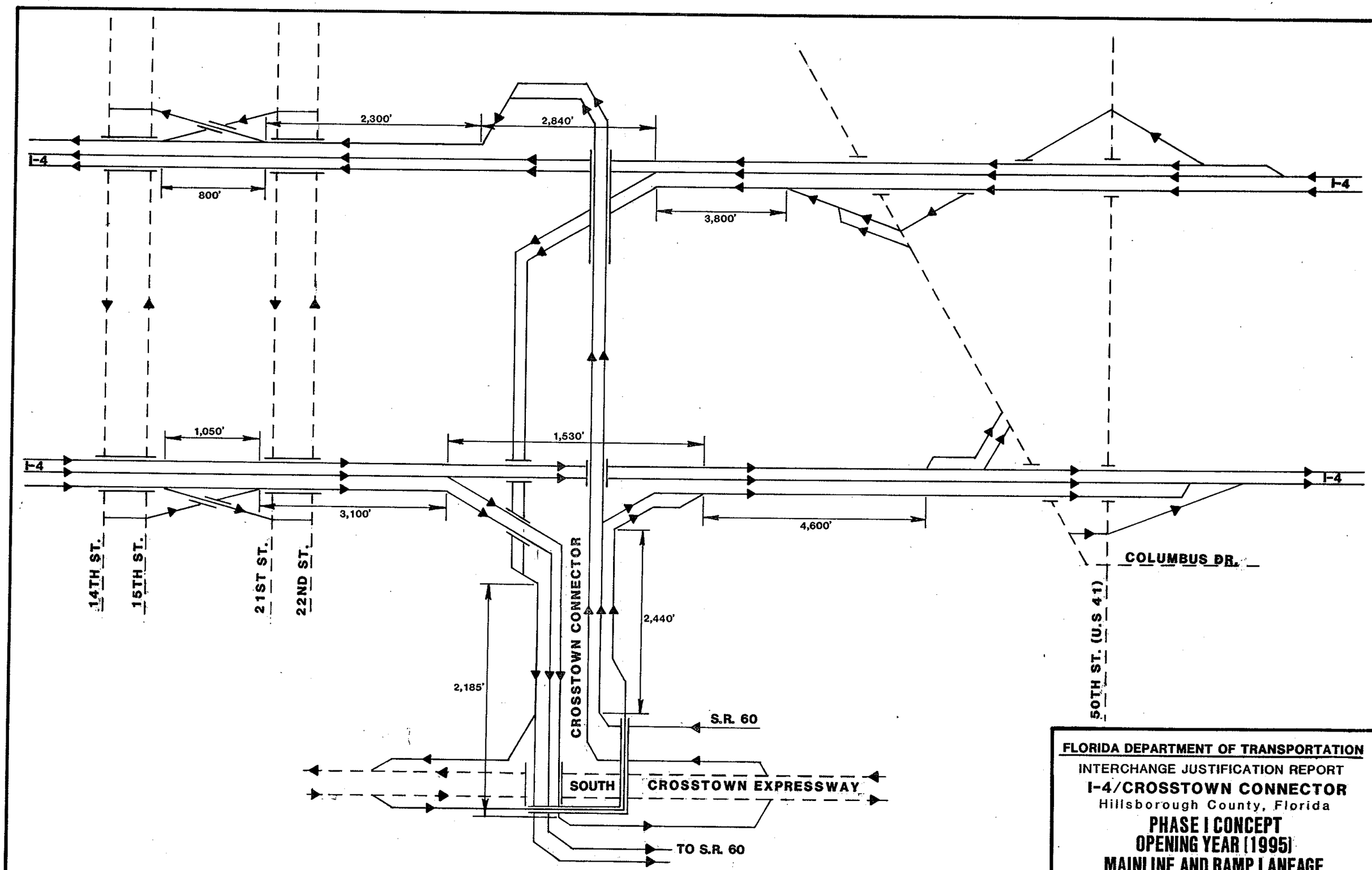
The following sections discuss the opening year, design year and No-Build alternatives and the corresponding operations analyses.

Opening Year (1995) Traffic Operations

Phase I Analysis

A schematic illustrating the opening year Phase I concept is provided on Exhibit 5. The Phase I improvement was developed as the initial phase of construction of the ultimate improvement. The Phase I concept reflects construction of the local access freeway lanes in the ultimate concept with the exception of the temporary ramps to and from the west at 21st Street. These temporary ramps are provided to maintain access to Ybor City and the eastern CBD. The permanent access will be provided at 14th Street.

The provision of access to/from I-4 at 14th/15th Streets (as opposed to the current access at 21st/22nd Streets) is required for the ultimate (Phase II) improvement due to the location of the Crosstown Connector. Traffic operations analyses conducted during the early stages of TIS indicated that the distances between the Crosstown Connector ramps to/from the west and the ramps to/from the east at 22nd Street were insufficient to provide acceptable levels of service on the I-4 local access freeway lanes.



Greiner, Inc.

FLORIDA DEPARTMENT OF TRANSPORTATION

INTERCHANGE JUSTIFICATION REPORT

I-4/CROSSTOWN CONNECTOR

Hillsborough County, Florida

PHASE I CONCEPT
OPENING YEAR (1995)
MAINLINE AND RAMP LANEAGE

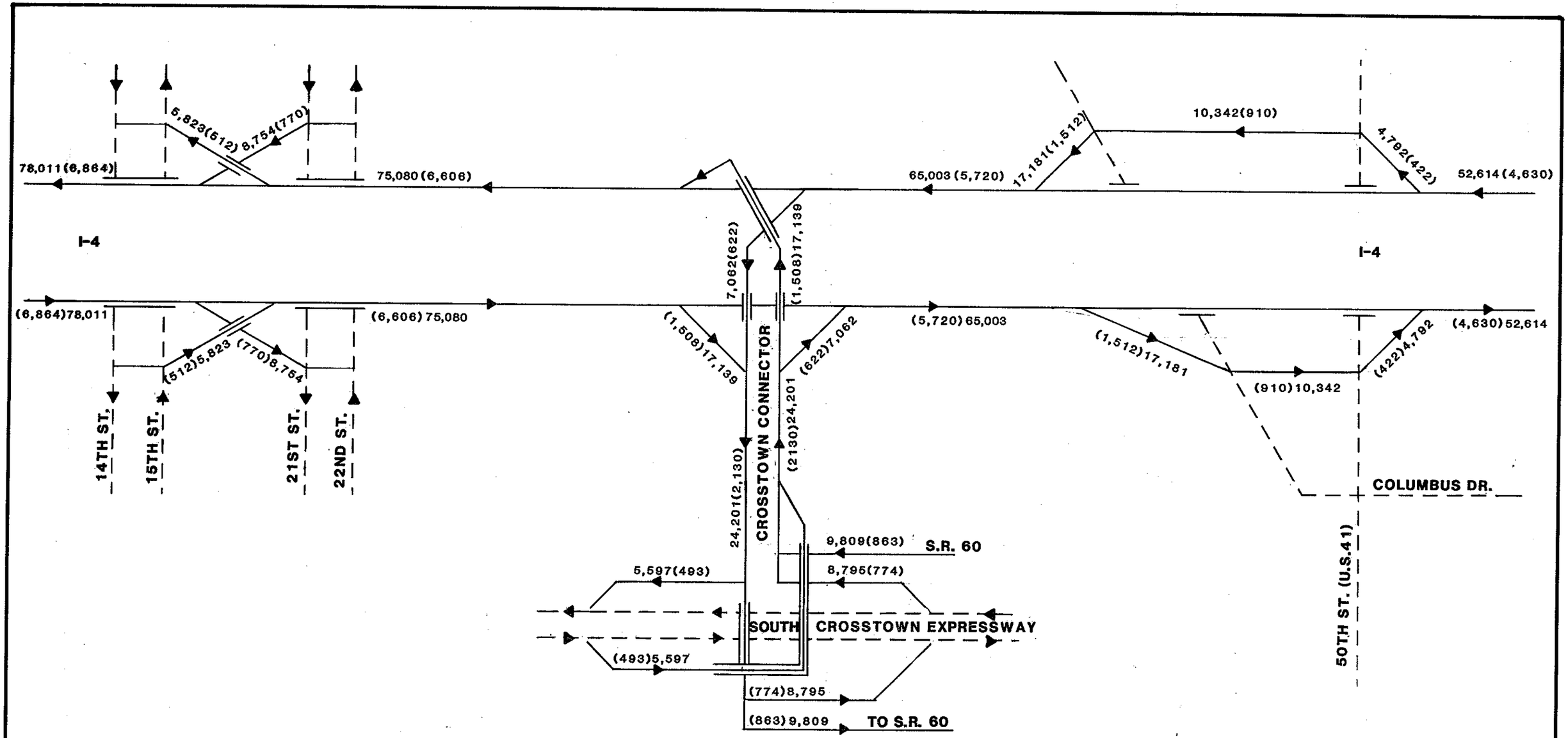
EXHIBIT 5

The construction of the ramps to and from the west at 14th Street are to be constructed as part of the ultimate (Phase II) improvement since they require substantial modifications to the I-4/I-275 interchange due to distances required between ramp gores.

The construction of temporary ramps to and from the west at 14th Street that tie to existing I-4 in Phase I was analyzed to determine the traffic operations impacts. The construction of temporary ramps at 14th Street would create weaving areas between these ramps and the I-4/I-275 junction. The eastbound and westbound weaving area lengths would be approximately 835 feet and 1,065 feet, respectively. The results of the traffic operations analyses indicated that the eastbound and westbound weaving areas were projected to operate at LOS F. In the eastbound weaving area, the speeds of the weaving and non-weaving vehicles were estimated to be 24.3 miles/hour and 21.4 miles/hour, respectively. In the westbound weaving area, the weaving and non-weaving vehicle speeds were projected to be 32.8 miles/hour and 26.9 miles/hour. It should also be noted that the 1995 volumes projected on I-4 between the I-275/I-4 and 14th/15th Street interchanges exceed the available capacity even if the weaving areas are not present. The capacity calculations for these weaving areas are included in Appendix B.

Based on these results, the permanent ramps to and from the east at 15th Street and temporary ramps to and from the west at 21st Street are provided in Phase I. A local circulation plan for the Ybor City/eastern CBD area (between 14th Street and 22nd Street) will be developed during the preliminary engineering design phase of this proposed project.

The opening year ADT and DDHV's are presented on Exhibit 6. The opening year Phase I analyses included evaluations of ramp junctions and weaving areas on I-4 and



Greiner, Inc.

LEGEND

65,043 Average Daily Traffic Volume
(5,720) Directional Design Hour Volume

FLORIDA DEPARTMENT OF TRANSPORTATION
INTERCHANGE JUSTIFICATION REPORT
I-4/CROSSTOWN CONNECTOR
Hillsborough County, Florida
PHASE I CONCEPT
OPENING YEAR (1995)
TRAFFIC VOLUMES

EXHIBIT 6

the Crosstown Connector. The analyses were conducted using the procedures contained in the HCM.

Table 10 summarizes the traffic operations analyses conducted on I-4 and the Crosstown Connector for opening year (1995). As indicated in Table 10, five of the 12 locations analyzed on I-4 will not operate at an acceptable level of service (LOS D) in the opening year with the proposed geometry. These locations are as follows:

* Eastbound I-4 off-ramp to 21st Street (LOS F).
* Eastbound I-4 weaving section between the Crosstown Connector on-ramp and the Columbus Drive off-ramp (LOS F).
* Eastbound I-4 on-ramp from 50th Street (LOS E).
* Westbound I-4 weaving section between the Columbus Drive on-ramp and the Crosstown Connector off-ramp (LOS E).
* Westbound I-4 on-ramp from 21st Street (LOS F).

Table 10 also indicates that the Crosstown Connector will operate at LOS B in the opening year. The capacity calculations for the ramp junctions and weaving areas are included in Appendix B.

No-Build Analysis

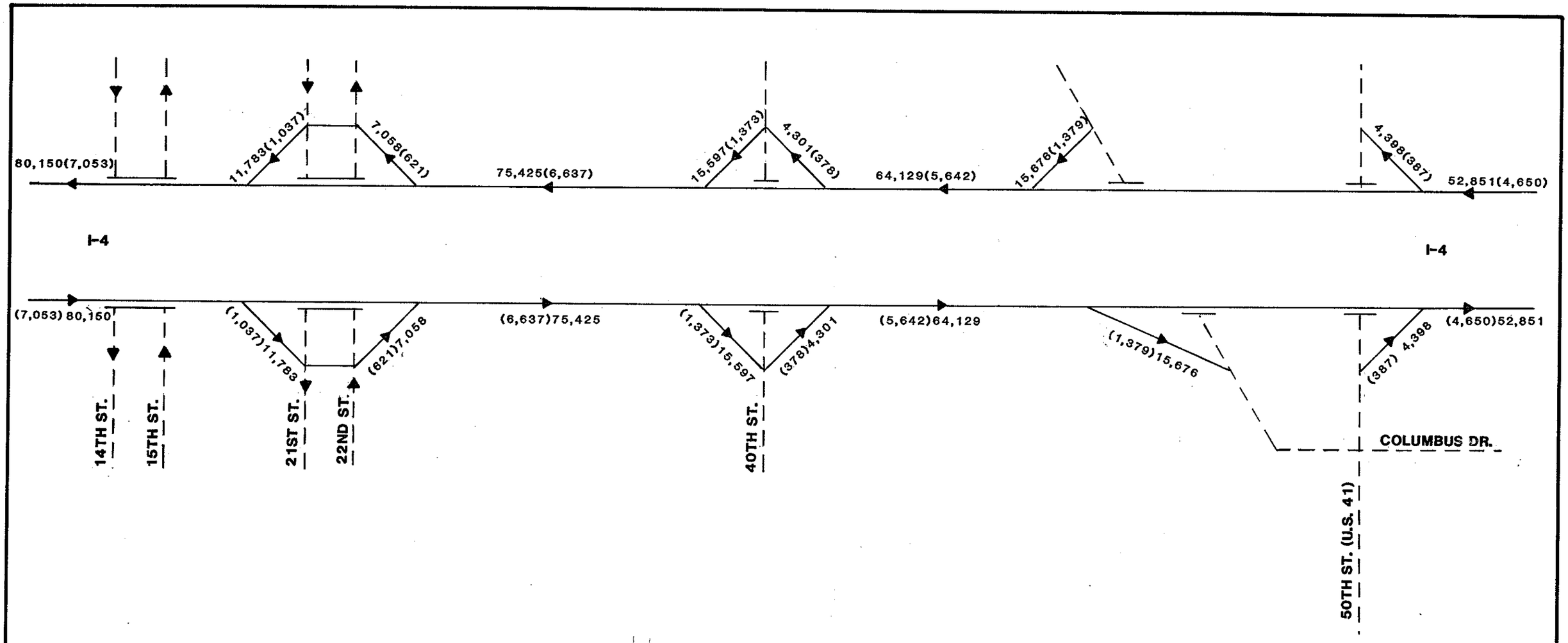
As was stated earlier, the No-Build Alternative assumed the existing geometry and interchange locations/configurations to be present in 1995. The 1995 No-Build Alternative ADT and DDHV's are illustrated on Exhibit 7. Table 11 summarizes the traffic operations analyses conducted on I-4 for the No-Build Alternative. As indicated in Table 11, only two of the 10 locations analyzed are projected to provide an acceptable level of service. These two locations are the eastbound I-4 off-ramp to

TABLE 10

OPENING YEAR (1995) I-4/CROSSTOWN CONNECTOR
FREEWAY OPERATIONS ANALYSIS SUMMARY - PHASE I
I-4/Crosstown Connector

Location	Freeway Volume (in vph)[1]	Merge Area			Diverge Area			Weaving Area				
		Ramp Volume (in vph)	Merge Volume (in pcph)	Merge Level of Service	Ramp Volume (in vph)	Diverge Volume (in pcph)	Diverge Level of Service	Type of Weave	Weaving Speed (in mph)	Weaving Level of Service	Non-Weaving Speed (in mph)	Non-Weaving Level of Service
EB I-4 Off-ramp to 21st Street	6,864				770	2,274	F					
EB I-4 between 15th Street and Crosstown Connector	6,606							B	40.3	C	40.0	D
EB I-4 between Crosstown Connector and Columbus Drive	5,720							C	33.7	E	29.4	F
EB I-4 on-ramp from 50th Street	4,208	422	2,148	E								
WB I-4 off-ramp to 50th Street	4,630				422	1,495	C					
WB I-4 between Columbus Drive and Crosstown Connector	5,720							C	37.9	D	33.2	E
WB I-4 between Crosstown Connector and 15th Street	6,606							B	38.5	D	36.4	D
WB I-4 on-ramp from 21st Street	6,094	770	2,374	F								
SB Crosstown Connector on-ramp from WB I-4	1,508	622	668	B								
SB Crosstown Connector off-ramp to WB Crosstown Expressway	2,130				493	896	B					
SB Crosstown Connector off-ramp to EB Crosstown Expressway	1,637				774	831	B					
NB Crosstown Connector diverge to EB and WB I-4	2,130				622	502/824	A/B					

[1] Refers to the freeway volume that occurs before merge or diverge.



Greiner, Inc.

LEGEND

64,129 Average Daily Traffic Volume
(5,642) Directional Design Hour Volume

FLORIDA DEPARTMENT OF TRANSPORTATION

INTERCHANGE JUSTIFICATION REPORT

I-4/CROSSTOWN CONNECTOR
Hillsborough County, Florida

NO-BUILD OPENING YEAR (1995) TRAFFIC VOLUMES

EXHIBIT 7

TABLE 11

NO BUILD (1995) I-4 FREEWAY OPERATIONS ANALYSIS SUMMARY
I-4/Crosstown Connector

Location	Freeway Volume (in vph)[1]	Merge Area			Diverge Area			Weaving Area				
		Ramp Volume (in vph)	Merge Volume (in pcph)	Merge Level of Service	Ramp Volume (in vph)	Diverge Volume (in pcph)	Diverge Level of Service	Type of Weave	Weaving Speed (in mph)	Weaving Level of Service	Non-Weaving Speed (in mph)	Non-Weaving Level of Service
EB I-4 off-ramp to 21st Street	7,053				1,037	1,114	B					
EB I-4 on-ramp from 22nd Street	6,016	621	3,026	F								
EB I-4 off-ramp to 40th Street	6,637				1,373	3,453	F					
EB I-4 between 40th Street and 50th Street/Columbus Drive	5,642							A	26.3	F	39.3	E
EB I-4 on-ramp from 50th Street	4,263	387	2,136	E								
WB I-4 off-ramp to 50th Street	4,650				387	2,156	E					
WB I-4 between 50th Street/ Columbus Drive and 40th Street	5,642							A	28.7	F	41.4	E
WB I-4 on-ramp from 40th Street	5,264	1,373	3,457	F								
WB I-4 off-ramp to 22nd Street	6,637				621	3,043	F					
WB I-4 on-ramp from 21st Street	6,016	1,037	1,114	C								

[1] Refers to the freeway volume that occurs before merge or diverge.

21st Street (a drop lane) and the westbound I-4 on-ramp from 21st Street (an add lane). The eastbound I-4 off-ramp to 21st Street is projected to operate at LOS B and the westbound I-4 on-ramp from 21st Street is projected to operate at LOS C in 1995. Of the eight locations that will operate at an unacceptable level of service, six of these are projected to operate at LOS F and the other two are anticipated to operate at LOS E. The capacity calculations for the ramp junctions and weaving areas are included in Appendix C.

It should be noted that although the actual eastbound diverge and westbound merge locations at 21st Street are projected to operate at LOS B and LOS C, respectively; the freeway segments immediately upstream and downstream of these locations are projected to operate at Level of Service F. The design hour volume on the two eastbound and westbound lanes east of the 21st Street on-/off-ramps is projected to be 6,016 vehicles per hour. This results in a per lane volume of 3,231 passenger cars per hour which exceeds the capacity (LOS E) by over 46 percent. The design hour volume on the three eastbound and westbound lanes west of the 21st Street on-/off-ramps is projected to be 7,053 vehicles per hour. This results in a per lane volume of 2,525 passenger cars per hour which exceeds the capacity by over 14 percent.

Given the large disparity between the add lane/drop lane volumes on the 21st Street ramps and the per lane volumes on mainline I-4 east and west of the add lane/drop lane, it is anticipated that a significant amount of lane changing will occur downstream of the on-ramp and upstream of the off-ramp. This lane changing is the result of drivers on mainline I-4 trying to improve their level of service by equalizing the lane volumes on the section of I-4 west of the 21st Street ramps. This driver behavior has been observed with the existing conditions and would be expected to

increase with the 1995 No-Build Alternative due to the projected increase in volume. This lane changing and disparity in lane volumes will result in increased turbulence, poorer operating conditions, and an increased potential for accidents.

A comparison of Tables 10 and 11 indicates that in 1995 unacceptable levels of service will exist at certain locations on I-4 with either the Phase I Alternative or the No-Build Alternative. However, the number of locations that will operate at LOS E or F with the Phase I Alternative (five) is less than with the No-Build Alternative (eight). In addition to the locations projected to operate at unacceptable levels of service, the per lane volumes exceed the available capacity for the adjacent freeway lanes within the study area (from west of 15th Street to 50th Street).

Exhibit 7 indicates that approximately 160,300 vehicles per day (vpd) are projected for I-4 east of the I-4/I-275 interchange in the year 1995 for the No-Build Alternative. Exhibit 6 identifies approximately 156,000 vpd projected for the year 1995 with the Crosstown Connector. These projections indicate that traffic is expected to shift from I-4/I-275 to the South Crosstown Expressway after construction of the Connector. It is anticipated that the distribution of traffic through the downtown interchange will not change due to the construction of the Connector, therefore, it is expected that each leg of the interchange will experience a decrease in traffic volumes. As a result, traffic operations for the I-4/I-275 interchange are not anticipated to degrade with the implementation of the Crosstown Connector compared to the No-Build Alternative.

Phase I Interim Improvement Analysis

Based on the results of the operations analyses conducted for the opening year (1995) Phase I concept, two interim improvement concepts were developed to improve traffic

operations on I-4. The first interim improvement concept (Option 1) was developed based on improving the traffic operations without increasing the pavement width beyond the width needed for the ultimate (Phase II) improvement. This concept would involve restriping the I-4 local access freeway lanes to provide one additional travel lane in each direction. This would result in a six-foot outside shoulder and a two-foot inside shoulder (as opposed to two, ten-foot shoulders). Upon completion of the express freeway system during Phase II, the local access freeway lanes would be restriped to provide the number of through lanes required in the ultimate improvement and ten-foot inside and outside shoulders.

The second interim improvement concept (Option 2) was developed based on improving traffic operations on I-4 and providing inside and outside shoulder widths that meet current design standards. With this concept, one additional travel lane in each direction would be constructed along with a ten-foot outside shoulder and a four-foot inside shoulder. The provision of these shoulder widths requires "overbuilding" the Phase II (Ultimate) local access freeway by a total of 12 feet, or six feet in each direction. Upon completion of the express freeway system in Phase II, the local access freeway would be restriped resulting in 13-foot inside and outside shoulders.

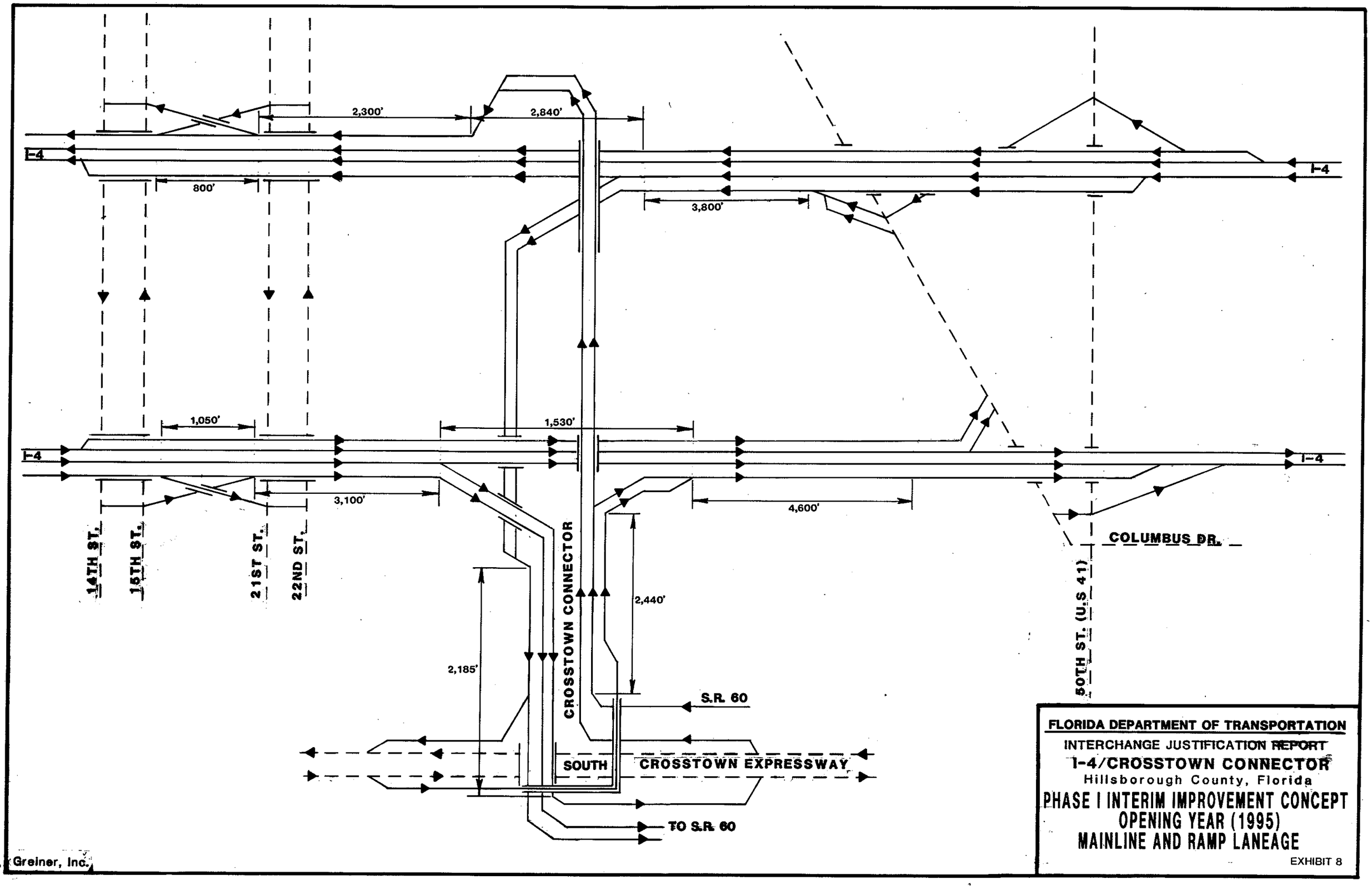
The overbuilding of the local freeway with Option 2 requires an additional 12 feet of full strength pavement with six feet less of shoulders for the roadway sections and appropriate bridge widening when compared with the cross section required for the ultimate concept. The additional cost associated with this concept was estimated to be $1,940,400.00 in 1990 dollars, which represents less than one percent of the total project cost.

Several discussions were held with the FHWA and the FDOT concerning the Phase I interim improvement concept. Based on the relatively minimal additional cost associated with overbuilding the local freeway and the desire to provide standard shoulder widths, Option 2 was selected as the Phase I interim improvement concept.

Exhibit 8 illustrates the laneage provided with the Phase I interim improvement concept. As indicated on Exhibit 8, the eastbound lane will be added west of the 21st Street off-ramp and dropped at the Columbus Drive off-ramp. The additional westbound lane will begin west of the 50th Street off-ramp and merge west of the 21st Street on-ramp. A concept plan on 100 scale aerial photography is included in the appended plan set.

Table 12 summarizes the traffic operations analyses conducted on I-4 and the Crosstown Connector for the Phase I interim improvement concept. As shown in the table, only two of the 12 locations analyzed are projected to operate at an unacceptable level of service. The eastbound I-4 weaving section between the Crosstown Connector on-ramp and the Columbus Drive off-ramp and the westbound I-4 on-ramp from 21st Street are both projected to operate at LOS E in 1995. Of the six locations on I-4 that operate at an acceptable level of service, four operate at LOS C while the other two operate at LOS D. All four locations on the Crosstown Connector are projected to operate at LOS B or better. The capacity calculations for the ramp junctions and weaving areas are included in Appendix D.

A comparison of the traffic operations projected for the eastbound weaving area between 40th Street and 50th Street in the No-Build Alternative with those projected for the eastbound weaving area between the Crosstown Connector and Columbus Drive



Greiner, Inc.

FLORIDA DEPARTMENT OF TRANSPORTATION

INTERCHANGE JUSTIFICATION ~~REPORT~~

I-4/CROSSTOWN CONNECTOR

Hillsborough County, Florida

PHASE I INTERIM IMPROVEMENT CONCEPT
OPENING YEAR (1995)
MAINLINE AND RAMP LANEAGE

EXHIBIT 8

TABLE 12

OPENING YEAR (1995) I-4/CROSSTOWN CONNECTOR
FREEWAY OPERATIONS ANALYSIS SUMMARY - PHASE I INTERIM IMPROVEMENT
I-4/Crosstown Connector

Location	Freeway Volume (in vph)[1]	Merge Area			Diverge Area			Weaving Area				
		Ramp Volume (in vph)	Merge Volume (in pcph)	Merge Level of Service	Ramp Volume (in vph)	Diverge Volume (in pcph)	Diverge Level of Service	Type of Weave	Weaving Speed (in mph)	Weaving Level of Service	Non-Weaving Speed (in mph)	Non-Weaving Level of Service
EB I-4 Off-ramp to 21st Street	6,864				770	1,556	C					
EB I-4 between 15th Street and Crosstown Connector	6,606							B	42.8	C	44.5	C
EB I-4 between Crosstown Connector and Columbus Drive	5,720							C	36.1	D	32.4	E
EB I-4 on-ramp from 50th Street	4,208	422	1,457	C								
WB I-4 off-ramp to 50th Street	4,630				422	1,495	C					
WB I-4 between Columbus Drive and Crosstown Connector	5,720							C	40.5	C	36.6	D
WB I-4 between Crosstown Connector and 15th Street	6,606							B	41.0	C	41.0	D
WB I-4 on-ramp from 21st Street	6,094	770	1,968	E								

[1] Refers to the freeway volume that occurs before merge or diverge.

in the Phase I Interim Improvement, indicates that the Phase I Interim Improvement Concept is expected to provide overall improved traffic operations for this section of I-4.

As indicated in Table 11, a weaving vehicle speed of 26.3 mph and a non-weaving vehicle speed of 39.3 mph is projected for the eastbound I-4 weaving area between 40th Street and 50th Street in the No-Build Alternative. Table 12 indicates that with the Phase I Interim Improvement, the weaving and non-weaving vehicle speeds for the eastbound I-4 weaving area between the Crosstown Connector and Columbus Drive are projected to be 36.4 mph and 32.4 mph, respectively. Therefore, the 13 mph travel speed differential anticipated to occur in the No-Build Alternative could be reduced to 4 mph with the implementation of the Phase I Interim Improvement. In general, the larger the disparity between vehicle operating speeds, the greater the potential for increased accidents. As a result, fewer accidents (and hence an improvement in safety) would be anticipated to occur on this section of I-4 with the Phase I Interim Improvement than with the No-Build Alternative. A comparison of Tables 11 and 12 also indicates that the projected level of service for the weaving vehicles is better with the Phase I Interim Improvement (LOS E) than with the No-Build Alternative (LOS F); while the level of service for the non-weaving vehicles remains the same (LOS E).

It should also be noted that the distance between the Crosstown Connector on-ramp and the Columbus Drive off-ramp (4,600 feet) greatly exceeds the maximum distance that the 1985 Highway Capacity Manual weaving area methodology was developed to analyze. Therefore, it is quite likely that the level of service in this area will be better than that estimated with the weaving analysis. The 5,720 vehicles per hour projected for the four eastbound I-4 lanes between the Crosstown Connector and

Columbus Drive results in a per lane flow rate of 1,536 passenger cars per hour. Based on a basic freeway segment analysis, this section of I-4 would be anticipated to operate at Level of Service C.

Although the westbound I-4 on-ramp from 21st Street is projected to operate at a lower level of service with the Phase I Interim Improvement concept (LOS E) than with the No-Build Alternative (LOS C), the Phase I Interim Improvement concept is anticipated to result in an improved level of service upstream of the merge area. The design hour volume on the four westbound lanes east of the 21st Street on-ramp is projected to be 6,094 vehicles per hour, which results in a per lane volume of 1,636 passenger cars per hour (LOS D). As stated earlier, with the No-Build Alternative, the per lane volume on the section of I-4 east of the 21st Street on-ramp is projected to be 3,231 passenger cars per hour (LOS F).

A comparison of Tables 10 and 12 indicates that the Phase I interim improvement concept results in improved traffic operations. The level of service at six of the eight locations analyzed on I-4 improved a minimum of one level with the Phase I interim improvement. No location will operate at LOS F and only two locations will operate at LOS E with the Phase I interim improvement concept. With the Phase I Concept three locations will operate at LOS F and two locations will operate at LOS E. It should also be noted that the per lane volumes on the freeway lanes do <u>not</u> exceed the available capacity. A comparison of Tables 11 and 12 indicates that the westbound I-4 off-ramp and the eastbound I-4 on-ramp to/from 50th Street are projected to operate at Level of Service E for the No-Build Alternative and Level of Service C for the Phase I interim improvement concept.

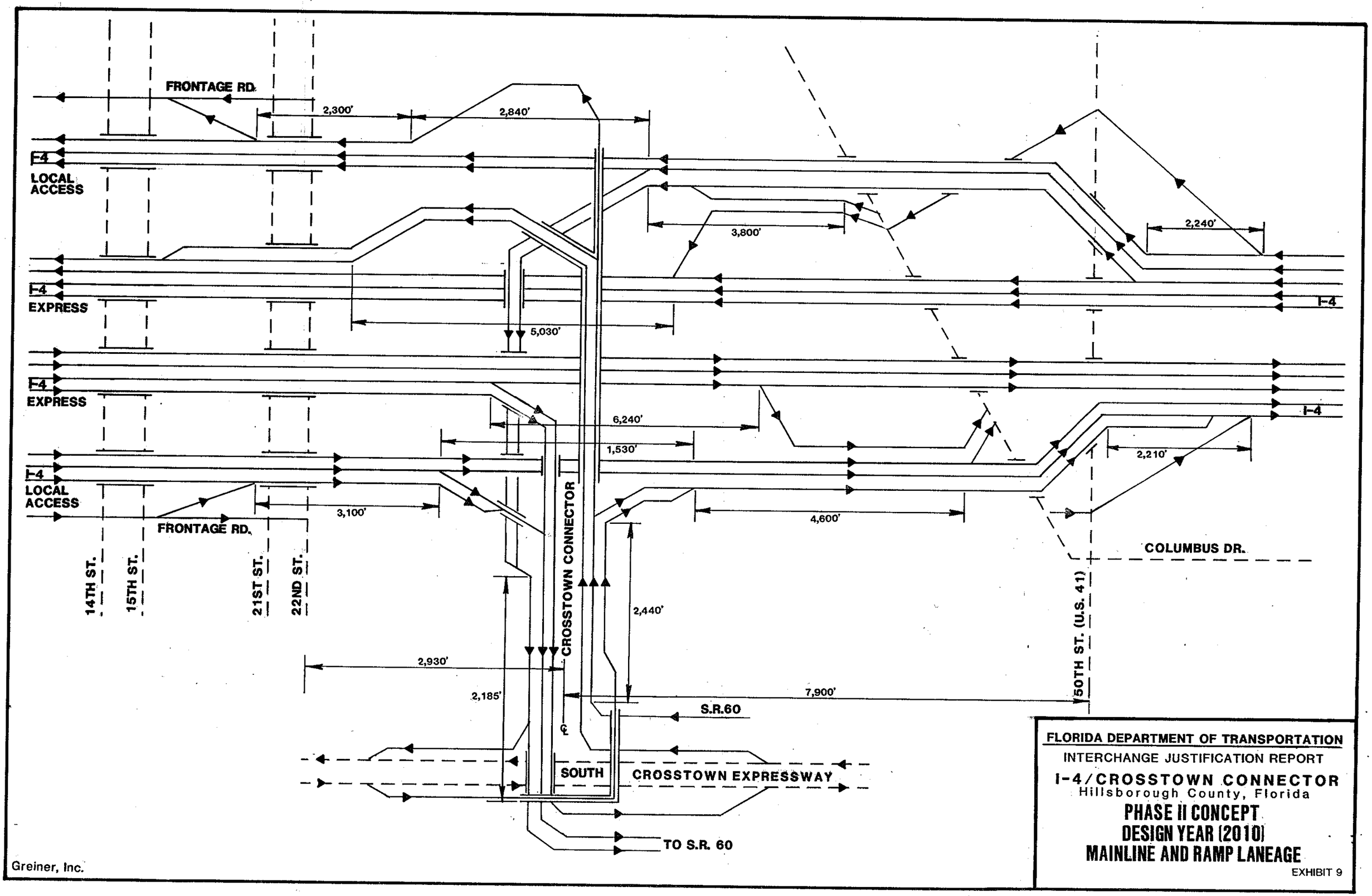
The improved traffic operations could be achieved with minor additional construction on the local access freeway lanes beyond that required for the ultimate concept. The local access freeway would be restriped upon completion of the express freeway system in the Phase II (Ultimate) concept resulting in 13-foot shoulders.

Design Year (2010) Traffic Operations

Phase II Analysis

The TIS Master Plan concept includes a four-roadway system on I-4 in the vicinity of the proposed project. The four-roadway system consists of an eight-lane express freeway system with two High Occupancy Vehicle (HOV) lanes and a two- to three-lane local access freeway system. The local access freeway lanes interchange with 14th/15th Streets, the Crosstown Connector, and Columbus Drive (to and from the west). The express freeway lanes interchange with the Crosstown Connector (to and from the west) and 50th Street (to and from the east). A schematic illustration of the ultimate concept is shown on Exhibit 9. A concept plan on 100 scale aerial photography is appended by reference.

The design year (2010) ADT's and DDHV's are provided on Exhibit 10 while the peak hour turning movements are provided on Exhibit 11. The design year analyses included evaluations of ramp junctions and weaving areas on I-4 and the Crosstown Connector and signalized intersection capacity analyses at the I-4 ramp terminals.



Greiner, Inc.

FLORIDA DEPARTMENT OF TRANSPORTATION

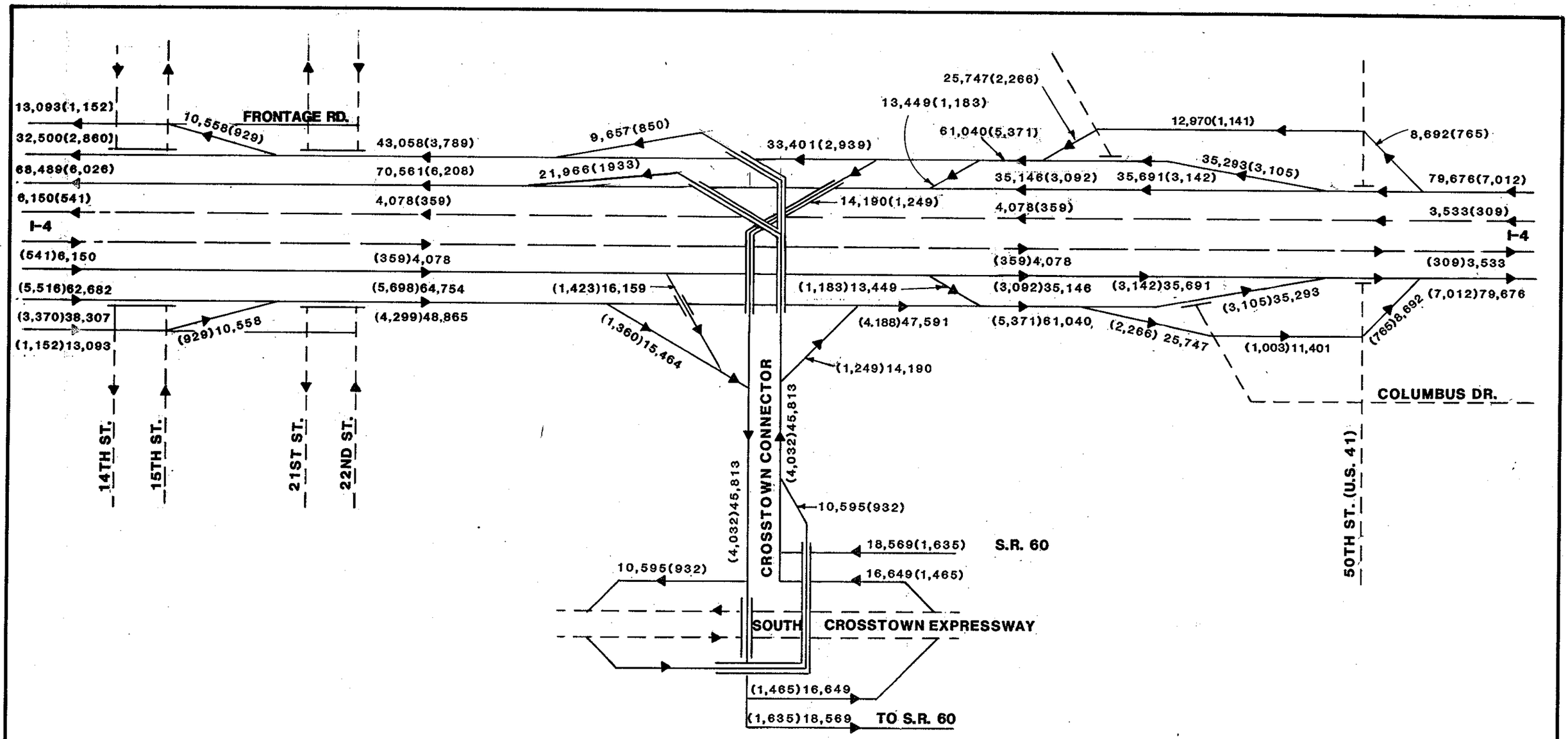
INTERCHANGE JUSTIFICATION REPORT

I-4/CROSSTOWN CONNECTOR

Hillsborough County, Florida

PHASE II CONCEPT
DESIGN YEAR (2010)
MAINLINE AND RAMP LANEAGE

EXHIBIT 9



Greiner, Inc.

LEGEND

- Concurrent Flow HOV Lane
- HOV Transitway
- **70,561** Average Daily Traffic Volume
- **(6,208)** Directional Design Hour Volume

REVISED: JULY 1991

FLORIDA DEPARTMENT OF TRANSPORTATION

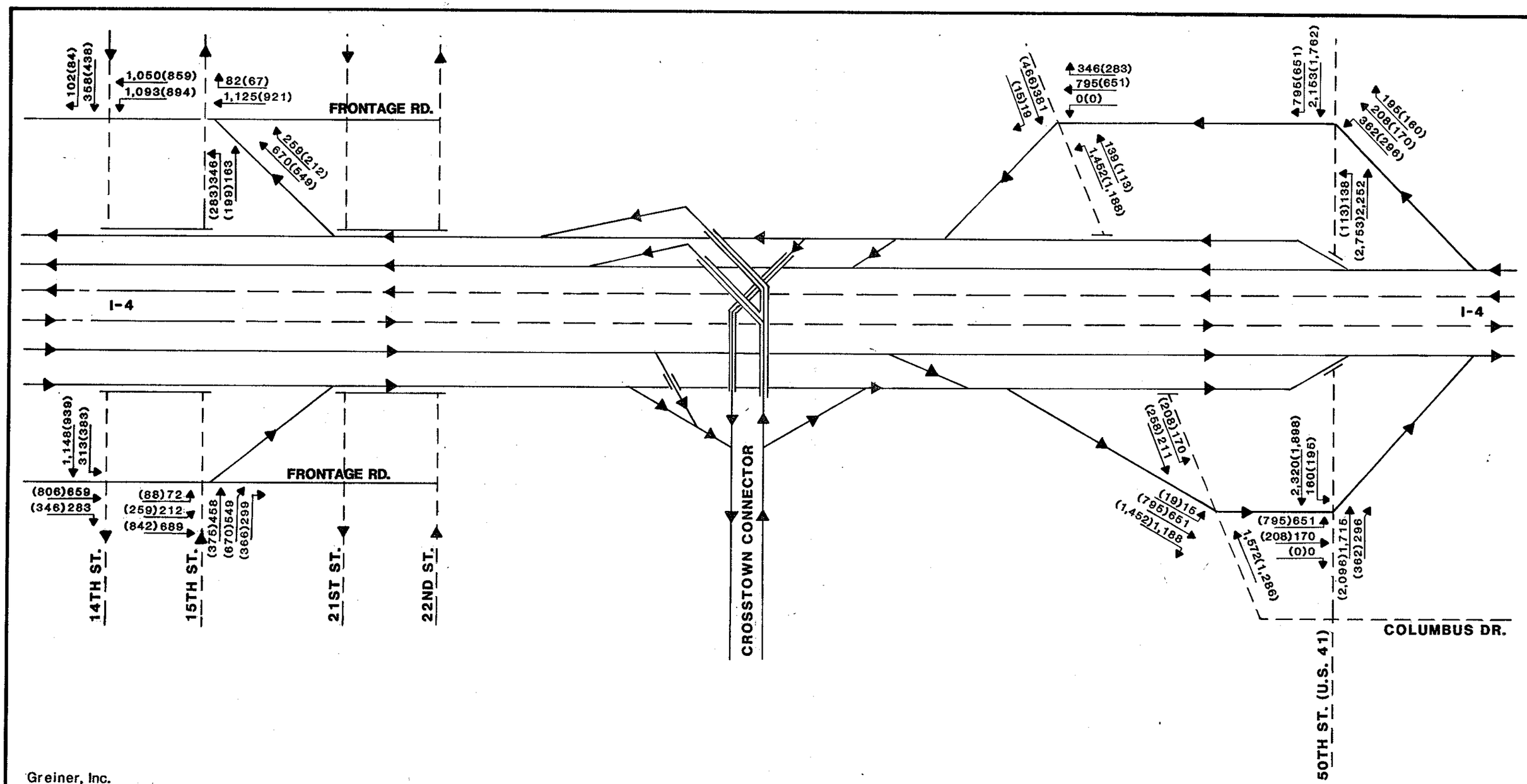
INTERCHANGE JUSTIFICATION REPORT

I-4/CROSSTOWN CONNECTOR

Hillsborough County, Florida

PHASE II CONCEPT DESIGN YEAR (2010) TRAFFIC VOLUMES

EXHIBIT 10



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LEGEND

- — — Concurrent Flow HOV Lane
- — - — HOV Transitway
- **651** A.M. Peak Hour
- **(795)** P.M. Peak Hour

FLORIDA DEPARTMENT OF TRANSPORTATION

INTERCHANGE JUSTIFICATION REPORT

I-4/CROSSTOWN CONNECTOR

Hillsborough County, Florida

PHASE II CONCEPT DESIGN YEAR (2010) PEAK HOUR TURNING MOVEMENTS

EXHIBIT 11

Table 13 summarizes the traffic operations analyses conducted on I-4 and the Crosstown Connector for the design year. Of the 16 locations listed in Table 13, 12 are weaving sections. As indicated in the table, all locations on I-4 are projected to operate at LOS D or better with the Phase II improvement concept. On I-4, six of the 14 locations analyzed will operate at LOS C or better while the remaining eight will operate at LOS D.

The northbound weaving area on the Crosstown Connector is projected to operate at LOS D in 2010. The projected speeds of the weaving and non-weaving vehicles are 41.3 miles/hour and 42.0 miles/hour, respectively. Results of the weaving analysis conducted for the southbound Crosstown Connector indicate that although the weaving vehicles are projected to operate at Level of Service D with an average travel speed of 40.7 miles/hour, the non-weaving vehicles are projected to operate at Level of Service E with an average travel speed of 40.9 miles/hour.

Although this projected non-weaving vehicle speed is approximately 1.1 miles/hour lower than the 42.0 miles/hour speed required for Level of Service D, the eastbound segment of the I-4 express freeway between the on-ramp from the southbound I-275 express freeway and the off-ramp to the Crosstown Connector is projected to operate at Level of Service C. In addition, with the signing of the southbound traffic (north of the Tampa CBD) destined for the Crosstown Connector on the I-275 local freeway, the weaving in this eastbound I-4 express freeway segment will be eliminated. The capacity calculations for the ramp junctions and weaving areas are included in Appendix E.

TABLE 13

DESIGN YEAR (2010) I-4/CROSSTOWN CONNECTOR
FREEWAY OPERATIONS ANALYSIS SUMMARY - PHASE II
I-4/Crosstown Connector

Location	Freeway Volume (in vph)[1]	Merge Area			Diverge Area			Weaving Area				
		Ramp Volume (in vph)	Merge Volume (in pcph)	Merge Level of Service	Ramp Volume (in vph)	Diverge Volume (in pcph)	Diverge Level of Service	Type of Weave	Weaving Speed (in mph)	Weaving Level of Service	Non-Weaving Speed (in mph)	Non-Weaving Level of Service
EB I-4 Express Freeway between SB I-275 Express Freeway and Crosstown Connector[2]	5,698				1,423	1,487 1,113	C B					
EB I-4 Express Freeway off-ramp to EB I-4 Local Freeway	4,275				1,183	1,781	D					
EB I-4 Express Freeway merge with EB I-4 Local Freeway	3,142	3,105	914	B								
EB I-4 Express Freeway between EB I-4 Local Freeway and 50th Street/Columbus Drive	6,247							B	44.1	D	47.1	D
EB I-4 Express Freeway between 50th Street and Buffalo Avenue	7,012							B	44.4	D	47.3	D
EB I-4 Local Freeway between SB I-275 Local Freeway and 15th Street	3,370							B	41.6	C	42.9	C
EB I-4 Local Freeway between 15th Street and Crosstown Connector	4,299							B	42.2	C	43.7	C
EB I-4 Local Freeway between Crosstown Connector and 50th Street/Columbus Drive	5,371							C	40.2	C	36.6	D
WB I-4 Express Freeway between Buffalo Avenue and 50th Street/ Columbus Drive	7,012							A	44.8	D	52.7	C
WB I-4 Express Freeway between 50th Street and WB I-4 Local Freeway	6,247							B	44.6	D	48.1	C

TABLE 13

DESIGN YEAR (2010) I-4/CROSSTOWN CONNECTOR
FREEWAY OPERATIONS ANALYSIS SUMMARY - PHASE II
I-4/Crosstown Connector
(Continued)

Location	Freeway Volume (in vph)[1]	Merge Area			Diverge Area			Weaving Area				
		Ramp Volume (in vph)	Merge Volume (in pcph)	Merge Level of Service	Ramp Volume (in vph)	Diverge Volume (in pcph)	Diverge Level of Service	Type of Weave	Weaving Speed (in mph)	Weaving Level of Service	Non-Weaving Speed (in mph)	Non-Weaving Level of Service
WB I-4 Express Freeway on-ramp from WB I-4 Local Freeway	3,092	1,183	1,925	D								
WB I-4 Express Freeway between Crosstown Connector and NB I-275 Express Freeway	6,208							B	45.3	C	49.2	C
WB I-4 Local Freeway between 50th Street/Columbus Drive and Crosstown Connector	5,371							C	43.6	C	40.9	D
WB I-4 Local Freeway between Crosstown Connector and 15th Street	3,789							B	42.2	C	43.5	C
SB Crosstown Connector between EB I-4 Local Freeway and EB Crosstown Expressway[2]	4,032							B	40.7	D	40.9	E
NB Crosstown Connector between WB Crosstown Expressway and WB I-4 Local Freeway	4,032							B	41.3	D	42.0	D

[1] Refers to the freeway volume that occurs before merge or diverge.

[2] Reflects the southbound I-275 traffic (north of the Tampa CBD) destined for the Crosstown Connector signed for the I-275 local freeway.

The results of the a.m. and p.m. peak hour ramp terminal operations analyses are summarized in Tables 14 and 15, respectively. These tables indicate that all the ramp terminals will operate at an acceptable level of service in 2010 with the proposed geometry. Table 14 shows that of the eight ramp terminals analyzed in the a.m. peak hour, four will operate at LOS B, three at LOS C and the remaining one at LOS D. Table 15 indicates that in the p.m. peak hour all eight ramp terminals will operate at LOS C or better. The capacity calculations for the ramp terminals are also included in Appendix E.

No-Build Analysis

Even without the proposed I-4/Crosstown Connector interchange, significant improvements to I-4 will need to be implemented by 2010 to provide acceptable operating conditions on this facility. Exhibit 12 contains a schematic illustration of the No-Build (2010) conceptual plan developed for this analysis.

The No-Build Alternative includes the four-roadway system (express and local access freeway lanes) on I-4 between I-275 and 50th Street (U.S. 41) however, there are several major differences between the No-Build Alternative and the Phase II Concept in the design year.

The No-Build Alternative includes the 40th Street interchange (instead of the Crosstown Connector) with ramps to and from the local access freeway lanes (both eastbound and westbound). Due to the spacing between the 40th Street and Columbus Drive/50th Street interchanges, both left-side and right-side ramps are required on the local access freeway lanes to provide acceptable levels of service. Two-lane slip ramps connecting the express freeway lanes with the local access freeway lanes are

TABLE 14

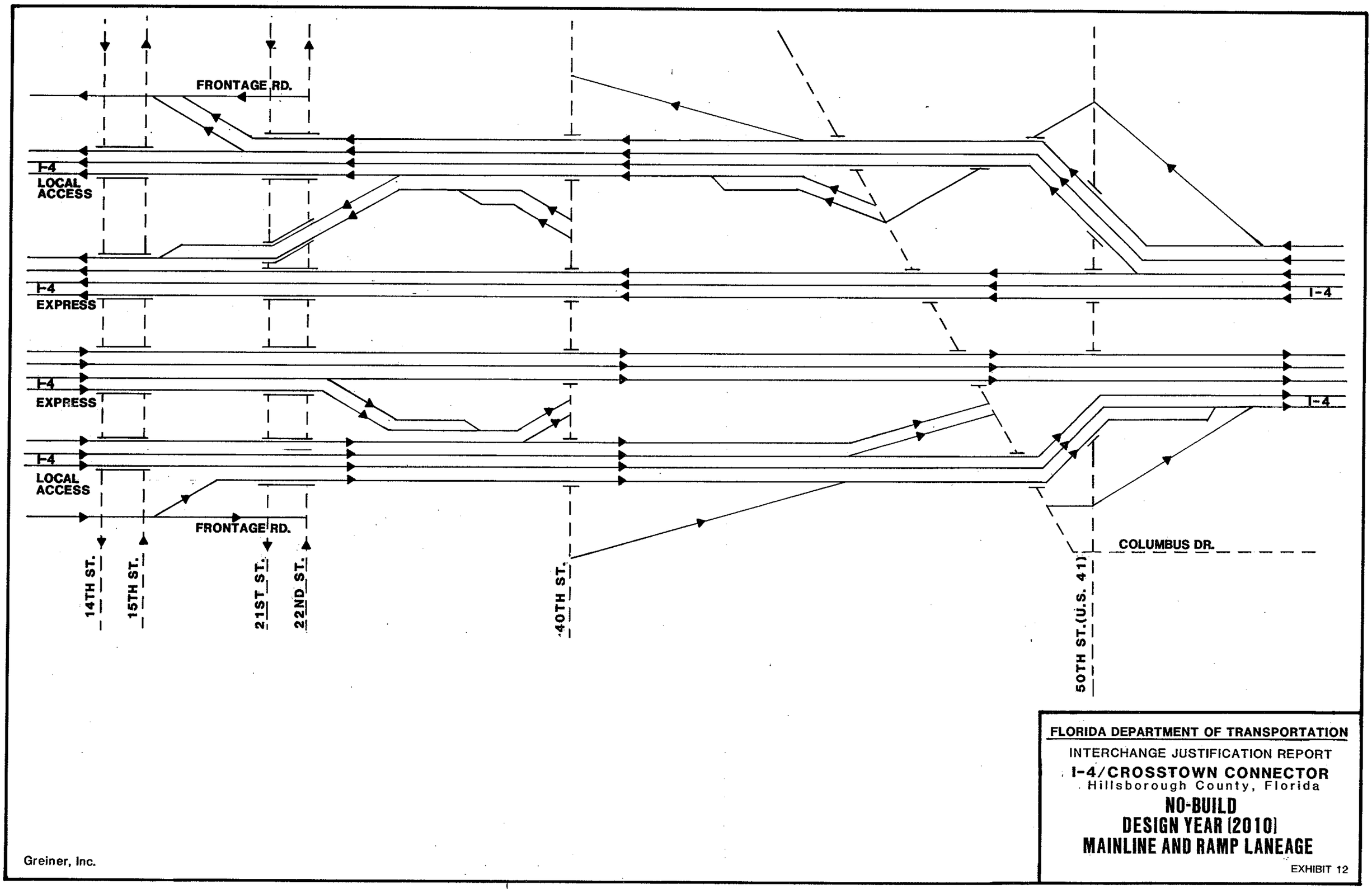
DESIGN YEAR (2010) I-4 RAMP TERMINAL OPERATIONS ANALYSIS SUMMARY-AM PEAK HOUR
I-4/Crosstown Connector

Location	Delay (in sec/veh)	V/C Ratio	Level of Service
I-4 Westbound On-Ramp and 14th Street	14.1	0.84	B
I-4 Eastbound Off-Ramp and 14th Street	12.5	0.68	B
I-4 Eastbound On-Ramp and 15th Street	12.7	0.71	B
I-4 Westbound Off-Ramp and 15th Street	15.6	0.74	C
I-4 Westbound On-Ramp and Columbus Drive	27.5	0.96	D
I-4 Eastbound Off-Ramp and Columbus Drive	14.7	0.73	B
I-4 Eastbound On-Ramp and 50th Street	19.2	0.78	C
I-4 Westbound Off-Ramp and 50th Street	19.9	0.84	C

TABLE 15

DESIGN YEAR (2010) I-4 RAMP TERMINAL OPERATIONS ANALYSIS SUMMARY-PM PEAK HOUR I-4/Crosstown Connector

Location	Delay (in sec/veh)	V/C Ratio	Level of Service
I-4 Westbound On-Ramp and 14th Street	11.7	0.72	B
I-4 Eastbound Off-Ramp and 14th Street	13.7	0.72	B
I-4 Eastbound On-Ramp and 15th Street	16.0	0.87	C
I-4 Westbound Off-Ramp and 15th Street	11.9	0.61	B
I-4 Westbound On-Ramp and Columbus Drive	23.7	0.84	C
I-4 Eastbound Off-Ramp and Columbus Drive	17.0	0.74	C
I-4 Eastbound On-Ramp and 50th Street	23.3	0.92	C
I-4 Westbound Off-Ramp and 50th Street	21.1	0.83	C



FLORIDA DEPARTMENT OF TRANSPORTATION

INTERCHANGE JUSTIFICATION REPORT

I-4/CROSSTOWN CONNECTOR

Hillsborough County, Florida

NO-BUILD DESIGN YEAR (2010) MAINLINE AND RAMP LANEAGE

EXHIBIT 12

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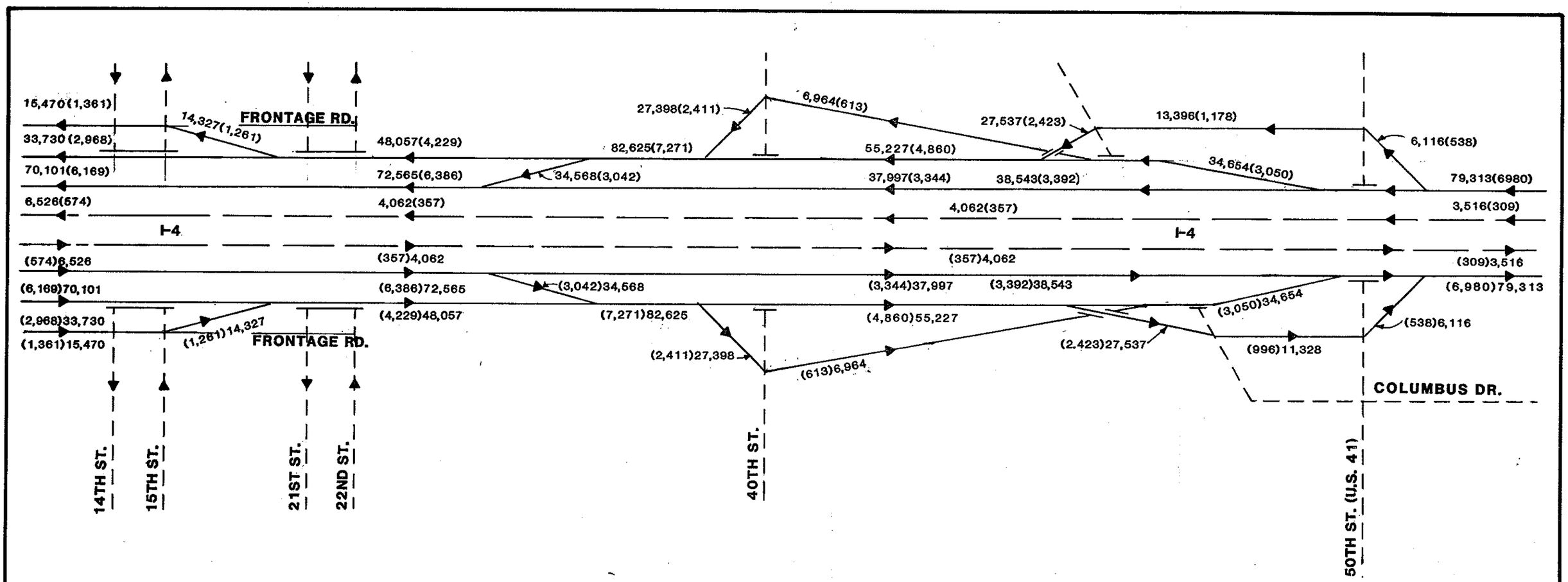
provided west of the 40th Street interchange. The 2010 ADT and DDHV's associated with the No-Build Alternative are provided on Exhibit 13. The 2010 a.m. and p.m. peak hour turning movements at the I-4 ramp terminals are provided on Exhibit 14.

Table 16 summarizes the traffic operations analyses conducted on I-4 for the 2010 No-Build Alternative. As indicated in the table, 13 out of 14 locations analyzed will operate at an acceptable level of service with the geometry provided in Exhibit 12. The No-Build Alternative includes eight weaving areas and six ramp junctions. Seven of the eight weaving areas are projected to operate at LOS D or better. The one exception is the westbound I-4 express freeway weaving section between the westbound I-4 local freeway and the northbound I-275 express freeway which is projected to operate at LOS E. Five of the six ramp junctions are projected to operate at LOS C or better while the other one is projected to operate at LOS D. The ramp junction and weaving capacity calculations are included in Appendix F.

Results of the a.m. and p.m. peak hour ramp terminal intersection analyses are summarized in Tables 17 and 18, respectively. Table 17 indicates that nine of the ten ramp terminals are projected to operate at LOS D or better in the a.m. peak hour. The one exception is the intersection of the I-4 westbound on-ramp with Columbus Drive which is projected to operate at LOS E with a v/c ratio of 1.02. The v/c ratio indicates the proportion of available intersection capacity that is being used by vehicles in the critical movements. If the v/c ratio exceeds 1.00, one or more of the critical movements will be oversaturated and breakdowns will occur. Six of the ten ramp terminals are projected to operate at LOS C or better while three are projected to operate at LOS D. Table 18 indicates that all ten ramp terminals will operate at LOS D or better in the p.m. peak hour and four of the ten will operate at LOS C



Greiner, Inc.

LEGEND

- —— Concurrent Flow HOV Lane
- —--— HOV Transitway
- **37,997** Average Daily Traffic Volume
- **(3,344)** Directional Design Hour Volume

FLORIDA DEPARTMENT OF TRANSPORTATION

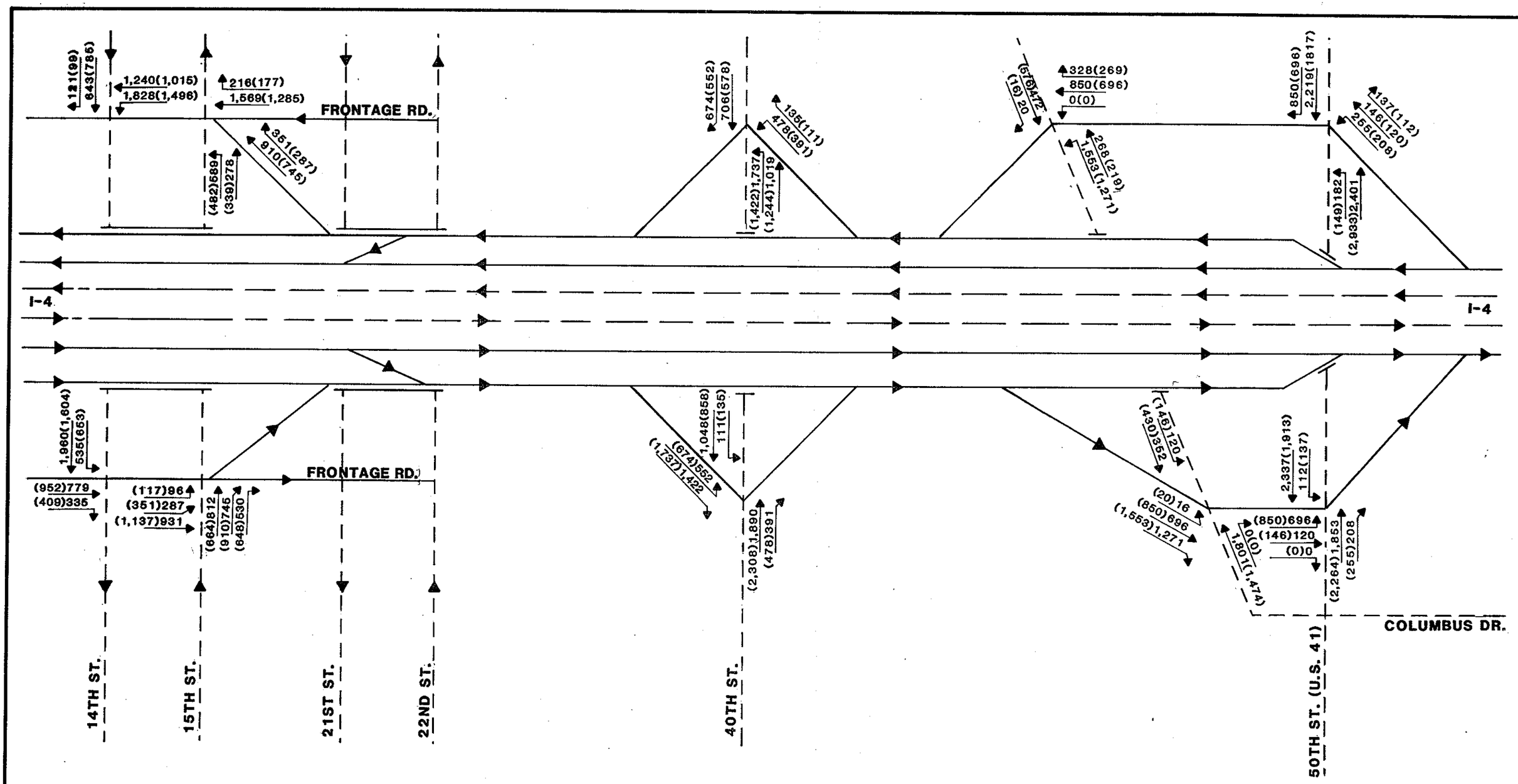
INTERCHANGE JUSTIFICATION REPORT

I-4/CROSSTOWN CONNECTOR

Hillsborough County, Florida

NO-BUILD DESIGN YEAR (2010) TRAFFIC VOLUMES

EXHIBIT 13



LEGEND

- Concurrent Flow HOV Lane
- HOV Transitway
- **696** A.M. Peak Hour
- **(851)** P.M. Peak Hour

FLORIDA DEPARTMENT OF TRANSPORTATION

INTERCHANGE JUSTIFICATION REPORT

I-4/CROSSTOWN CONNECTOR

Hillsborough County, Florida

NO-BUILD DESIGN YEAR (2010) PEAK HOUR TURNING MOVEMENTS

EXHIBIT 14

TABLE 16

NO-BUILD (2010) I-4 FREEWAY OPERATIONS ANALYSIS SUMMARY
I-4/Crosstown Connector

Location	Freeway Volume (in vph)[1]	Merge Area			Diverge Area			Weaving Area				
		Ramp Volume (in vph)	Merge Volume (in pcph)	Merge Level of Service	Ramp Volume (in vph)	Diverge Volume (in pcph)	Diverge Level of Service	Type of Weave	Weaving Speed (in mph)	Weaving Level of Service	Non-Weaving Speed (in mph)	Non-Weaving Level of Service
EB I-4 Express Freeway between SB I-275 Express Freeway and EB I-4 Local Freeway	6,386							A	41.5	D	46.2	D
EB I-4 Express Freeway between EB I-4 Local Freeway and 50th Street/Columbus Drive	6,442							B	43.9	D	46.8	D
EB I-4 Express Freeway between 50th Street/Columbus Drive and Buffalo Avenue	6,980							B	44.7	D	47.7	D
EB I-4 Local Freeway on-ramp from 15th Street	2,968	1,261	1,354	C								
EB I-4 Local Freeway between EB I-4 Express Freeway and 40th Street	7,271							B	40.6	C	40.3	D
EB I-4 Local Freeway off-ramp to 50th Street/Columbus Drive	4,860				2,423	1,546/1,617	C/C					
EB I-4 Local Freeway on-ramp from 40th Street	2,437	613	1,184	C								
WB I-4 Express Freeway between Buffalo Avenue and 50th Street/ Columbus Drive	6,980							A	45.2	C	53.2	C
WB I-4 Express Freeway between 50th Street/Columbus Drive and WB I-4 Local Freeway	6,442							B	44.5	D	47.8	D

TABLE 16

NO-BUILD (2010) I-4 FREEWAY OPERATIONS ANALYSIS SUMMARY
I-4/Crosstown Connector
(Continued)

Location	Freeway Volume (in vph)[1]	Merge Area			Diverge Area			Weaving Area				
		Ramp Volume (in vph)	Merge Volume (in pcph)	Merge Level of Service	Ramp Volume (in vph)	Diverge Volume (in pcph)	Diverge Level of Service	Type of Weave	Weaving Speed (in mph)	Weaving Level of Service	Non-Weaving Speed (in mph)	Non-Weaving Level of Service
WB I-4 Express Freeway between WB I-4 Local Freeway and NB I-275 Express Freeway	6,386							B	41.0	D	41.4	E
WB I-4 Local Freeway off-ramp to 40th Street	3,050				613	1,179	C					
WB I-4 Local Freeway on-ramp from 50th Street/Columbus Drive	2,437	2,423	1,660/1,923	D/D								
WB I-4 Local Freeway between 40th Street and EB I-4 Express Freeway	7,271							B	41.5	C	42.0	C
WB I-4 Local Freeway off-ramp to 15th Street	4,229				1,261	987/1,116	B/B					

[1] Refers to the freeway volume that occurs before merge or diverge.

TABLE 17

NO BUILD (2010) I-4 RAMP TERMINAL OPERATIONS ANALYSIS SUMMARY-AM PEAK HOUR
I-4/Crosstown Connector

Location	Delay (in sec/veh)	V/C Ratio	Level of Service
I-4 Westbound On-Ramp and 14th Street	11.0	0.85	B
I-4 Eastbound Off-Ramp and 14th Street	26.7	0.99	D
I-4 Eastbound On-Ramp and 15th Street	14.9	0.84	B
I-4 Westbound Off-Ramp and 15th Street	22.4	0.97	C
I-4 Westbound On/Off-Ramps and 40th Street	30.9	0.98	D
I-4 Eastbound On/Off-Ramps and 40th Street	29.7	0.72	D
I-4 Westbound On-Ramp and Columbus Drive	57.5	1.02	E
I-4 Eastbound Off-Ramp and Columbus Drive	24.3	0.79	C
I-4 Eastbound On-Ramp and 50th Street	21.5	0.81	C
I-4 Westbound Off-Ramp and 50th Street	19.1	0.82	C

TABLE 18

NO BUILD (2010) I-4 RAMP TERMINAL OPERATIONS ANALYSIS SUMMARY-PM PEAK HOUR
I-4/Crosstown Connector

Location	Delay (in sec/veh)	V/C Ratio	Level of Service
I-4 Westbound On-Ramp and 14th Street	10.8	0.75	B
I-4 Eastbound Off-Ramp and 14th Street	30.2	1.01	D
I-4 Eastbound On-Ramp and 15th Street	27.9	1.02	D
I-4 Westbound Off-Ramp and 15th Street	13.1	0.80	B
I-4 Westbound On/Off-Ramps and 40th Street	20.3	0.80	C
I-4 Eastbound On/Off-Ramps and 40th Street	30.8	0.88	D
I-4 Westbound On-Ramp and Columbus Drive	28.8	0.90	D
I-4 Eastbound Off-Ramp and Columbus Drive	26.5	0.79	D
I-4 Eastbound On-Ramp and 50th Street	25.6	0.94	D
I-4 Westbound Off-Ramp and 50th Street	14.9	0.82	B

or better. However, the v/c ratios at two ramp terminals, the I-4 eastbound off-ramp at 14th Street and the I-4 eastbound on-ramp at 15th Street, are projected to exceed 1.00. The capacity calculations for the ramp terminals are also included in Appendix F.

ALTERNATIVE ROUTES

The No-Build Alternative would severely impede traffic flows on the north-south arterials that interchange with I-4 and the South Crosstown Expressway. Without the proposed I-4/Crosstown Connector and its associated interchange, trips from I-4 to the South Crosstown Expressway and the return movements would have to use 14th/15th Streets, 40th Street or 50th Street, as well as Columbus Drive. The projected 2010 traffic volume on 14th/15th Streets would increase from 12,300 vehicles per day (vpd) to 20,500 vpd north of I-4 and from 34,000 vpd to 53,900 vpd south of I-4 without the Crosstown Connector. On Columbus Drive the ADT volume would increase from 11,000 vpd to 13,500 vpd north of I-4 and from 37,300 vpd to 43,000 vpd south of I-4. On 40th Street, the ADT volume would increase from 18,200 vpd to 31,400 vpd north of I-4 and from 18,200 vpd to 63,300 vpd south of I-4. Much smaller increases in daily traffic volumes would occur on 50th Street in the absence of the Crosstown Connector. North of I-4, the ADT would increase from 67,000 vpd to 69,800 vpd while south of I-4 the ADT volume would increase from 54,300 vpd to 55,200 vpd. These north-south arterials do not have sufficient capacity to accommodate the additional travel demand in the No-Build Alternative at an acceptable level of service.

Using the projected 2010 No-Build ADT volumes and the "Generalized Daily Level of Service Maximum Volumes for Florida's Urbanized Areas," the minimum lane requirements needed to provide an acceptable level of service for each of the alternative routes was estimated. Based on this analysis it was determined that four-lane one-way arterials would be required to provide acceptable levels of service on 14th/15th Streets south of I-4 and three-lane one-way arterials north of I-4. On 40th Street south of I-4 and 50th Street north and south of I-4, four-lane access controlled expressways are required to provide an acceptable level of service. North of I-4 on 40th Street, a six-lane arterial is required. On Columbus Drive, a four-lane arterial is required north of I-4 and a six-lane arterial is required south of I-4.

As discussed earlier, the intersection of the I-4 westbound on-ramp and Columbus Drive will not operate at an acceptable level of service (D or better) in 2010 in the a.m. peak hour with the No-Build Alternative. In addition, two of the ten ramp terminals in the p.m. peak hour are projected to operate with critical v/c ratios greater than 1.00 in the No-Build Alternative. As stated previously, critical v/c ratios greater than 1.00 indicate that one or more of the critical movements will be oversaturated.

Given these conditions, significant improvements would need to be made to the arterial street system to accommodate the travel demand if the Crosstown Connector is not implemented.

COST-EFFECTIVENESS ANALYSIS

A cost-effectiveness analysis (CEA) was also conducted for the proposed I-4/Crosstown Connector project. The analysis was performed to define, in economic terms, the net

benefits which can be expected to result if the proposed improvements are undertaken. The analysis compares the costs of implementing the improvements against the road user benefits which can be expected to accrue from having the improvements in place. Costs include engineering design, right-of-way acquisition, construction, maintenance, and operation costs of the new facility. Benefits include the reduction in road-user costs which would be expected to result from traffic operations on the more efficient and safer transportation network. The specific components of benefits and costs are discussed in detail in this section.

Methodology and Parameters

The methodology used in this analysis follows guidelines written in the American Association of State Highway and Transportation Officials (AASHTO) publication, A Manual On User Benefit Analysis Of Highway And Bus-Transit Improvements, 1977, hereinafter referred to as the "AASHTO manual." The AASHTO manual is the nationally accepted handbook of methodologies for conducting transportation project cost-effectiveness analyses. The AASHTO procedure emphasizes road user benefits and highway agency costs. Secondary and tertiary costs and benefits, which are difficult or impossible to quantify, are not included.

Present Value

The AASHTO Manual methodology prescribes the computation of "present value" (PV) for the periodic costs and benefits for a No-Build alternative and for each of the improvement alternatives over a specific time period to identify incremental costs and benefits attributable to the project. As defined in the AASHTO manual, "present

value" is an economic concept representing the translation of costs and/or benefits occurring over time into a single amount at a single instant (usually the present), and can also be called "present worth." "Net present value" refers to the net cumulative present value of a series of costs and benefits occurring over time, and is derived by applying, to each cost or benefit in the series, an appropriate discount factor which converts each cost or benefit to a present value. All costs, benefits, and other values presented in monetary terms are expressed in constant 1989 dollars.

Discount Rate

Selection of the appropriate "discount rate" for use in computing present value of future costs and benefits is important. The following passage from the AASHTO manual provides guidance to discount rate selection:

> "The discount rate for performing present value calculations on public projects should represent the opportunity cost of capital to the taxpayer, i.e., the estimated average market rate of return. However, the common practice of calculating benefits in constant dollars (usually at prices prevailing when the economy study is made) and discounting benefits at market rates of interest is in error, because the market or nominal rate of return includes (1) an allowance for expected inflation as well as (2) a return that represents the real cost of capital. Thus, if future benefits or costs are in constant dollars, they will be understated in relation to a market rate of return. Hence, if future benefits and costs are calculated in constant dollars, only the real cost of capital should be represented in the discount rate used. The real cost of capital has been estimated at about 4 percent in recent years for low-risk investments."

Based on the rationale presented above, four percent was selected as the discount rate for this analysis. However, the sensitivity of the analysis to increases in the discount rate was also examined and the results presented for discount rates of four, seven and ten percent. Discount rates greater than four percent yield more conservative results

because future year benefits, which are greatest in later years, are discounted more. This results in a lower present value of benefits available to offset project costs. Project costs are primarily composed of initial investment costs and occur in the earlier years. Thus, project costs are discounted less, resulting in a greater proportion of costs to benefits.

Time Period of the Analysis

Determination of the analysis period is another important element of the study. For the present study, the years 1993 through 2010 were used. Ideally, costs and benefits for investments should be analyzed over their entire economic lifetime which ranges from about five years for pavement markings to more than 50 years for earthwork and some bridges. However, road user benefits can only be computed based on traffic volume projections which are rarely available for more than 20 to 25 years into the future. For this analysis, traffic volume projections are available through the year 2010.

A construction schedule has been established for the purpose of conducting this analysis. Construction is assumed to take place in two phases. The initial phase (Phase I) is scheduled to occur during 1993 and 1994, opening to traffic in 1995. The final phase of construction (Phase II) will occur from 1997 through 1999. For the analysis, it was assumed that all of the required right-of-way would be acquired during initial construction. User benefits were calculated to begin in 1995 and continue through the end of the analysis period (2010).

In addition, benefits in years beyond 2010 would be realized as a result of the initial investment, but cannot be quantified for lack of traffic volume projections for these

years. Benefits will therefore most probably be more than those identified in the analysis. As such, if the project is found to be cost-effective using these conservative assumptions, the project sponsor can be confident of its economic desirability.

Measures of Economic Desirability

The output of this analysis is a series of indicators of economic feasibility and desirability. These indicators include:

* Net Present Value (NPV) - the difference between the present value of the total periodic benefits and the present value of the total periodic costs.
* Benefit/Cost (B/C) Ratio - the ratio of the present value of the total periodic benefits to the present value of the total periodic costs.
* Payback Period - the length of time required for the present value of accumulated benefits to exceed the present value of accumulated costs.
* Internal Rate of Return (IRR) - a measure of the profitability of the project, IRR is equal to the discount rate at which NPV = 0 and B/C = 1.0.

The NPV and B/C are calculated using equations (1) and (2), respectively:

$$NPV = PV(\Delta U) - [PV(\Delta I) + PV(\Delta M) - PV(\Delta R)] \quad (1)$$

$$B/C = PV(\Delta U) \div [PV(\Delta I) + PV(\Delta M) - PV(\Delta R)] \quad (2)$$

Where:

PV = the present value of the associated parenthetical amount or series of amounts over time, discounted at the selected discount rate.

ΔU = the reduction in the series of annual highway user costs due to the investment (costs without the improvements less costs with the improvements); also termed "User Benefit."

ΔI = the increased investment costs due to the construction of the improvements.

ΔM = the increase in annual maintenance and operating costs due to the construction of the improvements.

ΔR = the residual value of the improvements less the residual value of the no-build scenario (assuming the no-build scenario requires some improvements) at the end of the analysis period.

The "payback period" and "internal rate of return" measures are derived from the NPV and B/C calculations. The determination of the values used in the calculations is discussed below.

Determination of Benefits and Costs

In this section, each of the components introduced in equations (1) and (2) is explained and discussed in detail.

"ΔU" User Benefits

The determination of the economic benefits to the highway user resulting from the proposed facility is an important step in determining cost-effectiveness. The AASHTO manual prescribes the computation of total road user costs ("U") for the proposed improvement and for a No-Build alternative. The difference between these, "ΔU", represents the reduction in road user costs attributable to the proposed improvement, and reflects a "benefit" that is used in the benefit/cost (B/C) calculation.

For each alternative studied, "U" is a summation of three separate cost items: 1) vehicle operating costs, including fuel (gasoline), lubricating oil, tire wear, auto maintenance (and repair), and depreciation (new car) costs; 2) vehicle travel time

costs, or the cumulative dollar value of the vehicle occupants' time as they travel on a given facility at a given speed; and 3) vehicle accident costs, based on a historic average of the total dollar value of all fatality, injury, and property-damage accidents which occur in one year.

The AASHTO manual provides numerous tables, nomographs, charts, and formulas for computing or determining the values of the various components of "U" and prescribes that future users of the information should index the prices to current values using the Consumer Price Index (CPI).

Since the publishing of the AASHTO manual, the State of Alabama Highway Department Bureau of Urban Planning has consolidated the AASHTO manual procedures for determining "ΔU" into a more readily usable format. The results of this are contained in a handbook entitled Road User Costs (1980).

Vehicle Operating Costs

Vehicle operating costs are provided in the Road User Costs document, by road type and travel speed, for various price levels of gasoline. For the I-4/Crosstown Connector CEA, vehicle operating costs were determined based on a gasoline price of $1.00/gallon.

Vehicle Travel Time Costs

In determining vehicle travel time costs, the AASHTO manual used two studies from the University of Chicago and Stanford Research Institute which established the value of commuter travel time in the late 1960's to be approximately $2.80 per hour. The

AASHTO manual used more recent findings of a Highway Research Record study which indicated that the monetary value of travel time is sensitive to trip purpose, travelers' income levels, and the amount of time saved during a trip. Based on this research, the AASHTO manual provides a table for the value of travel time as a function of time saved and trip type. In the Road User Cost document, a value of $3.69 per hour per vehicle occupant is used. This represents the monetary value associated with a 5 to 15 minute work trip. This value was multiplied by a national average work trip auto occupancy of 1.25 persons per vehicle resulting in a monetary value of $4.61 (March 1980 dollars) per vehicle hour of travel time.

To index that value to present day (January 1989) dollars, the CPI was used as follows:

$$\frac{\text{CPI, January 1989}}{\text{CPI, March 1980}} = \frac{362.8}{239.8} = 1.5129 \text{ update factor}$$

$4.61 (March 1980 value) x 1.5129 update = $6.97/vehicle hour

Accident Costs

Accident costs per vehicle mile of travel were computed in the Road User Cost document using historic vehicle accident data for the State of Alabama and accident costs (by type of accident) obtained from the National Safety Council. Since the accident cost per vehicle mile calculated for Alabama agrees closely with the AASHTO manual average accident cost for a mix of freeway and non-freeway facilities, the Alabama accident cost values were used in this analysis, updated to present day dollar values.

Total Road User Costs

Total road user costs for the Build and No-Build alternatives for the years 1995 and 2010 were calculated using the traffic projections obtained from the FSUTMS simulations and the tables, nomographs, and equations provided for that purpose in the AASHTO manual and the Road User Costs document. The results are summarized in Table 19.

TABLE 19

ROAD USER COSTS

Alternatives	Year	Daily Vehicle Miles Traveled (VMT)	Daily Road User Costs ("U")	Cost/VMT
No-Build	1995	26,290,000	$13,471,200	$0.5124
Phase I	1995	26,289,000	$13,435,800	$0.5111
No-Build	2010	41,845,000	$24,189,600	$0.5781
Phase II	2010	41,861,000	$24,045,500	$0.5744

Using the values in Table 19, the daily road user benefits for the proposed project were calculated using equation (3) below:

$$\text{Road User benefits} = [U_0 - U_1] \times \left[\frac{V_0 + V_1}{2}\right] \qquad (3)$$

Where:

U_0 = the road user cost per vehicle mile of travel without the improvements (No-Build)

U_1 = the road user cost per vehicle mile of travel with the improvements (Build)

V_0 = the vehicle miles of travel without the improvement (No-Build)

V_1 = the vehicle miles of travel with the improvement (Build)

The road user benefits calculated using equation (3) are listed in Table 20.

TABLE 20

ROAD USER BENEFITS

Alternative	Year	Daily Road User Benefits ("ΔU")	Annual Road User Benefits ("ΔU")
Phase I	1995	$34,176	$12,474,240
Phase II	2010	$154,856	$56,522,440

As shown in the table, the annual road user benefits for the years 1995 and 2010 are approximately $12.5 million and $56.5 million, respectively. To determine "ΔU" for intermediate years in the analysis period, an average compound growth rate of 10.6 percent per year was used.

"ΔI" Investment Costs

"ΔI" is the difference between the investment cost for the Build alternative and the investment cost for the No-Build alternative. As stated earlier, I-4 would require substantial investment expenditures even without the Crosstown Connector to provide an acceptable level of service.

"ΔI" includes costs for engineering design, right-of-way acquisition, and construction of the improvements. For this analysis, it is assumed that construction activity would occur in two phases. Right-of-way acquisition would occur during the first phase. A summary of these investment costs is provided in Table 21.

TABLE 21

INVESTMENT COSTS ("ΔI")

Item	Build	No Build	"ΔI"
Construction	$140,348,118	$111,832,985	$28,515,133
Right-of-Way & Relocation	38,000,000	37,495,000	505,000
Administrative & Contingencies	47,571,855	40,345,297	7,226,558
TOTAL	$225,919,973	$189,673,282	$36,246,691

"ΔM" Maintenance Costs

Maintenance costs include routine or periodic upkeep of the facility (patching, striping, bridge painting, drainage cleanout, landscaping) and replacements (pavement resurfacing, crash barrier replacement). Ideally, the cost for maintenance of proposed facilities is determined through historic maintenance records for similar, in-place facilities held by the agency with jurisdiction. In the present analysis, historic annual maintenance costs indicate that $2,500 per lane mile is an appropriate maintenance cost estimate. It was determined that approximately five and seven and one-half lane miles would be constructed in the initial and second construction phase, respectively. Thus, annual maintenance costs were estimated to be $12,500 starting in 1995, increasing to $18,750 in 2000.

"ΔR" Residual Value

The residual value of the improvements is computed by multiplying the estimated construction cost by a factor which represents the portion of remaining useful life of the improvements and then adding the full cost of land for right-of-way (excluding

legal costs and costs due to relocations, business damages, and demolition activities). In the present analysis, the life of the roadway portions of the facility is estimated at 25 years. Bridge elements are assumed to have a useful life of approximately 50 years. Since the study period encompasses only 18 years due to the data limitations discussed earlier, the residual value of the improvements will be substantial. The value of "ΔR" is calculated by taking the residual value of the Build alternative and subtracting the residual value of the No-Build alternative. In the final year of the analysis, 2010, "ΔR" is estimated to be $15,874,952.

Results of the Analysis

As discussed previously, outputs of the analysis include:

* Benefit/Cost Ratio (B/C)
* Net Present Value (NPV)
* Payback Period
* Internal Rate of Return (IRR)

Table 22 provides the results of the computations of these cost-effectiveness indices for the proposed I-4/Crosstown Connector. Table 22 provides year-by-year benefits and costs, as well as a "running computation" of NPV and B/C using a four percent discount rate. As indicated in Table 22, the net present value is $280 million, the B/C ratio is 12.23, the payback period is 4 years and the IRR is 55.77 percent.

Economic desirability of a project is indicated by a NPV which is greater than zero, a B/C ratio greater than 1.0, and an IRR greater than the discount rate. Table 22 indicates that the I-4/Crosstown Connector interchange well exceeds these criteria. Therefore, the alternative is economically feasible in terms of road user savings.

TABLE 22

COST- EFFECTIVENESS ANALYSIS
NET PRESENT VALUE AND BENEFIT/COST RATIO
I-4/Crosstown Connector

Year	Compound Interest Factor (PV)	User Benefits ("ΔU")	Investment Costs ("ΔI")	Maintenance Costs ("ΔM")	Residual Value ("ΔR")	Net Present Value** (NPV)	Benefit/Cost Ratio*** (B/C)
1993	1.0000	0	8,808,233	0	0	(8,808,233)	0.00
1994	0.9615	0	10,765,618	0	0	(19,159,788)	0.00
1995	0.9246	12,474,370	0	12,500	0	(7,638,088)	0.60
1996	0.8890	13,796,391	0	12,500	0	4,615,740	1.24
1997	0.8548	15,258,519	5,001,852	12,500	0	13,372,497	1.57
1998	0.8219	16,875,602	6,669,136	12,500	0	21,751,194	1.75
1999	0.7903	18,664,061	5,001,852	12,500	0	32,538,757	1.99
2000	0.7599	20,642,059	0	18,750	0	48,210,777	2.46
2001	0.7307	22,829,684	0	18,750	0	64,878,503	2.97
2002	0.7026	25,249,151	0	18,750	0	82,605,048	3.51
2003	0.6756	27,925,031	0	18,750	0	101,457,531	4.08
2004	0.6496	30,884,498	0	18,750	0	121,507,333	4.68
2005	0.6246	34,157,606	0	18,750	0	142,830,361	5.33
2006	0.6006	37,777,595	0	18,750	0	165,507,345	6.01
2007	0.5775	41,781,227	0	18,750	0	189,624,135	6.74
2008	0.5553	46,209,160	0	18,750	0	215,272,030	7.52
2009	0.5339	51,106,360	0	18,750	0	242,548,123	8.34
2010	0.5134	56,522,561	0	18,750	15,874,952	279,705,443	12.23

Assumes Discount Rate = 4%

** NPV = PV("ΔU") - [PV("ΔI") + PV("ΔM") - PV("ΔR")]

*** B/C = PV("ΔU") / [PV("ΔI") + PV("ΔM") - PV("ΔR")]

Note: Internal Rate of Return = 55.77%

(Constant 1989 Dollars)

Table 23 presents a summary of the cost-effectiveness indices at discount rates of four, seven and ten percent. This table shows the sensitivity of the analysis with respect to interest rate. The I-4/Crosstown Connector interchange exceeds traditional criteria for cost-effectiveness analysis even at the seven and ten percent discount rates. Therefore, the proposed I-4/Crosstown Connector is an economically sound investment of public dollars.

As mentioned previously, only road user benefits were used to represent "benefits", and only facility construction and maintenance costs were used to represent "costs". No attempt was made to quantify and include indirect benefits which may result from the proposed project (for example, new business activity generated as a result of the project). In addition, no attempt was made to identify secondary benefits which may accrue from increased property values along the facility, or secondary costs which may accrue from deflated property values. Finally, no attempt was made to quantify and include environmental costs, aside from the inclusion in the project construction cost estimates of measures to minimize adverse air, water, and noise impacts.

The results of the CEA clearly indicate that the economic benefits that will be derived from traveling on the improved Interstate system, including the I-4/Crosstown Connector, will more than offset the costs of constructing and maintaining the facility.

ENVIRONMENTAL OVERVIEW

A preliminary environmental overview was also conducted for the proposed project to identify potential environmental impacts to be addressed in a separate environmental

TABLE 23

COST-EFFECTIVENESS ANALYSIS SUMMARY
I-4/Crosstown Connector

Discount Rate	B/C[a]	NPV[b] (in millions)	Payback[c] Period	IRR[d]
4%	12.23	$279.7	4 years	55.77%
7%	8.73	$200.1	4 years	55.77%
10%	6.62	$145.9	4 years	55.77%

(a) B/C = Benefit/Cost ratio; the ratio of the net present value of the total periodic benefits to the net present value of the total periodic costs.

(b) NPV = Net Present Value; the difference between the present value of the total periodic benefits and the present value of the total periodic costs.

(c) Payback Period = The length of time required for the present value of the accumulated benefits to exceed the present value of the accumulated costs.

(d) IRR = Internal rate of return; a measure of profitability of an investment, IRR is equal to the discount rate for which NPV = 0 and B/C = 1.0.

document prepared by the THCEA consultant in their on-going PD&E Study. Included in this overview was the identification of potential impacts relative to:

* Social Environment
* Cultural Environment
* Natural Environment
* Physical Environment

The following sections present a brief discussion of the potential environmental impacts.

Social Environment

Land use changes are expected to be significant as a result of the proposed project. The additional 300 feet of right-of-way needed, for construction of the local freeway, will require the acquisition of both business and residential properties. Due to the relocation of the 21st/22nd Street Ramps to 14th/15th Streets, there is also potential for land use changes in the existing mixed-use area around 14th and 15th Streets, however, local land use agencies will have ultimate control over this situation.

Adverse impacts on community cohesion are expected to be minimal. Although the proposed action will cause a minor encroachment of the Ybor City District, there will be no further splitting of the neighborhood or the social isolation impacts often triggered by such a division. Furthermore, it is anticipated that there will be no separation of residences from the community facilities within their service area.

The proposed action will, however, have some positive impacts on the Ybor City District. The obvious impact will be improved access to and from the area. This improved access would in turn enhance the potential for new development.

Relocation due to the proposed action will be significant. Business and residential displacement will occur on both sides of the existing interstate throughout the length of the project. However, the most extensive displacement will occur between 14th Street and 34th Street.

Impacts on churches and schools will be minimal. None of these facilities will be taken as part of the proposed right-of-way acquisition, however, there are several of these facilities within the near vicinity of the project. Within three blocks of the project area, there are six churches and three schools. The schools include the Ybor branch of Hillsborough Community College, Gary Public School and Oak Park Elementary. School districts will not be affected by the proposed action.

The proposed improvements will significantly impact certain ethnic and minority groups. These improvements were, however, developed in accordance with the Civil Rights Act of 1964, as amended by the Civil Rights Act of 1968.

Cultural Environment

It is anticipated that there will be significant impacts to 4(f) lands. Within the area of the proposed project, nearly all 4(f) involvement will concern properties of potential historical significance. The existing interstate and proposed local freeway are located within both the Barrio Latino Local District (established 1975) and the proposed district expansion to the National Register District (established 1974). Further discussion of the Historic Districts and potentially affected sites is found below. Other 4(f) involvement is expected to be minimal as no other category, of 4(f) sites, will be directly impacted by the proposed local freeway.

There will be a significant impact on historic sites within the project area. Structures within the Barrio Latino Local District and the proposed district expansion to the National Register District will be directly affected. According to current plans, right-of-way takes will involve potentially significant historic structures within the above mentioned districts as well as potentially significant historic structures outside the designated districts. According to the local Historical Board, there are approximately 118 structures within the project area which they consider to contribute to the historical significance of the district. As of this date, no structures listed on the National Register will be affected.

It is anticipated that the local freeway will have no impact on any archaeological sites. Initial data collection has not revealed the presence of any archaeological sites, however, the Department of Transportation will have to perform a survey to confirm this.

The local freeway is not expected to directly impact any parks or other recreation areas.

Natural Environment

The proposed local freeway and accompanying drainage system are not anticipated to adversely impact the area's existing water quality.

The 100 year floodplain is not located within the project area therefore floodplain impacts will be minimal. Located on the southside of the proposed improvement between 25th Street and 31st Street is an area that is intermittently subject to flooding at an average depth of less than one (1) foot.

There are no anticipated impacts on coastal zone consistency.

Literature reviews indicate that there may be several endangered or threatened species occurring within the study area, however, due to the nature of the highly urbanized area, it is unlikely that any threatened or endangered species are present. No designated critical habitats for endangered or threatened species exists within the vicinity of the proposed project. Field reviews performed in 1988 did not reveal the presence of any threatened or endangered species. Therefore no impact is expected.

Physical Environment

Noise impacts may be significant for the proposed project. An initial inventory of noise sensitive sites revealed 67 sites that could be affected by the new project.

This project is in an air quality nonattainment area which has transportation control measures in the State Implementation Plan (SIP) approved by the Environmental Protection Agency on June 15, 1981. The FHWA has determined that both the transportation plan and the transportation improvement program conform to the SIP. The FHWA has determined that this project is included in the transportation improvement program for Hillsborough County. Therefore, pursuant to 23FR 770.9(c)(2) this project conforms to the SIP. Impact is anticipated to be minimal.

During construction activities of the study area, consideration will be given to air, noise, water quality, traffic flow and visual impacts.

Air quality impacts should be temporary and will primarily be in the form of emissions from diesel-powered construction equipment and dust from embankment and haul road areas.

Noise vibrations impacts will occur from heavy equipment movement and construction activities, such as pile driving and compaction of embankment.

Water quality impacts resulting from erosion and sedimentation should be controlled and minimized.

Maintenance of traffic and sequence of construction will be planned and scheduled to minimize traffic delays throughout the study area.

According to prior hazardous materials investigations, impact to hazardous material sites should be minimum.

FINANCIAL ACTION PLAN

FDOT and the Tampa Hillsborough County Expressway Authority (THCEA) consider the I-4/Crosstown Connector an integral part of the efficient operation of the Tampa Expressway System and are committed to jointly funding the project. The exact amount of funding to be provided by each participant will be determined at a later date pending further feasibility and traffic and revenue studies. The current status of the project development and funding commitment is as follows:

* The FDOT is currently preparing an Environmental Impact Statement (EIS) as part of the Tampa Interstate Study (TIS). The segments included in the EIS are: I-275 from Dale Mabry Highway to Dr. Martin Luther King, Jr. Blvd.; I-4 from I-275 to 50th Street; and the I-4/Crosstown Connector. The THCEA could begin design on the Connector following approval of the IJR. The PD&E study must be completed before the final design is completed.

* The THCEA completed a preliminary feasibility study for this project in 1987. The results of that study indicated the project would be a feasible toll project. As a result, the THCEA will finance the design of the Connector as soon as the IJR is approved.

* Following final design, the THCEA will update the feasibility study by obtaining new traffic and revenue information. This feasibility study will determine the amounts to be financed by the participants. The FDOT amount will be a mixture of federal and state funds with the breakdown to be determined following the completion of the feasibility study.

SUMMARY AND ACTION

The proposed I-4/Crosstown Connector interchange provides a vital freeway to freeway link between I-4 and the South Crosstown Expressway. As documented herein, traffic operations on I-4 will provide an acceptable level of service in the design year with the proposed improvement. Furthermore, without the Crosstown Connector, vehicle trips between I-4 and the South Crosstown Expressway would be required to use the existing arterial street system. The existing arterial street system would require substantial improvements beyond those outlined in the long-range plan to accommodate projected traffic volumes safely and efficiently without the proposed project. The addition of the Crosstown Connector will divert a substantial number of vehicles from 14th/15th Streets, 40th Street and 50th Street, thus enabling these roadways to maintain an acceptable level of service in the future.

The proposed project will also improve traffic flow as a maintenance of traffic route during reconstruction of the Interstate. The Crosstown Connector will provide an alternative route for traffic on I-4 to access the CBD during the reconstruction of the downtown and I-4/I-275 interchanges.

In view of the facts presented in this report, it is proposed and recommended that the I-4/Crosstown Connector interchange be undertaken, as it is vital to the transportation needs of Hillsborough County. It is further proposed and recommended that the justification contained herein provides the necessary data and evaluations for FDOT to recommend approval to the FHWA.

APPENDIX A

EXISTING CONDITIONS (1988) CAPACITY ANALYSES

Greiner, Inc.

JOB I-4 / Crosstown Connector SHEET 1 OF 6 PROJ. NO. C1104.61
DESCRIPTION EXISTING TRAFFIC T-4 COMPUTED BY EKM DATE
AM Peak Ramp Junctions CHECKED BY GSR/4/98 DATE 3/27/89 5/6/98
Eastbound

GSR

EAST BOUND Exit to 21st Street

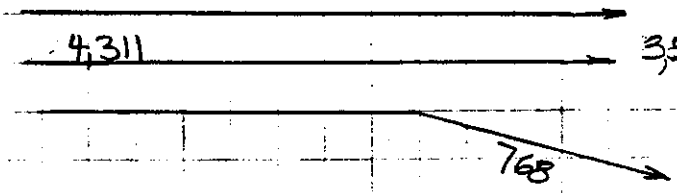


Table 5-2 for a 4-Ln freeway treat as isolated ramps
Lane Drop Table 5-1 applied to off ramp flow.

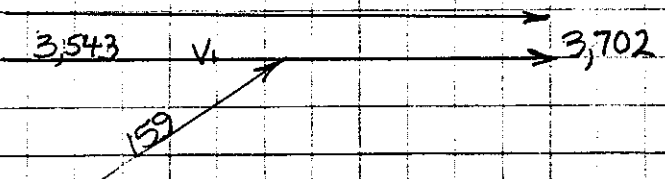
$V_D = 768/(0.95)(0.98) = 825$ pcph (LOS B)

Assuming even distribution

$V_2 = V_3 = 3,543/2 = 1,772$ vph $/(0.95)(0.98) = 1,903$ pcph (LOS E)

GSR

EASTBOUND ENTRANCE RAMP EAST of 22ND STREET



$f_1 = 3,543(.82)(.03) = 87$
$P_{T_1} = 87/1340 = 0.065$ ✓
$f_{HV} = 1/1 + 0.065(1.7-1)$
$f_{HV} = 0.956$ ✓

Figure 5-1 $V_1 = 136 + 0.345V_f - 0.115V_r$
$V_1 = 136 + 0.345(3,543) - 0.115(159)$
$V_1 = 1340$ vph ✓

$V_2 = V_f - V_1 = 3,543 - 1340$
$= 2,203$ vph

$V_1 = 1,340/(0.956 \times 0.95) = 1,475$ pcph ✓ ✓
$V_r = 159/(0.98 \times 0.95) = 171$ pcph

$P_{T_2} = 3,543(.18)(0.03)/2,203 = 0.009$
$f_{HV} = 1/1 + 0.009(1.7-1) = 0.994$

$V_m = 1,475 + 171 = 1,646$ pcph (LOS D)

$V_2 = 2,203/(0.994 \times 0.95) = 2,333$ (LOS E)

Form No. C1002-87

Greiner, Inc.

JOB I-4/CROSSTOWN — SHEET 2 OF 6 PROJ. NO. C1104.61
DESCRIPTION EXISTING TRAFFIC AM PEAK Ramp Junctions Eastbound — COMPUTED BY EKM DATE
CHECKED BY GSR/HJE DATE 3/27/89

68L EASTBOUND EXIT RAMP to 40th Sheet

Since upstream ramp is GT. 3200' treated as an isolated ramp

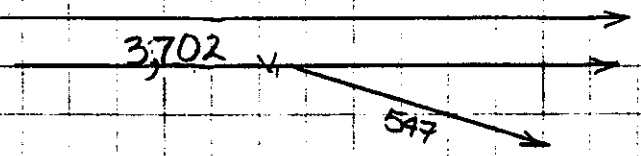


Fig J 5-2

$V_1 = 165 + 0.345 V_f + 0.520 V_r$

$V_1 = 165 + 0.345(3702) + 0.520(547)$

$V_1 = 1727$ vph ✓

$V_2 = 3,702 - 1,727$
$= 1,975$ vph

$T_1 = 3,702 (.82)(.03) = 91$; $P_{T_1} = 91/1727 = 0.053$

$f_{HV} = 1/1 + (0.053)(1.7-1)$

$f_{HV} = 0.964$ ✓

$P_{T_2} = \frac{3,702(.18)(0.03)}{1,975}$
$= 0.010$

$V_D = V_1 = 1,727$ vph $/ (0.964)(0.95)$

$V_D = 1,886$ pcph (LOS D) ✓

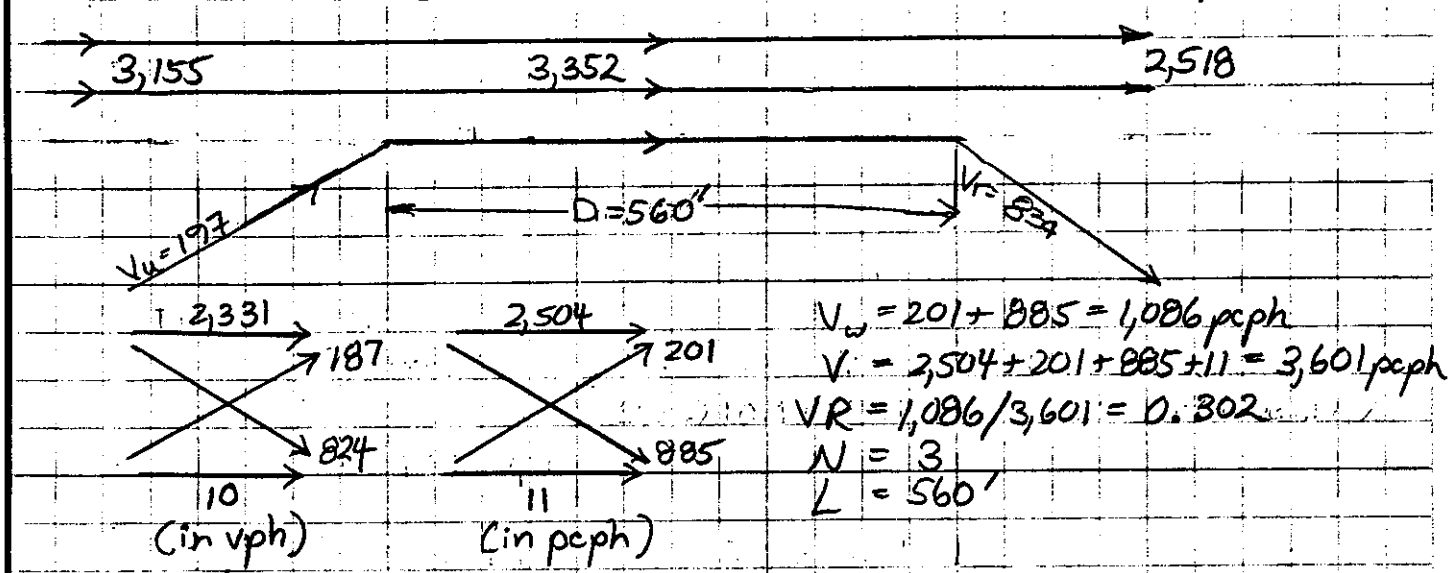
$\delta_{HV} = 1/1 + [(0.010)(1.7-1)]$
$= 0.993$

$V_2 = 1,975/(0.993 \times 0.95)$
$= 2,094$ pcph (LOS E)

Greiner, Inc.

JOB I-4/CROSSTOWN — SHEET 3 OF 6 PROJ. NO. C1104.61
DESCRIPTION EXISTING TRAFFIC, AM PEAK, Ramp Junctions Eastbound — COMPUTED BY EKM DATE
CHECKED BY GSR/MJE DATE 3/27/89

GSR EASTBOUND WEAVING SECTION BETWEEN 40TH ST. AND SOUTH ST./COLUMBUS DR.



$V_w = 201 + 885 = 1,086$ pcph
$V = 2,504 + 201 + 885 + 11 = 3,601$ pcph
$VR = 1,086/3,601 = 0.302$
$N = 3$
$L = 560'$

Type A Weave

$$S_w = 15 + \frac{50}{1+[(0.28)(1.302)^{2.2}(3,601/3)^{1.0}/(560)^{0.97}]} = 31.56 \text{ mph (LOS F)}$$

$$S_{ww} = 15 + \frac{50}{1+[(0.02)(1.302)^{4.0}(3,601/3)^{0.88}/(560)^{0.6}]} = 45.10 \text{ mph (LOS D)}$$

GSR EASTBOUND ENTRANCE EAST of 50th Street

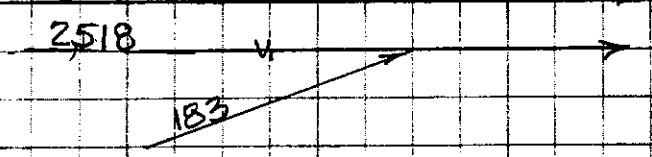


Table 5-6
$V_{T1} = 26.18(0.607)(0.03) = 51$
$P_{T1} = 51/984 = 0.052$
$f_{HV} = 1/(1+(1.7-1)(0.052))$
$f_{HV} = .965$

Figure I.5-1 $V_1 = 136 + 0.345V_4 - 0.115V_r$
$V_1 = 136 + 0.345(2,518) - 0.115(183)$
$V_1 = 984$ vph ✓

$V_2 = 2,518 - 984 = 1,534$ vph
$P_{T2} = \frac{2,518(0.33)(0.03)}{1,534} = 0.016$
$f_{HV} = 1/[1+(0.016)(1.7-1)] = 0.989$
$V_2 = 1,534/(0.989 \times 0.95) = 1,633$ pcph (LOS D)

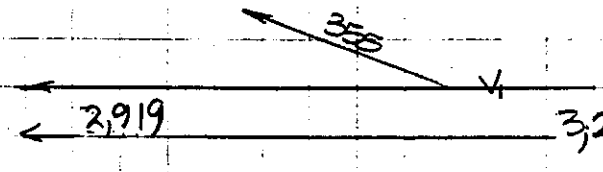
$V_1 = 984/0.965(0.95)$
$V_1 = 1,073$ pcph
$V_M = V_1 + V_r = 1,073 + 197$
$V_M = 1,270$ pcph (LOS C)

$V_r = 183/0.98(0.95)$
$V_r = 197$ pcph

Greiner, Inc.

JOB I-4 / CROSSTOWN — SHEET 4 OF 6 PROJ. NO. C1104.61
DESCRIPTION EXISTING TRAFFIC AM Peak, Ramp Junctions Westbound — COMPUTED BY EKM — DATE
CHECKED BY GSR/AJE — DATE 3/27/89

WESTBOUND EXIT to 50th Street



$T_T = 3274\ (.80)(0.03) = 79$ ✓

$P_{T_1} = 79/1,479 = 0.053$ ✓

$f_{HV} = 1/1+(0.053)(1.7-1)$

$f_{HV} = 0.964$

Fig I.5-2 $V_1 = 165 + 0.345\,V_f + 0.520\,V_r$

$V_1 = 165 + 0.345(3,274) + 0.520(355)$

$V_1 = 1,479$ vph ✓

$V_D = V_1 = 1479/(0.964)(0.95)$ ✓

$V_D = 1,615$ pcph (LOS C)

$V_2 = 3,274 - 1,479 = 1,795$ vph

$P_{T_2} = 3,274(0.20)(0.03)/1,795 = 0.011$

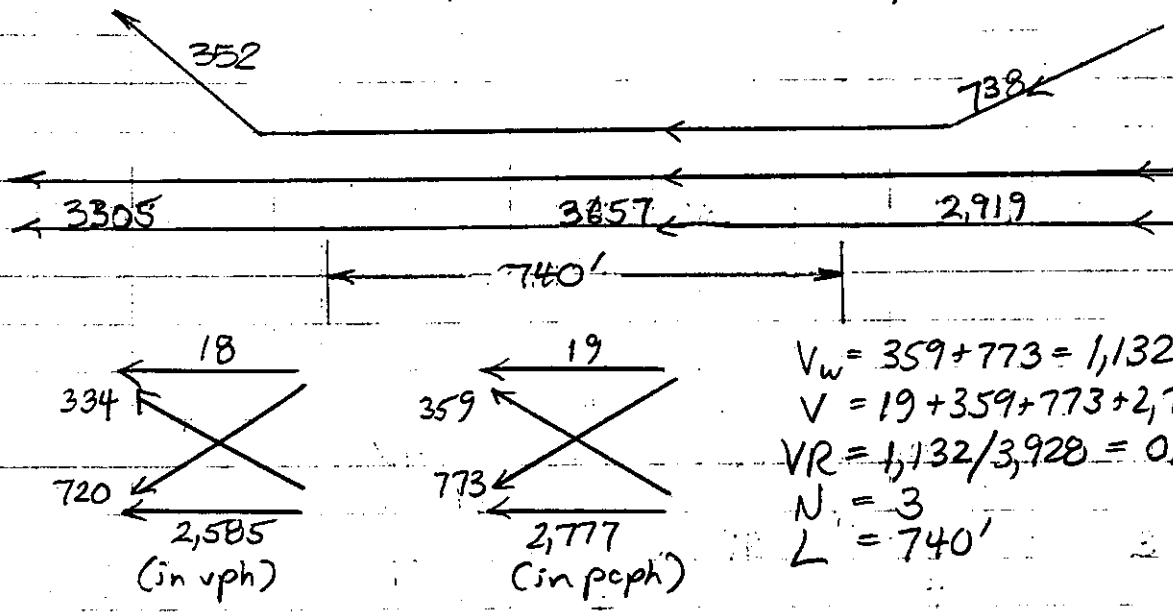
$f_{HV} = 1/1+[(0.011)(1.7-1)] = 0.992$

$V_2 = 1,795/(0.992 \times 0.95) = 1,904$ pcph (LOS E)

Greiner, Inc.

JOB I-4/CROSSTOWN — SHEET 5 OF 6 PROJ. NO. C1104.61
DESCRIPTION Existing Traffic AM Peak, Ramp Junctions Westbound — COMPUTED BY EKM DATE
CHECKED BY GSR/HJE DATE 3/27/89

GSR WESTBOUND WEAVING SECTION BETWEEN 50TH ST./COLUMBUS DR AND 40TH ST.

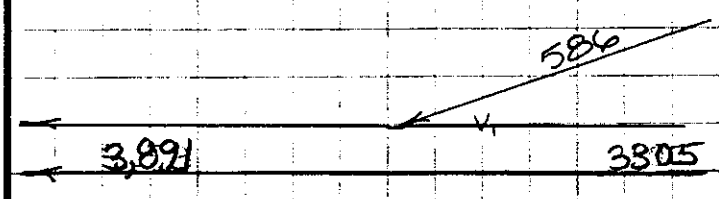


$V_w = 359 + 773 = 1{,}132$ pcph
$V = 19 + 359 + 773 + 2{,}777 = 3{,}928$ pcph
$VR = 1{,}132/3{,}928 = 0.288$
$N = 3$
$L = 740'$

$$S_w = 15 + \frac{50}{1 + [(0.28)(1.288)^{2.2}(3{,}928/3)^{1.0}/(740)^{0.9}]} = 33.70 \text{ mph (LOS F)}$$

$$S_{NW} = 15 + \frac{50}{1 + [(0.02)(1.288)^{4.0}(3{,}928/3)^{0.88}/(740)^{0.6}]} = 46.68 \text{ mph (LOS D)}$$

GSR WESTBOUND Entrance Ramp west of 40th Street



$T_1 = 3305(0.03)(0.82) = 81$ ✓
$P_{T_1} = 81/1209 = 0.067$ ✓
$f_{HV} = 1/1 + (0.067)(1.7-1) = 0.955$ ✓

Figuree I.5-1 $V_1 = 136 + 0.345\,V_f - 0.115\,V_r$
$V_1 = 136 + 0.345(3305) - 0.115(586)$
$V_1 = 1209$ vph ✓
$V_1 = 1209/(0.955)(0.95)$ $V_r = 586/(.95)(.98)$
$V_1 = 1{,}333$ pcph $V_r = 629$ pcph ✓

$V_2 = 3{,}305 - 1{,}209 = 2{,}096$ vph
$P_{T_2} = 3305(0.18)(0.03)/2{,}096$
$= 0.009$
$f_{HV} = 1/[1 + (0.009)(1.7-1)] = 0.994$
$N_2 = 2{,}096/(0.994 \times 0.95) = 2{,}220$ (LOS F)

$V_M = V_1 + V_r$
$V_M = 1{,}333 + 629$
$V_M = 1{,}962$ pcph (LOS E)

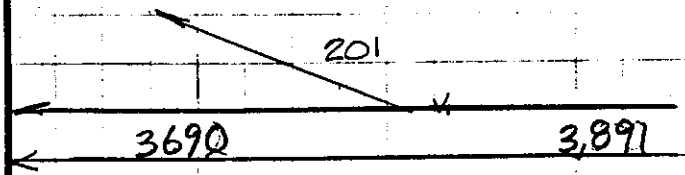
Greiner, Inc.

JOB I-4 / Crosstown
DESCRIPTION Existing Traffic AM Peak, Ramp Junctions Westbound
SHEET 6 OF 6 PROJ. NO. C1104.61
COMPUTED BY EKM DATE
CHECKED BY GSR/MJF DATE 3/27/89

GSR

WESTBOUND EXIT RAMP to 22ND STREET

Distance between this & upstream ramp is 5075' which is G.T 3200 ∴ TREAT as independent ramp



$P_T = 3891 (0.82)(0.03) = 96$ ✓

$P_T = 96/1612 = 0.060$ ✓

$f_{HV} = 1/1 + (0.060)(1.7-1) = 0.960$ ✓

FIGURE I.5-2 $V_1 = 165 + 0.345 V_f + 0.520 V_r$

$V_1 = 165 + 0.345 (3,891) + 0.520 (201)$

$V_1 = 1612$ vph ✓

$V_2 = 3,891 - 1,612 = 2,279$ vph $V_D = V_1 = 1612/(0.960)(0.95)$

$P_{T_2} = (3891)(0.18)(0.03)/2,279$ $V_D = 1,768$ pcph (LOS D)

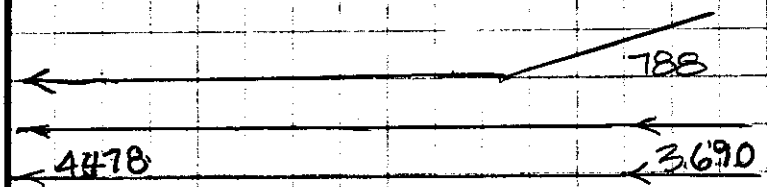
$= 0.009$

$f_{HV} = 1/[1 + (0.009)(1.7-1)] = 0.994$

$V_2 = 2,279/(0.994 \times 0.95) = 2,413$ pcph (LOS F)

SSR

WESTBOUND ENTRANCE RAMP WEST of 21ST Street



$V_r = 788$ vph

$V_m = 788/0.95(0.98)$ ✓

$V_m = 846$ pcph (LOS B)

Assuming even distribution:

$V_2 = V_3 = 3690/2 = 1845$ vph

$N_{T_2} = N_3 = 3690(0.03)/2 = 55$

$P_{T_2} = P_{T_3} = 55/1845 = 0.030$

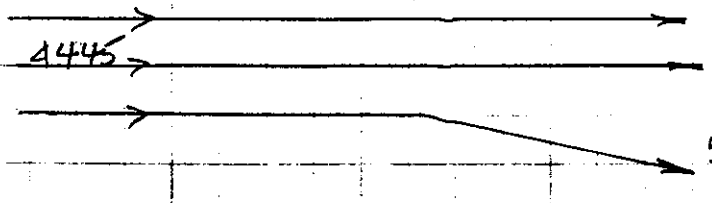
$f_{HV} = 1/[1 + (0.03)(1.7-1)] = 0.98$

$V_2 = V_3 = 1,845/(0.98 \times 0.95) = 1,982$ pcph (LOS E)

Greiner, Inc.

JOB I-4/Crosstown
DESCRIPTION EXISTING TRAFFIC PM PEAK Ramp Junctions
SHEET 1 OF 6 PROJ. NO. C1104.61
COMPUTED BY EKM DATE
CHECKED BY GSR/KDE DATE 3/27/89

GSR EAST BOUND EXIT RAMP to 21st Street



$V_r = 567$ vph

$V_D = 567/(0.98 \times 0.95) = 609$ pcph (LOS A)

Assuming even distribution

$V_2 = V_3 = 3,878/2 = 1,939$ vph $/(0.98 \times 0.95) = 2,083$ pcph (LOS E)

GSR EASTBOUND Entrance Ramp East of 22nd Street

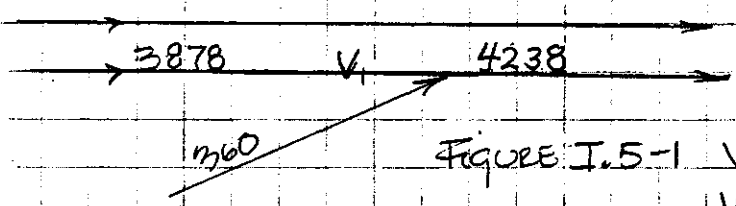


Figure I.5-1

$V_i = 136 + 0.345 V_f - 0.115 V_r$

$V_1 = 136 + 0.345(3878) - 0.115(360)$

$V_1 = 1433$ vph ✓

$V_1 = 1433/0.956(0.95)$

$V_1 = 1,578$ pcph ✓

$V_r = 360\ (0.98)(0.95)$

$V_r = 387$ pcph ✓

$V_H = 1,578 + 387$ ✓

$V_H = 1,965$ pcph (LOS E)

$T_1 = 3878\ (.82)(.03) = 95$ ✓

$P_{T_1} = 95/1433 = 0.066$

$f_{HV} = 1/[1 + (0.066)(1.7-1)]$

$f_{HV} = 0.956$ ✓

$V_2 = 3,878 - 1,433 = 2,445$ vph

$P_{T_2} = 3878(0.18)(0.03)/2,445 = 0.009$

$f_{HV} = 1/[1 + (0.009)(1.7-1)] = 0.994$

$V_2 = 2,445/(0.994 \times 0.95) = 2,589$ pcph (LOS F)

Greiner, Inc.

JOB I-4/Crosstown — SHEET 2 OF 6 PROJ. NO. C1104.61
DESCRIPTION EXISTING TRAFFIC PM PEAK, Ramp Junctions — COMPUTED BY EKM DATE
CHECKED BY SR/KJE DATE 3/27/89

SR Eastbound Exit to 40th Street

4,238 → V_1 → 3965
V_1 → 273

$T_1 = 4,238(.03)(.82) = 104$ ✓
$P_{T_1} = 104/1,769 = 0.059$ ✓
$f_{HV} = 1/1+(0.059)(1.7-1)$
$f_{HV} = 0.960$ ✓

Figure J.5-2 $V_1 = 165 + 0.345V_f + 0.520V_e$
$V_1 = 165 + 0.345(4,238) + 0.520(273)$
$V_1 = 1,769$ vph ✓
$V_D = V_1 = 1,769/0.960(0.95)$ ✓
$V_D = 1,940$ pcph (LOS D)

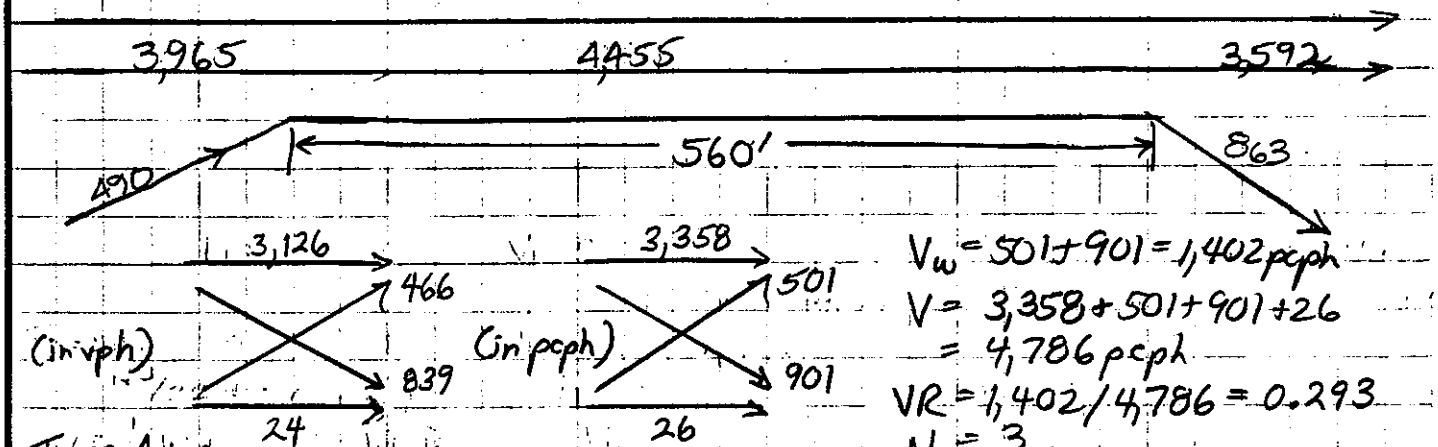
$V_2 = 4,238 - 1,769 = 2,469$ vph
$P_{T_2} = 4,238(0.18)(0.03)/2,469 = 0.009 \Rightarrow f_{HV} = 0.994$
$V_2 = 2,469/(0.994 \times 0.95) = 2,615$ pcph (LOS F)

Greiner, Inc.

JOB I-4 / Crosstown
DESCRIPTION Existing Traffic PM Peak Ramp Junctions
SHEET 3 OF 6 PROJ. NO. C1104.61
COMPUTED BY EKM DATE
CHECKED BY GSR/MJG DATE 3/27/89

GSR

EASTBOUND EXIT RAMP to Columbus / 50th Street



$V_w = 501 + 901 = 1,402$ pcph

$V = 3,358 + 501 + 901 + 26 = 4,786$ pcph

$VR = 1,402 / 4,786 = 0.293$

$N = 3$

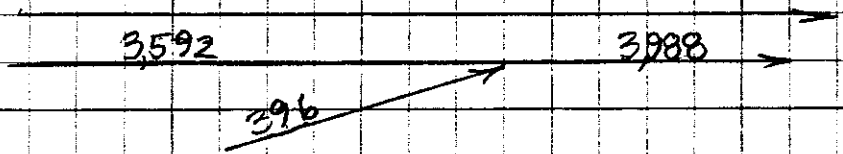
Type A weave

$$S_W = 15 + \frac{50}{1 + [(0.28)(1.293)^{2.2}(4,786/3)^{1.00}/(560)^{0.9}]} = 28.72 \text{ mph (LOS F)}$$

$$S_{NW} = 15 + \frac{50}{1 + [(0.02)(1.293)^{4.0}(4,786/3)^{0.80}/(560)^{0.6}]} = 42.38 \text{ mph (LOS D)}$$

GSR

EASTBOUND Entrance East of 50th Street



$T_1 = 3,592(0.82)(0.03) = 88$

$P_{T_1} = 88/1,330 = 0.066$

$f_{HV} = 1/[1 + (0.066)(1.7-1)]$

$f_{HV} = 0.956$

FIGURE I.5-1

$V_1 = 136 + 0.345 V_f - 0.115 V_r$

$V_1 = 136 + 0.345(3,592) - 0.115(396)$

$V_1 = 1,330$ vph ✓

$V_1 = 1,330 / 0.956(0.95)$

$V_1 = 1,464$ pcph ✓

$V_r = 396 / 0.95(0.98)$

$V_r = 425$ pcph ✓

$V_M = V_1 + V_r$

$V_M = 1,464 + 425$

$V_M = 1,889$ pcph (LOS D) ✓

$V_2 = 3,592 - 1,330 = 2,262$ vph

$P_{T_2} = 3,592(0.18)(0.03)/2,262$

≈ 0.009

$f_{HV} = 1/[1 + (0.009)(1.7-1)]$

$\doteq 0.994$

$V_2 = 2,262/(0.994 \times 0.95)$

$= 2,395$ pcph (LOS F)

Greiner, Inc.

JOB I-4/Crosstown SHEET 4 OF 6 PROJ. NO. C1104.61
DESCRIPTION Existing Traffic, PM Peak Ramp Junctions COMPUTED BY EKM DATE
CHECKED BY GSR/HJE DATE 3/27/89

GSL WESTBOUND EXIT TO 50th STREET

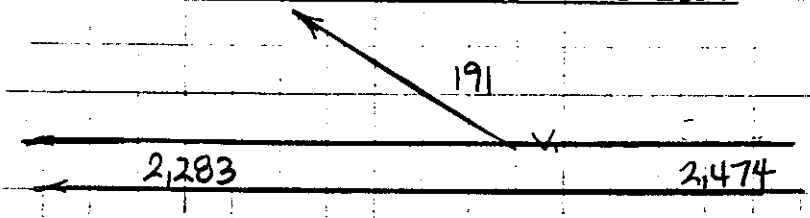


Figure I.5-2 $V_1 = 165 + 0.345 V_f + 0.520 V_r$

$V_1 = 165 + 0.345(2474) + 0.520(191)$

$V_1 = 1,118$ vph ✓

% D TRUCKS FROM Table 5.6 IS 66%

$P_T = (2,474)(.67)(.03) = 50 \Rightarrow 50/1,118 = 0.045$ ✓

$f_{HV} = 1/[1 + (0.045)(1.7-1)] = 0.969$ ✓

$V_D = V_1 = 1,118 / 0.969(0.95)$

$V_D = 1,214$ pcph (LOS C) ✓

$V_2 = 2,474 - 1,118 = 1,356$ vph

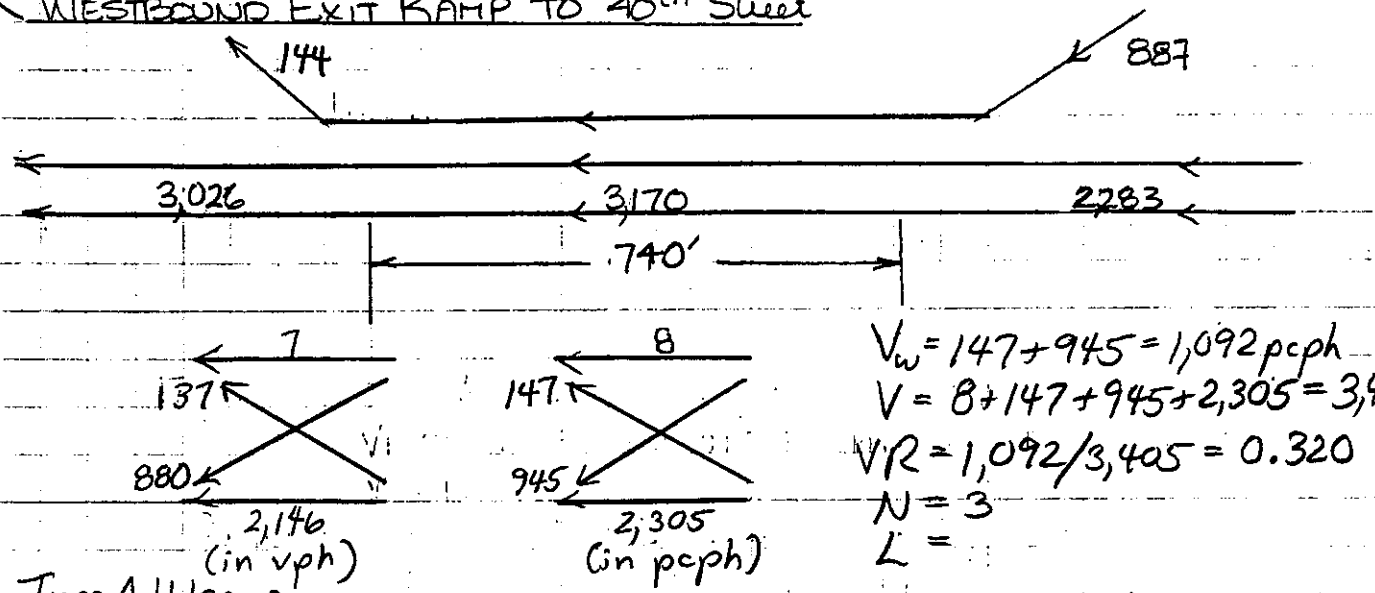
$P_{T_2} = 2,474(0.33)(0.03)/1,356 = 0.018 \Rightarrow f_{HV} = 1/[1 + (0.018)(1.7-1)] = 0.988$

$V_2 = 1,356/(0.988 \times 0.95) = 1,445$ pcph (LOS C)

Greiner, Inc.

JOB I-4 Crosstown — SHEET 5 OF 6 PROJ. NO. C1104.61
DESCRIPTION Existing Traffic PM Peak Ramp Junctions — COMPUTED BY _____ DATE _____
CHECKED BY GSR/MJE DATE 3/27/89

GSR Westbound Exit Ramp to 40th Street



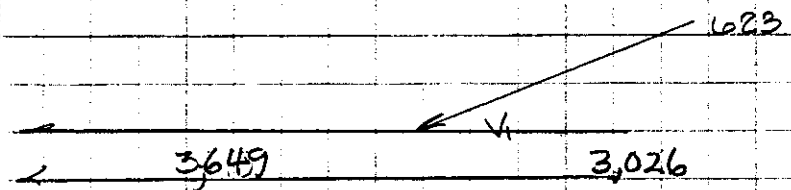
$V_w = 147 + 945 = 1,092$ pcph
$V = 8 + 147 + 945 + 2,305 = 3,405$ pcph
$VR = 1,092/3,405 = 0.320$
$N = 3$
$L =$

Type A Weave

$$S_w = 15 + \frac{50}{1+[(0.28)(1.32)^{2.2}(3,405/3)^{1.00}/(740)^{0.9}]} = 34.75 \text{ mph (LOS F)}$$

$$S_{NW} = 15 + \frac{50}{1+[(0.02)(1.32)^{4.0}(3,405/3)^{0.88}/(740)^{0.6}]} = 47.00 \text{ mph (LOS D)}$$

GSR Westbound Entrance Ramp west of 40th Street



← Table 5-6

$T_1 = 3,026\,(0.80)(0.03) = 73$
$P_{T_1} = 73/1,108 = 0.066$
$f_{HV} = 1/[1 + (0.066)(1.7-1)] = 0.956$

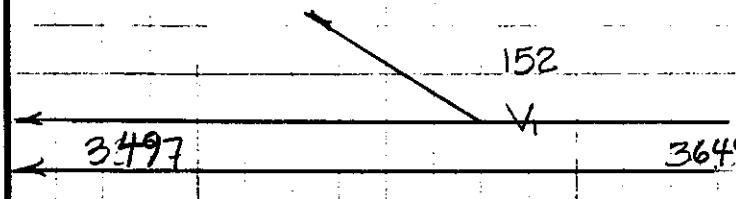
Figure J.5-1 $V_1 = 136 + 0.345\,V_f - 0.115\,V_r$
$V_1 = 136 + 0.345(3,026) - 0.115(623)$
$V_1 = 1,108$ vph ✓
$V_1 = 1,108/0.956(0.95)$
$V_1 = 1,220$ pcph ✓
$V_r = 623/0.98\,(0.95)$
$V_r = 669$ pcph ✓
$V_M = V_1 + V_r$
$V_M = 1,220 + 669$ ✓
$V_M = 1889$ pcph (LOS D)

$V_2 = 3,026 - 1,108 = 1,918$ vph
$P_{T_2} = 3,026(0.20)(0.03)/1,918$
$= 0.009$
$f_{HV} = 1/[1 + (0.009)(1.7-1)]$
$= 0.994$
$V_2 = 1,918/(0.994 \times 0.95)$
$= 2,031$ pcph (LOS E)

Greiner, Inc.

JOB I-4/Crosstown — SHEET 6 OF 6 PROJ. NO. C1104.61
DESCRIPTION Existing Traffic PM Peak Ramp Junctions — COMPUTED BY ____ DATE ____
CHECKED BY GSR/MJE DATE 3/27/89

GSR — Westbound Exit Ramp to 22nd Street



$T_1 = 3649(.82)(.03) = 90$ ✓

$P_{T_1} = 90/1503 = 0.060$

$f_{HV} = 1/[1+(0.060)(1.7-1)] = 0.960$

Figure I.5-2 $V_1 = 165 + 0.345V_f + 0.520V_r$

$V_1 = 165 + 0.345(3649) + 0.520(152)$

$V_1 = 1{,}503$ vph ✓

$V_1 = 1{,}503/(0.960)(0.95)$

$V_D = V_1 = 1{,}648$ pcph (LOS C) ✓

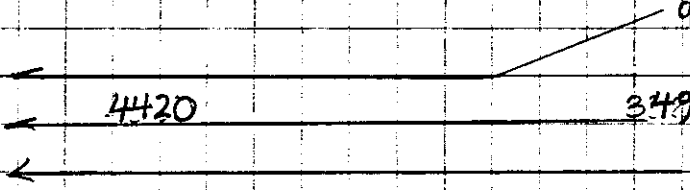
$V_2 = 3649 - 1{,}503 = 2{,}146$ vph

$P_{T_2} = 3{,}649(0.18)(0.03)/2{,}146 = 0.009$

$f_{HV} = 1/[1+(0.009)(1.7-1)] = 0.994$

$V_2 = 2{,}146/(0.994 \times 0.95) = 2{,}273$ pcph (LOS F)

GSR — Westbound Entrance Ramp WEST of 21st Street



$V_r = 923$ vph

$V_m = 923/(0.95)(0.98)$

$V_m = 991$ pcph (LOS B) ✓

Assuming even distribution

$V_2 = V_3 = 3{,}497/2 = 1{,}749$ vph $/(0.98 \times 0.95) = 1{,}879$ pcph (LOS E)

5 HCM: SIGNALIZED INTERSECTIONS
UMMARY REPORT

****

ERSECTION..I-4/21ST/22ND STREETS
A TYPE.....OTHER
NALYST.....GSR
TE.....4/4/89
E.....A.M. PEAK HOUR
OMMENT.....EXISTING CONDITIONS(1988)/FILE NAME 2122AE

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB		EB		WB		NB		SB	
T	99	154	643	45	LT	12.0	L	12.0	L	12.0	LT	12.0	
T	26	33	171	204	T	12.0	T	12.0	T	12.0	T	12.0	
R	0	14	96	199		12.0	TR	12.0	TR	12.0	R	12.0	
R	0	0	0	0		12.0		12.0		12.0		12.0	
						12.0		12.0		12.0		12.0	
						12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	5.00	N	0	0	0.88	50	N	20.5	3
WB	0.00	5.00	N	0	0	0.88	50	N	20.5	3
NB	0.00	5.00	N	0	0	0.88	50	N	17.5	3
SB	0.00	5.00	N	0	0	0.88	50	N	17.5	3

SIGNAL SETTINGS — CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X			
	TH	X					TH	X			
	RT						RT	X			
	PD						PD				
WB	LT		X			SB	LT		X		
	TH		X				TH		X		
	RT		X				RT		X		
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.578	0.117	41.2	E	39.1	D
	T	0.144	0.117	30.8	D		
WB	L	0.700	0.150	42.5	E	39.1	D
	TR	0.111	0.150	28.5	D		
NB	L	0.974	0.450	44.3	E	34.8	D
	TR	0.213	0.450	13.0	B		
SB	L	0.167	0.183	31.4	D	29.0	D
	T	0.720	0.183	34.2	D		
	R	0.505	0.300	23.1	C		

NTERSECTION: Delay = 34.1 (sec/veh) V/C = ~~1.477~~ 0.849 LOS = D

5 HCM: SIGNALIZED INTERSECTIONS
MARY REPORT

ERSECTION..I-4/21ST/22ND STREETS
A TYPE.....OTHER
NALYST.....GSR
TE.....4/4/89
E.....P.M. PEAK HOUR
OMMENT.....EXISTING CONDITIONS(1988)/FILE NAME 2122PE

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB		EB		WB		NB		SB	
T	126	137	687	54	LT	12.0	L	12.0	L	12.0	LT	12.0	
H	52	24	254	81	T	12.0	T	12.0	T	12.0	T	12.0	
R	0	46	257	257		12.0	TR	12.0	TR	12.0	R	12.0	
R	0	0	0	0		12.0		12.0		12.0		12.0	
						12.0		12.0		12.0		12.0	
						12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR.	TYPE
EB	0.00	5.00	N	0	0	0.85	50	N	20.5		3
WB	0.00	5.00	N	0	0	0.85	50	N	20.5		3
NB	0.00	5.00	N	0	0	0.85	50	N	17.5		3
SB	0.00	5.00	N	0	0	0.85	50	N	17.5		3

SIGNAL SETTINGS — CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X			
	TH	X					TH	X			
	RT						RT	X			
	PD						PD				
WB	LT		X			SB	LT		X		
	TH		X				TH		X		
	RT		X				RT		X		
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.821	0.108	56.6	E	49.5	E
	T	0.322	0.108	32.2	D		
WB	L	0.829	0.117	56.1	E	47.4	E
	TR	0.234	0.117	31.1	D		
NB	L	1.021	0.475	54.2	E	36.3	D
	TR	0.410	0.475	13.4	B		
SB	LT	0.242	0.200	26.1	D	25.6	D
	R	0.657	0.308	25.3	D		

NTERSECTION: Delay = 36.5 (sec/veh) V/C = ~~1.574~~ 0.971 LOS = D

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 ON/OFF RAMPS/40TH STREET
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/5/89
TIME.....A.M. PEAK HOUR
COMMENT.....EXISTING CONDITIONS(1988)/FILE NAME 40AE

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB		EB		WB		NB		SB	
LT	178	291	286	77	: L	12.0	L	12.0	L	12.0	LT	12.0	
TH	0	0	391	677	:	12.0	R	12.0	T	12.0	T	12.0	
RT	0	61	120	300	:	12.0		12.0	TR	12.0	R	12.0	
RR	0	20	0	20	:	12.0		12.0		12.0		12.0	
					:	12.0		12.0		12.0		12.0	
					:	12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	5.00	N	0	0	0.90	50	N	25.8	3
WB	0.00	5.00	N	0	0	0.90	50	N	25.8	3
NB	0.00	5.00	N	0	0	0.90	50	N	16.8	3
SB	0.00	5.00	N	0	0	0.90	50	N	16.8	3

SIGNAL SETTINGS — CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X			
	TH						TH	X			
	RT						RT	X			
	PD						PD				
WB	LT		X			SB	LT		X		
	TH						TH		X		
	RT		X				RT		X		
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.712	0.167	41.5	E	41.5	E
WB	L	0.802	0.242	40.2	E	38.1	D
	R	0.127	0.242	23.0	C		
NB	L	0.817	0.233	41.9	E	34.2	D
	TR	0.754	0.233	30.1	D		
SB	LT	0.975	0.258	43.7	E	41.2	E
	R	0.808	0.258	34.0	D		

INTERSECTION: Delay = 38.4 (sec/veh) V/C = 0.839 LOS = D

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 ON/OFF RAMPS/40TH STREET
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/5/89
TIME.....P.M. PEAK HOUR
COMMENT.....EXISTING CONDITIONS(1988)/FILE NAME 40PE

	VOLUMES				GEOMETRY							
	EB	WB	NB	SB	EB		WB		NB		SB	
LT	171	78	385	110	L 12.0	L	12.0	L	12.0	LT	12.0	
TH	0	0	534	495	12.0	R	12.0	T	12.0	T	12.0	
RT	0	66	380	238	12.0		12.0	TR	12.0	R	12.0	
RR	0	20	0	20	12.0		12.0		12.0		12.0	
					12.0		12.0		12.0		12.0	
					12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	5.00	N	0	0	0.92	50	N	25.8	3
WB	0.00	5.00	N	0	0	0.92	50	N	25.8	3
NB	0.00	5.00	N	0	0	0.92	50	N	16.8	3
SB	0.00	5.00	N	0	0	0.92	50	N	16.8	3

SIGNAL SETTINGS — CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X			
	TH						TH	X			
	RT						RT	X			
	PD						PD				
WB	LT		X			SB	LT		X		
	TH						TH		X		
	RT		X				RT		X		
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.582	0.192	35.5	D	35.5	D
WB	L	0.381	0.133	36.6	D	34.3	D
	R	0.250	0.133	30.2	D		
NB	L	0.735	0.342	29.8	D	31.8	D
	TR	0.928	0.342	32.6	D		
SB	LT	0.851	0.233	33.6	D	32.7	D
	R	0.680	0.233	30.2	D		

INTERSECTION: Delay = 32.5 (sec/veh) V/C = 0.753 LOS = D

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..COLUMBUS DRIVE/50TH STREET(U.S.41)
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/5/89
TIME.....A.M. PEAK HOUR
COMMENT.....EXISTING CONDITIONS(1988)/FILE NAME 50AE

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB		EB		WB		NB		SB	
LT	221	47	260	128	: L	12.0	L	12.0	L	12.0	L	12.0	
TH	250	306	738	853	: L	12.0	T	12.0	L	12.0	T	12.0	
RT	0	136	26	437	: T	12.0	T	12.0	T	12.0	T	12.0	
RR	0	20	0	20	:	12.0	R	12.0	TR	12.0	R	12.0	
					:	12.0		12.0		12.0		12.0	
					:	12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	5.00	N	0	0	0.85	50	N	31.8	3
WB	0.00	5.00	N	0	0	0.85	50	N	31.8	3
NB	0.00	5.00	N	0	0	0.85	50	N	28.8	3
SB	0.00	5.00	N	0	0	0.85	50	N	28.8	3

SIGNAL SETTINGS — CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X	X			NB	LT	X			
	TH		X	X			TH		X		
	RT						RT		X		
	PD						PD				
WB	LT	X				SB	LT	X			
	TH			X			TH		X		
	RT			X			RT		X		
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.483	0.175	34.4	D	30.9	D
	T	0.649	0.258	27.5	D		
WB	L	0.306	0.108	37.8	D	27.1	D
	T	0.562	0.192	29.1	D		
	R	0.249	0.367	17.2	C		
NB	L	0.568	0.175	35.5	D	26.5	D
	TR	0.754	0.358	23.4	C		
SB	L	0.516	0.175	35.4	D	23.2	C
	T	0.838	0.358	25.9	D		
	R	0.616	0.533	13.5	B		

INTERSECTION: Delay = 25.8 (sec/veh) V/C = 0.699 LOS = D

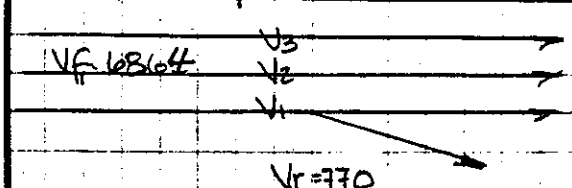
APPENDIX B

OPENING YEAR (1995) PHASE I CAPACITY ANALYSES

Greiner, Inc.

JOB I-4/Crosstown Connector — SHEET 1 OF 4 PROJ. NO. C1104.61
DESCRIPTION ALT A Toll Scheme — COMPUTED BY EKM — DATE 16 Dec 88
1995 MOT TRAFFIC
EASTBOUND — CHECKED BY GSR/MJE — DATE 3/27/89

GSR – Exit Ramp to 21st/22nd Street



* Fig I.5-7 $V_1 = 94 + 0.231V_f + 0.473V_r + 215V_u/D_u$
$V_1 = 94 + 0.231(6864) + 0.473(770) + 2$
$V_1 = 2046$ vph ✓

$P_T = 6864(0.03)(0.80) = 165$; $165/2046 = 0.081$ ✓
$f_{HV} = 1/1 + (0.081)(1.7-1) = 0.947$ ✓

$V_{f1} = 6864/0.98(0.95) = 7373$ pcph ✓
$V_2 + V_3 = 7378 - 2274 = 5099$ pcph ✓
$V_{f2} = 6094/0.98(095) = 6546$ pcph ✓

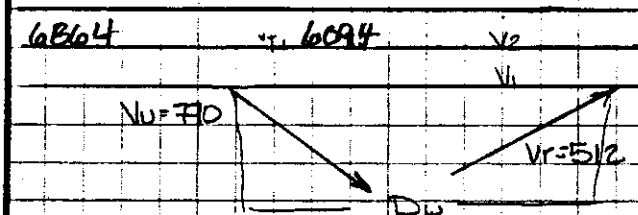
$V_D = V_1 = 2046/(0.947)(0.95) = 2274$ pcph ✓
LOS F

$V_{f1}/V_c = 5099/4200 = 1.21$ ✓
$V_1/V_c = 2274/2200 = 1.03$ ✓

* Not Vf exceeds normal range for equation use

$V_{f2}/V_c = 6546/6300 = 1.04$ ✓

Entrance Ramp from 15th Street



To calculate per lane V/C as this is a weaving section

Fig I.5-6 $V_1 = -121 + 0.244V_f - 0.085V_u + 640\,V_d/D_d$
* $640\,V_d/D_d = 5$

$V_1 = -121 + 0.244(6094) - 0.085(770) + 5$
$V_1 = 1300$ vph ✓

$V_{f1} = 6094/0.98(0.95) = 6546$ pcph ✓
$V_2 + V_3 = 6546 - 1476 = 5070$ pcph
$V_{f2} = 6606/0.98(0.95) = 7096$ pcph ✓
$V_{M2} + V_{M3} = 7096 - 2026 = 5070$ pcph

$P_T = 6094(0.03)(0.80) = 146$; $146/1300 = 0.112$ ✓
$f_{HV} = 1/1 + 0.112(1.7-1) = 0.927$ ✓
$V_1 = 1300/0.927(0.95) = 1476$ pcph ✓
$V_r = 512/0.98(095) = 550$ pcph ✓
$V_M = 1976 - 550 = 2026$ pcph ✓

$V_{f1}/V_c = 6546/6300 = 1.04$ ✓

$V_M/V_c = 2026/2200 = 0.92$ ✓

$V_{f2}/V_c = 5070/4200 = 1.21$ ✓

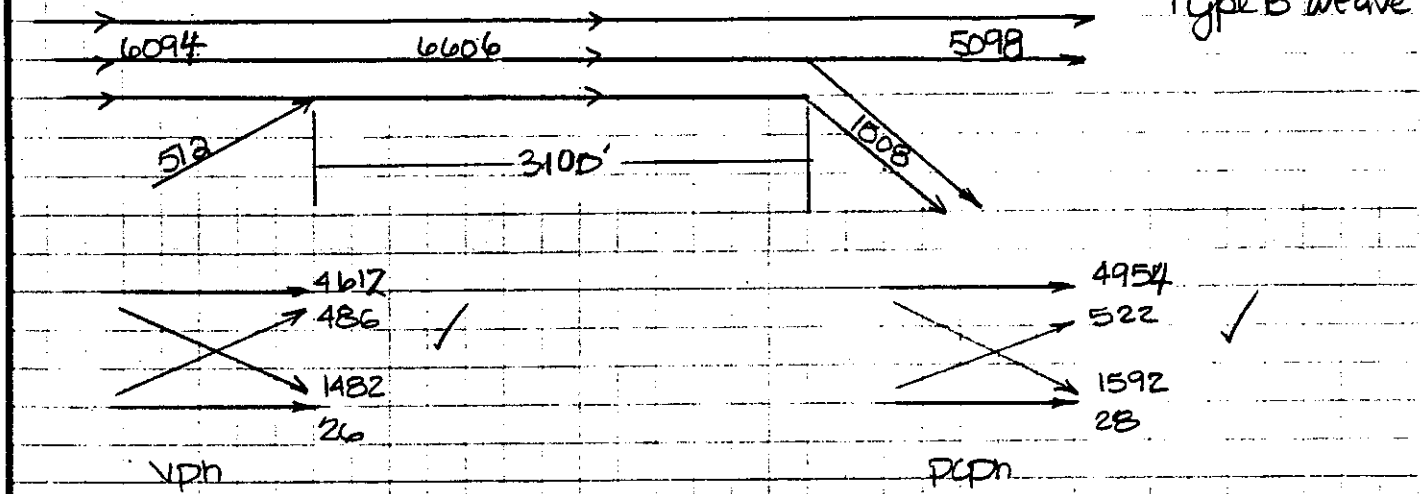
Weaving section evaluation on next page

Greiner, Inc.

JOB I-4/Crosstown Connector
DESCRIPTION ALTA Toll Scheme
1995 MOT
EASTBOUND

SHEET 2 OF 4 PROJ. NO. C110461
COMPUTED BY EKM DATE 21Jan09
CHECKED BY GSR/MJE DATE 3/27/09

GSR 15th Street on-ramp to Exit to Southbound Connector



$V_w = 522 + 1592 = 2114$ pcph ✓
$v = 522 + 1592 + 4954 + 28 = 7096$ pcph ✓
$VR = 2114/7096 = 0.298$ ✓
$N = 3$
$L = 3100$ ✓

$$S_w = 15 + \frac{50}{1 + 0.10(1 + 0.298)^{1.2}\left[(7096/3)^{.71}/3100^{.5}\right]}$$

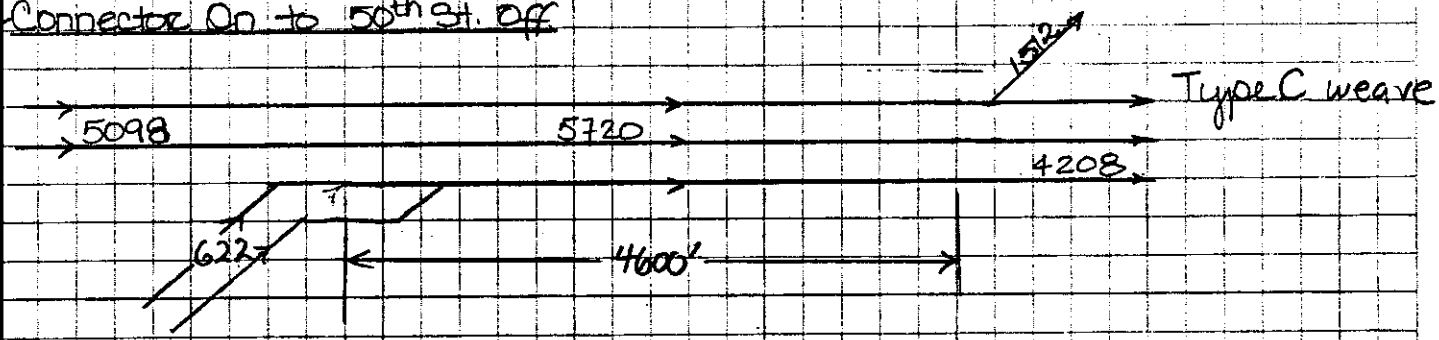
$S_w = \boxed{40.34 \text{ mph (LOS C)}}$ ✓

$$S_{nw} = 15 + \frac{50}{1 + 0.02(1 + 0.298)^{2}\left[(7096/3)^{1.42}/3100^{.95}\right]}$$

$S_{nw} = \boxed{39.95 \text{ mph (LOS D)}}$ ✓

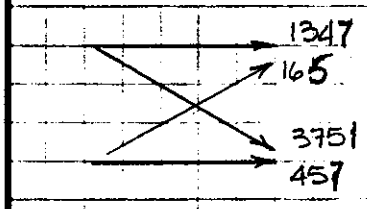
$N_w = 3\{0.005 + 0.703(0.298) + (234.8/3100) - 0.018(39.95 - 40.34)\} = 1.13 < 3.0$
⇒ UNCONSTRAINED

GSR Connector On to 50th St. Off

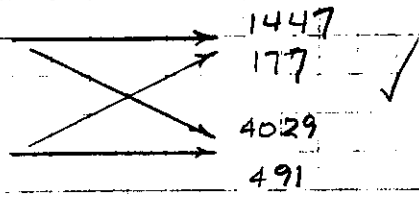


Greiner, Inc.

JOB I-4/Crosstown Connector — SHEET 3 OF 4 PROJ. NO. C1104.61
DESCRIPTION ALT A Toll Scheme — COMPUTED BY EKM DATE 21Jan89
1995 MOT — CHECKED BY GSR/[illegible] DATE 3/27/89
Eastbound



vph



pcph

$V_w = 177 + 4029 = 4206$ pcph ✓
$V = 177 + 4029 + 1447 + 491 = 6144$ pcph ✓
$v_c = 4206/6144 = 0.685$ ✓
$N = 3$ ✓
$L = 4600$ ✓

$$S_w = \frac{50}{15 + 1 + 0.10(1+0.685)^{1.8}(6144/3)^{0.80}/4600^{0.5}]}$$

$$= \boxed{33.65 \text{ mph (LOS E)}}$$ ✓

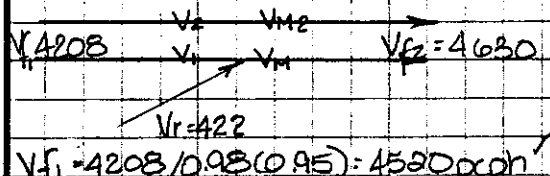
$$S_{nw} = 15 + \frac{50}{1 + 0.015(1+0.685)^{1.8}(6144/3)^{1.10}/4600^{0.5}]}$$

$$= \boxed{29.35 \text{ mph (LOS F)}}$$ ✓

$$N_w = 3\{0.761 - 0.011(46) - 0.005(29.35 - 33.65) + 0.047(0.685)\} = 0.926 < 3.0$$

$\Rightarrow$ UNCONSTRAINED

GSR On Ramp from 50th St.



$V_{f1} = 4208/0.98(0.95) = 4520$ pcph ✓
$V_2 = 4520 - 1695 = 2825$ pcph ✓
$V_{f2} = 4630/0.98(0.95) = 4973$ pcph ✓
$V_{M2} = 4973 - 2148 = 2825$ pcph ✓

$V_2/V_c = 2825/2200 = 1.28$

$V_M/V_c = 2148/2200 = 0.98$ ✓

* Fig I.5-1 $V_1 = 136 + 0.345V_f - 0.115V_r$
$V_1 = 136 + 0.345(4208) - 0.115(422)$
$V_1 = 1539$ vph ✓

$P_T = 4208(0.03)(0.80) = 101$; $101/1539 = 0.066$ ✓
$f_{HV} = 1/1 + 0.066(1.7-1) = 0.956$ ✓
$V_1 = 1539/(0.956)(0.95) = 1695$ pcph ✓
$V_r = 422/0.98(0.95) = 453$ pcph ✓
$V_M = 1695 + 453 = \boxed{2148 \text{ pcph}}$ ✓
LOS E

* Note V_f exceeds normal range for the equation

Greiner, Inc.

JOB I-4/Crosstown Connector SHEET 4 OF 4 PROJ. NO. C1104.61
DESCRIPTION ALT A Toll Scheme) COMPUTED BY _____ DATE _____
1995 MOT Traffic CHECKED BY GSR/MJE DATE 3/27/89
Eastbound

Basic Freeway Segments.

GSR West of off to 21st/22nd

Vf = 6864 vph ✓ Vf = 6864/0.95(0.98)
Vf/Vc = 7373/6300 = 1.17 Vf = 7373 pcph 6LN
LOSF

West of entrance from 15th St

GSR Vf = 6094 vph Vf = 6094/0.95(0.98)
Vf/Vc = 6546/6300 = 1.04 ✓ Vf = 6546 6LN freeway
LOSE

GSR East of exit to South connector

Vf = 5098 vph ✓ Vf = 5098/0.98(0.95)
Vf/Vc = 5476/4200 = 1.30 Vf = 5476 pcph 4LN freeway
LOSF

GSR East of exit to 50th St

Vf = 4208 vph ✓ Vf = 4208/(0.98)(0.95)
Vf/Vc = 4520/4200 = 1.08 Vf = 4520 pcph 4LN freeway
LOSF

GSR East of on from 50th St

Vf = 4630 vph Vf = 4630/0.98(0.95)
Vf/Vc = 4973/4200 = 1.18 ✓ Vf = 4973 pcph 4LN freeway
LOSF

Greiner, Inc.

JOB I-4 / Crosstown Connector — SHEET 1 OF 4 — PROJ. NO. C1104.61
DESCRIPTION ALT A Toll Scheme — COMPUTED BY EKH — DATE 2Jan89
1995 MOT Traffic WESTBOUND — CHECKED BY GSR/MJE — DATE 3/27/89
Revised Final Design

GSR Exit to 50th Street

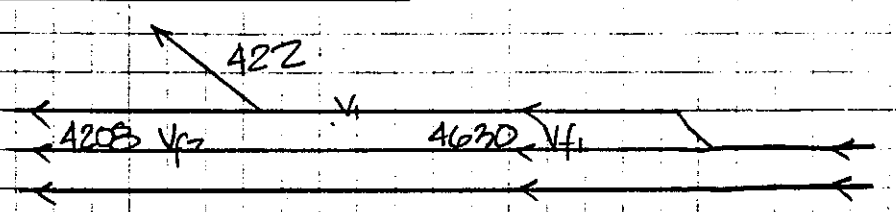


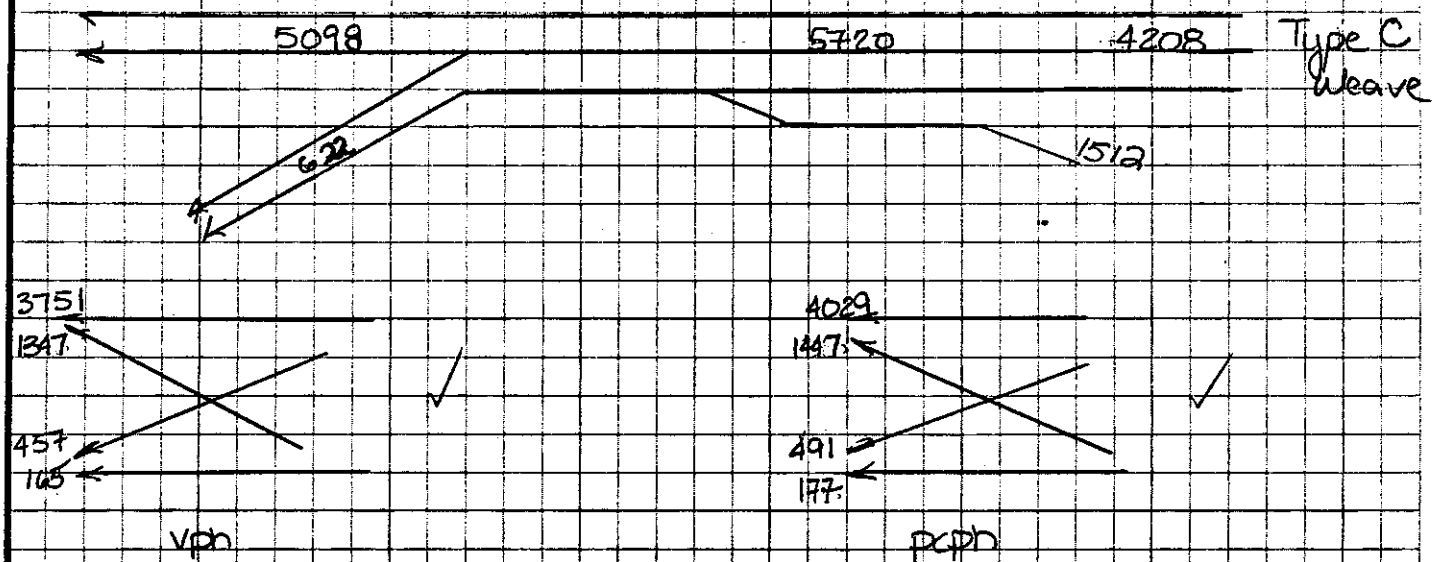
Fig I5-7

$V_1 = 94 + 0.231 V_f + 0.473 V_r + 2$
$V_1 = 94 + 0.231 (4630) + 0.473 (422) + 2$
$V_1 = 1365$ vph ✓
$V_D = V_1 = 1365 / 0.961(.095)$
$V_D = 1495$ pcph ✓
LOS C

$P_T = 4630(0.03)(0.57) = 79$
$P_T = 79/1365 = .058$ ✓

$f_{HV} = 1/1 + 0.058(1.7-1)$
$f_{HV} = 0.961$ ✓

GSR From 50th St to Connector SOUTHBOUND



$V_W = 1447 + 491 = 1938$ pcph ✓
$V = 4029 + 1447 + 491 + 177 = 6144$ pcph
$VR = 1938/6144 = 0.315$ ✓
N = 3 ✓
L = 3800'

Greiner, Inc.

JOB I-4 / Crosstown Connector — SHEET 2 OF 4 — PROJ. NO. C1104.61
DESCRIPTION ALT A Toll Scheme — COMPUTED BY EKM — DATE 21 Jan 89
1995 Mot Traffic Westbound — CHECKED BY GSR/MJE — DATE 3/27/89
Revised Final Design

$$Sw = 15 + \frac{50}{1 + 0.10(1+0.315)^{1.8}(6144/3)^{.80}/3800^{.5}}$$

$Sw = 37.90$ mph (LOS D) ✓

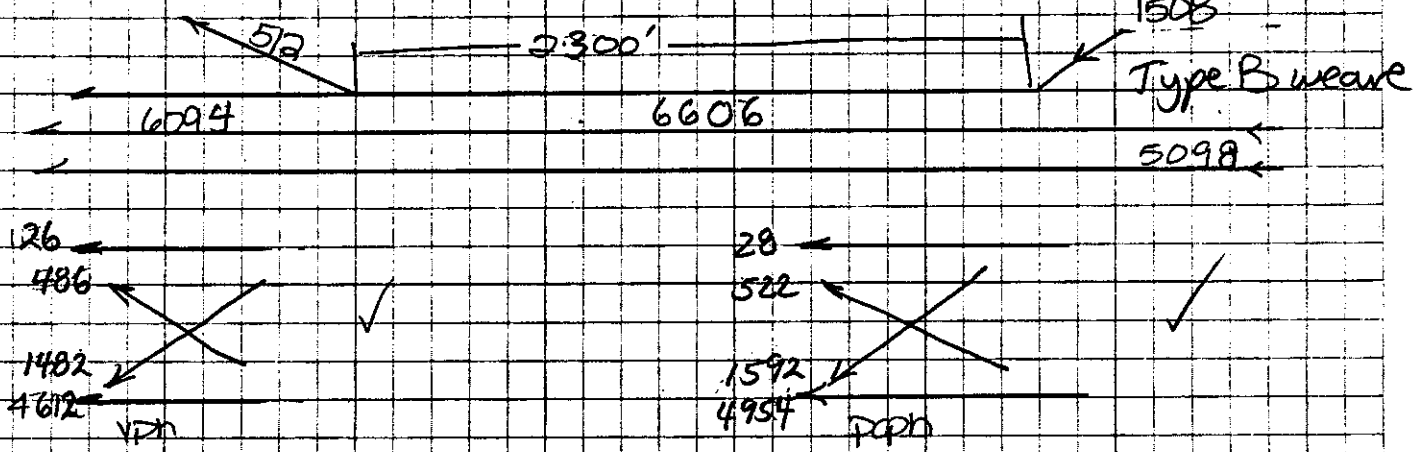
$$Snw = 15 + \frac{50}{1 + 0.015(1+0.315)^{1.8}(6144/3)^{1.10}/3800^{.5}}$$

$Snw = 33.19$ mph (LOS E) ✓

$N_w = 3\{0.761 - 0.011(38) - 0.005(33.19 - 37.90) + 0.047(0.315)\} = 1.14 < 3.0$
⇒ UNCONSTRAINED

GSR

NORTHBOUND Connector to 15th ST Off



$V_w = 522 + 1592 = 2114$ pcph ✓
$T = 28 + 522 + 1592 + 4954 = 7096$ pcph ✓
$V/C = 2114/7096 = 0.298$ ✓
$L = 2300'$ ✓
$N = 3$

$$Sw = 15 + \frac{50}{1 + [0.10(1+0.298)^{1.2}(7096/3)^{.77}/2300^{.5}]}$$

$Sw = 38.48$ mph (LOS D)

$$Snw = 15 + \frac{50}{1 + [0.09(1+0.298)^{2}(7096/3)^{1.42}/2300^{.95}]}$$

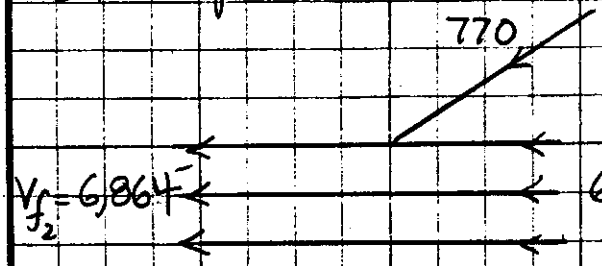
$Snw = 36.43$ mph (LOS D)

$N_w = 3\{0.085 + 0.703(0.298) + (234.8/2300) - 0.018(38.48 - 36.04)\} = 1.06 < 3.0$
⇒ UNCONSTRAINED

Greiner, Inc.

JOB I-4/Crosstown Connector — SHEET 3 OF 4 PROJ. NO. C1104.61
DESCRIPTION Alt A Toll Scheme 1995 Most Traffic Westbound — COMPUTED BY GSR DATE 3/27/89
CHECKED BY MJE DATE

On-ramp from 21st St.



Using Fig I.5-6

$V_1 = -121 + 0.244(6,094) - 0.085(50) + 5 = 1,367$ vph

# of trucks in lane 1 = (0.80)(0.03)(6,094) = 146

$P_{T_1} = 146/1,367 = 0.107$

$f_{HV} = 1/1 + [(0.107)(1.7-1)] = 0.930$

$V_1 = 1,367/(0.930 \times 0.95) = 1,547$ pcph

$V_r = 770/(0.98 \times 0.95) = 827$ pcph

$V_m = V_1 + V_r = 1,547 + 827 = 2,374$ pcph (LOS F)

$V_{f_{31}} = 6094/(0.98)(0.95) = 6,546$ pcph $\quad \frac{V_{f_1}}{V_c} = \frac{6,546}{6,300} = 1.04$

$V_{f_2} = 6,864/(0.98)(0.95) = 7,373$ pcph

$V_{2+3} = 6864 - 1547 = 5317$ pcph

$V_{2+3}/V_c = 5317/4200 = 1.27$

Greiner, Inc.

JOB I-4/Crosstown Connector — SHEET 4 OF 4 PROJ. NO. C110461
DESCRIPTION Alt A Toll Scheme — COMPUTED BY EKM — DATE 21Jan89
1995 MOT TRAFFIC — CHECKED BY GSR/KJF — DATE 3/27/89
WESTBOUND

Basic Freeway Segments

GSR West of 50th Street

Vf=4208 vph Vf = 4208/(0.98X0.95) Vf/Vc = 4520/4200 = 1.08 ✓
Vf = 4520 pcph on 4LN Freeway
LOSF

GSR West of split to South Connector

Vf = 5098 vph Vf = 5098/0.98(0.95) Vf/Vc = 5476/4200 = 1.30 ✓
Vf = 5476 pcph on 4LN Freeway
LOSF

GSR West of exit to 15th ST

Vf = 6094 vph Vf = 6094/0.98(0.95) Vf/Vc = 6546/6300 = 1.04 ✓
Vf = 6546 pcph on 6LN Freeway
LOSE

GSR West of entrance from 21st/20th

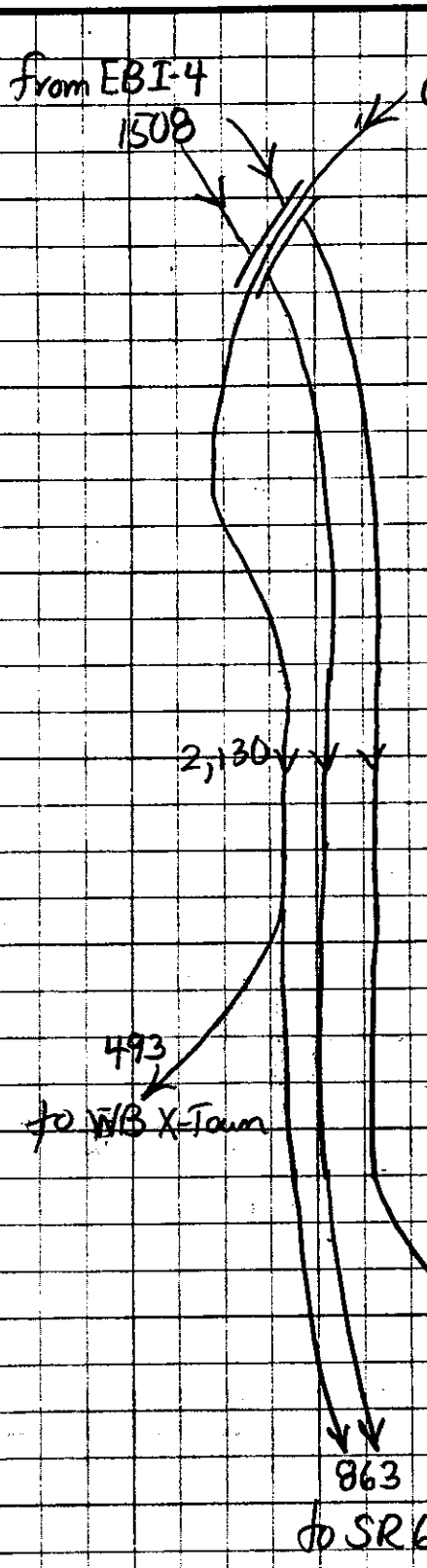
Vf = 6864 vph Vf = 6864/0.98(0.95) Vf/Vc = 7373/6300 = 1.17 ✓
Vf = 7373 pcph on 6LN Freeway
LOSF

GSR ← EAST of off to 50th

Vf = 4630 Vf = 4630/0.98(0.95) Vf/Vc = 4973/6300 = 0.79 ✓
Vf = 4973 pcph 6LN
LOS D

Greiner, Inc.

JOB I-4/Crosstown Connector IJR SHEET 1 OF 2 PROJ. NO. C1104.61
DESCRIPTION 1995 Phase I Improvement (Southbound) COMPUTED BY GSR DATE 3/28/89
CHECKED BY HJE DATE



WB I-4 to WB X-Town = 493 vph
WB I-4 to SR 60 = 622 - 493 = 129 vph
EB I-4 to SR 60 = 863 - 129 = 734 vph
EB I-4 to EB X-Town = 1508 - 734 = 774 vph

- On-ramp from WB I-4 (1 lane add)

$V_m = 622/(0.95 \times 0.98) = 668$ pcph (LOS B)

- Off-ramp to WB X-Town Expressway

Using Fig. I.5-7

$V_1 = 94 + 0.231(2,130) + 0.473(493) + 2$
$= 821$ vph

# of trucks in lane 1 $= (0.65)(0.03)(2,130) = 42$

$P_{T_1} = 42/821 = 0.051$

$f_{HV} = 1/1 + 0.051[1.7 - 1] = 0.965$

$V_d = 821/(0.965 \times 0.95) = 896$ pcph (LOS B)

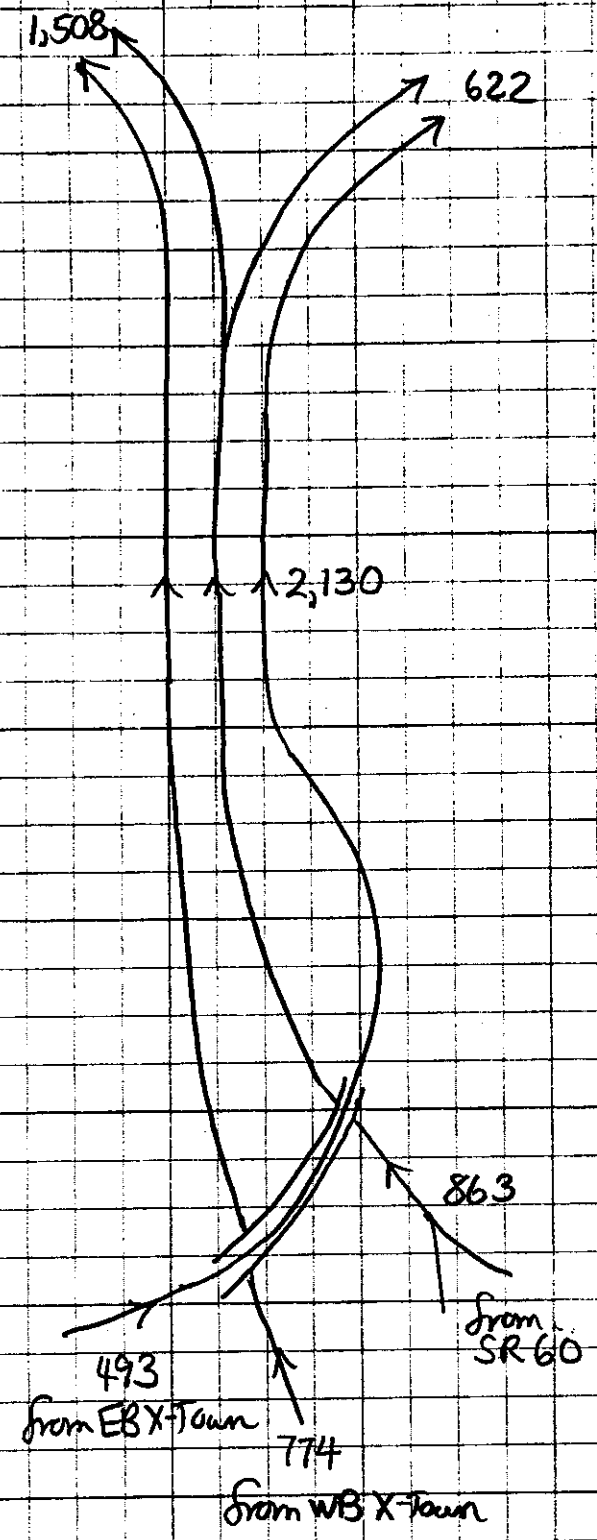
- Off-ramp to EB X-Town Expressway (1 lane drop)

774 to EB X-Town

$V_d = 774/(0.98 \times 0.95) = 831$ pcph (LOS B)

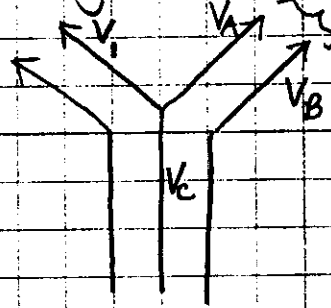
Greiner, Inc.

JOB I-4/Crosstown Connector IJR SHEET 2 OF 2 PROJ. NO. C1104.61
DESCRIPTION 1995 Phase I Improvement (Northbound) COMPUTED BY GSR DATE 3/28/89
CHECKED BY MJE DATE



WB X-Town to WB I-4 = 774vph
EB X-Town to EB I-4 = 493vph
SR60 to WB I-4 = 1,508-774 = 734vph
SR60 to EB I-4 = 622-493 = 129vph

Major Fork analysis using Fig. I.5-1



$V_c = 64 + 0.285(2,130) + 0.141(622) = 759$vph

$V_1 = 173 + 0.295(2,130) - 0.320(622) = 602$vph

$V_A = V_c - V_1 = 759 - 602 = 157$vph

$V_B = V_r - V_A = 622 - 157 = 465$vph

# of trucks in lane B = (0.86)(0.03)(622)
= 16

$P_{T_B} = 16/465 = 0.034$

$f_{HV} = 1/1+[(0.034)(1.7-1)] = 0.976$

# of trucks in lane C = (0.14)(0.03)(622)
+ (0.70)(0.03)(1,508)
= 34

$P_{T_C} = 34/759 = 0.045$

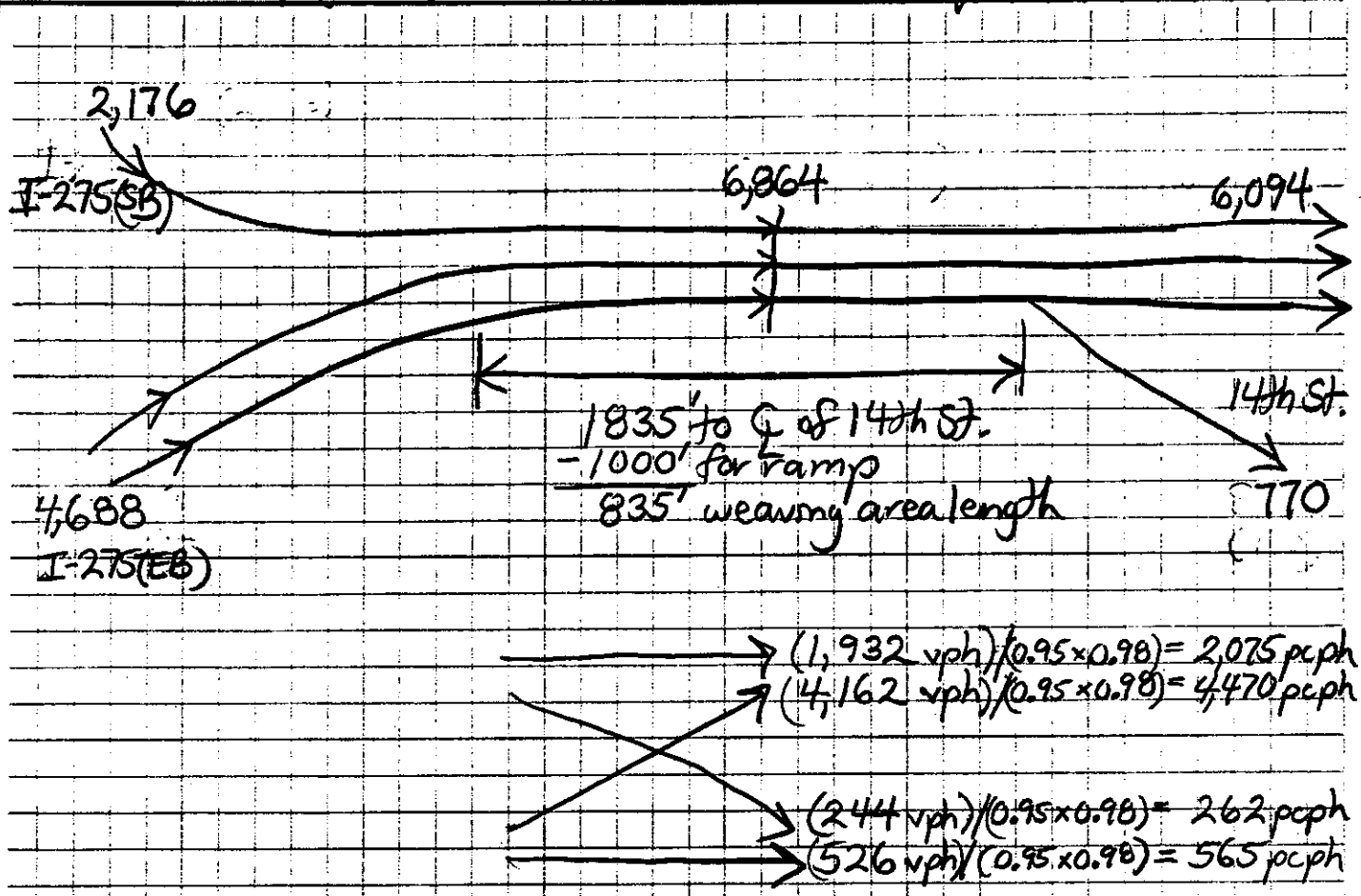
$f_{HV} = 1/1+[(0.045)(1.7-1)] = 0.970$

$V_{d_1} = V_c = 759/(0.97 \times 0.95) = 824$pcph (LOS B)

$V_{d_2} = V_B = 465/(0.976 \times 0.95) = 502$pcph (LOS A)

Greiner, Inc.

JOB I-4/Crosstown Connector IOR SHEET 1 OF 2 PROJ. NO. C1104.70
DESCRIPTION EB Weaving area between I-275(SB)/I-275(EB) junction and 14th St. off-ramp (1995) COMPUTED BY GSK DATE 11/7/90
CHECKED BY MJE DATE 11/12/90



$V_w = 4470\text{pcph} + 262\text{pcph} = 4,732\text{ pcph}$

$V = 2,075\text{pcph} + 4,470\text{pcph} + 262\text{pcph} + 565\text{pcph} = 7,372\text{ pcph}$

$VR = V_w/V = 4,732\text{pcph}/7,372\text{pcph} = 0.642$

$V/N = 7,372\text{ pcph}/3\text{ lanes} = 2,457.33\text{ pcphpl}$

$L = 835\text{ ft.}$

Type C Weave (Unconstrained)

$$S_W = 15 + \frac{50}{1+[(0.100)(1+0.642)^{1.8}(7,372/3)^{0.80}/(835)^{0.5}]} = 24.33\text{ mph (LOS F)}$$

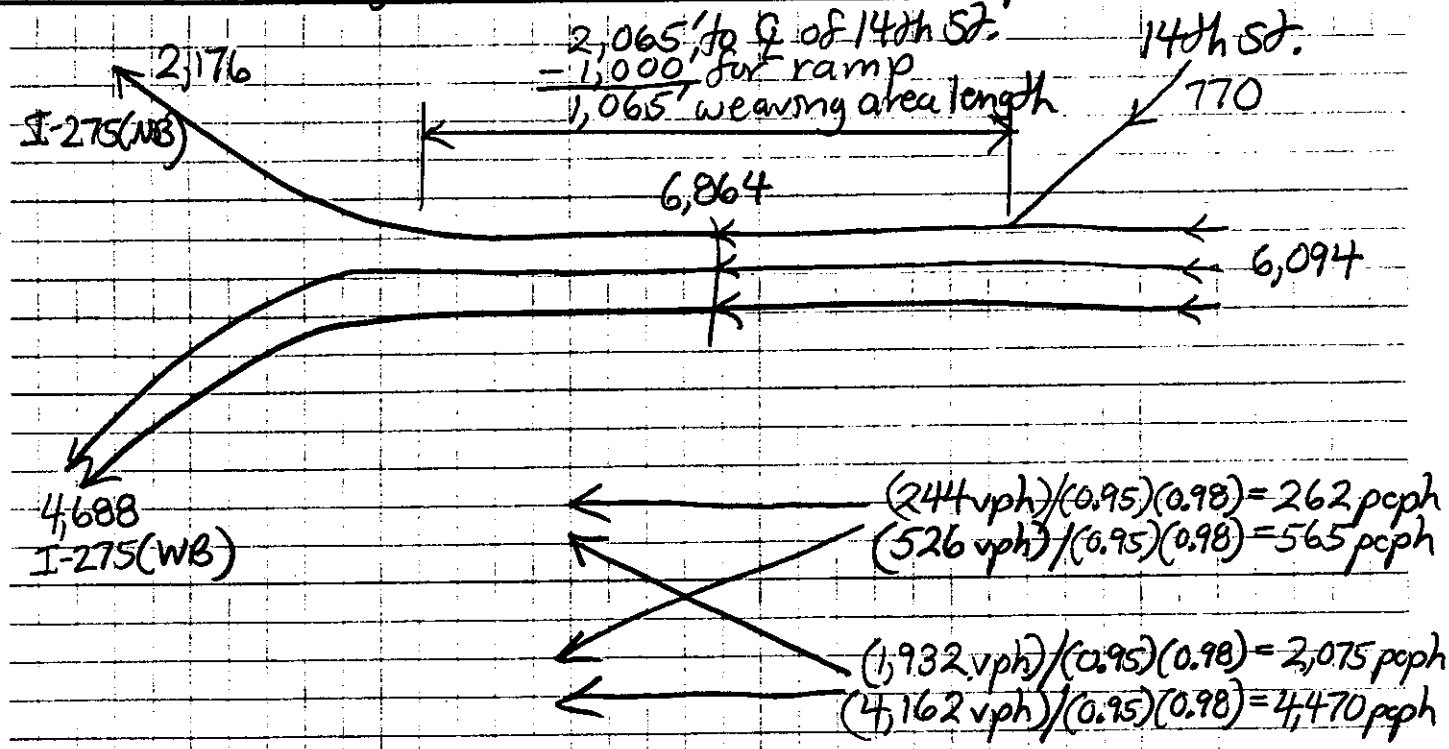
$$S_{NW} = 15 + \frac{50}{1+[(0.015)(1+0.642)^{1.8}(7,372/3)^{0.10}/(835)^{0.5}]} = 21.41\text{ mph (LOS F)}$$

$$N_W = 3\{0.761 - 0.011(8.35) - 0.005(21.41-24.33) + 0.047(0.642)\} = 2.14$$

Since $2.14 < N_W(\max) = 3.0 \Rightarrow$ Unconstrained

Greiner, Inc.

JOB I-4/Crosstown Connector IJR SHEET 2 OF 2 PROJ. NO. C1104.70
DESCRIPTION WB Weaving area between 14th St. on-ramp and I-275(NB)/I-275(WB) diverge (1995) COMPUTED BY GSR DATE 11/7/90
CHECKED BY MJE DATE 11/12/90



$V_w = 2,075\ pcph + 565\ pcph = 2,640\ pcph$

$V = 262\ pcph + 565\ pcph + 2,075\ pcph + 4,470\ pcph = 7,372\ pcph$

$VR = 2,640\ pcph / 7,372\ pcph = 0.358$

$V/N = 7,372\ pcph / 3\ lanes = 2,457.33\ pcphpl$

$L = 1,065\ ft.$

Type B Weave (Unconstrained)

$$S_w = 15 + \frac{50}{1 + [(0.100)(1+0.358)^{1.2}(7,372/3)^{0.77}/(1,065)^{0.5}]} = 32.83 \text{ (LOS F)}$$

$$S_{NW} = 15 + \frac{50}{1 + [(0.02)(1+0.358)^{2.0}(7,372/3)^{1.42}/(1,065)^{0.95}]} = 26.90 \text{ (LOS F)}$$

$$N_w = 3\{0.085 + 0.703(0.358) + (234.8/1,065) - 0.018(26.90 - 32.82)\}$$

$= 1.99 < N_w(max) = 3.0 \Rightarrow$ Unconstrained

APPENDIX C

OPENING YEAR (1995) NO-BUILD CAPACITY ANALYSES

Greiner, Inc.

JOB I-4 / Crosstown Connector — SHEET 1 OF 4 PROJ. NO. C1104.61
DESCRIPTION Alt A Toll Scheme — COMPUTED BY EKM DATE 16 Dec 88
1995 No Build Analysis — CHECKED BY GSR/HJE DATE 3/27/89
EASTBOUND Ramp Junctions

Exit to 21st/22nd ST

Lane Drop

V_{f1} 7053 → V_D 1037; $V_{f2} = 6016$

$V_D = 1037/0.95(0.98)$

$V_D = 1114$ pcph LDSB

$V_{f_1} = 7053/(0.98 \times 0.95) = 7,576$ $\quad V_{f_2} = 6016/(0.98 \times 0.95) = 6,462$

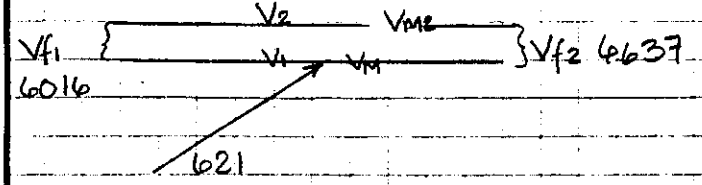
$V_{2+3} = 7576 - 1114 = 6462$ pcph

$V_{2+3}/V_c = 6462/4200 = 1.54$

$V_d/V_c = 1114/2200 = 0.51$

Entrance Ramp from 22nd St

Figure 5-1



* $V_1 = 136 + 0.345\,V_f - 0.115\,V_r$

$V_1 = 136 + 0.345(6016) - 0.115(621)$

$V_1 = 2140$ vph ✓

$P_T = (0.03)(0.80)(6016) = 144 = 144/2145 = .067$

$f_{HV} = 1/1 + 0.067\,(1.7-1)$

$f_{HV} = 0.955$ ✓

$V_r = 621/0.95(0.98)$

$V_r = 667$ pcph ✓

$V_1 = 2140/(0.955)(0.95)$

$V_1 = 2,359$ pcph ✓

$V_M = V_1 + V_r$

$V_M = 667 + 2359$

$V_M = 3026$ pcph LDSF ✓

$V_{f_1} = 6016/(0.95)(0.98) = 6462$ pcph ✓

$V_2 = V_{f_1} - V_1 = 6462 - 2359 = 4103$ pcph ✓

$V_2/V_c = 4103/2100 = 1.95$

$V_m/V_c = 3026/2200 = 1.38$

* Note Vf volumes exceed range for formula use.

Greiner, Inc.

JOB I-4/Crosstown Connector — SHEET 2 OF 4 PROJ. NO. C1104.61
DESCRIPTION ALT A TOLL Scheme — COMPUTED BY EKM DATE 16 Dec 88
1995 No Build Analysis — CHECKED BY GSR/HGE DATE 3/27/89
Eastbound Ramp Junctions

GSR

Exit Ramp to 40th Street

* Fig 5-2; $V_1 = 165 + 0.345V_f + 0.520V_r$

6637 V_{f1} — V_2 — 5264 V_{f2}
V_D
1373

$V_1 = 165 + 0.345(6637) + 0.520(1373)$
$V_D = V_1 = 3169$ vph ✓

$P_T = 6637(0.03)(0.80) = 159 = 159/3169 = 0.050$ ✓
$f_{HV} = 1/1 + 0.050(1.7 - 1) = 0.966$

$V_D = 3169/0.966(0.95)$ ✓
$V_D = 3453$ pcph LOS F

$V_{f1} = 6637/0.98(0.95) = 7129$ pcph ✓
$V_2 = V_{f1} - V_D = 7129 - 3453 = 3676$ pcph ✓

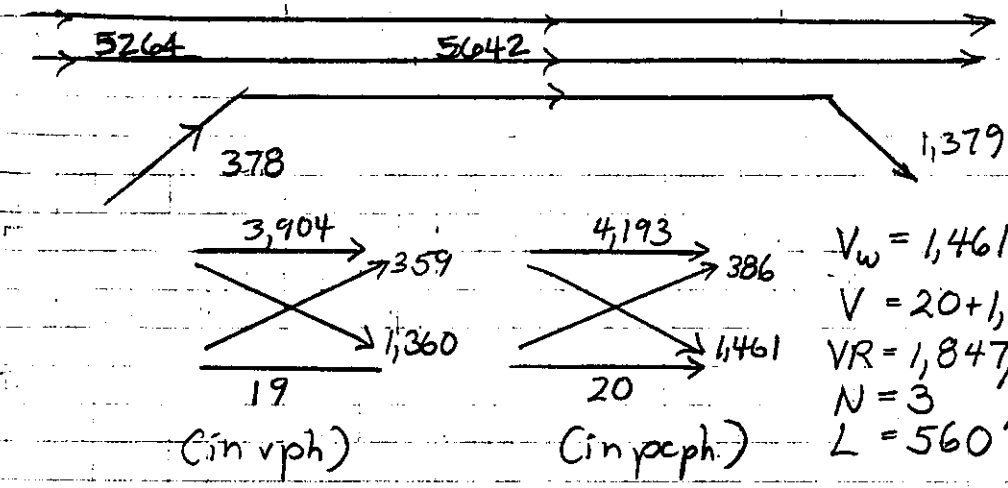
$V_{f1}/N_C = 7129/4200 = 1.70$ ✓
$V_D/N_C = 3453/2200 = 1.57$
$V_2/N_C = 3676/2100 = 1.75$

* Note V_f volumes exceed normal range for the equation

Greiner, Inc.

JOB I-4/Crosstown Connector — SHEET 3 OF 4 PROJ. NO. C1104.61
DESCRIPTION ALT A TOLL Scheme — COMPUTED BY ERM DATE 16 Dec 88
1995 No Build Analysis — CHECKED BY GSR/MFF DATE 3/27/89
Eastbound RAmp Junctions

GSR Eastbound Weaving Section between 40th Street and 50th Street/Columbus Dr.



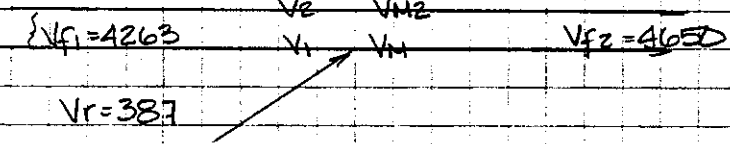
$V_w = 1,461 + 386 = 1,847$ pcph
$V = 20 + 1,461 + 386 + 4,193 - 6,060$
$VR = 1,847/6,060 = 0.305$
$N = 3$
$L = 560'$

Type A Weave

$$S_w = 15 + \frac{50}{1+[(0.28)(1.305)^{2.2}(6,060/3)^{1.0}/(560)^{0.9}]} = 26.32 \text{ mph (LOS F)}$$

$$S_{NW} = 15 + \frac{50}{1+[(0.02)(1.305)^{4.0}(6,060/3)^{0.88}/(560)^{0.6}]} = 39.33 \text{ mph (LOS E)}$$

GSR Entrance from 50th Street



$V_{f1} = 4263/0.95(0.98) = 4579$ pcph ✓
$V_2 = 4579 - 1720 = 2859$ pcph
$V_{f2} = 4650/0.95(0.98) = 4995$ pcph ✓
$V_{M2} = 4995 - 2136 = 2859$ pcph ✓
$V_{f1}/V_c = 4579/4200 = 1.09$ ✓
$V_M/V_c = 2136/2200 = 0.97$ ✓
$V_2/V_c = 2859/2100 = 1.136$

* Eq I.5-1 $V_1 = 136 + 0.345 V_f - 0.115 V_r$
$V_1 = 136 + 0.345(4263) - 0.115(387)$
$V_1 = 1562$ vph ✓

$P_T = 4263(0.03)(.80) = 102$; $102/1562 = 0.065$ ✓
$f_{HV} = 1/(1+(0.065)(1.7-1)) = 0.956$ ✓

$V_1 = 1562/0.956(0.95) = 1720$ pcph ✓
$V_r = 387/0.98(0.95) = 416$ pcph ✓

$V_M = V_1 + V_r = 1720 + 416 = 2136$ pcph ✓ LOSE

* Note: Vf values exceed the normal range of use for the equation

Greiner, Inc.

JOB I-4/Crosstown Connector — SHEET 4 OF 4 PROJ. NO. C1104.61
DESCRIPTION Alt A Toll Scheme — COMPUTED BY EKM DATE
1995 No Build Analysis — CHECKED BY MJS DATE
Eastbound Basic Segments

GSR West of 21ST/22ND ST

Vf = 7053 vph Vf = 7053/0.98(0.95) = 7576 pcph 6LN.
LOSF ✓

Vf/Vc = 7576/6800 = 1.20 ✓

GSR EAST of 21ST/22ND ST

Vf = 6637 vph Vf = 6637/0.98(0.95) = 7129 pcph 4LN.
LOSF ✓

Vf/Vc = 7129/4200 = 1.70 ✓

GSR EAST OF 40th ST

Vf = 5642 vph Vf = 5642/0.98(0.95) = 6060 pcph 4LN
LOSF ✓

Vf/Vc = 6060/4200 = 1.44 ✓

GSR EAST of 50th ST

Vf = 4650 vph Vf = 4650/0.98(0.95) = 4995 pcph 4LN
LOSF ✓

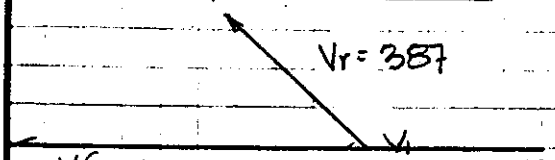
Vf/Vc = 4995/4200 = 1.19 ✓

Greiner, Inc.

JOB I-4/Crosstown Connector — SHEET 1 OF 4 PROJ. NO. C1104.61
DESCRIPTION Alt A Toll Scheme — COMPUTED BY CRM DATE 16 Dec 88
1995 No Build Analysis — CHECKED BY GSR/HJE DATE 3/27/89
Westbound Ramp Junctions

GSR

Exit Ramp to 50th Street



Eq I.5-2 $V_I = 165 + 0.345 V_f + 0.520 V_r$

* $V_I = 165 + 0.345(4650) + 0.520(387)$

$V_I = 1970$ uph ✓

$P_T = 0.03(.80)(4650) = 112$; $112/1970 = 0.057$

$f_{HV} = 1/1 + (0.057)(1.7 - 1) = 0.962$

$V_{f1} = 4650/0.98(0.95) = 4995$ pcph ✓

$V_2 = 4995 - 2156 = 2839$ pcph

$V_D = 1970/0.962(0.95) = 2156$ DCph LOSE

* Note: V_f exceeds the normal range for the equation

$V_{f1}/V_c = 4995/4200 = 1.19$ ✓

$V_I/V_c = 2156/2200 = 0.98$ ✓

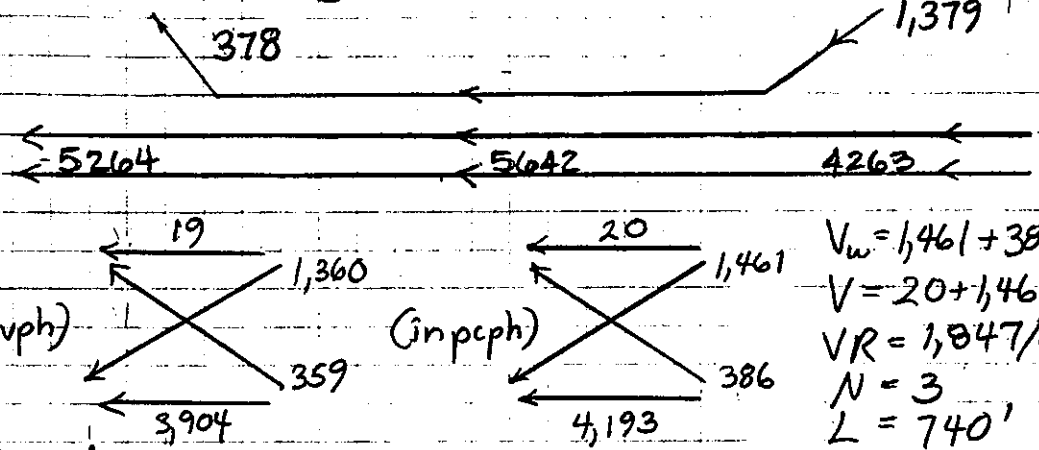
$V_2/V_c = 2839/2100 = 1.29$

Greiner, Inc.

JOB I-4/Crosstown Connector
DESCRIPTION ALT A Toll Scheme
1995 No Build Analysis
Westbound Ramp Junctions

SHEET 2 OF 4 PROJ. NO. C1104.61
COMPUTED BY EKM DATE 16 Dec 88
CHECKED BY GSR/MJE DATE 3/27/89

GSR Westbound Weaving Section between 50th Street/Columbus Dr. and 40th Street



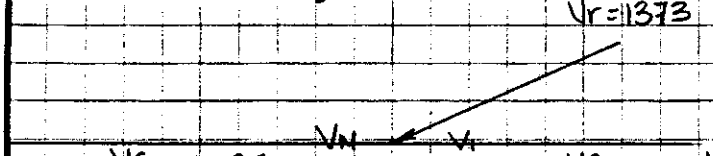
$V_w = 1,461 + 386 = 1,847$ pcph
$V = 20 + 1,461 + 386 + 4,193 = 6,060$ pcph
$VR = 1,847/6,060 = 0.305$
$N = 3$
$L = 740'$

Type A Weave

$$S_w = 15 + \frac{50}{1+[(0.28)(1.305)^{2.2}(6,060/3)^{1.0}/(740)^{0.9}]} = 28.67 \text{ mph (LOS F)}$$

$$S_{nw} = 15 + \frac{50}{1+[(0.02)(1.305)^{4.0}(6,060/3)^{0.88}/(740)^{0.6}]} = 41.42 \text{ mph (LOS E)}$$

GSR Entrance Ramp from 40th St.



$V_{f1} = 5264/0.98(0.95) = 5654$ pcph ✓
$V_{12} = 5654 - 1982 = 3672$ pcph ✓ ✓

* Fig I.5-1 $V_1 = 136 + 0.345 V_f - 0.115 V_r$
$V_1 = 136 + 0.345(5264) - 0.115(1373)$
$V_1 = 1794$ vph ✓

$P_T = 5264(0.03)(0.80) = 126$; $126/1794 = 0.070$
$f_{HV} = 1/1 + 0.070(1.7-1) = 0.953$ ✓

$V_1 = 1794/0.953(0.95) = 1982$ pcph ✓
$V_r = 1373/0.98(0.95) = 1475$ pcph ✓

$V_M = V_1 + V_r = 1982 + 1475 = 3457$ pcph
LOS F

$V_{f1}/V_c = 5654/4200 = 1.35$ ✓

* Note V_f exceeds the normal range for the equation

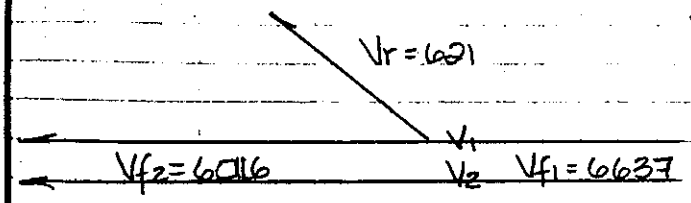
$V_M/V_c = 3457/2200 = 1.57$ ✓

$V_2/V_c = 3672/2100 = 1.75$ ✓

Greiner, Inc.

JOB I-4/Crosstown Connector — SHEET 3 OF 4 — PROJ. NO. C110461
DESCRIPTION ALT A Toll Scheme — COMPUTED BY _____ DATE _____
1995 No Build Analysis — CHECKED BY GSR/MJE DATE 3/27/89
Westbound Ramp Junctions

GSR Exit Ramp to 29th St



* Fig 15-2 $V_1 = 165 + 0.345 V_f + 0.520 V_r$
$V_1 = 165 + 0.345(6637) + 0.520(621)$
$V_1 = 2778$ vph ✓

$P_T = 6637(0.03)(0.80) = 159$; $159/2778 = 0.057$ ✓
$f_{HV} = 1/1 + (0.057)(1.7 - 1) = 0.961$ ✓

$V_{f1} = 6637/0.98(0.95) = 7129$ pcph ✓
$V_2 = 7129 - 3043 = 4086$ pcph ✓

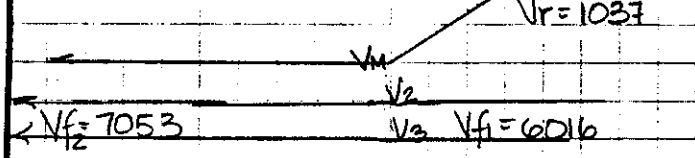
$V_1 = V_D = 2778/0.961(0.95)$ ✓
$V_D = 3043$ pcph
LOS F

$V_{f1}/V_c = 7129/4200 = 1.70$ ✓
$V_1/V_c = 3043/2200 = 1.38$ ✓
$V_2/V_c = 4086/2100 = 1.95$ ✓

* Note: V_f exceeds the normal range for the equation

GSR Entrance Ramp from 29th St

Lane Add
$V_M = 1037$ vph $/0.98(0.95) = 1114$ pcph
LOS B



$V_2 + V_3 = V_{f1} = 6016/0.98(0.95)$
$V_{f1} = 6462$ pcph ✓

$V_{f2} = 7053/0.98(0.95) = 7576$ pcph ✓

$V_{2;3} = 7576 - 1114 = 6462$

$V_f/V_c = 6462/4200 = 1.54$ ✓
$V_M/V_c = 1114/2200 = 0.51$ ✓

✓

Greiner, Inc.

JOB I-4/Crosstown Connector
DESCRIPTION ALT A Toll Scheme
1995 No Build Analysis
Westbound Basic Segments

SHEET 4 OF 4 PROJ. NO. C1104.61
COMPUTED BY GSR DATE
CHECKED BY GSR/MK DATE 3/27/89

GSR East of 50th ST

Vf = 4650 vph Vf = 4650/0.98(0.95) = 4995 pcph 4LN LOSF

Vf/Nc = 4995/4200 = 1.19 ✓

GSR West of 50th ST

Vf = 5642 vph Vf = 5642/0.98(0.95) = 6060 pcph 4LN LOSF

Vf/Nc = 6060/4200 = 1.44 ✓

GSR West of 40th ST

Vf = 6637 vph Vf = 6637/0.98(0.95) = 7129 pcph 4LN LOSF

Vf/Nc = 7129/4200 = 1.70 ✓

GSR West of 21ST/22ND ST

Vf = 7053 vph Vf = 7053/0.98(0.95) = 7576 pcph 6LN LOSF

Vf/Nc = 7576/6800 = 1.20 ✓

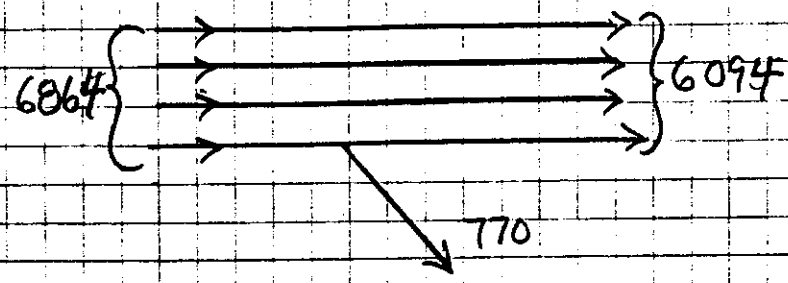
APPENDIX D

OPENING YEAR (1995) PHASE I INTERIM IMPROVEMENT CAPACITY ANALYSES

Greiner, Inc.

JOB I-4/Crosstown Connector SHEET 1 OF 4 PROJ. NO. C1104.61
DESCRIPTION 1995 Interim Improvement-restriped Eastbound COMPUTED BY GSR DATE 1/25/89
CHECKED BY HJE DATE

EXIT RAMP TO 21ST/22ND STREET (EASTBOUND)



Approximating Using Table 5-3 and Figure 5-5

$V_1 = (0.10)(6094) + 770 = 1379$ vph

# of trucks in lane 1 = (0.68)(0.03)(6864) = 140

$P_{T_1} = 140/1379 = 0.102$

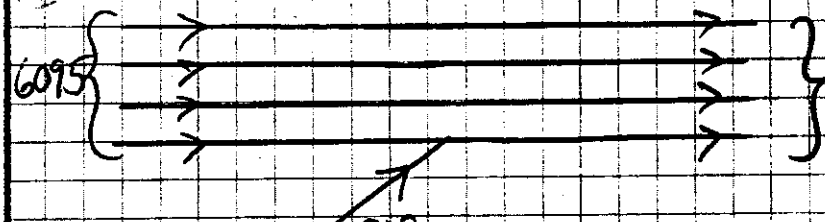
$f_{HV} = \frac{1}{1+[(0.102)(1.7-1)]} = 0.933$

$V_d = 1379/(0.933 \times 0.95) = 1,556$ pcph (LOS C)

$V_p = 6864/0.98(0.95) = 7373$
$V_{2\to4} = 7373 - 1556 = 5817$
$V_p/V_c = 7373/8400 = 0.88$
$V_{2\to4}/V_c = 5817/6300 = 0.923$

ENTRANCE RAMP FROM 15TH STREET (EASTBOUND)

USE TO ESTIMATE V/C ratios
Weaving Analysis on next sheet



Using Fig. I.5-9

$V_1 = -312 + 0.201(6095) + 0.127(512) = 978$ vph

# of trucks in lane 1 = (0.57)(0.03)(6095) = 104

$P_{T_1} = 104/978 = 0.106$

$f_{HV} = \frac{1}{1+[(0.106)(1.7-1)]} = 0.931$ (LOS)

$V_m = V_1 + V_r = 978/(0.931 \times 0.95) + 512/(0.98 \times 0.95) = 1656$ pcph

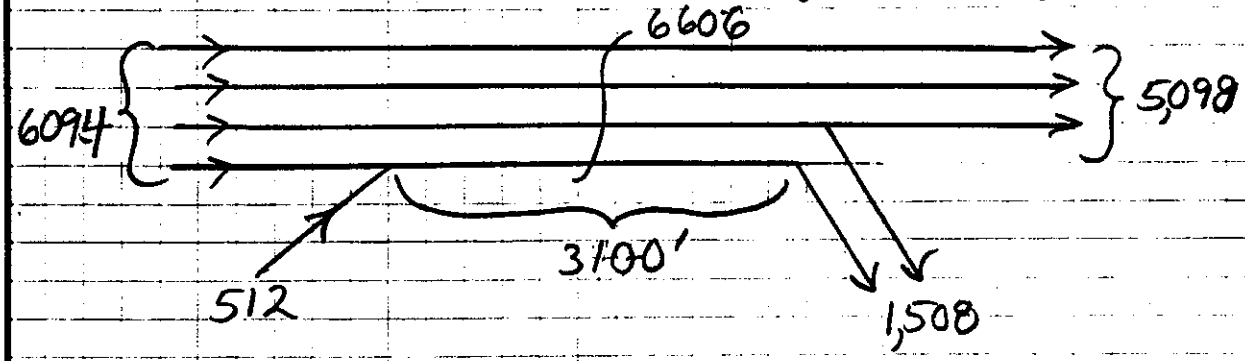
$V_p = 6095/(0.98)(0.95) = 6547$
$V_{p_1} = 6607/(0.98)(0.95) = 7097$
$V_{2-4} = 7097 - 1656 = 5441$
$V_p/V_c = 6547/8400 = 0.78$
$V_{2-4}/V_c = 5441/6300 = 0.86$

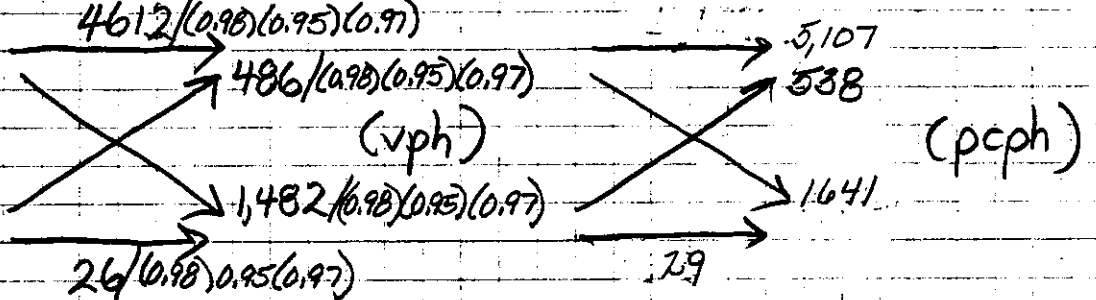
Greiner, Inc.

JOB I-4/Crosstown Connector
DESCRIPTION 1995 Interim Improvement - restriped Eastbound

SHEET 2 OF 4 PROJ. NO. C1104.6
COMPUTED BY GSR DATE 1/25/89
CHECKED BY MJE DATE

WEAVE BETWEEN 15TH ST. ON-RAMP AND OFF-RAMP TO CROSSTOWN CONNECTOR (EASTBOUND)





$V_w = 538 + 1641 = 2,179$

$V = 538 + 1641 + 29 + 5107 = 7315$

$VR = 2179/7315 = 0.298$

$N = 4$

$L = 3,100'$

TYPE B (UNCONSTRAINED)

$$S_w = 15 + \frac{50}{1 + [(0.10)(1.298)^{1.2}(7315/4)^{0.77}/(3100)^{0.5}]}$$

$$= 42.81 \text{ mph (LOS C)}$$

$$S_{NW} = 15 + \frac{50}{1 + [(0.02)(1.298)^{2.0}(7315/4)^{1.42}/(3100)^{0.95}]}$$

$$= 44.47 \text{ mph (LOS C)}$$

$N_w = 4\{0.085 + 0.703(0.298) + (234.8/3100) - 0.018(44.47 - 42.81)\} = 1.36 < 3.$

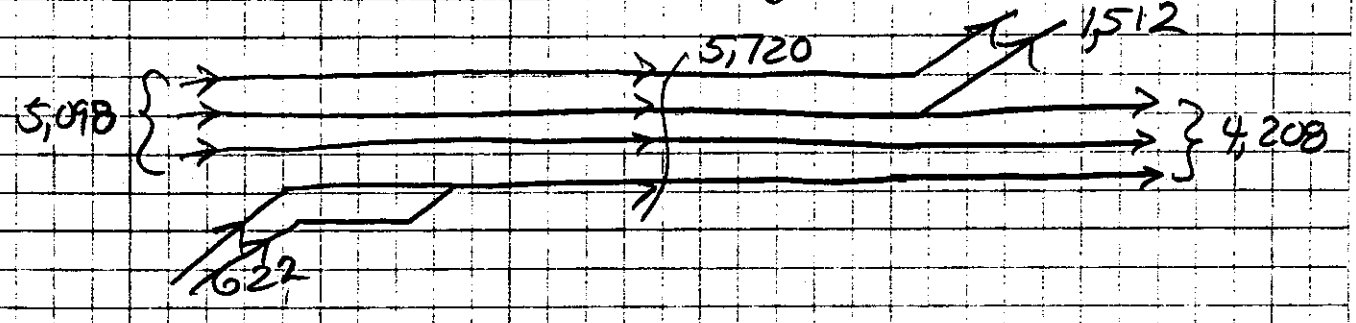
$\Rightarrow$ UNCONSTRAINED

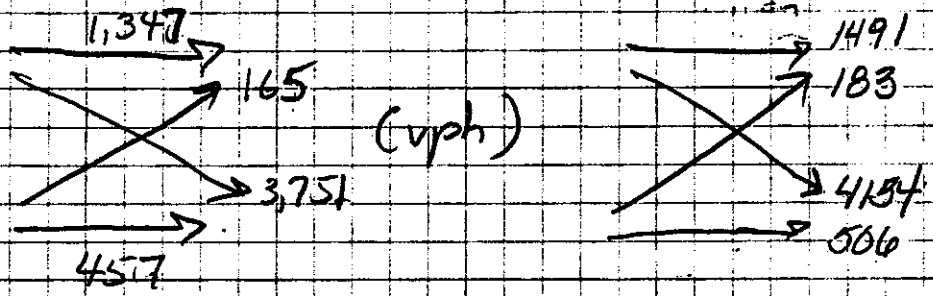
Form No. GI002-87

Greiner, Inc.

JOB I-4/Crosstown Connector SHEET 3 OF 4 PROJ. NO. C1104.61
DESCRIPTION 1995 Interim Improvement - restriped Eastbound COMPUTED BY GSR DATE 1/25/89
CHECKED BY MJE DATE

WEAVE BETWEEN X-TOWN CONNECTOR ON-RAMP AND OFF-RAMP TO 50TH ST. (EASTBOUND)





$V_w = 183 + 4154 = 4337$

$V = 183 + 4154 + 1491 + 506 = 6334$

$VR = 4337/6334 = 0.685$

$N = 4$

$L = 4,600'$

Type C Weave

$$S_w = 15 + \frac{50}{1 + [(0.10)(1.685)^{1.8}(6334/4)^{0.80}/(4600)^{0.5}]} = 36.11 \text{ mph (LOS D)}$$

$$S_{NW} = 15 + \frac{50}{1 + [(0.015)(1.685)^{1.8}(6334/4)^{1.10}/(4600)^{0.5}]} = 32.41 \text{ mph (LOS E)}$$

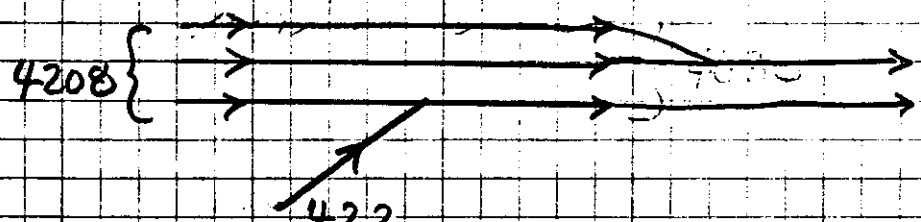
$$N_w = 4\{0.761 - 0.011(46) - 0.005(32.41 - 36.11) + 0.047(0.685)\} = 1.22 < 3.0$$

$\Rightarrow$ UNCONSTRAINED

Greiner, Inc.

JOB I-4/Crosstown Connector SHEET 4 OF 4 PROJ. NO. C1104.61
DESCRIPTION 1995 Interim Improvement - restripe Eastbound COMPUTED BY GSR DATE 1/25/89
CHECKED BY _____ DATE _____

ENTRANCE RAMP FROM 50TH STREET (EASTBOUND)



Using Fig. I.5-6

$V_1 = -121 + 0.244(4,208) - 0.085(50) + 5 = 907$ vph

# of trucks in lane 1 $= (0.53)(0.03)(4208) = 67$

$P_{T_1} = 67/907 = 0.074$

$f_{HV} = \frac{1}{1+[(0.074)(1.7-1)]} = 0.951$

$V_m = V_1 + V_r = 907/(0.951 \times 0.95) + 422/(0.98 \times 0.95)$

$= 1,457$ pcph (LOS C)

Greiner, Inc.

JOB I-4/Crosstown Connector SHEET 1 OF 1 PROJ. NO. C1104.61
DESCRIPTION 1995 Interim Improvement-restripe Eastbound COMPUTED BY GSR DATE 1/25/89
CHECKED BY _____ DATE _____

BASIC FREEWAY SEGMENTS

- WEST OF RAMPS TO/FROM 21ST ST.

$V_f = 6,864$ vph (f_{HV}, PHF, f_w)
$= 6,864/(0.98 \times 0.95 \times 0.97) = 7,601$ pcph

$V/C = 7,601/8400 = 0.90$ (LOS E)

- WEST OF RAMPS TO/FROM 15TH ST.

$V_f = 6,094$ vph
$= 6,094/(0.98 \times 0.95 \times 0.97) = 6,748$ pcph
$V/C = 6,748/8,400 = 0.80$ (LOS D)

- EAST OF RAMPS TO/FROM X-TOWN CONNECTOR

$V_f = 5,720$ vph
$= 5,720/(0.98 \times 0.95 \times 0.97) = 6,334$ pcph
$V/C = 6,334/8,400 = 0.75$ (LOS D)

- IN BETWEEN EASTSIDE RAMPS TO/FROM 50TH ST. AND WESTSIDE RAMPS TO/FROM 50TH ST.

$V_f = 4,208$ vph
$= 4,208/(0.98 \times 0.95 \times 0.97) = 4,660$ pcph
$V/C = 4,660/6,300 = 0.74$ (LOS D)

- EAST OF RAMPS TO/FROM 50TH ST. (EASTSIDE OF 50TH ST.)

$V_f = 4,630$ vph
$= 4,630/(0.98 \times 0.95 \times 0.97) = 5,127$ pcph
$V/C = 5,127/6,300 = 0.81$ (LOS D)

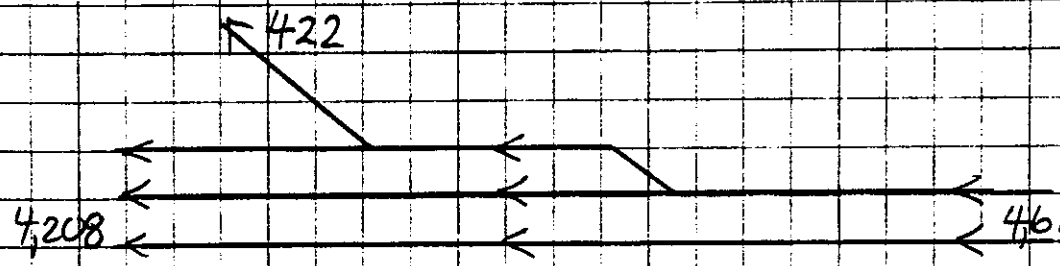
Form No. GI002-87

Greiner, Inc.

JOB I-4/Crosstown Connector
DESCRIPTION 1995 Interim Improvement - Restriped Westbound

SHEET 1 OF 4 PROJ. NO. C1104.61
COMPUTED BY BSR DATE 1/25/09
CHECKED BY MJE DATE

EXIT RAMP TO SOUTH ST. (WESTBOUND)



Using Fig. I.5-6

$V_1 = 94 + 0.231(4,630) + 0.473(422) + 2 = 1,365$ vph

# of trucks in lane 1 $= (0.57)(0.03)(4,630) = 79$

$P_{T_1} = 79/1,365 = 0.058$

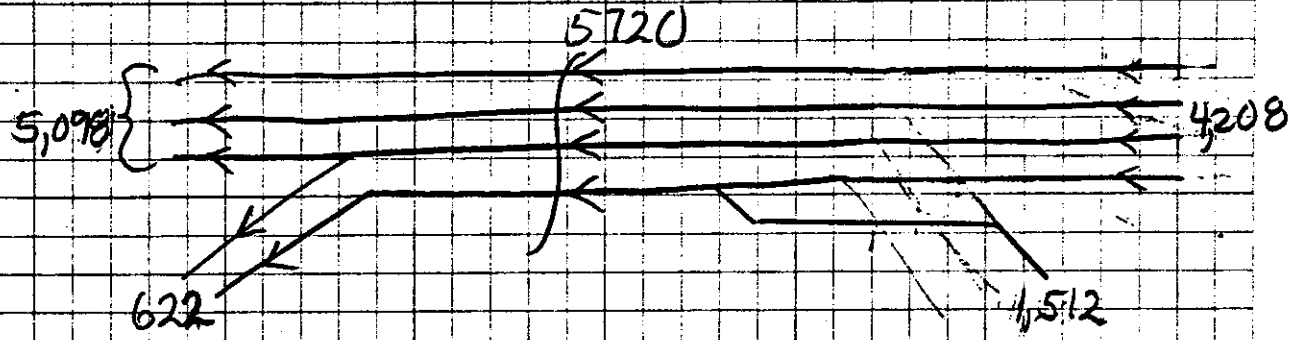
$f_{HV} = 1/[1 + (0.058)(1.7-1)] = 0.961$

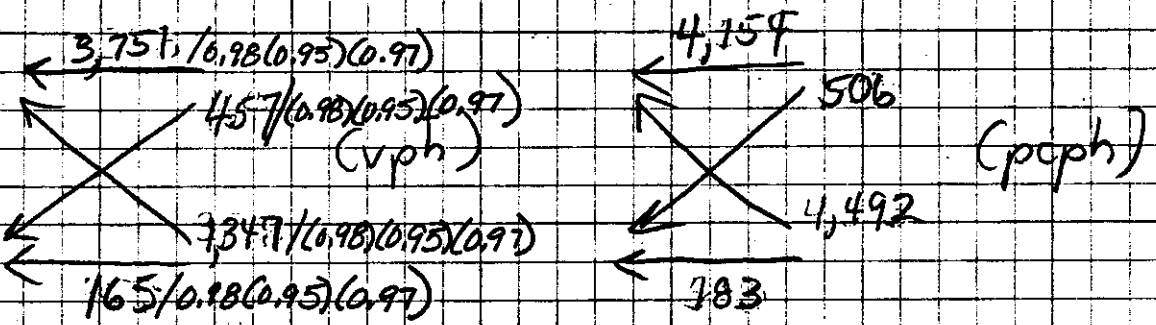
$V_d = 1,365/(0.961 \times 0.95) = 1,495$ pcph (LOS C)

Greiner, Inc.

JOB I-4/Crosstown Connector SHEET 2 OF 4 PROJ. NO. C1104.61
DESCRIPTION 1995 Interim Improvement - Restriped Westbound COMPUTED BY GSR DATE 1/25/89
CHECKED BY MJE DATE

WEAVE BETWEEN 50TH ST. ON-RAMP AND OFF-RAMP TO X-TOWN CONNECTOR (WESTBOUND)





$V_w = 506 + 1,492 = 1,998$ pcph

$V = 4,154 + 506 + 1,492 + 183 = 6,335$ pcph

$VR = 1,998 / 6,335 = 0.315$

$N = 4$

$L = 3800'$

Type C Weave

$$S_w = 15 + \frac{50}{1 + [(0.10)(1.315)^{1.8}(6335/4)^{0.8}/(3800)^{0.5}]} = 40.46 \text{ mph (LOS C)}$$

$$S_{nw} = 15 + \frac{50}{1 + [(0.015)(1.315)^{1.8}(6335/4)^{1.1}/(3800)^{0.5}]} = 36.57 \text{ mph (LOS D)}$$

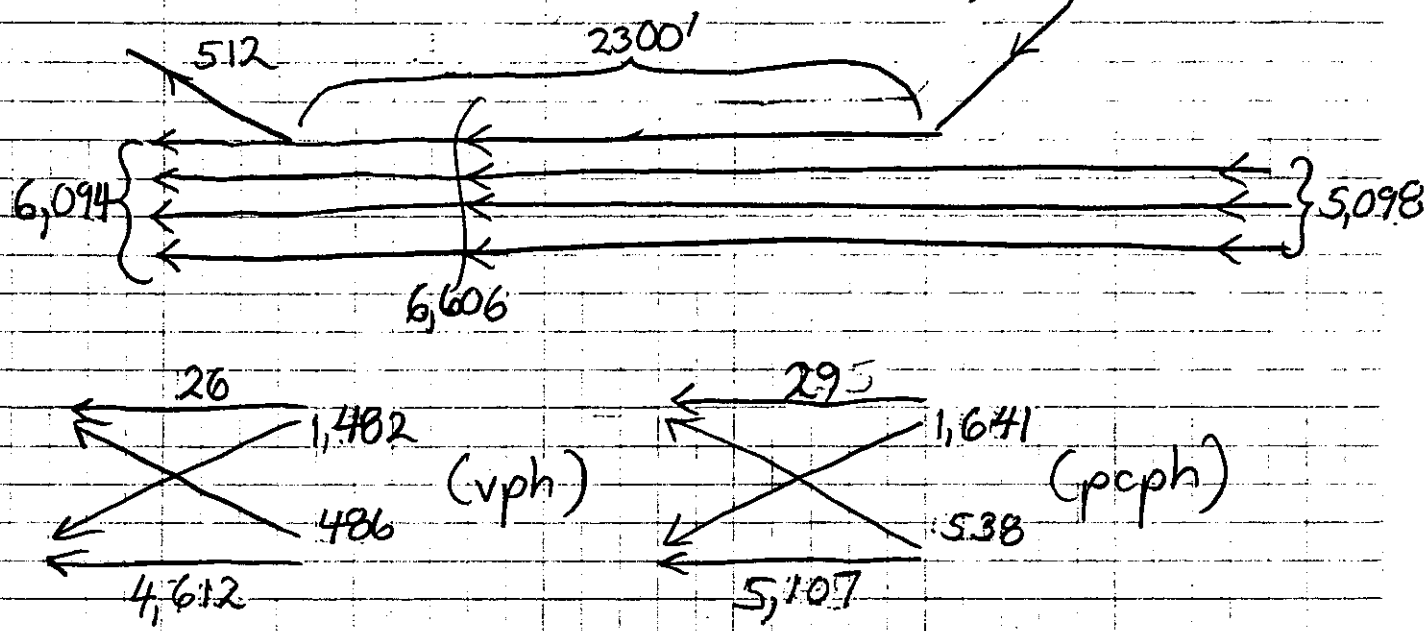
$$N_w = 4\{0.761 - 0.011(38) - 0.005(36.57 - 40.46) + 0.047(0.315)\} = 1.51 < 3.0$$

$\Rightarrow$ UNCONSTRAINED

Greiner, Inc.

JOB I-4/Crosstown Connector SHEET 3 OF 4 PROJ. NO. C1104.61
DESCRIPTION 1995 Interim Improvement-restripe Westbound COMPUTED BY GSR DATE 1/25/89
CHECKED BY MJE DATE

WEAVE BETWEEN CROSSTOWN CONNECTOR ON-RAMP AND 15TH ST. OFF-RAMP (WESTBOUND)



$V_w = 538 + 1,641 = 2,179$ pcph

$V = 29 + 1,641 + 538 + 5,107 = 7,315$ pcph

$VR = 2,179/7,315 = 0.298$

$N = 4$

$L = 2300'$

TYPE B (UNCONSTRAINED)

$$S_w = 15 + \frac{50}{1 + [(0.10)(1.298)^{1.2}(\frac{7315}{4})^{0.77}/(2300)^{0.5}]}$$

$= 40.95$ mph (LOS C)

$$S_{NW} = 15 + \frac{50}{1 + [(0.02)(1.298)^{2.0}(\frac{7,315}{4})^{1.42}/(2300)^{0.95}]}$$

$= 40.97$ mph (LOS D)

$N_w = 4\{0.085 + 0.703(0.298) + (234.8/2300) - 0.018(40.97 - 40.95)\} = 1.58 < 3.5$

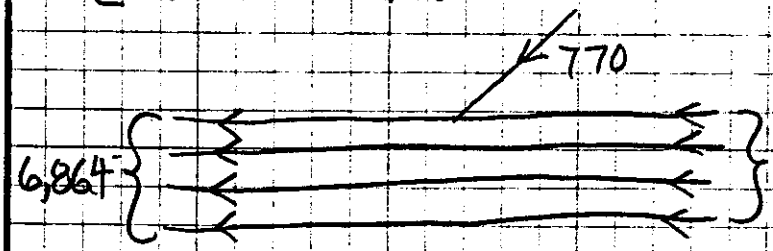
$\Rightarrow$ UNCONSTRAINED

Form No. G1002-87

Greiner, Inc.

JOB I-4/Crosstown Connector SHEET 4 OF 4 PROJ. NO. C1104.61
DESCRIPTION 1995 Interim Improvement-restripe Westbound COMPUTED BY GSR DATE 1/25/89
CHECKED BY MJE DATE

ENTRANCE RAMP FROM 21ST ST. (WESTBOUND)



Using Fig I.5-9

$V_1 = -312 + 0.201(6,094) + 0.127(770) = 1,011$ vph

# of trucks in lane 1 $= (0.57)(0.03)(6,094) = 104$

$P_{T_1} = 104/1,011 = 0.103$

$f_{HV} = \frac{1}{1+[(0.103)(1.7-1)]} = 0.933$

$V_m = 1,011/(0.933 \times 0.95) + 770/(0.98 \times 0.95) = 1,968$ pcph (LOS E)

$V_{f_1} = 6094/(0.98)(0.95)(0.97) = 6748$ pcph

$V_{f_2} = 6864/0.98(0.95)(0.97) = 7601$ pcph

$V_{2\to4} = 7601 - 1968 = 5633$ pcph

$V_{f_1}/V_c = 6748/8400 = 0.80$

$V_1/V_c = 1968/2200 = 0.90$

$V_{2\to4}/V_c = 5033/6300 = 0.89$

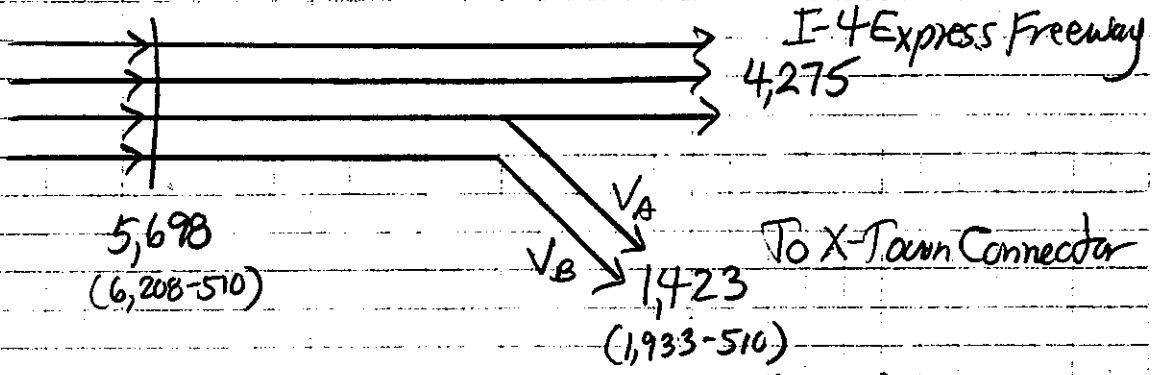
APPENDIX E

DESIGN YEAR (2010) PHASE II CAPACITY ANALYSES

Greiner, Inc.

JOB I-4/X-TOWN CONNECTOR JOR — SHEET 1 OF 4 — PROJ. NO.
DESCRIPTION REVISED ANALYSIS — COMPUTED BY GSR — DATE 6/18/91
CHECKED BY MJE — DATE 6/19/91

I-4 DIVERGE TO CROSSTOWN CONNECTOR



Using Fig. I.5-12 to determine off-ramp distribution

$V_{1+A} = -158 + 0.035(5,698) + 0.567(1,423) = 848$ vph

$V_1 = 18 + 0.060(5,698) + 0.072(1,423) = 462$ vph

$V_A = V_{1+A} - V_1 = 848 - 462 = 386$ vph

$V_B = V_r - V_A = 1,423 - 386 = 1,037$ vph ($\approx 73\%$ of V_r)

# of trucks in lane B = $(0.68)(0.03)(1,423) = 29$

$P_{T_B} = 29/1,037 = 0.028$ $f_{HV} = 1/[1+(0.028)(1.7-1)] = 0.981$

# of trucks in lane A = $(0.32)(0.03)(1,423) + (0.53)(0.03)(4,275)$
$= 82$

Using Fig. I.5-7

$V_1 = 94 + 0.231(5,698 - 1,037) + 0.473(386) + 2 = 1,355$ vph

$P_{T_A} = 82/1,355 = 0.061$ $f_{HV} = 1/[1+(0.061)(1.7-1)] = 0.959$

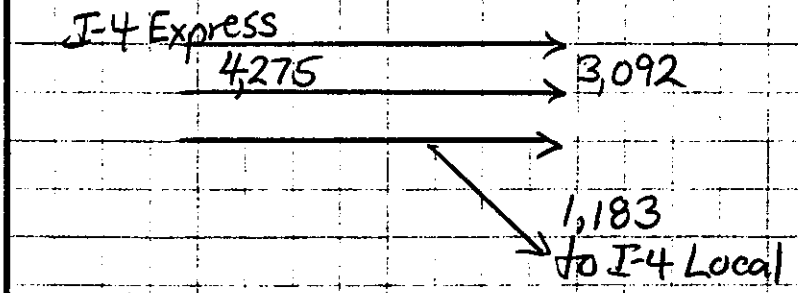
$V_{d_1} = V_1 = 1,355/(0.959)(0.95) = 1,487$ pcph (LOS C)

$V_{d_2} = V_B = 1,037/(0.981)(0.95) = 1,113$ pcph (LOS B)

Greiner, Inc.

JOB I-4/Cross-town Connector IJR SHEET 2 OF 4 PROJ. NO. C1104.61
DESCRIPTION Express Lanes (Eastbound) COMPUTED BY GSR DATE 3/29/89
CHECKED BY MJS DATE

Off-ramp to I-4 Local



Using Fig. I.5-7

$V_1 = 94 + 0.231(4,275) + 0.473(1,183) + 2 = 1,643$ vph

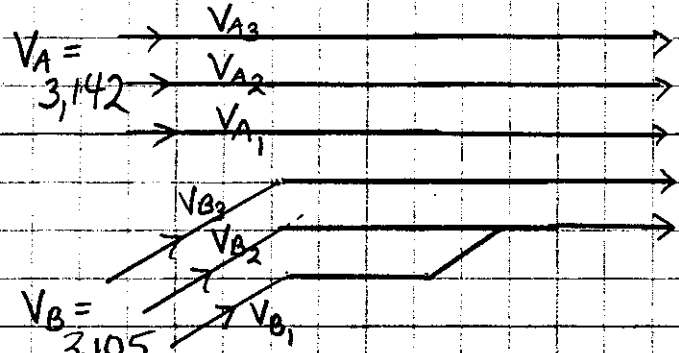
# of trucks in lane 1 $= (0.54)(0.03)(4,275) = 69$

$P_{T_1} = 69/1,643 = 0.042$

$f_{HV} = 1/[1 + (0.042)(1.7-1)] = 0.971$

$V_d = V_1 = 1,643/(0.971 \times 0.95) = 1,781$ pcph (LOS D)

I-4 Express Merge with I-4 Local



$V_{A_3} = 0.47(3,142) = 1,477$ vph

$V_{B_1} = 0.06(3,105) = 186$ vph

$V_f = (3,142 - 1,477) + (3,105 - 186) = 4,584$ vph

Using Fig I.5-9

$V_1 = -312 + 0.201(4,584) + 0.127(186) = 633$ vph

# of trucks in lane $B_1 = (0.49)(0.03)(3,105) = 46$

$P_{T_{B_1}} = 46/186 = 0.247$

$f_{HV} = 1/[1 + (0.247)(1.7-1)] = 0.852$

$V_r = V_{B_1} = 186/(0.852 \times 0.95) = 230$ pcph

Greiner, Inc.

JOB I-4/Crosstown Connector IJR SHEET 3 OF 4 PROJ. NO. C1104.61
DESCRIPTION Express Lanes (Eastbound) COMPUTED BY GSR DATE 3/29/89
CHECKED BY MJE DATE

# of trucks in lane $B_2 = \left(\frac{I-0.49}{2}\right)(0.03)(3,105) = 24$

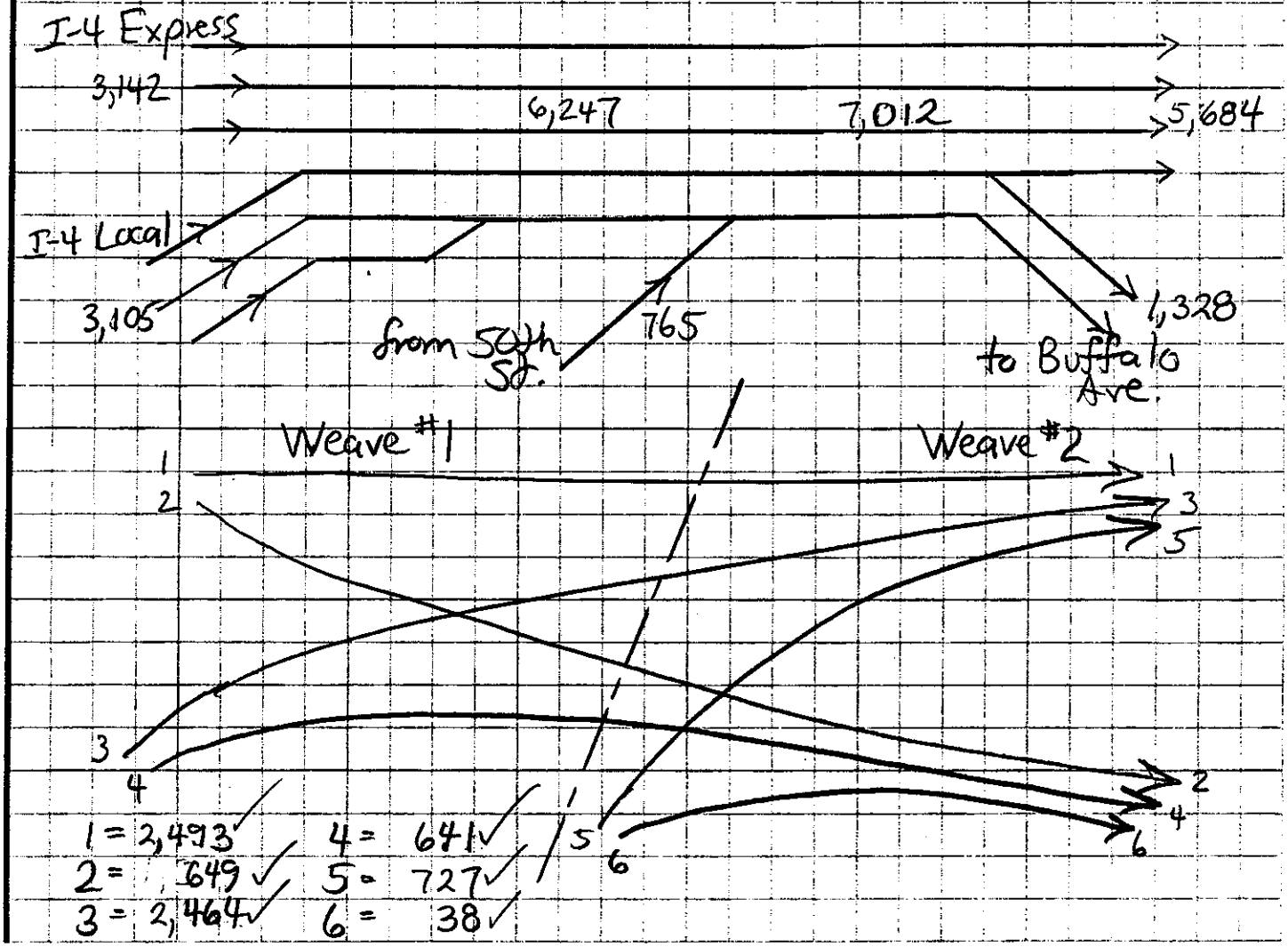
$P_{T_{B_2}} = 24/633 = 0.038$

$f_{HV} = 1/[1+(0.038)(1.7-1)] = 0.974$

$V_1 = 633/(0.974 \times 0.95) = 684$ pcph

$V_m = V_1 + V_r = 684 + 230 = 914$ pcph (LOS B)

Multiple Weaving Section between I-4 Express Freeway / I-4 Local Freeway, 50th Street and Buffalo Avenue



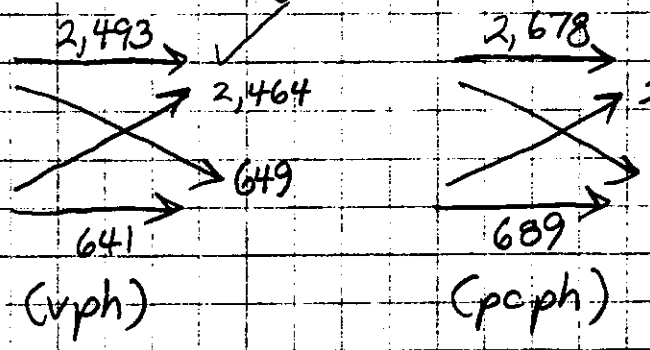
1 = 2,493 ✓ 4 = 641 ✓
2 = 649 ✓ 5 = 727 ✓
3 = 2,464 ✓ 6 = 38 ✓

Form No. G1003-87

Greiner, Inc.

JOB I-4/Crosstown Connector IJR SHEET 4 OF 4 PROJ. NO. C1104.61
DESCRIPTION Express Lanes (Eastbound) COMPUTED BY GSR DATE 3/29/89
CHECKED BY MJE DATE

Weave #1 (Type B)

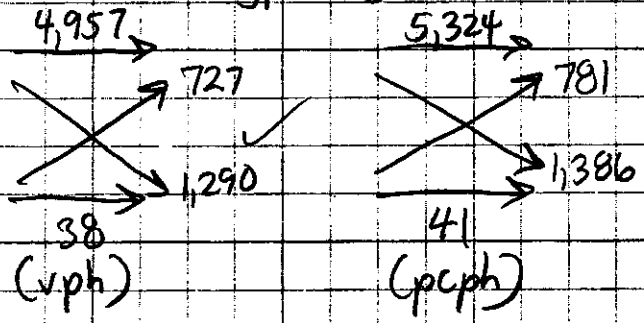


$V_w = 2,647 + 697 = 3344$ pcph
$V = 2,678 + 2,647 + 697 + 689 = 6,711$ pcph
$VR = 3,344/6,711 = 0.498$
$N = 5$
$L = 3,350'$

$$S_w = 15 + \frac{50}{1 + [(0.10)(1.498)^{1.2}(6,711/5)^{0.77}/(3,350)^{0.5}]} = 44.09 \text{ (LOS D)}$$

$$S_{nw} = 15 + \frac{50}{1 + [(0.02)(1.498)^{2.0}(6,711/5)^{1.42}/(3,350)^{0.95}]} = 47.14 \text{ (LOS D)}$$

Weave #2 (Type B)



$V_w = 781 + 1,386 = 2,167$ pcph
$V = 5,324 + 781 + 1,386 + 41 = 7,532$
$VR = 2,167/7,532 = 0.288$
$V/N = 7,532/5$
$L = 2,950$

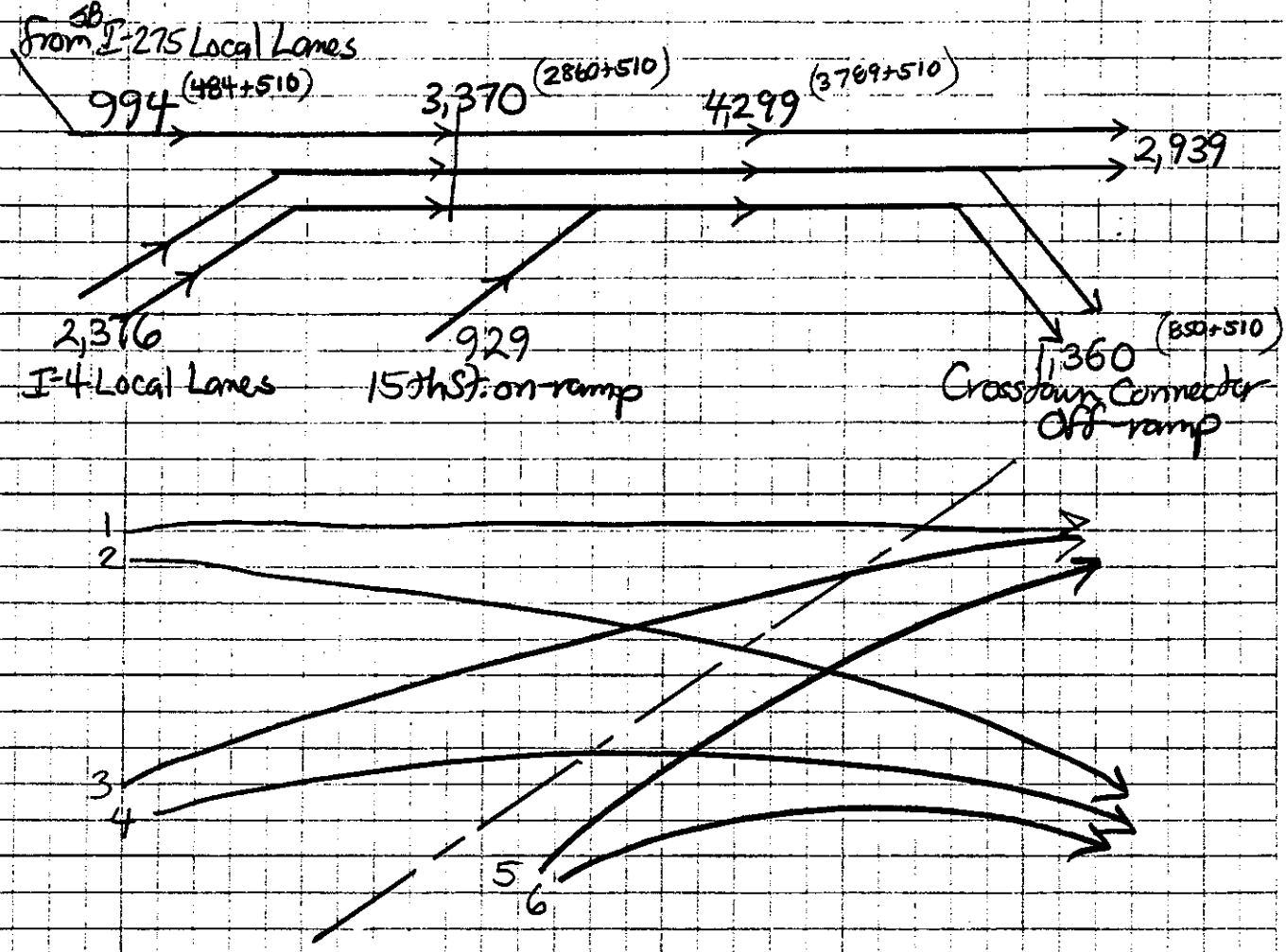
$$S_w = 15 + \frac{50}{1 + [(0.10)(1.288)^{1.2}(7,532/5)^{0.77}/(2,950)^{0.5}]} = 44.44 \text{ mph (LOS D)}$$

$$S_{nw} = 15 + \frac{50}{1 + [(0.02)(1.288)^{2.0}(7,532/5)^{1.42}/(2,950)^{0.95}]} = 47.34 \text{ mph (LOS D)}$$

Greiner, Inc.

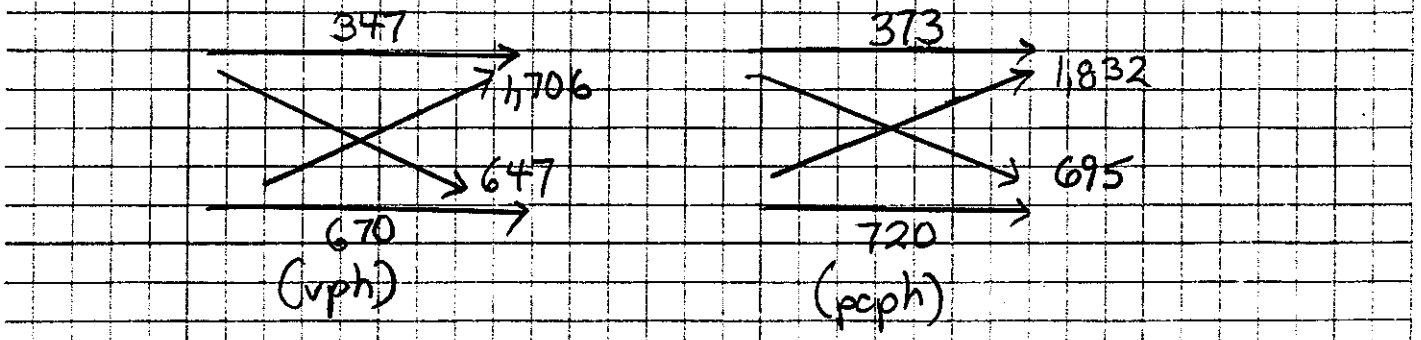
JOB I-4/X-TOWN CONNECTOR IJR — SHEET 1 OF 3 PROJ. NO.
DESCRIPTION REVISED ANALYSIS — COMPUTED BY GSR DATE 6/18/91
CHECKED BY LOE DATE 6/19/91

MULTIPLE WEAVING SECTION BTWN. I-275 LOCAL FWY. AND X-TOWN CONN.



1 = 347
2 = 647 (137+510)
3 = 1,706
4 = 670
5 = 886
6 = 43

Weave #1



Greiner, Inc.

JOB I-4/X-TOWN CONNECTOR EIR — SHEET 2 OF 3 PROJ. NO.
DESCRIPTION REVISED ANALYSIS — COMPUTED BY GSR DATE 6/18/91
CHECKED BY MJE DATE 6/19/91

$V_w = 1,832 + 695 = 2,527$ pcph

$V = 373 + 1,832 + 695 + 720 = 3,620$ pcph

$VR = 2,527/3,620 = 0.698$

$L = 2,560'$

$N = 3$

Type B Weave

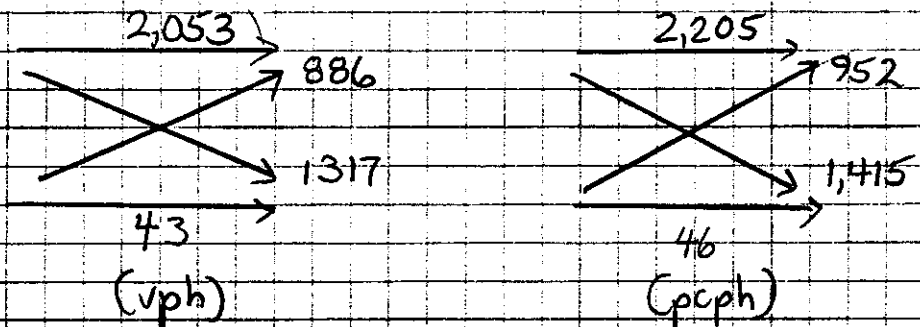
$$S_w = 15 + \frac{50}{1 + [(0.10)(1.698)^{1.2}(3,620/3)^{0.77}/(2560)^{0.5}]}$$

$= 41.59$ mph (LOS C)

$$S_{nw} = 15 + \frac{50}{1 + [(0.02)(1.698)^{2.0}(3,620/3)^{1.42}/(2560)^{0.95}]}$$

$= 42.90$ mph (LOS C)

Weave #2



$V_w = 952 + 1,415 = 2,367$ pcph

$V = 2,205 + 952 + 1,415 + 46 = 4,618$ pcph

$VR = 2,367/4,618 = 0.513$

$L = 3,100'$

$N = 3$

Type B Weave

Greiner, Inc.

JOB I-4/X-TOWN CONNECTOR IJR
DESCRIPTION REVISED ANALYSIS
SHEET 3 OF 3 PROJ. NO.
COMPUTED BY QSR DATE 6/18/91
CHECKED BY HJE DATE 6/19/91

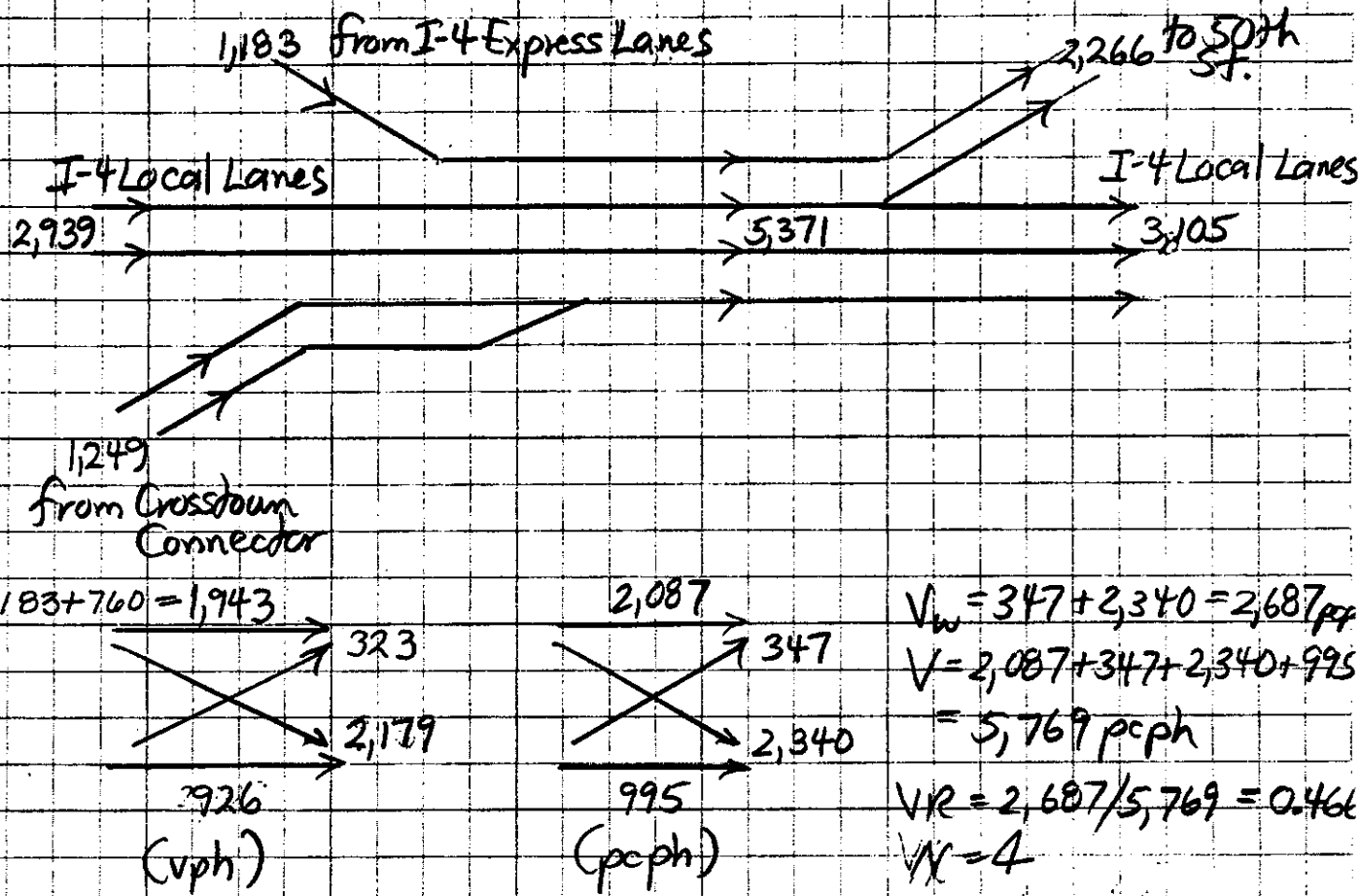
$$S_W = 15 + \frac{50}{1 + [(0.10)(1.513)^{1.2}(4{,}618/3)^{0.77}/(3{,}100)^{0.5}]} = 42.17 \text{ (LOS C)}$$

$$S_{NW} = 15 + \frac{50}{1 + [(0.02)(1.513)^{2.0}(4{,}618/3)^{1.42}/(3{,}100)^{0.95}]} = 43.72 \text{ (LOS C)}$$

Greiner, Inc.

JOB I-4/Crosstown Connector IJR SHEET 3 OF 3 PROJ. NO. C1104.61
DESCRIPTION Local Lanes (Eastbound) COMPUTED BY GSR DATE 3/29/09
2010 Build Phase II CHECKED BY MJE DATE

Crosstown Connector On-ramp to 50th St. off-ramp



$V_w = 347 + 2,340 = 2,687$ pcph
$V = 2,087 + 347 + 2,340 + 995$
$= 5,769$ pcph
$V_R = 2,687/5,769 = 0.466$
$V_X = 4$
$L = 4600'$

Type C Weave

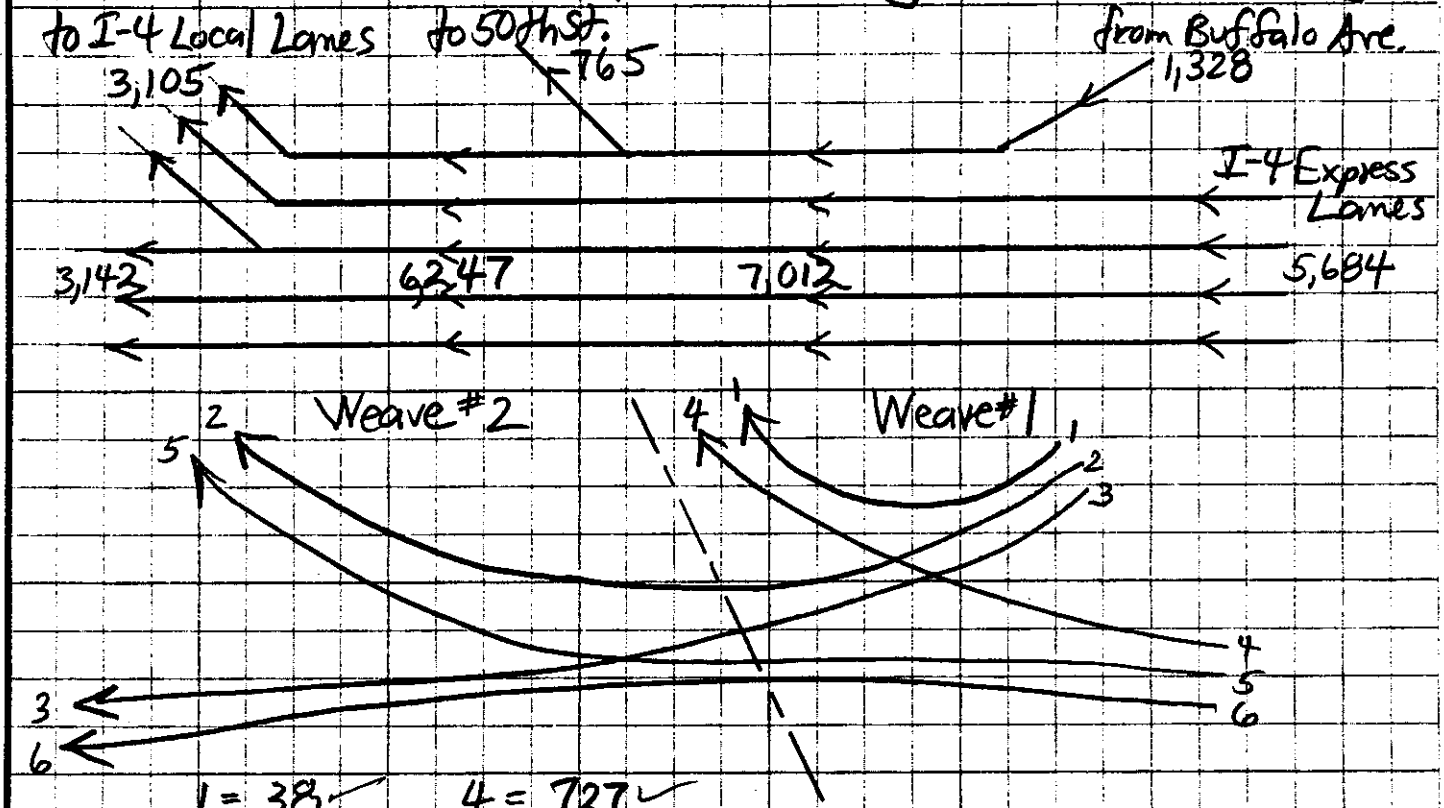
$$S_W = 15 + \frac{50}{1 + [(0.10)(1.466)^{1.8}(5,769/4)^{0.8}/(4600)^{0.5}]} = 40.15 \text{ mph (LOS C)}$$

$$S_{NW} = 15 + \frac{50}{1 + [(0.015)(1.466)^{1.8}(5,769/4)^{1.1}/(4600)^{0.5}]} = 36.60 \text{ mph (LOS D)}$$

Greiner, Inc.

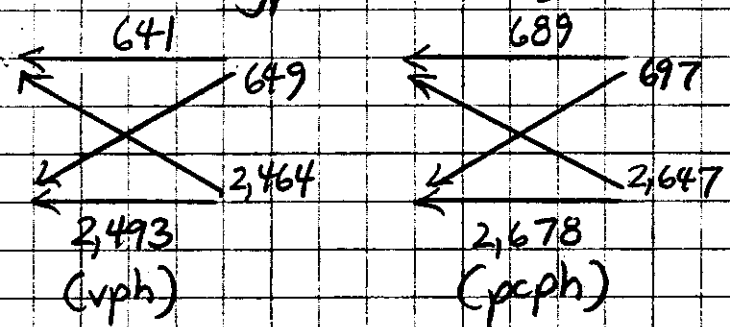
JOB I-4/Crosstown Connector IJR SHEET 1 OF 5 PROJ. NO. C1104.61
DESCRIPTION Express Lanes (Westbound) COMPUTED BY GSR DATE 4/3/89
2010 Build Phase II CHECKED BY MJE DATE

Multiple Weaving Section between Buffalo Avenue, 50th Street and I-4 Express Freeway/I-4 Local Freeway



1 = 38 ✓ 4 = 727 ✓
2 = 641 ✓ 5 = 2,464 ✓
3 = 649 ✓ 6 = 2,493 ✓

Weave #2 (Type B Weave)



$V_w = 697 + 2,647 = 3,344$ pcph
$V = 689 + 697 + 2,647 + 2,678 = 6,711$ pcph
$VR = 3,344/6,711 = 0.498$
$N = 5$
$L = 2350'$

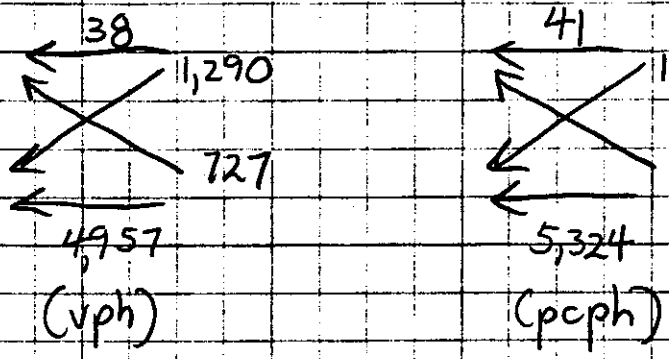
$$S_w = 15 + \frac{50}{1 + [(0.10)(1.498)^{1.2}(6,711/5)^{0.77}/(3650)^{0.5}]} = 44.61 \text{ mph (LOS D)}$$

$$S_{NW} = 15 + \frac{50}{1 + [(0.02)(1.498)^{2.0}(6,711/5)^{1.42}/(3650)^{0.95}]} = 48.07 \text{ mph (LOS C)}$$

Greiner, Inc.

JOB I-4/Crosstown Connector IJR SHEET 2 OF 5 PROJ. NO. C1104.61
DESCRIPTION Express Lanes (Westbound) COMPUTED BY QSR DATE 4/26/89
2010 Build Phase II CHECKED BY HJE DATE

Weave #1 (Type A Weave)



$V_w = 1,386 + 781 = 2,167$ pcph

$V = 41 + 1,386 + 781 + 5,324 = 7,532$ pcph

$VR = 2,167 / 7,532 = 0.288$

$N = 5$

$L = 2,350'$

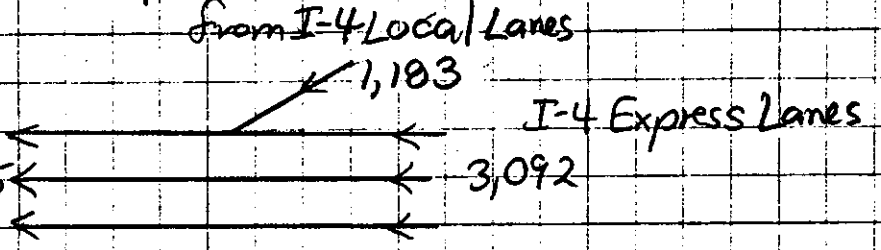
$$S_W = 15 + \frac{50}{1 + [(0.28)(1.288)^{2.2}(7,532/5)^{1.0}/(2350)^{0.9}]} = 44.75 \text{ mph (LOS D)}$$

$$S_{NW} = 15 + \frac{50}{1 + [(0.02)(1.288)^{4.0}(7,532/5)^{0.88}/(2350)^{0.6}]} = 52.68 \text{ mph (LOS C)}$$

Greiner, Inc.

JOB I-4/Crosstown Connector IJR SHEET 3 OF 5 PROJ. NO. C1104.61
DESCRIPTION Express Lanes (Westbound) COMPUTED BY GSR DATE 4/3/89
2010 Build Phase II CHECKED BY KJE DATE

On-ramp from I-4 Local



Using Fig. I.5-6

$V_1 = -12 + 0.244(3,092) - 0.085(50) + 5 = 634$ vph

# of trucks in lane 1 $= (0.49)(0.03)(3,092) = 45$

$P_{T_1} = 45/634 = 0.071$

$f_{HV} = 1/[1 + (0.071)(1.7-1)] = 0.953$

$V_1 = 634/(0.953 \times 0.95) = 700$ pcph

$V_r = 1,183/(0.98 \times 0.95) = 1,271$ pcph

$V_m = V_1 + V_r = 700 + 1,271 = 1,971$ pcph (LOS E)

Maximum # of vehicles that can be in lane 1 and not exceed LOS D for the merge

$= 1,925 - 1,271 = 654$ pcph $\times 0.95 \times 0.95 = 590$ vph

# of trucks in lane 1 = 45 (same as before)

$P_{T_1} = 45/590 = 0.076$

$f_{HV} = 1/[1 + (0.076)(1.7-1)] = 0.949$

$V_1 = 590/(0.949 \times 0.95) = 654$ pcph

$V_r = 1,183/(0.98 \times 0.95) = 1,271$ pcph

$V_m = V_1 + V_r = 654 + 1,271 = 1,925$ pcph (LOS D)

Greiner, Inc.

JOB I-4/Crosstown Connector JDR SHEET 4 OF 5 PROJ. NO. C1104.61
DESCRIPTION Express Lanes (Westbound) COMPUTED BY GSR DATE 4/3/89
2010 Build Phase II CHECKED BY PJE DATE

Traffic volume in remaining 2 freeway lanes
= 3,092 - 590 = 2,502 vph
per lane volume = 2,502/2 = 1,251 vph
Assuming trucks evenly distribute in remaining 2 lanes

$T = (1-0.49)(0.03)(3,092)/2 = 24$ trucks per lane

$P_T = 24/1,251 = 0.019$

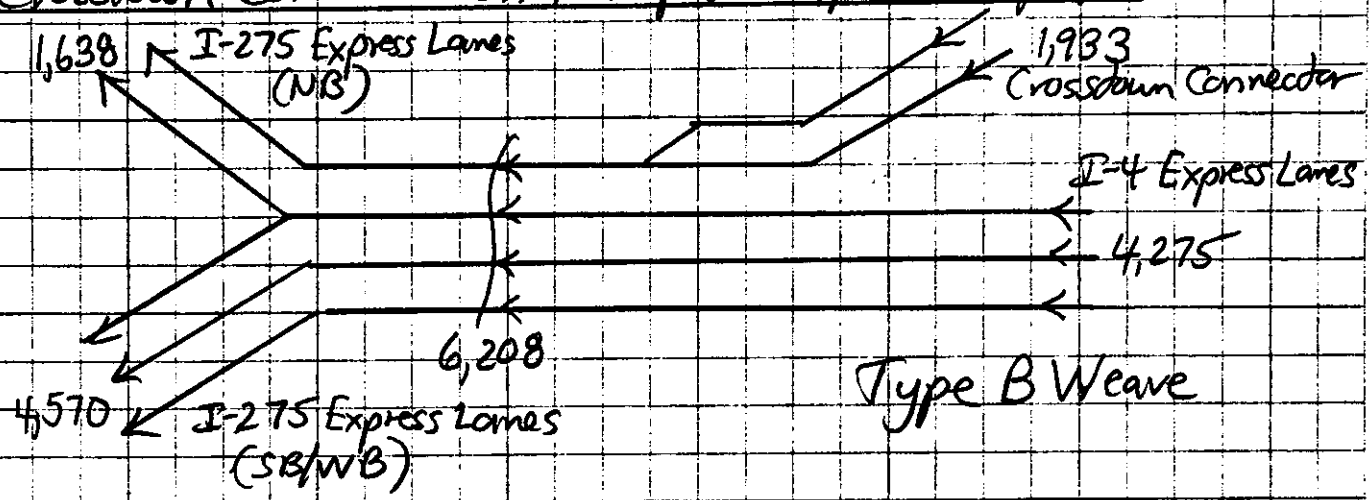
$f_{HV} = 1/[1+(0.019)(1.7-1)] = 0.987$

Service volume = $1,251/(0.987 \times 0.95) = 1,334$ pcphpl
(LOS C)

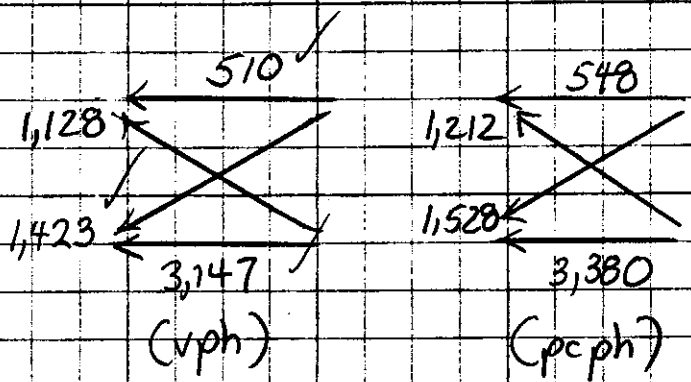
Greiner, Inc.

JOB I-4/Crosstown-Connector IJR SHEET 5 OF 5 PROJ. NO. C1104.61
DESCRIPTION Express Lanes (Westbound) COMPUTED BY GSR DATE 4/3/89
2010 Build Phase II CHECKED BY LQE DATE

Crossdown Connector On-Ramp to I-4/I-275 Split



Type B Weave



$V_w = 1,212 + 1,528 = 2740$ pcph

$V = 548 + 1,212 + 1,528 + 3,380 = 6668$ pcph

$VR = 2,740/6668 = 0.411$

$N = 4$

$L = 4,950'$

$$S_w = 15 + \frac{50}{1 + [(0.10)(1.411)^{1.2}(6668/4)^{0.77}/(4950)^{0.5}]}$$

$= 45.30$ mph (LOS C)

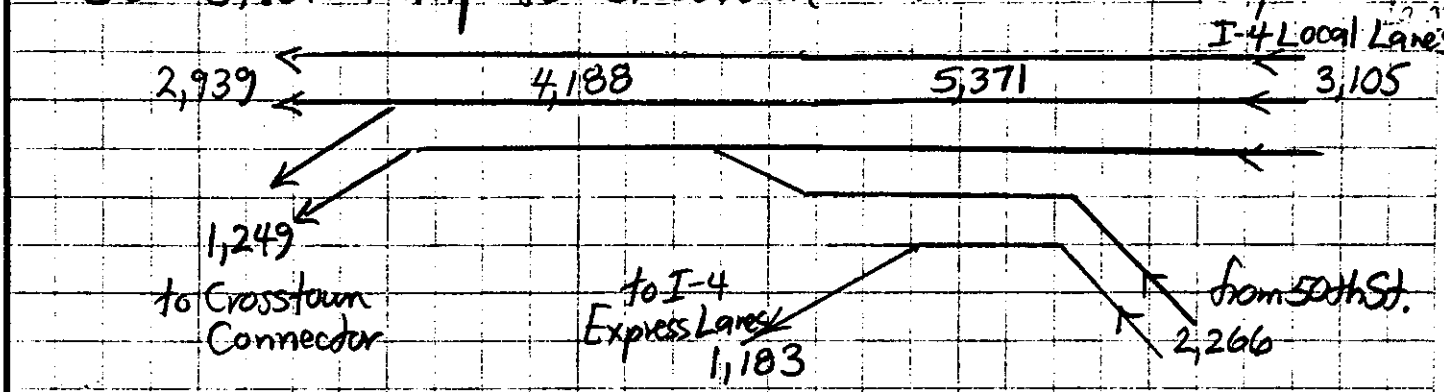
$$S_{NW} = 15 + \frac{50}{1 + [(0.02)(1.411)^{2.0}(6668/4)^{1.42}/(4950)^{0.95}]}$$

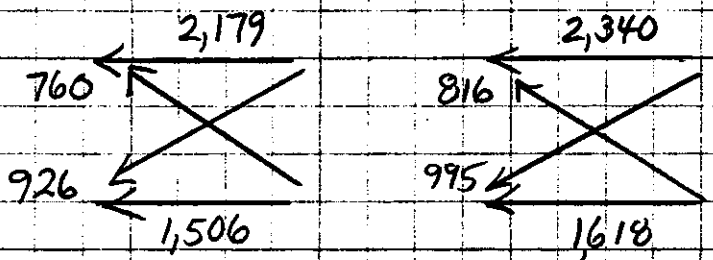
$= 49.18$ mph (LOS C)

Greiner, Inc.

JOB I-4/Crosstown Connector IJR SHEET 1 OF 2 PROJ. NO. C1104.61
DESCRIPTION Local Lanes (Westbound) COMPUTED BY GSR DATE 4/3/09
2010 Build Phase II CHECKED BY MJE DATE

50th St. On-ramp to Crosstown Connector off-ramp





(vph) (pcph)

$V_w = 816 + 995 = 1,811$ pcph

$V = 2,340 + 816 + 995 + 1,618 = 5,769$

$VR = 1,811/5,769 = 0.314$

$N = 5$

$L = 3800'$

Type C Weave

$$S_w = 15 + \frac{50}{1+[(0.10)(1.314)^{1.8}(5,769/5)^{0.8}/(3800)^{0.5}]}$$

$= 43.62$ mph (LOS C)

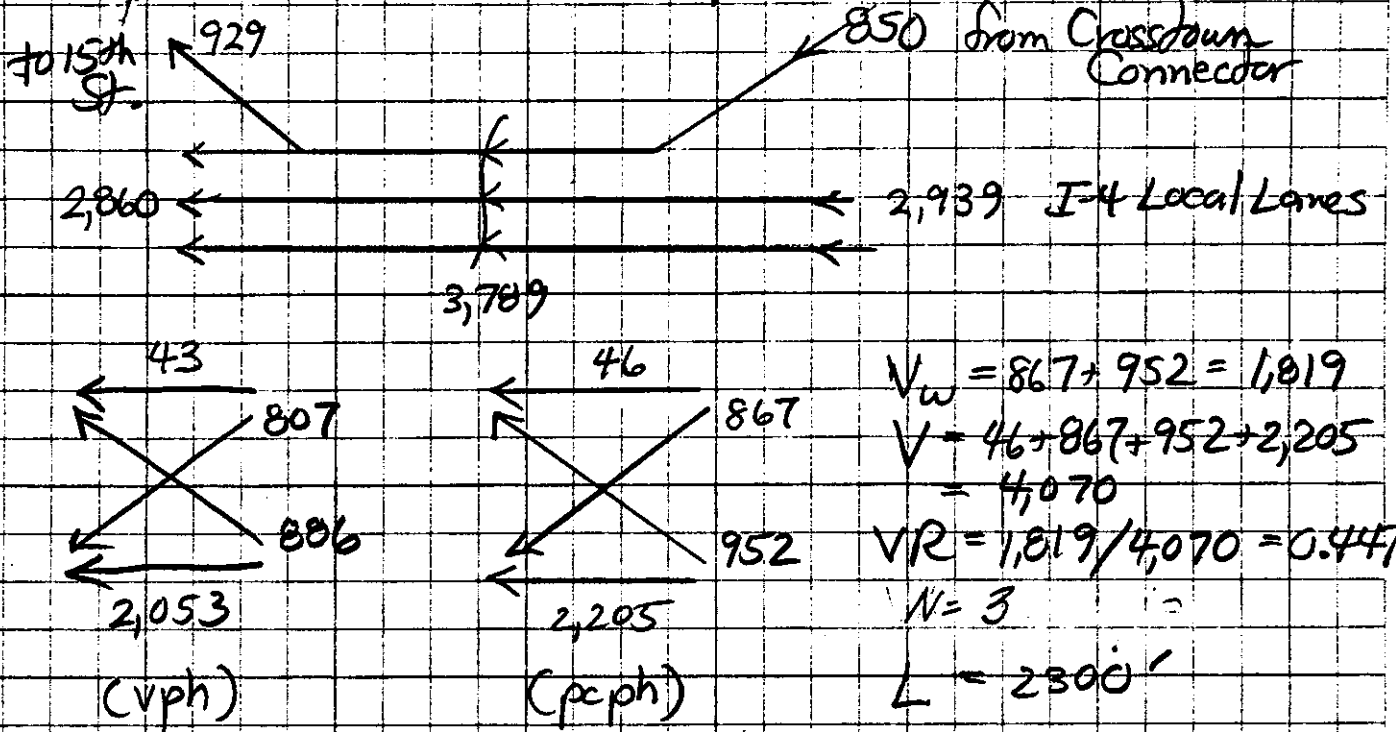
$$S_{uw} = 15 + \frac{50}{1+[(0.015)(1.314)^{1.8}(5,769/5)^{1.1}/(3800)^{0.5}]}$$

$= 40.92$ mph (LOS D)

Greiner, Inc.

JOB I-4/ Crosstown Connector IJR SHEET 2 OF 2 PROJ. NO. C1104.61
DESCRIPTION Local Lanes (Westbound) COMPUTED BY GSR DATE 4/3/89
2010 Build Phase II CHECKED BY MJE DATE

Crosstown Connector On-ramp to 15th St. off-ramp



$V_w = 867 + 952 = 1,819$

$V = 46 + 867 + 952 + 2,205 = 4,070$

$VR = 1,819 / 4,070 = 0.447$

$N = 3$

$L = 2300'$

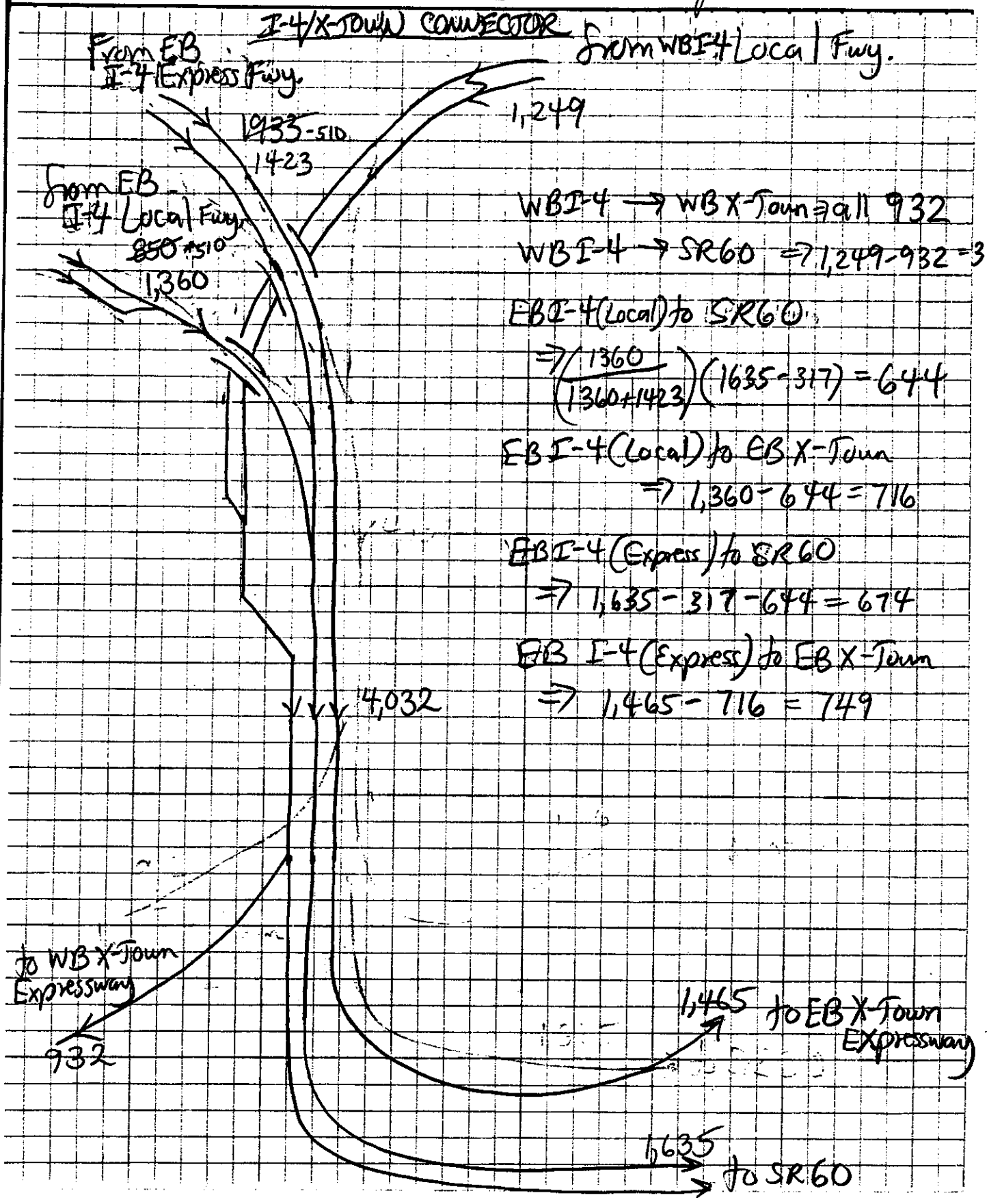
Type B Weave

$$S_w = 15 + \frac{50}{1 + [(0.10)(1.447)^{1.2}(4,070/3)^{0.77}/(2300)^{0.5}]} = 42.19 \text{ (LOS C)}$$

$$S_{NW} = 15 + \frac{50}{1 + [(0.02)(1.447)^{2.0}(4,070/3)^{1.42}/(2300)^{0.75}]} = 43.53 \text{ (LOS C)}$$

Greiner, Inc.

JOB I-4/X-TOWN CONNECTOR IJR
DESCRIPTION REVISED ANALYSIS
SHEET 1 OF 3 PROJ. NO.
COMPUTED BY GSR DATE 6/18/91
CHECKED BY LJE DATE 6/19/91



WBI-4 → WB X-Town ⇒ all 932

WBI-4 → SR60 ⇒ 1,249 - 932 = 317

EBI-4 (Local) to SR60

$\Rightarrow \left(\frac{1360}{1360+1423}\right)(1635-317) = 644$

EBI-4 (Local) to EB X-Town

⇒ 1,360 - 644 = 716

EBI-4 (Express) to SR60

⇒ 1,635 - 317 - 644 = 674

EB I-4 (Express) to EB X-Town

⇒ 1,465 - 716 = 749

Greiner, Inc.

JOB I-4/X-TOWN CONNECTOR IJR — SHEET 2 OF 3 PROJ. NO.
DESCRIPTION REVISED ANALYSIS — COMPUTED BY GSR DATE 6/18/91
CHECKED BY MJE DATE 6/19/91

I-4/X-TOWN CONNECTOR

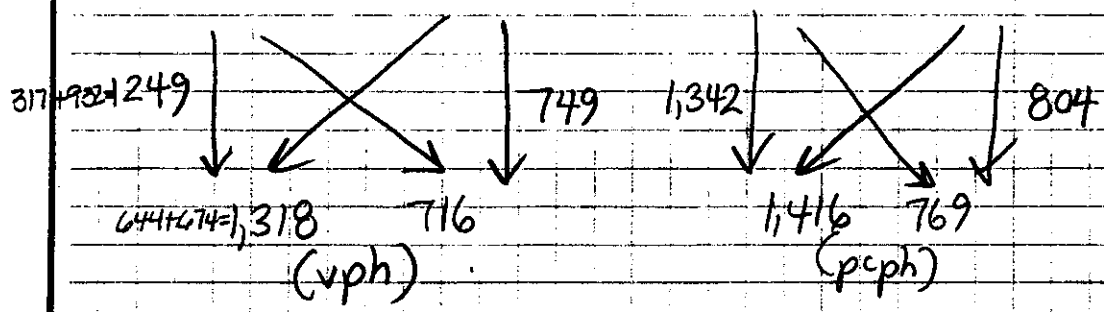
Southbound movements

EB I-4 (Local) to EB Crosstown 447+269 = 716 }
EB I-4 (Local) to SR 60 403+241 = 644 } 1360

EB I-4 (Express) to EB Crosstown 1018-269 = 749 }
EB I-4 (Express) to SR 60 915-241 = 674 } 1423

WB I-4 (Local) to SR 60 = 317 }
WB I-4 (Local) to WB Crosstown = 932 } 1249

Weaving Diagram



$V_w = 1,416 + 769 = 2,185$ pcph

$V = 1,342 + 1,416 + 769 + 804 = 4,331$ pcph

$VR = 2,185/4,331 = 0.505$

$N = 3$

$L = 2,185$

Type B Weave

$$S_w = 15 + \frac{50}{1 + [(0.10)(1.505)^{1.2}(4,331/3)^{0.77}/(2,185)^{0.5}]} = 40.69 \text{ (LOS D)}$$

$$S_{NW} = 15 + \frac{50}{1 + [(0.02)(1.505)^{2.0}(4,331/3)^{1.42}/(2,185)^{0.85}]} = 40.86 \text{ (LOS E)}$$

Greiner, Inc.

JOB I-4/Crosstown Connector IOR SHEET 3 OF 3 PROJ. NO. C1104.61
DESCRIPTION 2010 Ultimate Conc. of Crosstown Connector (Northbound) COMPUTED BY GSR DATE 3/28/89
CHECKED BY _____ DATE _____

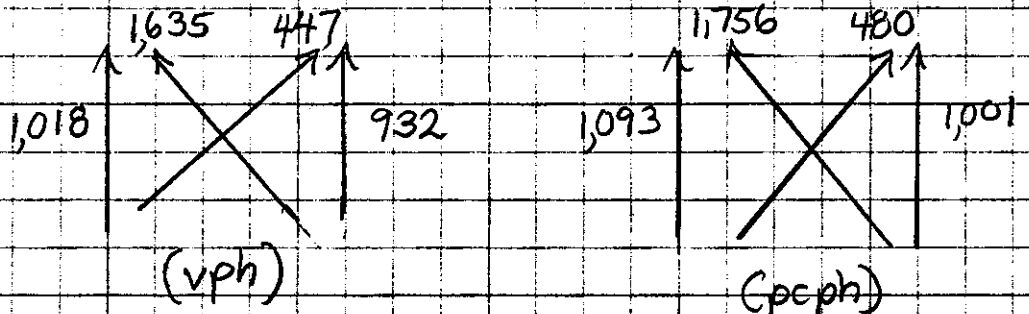
Northbound

EB X-Town to EB I-4 (Local) = 932 ✓

WB X-Town to WB I-4 (Local) = 447
WB X-Town to WB I-4 (Express) = 1018 ✓

SR60 to EB I-4 (Local) = 317 ✓
SR60 to WB I-4 (Local) = 403
SR60 to WB I-4 (Express) = 915

Weaving Diagram



$V_w = 1,756 + 480 = 2,236$ pcph

$V = 1,093 + 1,756 + 480 + 1,001 = 4,330$ pcph

$VR = 2236/4,330 = 0.516$

$N = 3$

$L = 2440'$

Type B Weave (Unconstrained)

$$S_W = 15 + \frac{50}{1 + [(0.10)(1.516)^{1.2}(4,330/3)^{0.77}/(2440)^{0.5}]}$$

$= 41.27$ mph (LOS D)

$$S_{NW} = 15 + \frac{50}{1 + [(0.02)(1.516)^{2.0}(4,330/3)^{1.42}/(2440)^{0.95}]}$$

$= 41.99$ mph (LOS D)

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 W.B. ON-RAMP/14TH STREET
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/12/88
TIME.....A.M. PEAK HOUR
COMMENT.....2010 WITH CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY				
	EB	WB	NB	SB		EB		WB	NB		SB
LT	0	1093	0	0	:	12.0	L	12.0	12.0	T	12.0
TH	0	1050	0	358	:	12.0	T	12.0	12.0	T	12.0
RT	0	0	0	102	:	12.0	T	12.0	12.0	TR	12.0
RR	0	0	0	0	:	12.0		12.0	12.0		12.0
					:	12.0		12.0	12.0		12.0
					:	12.0		12.0	12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR.	TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
WB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
NB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
SB	0.00	3.00	N	0	0	0.95	50	N	14.3		3

SIGNAL SETTINGS CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT					NB	LT				
	TH						TH				
	RT						RT				
	PD						PD				
WB	LT	X				SB	LT				
	TH	X					TH	X			
	RT						RT	X			
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
WB	L	0.961	0.711	21.9	C	12.7	B
	T	0.460	0.711	3.7	A		
SB	TR	0.466	0.222	19.8	C	19.8	C

INTERSECTION: Delay = 14.1 (sec/veh) V/C = 0.843 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 W.B. ON-RAMP/14TH STREET
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/12/89
TIME.....P.M. PEAK HOUR
COMMENT.....2010 WITH CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY					
	EB	WB	NB	SB		EB		WB	NB		SB
LT	0	894	0	0	:	12.0	L	12.0	12.0	T	12.0
TH	0	859	0	438	:	12.0	T	12.0	12.0	T	12.0
RT	0	0	0	84	:	12.0	T	12.0	12.0	TR	12.0
RR	0	0	0	0	:	12.0		12.0	12.0		12.0
					:	12.0		12.0	12.0		12.0
					:	12.0		12.0	12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR.	TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
WB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
NB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
SB	0.00	3.00	N	0	0	0.95	50	N	14.3		3

SIGNAL SETTINGS — CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT					NB	LT				
	TH						TH				
	RT						RT				
	PD						PD				
WB	LT	X				SB	LT				
	TH	X					TH		X		
	RT						RT		X		
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
WB	L	0.867	0.644	15.2	C	10.1	B
	T	0.415	0.644	5.1	B		
SB	TR	0.403	0.289	16.7	C	16.7	C

INTERSECTION: Delay = 11.7 (sec/veh) V/C = 0.723 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 E.B. OFF-RAMP/14TH STREET
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/12/89
TIME.....A.M. PEAK PERIOD
COMMENT.....2010 WITH CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY				
	EB	WB	NB	SB		EB	WB	NB		SB
LT	0	0	0	313	T	12.0	12.0	12.0	LT	12.0
TH	659	0	0	1146	TR	12.0	12.0	12.0	T	12.0
RT	283	0	0	0		12.0	12.0	12.0	T	12.0
RR	0	0	0	0		12.0	12.0	12.0		12.0
						12.0	12.0	12.0		12.0
						12.0	12.0	12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR.	TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
WB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
NB	0.00	3.00	N	0	0	0.95	50	N	11.3		3
SB	0.00	3.00	N	0	0	0.95	50	N	11.3		3

SIGNAL SETTINGS — CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT					NB	LT				
	TH	X					TH				
	RT	X					RT				
	PD						PD				
WB	LT					SB	LT	X			
	TH						TH	X			
	RT						RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	TR	0.692	0.444	13.6	B	13.8	B
SB	LT	0.672	0.489	11.7	B	11.7	B

INTERSECTION: Delay = 12.5 (sec/veh) V/C = 0.682 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 E.B. OFF-RAMP/14TH STREET
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/12/89
TIME.....P.M. PEAK HOUR
COMMENT.....2010 WITH CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY				
	EB	WB	NB	SB		EB	WB	NB		SB
LT	0	0	0	383	T	12.0	12.0	12.0	LT	12.0
TH	806	0	0	939	TR	12.0	12.0	12.0	T	12.0
RT	346	0	0	0		12.0	12.0	12.0	T	12.0
RR	0	0	0	0		12.0	12.0	12.0		12.0
						12.0	12.0	12.0		12.0
						12.0	12.0	12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR.	TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	11.5		3
WB	0.00	3.00	N	0	0	0.95	50	N	11.5		3
NB	0.00	3.00	N	0	0	0.95	50	N	8.5		3
SB	0.00	3.00	N	0	0	0.95	50	N	8.5		3

SIGNAL SETTINGS CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4
EB	LT				
	TH	X			
	RT	X			
	PD				
WB	LT				
	TH				
	RT				
	PD				
NB	LT				
	TH				
	RT				
	PD				
SB	LT		X		
	TH		X		
	RT				
	PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	TR	0.769	0.489	13.5	B	13.5	B
SB	L	0.539	0.444	14.5	B	13.6	B
	T	0.659	0.444	13.3	B		

INTERSECTION: Delay = 13.7 (sec/veh) V/C = 0.716 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 E.B. ON-RAMP/15TH STREET
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/12/89
TIME.....A. M. PEAK PERIOD
COMMENT.....2010 WITH CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY				
	EB	WB	NB	SB		EB	WB		NB	SB
LT	72	0	0	0	LT	12.0	12.0	T	12.0	12.0
TH	901	0	458	0	T	12.0	12.0	TR	12.0	12.0
RT	0	0	848	0		12.0	12.0	R	12.0	12.0
RR	0	0	0	0		12.0	12.0		12.0	12.0
						12.0	12.0		12.0	12.0
						12.0	12.0		12.0	12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	RUT. min T	ARR.	TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
WB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
NB	0.00	3.00	N	0	0	0.95	50	N	11.3		3
SB	0.00	3.00	N	0	0	0.95	50	N	11.3		3

SIGNAL SETTINGS — CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT				
	TH	X					TH	X			
	RT						RT	X			
	PD						PD				
WB	LT					SB	LT				
	TH						TH				
	RT						RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	LT	0.690	0.444	13.7	B	13.7	B
NB	TR	0.543	0.489	10.6	B	11.8	B
	R	0.727	0.489	13.9	B		

INTERSECTION: Delay = 12.7 (sec/veh) V/C = 0.709 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 E.B. ON-RAMP/15TH STREET
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/12/89
TIME.....P.M. PEAK HOUR
COMMENT.....2010 WITH CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY				
	EB	WB	NB	SB		EB	WB		NB	SB
LT	88	0	0	0	LT	12.0	12.0	T	12.0	12.0
TH	1101	0	375	0	T	12.0	12.0	TR	12.0	12.0
RT	0	0	1036	0		12.0	12.0	R	12.0	12.0
RR	0	0	0	0		12.0	12.0		12.0	12.0
						12.0	12.0		12.0	12.0
						12.0	12.0		12.0	12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	14.3	3
WB	0.00	3.00	N	0	0	0.95	50	N	14.3	3
NB	0.00	3.00	N	0	0	0.95	50	N	11.3	3
SB	0.00	3.00	N	0	0	0.95	50	N	11.3	3

SIGNAL SETTINGS CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT				
	TH	X					TH	X			
	RT						RT	X			
	PD						PD				
WB	LT					SB	LT				
	TH						TH				
	RT						RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	LT	0.865	0.433	18.3	C	18.3	C
NB	TR	0.534	0.500	10.1	B	14.0	B
	R	0.869	0.500	19.2	C		

INTERSECTION: Delay = 16.0 (sec/veh) V/C = 0.867 LOS = C

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 W.B. OFF-RAMP/15TH STREET
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/12/89
TIME.....A.M. PEAK PERIOD
COMMENT.....2010 WITH CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB		EB		WB		NB		SB	
LT	0	0	346	0	:	12.0	T	12.0	L	12.0		12.0	
TH	0	1795	163	0	:	12.0	T	12.0	T	12.0		12.0	
RT	0	341	0	0	:	12.0	TR	12.0	T	12.0		12.0	
RR	0	0	0	0	:	12.0		12.0		12.0		12.0	
					:	12.0		12.0		12.0		12.0	
					:	12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR.	TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	14.3	3	
WB	0.00	3.00	N	0	0	0.95	50	N	14.3	3	
NB	0.00	3.00	N	0	0	0.95	50	N	14.3	3	
SB	0.00	3.00	N	0	0	0.95	50	N	14.3	3	

SIGNAL SETTINGS — CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT					NB	LT	X			
	TH						TH	X			
	RT						RT				
	PD						PD				
WB	LT					SB	LT				
	TH	X					TH				
	RT	X					RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
WB	TR	0.912	0.522	15.9	C	15.9	C
NB	L	0.526	0.411	15.7	C	14.0	B
	T	0.124	0.411	10.6	B		

INTERSECTION: Delay = 15.6 (sec/veh) V/C = 0.742 LOS = C

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 W.B. OFF-RAMP/15TH STREET
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/12/89
TIME.....P.M. PEAK PERIOD
COMMENT.....2010 WITH CROSSTOWN CONNECTOR

	VOLUMES				GEOMETRY							
	EB	WB	NB	SB	EB		WB		NB		SB	
LT	0	0	283	0	12.0	T	12.0	L	12.0		12.0	
TH	0	1470	199	0	12.0	T	12.0	T	12.0		12.0	
RT	0	279	0	0	12.0	TR	12.0	T	12.0		12.0	
RR	0	0	0	0	12.0		12.0		12.0		12.0	
					12.0		12.0		12.0		12.0	
					12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR.	TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
WB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
NB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
SB	0.00	3.00	N	0	0	0.95	50	N	14.3		3

SIGNAL SETTINGS — CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT					NB	LT	X			
	TH						TH	X			
	RT						RT				
	PD						PD				
WB	LT					SB	LT				
	TH	X					TH				
	RT	X					RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
WB	TR	0.747	0.522	11.6	B	11.6	B
NB	L	0.430	0.411	14.7	B	13.0	B
	T	0.151	0.411	10.8	B		

INTERSECTION: Delay = 11.9 (sec/veh) V/C = 0.607 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 W.B. ON-RAMP/COLUMBUS DRIVE
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/12/89
TIME.....A.M. PEAK HOUR
COMMENT.....2010 WITH CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB		EB		WB		NB		SB	
LT	0	5	1452	0		12.0	LT	12.0	L	12.0	T	12.0	
TH	0	795	139	381		12.0	T	12.0	L	12.0	TR	12.0	
RT	0	0	0	19		12.0		12.0	T	12.0	R	12.0	
RR	0	0	0	0		12.0		12.0		12.0		12.0	
						12.0		12.0		12.0		12.0	
						12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR.	TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	25.8		3
WB	0.00	3.00	N	0	0	0.95	50	N	25.8		3
NB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
SB	0.00	3.00	N	0	0	0.95	50	N	14.3		3

SIGNAL SETTINGS — CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT					NB	LT	X			
	TH						TH	X			
	RT						RT				
	PD						PD				
WB	LT	X				SB	LT				
	TH	X					TH		X		
	RT						RT		X		
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
WB	LT	0.936	0.267	30.8	D	30.8	D
NB	L	0.984	0.500	30.8	D	28.9	D
	T	0.165	0.500	7.9	B		
SB	TR	0.891	0.133	36.0	D	35.0	D
	R	0.100	0.133	22.1	C		

INTERSECTION: Delay = 27.5 (sec/veh) V/C = 0.956 LOS = D

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 W.B. ON-RAMP/COLUMBUS DRIVE
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/12/89
TIME.....P.M. PEAK HOUR
COMMENT.....2010 WITH CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB		EB		WB		NB		SB	
LT	0	5	1188	0	:	12.0	LT	12.0	L	12.0	T	12.0	
TH	0	651	113	466	:	12.0	T	12.0	L	12.0	TR	12.0	
RT	0	0	0	15	:	12.0		12.0	T	12.0	R	12.0	
RR	0	0	0	0	:	12.0		12.0		12.0		12.0	
					:	12.0		12.0		12.0		12.0	
					:	12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR.	TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	25.8		3
WB	0.00	3.00	N	0	0	0.95	50	N	25.8		3
NB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
SB	0.00	3.00	N	0	0	0.95	50	N	14.3		3

SIGNAL SETTINGS CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT					NB	LT	X			
	TH						TH	X			
	RT						RT				
	PD						PD				
WB	LT	X				SB	LT				
	TH	X					TH		X		
	RT						RT		X		
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
WB	LT	0.801	0.256	23.4	C	23.4	C
NB	L	0.906	0.444	23.8	C	22.6	C
	T	0.151	0.444	9.6	B		
SB	TR	0.726	0.200	24.0	C	26.1	D
	R	0.052	0.200	18.8	C		

INTERSECTION: Delay = 23.7 (sec/veh) V/C = 0.836 LOS = C

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 E.B. OFF-RAMP/COLUMBUS DRIVE
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/12/89
TIME.....A.M. PEAK HOUR
COMMENT.....2010 WITH CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY					
	EB	WB	NB	SB		EB	WB		NB		SB
LT	15	0	0	170	LT	12.0	12.0	T	12.0	L	12.0
TH	651	0	1572	211	T	12.0	12.0	T	12.0	T	12.0
RT	1188	0	5	0	R	12.0	12.0	TR	12.0	T	12.0
RR	40	0	0	0	R	12.0	12.0		12.0		12.0
						12.0	12.0		12.0		12.0
						12.0	12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	20.5	3
WB	0.00	3.00	N	0	0	0.95	50	N	20.5	3
NB	0.00	3.00	N	0	0	0.95	50	N	14.5	3
SB	0.00	3.00	N	0	0	0.95	50	N	14.5	3

SIGNAL SETTINGS — CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT				
	TH	X					TH	X			
	RT	X					RT	X			
	PD						PD				
WB	LT					SB	LT		X		
	TH						TH		X		
	RT						RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	LT	0.815	0.256	23.8	C	12.6	B
	R	0.693	0.689	6.1	B		
NB	TR	0.792	0.433	15.4	C	15.4	C
SB	L	0.503	0.211	24.8	C	21.8	C
	T	0.312	0.211	19.4	C		

INTERSECTION: Delay = 14.7 (sec/veh) V/C = ~~1.030~~ 0.730 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 E.B. OFF-RAMP/COLUMBUS DRIVE
AREA TYPE.....OTHER
ANALYST.......GSR
DATE..........4/12/89
TIME..........P.M. PEAK PERIOD
COMMENT.......2010 WITH CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB		EB		WB		NB		SB	
LT	19	0	0	208	LT	12.0		12.0	T	12.0	L	12.0	
TH	795	0	1286	258	T	12.0		12.0	T	12.0	T	12.0	
RT	1452	0	5	0	R	12.0		12.0	TR	12.0	T	12.0	
RR	40	0	0	0	R	12.0		12.0		12.0		12.0	
						12.0		12.0		12.0		12.0	
						12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	25.8	3
WB	0.00	3.00	N	0	0	0.95	50	N	25.8	3
NB	0.00	3.00	N	0	0	0.95	50	N	17.3	3
SB	0.00	3.00	N	0	0	0.95	50	N	17.3	3

SIGNAL SETTINGS — CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT				
	TH	X					TH	X			
	RT	X					RT	X			
	PD						PD				
WB	LT					SB	LT		X		
	TH						TH		X		
	RT						RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	LT	0.764	0.333	19.1	C	14.1	B
	R	0.880	0.667	11.2	B		
NB	TR	0.843	0.333	20.3	C	20.3	C
SB	L	0.557	0.233	24.4	C	21.2	C
	T	0.345	0.233	18.7	C		

INTERSECTION: Delay = 17.0 (sec/veh) V/C = ~~1.187~~ 0.740 LOS = C

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 E.B. ON-RAMP/50TH STREET(U.S. 41)
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/12/89
TIME.....A.M. PEAK HOUR
COMMENT.....2010 WITH CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY					
	EB	WB	NB	SB		EB		WB		NB		SB
LT	651	0	0	160	L	12.0		12.0	T	12.0	L	12.0
TH	170	0	1715	2320	L	12.0		12.0	T	12.0	T	12.0
RT	0	0	296	0	TR	12.0		12.0	T	12.0	T	12.0
RR	0	0	20	0		12.0		12.0	R	12.0	T	12.0
						12.0		12.0		12.0		12.0
						12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	31.8	3
WB	0.00	3.00	N	0	0	0.95	50	N	31.8	3
NB	0.00	3.00	N	0	0	0.95	50	N	14.3	3
SB	0.00	3.00	N	0	0	0.95	50	N	14.3	3

SIGNAL SETTINGS — CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT				
	TH	X					TH		X		
	RT	X					RT		X		
	PD						PD				
WB	LT					SB	LT	X			
	TH						TH	X	X		
	RT						RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.756	0.292	31.8	D	29.8	D
	TR	0.346	0.292	21.8	C		
NB	T	0.896	0.417	24.3	C	23.3	C
	R	0.463	0.417	16.7	C		
SB	L	0.462	0.217	31.8	D	12.6	B
	T	0.797	0.633	11.4	B		

INTERSECTION: Delay = 19.2 (sec/veh) V/C = 0.784 LOS = C

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 E.B. ON-RAMP/50TH STREET(U.S. 41)
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/12/89
TIME.....P.M. PEAK HOUR
COMMENT.....2010 WITH CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB		EB		WB		NB		SB	
LT	795	0	0	195	: L	12.0		12.0	T	12.0	L	12.0	
TH	208	0	2096	1898	: L	12.0		12.0	T	12.0	T	12.0	
RT	0	0	362	0	: TR	12.0		12.0	T	12.0	T	12.0	
RR	0	0	20	0	:	12.0		12.0	R	12.0	T	12.0	
					:	12.0		12.0		12.0		12.0	
					:	12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	26.5	3
WB	0.00	3.00	N	0	0	0.95	50	N	26.5	3
NB	0.00	3.00	N	0	0	0.95	50	N	11.5	3
SB	0.00	3.00	N	0	0	0.95	50	N	11.5	3

SIGNAL SETTINGS — CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT				
	TH	X					TH		X		
	RT	X					RT		X		
	PD						PD				
WB	LT					SB	LT	X			
	TH						TH	X	X		
	RT						RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.874	0.308	36.0	D	33.1	D
	TR	0.401	0.308	21.4	C		
NB	T	0.996	0.458	32.1	D	29.9	D
	R	0.521	0.458	15.4	C		
SB	L	0.665	0.183	38.3	D	11.3	B
	T	0.644	0.642	8.7	B		

INTERSECTION: Delay = 23.3 (sec/veh) V/C = 0.916 LOS = C

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 W.B. OFF-RAMP/50TH STREET(U.S. 41)
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/12/89
TIME.....A.M. PEAK HOUR
COMMENT.....2010 WITH CROSSTOWN CONNECTOR

	VOLUMES				GEOMETRY							
	EB	WB	NB	SB	EB		WB		NB		SB	
LT	0	362	138	0	12.0	L	12.0	L	12.0	T	12.0	
TH	0	208	2252	2153	12.0	LT	12.0	T	12.0	T	12.0	
RT	0	195	0	795	12.0	R	12.0	T	12.0	TR	12.0	
RR	0	20	0	0	12.0		12.0	T	12.0	R	12.0	
					12.0		12.0		12.0		12.0	
					12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	26.5	3
WB	0.00	3.00	N	0	0	0.95	50	N	26.5	3
NB	0.00	3.00	N	0	0	0.95	50	N	11.5	3
SB	0.00	3.00	N	0	0	0.95	50	N	11.5	3

SIGNAL SETTINGS — CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT					NB	LT	X			
	TH						TH	X	X		
	RT						RT				
	PD						PD				
WB	LT	X				SB	LT				
	TH	X					TH		X		
	RT	X					RT		X		
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
WB	L	0.788	0.258	37.9	D	31.0	D
	LT	0.574	0.258	26.2	D		
	R	0.473	0.258	24.9	C		
NB	L	0.575	0.150	38.4	D	10.5	B
	T	0.735	0.667	8.9	B		
SB	TR	0.946	0.517	22.7	C	25.1	D
	R	0.967	0.517	33.4	D		

INTERSECTION: Delay = 19.9 (sec/veh) V/C = 0.842 LOS = C

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 W.B. OFF-RAMP/50TH STREET(U.S. 41)
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/12/89
TIME.....P.M. PEAK HOUR
COMMENT.....2010 WITH CROSSTOWN CONNECTOR

	VOLUMES				GEOMETRY							
	EB	WB	NB	SB	EB		WB		NB		SB	
LT	0	296	113	0	12.0	L	12.0	L	12.0	T	12.0	
TH	0	170	2753	1762	12.0	LT	12.0	T	12.0	T	12.0	
RT	0	160	0	651	12.0	R	12.0	T	12.0	TR	12.0	
RR	0	20	0	0	12.0		12.0	T	12.0	R	12.0	
					12.0		12.0		12.0		12.0	
					12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR.	TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	26.5	3	
WB	0.00	3.00	N	0	0	0.95	50	N	26.5	3	
NB	0.00	3.00	N	0	0	0.95	50	N	11.5	3	
SB	0.00	3.00	N	0	0	0.95	50	N	11.5	3	

SIGNAL SETTINGS

CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4
EB	LT				
	TH				
	RT				
	PD				
WB	LT	X			
	TH	X			
	RT	X			
	PD				
NB	LT	X			
	TH	X	X		
	RT				
	PD				
SB	LT				
	TH		X		
	RT		X		
	PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
WB	L	0.588	0.283	29.5	D	25.7	D
	LT	0.428	0.283	23.0	C		
	R	0.345	0.283	22.2	C		
NB	L	0.368	0.192	32.4	D	17.8	C
	T	0.946	0.633	17.2	C		
SB	TR	0.889	0.450	22.4	C	24.0	C
	R	0.909	0.450	29.7	D		

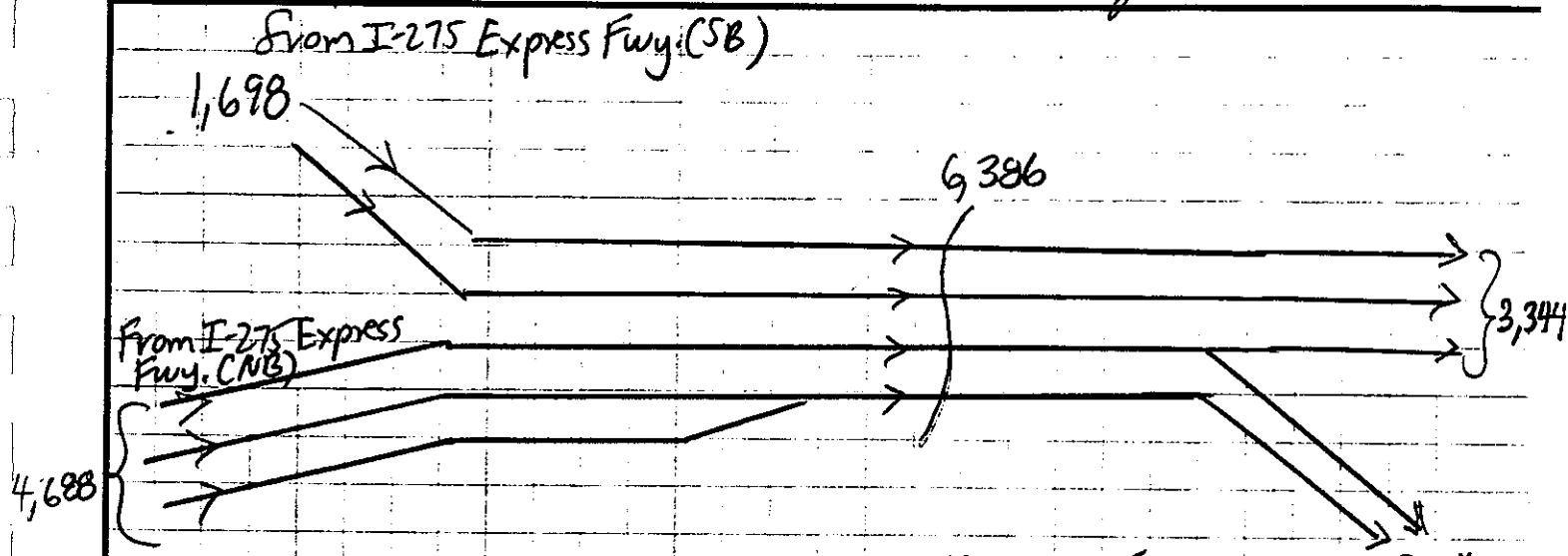
INTERSECTION: Delay = 21.1 (sec/veh) V/C = 0.828 LOS = C

APPENDIX F

DESIGN YEAR (2010) NO-BUILD CAPACITY ANALYSES

Greiner, Inc.

JOB I-4/Crosstown Connector SHEET 1 OF 3 PROJ. NO. C1104.61
DESCRIPTION Express Lanes (Eastbound) COMPUTED BY GSR DATE 2/2/09
2010 No Build CHECKED BY MJE DATE



$V_w = 3,506$ pcph
$V = 6,859$ pcph
$VR = 0.511$
$N = 4$
$L = 2980$

TYPE A WEAVE (CONSTRAINED)

$$S_w = 15 + \frac{50}{1+[(0.28)(1.511)^{2.2}(6,859/4)^{1.0}/(2980)^{0.9}]}$$

$$S_{NW} = 15 + \frac{50}{1+[(0.02)(1.511)^{4.9}(6,859/4)^{0.88}/2980^{0.6}}$$

$S_w = 41.46$ mph LOS D

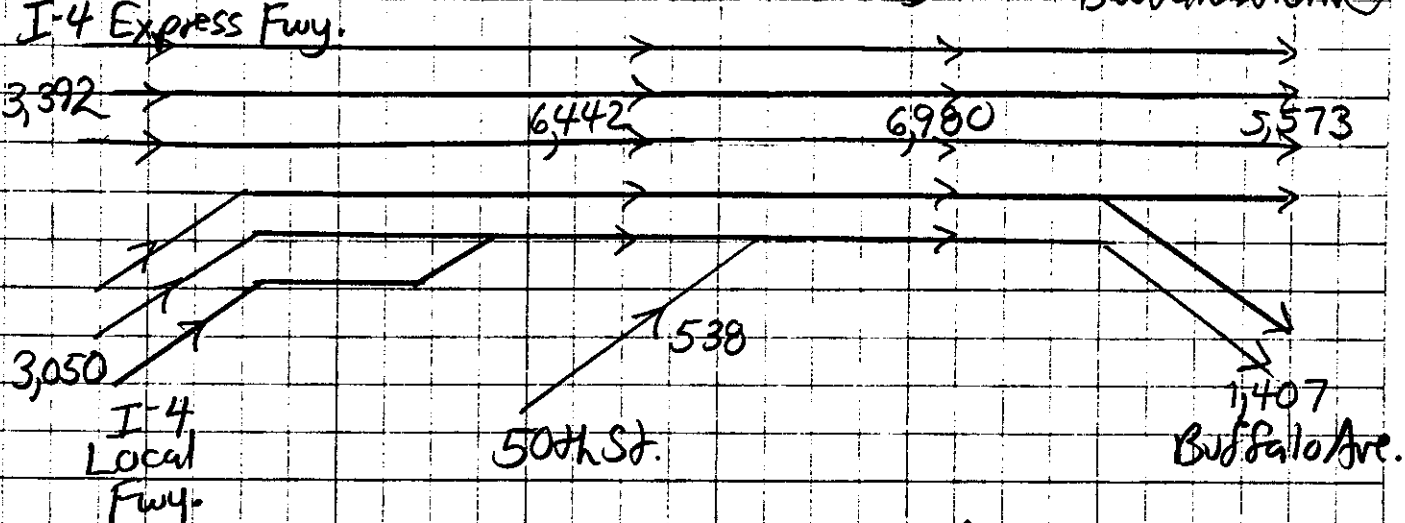
$S_{NW} = 46.21$ mph LOS D

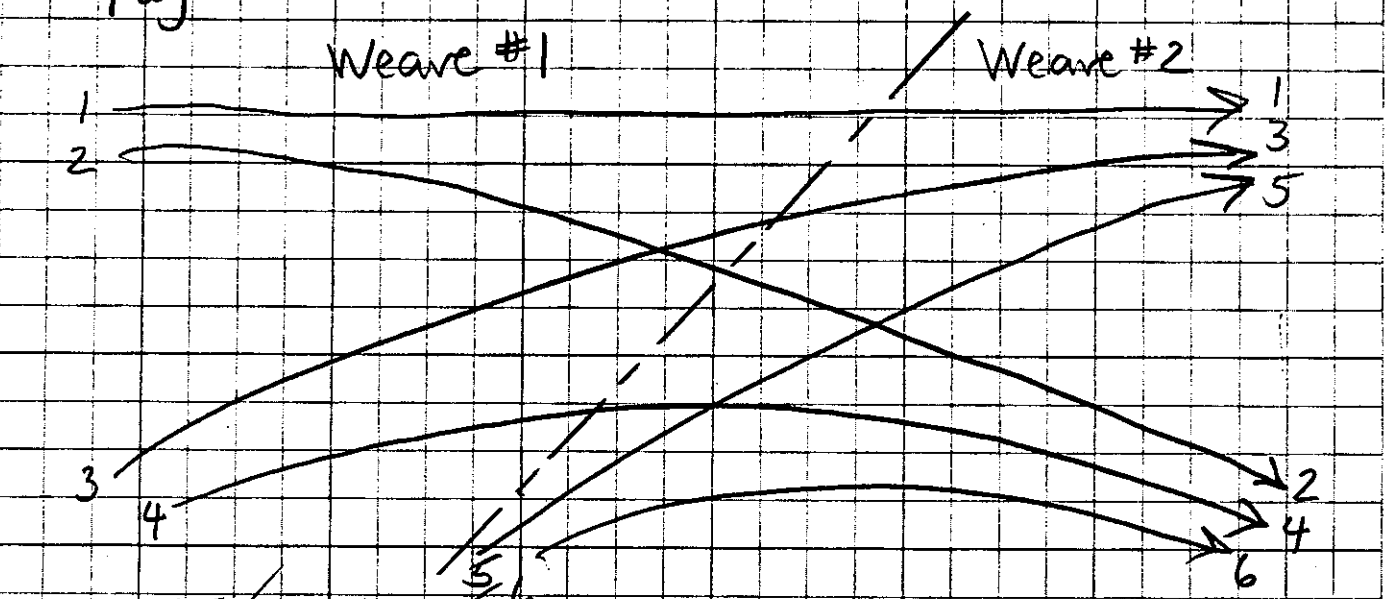
Form No. G1083-87

Greiner, Inc.

JOB I-4/Crosstown Connector JOR SHEET 2 OF 3 PROJ. NO. C1104.61
DESCRIPTION Express Lanes (Eastbound COMPUTED BY GSR DATE 4/28/89
2010 No Build CHECKED BY MJE DATE

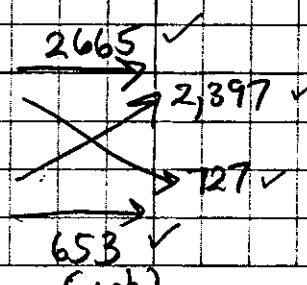
Multiple Weave between I-4 Local Freeway, 50th Street and Buffalo Avenue

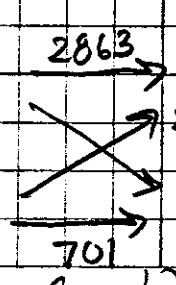




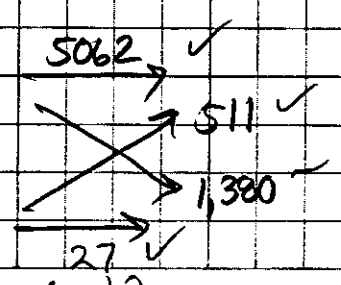
1 = 2,665 ✓ 4 = 653 ✓
2 = 727 ✓ 5 = 511 ✓
3 = 2,397 ✓ 6 = 27 ✓

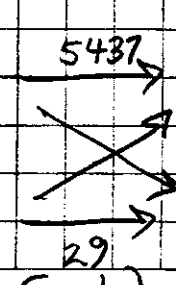
Weave #1





Weave #2





Greiner, Inc.

JOB I-4/Crosstown Connector SHEET 3 OF 3 PROJ. NO. C1104.61
DESCRIPTION Express Lanes (Eastbound) COMPUTED BY GSR DATE 4/28/89
2010 No Build CHECKED BY MJE DATE

Weave #1 (Type B)

$V_w = 2,575 + 781 = 3,356$ pcph

$V = 2,863 + 2,575 + 781 + 701 = 6,920$ pcph

$VR = 3,356/6,920 = 0.485$

$N = 5$

$L = 3,350'$

$$S_w = 15 + \frac{50}{1+[(0.10)(1.485)^{1.2}(6,920/5)^{0.77}/(3,350)^{0.5}]} = 43.93 \text{ mph (LOS D)}$$

$$S_{NW} = 15 + \frac{50}{1+[(0.02)(1.485)^{2.0}(6,920/5)^{1.42}/(3,350)^{0.95}]} = 46.84 \text{ mph (LOS D)}$$

Weave #2 (Type B)

$V_w = 549 + 1,482 = 2,031$ pcph

$V = 5,437 + 549 + 1,482 + 29 = 7,497$ pcph

$VR = 2,031/7,497 = 0.271$

$N = 5$

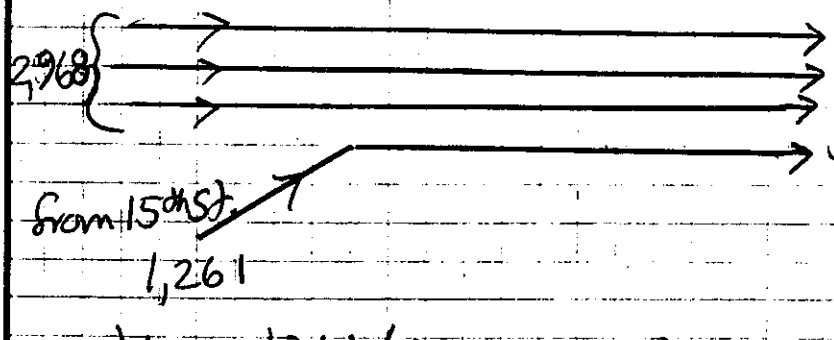
$L = 2950'$

$$S_w = 15 + \frac{50}{1+[(0.10)(1.271)^{1.2}(7,497/5)^{0.77}/(2,950)^{0.5}]} = 44.68 \text{ mph (LOS D)}$$

$$S_{NW} = 15 + \frac{50}{1+[(0.02)(1.271)^{2.0}(7,497/5)^{1.42}/(2,950)^{0.95}]} = 47.72 \text{ mph (LOS D)}$$

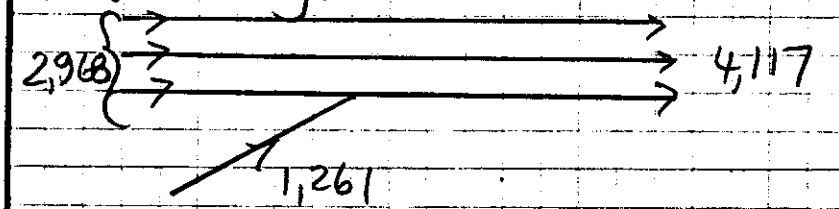
Greiner, Inc.

JOB I-4/Crosstown Connector SHEET 1 OF 4 PROJ. NO. C1104.61
DESCRIPTION Local Lanes (Eastbound) COMPUTED BY GSR DATE 2/21/89
2010 No Build CHECKED BY HJE DATE



$V_m = 1261/(0.95 \times 0.98) = 1,354$ pcph (LOS C)

Note: the use of an add lane @ 15th was the result of the following:



Using Fig. I. 5-6

$V_1 = -121 + 0.244(2,968) - (0.085)(50) + 5 = 604$ vph

# of trucks in lane 1 $= (0.50)(0.03)(2,968) = 45$

$P_{T_1} = 45/604 = 0.075$

$f_{HV} = \frac{1}{1+[(0.075)(1.7-1)]} = 0.950$

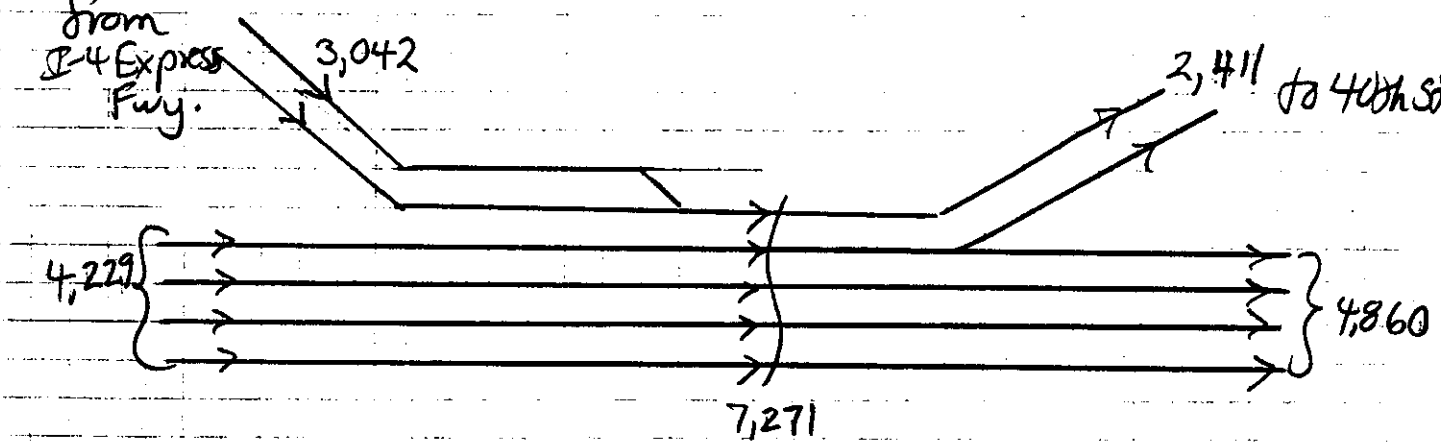
$V_l = 604/(0.95 \times 0.95) = 669$ pcph

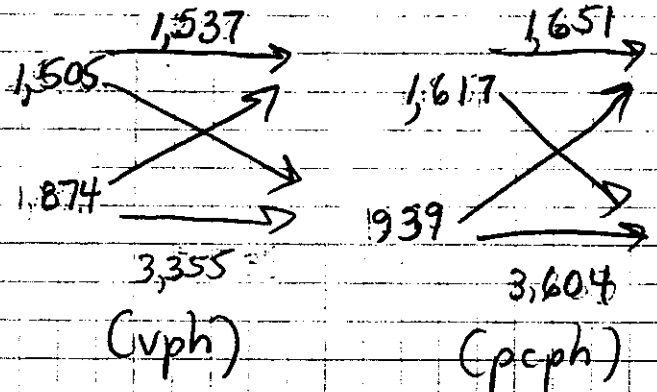
$V_r = 1,261/(0.98 \times 0.95) = 1,354$ pcph

$V_m = V_l + V_r = 669 + 1,354 = 2,023$ pcph (LOS E)

Greiner, Inc.

JOB I-4/Crosstown
DESCRIPTION Local Lanes (Eastbound) 2010 No Build
SHEET 2 OF 4 PROJ. NO. C1104.61
COMPUTED BY GSR DATE 2/21/89
CHECKED BY HQE DATE





$V_w = 1,617 + 1939 = 2,556$

$V = 1,617 + 1,651 + 939 + 3,604$

$= 7,811$

$VR = 2,556 / 7,811 = 0.327$

$N = 5$

$L = 1800'$

Type B Weave (Unconstrained)

$$S_w = 15 + \frac{50}{1 + [(0.10)(1.327)^{1.2}(7,811/5)^{0.77}/(1800)^{0.5}]}$$

$= 40.60 \text{ mph (LOS C)}$

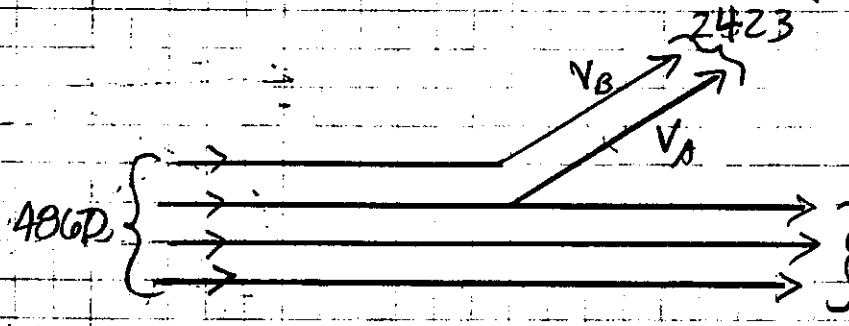
$$S_{ww} = 15 + \frac{50}{1 + [(0.02)(1.327)^{2.0}(7,811/5)^{1.42}/(1800)^{0.95}]}$$

$= 40.31 \text{ mph (LOS D)}$

Form No. GI002-87

Greiner, Inc.

JOB I-4/Crosstown Connector SHEET 3 OF 4 PROJ. NO. C1104.61
DESCRIPTION Local Lanes (Eastbound) COMPUTED BY GSR DATE 2/21/89
2010 No Build CHECKED BY HOE DATE
to 50th St.



$V_B = 1{,}505$ vph

$V_A = 2{,}423 - 1{,}505 = 918$ vph

Left side ramp adjustment
$V_3 = (1.1)(1{,}305) = 1{,}436$ vph

Using Fig. I.5-7

$V_1 = 94 + 0.231(4860 - 1{,}505) + 0.473(918) + 2 = 1{,}305$ vph

# of trucks in lane 3 $= (0.03)(918) + \left(\frac{1-0.50}{2}\right)(0.03)(2437)$
$= 46$

$P_{T_1} = 46/1{,}436 = 0.032$

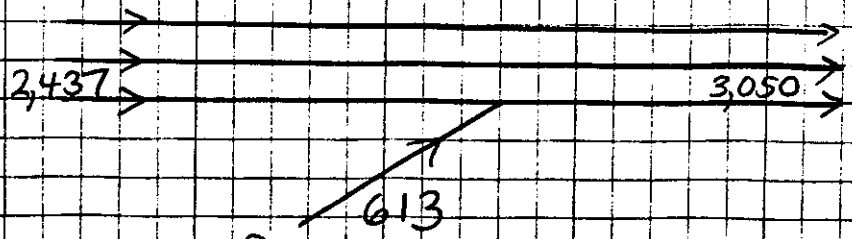
$f_{HV} = \frac{1}{1 + [(0.032)(1.7-1)]} = 0.978$

$V_{d_1} = V_1 \div (1{,}436)/(0.978 \times 0.95) = 1{,}546$ pcph (LOS C)

$V_{d_2} = V_B = 1{,}505/(0.98 \times 0.95) = 1{,}617$ pcph (LOS C)

Greiner, Inc.

JOB I-4/Crosstown Connector SHEET 4 OF 4 PROJ. NO. C1104.61
DESCRIPTION Local Lanes (Eastbound) COMPUTED BY GSR DATE 2/21/89
2010 No-Build CHECKED BY LQE DATE



Using Fig. I.5-6

$V_1 = -121 + 0.244(2,437) - 0.085(50) + 5 = 474$ vph

# of trucks in lane 1 $= (0.50)(0.03)(2,437) = 37$

$P_{T_1} = 37/474 = 0.078$

$f_{HV} = 1/[1 + (0.078)(1.7-1)] = 0.948$

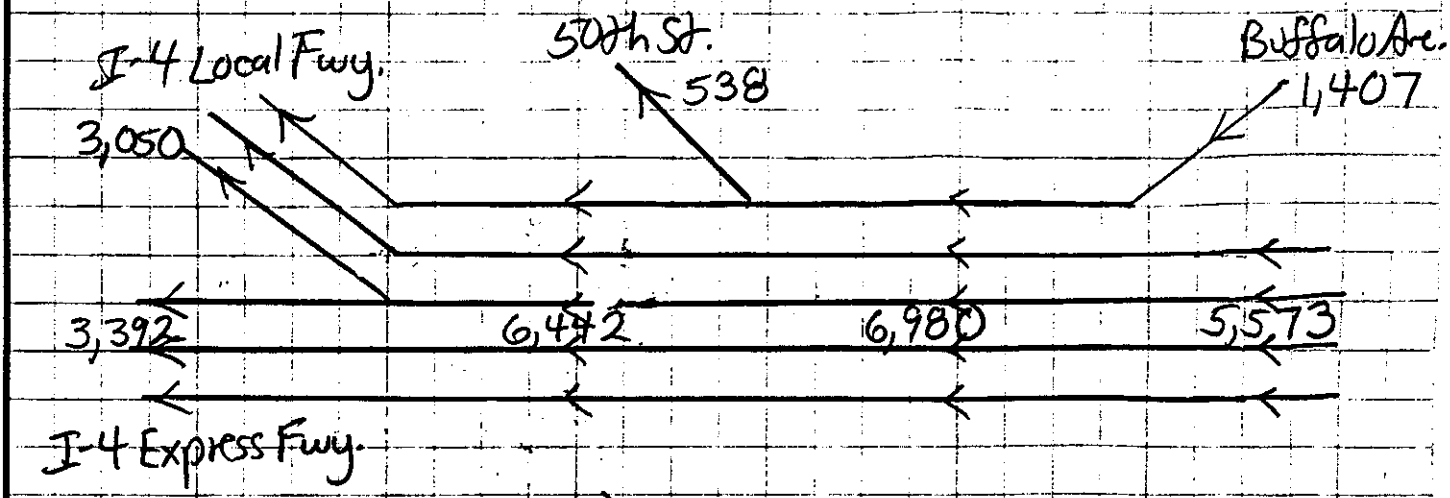
$V_1 = 474/(0.948 \times 0.95) = 526$ pcph

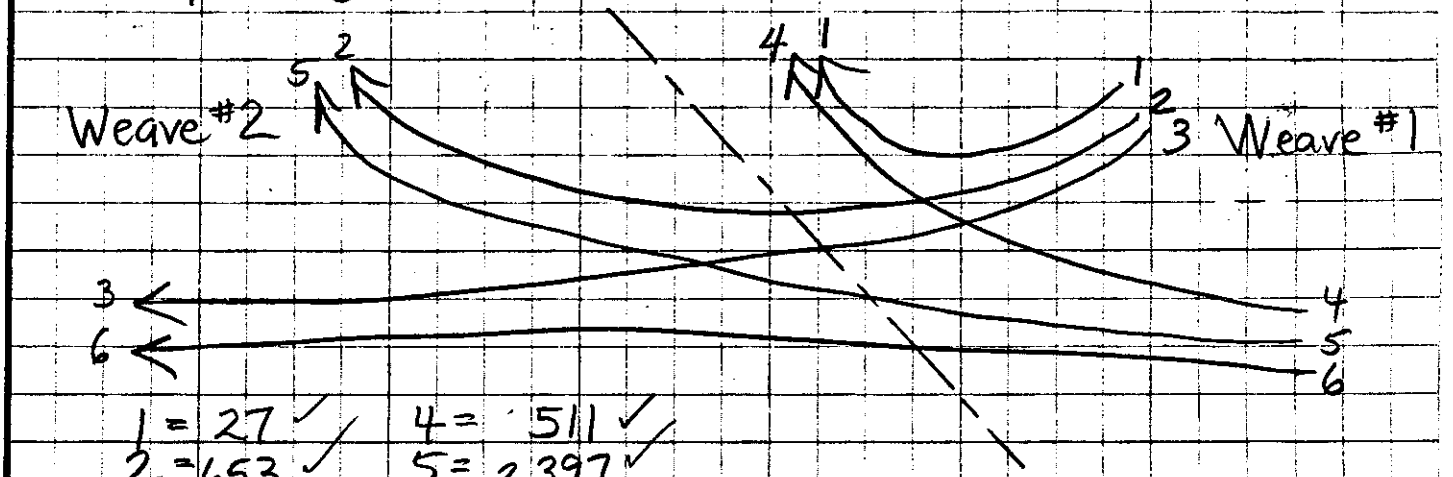
$V_r = 613/(0.98 \times 0.95) = 658$ pcph

$V_m = V_1 + V_r = 526 + 658 = 1,184$ pcph (LOS C)

Greiner, Inc.

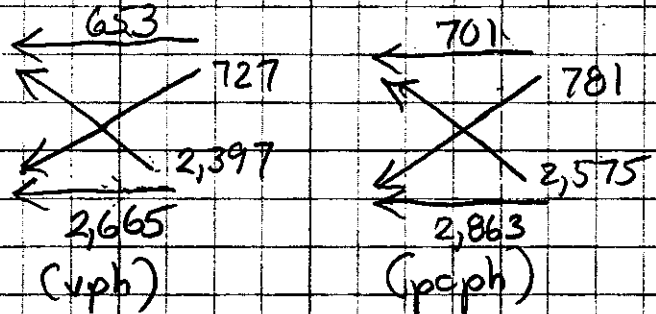
JOB I-4/CROSSTOWN CONNECTOR SHEET 1 OF 3 PROJ. NO. C1104.61
DESCRIPTION Express Lanes (Westbound) COMPUTED BY GSR DATE 4/28/09
2010 No Build CHECKED BY HJE DATE





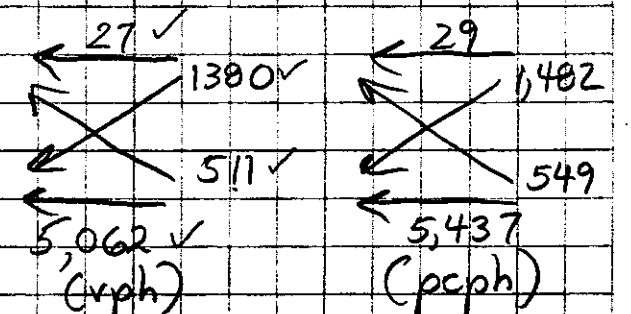
1 = 27 ✓
2 = 653 ✓
3 = 727 ✓
4 = 511 ✓
5 = 2,397 ✓
6 = 2,665 ✓

Weave #2



$V_w = 781 + 2,575 = 3,356$ pcph
$V = 701 + 781 + 2,575 + 2,863 = 6,920$ pcph
$VR = 3,356 / 6,920 = 0.485$
$N = 5$
$L = 3650'$

Weave #1



$V_w = 1,482 + 549 = 2,031$ pcph
$V = 29 + 1,482 + 549 + 5,437 = 7,497$
$VR = 2,031 / 7,497 = 0.271$
$N = 5$
$L = 2350'$

Greiner, Inc.

JOB I-4/CROSSTOWN CONNECTOR SHEET 2 OF 3 PROJ. NO. C1104.61
DESCRIPTION Express Lanes (Westbound) COMPUTED BY GSR DATE 4/28/99
2010 NoBuild CHECKED BY MJE DATE

Weave #1 (Type A Weave)

$$S_w = 15 + \frac{50}{1 + [(0.28)(1.271)^{2.2}(7{,}497/5)^{1.0}/(2{,}350)^{0.97}]} = 45.16 \text{ mph}$$

LOS C

$$S_{NW} = 15 + \frac{50}{1 + [(0.02)(1.271)^{4.0}(7{,}497/5)^{0.88}/(2{,}350)^{0.6}]} = 53.20 \text{ mph}$$

LOS C

Weave #2 (Type B Weave)

$$S_w = 15 + \frac{50}{1 + [(0.10)(1.485)^{1.2}(6{,}920/5)^{0.77}/(3{,}650)^{0.5}]} = 44.45 \text{ mph}$$

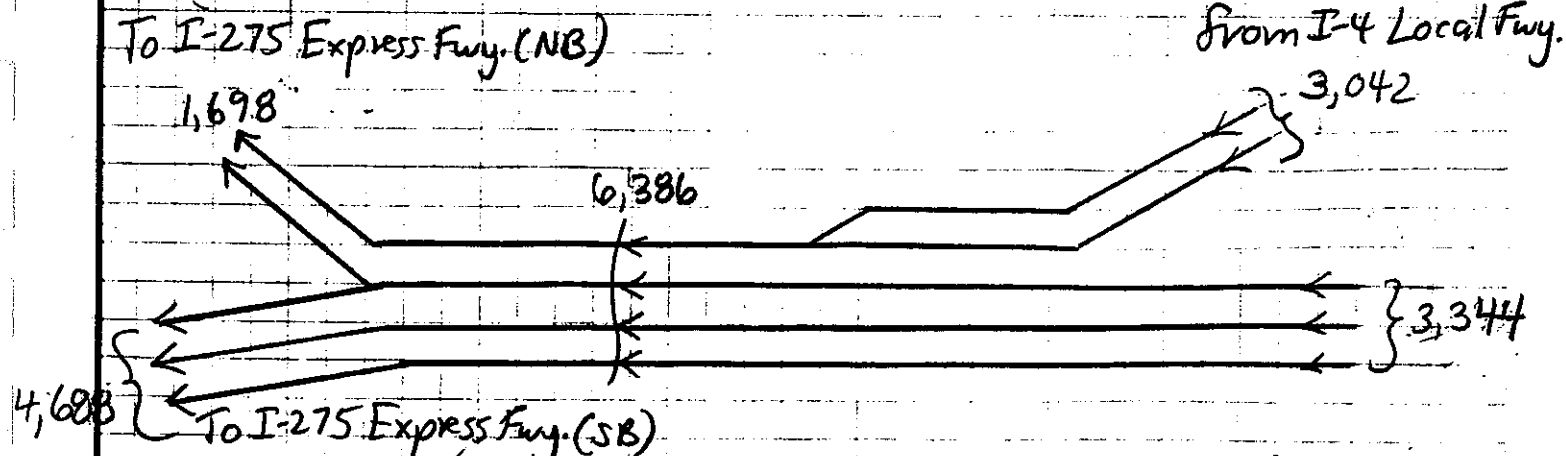
LOS D

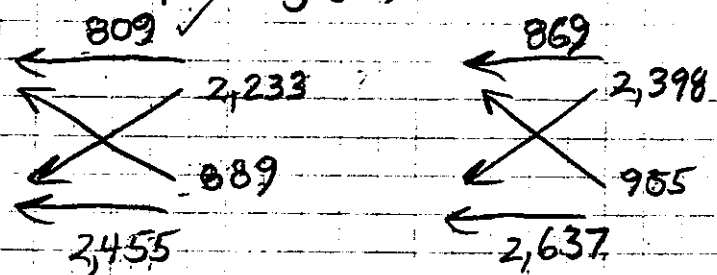
$$S_{NW} = 15 + \frac{50}{1 + [(0.02)(1.485)^{2.0}(6{,}920/5)^{1.42}/(3{,}650)^{0.95}]} = 47.77 \text{ mph}$$

LOS D

Greiner, Inc.

JOB I-4/Crosstown Connector SHEET 3 OF 3 PROJ. NO. C1104.61
DESCRIPTION Express Lanes (Westbound) COMPUTED BY GSR DATE 2/21/89
2010 No Build CHECKED BY MJE DATE





$V_w = 2,398 + 955 = 3353$ pcph

$V = 3,353 + 869 + 2,687$

$= 6,859$ pcph

$VR = 3,353/6,859 = 0.489$

$N = 4$

$L = 2,900'$

TYPE B WEAVE (UNCONSTRAINED)

$$S_w = 15 + \frac{50}{1 + [(0.10)(1.489)^{1.2}(6,859/4)^{0.77}/(2,900)^{0.5}]} = 40.96 \text{ mph (LOSD)}$$

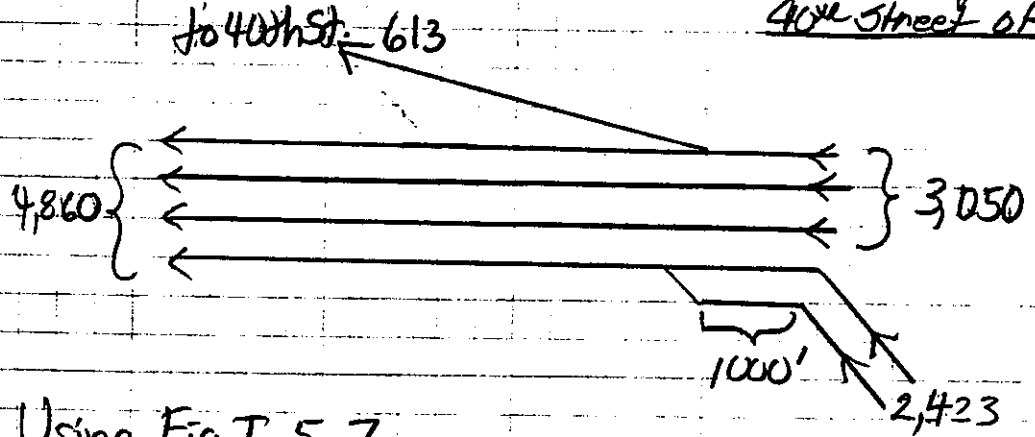
$$S_{NW} = 15 + \frac{50}{1 + [(0.02)(1.489)^{2.0}(6,859/4)^{1.42}/(2,900)^{0.95}]} = 41.43 \text{ mph (LOSE)}$$

Greiner, Inc.

JOB I-4/Crosstown Connector
DESCRIPTION Local Lanes (Westbound) 2010 No Build

SHEET 1 OF 4 PROJ. NO. C1104.61
COMPUTED BY GSR DATE 2/21/89
CHECKED BY MJE DATE 2/22/89

40th Street off-ramp



Using Fig I.5-7

$V_1 = 94 + 0.231(3,050) + 0.473(613) + 2 = 1,090$ vph

# of trucks in lane 1 = $(0.48)(0.03)(3,050) = 44$

$P_{T_1} = 44 / 1,090 = 0.040$

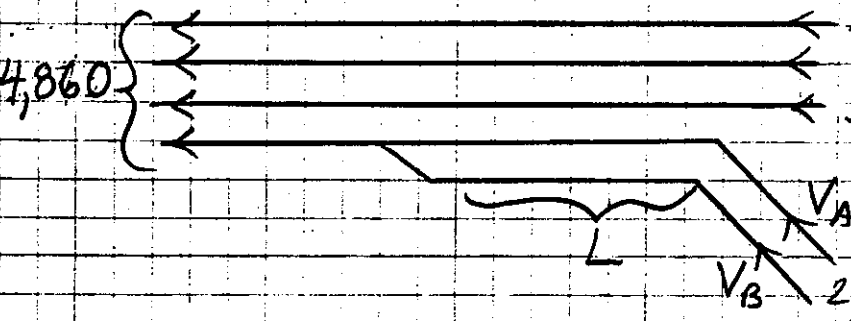
$f_{HV} = \frac{1}{1 + [(0.040)(1.7-1)]} = 0.973$

$V_d = V_1 = 1,090 / (0.973 \times 0.95) = 1,179$ pcph (LOS C)

Greiner, Inc.

JOB I-4/ Crosstown Connector SHEET 2 OF 4 PROJ. NO. C1104.61
DESCRIPTION Local Lanes (Westbound) COMPUTED BY GSR DATE 2/21/89
2010 No Build CHECKED BY MJE DATE 2/27/89

50th Street On-Ramp



Using Fig I.5-11 to determine ramp distribution

$V_1 = 54 + 0.070(2,437) + 0.049(2,423) = 343$ vph

$V_{1+A} = -205 + 0.287(2,437) + 0.575(2,423) = 1,888$ vph

$V_A = V_{1+A} - V_1 = 1,888 - 343 = 1,545$ vph

$V_B = V_r - V_A = 2,423 - 1,545 = 878$ vph

$V_{m_1} = 1,545 / (0.98 \times 0.95) = 1,660$ pcph

Length required for V_B to merge @ LOS D

$V_m(max)$ for LOS D $- V_B = 1,925(0.98)(0.95) - 878$

$= 1,914$ vph

Proportion of V_A remaining prior to V_B merge $= \frac{1,914}{1,545} = 0.59$

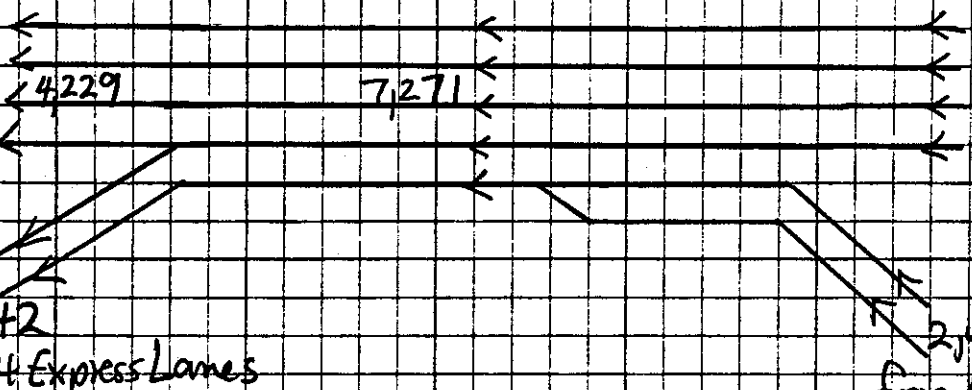
Length required to achieve 59% of $V_A \approx 1020'$

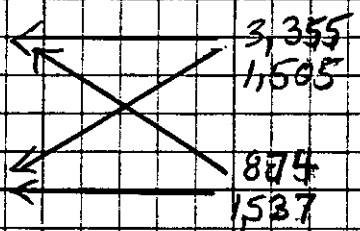
Design L for $1020' \Rightarrow$

$V_{m_2} = 1,545(0.59) + 878 = 1,790$ vph $\Rightarrow 1,923$ pcph

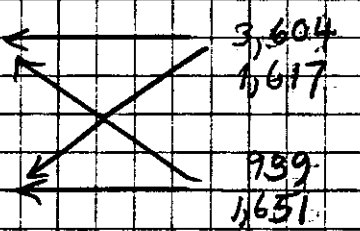
Greiner, Inc.

JOB I-4/ Crosstown Connector SHEET 3 OF 4 PROJ. NO. C1104.61
DESCRIPTION Local Lanes (Westbound) COMPUTED BY GSK DATE 2/21/89
2010 No Build CHECKED BY HJE DATE





(in vph)



(in pcph)

$V_w = 1,617 + 939 = 2,556$ pcph

$V = 3,604 + 1,617 + 939 + 1,651 = 7,811$ pcph

$VR = 2,556/7,811 = 0.327$

$N = 3$

$L = 2070'$

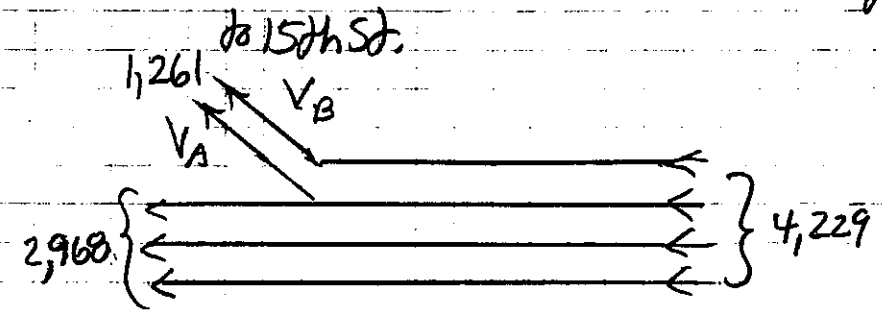
Type B Weave (unconstrained)

$$S_w = 15 + \frac{50}{1 + [(0.10)(1.327)^{1.2}(7,811/5)^{0.77}/(2,070)^{0.5}]} = 41.48 \text{ mph (LOS C)}$$

$$S_{nw} = 15 + \frac{50}{1 + [(0.02)(1.327)^{2.0}(7,811/5)^{1.42}/(2,070)^{0.95}]} = 41.96 \text{ mph (LOS D)}$$

Greiner, Inc.

JOB I-4/Crosstown Connector SHEET 4 OF 4 PROJ. NO. C1104.61
DESCRIPTION Local Lanes (Westbound) COMPUTED BY GSR DATE 2/21/89
2010 No Build CHECKED BY MJE DATE



Using Fig I.5-12 to determine ramp distribution

$V_{1+A} = -158 + 0.035(4,229) + 0.567(1,261) = 705$ vph

$V_1 = 18 + 0.060(4,229) + 0.072(1,261) = 363$ vph

$V_A = V_{1+A} - V_1 = 705 - 363 = 342$ vph

$V_B = V_r - V_A = 1,261 - 342 = 919$ vph

$V_{d_1} = 919/(0.98 \times 0.95) = 987$ pcph

Using Fig. I.5-7

$V_1 = 94 + 0.231(4,229 - 919) + 0.473(342) + 2 = 1,022$ vph

# of trucks in lane 1 $= (342)(0.03) + (0.50)(0.03)(2,968)$
$= 55$

$P_{T_1} = 55/1,022 = 0.054$

$f_{HV} = \frac{1}{1 + [(0.054)(1.7-1)]} = 0.964$

$V_{d_2} = 1,022/(0.964 \times 0.95) = 1,116$ pcph

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 W.B. ON-RAMP/14TH STREET
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/14/89
TIME.....A.M. PEAK HOUR
COMMENT.....2010 WITHOUT CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB	:	EB		WB		NB		SB	
LT	0	1828	0	0	:	12.0	L	12.0		12.0	T	12.0	
TH	0	1240	0	643	:	12.0	L	12.0		12.0	T	12.0	
RT	0	0	0	121	:	12.0	T	12.0		12.0	TR	12.0	
RR	0	0	0	0	:	12.0	T	12.0		12.0		12.0	
					:	12.0		12.0		12.0		12.0	
					:	12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR.	TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
WB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
NB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
SB	0.00	3.00	N	0	0	0.95	50	N	14.3		3

SIGNAL SETTINGS — CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT					NB	LT				
	TH						TH				
	RT						RT				
	PD						PD				
WB	LT		X			SB	LT				
	TH		X				TH		X		
	RT						RT		X		
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
WB	L	0.871	0.711	10.3	B	7.8	B
	T	0.544	0.711	4.1	A		
SB	TR	0.767	0.222	23.1	C	23.1	C

INTERSECTION: Delay = 11.0 (sec/veh) V/C = 0.846 LOS = B

SUMMARY REPORT

****

INTERSECTION..I-4 W.B. ON-RAMP/14TH STREET
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/14/89
TIME.....P.M. PEAK HOUR
COMMENT.....2010 WITHOUT CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB		EB		WB		NB		SB	
LT	0	1496	0	0	:	12.0	L	12.0		12.0	T	12.0	
TH	0	1015	0	785	:	12.0	L	12.0		12.0	T	12.0	
RT	0	0	0	99	:	12.0	T	12.0		12.0	TR	12.0	
RR	0	0	0	0	:	12.0	T	12.0		12.0		12.0	
					:	12.0		12.0		12.0		12.0	
					:	12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	11.5	3
WB	0.00	3.00	N	0	0	0.95	50	N	11.5	3
NB	0.00	3.00	N	0	0	0.95	50	N	14.5	3
SB	0.00	3.00	N	0	0	0.95	50	N	14.5	3

SIGNAL SETTINGS CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT					NB	LT				
	TH						TH				
	RT						RT				
	PD						PD				
WB	LT		X			SB	LT				
	TH		X				TH		X		
	RT						RT		X		
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
WB	L	0.760	0.667	8.8	B	7.2	B
	T	0.475	0.667	4.8	A		
SB	TR	0.734	0.267	20.7	C	20.7	C

INTERSECTION: Delay = 10.8 (sec/veh) V/C = 0.753 LOS = B

SUMMARY REPORT

****

INTERSECTION..I-4 E.B. OFF-RAMP/14TH STREET
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/17/89
TIME.....A.M. PEAK HOUR
COMMENT.....2010 WITHOUT CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY				
	EB	WB	NB	SB		EB	WB	NB		SB
LT	0	0	0	535	T	12.0	12.0	12.0	LT	12.0
TH	779	0	0	1960	TR	12.0	12.0	12.0	T	12.0
RT	335	0	0	0		12.0	12.0	12.0	T	12.0
RR	0	0	0	0		12.0	12.0	12.0		12.0
						12.0	12.0	12.0		12.0
						12.0	12.0	12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	11.5	3
WB	0.00	3.00	N	0	0	0.95	50	N	11.5	3
NB	0.00	3.00	N	0	0	0.95	50	N	8.5	3
SB	0.00	3.00	N	0	0	0.95	50	N	8.5	3

SIGNAL SETTINGS — CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT					NB	LT				
	TH		X				TH				
	RT		X				RT				
	PD						PD				
WB	LT					SB	LT		X		
	TH						TH		X		
	RT						RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	TR	0.963	0.378	28.4	D	28.4	D
SB	LT	1.010	0.556	26.0	D	26.0	D

INTERSECTION: Delay = 26.7 (sec/veh) V/C = 0.991 LOS = D

SUMMARY REPORT

****

INTERSECTION..I-4 E.B. OFF-RAMP/14TH STREET
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/17/89
TIME.....P.M. PEAK HOUR
COMMENT.....2010 WITHOUT CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY				
	EB	WB	NB	SB		EB	WB	NB		SB
LT	0	0	0	653	T	12.0	12.0	12.0	LT	12.0
TH	952	0	0	1604	TR	12.0	12.0	12.0	T	12.0
RT	409	0	0	0		12.0	12.0	12.0	T	12.0
RR	0	0	0	0		12.0	12.0	12.0		12.0
						12.0	12.0	12.0		12.0
						12.0	12.0	12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	11.5	3
WB	0.00	3.00	N	0	0	0.95	50	N	11.5	3
NB	0.00	3.00	N	0	0	0.95	50	N	8.5	3
SB	0.00	3.00	N	0	0	0.95	50	N	8.5	3

SIGNAL SETTINGS — CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT					NB	LT				
	TH	X					TH				
	RT	X					RT				
	PD						PD				
WB	LT					SB	LT		X		
	TH						TH		X		
	RT						RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	TR	1.025	0.433	37.5	D	37.5	D
SB	L	0.816	0.500	18.8	C	25.8	D
	T	1.000	0.500	28.5	D		

INTERSECTION: Delay = 30.2 (sec/veh) V/C = 1.012 LOS = D

SUMMARY REPORT

****

INTERSECTION..I-4 E.B. ON-RAMP/15TH STREET
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/17/89
TIME.....A.M. PEAK HOUR
COMMENT.....2010 WITHOUT CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY				
	EB	WB	NB	SB		EB	WB		NB	SB
LT	96	0	0	0	LT	12.0	12.0	T	12.0	12.0
TH	1218	0	812	0	T	12.0	12.0	TR	12.0	12.0
RT	0	0	1275	0	T	12.0	12.0	R	12.0	12.0
RR	0	0	0	0		12.0	12.0		12.0	12.0
						12.0	12.0		12.0	12.0
						12.0	12.0		12.0	12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	11.5	3
WB	0.00	3.00	N	0	0	0.95	50	N	11.5	3
NB	0.00	3.00	N	0	0	0.95	50	N	11.5	3
SB	0.00	3.00	N	0	0	0.95	50	N	11.5	3

SIGNAL SETTINGS — CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT				
	TH	X					TH	X			
	RT						RT	X			
	PD						PD				
WB	LT					SB	LT				
	TH						TH				
	RT						RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	LT	0.813	0.356	18.7	C	18.7	C
NB	TR	0.797	0.578	11.1	B	12.3	B
	R	0.848	0.578	14.9	B		

INTERSECTION: Delay = 14.9 (sec/veh) V/C = 0.835 LOS = B

SUMMARY REPORT

****

INTERSECTION..I-4 E.B. ON-RAMP/15TH STREET
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/17/89
TIME.....P.M. PEAK HOUR
COMMENT.....2010 WITHOUT CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY				
	EB	WB	NB	SB		EB	WB		NB	SB
LT	117	0	0	0	LT	12.0	12.0	T	12.0	12.0
TH	1488	0	664	0	T	12.0	12.0	TR	12.0	12.0
RT	0	0	1558	0	T	12.0	12.0	R	12.0	12.0
RR	0	0	0	0		12.0	12.0		12.0	12.0
						12.0	12.0		12.0	12.0
						12.0	12.0		12.0	12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	11.5	3
WB	0.00	3.00	N	0	0	0.95	50	N	11.5	3
NB	0.00	3.00	N	0	0	0.95	50	N	11.5	3
SB	0.00	3.00	N	0	0	0.95	50	N	11.5	3

SIGNAL SETTINGS — CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT				
	TH	X					TH	X			
	RT						RT	X			
	PD						PD				
WB	LT					SB	LT				
	TH						TH				
	RT						RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	LT	1.026	0.344	38.5	D	38.5	D
NB	TR	0.783	0.589	10.4	B	19.8	C
	R	1.016	0.589	35.4	D		

INTERSECTION: Delay = 27.9 (sec/veh) V/C = 1.020 LOS = D

SUMMARY REPORT

****

INTERSECTION..I-4 W.B. OFF-RAMP/15TH STREET
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/17/89
TIME.....A.M. PEAK HOUR
COMMENT.....2010 WITHOUT CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB		EB		WB		NB		SB	
LT	0	0	589	0	:	12.0	T	12.0	L	12.0		12.0	
TH	0	2479	278	0	:	12.0	T	12.0	T	12.0		12.0	
RT	0	567	0	0	:	12.0	T	12.0	T	12.0		12.0	
RR	0	0	0	0	:	12.0	R	12.0		12.0		12.0	
					:	12.0		12.0		12.0		12.0	
					:	12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR.	TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
WB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
NB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
SB	0.00	3.00	N	0	0	0.95	50	N	14.3		3

SIGNAL SETTINGS CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT					NB	LT	X			
	TH						TH	X			
	RT						RT				
	PD						PD				
WB	LT					SB	LT				
	TH	X					TH				
	RT	X					RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
WB	T	0.991	0.544	22.6	C	20.8	C
	R	0.727	0.544	11.9	B		
NB	L	0.947	0.389	36.9	D	28.6	D
	T	0.223	0.389	11.9	B		

INTERSECTION: Delay = 22.4 (sec/veh) V/C = 0.973 LOS = C

SUMMARY REPORT

****

INTERSECTION..I-4 W.B. OFF-RAMP/15TH STREET
AREA TYPE.....OTHER
ANALYST.......GSR
DATE..........4/17/89
TIME..........P.M. PEAK HOUR
COMMENT.......2010 WITHOUT CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB	:	EB		WB		NB		SB	
LT	0	0	482	0	:	12.0	T	12.0	L	12.0		12.0	
TH	0	2030	339	0	:	12.0	T	12.0	T	12.0		12.0	
RT	0	464	0	0	:	12.0	T	12.0	T	12.0		12.0	
RR	0	0	0	0	:	12.0	R	12.0		12.0		12.0	
					:	12.0		12.0		12.0		12.0	
					:	12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	14.3	3
WB	0.00	3.00	N	0	0	0.95	50	N	14.3	3
NB	0.00	3.00	N	0	0	0.95	50	N	14.3	3
SB	0.00	3.00	N	0	0	0.95	50	N	14.3	3

SIGNAL SETTINGS — CYCLE LENGTH = 90.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT					NB	LT	X			
	TH						TH	X			
	RT						RT				
	PD						PD				
WB	LT					SB	LT				
	TH		X				TH				
	RT		X				RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
WB	T	0.812	0.544	11.9	B	11.5	B
	R	0.595	0.544	9.7	B		
NB	L	0.775	0.389	22.3	C	18.0	C
	T	0.272	0.389	12.2	B		

INTERSECTION: Delay = 13.1 (sec/veh) V/C = 0.796 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 W.B. ON/OFF-RAMPS/40TH STREET
AREA TYPE.....OTHER
ANALYST.......GSR
DATE.....4/17/89
TIME.....A.M. PEAK HOUR
COMMENT.....2010 WITHOUT CROSSTOWN CONNECTOR

	VOLUMES				GEOMETRY							
	EB	WB	NB	SB	EB		WB		NB		SB	
LT	0	478	1737	0	12.0	L	12.0	L	12.0	T	12.0	
TH	0	0	1019	706	12.0	L	12.0	L	12.0	T	12.0	
RT	0	135	0	674	12.0	R	12.0	T	12.0	T	12.0	
RR	0	0	0	30	12.0		12.0	T	12.0	R	12.0	
					12.0		12.0	T	12.0	R	12.0	
					12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	28.8	3
WB	0.00	3.00	N	0	0	0.95	50	N	28.8	3
NB	0.00	3.00	N	0	0	0.95	50	N	14.3	3
SB	0.00	3.00	N	0	0	0.95	50	N	14.3	3

SIGNAL SETTINGS — CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT					NB	LT	X			
	TH						TH	X	X		
	RT						RT				
	PD						PD				
WB	LT	X				SB	LT				
	TH						TH		X		
	RT	X					RT		X		
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
WB	L	0.883	0.183	46.6	E	43.0	E
	R	0.514	0.183	29.7	D		
NB	L	1.023	0.575	41.7	E	27.1	D
	T	0.299	0.742	3.3	A		
SB	T	0.922	0.167	40.9	E	33.3	D
	R	0.764	0.350	24.6	C		

INTERSECTION: Delay = 30.9 (sec/veh) V/C = 0.977 LOS = D

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION.. I-4 W.B. ON/OFF-RAMPS/40TH STREET
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/17/89
TIME.....P.M. PEAK HOUR
COMMENT.....2010 WITHOUT CROSSTOWN CONNECTOR

	VOLUMES				GEOMETRY							
	EB	WB	NB	SB	EB		WB		NB		SB	
LT	0	391	1422	0	12.0	L	12.0	L	12.0	T	12.0	
TH	0	0	1244	578	12.0	L	12.0	L	12.0	T	12.0	
RT	0	111	0	552	12.0	R	12.0	T	12.0	T	12.0	
RR	0	0	0	30	12.0		12.0	T	12.0	R	12.0	
					12.0		12.0	T	12.0	R	12.0	
					12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR.	TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	28.8		3
WB	0.00	3.00	N	0	0	0.95	50	N	28.8		3
NB	0.00	3.00	N	0	0	0.95	50	N	14.3		3
SB	0.00	3.00	N	0	0	0.95	50	N	14.3		3

SIGNAL SETTINGS — CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT					NB	LT	X			
	TH						TH	X	X		
	RT						RT				
	PD						PD				
WB	LT	X				SB	LT				
	TH						TH		X		
	RT	X					RT		X		
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
WB	L	0.636	0.208	34.3	D	32.7	D
	R	0.372	0.208	26.6	D		
NB	L	0.932	0.517	27.8	D	16.6	C
	T	0.378	0.717	4.3	A		
SB	T	0.629	0.200	29.1	D	23.8	C
	R	0.531	0.408	17.7	C		

INTERSECTION: Delay = 20.3 (sec/veh) V/C = 0.800 LOS = C

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 E.B. ON/OFF-RAMPS/40TH STREET
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/17/89
TIME.....A.M. PEAK HOUR
COMMENT.....2010 WITHOUT CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB		EB		WB		NB		SB	
LT	552	0	0	111	: L	12.0		12.0	T	12.0	L	12.0	
TH	0	0	1890	1048	: L	12.0		12.0	T	12.0	T	12.0	
RT	1422	0	391	0	: R	12.0		12.0	T	12.0	T	12.0	
RR	40	0	0	0	: R	12.0		12.0	R	12.0	T	12.0	
					:	12.0		12.0		12.0		12.0	
					:	12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	26.5	3
WB	0.00	3.00	N	0	0	0.95	50	N	26.5	3
NB	0.00	3.00	N	0	0	0.95	50	N	11.5	3
SB	0.00	3.00	N	0	0	0.95	50	N	11.5	3

SIGNAL SETTINGS — CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT				
	TH						TH		X		
	RT	X					RT		X		
	PD						PD				
WB	LT					SB	LT	X			
	TH						TH	X	X		
	RT						RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.477	0.392	21.0	C	34.0	D
	R	1.029	0.558	39.2	D		
NB	T	1.008	0.408	37.1	D	34.4	D
	R	0.669	0.408	20.3	C		
SB	L	0.555	0.125	39.9	D	13.5	B
	T	0.428	0.533	11.0	B		

INTERSECTION: Delay = 29.7 (sec/veh) V/C = ~~1.141~~ 0.721 LOS = D

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 E.B. ON/OFF-RAMPS/40TH STREET
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/17/89
TIME.....P.M. PEAK HOUR
COMMENT.....2010 WITHOUT CROSSTOWN CONNECTOR

	VOLUMES				:	GEOMETRY					
	EB	WB	NB	SB	:	EB	WB		NB		SB
LT	674	0	0	135	: L	12.0	12.0	T	12.0	L	12.0
TH	0	0	2308	858	: L	12.0	12.0	T	12.0	T	12.0
RT	1737	0	478	0	: R	12.0	12.0	T	12.0	T	12.0
RR	60	0	0	0	: R	12.0	12.0	R	12.0	T	12.0
					:	12.0	12.0		12.0		12.0
					:	12.0	12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	26.5	3
WB	0.00	3.00	N	0	0	0.95	50	N	26.5	3
NB	0.00	3.00	N	0	0	0.95	50	N	11.5	3
SB	0.00	3.00	N	0	0	0.95	50	N	11.5	3

SIGNAL SETTINGS — CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT				
	TH						TH		X		
	RT	X					RT		X		
	PD						PD				
WB	LT					SB	LT	X			
	TH						TH	X	X		
	RT						RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.783	0.292	32.7	D	37.0	D
	R	1.046	0.667	38.8	D		
NB	T	1.022	0.492	36.1	D	33.0	D
	R	0.679	0.492	16.5	C		
SB	L	0.596	0.142	39.6	D	10.6	B
	T	0.295	0.633	6.4	B		

INTERSECTION: Delay = 30.8 (sec/veh) V/C = ~~1.288~~ 0.861 LOS = D

85 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

INTERSECTION..I-4 W.B. ON-RAMP/COLUMBUS DRIVE
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/17/89
TIME.....A.M. PEAK HOUR
COMMENT.....2010 WITHOUT CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB		EB		WB		NB		SB	
LT	0	5	1553	0	:	12.0	LT	12.0	L	12.0	T	12.0	
TH	0	850	268	472	:	12.0	T	12.0	L	12.0	TR	12.0	
RT	0	0	0	20	:	12.0		12.0	T	12.0	R	12.0	
RR	0	0	0	0	:	12.0		12.0		12.0		12.0	
					:	12.0		12.0		12.0		12.0	
					:	12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	25.8	3
WB	0.00	3.00	N	0	0	0.95	50	N	25.8	3
NB	0.00	3.00	N	0	0	0.95	50	N	11.3	3
SB	0.00	3.00	N	0	0	0.95	50	N	11.3	3

SIGNAL SETTINGS — CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT					NB	LT	X			
	TH						TH	X			
	RT						RT				
	PD						PD				
WB	LT		X			SB	LT				
	TH		X				TH		X		
	RT						RT		X		
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
WB	LT	0.941	0.283	37.2	D	37.2	D
NB	L	1.108	0.475	81.6	F	71.9	F
	T	0.335	0.475	12.8	B		
SB	TR	0.883	0.167	40.4	E	39.8	D
	R	0.084	0.167	27.3	D		

INTERSECTION: Delay = 57.5 (sec/veh) V/C = 1.016 LOS = E

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 W.B. ON-RAMP/COLUMBUS DRIVE
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/17/89
TIME.....P.M. PEAK HOUR
COMMENT.....2010 WITHOUT CROSSTOWN CONNECTOR

	VOLUMES				GEOMETRY							
	EB	WB	NB	SB	EB		WB		NB		SB	
LT	0	5	1271	0	12.0	LT	12.0	L	12.0	T	12.0	
TH	0	696	219	576	12.0	T	12.0	L	12.0	TR	12.0	
RT	0	0	0	16	12.0		12.0	T	12.0	R	12.0	
RR	0	0	0	0	12.0		12.0		12.0		12.0	
					12.0		12.0		12.0		12.0	
					12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	25.8	3
WB	0.00	3.00	N	0	0	0.95	50	N	25.8	3
NB	0.00	3.00	N	0	0	0.95	50	N	11.3	3
SB	0.00	3.00	N	0	0	0.95	50	N	11.3	3

SIGNAL SETTINGS — CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT					NB	LT	X			
	TH						TH	X			
	RT						RT				
	PD						PD				
WB	LT	X				SB	LT				
	TH	X					TH		X		
	RT						RT		X		
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
WB	LT	0.847	0.258	31.8	D	31.8	D
NB	L	0.957	0.450	35.0	D	31.9	D
	T	0.289	0.450	13.5	B		
SB	TR	0.829	0.217	33.5	D	35.6	D
	R	0.052	0.217	24.1	C		

INTERSECTION: Delay = 28.8 (sec/veh) V/C = 0.896 LOS = D

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..I-4 E.B. OFF-RAMP/COLUMBUS DRIVE
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/17/89
TIME.....A.M. PEAK HOUR
COMMENT.....2010 WITHOUT CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB		EB		WB		NB		SB	
LT	16	0	0	120	LT	12.0		12.0	T	12.0	L	12.0	
TH	696	0	1801	352	T	12.0		12.0	T	12.0	T	12.0	
RT	1271	0	5	0	R	12.0		12.0	TR	12.0	T	12.0	
RR	30	0	0	0	R	12.0		12.0		12.0		12.0	
						12.0		12.0		12.0		12.0	
						12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	25.8	3
WB	0.00	3.00	N	0	0	0.95	50	N	25.8	3
NB	0.00	3.00	N	0	0	0.95	50	N	17.3	3
SB	0.00	3.00	N	0	0	0.95	50	N	17.3	3

SIGNAL SETTINGS — CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT				
	TH	X					TH	X			
	RT	X					RT	X			
	PD						PD				
WB	LT					SB	LT		X		
	TH						TH		X		
	RT						RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	LT	0.763	0.292	27.1	D	15.3	C
	R	0.745	0.692	8.6	B		
NB	TR	0.983	0.400	33.0	D	33.0	D
SB	L	0.321	0.233	29.1	D	26.7	D
	T	0.470	0.233	25.9	D		

INTERSECTION: Delay = 24.3 (sec/veh) V/C = ~~1.101~~ 0.785 LOS = C

5 HCM: SIGNALIZED INTERSECTIONS
MARY REPORT
****
ERSECTION..I-4 E.B. OFF-RAMP/COLUMBUS DRIVE
A TYPE.....OTHER
NALYST.....GSR
ATE.....4/17/89
E.....P.M. PEAK HOUR
MENT.....2010 WITHOUT CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY					
	EB	WB	NB	SB		EB	WB	NB		SB	
T	20	0	0	146	LT	12.0	12.0	T	12.0	L	12.0
H	850	0	1474	430	T	12.0	12.0	T	12.0	T	12.0
T	1553	0	5	0	R	12.0	12.0	TR	12.0	T	12.0
R	30	0	0	0	R	12.0	12.0		12.0		12.0
						12.0	12.0		12.0		12.0
						12.0	12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR.	TYPE
B	0.00	3.00	N	0	0	0.95	50	N	25.8		3
E	0.00	3.00	N	0	0	0.95	50	N	25.8		3
E	0.00	3.00	N	0	0	0.95	50	N	17.3		3
B	0.00	3.00	N	0	0	0.95	50	N	17.3		3

SIGNAL SETTINGS — CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
B	LT	X				NB	LT				
	TH	X					TH	X			
	RT	X					RT	X			
	PD						PD				
B	LT					SB	LT		X		
	TH						TH		X		
	RT						RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
B	LT	0.859	0.317	29.0	D	23.8	C
	R	0.961	0.658	20.8	C		
B	TR	0.942	0.342	31.3	D	31.3	D
B	L	0.342	0.267	27.2	D	25.1	D
	T	0.503	0.267	24.4	C		

NTERSECTION: Delay = 26.6 (sec/veh) V/C = ~~1.398~~ 0.787 LOS = D

SUMMARY REPORT

****

INTERSECTION..I-4 E.B. ON-RAMP/50TH STREET(U.S. 41)
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/17/89
TIME.....A.M. PEAK HOUR
COMMENT.....2010 WITHOUT CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB		EB		WB		NB		SB	
LT	696	0	0	112	L	12.0		12.0	T	12.0	L	12.0	
TH	120	0	1853	2337	L	12.0		12.0	T	12.0	T	12.0	
RT	0	0	208	0	TR	12.0		12.0	T	12.0	T	12.0	
RR	0	0	0	0		12.0		12.0	R	12.0	T	12.0	
						12.0		12.0		12.0		12.0	
						12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	31.8	3
WB	0.00	3.00	N	0	0	0.95	50	N	31.8	3
NB	0.00	3.00	N	0	0	0.95	50	N	14.3	3
SB	0.00	3.00	N	0	0	0.95	50	N	14.3	3

SIGNAL SETTINGS — CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT				
	TH	X					TH		X		
	RT	X					RT		X		
	PD						PD				
WB	LT					SB	LT	X			
	TH						TH	X	X		
	RT						RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.808	0.292	33.6	D	31.9	D
	TR	0.244	0.292	21.0	C		
NB	T	0.968	0.417	30.0	D	28.7	D
	R	0.349	0.417	15.6	C		
SB	L	0.323	0.217	30.3	D	12.3	B
	T	0.803	0.633	11.5	B		

INTERSECTION: Delay = 21.5 (sec/veh) V/C = 0.805 LOS = C

SUMMARY REPORT

****

INTERSECTION..I-4 E.B. ON-RAMP/50TH STREET(U.S. 41)
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/17/89
TIME.....P.M.PEAK HOUR
COMMENT.....2010 WITHOUT CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB		EB		WB		NB		SB	
LT	850	0	0	137	L	12.0		12.0	T	12.0	L	12.0	
TH	146	0	2264	1913	L	12.0		12.0	T	12.0	T	12.0	
RT	0	0	255	0	TR	12.0		12.0	T	12.0	T	12.0	
RR	0	0	0	0		12.0		12.0	R	12.0	T	12.0	
						12.0		12.0		12.0		12.0	
						12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	26.5	3
WB	0.00	3.00	N	0	0	0.95	50	N	26.5	3
NB	0.00	3.00	N	0	0	0.95	50	N	11.5	3
SB	0.00	3.00	N	0	0	0.95	50	N	11.5	3

SIGNAL SETTINGS — CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT				
	TH	X					TH		X		
	RT	X					RT		X		
	PD						PD				
WB	LT					SB	LT	X			
	TH						TH	X	X		
	RT						RT				
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.909	0.317	38.3	D	35.7	D
	TR	0.274	0.317	19.9	C		
NB	T	1.020	0.483	36.0	D	33.8	D
	R	0.369	0.483	12.7	B		
SB	L	0.571	0.150	38.3	D	11.0	B
	T	0.658	0.633	9.2	B		

INTERSECTION: Delay = 25.6 (sec/veh) V/C = 0.937 LOS = D

SUMMARY REPORT

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INTERSECTION..I-4 W.B. OFF-RAMP/50TH STREET(U.S. 41)
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/17/89
TIME.....A.M. PEAK PERIOD
COMMENT.....2010 WITHOUT CROSSTOWN CONNECTOR

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB		EB		WB		NB		SB	
LT	0	255	182	0	:	12.0	L	12.0	L	12.0	T	12.0	
TH	0	146	2401	2219	:	12.0	LT	12.0	T	12.0	T	12.0	
RT	0	137	0	850	:	12.0	R	12.0	T	12.0	TR	12.0	
RR	0	20	0	0	:	12.0		12.0	T	12.0	R	12.0	
					:	12.0		12.0		12.0		12.0	
					:	12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	31.8	3
WB	0.00	3.00	N	0	0	0.95	50	N	31.8	3
NB	0.00	3.00	N	0	0	0.95	50	N	14.3	3
SB	0.00	3.00	N	0	0	0.95	50	N	14.3	3

SIGNAL SETTINGS — CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT					NB	LT	X			
	TH						TH	X	X		
	RT						RT				
	PD						PD				
WB	LT	X				SB	LT				
	TH	X					TH		X		
	RT	X					RT		X		
	PD						PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
WB	L	0.688	0.208	37.2	D	31.8	D
	LT	0.500	0.208	27.9	D		
	R	0.392	0.208	26.8	D		
NB	L	0.620	0.183	37.0	D	8.9	B
	T	0.729	0.717	7.0	B		
SB	TR	0.945	0.533	21.9	C	25.9	D
	R	1.002	0.533	39.4	D		

INTERSECTION: Delay = 19.1 (sec/veh) V/C = 0.823 LOS = C

SUMMARY REPORT

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INTERSECTION..I-4 W.B. OFF-RAMP/50TH STREET(U.S. 41)
AREA TYPE.....OTHER
ANALYST.....GSR
DATE.....4/17/89
TIME.....P.M. PEAK HOUR
COMMENT.....2010 WITHOUT CROSSTOWN CONNECTOR

	VOLUMES				GEOMETRY							
	EB	WB	NB	SB	EB		WB		NB		SB	
LT	0	208	149	0	12.0	L	12.0	L	12.0	T	12.0	
TH	0	120	2933	1817	12.0	LT	12.0	T	12.0	T	12.0	
RT	0	112	0	696	12.0	R	12.0	T	12.0	TR	12.0	
RR	0	20	0	0	12.0		12.0	T	12.0	R	12.0	
					12.0		12.0		12.0		12.0	
					12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	3.00	N	0	0	0.95	50	N	31.8	3
WB	0.00	3.00	N	0	0	0.95	50	N	31.8	3
NB	0.00	3.00	N	0	0	0.95	50	N	14.3	3
SB	0.00	3.00	N	0	0	0.95	50	N	14.3	3

SIGNAL SETTINGS — CYCLE LENGTH = 120.0

		PH-1	PH-2	PH-3	PH-4
EB	LT				
	TH				
	RT				
	PD				
WB	LT	X			
	TH	X			
	RT	X			
	PD				
NB	LT	X			
	TH	X	X		
	RT				
	PD				
SB	LT				
	TH		X		
	RT		X		
	PD				

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
WB	L	0.610	0.192	36.1	D	31.6	D
	LT	0.446	0.192	28.3	D		
	R	0.335	0.192	27.3	D		
NB	L	0.414	0.225	30.6	D	10.0	B
	T	0.871	0.733	9.1	B		
SB	TR	0.812	0.508	17.2	C	18.4	C
	R	0.861	0.508	22.6	C		

INTERSECTION: Delay = 14.9 (sec/veh) V/C = 0.817 LOS = B