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Technical Memo

To: Steve Gramm	
From: HDR	Project: I-190 Study Phase 1 Amendment
CC:	
Date: 12/10/2010	Job No:

RE: Additional analysis

This technical memorandum documents the additional analysis authorized under work order PD-02-09, agreement 410445. The work is presented to correspond with the task items in the amendment scope of services and is intended to facilitate discussion and decision-making.

Task 1: Data Gathering

Travel time runs were conducted on four routes to help validate forecast model output and provide a basis for mobility analysis. The four routes are:

- I-190, Omaha Street to I-90
- Omaha Street, I-190 to 5th Street
- Haines Avenue/5th Street, Omaha Street to Disk Drive
- I-90, from Exit 55 (Deadwood Ave.) to Exit 58 (Haines Ave.)

Travel time data is summarized in Table 1.

TABLE 1 - TRAVEL TIME SUMMARY

ROUTE	DIRECTION	TIME PERIOD	AVERAGE TRAVEL TIME (MINUTES:SECONDS)	AVERAGE SPEED (MPH)
I-190	NB	AM	2:27	50.4
	SB	AM	2:11	50.8
	NB	PM	2:24	51.5
	SB	PM	2:08	52.1
OMAHA ST.	EB	AM	1:04	27.4
	WB	AM	1:25	20.6
	EB	PM	1:19	22.2
	WB	PM	1:45	16.8
HAINES/5TH	NB	AM	3:45	31.8
	SB	AM	5:10	23.1
	NB	PM	4:51	24.6
	SB	PM	5:46	20.7
I-90	EB	AM	2:42	67.3
	WB	AM	2:50	64.5
	EB	PM	2:41	67.7
	WB	PM	2:51	64.2

Task 2: Traffic Forecasting

Traffic was forecasted for 2035 conditions, using output from the regional model provided by the City of Rapid City. Additional mobility statistics were also supplied from regional model output. The forecasts were prepared for four alternatives:

- Alternative 1: I-190/US-16 route with interchange at Silver Street
- Alternative 2: US-16 route with interchange at Silver Street and connection to Mall Drive
- Alternative 3: US-16 route with at-grade intersection at Silver Street
- Alternative 4: US-16 route with at-grade intersection at Silver Street and connection to Mall Drive

Forecast link volumes for the AM and PM peak periods are shown in Figures 1 through 8.

Task 3: Analyze Operations

Operations analysis was conducted for the four forecast scenarios under 2035 AM and PM peak traffic conditions. The results of the interstate operations analysis are shown in Tables 2 and 3. The results of the surface streets operations analysis are shown in Figures 9 through 16.

TABLE 2 - INTERSTATE MAINLINE LEVEL OF SERVICE (2035)

			ALT. 1		ALT. 2		ALT. 3		ALT. 4	
ROUTE	FROM	TO	AM	PM	AM	PM	AM	PM	AM	PM
I-190 NB	OMAHA ST.	SILVER OFF	B	B						
	SILVER OFF	SILVER ON	B	B						
	SILVER ON	I-90	B	B						
I-190 SB	I-90	SILVER OFF	B	B						
	SILVER OFF	SILVER ON	A	B						
	SILVER ST.	OMAHA ST.	B	B						
I-90 EB	DEADWOOD ON	I-190 OFF	C	C	C	C	C	C	C	C
	I-190 OFF	I-190 ON	B	C	B	C	B	C	B	C
	I-190 ON	HAINES OFF	B	C	B	C	B	C	B	C
	HAINES OFF	HAINES ON	C	C	C	C	C	C	C	C
	HAINES ON	LACROSSE OFF	C	C	C	C	C	C	C	C
I-90 WB	LACROSSE ON	HAINES OFF	C	C	C	C	C	C	C	C
	HAINES OFF	HAINES ON	C	C	C	C	C	C	C	C
	HAINES ON	I-190 OFF	B	B	B	B	B	B	B	B
	I-190 OFF	I-190 ON	B	C	B	C	B	C	B	C
	I-190 ON	DEADWOOD OFF	C	C	C	C	C	C	C	C

The intersection of Haines Avenue/Disk Drive is of particular concern due to the potential for increased trips through the intersection with a new connection between I-190/US 16 and Disk Drive. While there are additional trips through the intersection under all four future scenarios, many of the trips associated with a new Disk Drive connection pass through the Haines Avenue/Disk Drive intersection as through trips. Analysis indicates that the intersection will continue to operate acceptably with the existing lane configuration. See Figures 9-16 for intersection traffic volumes and levels of service.

The I-190-US 16/Omaha intersection operates of level of service D under some future scenarios. Analysis indicates and adding a through lane to the north and south approaches will bring the level of service to C.

TABLE 3 - INTERSTATE RAMP LEVEL OF SERVICE (2035)

		ALT. 1		ALT. 2		ALT. 3		ALT. 4	
ROUTE	RAMP	AM	PM	AM	PM	AM	PM	AM	PM
I-190	NB SILVER OFF	A	A	A	A				
	NB SILVER ON	A	A	A	A				
	NB I-190 OFF	A	A	A	A				
	SB I-190 ON	A	A						
	SB SILVER OFF	A	A						
	SB SILVER ON	A	B	A	B				
I-90	EB I-190 OFF	B	C	B	C	B	C	B	C
	EB I-190 ON	B	C	C	C	B	C	C	C
	EB HAINES OFF	B	C	B	C	B	C	B	C
	EB HAINES ON	B	C	B	C	B	C	B	C
	WB HAINES OFF	B	B	B	B	B	B	B	B
	WB HAINES ON	C	C	C	C	C	C	C	C
	WB I-190 OFF	A	A	B	C	A	A	B	C
	WB I-190 ON	A	A	B	B	A	A	B	B
	WB I-190 TO HAINES WEAVE	C	D	C	D	C	D	C	D

Task 4: Estimate Mobility

Summary statistics from the regional traffic forecasting model were examined to determine which of the alternatives may provide the best overall mobility. The model-produced statistics were adjusted to produce an estimated comparison of total network delay, shown in Table 4. The comparison shows that the alternative with an interchange at Silver Street and a connection to Disk Drive provides the lowest overall delay. It should be noted, however, that the variance between the results of the four alternatives is less than 1%, a small difference that may not be significant in relation to the precision possible in traffic forecasting.

Future travel times were also estimated for various routes through the study area under each scenario. The travel times are shown in Table 5.

TABLE 4 - TOTAL NETWORK DELAY ESTIMATE

SCENARIO	TOTAL NETWORK DELAY (HOURS)
SILVER ST. INTERCHANGE	13,083
SILVER ST. INTERCHANGE WITH DISK DRIVE CONNECTION	12,999
SILVER ST. INTERSECTION	13,075
SILVER ST. INTERSECTION WITH DISK DRIVE CONNECTION	13,004

TABLE 5 - TRAVEL TIME COMPARISON

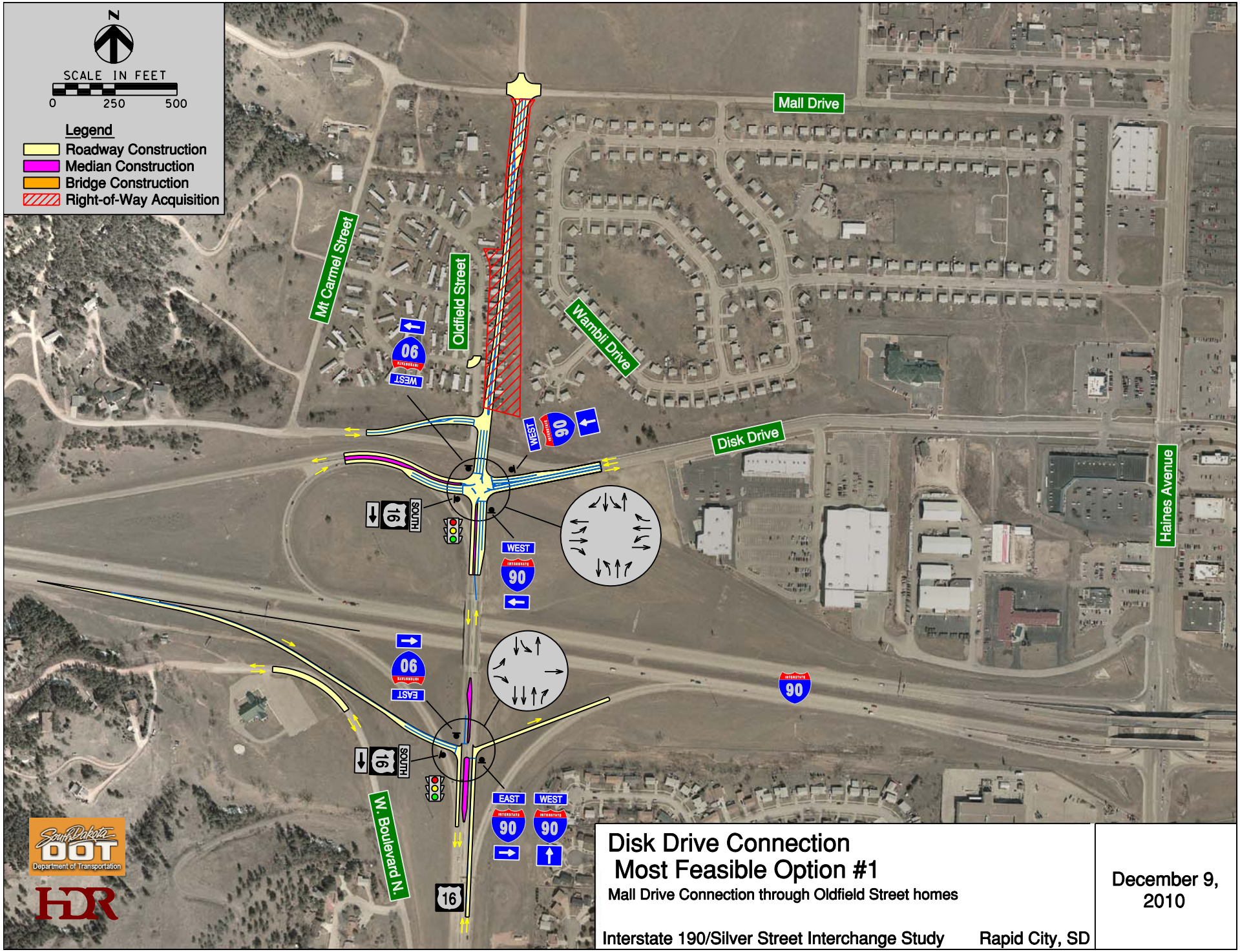
ESTIMATED 2035 PM TRAVEL TIMES

SCENARIO				TRAVEL TIME PER SYSTEM INTERCHANGE OPTION (MINUTES)		
ORIGIN	DESTINATION	ROUTE	SILVER STREET	NO BUILD	OPTION 3C	OPTION 6
OMAHA ST. & WEST BLVD.	HAINES AVE. & DISK DR.	I-190/US 16 TO I-90 TO HAINES AVE. TO DISK DR.	INTERCHANGE	3.40	N/A	N/A
OMAHA ST. & WEST BLVD.	HAINES AVE. & DISK DR.	I-190/US 16 TO I-90 TO HAINES AVE. TO DISK DR.	INTERSECTION	3.95	4.06	5.24
OMAHA ST. & WEST BLVD.	HAINES AVE. & DISK DR.	I-190/US 16 TO DISK DR. TO HAINES AVE.	INTERSECTION	N/A	3.43	3.48
OMAHA ST. & WEST BLVD.	I-90 @ DEADWOOD AVE.	I-190/US 16 TO I-90 TO DEADWOOD AVE.	INTERCHANGE	4.19	N/A	N/A
OMAHA ST. & WEST BLVD.	I-90 @ DEADWOOD AVE.	I-190/US 16 TO I-90 TO DEADWOOD AVE.	INTERSECTION	4.74	5.23	5.29
HAINES AVE. & DISK DR.	OMAHA ST. & WEST BLVD.	HAINES AVE. TO I-90 TO I-190/US 16 TO OMAHA ST.	INTERCHANGE	3.26	N/A	N/A
HAINES AVE. & DISK DR.	OMAHA ST. & WEST BLVD.	HAINES AVE. TO I-90 TO I-190/US 16 TO OMAHA ST.	INTERSECTION	3.55	3.79	4.16
HAINES AVE. & DISK DR.	OMAHA ST. & WEST BLVD.	DISK DR. TO I-190/US 16 TO OMAHA ST.	INTERSECTION	N/A	5.53	5.90
I-90 @ DEADWOOD AVE.	OMAHA ST. & WEST BLVD.	I-90 TO I-190/US 16 TO OMAHA ST.	INTERCHANGE	3.77	N/A	N/A
I-90 @ DEADWOOD AVE.	OMAHA ST. & WEST BLVD.	I-90 TO I-190/US 16 TO OMAHA ST.	INTERSECTION	4.06	4.65	4.29
I-90 @ DEADWOOD AVE.	HAINES AVE. & DISK DR.	I-90 TO HAINES AVE. TO DISK DR.	INTERCHANGE	3.86	N/A	N/A
I-90 @ DEADWOOD AVE.	HAINES AVE. & DISK DR.	I-90 TO HAINES AVE. TO DISK DR.	INTERSECTION	3.86	3.86	3.86
I-90 @ DEADWOOD AVE.	HAINES AVE. & DISK DR.	I-90 TO I-190/US 16 TO DISK DR. TO HAINES AVE.	INTERSECTION	N/A	4.47	4.00
HAINES AVE. & DISK DR.	I-90 @ DEADWOOD AVE.	HAINES AVE. TO I-90 TO DEADWOOD AVE.	INTERCHANGE	3.10	N/A	N/A
HAINES AVE. & DISK DR.	I-90 @ DEADWOOD AVE.	HAINES AVE. TO I-90 TO DEADWOOD AVE.	INTERSECTION	3.10	3.10	3.10
HAINES AVE. & DISK DR.	I-90 @ DEADWOOD AVE.	DISK DR. TO I-190/US 16 TO I-90 TO DEADWOOD AVE.	INTERSECTION	N/A	3.49	3.49

Task 5: Develop Concept Drawing/Estimate

Two concept drawings were created for conversion of the I-90/I-190 system interchange into a full-movement service interchange. The first concept involves converting the existing I-90/I-190 interchange into a service interchange with one loop quadrant. The second concept is similar to the first, but includes a second loop quadrant. The concept drawings are shown in Figures 17 and 18.

Planning-level cost estimates were prepared for each of the concepts. The estimates are provided in Figures 19 and 20.

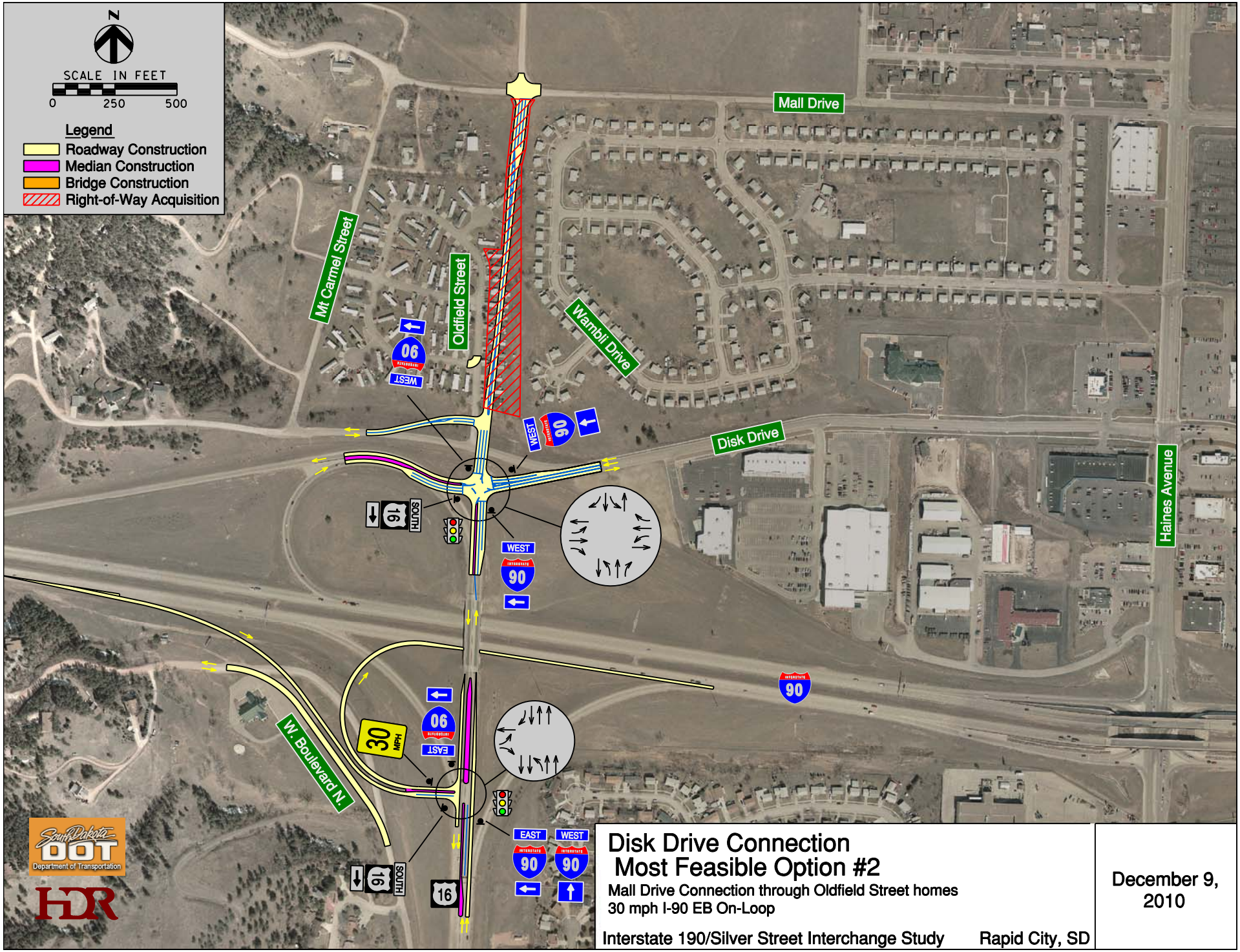


Disk Drive Connection
Most Feasible Option #1

Mall Drive Connection through Oldfield Street homes

Interstate 190/Silver Street Interchange Study — Rapid City, SD

December 9, 2010

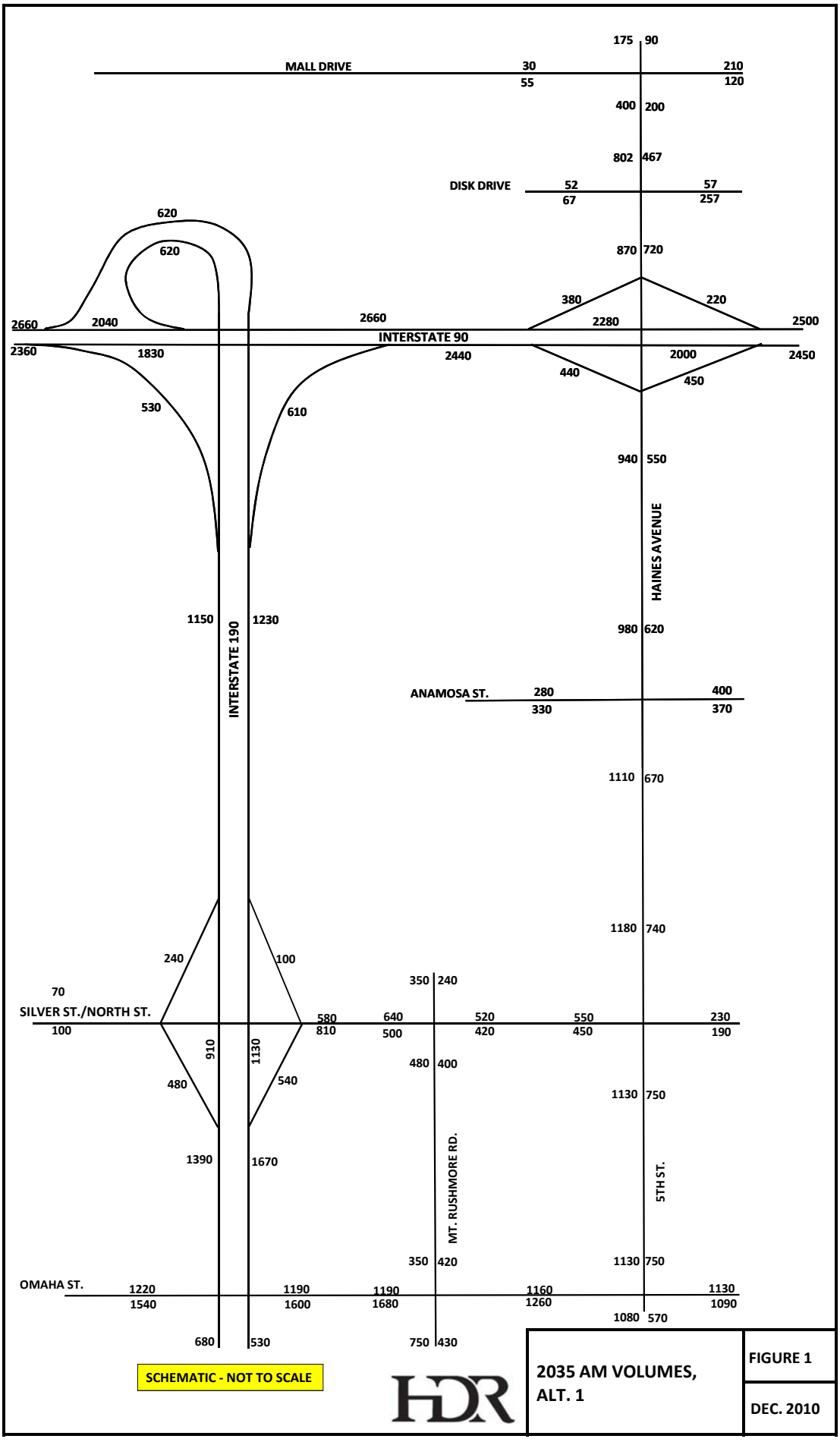


Disk Drive Connection
Most Feasible Option #2

Mall Drive Connection through Oldfield Street homes
30 mph I-90 EB On-Loop

Interstate 190/Silver Street Interchange Study — Rapid City, SD

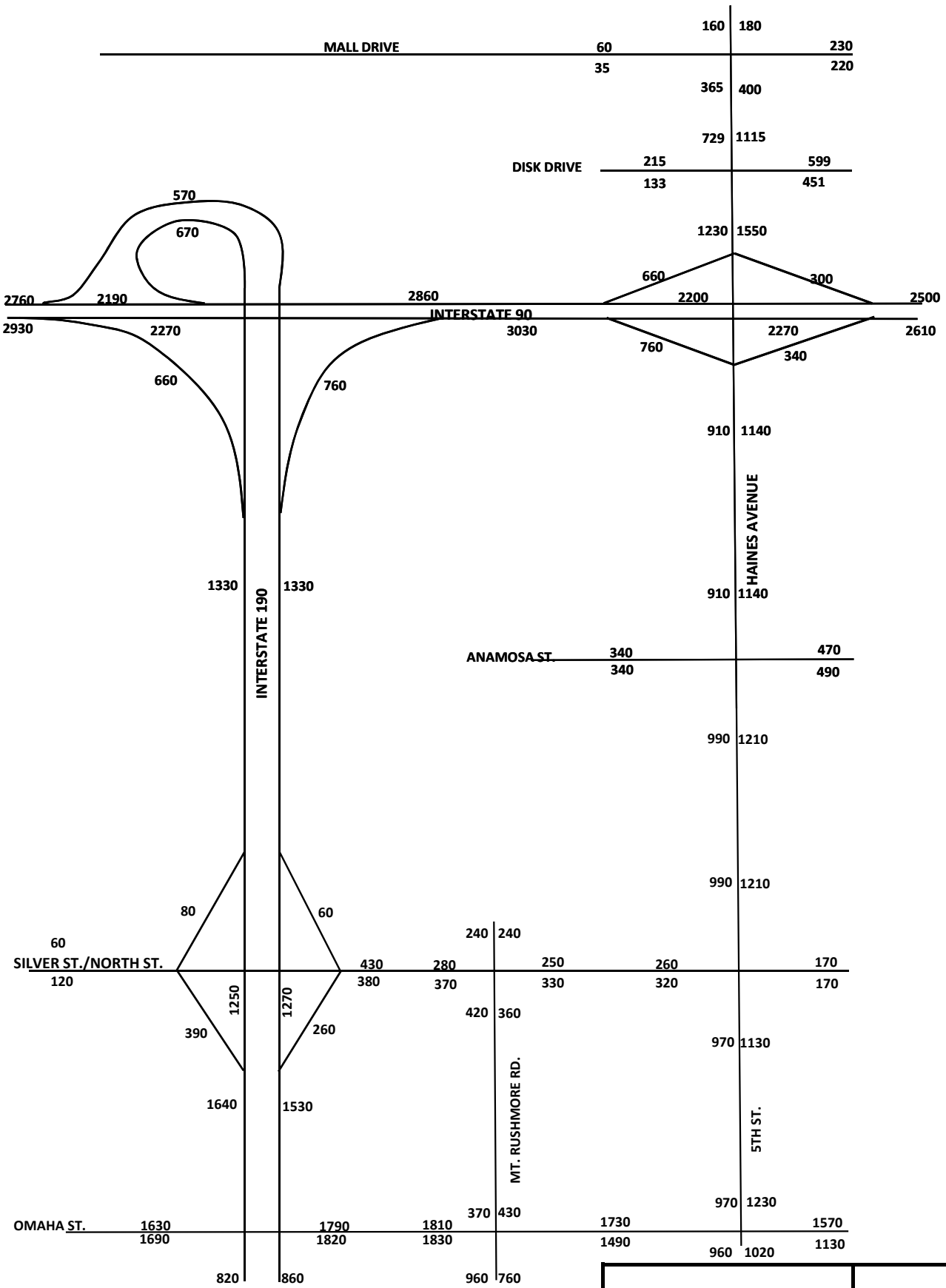
December 9, 2010



2035 AM VOLUMES, ALT. 1

FIGURE 1

DEC. 2010



SCHEMATIC - NOT TO SCALE

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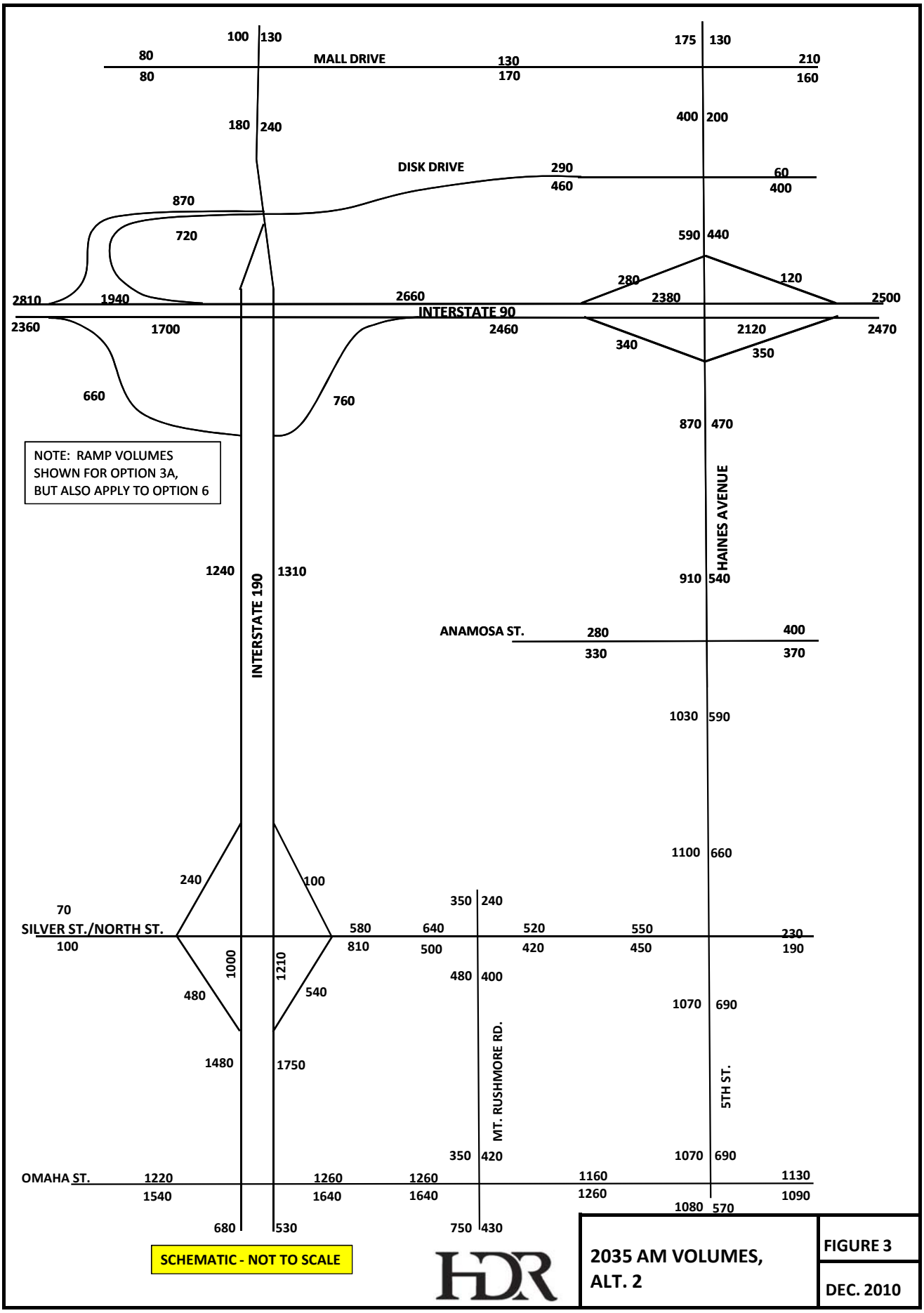
2035 PM VOLUMES, ALT. 1

FIGURE 2

DEC. 2010



2035 AM VOLUMES, ALT. 2

FIGURE 3

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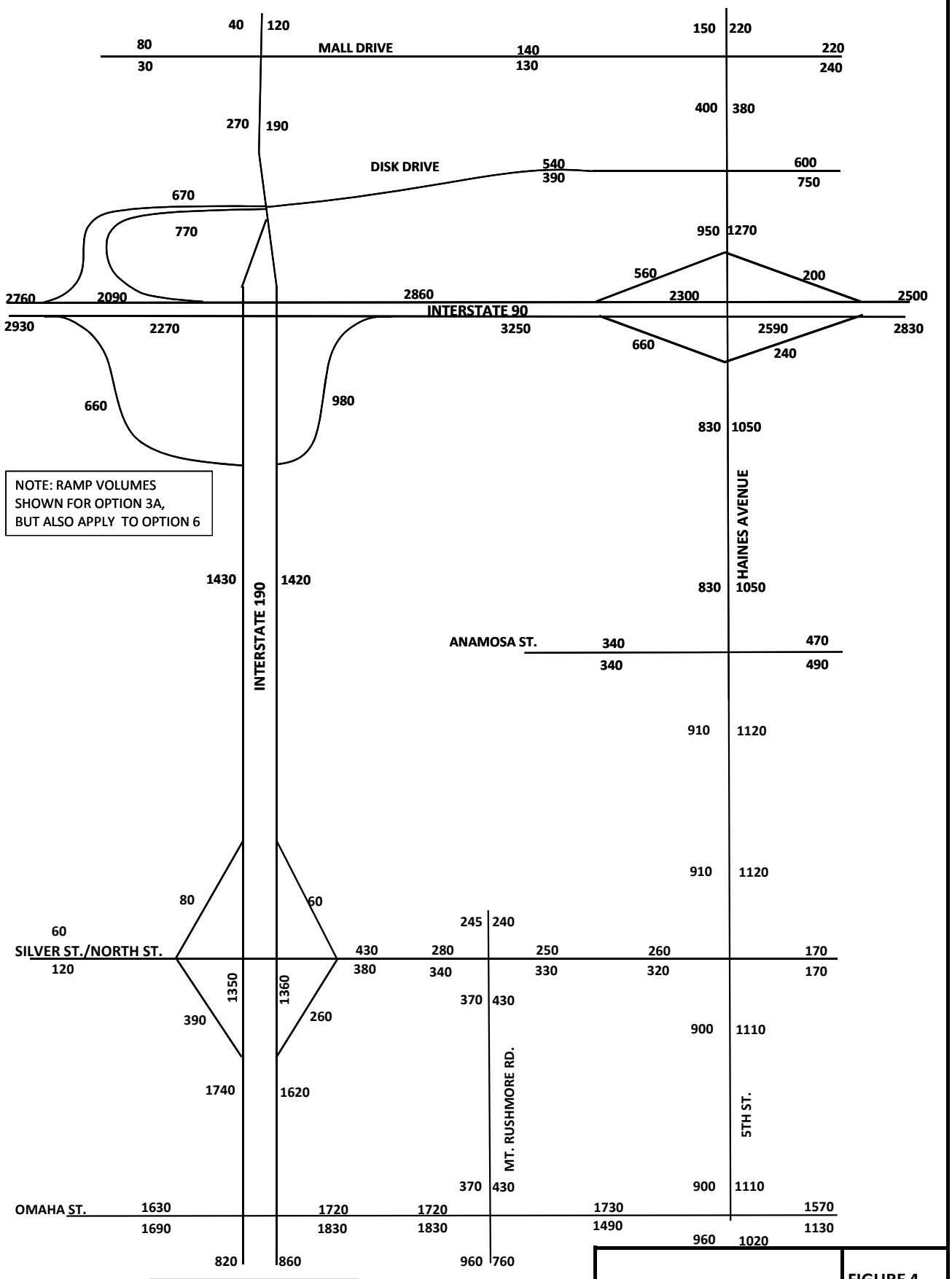

2035 PM VOLUMES, ALT. 2

FIGURE 4

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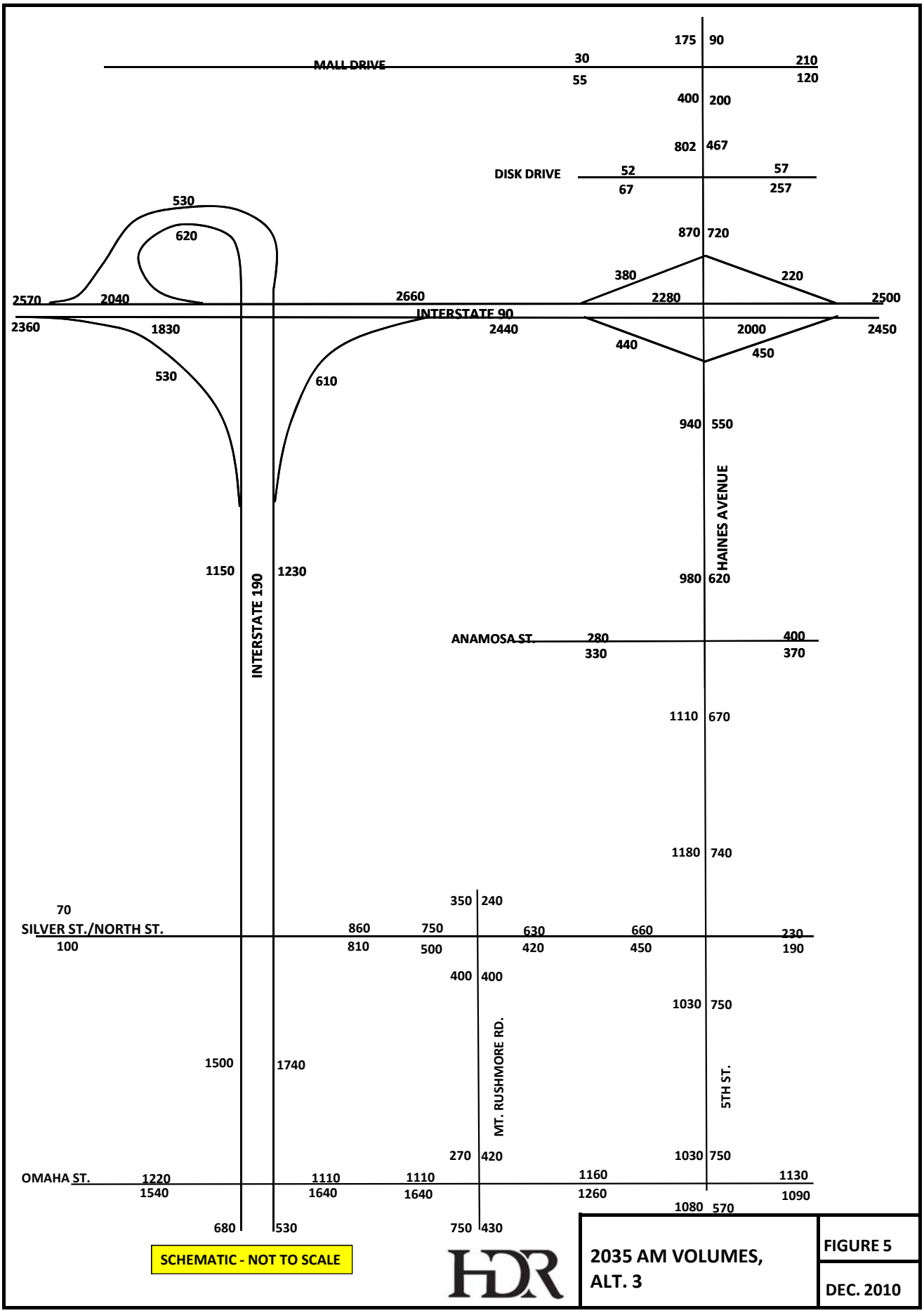

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2035 AM VOLUMES, ALT. 3

FIGURE 5

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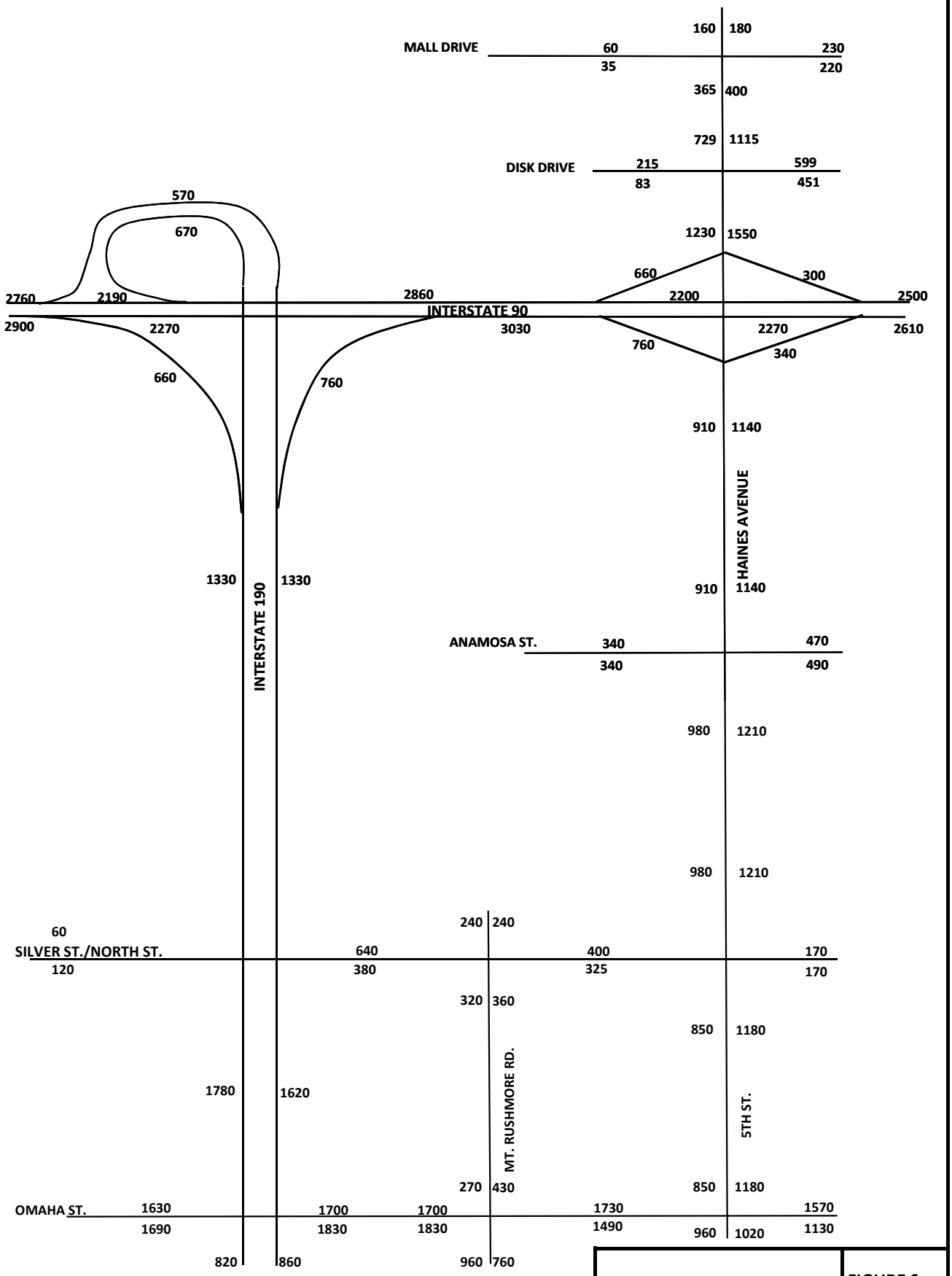

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2035 PM VOLUMES, ALT. 3

FIGURE 6

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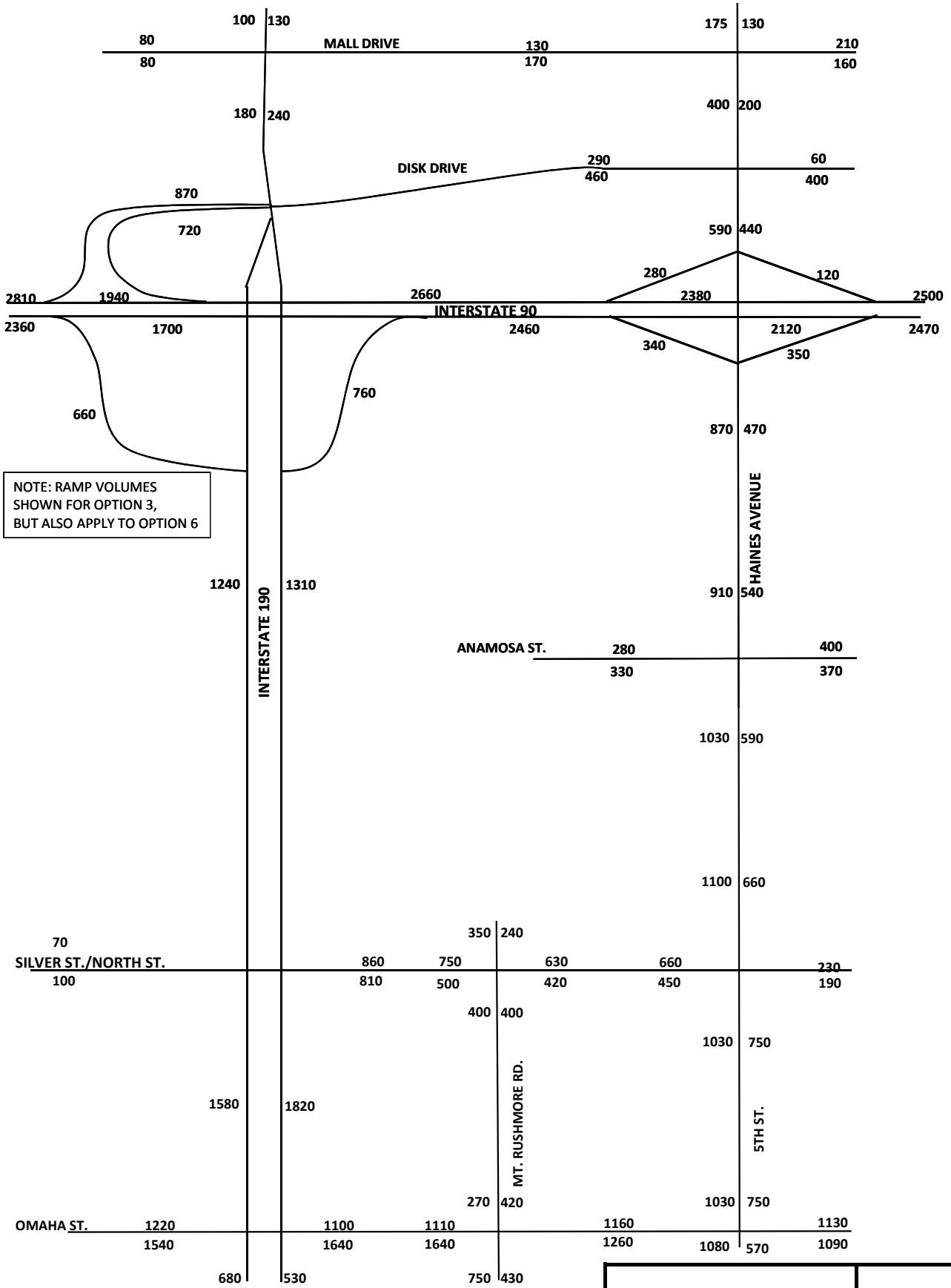
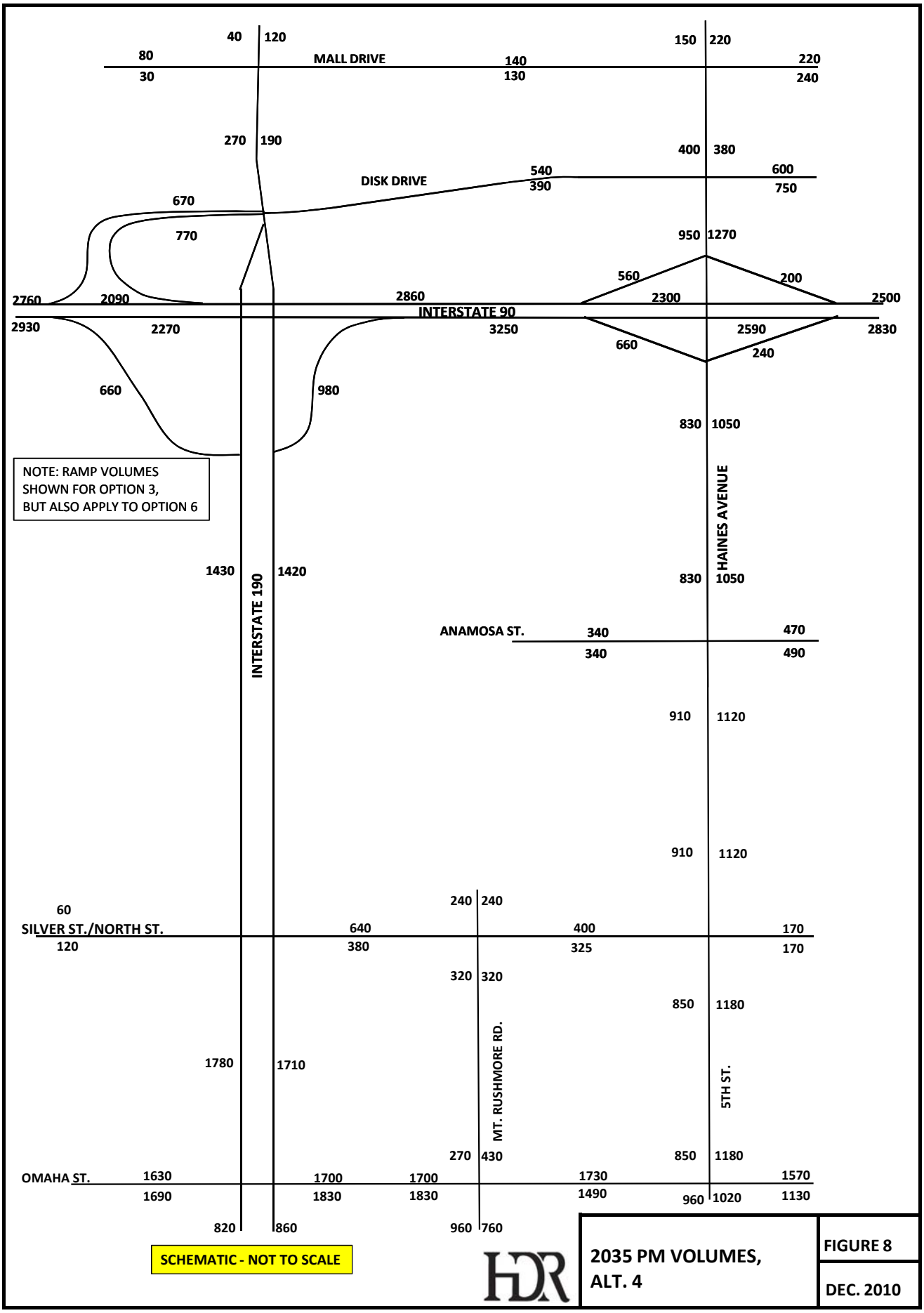


2035 AM VOLUMES, ALT. 4

FIGURE 7

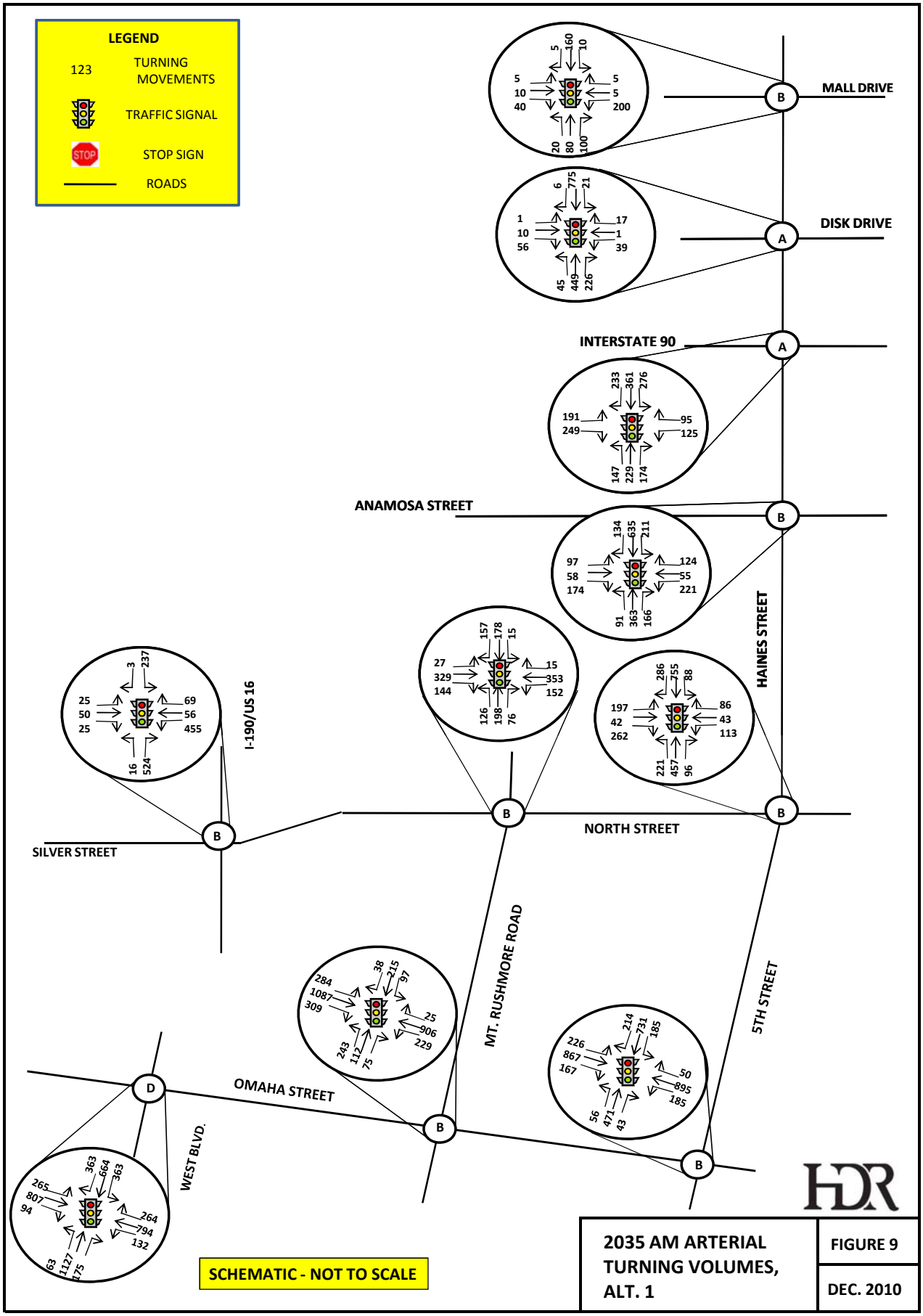
DEC. 2010



2035 PM VOLUMES, ALT. 4

FIGURE 8

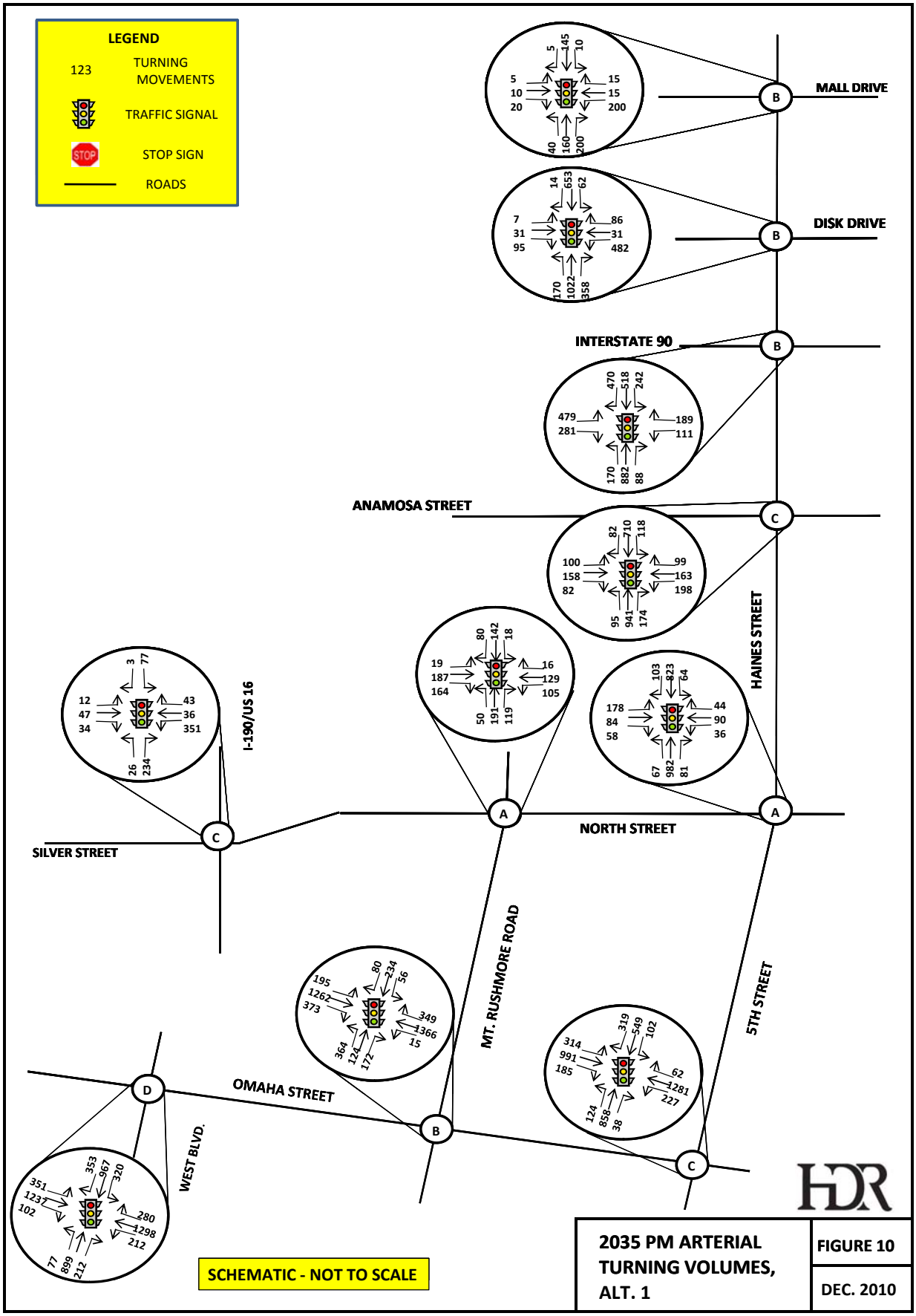
DEC. 2010



2035 AM ARTERIAL TURNING VOLUMES, ALT. 1

FIGURE 9

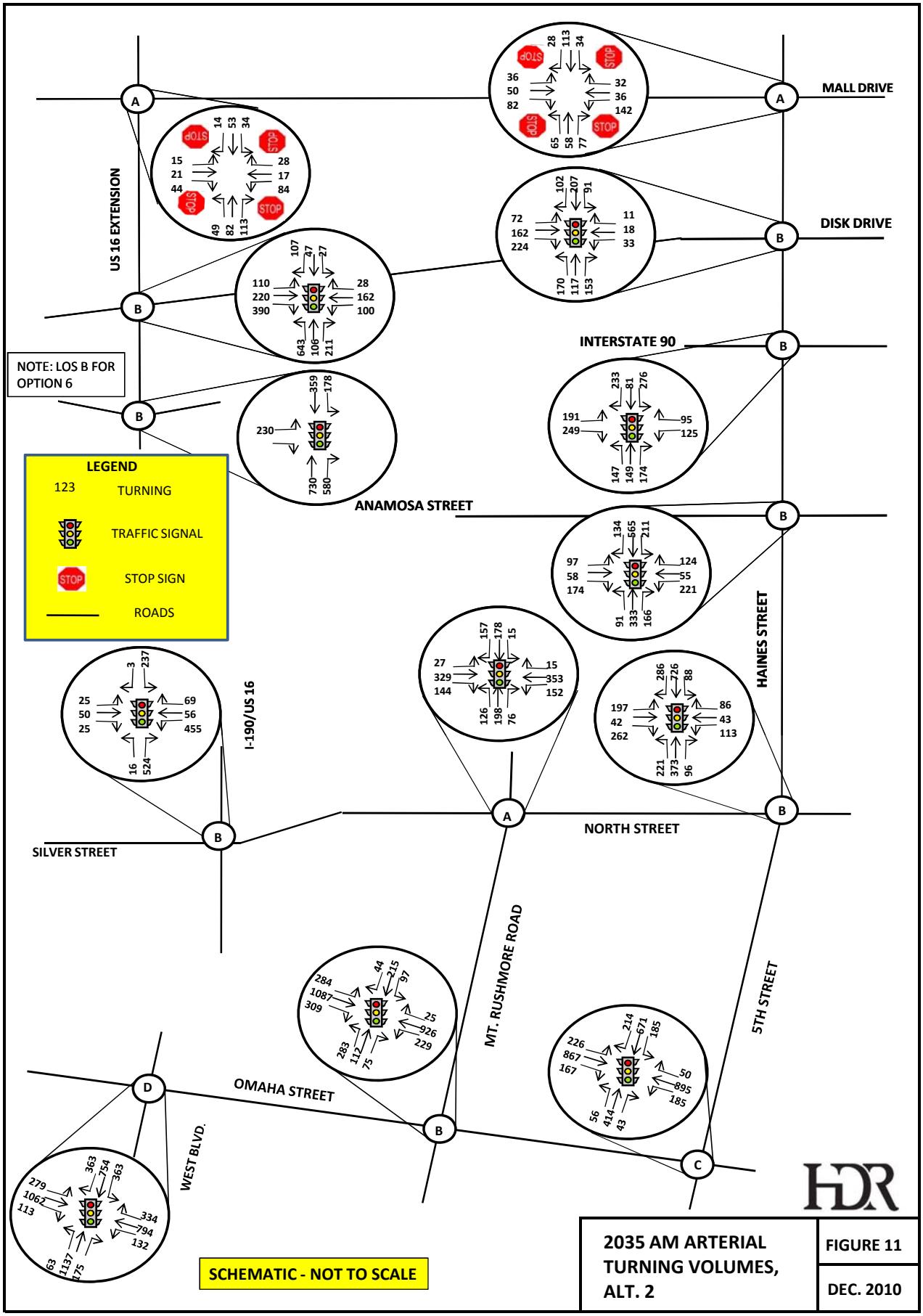
DEC. 2010



2035 PM ARTERIAL TURNING VOLUMES, ALT. 1

FIGURE 10

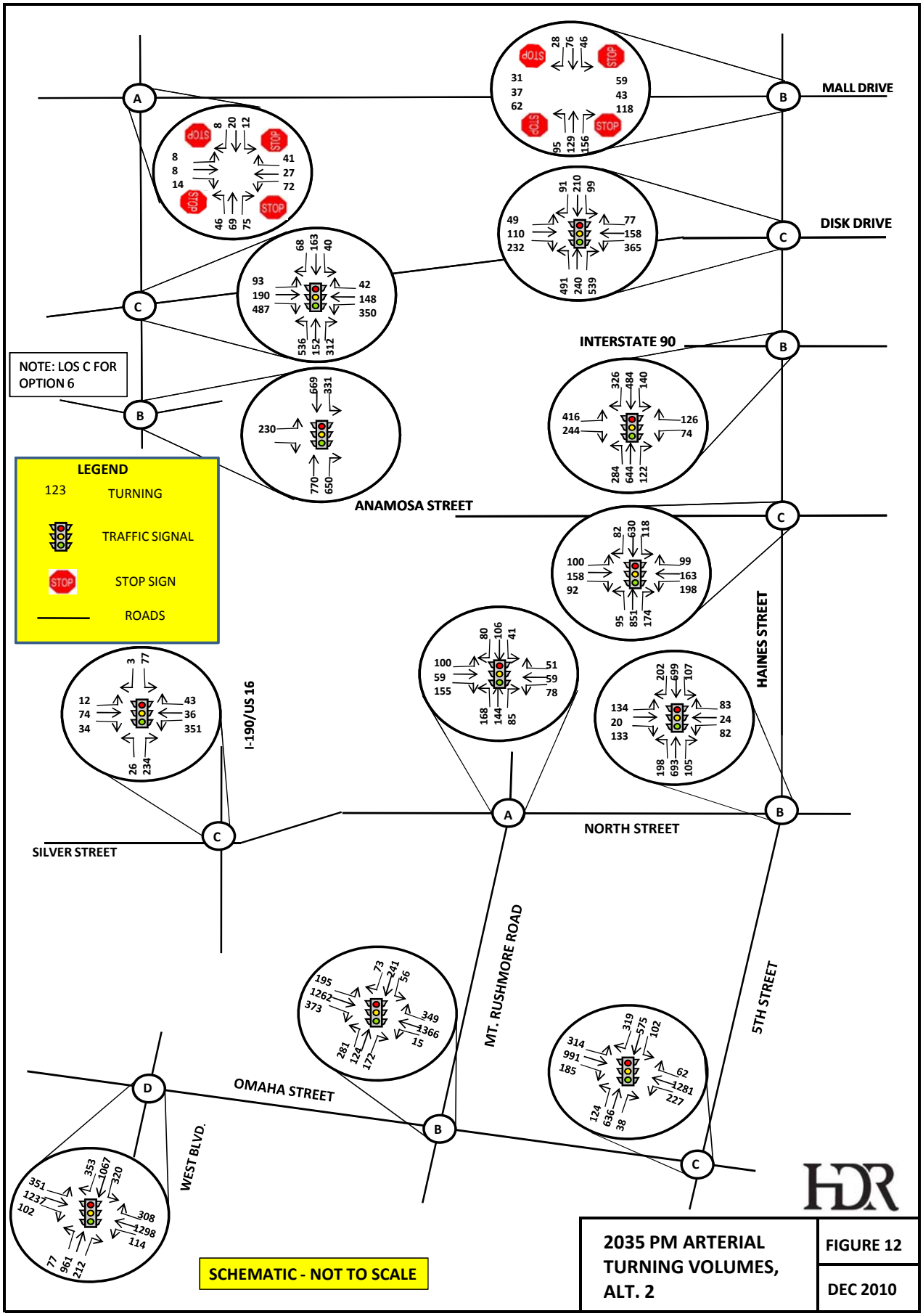
DEC. 2010



2035 AM ARTERIAL TURNING VOLUMES, ALT. 2

FIGURE 11

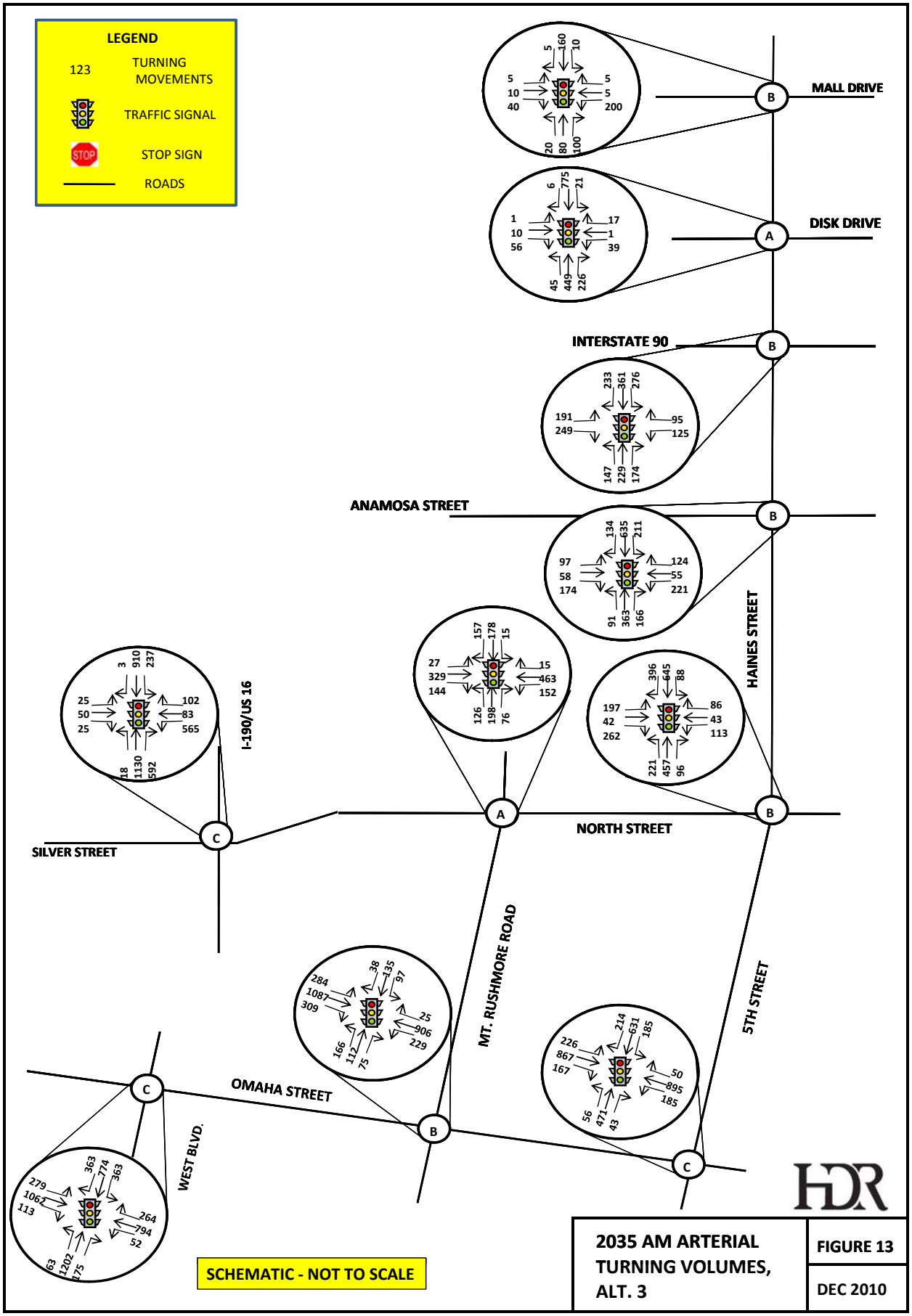
DEC. 2010



2035 PM ARTERIAL TURNING VOLUMES, ALT. 2

FIGURE 12

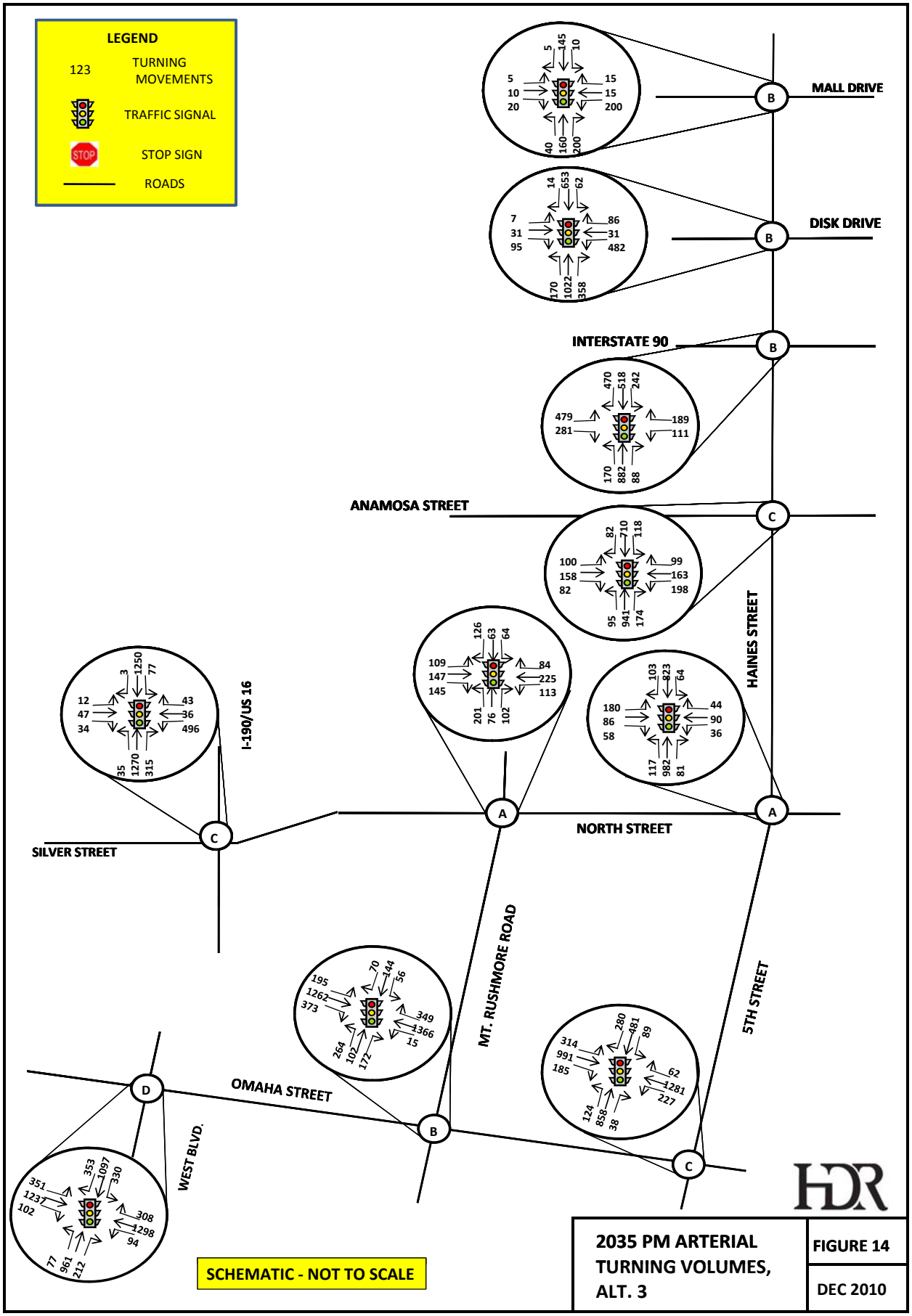
DEC 2010



2035 AM ARTERIAL TURNING VOLUMES, ALT. 3

FIGURE 13

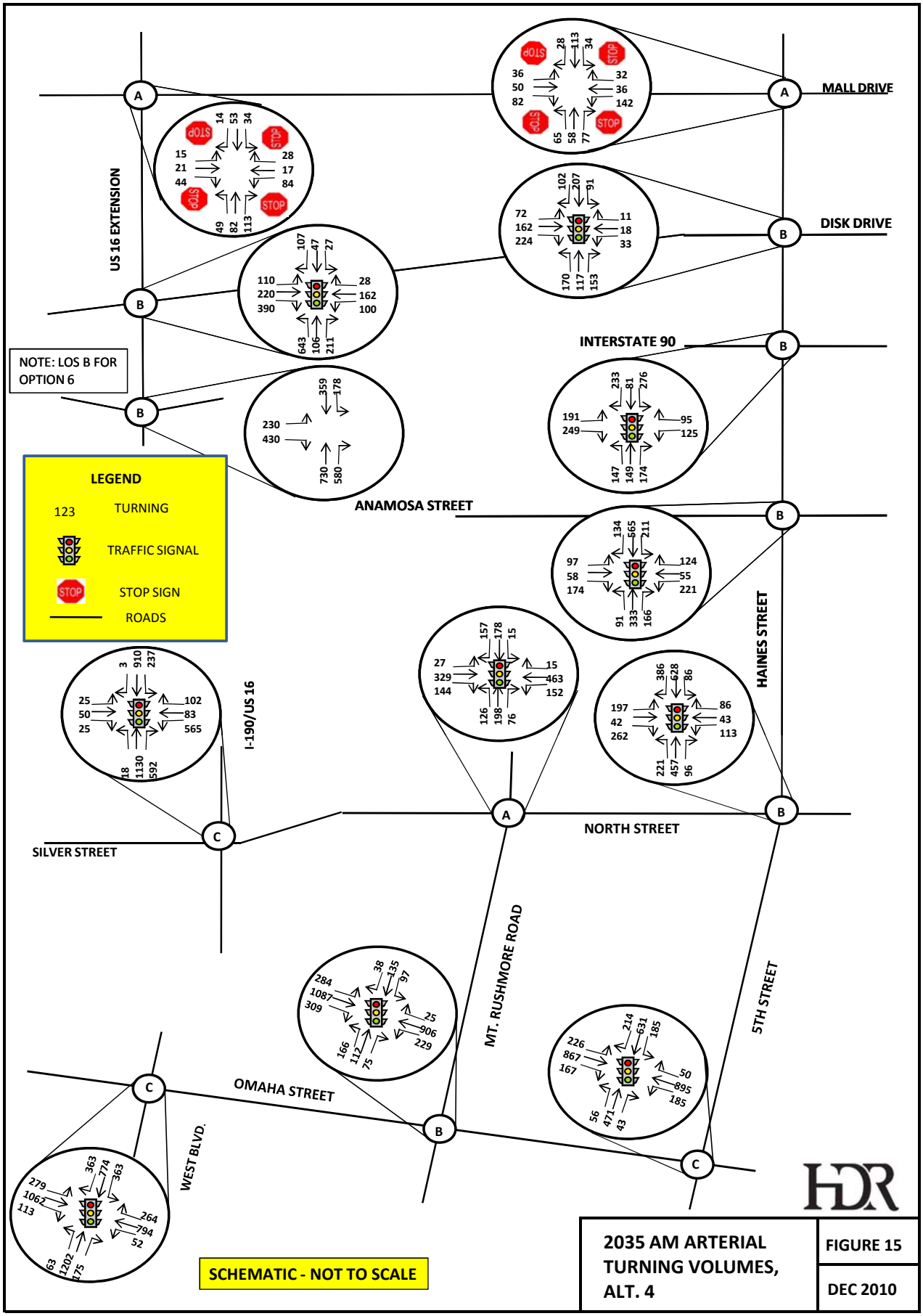
DEC 2010



2035 PM ARTERIAL TURNING VOLUMES, ALT. 3

FIGURE 14

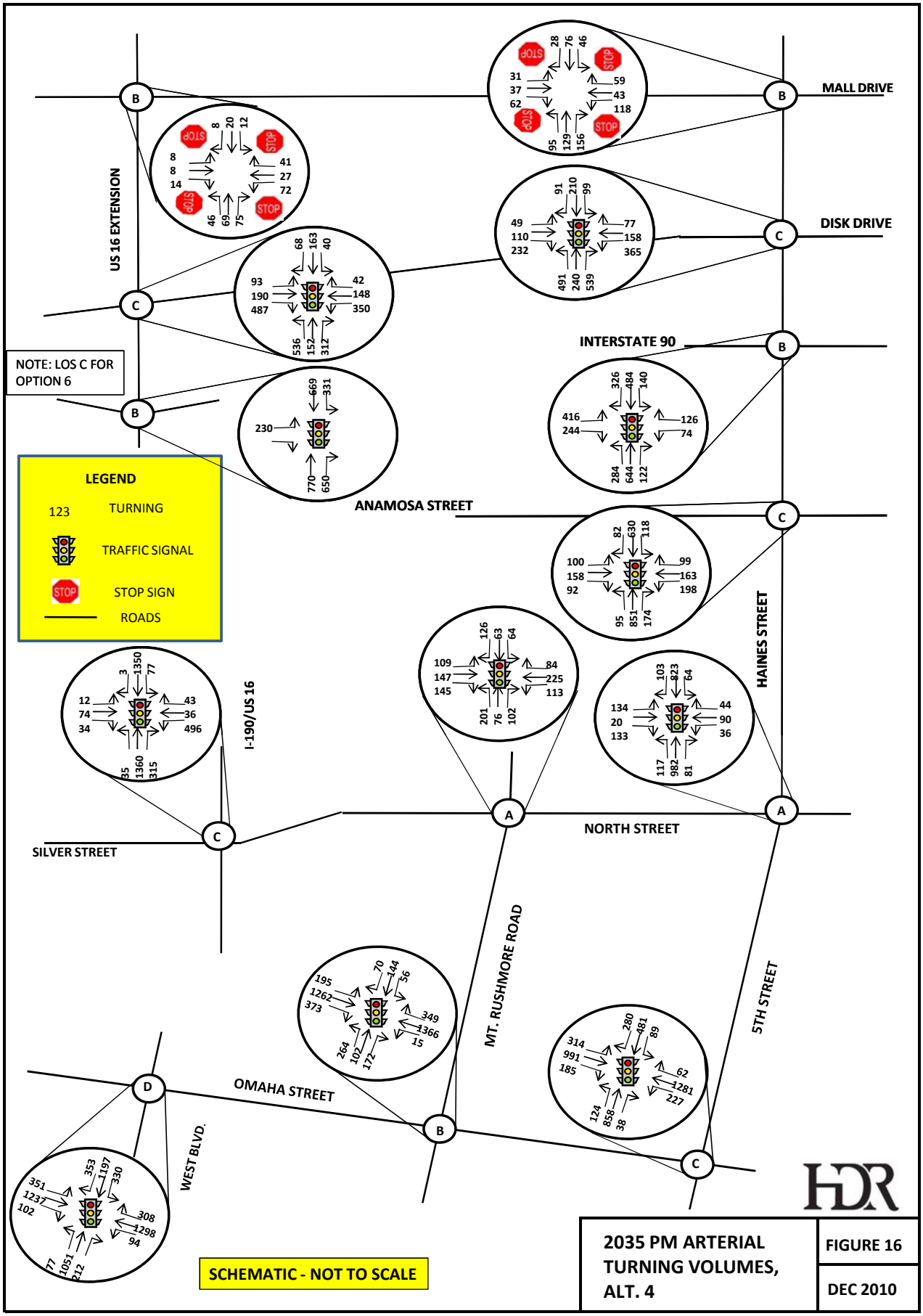
DEC 2010



2035 AM ARTERIAL TURNING VOLUMES, ALT. 4

FIGURE 15

DEC 2010



2035 PM ARTERIAL TURNING VOLUMES, ALT. 4

FIGURE 16

DEC 2010

DISK DRIVE CONNECTION FEASIBLY PREFERRED OPTION #1
MALL DRIVE CONNECTION THROUGH OLDFIELD STREET HOMES

NO.	ITEM DESCRIPTION	APPROX QTY	UNIT	UNIT BID PRICE	EXTENDED PRICE
	Roadway				
1	Mobilization	1	LS	$ 200,000.00	$ 200,000.00
2	Construction Staking	1	LS	$ 40,000.00	$ 40,000.00
3	Clearing	1	LS	$ 35,000.00	$ 35,000.00
4	Remove Concrete Curb & Gutter	2,000	LF	$ 5.00	$ 10,000.00
5	Remove Barrier Wall	1,410	FT	$ 4.00	$ 5,600.00
6	Remove Concrete Pavement	21,077	SY	$ 4.00	$ 84,300.00
7	Remove Luminaire Pole	2	EA	$ 150.00	$ 300.00
8	Unclassified Excavation	50,000	CY	$ 2.50	$ 125,000.00
9	Remove & Place Topsoil	3,700	CY	$ 2.50	$ 9,300.00
10	Incidental Work, Grading	1	LS	$ 20,000.00	$ 20,000.00
11	Base Course	9,600	TON	$ 13.00	$ 124,800.00
12	Asphalt Concrete Composite	980	TON	$ 90.00	$ 88,200.00
13	10.5" Nonreinforced PCC Pavement	23,107	SY	$ 35.00	$ 808,700.00
14	6" Median PCC Pavement	1,624	SY	$ 26.00	$ 42,200.00
15	Storm Sewer Modifications	1	LS	$ 150,000.00	$ 150,000.00
16	Watermain Modifications	1	LS	$ 20,000.00	$ 20,000.00
17	Sanitary Sewer Modifications	1	LS	$ 20,000.00	$ 20,000.00
18	Pavement Marking	8,450	LF	$ 0.60	$ 5,100.00
19	Traffic Control / Detours	1	LS	$ 40,000.00	$ 40,000.00
20	Type B610.5 Concrete Curb and Gutter	11,146	LF	$ 16.00	$ 178,300.00
21	Seeding, Fertilizing, Mulching	1	LS	$ 15,000.00	$ 15,000.00
22	Erosion Control	1	LS	$ 34,000.00	$ 34,000.00
23	Landscaping Restoration	1	LS	$ 20,000.00	$ 20,000.00
24	Roadway Lighting	1	LS	$ 60,000.00	$ 60,000.00
25	Signal System	1	EA	$ 80,000.00	$ 80,000.00
				Subtotal:	$ 2,215,800.00
				Contingency (20%)	$ 443,160.00
				Roadway Subtotal:	**$ 2,659,000.00**

NO.	ITEM DESCRIPTION	APPROX QTY	UNIT	UNIT BID PRICE	EXTENDED PRICE
	Bridge Structure and Walls				
26	Incidental Work, Structure	1	LS	$ 25,000.00	$ 25,000.00
27	Structure Widening (6' Sidewalk & 10' Shared Use Path)	5,760	SQFT	$ 110.00	$ 633,600.00
				Subtotal:	$ 658,600.00
				Contingency (20%)	$ 131,720.00
				Structure & Wall Subtotal:	$ 790,000.00

Construction Total: $ 3,449,000.00

NO.	ITEM DESCRIPTION	APPROX QTY	UNIT	UNIT BID PRICE	EXTENDED PRICE
	Right-of-Way And Utilities				
28	Right-of-Way Impacts* (Including Trailer Court)	172,000	SQFT	$ 20.00	$ 3,440,000.00
29	Purchase Mobile Homes	15	EACH	$ 25,000.00	$ 375,000.00
30	Tenant/Owner Relocation Costs	15	EACH	$ 10,000.00	$ 150,000.00
31	Private Utility Relocations	1	LS	$ 30,000.00	$ 30,000.00
	* Includes Damages to Remaining Trailer Park			ROW Subtotal:	$ 3,995,000.00

Grand Total: $ 7,444,000.00

DISK DRIVE CONNECTION FEASIBLY PREFERRED OPTION #2
MALL DRIVE CONNECTION THROUGH OLDFIELD STREET HOMES W/ EB ON RAMP LOOP

NO.	ITEM DESCRIPTION	APPROX QTY	UNIT	UNIT BID PRICE	EXTENDED PRICE
	Roadway				
1	Mobilization	1	LS	$ 200,000.00	$ 200,000.00
2	Construction Staking	1	LS	$ 40,000.00	$ 40,000.00
3	Clearing	1	LS	$ 35,000.00	$ 35,000.00
4	Remove Concrete Curb & Gutter	2,000	LF	$ 5.00	$ 10,000.00
5	Remove Barrier Wall	1,785	FT	$ 4.00	$ 7,100.00
6	Remove Concrete Pavement	28,050	SY	$ 4.00	$ 112,200.00
7	Remove Luminaire Pole	2	EA	$ 150.00	$ 300.00
8	Unclassified Excavation	60,000	CY	$ 2.50	$ 150,000.00
9	Remove & Place Topsoil	4,500	CY	$ 2.50	$ 11,300.00
10	Incidental Work, Grading	1	LS	$ 20,000.00	$ 20,000.00
11	Base Course	12,000	TON	$ 13.00	$ 156,000.00
12	Asphalt Concrete Composite	2,010	TON	$ 90.00	$ 180,900.00
13	10.5" Nonreinforced PCC Pavement	26,414	SY	$ 35.00	$ 924,500.00
14	6" Median PCC Pavement	2,224	SY	$ 26.00	$ 57,800.00
15	Storm Sewer Modifications	1	LS	$ 150,000.00	$ 150,000.00
16	Watermain Modifications	1	LS	$ 20,000.00	$ 20,000.00
17	Sanitary Sewer Modifications	1	LS	$ 20,000.00	$ 20,000.00
18	Pavement Marking	8,500	LF	$ 0.60	$ 5,100.00
19	Traffic Control / Detours	1	LS	$ 40,000.00	$ 40,000.00
20	Type B610.5 Concrete Curb and Gutter	12,606	LF	$ 16.00	$ 201,700.00
21	Seeding, Fertilizing, Mulching	1	LS	$ 15,000.00	$ 15,000.00
22	Erosion Control	1	LS	$ 34,000.00	$ 34,000.00
23	Landscaping Restoration	1	LS	$ 20,000.00	$ 20,000.00
24	Roadway Lighting	1	LS	$ 60,000.00	$ 60,000.00
25	Signal System	2	EA	$ 80,000.00	$ 160,000.00
				Subtotal:	$ 2,630,900.00
				Contingency (20%)	$ 526,180.00
				Roadway Subtotal:	**$ 3,157,000.00**

NO.	ITEM DESCRIPTION	APPROX QTY	UNIT	UNIT BID PRICE	EXTENDED PRICE
	Bridge Structure and Walls				
26	Incidental Work, Structure	1	LS	$ 25,000.00	$ 25,000.00
27	Structure Widening (6' Sidewalk & 10' Shared Use Path)	5,760	SQFT	$ 110.00	$ 633,600.00
				Subtotal:	$ 658,600.00
				Contingency (20%)	$ 131,720.00
				Structure & Wall Subtotal:	$ 790,000.00

Construction Total: $ 3,947,000.00

NO.	ITEM DESCRIPTION	APPROX QTY	UNIT	UNIT BID PRICE	EXTENDED PRICE
	Right-of-Way And Utilities				
28	Right-of-Way Impacts* (Including Trailer Court)	202,000	SQFT	$ 20.00	$ 4,040,000.00
29	Purchase Mobile Homes	15	EACH	$ 25,000.00	$ 375,000.00
30	Tenant/Owner Relocation Costs	15	EACH	$ 10,000.00	$ 150,000.00
31	Building Impacts	1	EACH	$ 150,000.00	$ 150,000.00
32	Private Utility Relocations	1	LS	$ 30,000.00	$ 30,000.00
				ROW Subtotal:	$ 4,745,000.00

* Includes Damages to Remaining Trailer Park

Grand Total: $ 8,692,000.00