I-10 (Papago Freeway)/Dean Road Interchange
Feasibility Study

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Final
Technical Memorandum

Prepared for:
Maricopa Association of Governments

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1 INTRODUCTION

The interchange between Interstate 10 (I-10) and Dean Road is needed to support the continuing development and growth, both occurring and anticipated, in the west valley. Significant growth is anticipated in this region that could result in population growth, economic development, and increased traffic volumes.

In support of project scoping and in continuation of the project development process, Maricopa Association of Governments (MAG) has initiated the preparation of this technical memorandum. This Memorandum outlines the preliminary design to determine the feasibility of implementing a traffic interchange along I-10 at Dean Road.

1.1 Purpose

The principle focus of this feasibility study is to explore preliminary alternatives for a traffic interchange between Dean Road and Interstate 10 (I-10). This study will establish a roadway footprint and develop the ultimate right of way requirements. This will enable the City of Buckeye and MAG to develop consensus on the type of facility, number of lanes and to guide future development of the area. Finally, the project will inform the City and MAG of the estimated costs associated with the construction.

1.2 Summary

This study concentrates on two alternative interchange configurations; a Diamond Interchange and a Partial Cloverleaf (Par-Clo) Interchange. Traffic figures, derived from MAG's traffic model, were analyzed to determine the necessary future lane configurations for each interchange to operate with acceptable levels-of-service for a design year of 2035. Each interchange configuration was laid out based on the lane configurations and the design parameters stipulated in the Arizona Department of Transportation Roadway Design Guide Lines. A planning-level cost estimate for each alternative was developed. The probable cost of the Diamond Interchange is $17,944,859 and the Par-Clo is $21,677,533. The plans for each of the alternatives are shown in **Appendix 1**.

2 EXISTING CONDITIONS

The project is located approximately 6 mile east of State Route 85 in northwestern Maricopa County. The study area includes lands under the jurisdiction of the City of Buckeye and unincorporated Maricopa County. The project study location is shown in **Figure 1.**

Currently there is no connection between I-10 and Dean Road. Dean Road is designated as an Arterial Street in the City of Buckeye's General Plan. Currently Dean Road is a two lane roadway that terminates at Yuma Road, approximately 1.4 miles south of the I-10.

The I-10 at this location is a four lane divided freeway with an 80 feet open median running in a southwest/northeast direction. The freeway is situated at or very near the elevation of the existing ground and has a right of way of 308 feet. The 2011 Average Daily Traffic Volumes (ADT) on the freeway at the proposed location of the Dean Road Interchange are approximately 26,600 vehicles per day in each direction.

The general area reflects the characteristics of the arid southwest Sonoran desert. There are small ill-defined washes throughout the area. Vegetation is sparse consisting of mesquite and Palo Verde trees, saguaros, creosote bush, wild grasses, and miscellaneous shrubs. The topography slopes from the north to the south.

Much of the land adjacent to the proposed interchange is vacant with the exception of a large subdivision (Sundance) approximately half a mile to the south west. Land to the west of the Dean Road alignment is owned by the Arizona State Land Department (ASLD). To the east of Dean Road between McDowell Road and Van Buren Street the land is owned by a developer, BT Airport Road LLC. South of Van Buren Street the land is own by ASLD. The existing land ownership is shown in **Figure 2.**

Approximately 1,300 ft. north of the proposed intersection is Flood Control District of Maricopa County (FCDMC) Flood Retarding Structure Buckeye FRS # 3. The structure is 2.3 miles in length and has a height of 21 feet. The structure provides flood protection for areas downstream (south). Offsite flows impact I-10 in a sheet-flow fashion and water is transported under the freeway through a series of corrugated metal pipes ranging from 24 inches to 48 inches.

To the east of the proposed intersection an APS overhead power line parallels the I-10 approximately 110 feet north of the freeway. The power line changes to an east/west direction crossing the proposed alignment of Dean Road approximately 450 feet north of I-10.

Figure 1: Location Map

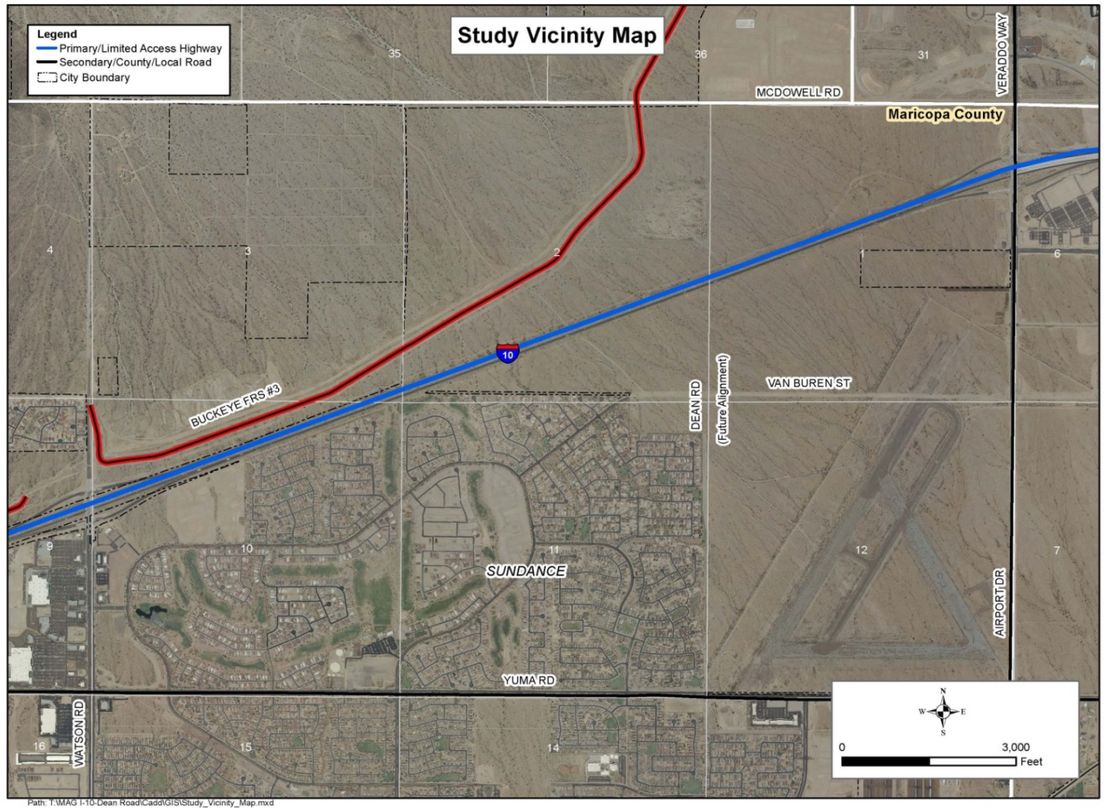
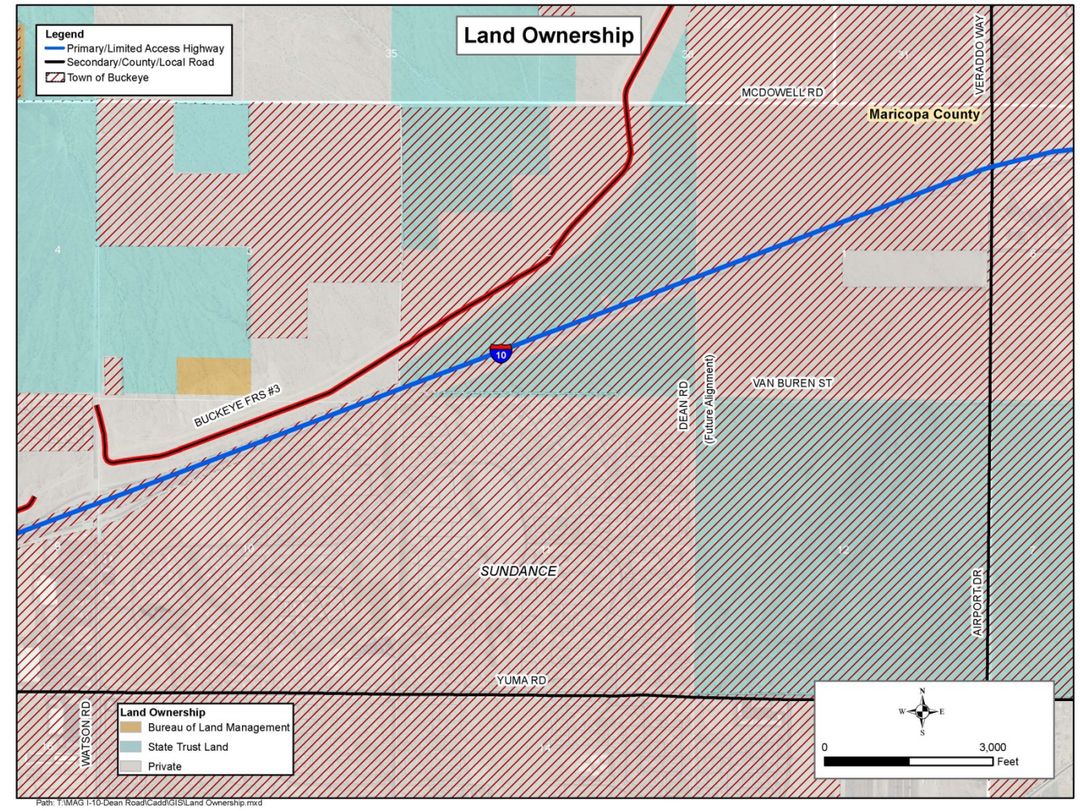


Figure 2: Land Ownership



3 FUTURE CONDITIONS

3.1 Future Land Use

The property owned by BT Airport Road LLC have preliminary plans to develop the land as a business park with mixed business and professional offices and some commercial corners. West of this property and to the north of I-10 the property is owned by Banner Health who plans to develop a Health Campus. South of the I-10 the property has been set aside by Buckeye Union High School District 201 for a high new school.

On the ASLD land to the west of Dean Road and south of Van Buren Street, Sunbelt Investment Holdings has produced preliminary plans to develop the area with mixed use residential and commercial properties.

West of Dean Road the ASLD land currently has no plans for development although Buckeye's general plan shows the area as very low density residential. This land ultimately is available for development and may eventually transfer to private interest through either sale or lease. ASLD is charged with the stewardship of State Trust lands. The mission of the ASLD is to enhance value and optimize economic return for designated beneficiaries. The State's Common Schools (K-12) constitute the largest beneficiary, owning approximately 87% of the State Trust lands and receiving close to 90% of revenue from the sale, usually an auction, of such lands. The ASLD has authority over State Trust lands until they are sold or leased, at which time planning and development authority is transferred to the appropriate municipality or county.

3.2 Future Transportation Network

MAG's Regional Transportation Plan (RTP) indicates that the I-10 will ultimately have an additional general purpose lane and High Occupancy Vehicle (HOV) lane in each direction. This will result in six general purpose lanes and two HOV lanes to match the existing configuration west of Verrado Way Interchange.

To the north of I-10 is McDowell Road. The McDowell Parkway Corridor Feasibility Study dated June 2010, recommends that McDowell Road be developed as an eight lane Arizona Parkway. This facility will have a right of way of 200 feet with a design speed of 55 mile per hour (MPH). The study indicates that the Parkway will cross the Dean Road alignment at its current location where there will be an at grade intersection.

Dean Road is classified as an Arterial Street which will ultimately be four to six lanes depending on traffic volumes. Dean Road will be six lanes through the proposed intersection with the I-10. This will be outlined in Section 5 below. The future 2035 Average Daily Traffic (ADT) volumes on I-10 will be approximately 61,000 vehicles per day (vpd) in each direction and Dean Road will be approximately 13,000 vpd in each direction. See **Appendix 2** for details.

4 ALTERNATIVES

Two alternative interchange configurations were chosen by MAG to investigate. Firstly, the Standard Diamond Interchange chosen because it is the most common interchange throughout the State and drivers are very familiar with its operational aspects. Secondly, the Par-Clo Interchange was chosen to provide additional capacity for the volume of traffic that is predicted to be generated when the McDowell Parkway is constructed.

4.1 General Design Criteria

This section describes the design controls and design features for I-10, Dean Road and the service interchange ramps within the study limits.

Table 1: General Design Criteria for I-10

Description	Value for Design
Design Year:	2035
Design Speed:	65 mph
Superelevation:	Match existing (0.06 ft./ft. maximum)
Cross Slope:	Match existing (2.0%)
Lane Width:	12 ft.
Shoulder Width:	
• Median:	Match existing (4 ft.)
• Outside:	12 ft.
Maximum Horizontal Curve:	3 degree, 27 minutes
Maximum Gradient:	3%
Taper Rate:	65:1
Slope Standards:	
• Cut slopes:	Varies, 3:1 maximum
• Fill slopes:	Varies, 3:1 maximum
Minimum Vertical Clearance:	16.5 ft.

Table 2: General Design Criteria for Service Interchange

Description	Value for Design
Design Year	2035
Design Speed	
• Nose of gore (exit ramps):	60 mph
• Nose of gore (entrance ramps):	55 mph
• Ramp body:	50 mph
• Ramp terminal:	35 mph
• Loop ramp :	30 mph
Paved Width	34 ft.
Lane Width	12 ft.
Shoulder width	Left 2 ft. Right 8 ft.
Clear Zone	30 ft.
Maximum Superelevation	6.00%
Maximum Gradient	4% (max up grade) 5% (max down grade)
Minimum Gradient	0.25%
Minimum Horizontal Curve Radius	6 degrees, 53 minutes, 230 ft. (for Loop Ramp)
Vertical Curve	
• Type	Symmetrical Parabola
• Required when	Grade Change Exceeds 0.20%
• Minimum Length	200 ft.
Slope Standards:	
• Cut slopes:	Varies, 3:1 maximum
• Fill slopes:	Varies, 3:1 maximum

Table 3: General Design Criteria for Dean Road

Description	Value for Design
Design Year:	2035
Design Speed:	45 mph
Superelevation:	Normal crown
Cross Slope:	2%
Lane Width:	
• Median Lane:	11 ft.
• Outside Lane:	14 ft.
Maximum Horizontal Curve:	8 degree, 55 minutes
Maximum Gradient:	6%
Taper Rate:	40:1
Slope Standards:	
• Cut slopes:	Varies, 3:1 maximum
• Fill slopes:	Varies, 3:1 maximum

4.2 Alternative 1 – Diamond Interchange

Alternative 1 is a standard diamond interchange. Diamond interchanges are characterized by ramps that are essentially in the same direction as the main roadway. Four ramps provide for all eight turning movements to and from a crossroad. Diamond interchanges are the simplest of the interchange types. Drivers are very familiar with the operational aspects of the diamond interchange; it is simple in concept and logical in use. This type of interchange tends to lose efficiency with an increase in demand for left turns at the ramp/crossroad intersections. The compact diamond may effectively be used with frontage roads.

At this location Dean Road is elevated over I-10 with the four ramps leading up from or down to the exiting I-10. The west facing ramp will connect into the exiting ramp from the Verrado Interchange to produce an auxiliary lane. The east facing ramps will be parallel type entrance/exit ramps. This will allow for future expansion of the I-10 and in anticipation of the surrounding area becoming more urbanized

It is anticipated that the bridge to take Dean Road over I-10 will consist of two 125 foot spans using prestressed concrete I-girders. The total width of the structure will be 130 feet. The superstructure will consist of drop cap style bent piers installed along the existing I-10 centerline with stub type abutments.

4.3 Alternative 2 – Partial Cloverleaf Interchange

Alternative 2 is a Partial Cloverleaf (Par-Clo) interchange. Par-clo interchanges provide loop on-ramps to the highway in addition to the four spread diamond-type ramps. This interchange is suitable for large volume turning movements. Left-turn movements from the crossroad are eliminated, thus permitting two-phase operation at the ramp intersections when signalized.

As with the Alternative 1 Dean Road is elevated over I-10 with the four direct ramps leading up from or down to the exiting I-10. The west facing ramp will connect into the exiting ramp from the Verrado Interchange to produce auxiliary lane. The east facing ramps will be parallel type entrance/exit ramps. This will allow for future expansion of the I-10 and in anticipation of the surrounding area becoming more urbanized. The loop ramps will merge with the direct on ramp before merging on to I-10. This will enable traffic to enter I-10 in one lane by reducing the amount of weaving.

It is anticipated that the bridge to take Dean Road over I-10 will consist of two 140 feet spans using prestressed concrete I-girders. The total width of the structure will be 95 feet. The superstructure will consist of drop cap style bent piers installed along the existing I-10 centerline. The abutments will be semi- full height abutments to reduce the span length in order to make I-girders feasible.

5 TRAFFIC

MAG's 2035 travel demand forecast was used to develop 2035 future average daily traffic (ADT) volumes for both the diamond interchange layout and the partial cloverleaf layout. MAG provided Baker with the 2035 ADT volumes for the diamond interchange layout and the partial cloverleaf layout which are included in **Appendix 2**. The two interchange configurations were analyzed to determine the necessary future lane configurations for each interchange to operate with acceptable levels-of-service with 2035 future traffic volumes.

5.1 Development of Peak Hour Volumes

2013 ADT and peak hour traffic counts were provided by Maricopa County Department of Transportation (MCDOT) along Airport Road and are included in **Appendix 2**. The traffic counts collected along Airport Road in 2013 were used to calculate a K-factor. The K-factor is also known as the design hour factor and is used to calculate peak hour volumes from ADT traffic volumes. **Table 4** shows the ADT and peak hour volumes provided by MCDOT along Airport Road and the computed K-factor. The City of Buckeye's *Engineering Design Standards, Section 6-1 Traffic Impact Analysis* states that K factor shall range from 0.0833 to 0.10. Based on the 2013 traffic counts along Airport Road, the calculated K-factors and the City of Buckeye Design Standards, the K-factor assumed for Dean Road is 10 percent. The 10 percent K-factor is applied to the 2035 future ADT volumes to obtain the 2035 peak hour volume.

Table 4: Volumes and K-Factors Along Airport Road

Location	ADT (vpd)	AM Peak Hour (vph)	Calculated K (%)	PM Peak Hour (vph)	Calculated K (%)
N. of Beloat Rd	637	73	11	56	9
N. of Broadway Rd	1,728	263	15	202	12
N. of MC 85	1,553	183	12	143	9
N. Narramore Rd	800	51	6	70	9
S. of Yuma Rd	3,107	633	20	532	17

2035 peak hour traffic volumes for the diamond interchange layout and partial cloverleaf layout are shown in **Figure 3**.

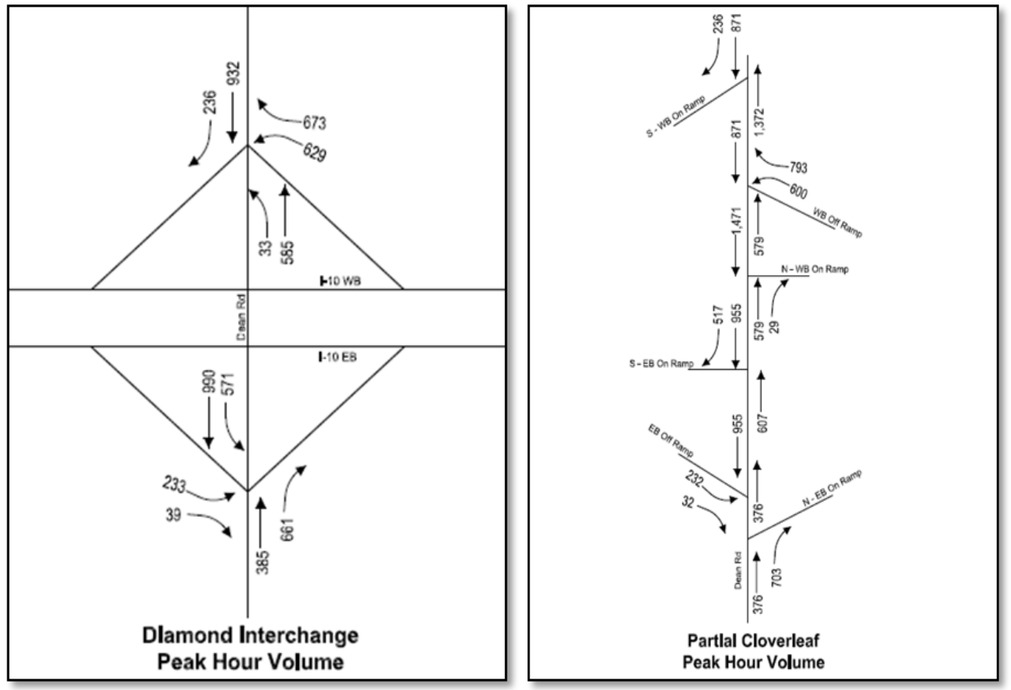


Figure 3: Peak Hour Traffic Volumes

5.2 Level-of-Service

The ability of a transportation system to transmit the transportation demand is characterized as its level-of-service (LOS). LOS is a rating system from A, representing the best operation, to F, representing the worst operation. The appropriate reference for LOS operation is the *2010 Highway Capacity Manual*, published by the Transportation Research Board.

This manual considers the average delay per vehicle as the measure to determine the LOS of a signalized and unsignalized intersection. The delay and LOS are calculated for the intersection, each approach, and each turning movement. **Table 5** and **Table 6** list the LOS criteria for signalized and unsignalized intersections, respectively, as stated in the 2010 *Highway Capacity Manual*.

Table 5: Level-of-Service Criteria for Signalized Intersections

Level-of-Service	Average Control Delay (s/veh)
A	≤ 10
B	> 10-20
C	> 20-35
D	> 35-55
E	> 55-80
F	> 80

Table 6: Level-of-Service Criteria for Unsignalized Intersections

Level-of-Service	Average Control Delay (s/veh)
A	≤ 10
B	> 10-15
C	> 15-25
D	> 25-35
E	> 35-50
F	> 50

One of the important conditions for determining LOS at an intersection is the number of lanes provided for each movement on each approach at the intersection. During a meeting on April 29, 2014 with MAG, the City of Buckeye, W.C. Scoutten and Baker, the City of Buckeye requested that Dean Road between McDowell Road and Van Buren Street have a 6-lane cross section for the purpose of this analysis.

The LOS for the diamond interchange layout was evaluated using *Synchro 8* software, which utilizes the criteria described in **Table 5**. The 2035 LOS for the diamond interchange layout signalized intersections are shown in **Table 7**. **Appendix 3** provides the complete results of the 2035 LOS analyses for the diamond interchange layout.

Table 7: 2035 Traffic Level-of-Service Summary – Diamond Interchange Signalized Intersections

Intersection	2035 Level-of-Service (LOS)
Dean Road & WB I-10 Ramps	
Peak Hour LOS	C
Peak Hour Delay	23.2 seconds
Dean Road & EB I-10 Ramps	
Peak Hour LOS	B
Peak Hour Delay	13.6 seconds

The LOS for the partial cloverleaf interchange layout was evaluated using *Synchro 8* software, which utilizes the criteria described in **Table 5** and **Table 6**. The 2035 LOS for the partial cloverleaf interchange layout signalized intersections are shown in **Table 8** and **Table 9** shows the 2035 LOS for the unsignalized intersections. **Appendix 3** provides the complete results of the 2035 LOS analyses for the partial cloverleaf interchange layout.

Table 8: 2035 Traffic Level-of-Service Summary – Partial Cloverleaf Interchange Signalized Intersections

Intersection	2035 Level-of-Service (LOS)
Dean Road & WB I-10 Off-Ramp	
Peak Hour LOS	B
Peak Hour Delay	17.9 seconds
Dean Road & EB I-10 Off-Ramp	
Peak Hour LOS	B
Peak Hour Delay	12.3 seconds

Table 9: 2035 Traffic Level-of-Service Summary – Partial Cloverleaf Interchange Unsignalized Intersections

Intersection	2035 Level-of-Service											
	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
SB Dean Road & WB I-10 On-Ramp												
Peak Hour LOS	-	A	-	-	A	A	-	-	-	-	-	-
SB Dean Road & EB I-10 On-Ramp												
Peak Hour LOS	-	A	-	-	A	A	-	-	-	-	-	-
NB Dean Road & EB I-10 On-Ramp												
Peak Hour LOS	-	A	A	-	A	-	-	-	-	-	-	-
NB Dean Road & WB I-10 On-Ramp												
Peak Hour LOS	-	A		-	A	-	-	-	-	-	-	-

5.3 Deceleration Lanes

Based on the Arizona Department of Transportation (ADOT) *Traffic Engineering Polices, Guidelines, and Procedures, Section 430 – Turn Lane Design*, the right-turn and left-turn storage lengths are calculated by summing the queue length and the braking distance. The queue lengths for unsignalized traffic control should be determined based on the anticipated turning volume from an average two-minute period. For signalized traffic controlled intersections, the traffic signal cycle length shall be used to determine the queue lengths. The right-turn and left-turn storage lane length calculations are included in **Appendix 4**.

Table 10 and **Table11** summarize the results of the left-turn lane storage lengths requirements for the diamond interchange layout and the partial cloverleaf interchange layout, respectively.

Table 10: Required Left-Turn Storage Lengths for Diamond Interchange

Intersection	Dir.	Calculated Queue	Min. Braking Distance	Total Turn Lane Length	Recommended
Dean Rd & I-10 WB Ramps	NB	25	50	75	100
	WB	175*	40	215*	215*
Dean Rd & I-10 EB Ramps	SB	175*	50	225*	225*
	EB	150	40	190	190

*Dual Left-Turn Lanes

Table 11: Required Left-Turn Storage Lengths for Partial Cloverleaf Interchange

Intersection	Dir.	Calculated Queue	Min. Braking Distance	Total Turn Lane Length	Recommended
Dean Rd & I-10 WB Off-Ramp	WB	250	40	290	290
Dean Rd & I-10 EB Off-Ramp	EB	150	40	190	190

The minimum queue length for all traffic control situations shall be 50 feet to accommodate two passenger vehicles per ADOT's *Traffic Engineering Polices, Guidelines, and Procedures, Section 430 – Turn Lane Design*. Therefore the northbound left-turn lane length at Dean Road and I-10 WB Ramps for the diamond interchange layout is recommended to be greater than the calculated total turn lane length.

Table 12 and **Table13** summarize the results of the right-turn lane storage lengths requirements for the diamond interchange layout and the partial cloverleaf interchange layout, respectively.

Table 12: Required Right-Turn Storage Lengths for Diamond Interchange

Intersection	Dir.	Calculated Queue	Min. Braking Distance	Total Turn Lane Length	Recommended
Dean Rd & I-10 WB Ramps	SB	150	50	200	200
	WB	250	40	290	290
Dean Rd & I-10 EB Ramps	NB	250	50	300	300

Table 13: Required Right-Turn Storage Lengths for Partial Cloverleaf Interchange

Intersection	Dir.	Calculated Queue	Min. Braking Distance	Total Turn Lane Length	Recommended
SB Dean Rd & I-10 WB On-Ramp	SB	200	50	250	150*
SB Dean Rd & I-10 EB On-Ramp	SB	450	50	500	150*
Dean Rd & I-10 EB Off-Ramp	EB	25	40	65	190
NB Dean Rd & I-10 EB On-Ramp	NB	600	50	650	150*
NB Dean Rd & I-10 WB On-Ramp	NB	25	50	75	150*
Dean Rd & I-10 WB Off-Ramp	WB	350	40	390	390

*Free-flow movements

The northbound and southbound right-turn lane lengths at the EB I-10 on-ramps and WB I-10 on-ramps for the partial cloverleaf interchange layout are recommended to be less than the calculated total turn lane length. These movements are free-flow right-turns and, therefore; vehicles will only be required to slow down to a speed safe to turn, but never anticipated to stop. With the recommended 150 feet of storage at these locations, the Synchro output indicates no queue spill back into the through lane. The eastbound right-turn lane length at the Dean Road and EB I-10 off-ramp is recommended to be greater than the calculated total turn lane length to match the recommended left-turn storage length at this location.

6 PROBABLE COST

6.1 Order of Magnitude of Project Cost

The order of magnitude estimate of project cost for the each alternative includes for right-of-way, design and for construction management as shown in Table 14 and 15. The estimated unit costs are based on the unit prices obtained from recent ADOT bid results. The estimated costs for right-of-way were provided by Western Land Company LLC.

Table 14: Order of Cost for Diamond Interchange

ITEM	ITEM DESCRIPTION	UNIT	UNIT PRICE	QUANTITY	TOTAL
1	NEW PAVEMENT	SY	$ 45.00	58,500	$ 2,632,500.00
2	AGGREGATE BASE, CLASS 2	CY	$ 32.00	22,500	$ 720,000.00
3	ROADWAY EXCAVATION	CY	$ 11.00	27,000	$ 297,000.00
4	BORROW (IN PLACE)	CY	$ 9.00	41,000	$ 369,000.00
5	DRAINAGE	LSUM	N/A	15% of Item 1-4	$ 602,775.00
6	STRUCTURES	SF	$ 125.00	32,500	$ 3,737,500.00
7	LIGHTING	LSUM	N/A	5% of Items 1-4	$ 200,925.00
8	SIGNING/SIGNALS	LSUM	N/A	15% of Items 1-4	$ 602,775.00
	Total Construction Cost				**$ 9,162,475.00**
	Contingency for Unidentified Items (20%)				$ 1,832,495.00
	Subtotal				**$10,994,970.00**
	Construction Survey (2%)				$ 219,899.40
	Erosion Control (1%)				$ 109,949.70
	Quality Control (2%)				$ 219,899.40
	Maint. Protection of Traffic (12%)				$ 1,319,396.40
	Mobilization (10%)				$ 1,099,497.00
	Subtotal				**$13,963,611.90**
	Design & Construction Management (9%)				$ 1,256,725.07
	Indirect Cost Allocation (5.16%)				$ 720,522.37
	Subtotal				**$15,940,859.35**
	ROW ACQUISITION	ACRE	$60,000.00	33.4	$ 2,004,000.00
	UTILITIES	LSUM	N/A	1	$ 200,000.00
	Order of Magnitude Project Cost				**$17,944,859.35**

Table 15: Order of Cost for Par-Clo Interchange

ITEM	ITEM DESCRIPTION	UNIT	UNIT PRICE	QUANTITY	TOTAL
1	NEW PAVEMENT	SY	$ 45.00	66,800	$ 3,006,000.00
2	AGGREGATE BASE, CLASS 2	CY	$ 32.00	24,300	$ 777,600.00
3	ROADWAY EXCAVATION	CY	$ 11.00	50,550	$ 556,050.00
4	BORROW (IN PLACE)	CY	$ 9.00	180,000	$ 1,620,000.00
5	DRAINAGE	LSUM	N/A	15% of Item 1-4	$ 893,947.50
6	STRUCTURES	SF	$ 125.00	26,320	$ 3,290,000.00
7	LIGHTING	LSUM	N/A	5% of Items 1-4	$ 297,982.50
8	SIGNING/SIGNALS	LSUM	N/A	15% of Items 1-4	$ 893,947.50
Total Construction Cost					**$11,335,527.50**
	Contingency for Unidentified Items (20%)				$ 2,267,105.50
Subtotal					**$13,602,633.00**
	Construction Survey (2%)				$ 272,052.66
	Erosion Control (1%)				$ 136,026.33
	Quality Control (2%)				$ 272,052.66
	Maint. Protection of Traffic (12%)				$ 1,632,315.96
	Mobilization (10%)				$ 1,360,263.30
Subtotal					**$17,275,343.91**
	Design & Construction Management (9%)				$ 1,554,780.95
	Indirect Cost Allocation (5.16%)				$ 891,407.75
Subtotal					**$19,721,532.61**
	ROW ACQUISITION	ACRE	$60,000.00	29.1	$ 1,746,000.00
	UTILITIES	LSUM	N/A	1	$ 200,000.00
Order of Magnitude Project Cost					**$21,667,532.61**

7 CONCLUSION

The Diamond interchange has less capital cost than the Par-Clo interchange, with less earthwork and right of way take. However, the structure is larger on the Diamond interchange which could lead to higher maintenance cost. The Par-Clo interchange has greater capacity and provides less delay so user cost savings may outweigh additional capital and operation/maintenance cost.

8 FUNDING OPTIONS

There are a number of mechanisms that can be used to finance the new Dean Road traffic interchange with Interstate 10. These can be executed through Federal, State or Local level and include:

Federal
- Transportation Infrastructure Finance and Innovation Act (TIFIA)
- Grant Anticipation Revenue Vehicles (Garvees)

State
- Grant Anticipation Notes (GAN)
- Grant Anticipated Notes (GAN)
- Highway Project Advancement Notes (H-Pan)
- Highway Extension and Expansion Loan Program (HELP)

Local
- General Obligation Bonds

To fund these financing mechanisms the Federal, State and Local governments can utilize a number of funding sources:

Federal – Transportation, State, or Regional Discretion
- Surface Transportation Program (STP)
- National Highway System (NHS)

Federal – Other
- Community Development Block Grant (CDBG)

State Shared – Transportation, Local Discretion
- Highway User Revenue Fund (HURF)
- Vehicle License Tax (VLT)

Regional – Regional Discretion
- Regional Area Road Fund (RARF)

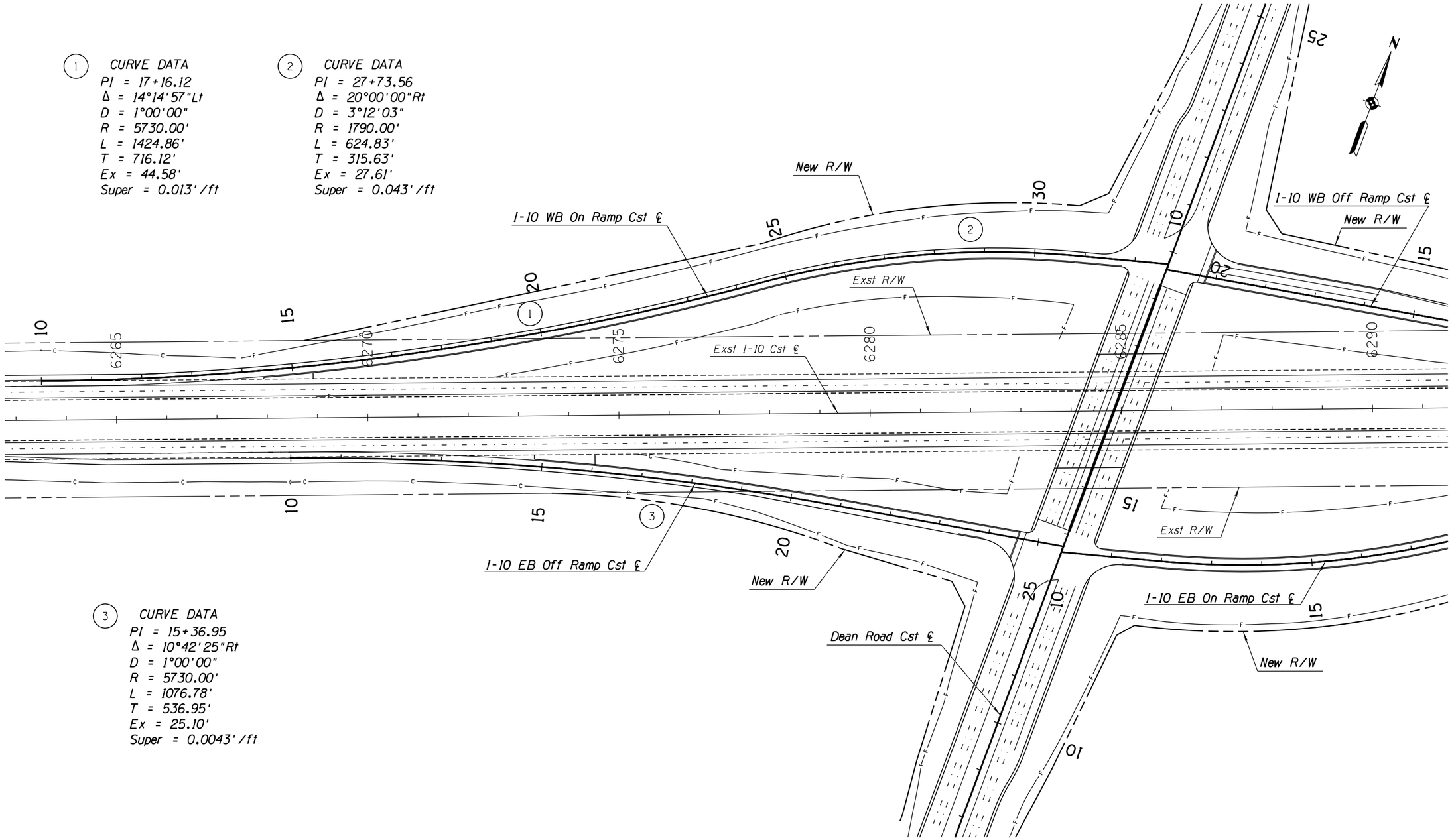
Local – Local Discretion
- Developer Contribution
  - Development Impact Fees
  - Development Stipulations
  - Development Exactions
- Other Local
  - General Fund
  - Transaction Privilege Tax
  - Hotel Bed Tax
- District
  - Local Improvement District
  - Community Facilities District

APPENDCIES

APPENDIX 1
Alternative Plans

(1) CURVE DATA
PI = 17+16.12
Δ = 14°14'57"Lt
D = 1°00'00"
R = 5730.00'
L = 1424.86'
T = 716.12'
Ex = 44.58'
Super = 0.013'/ft

(2) CURVE DATA
PI = 27+73.56
Δ = 20°00'00"Rt
D = 3°12'03"
R = 1790.00'
L = 624.83'
T = 315.63'
Ex = 27.61'
Super = 0.043'/ft



(3) CURVE DATA
PI = 15+36.95
Δ = 10°42'25"Rt
D = 1°00'00"
R = 5730.00'
L = 1076.78'
T = 536.95'
Ex = 25.10'
Super = 0.0043'/ft

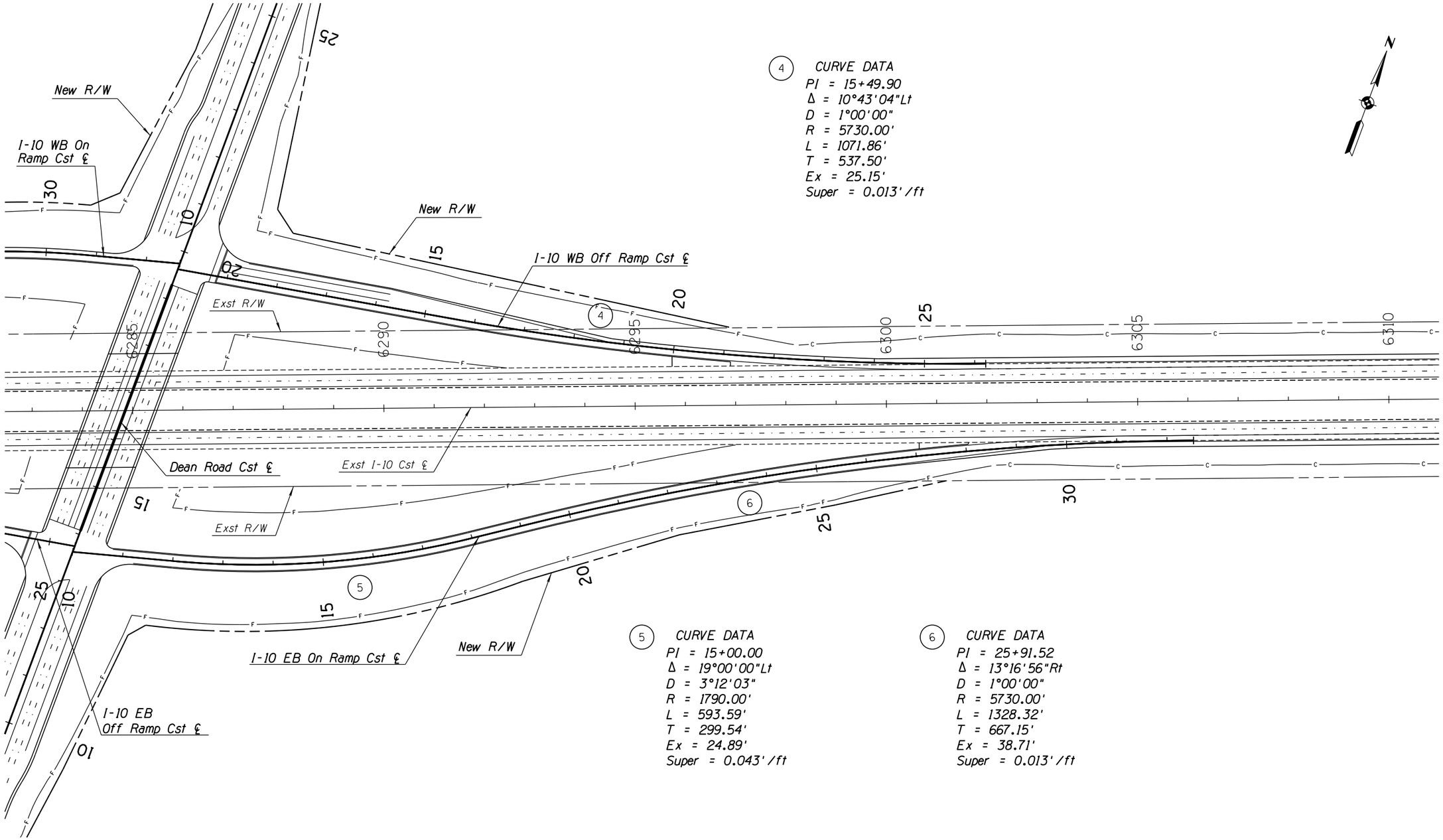
MARICOPA ASSOCIATION of GOVERNMENTS

FULL DIAMOND

I–10 WB ON RAMP &
I–10 EB OFF RAMP
PLAN SHEET

SHEET 01

Baker



4 CURVE DATA
PI = 15+49.90
Δ = 10°43'04"Lt
D = 1°00'00"
R = 5730.00'
L = 1071.86'
T = 537.50'
Ex = 25.15'
Super = 0.013'/ft

5 CURVE DATA
PI = 15+00.00
Δ = 19°00'00"Lt
D = 3°12'03"
R = 1790.00'
L = 593.59'
T = 299.54'
Ex = 24.89'
Super = 0.043'/ft

6 CURVE DATA
PI = 25+91.52
Δ = 13°16'56"Rt
D = 1°00'00"
R = 5730.00'
L = 1328.32'
T = 667.15'
Ex = 38.71'
Super = 0.013'/ft

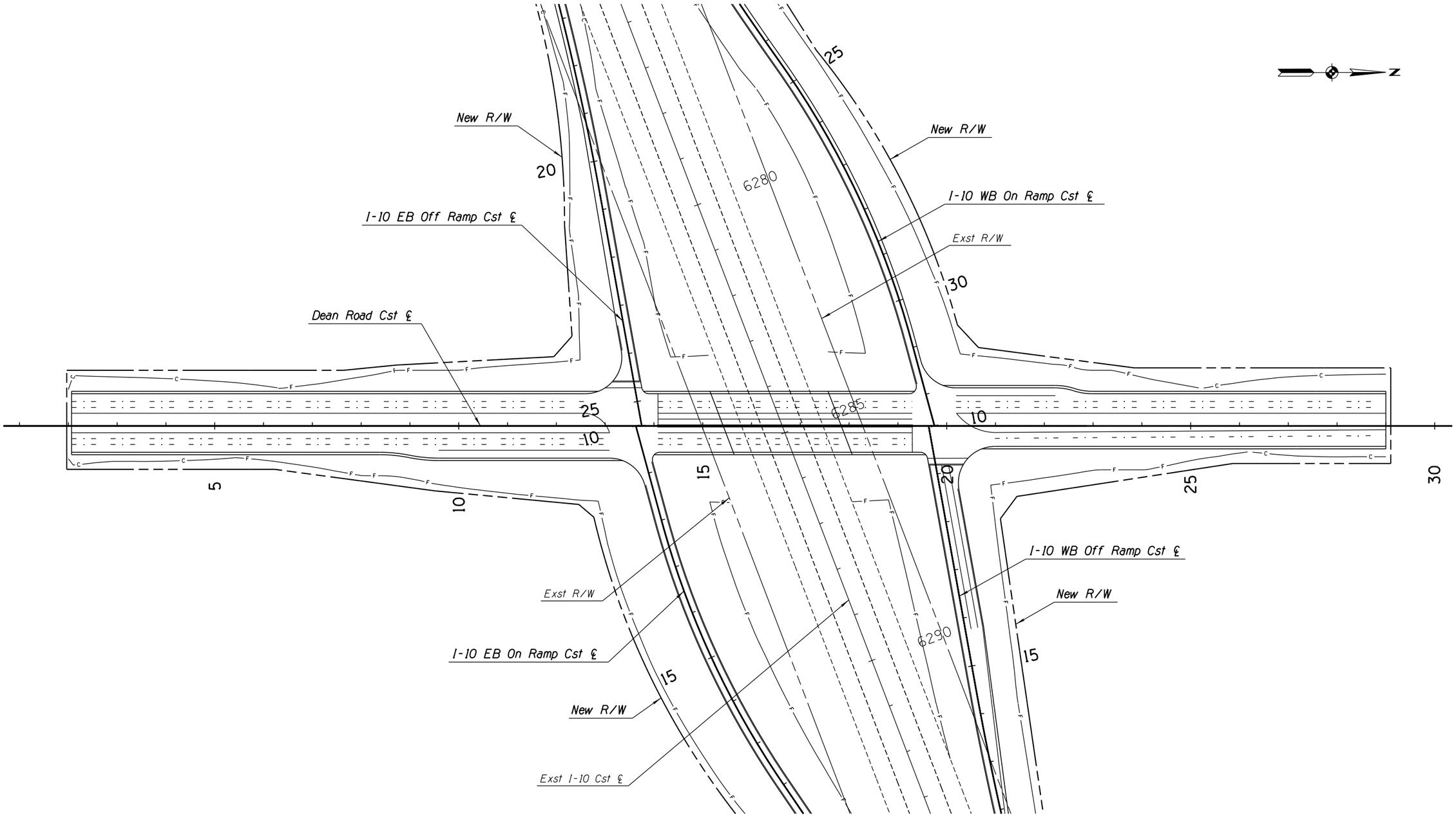
MARICOPA ASSOCIATION of GOVERNMENTS

FULL DIAMOND

I–10 EB ON RAMP & I–10 WB OFF RAMP PLAN SHEET

SHEET 02

Baker

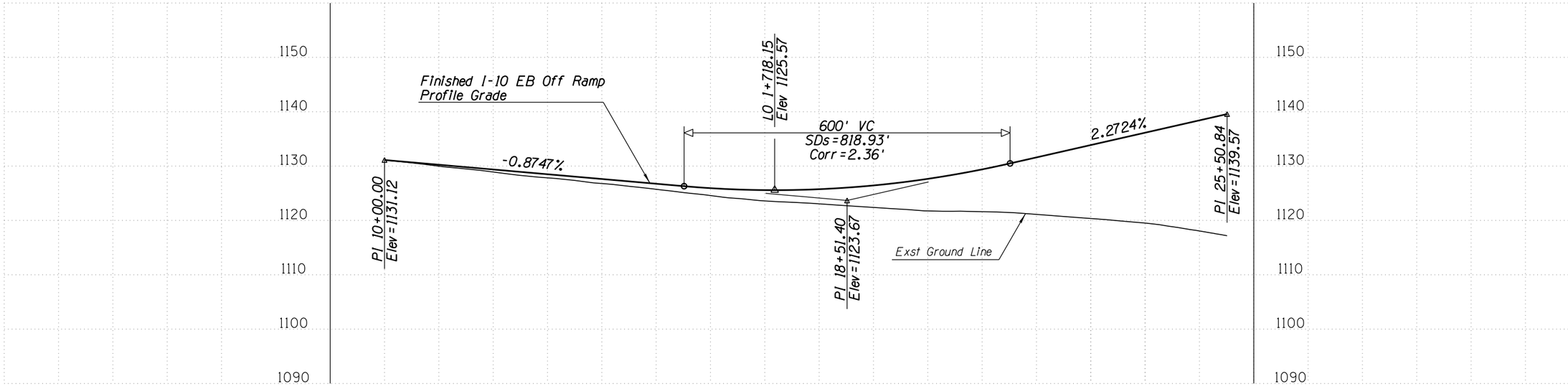


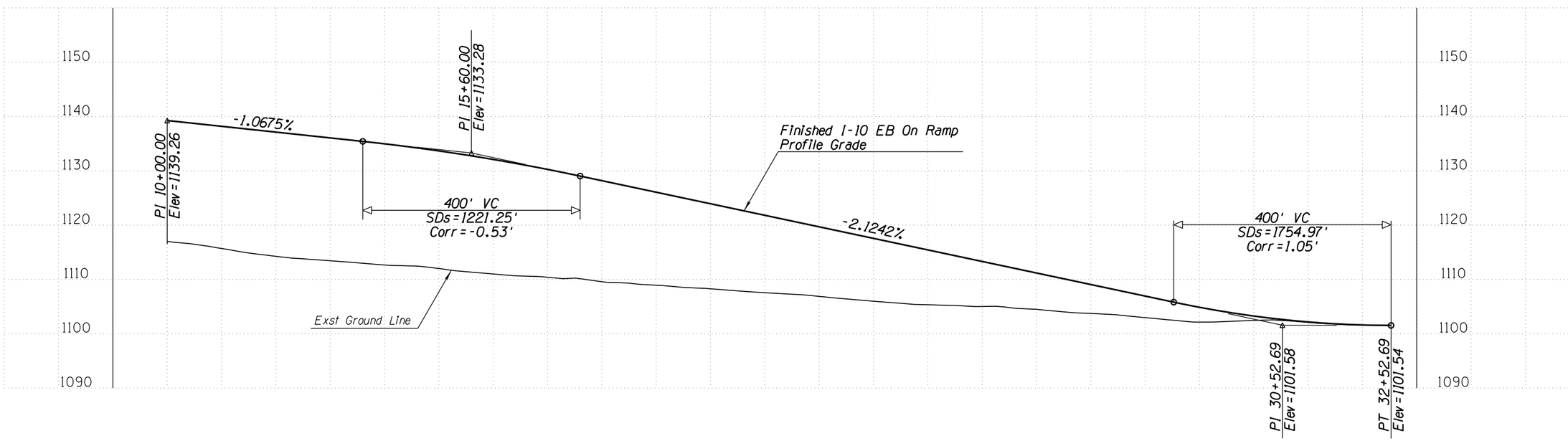
MARICOPA ASSOCIATION of GOVERNMENTS

FULL DIAMOND
DEAN ROAD

DEAN ROAD
PLAN SHEET
STA 2+06.61 TO STA 29+00
SHEET 03

Baker





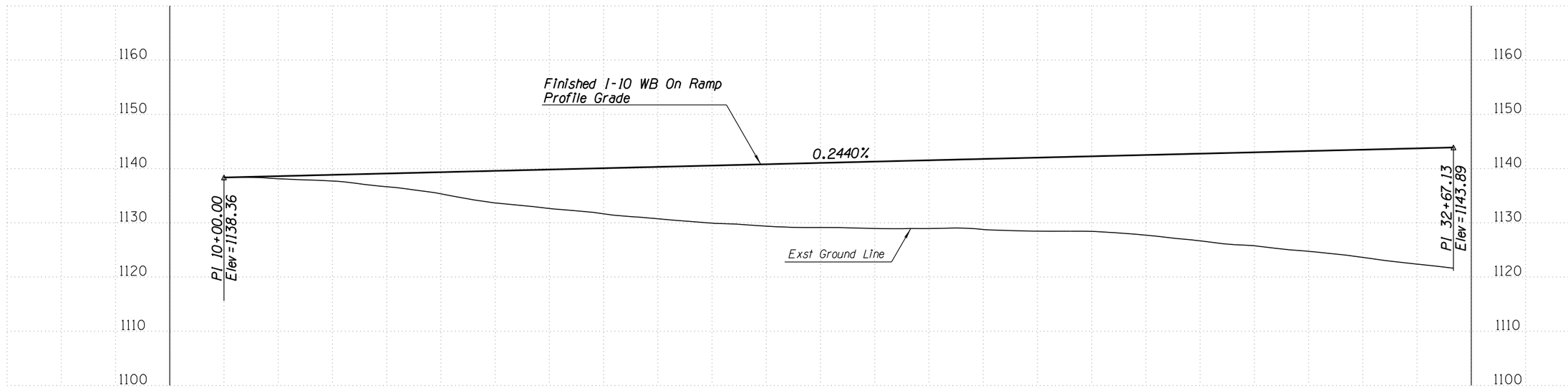
MARICOPA ASSOCIATION of GOVERNMENTS

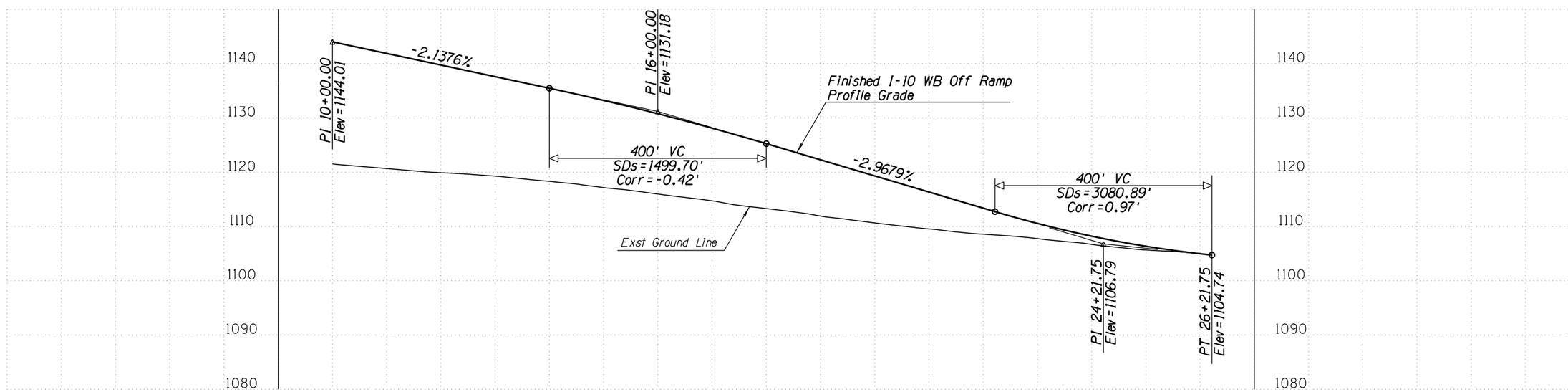
FULL DIAMOND

1–10 EB OFF RAMP & 1–10 EB ON RAMP PROFILE SHEET

SHEET 04

Baker





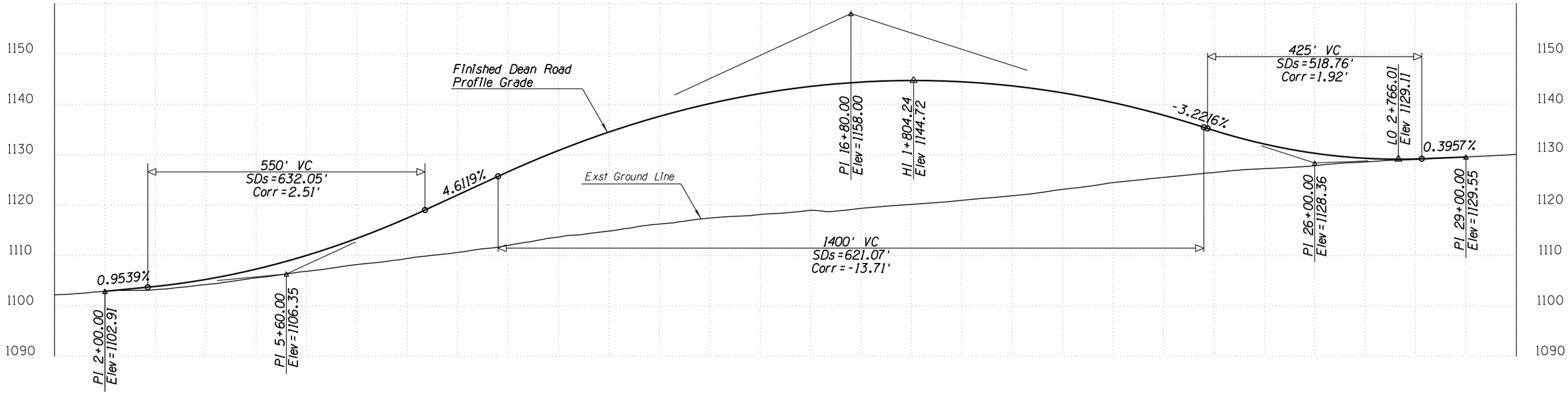
MARICOPA ASSOCIATION of GOVERNMENTS

FULL DIAMOND

1–10 WB ON RAMP & 1–10 WB OFF RAMP PROFILE SHEET

SHEET 05

Baker



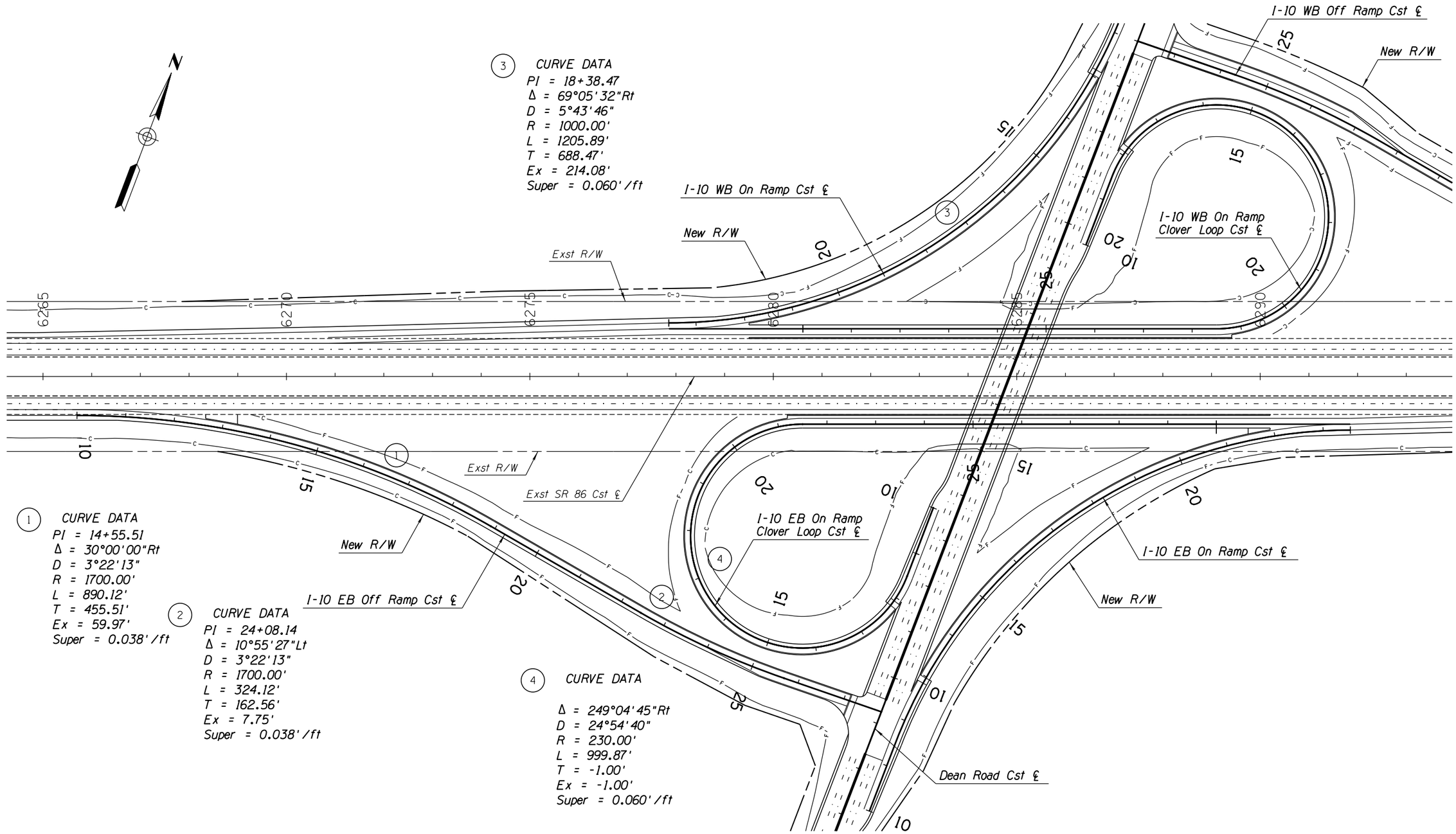
MARICOPA ASSOCIATION of GOVERNMENTS

DEAN ROAD

DEAN ROAD
PROFILE SHEET

SHEET 06

Baker

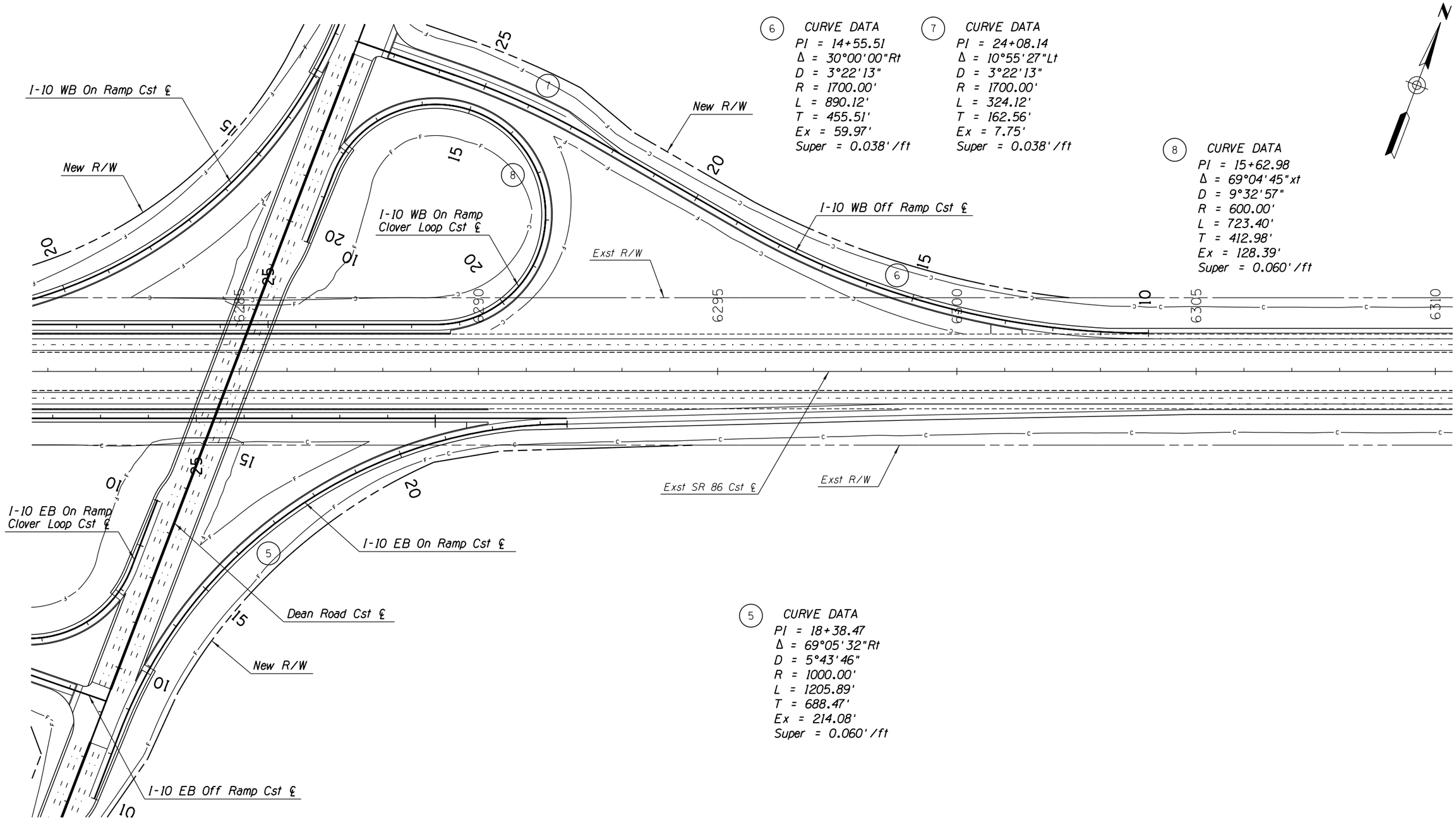


MARICOPA ASSOCIATION of GOVERNMENTS

PARTIAL CLOVERLEAF (65 MPH)

I–10 EB OFF RAMP
I–10 WB ON RAMP
I–10 EB ON RAMP CLOVERLEAF
PLAN SHEET
SHEET 01

Baker



(6) CURVE DATA
PI = 14+55.51
Δ = 30°00'00"Rt
D = 3°22'13"
R = 1700.00'
L = 890.12'
T = 455.51'
Ex = 59.97'
Super = 0.038'/ft

(7) CURVE DATA
PI = 24+08.14
Δ = 10°55'27"Lt
D = 3°22'13"
R = 1700.00'
L = 324.12'
T = 162.56'
Ex = 7.75'
Super = 0.038'/ft

(8) CURVE DATA
PI = 15+62.98
Δ = 69°04'45"xt
D = 9°32'57"
R = 600.00'
L = 723.40'
T = 412.98'
Ex = 128.39'
Super = 0.060'/ft

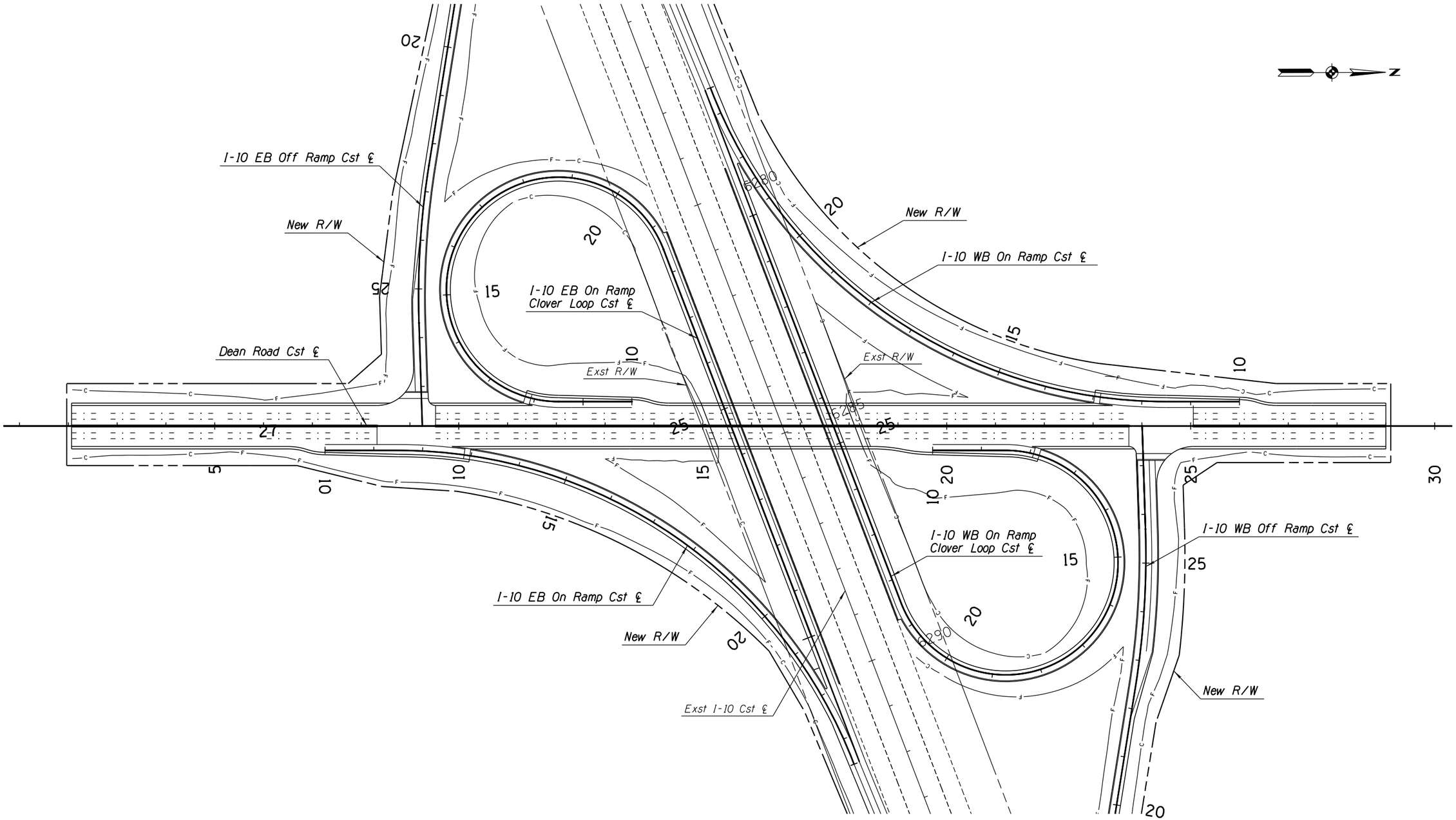
(5) CURVE DATA
PI = 18+38.47
Δ = 69°05'32"Rt
D = 5°43'46"
R = 1000.00'
L = 1205.89'
T = 688.47'
Ex = 214.08'
Super = 0.060'/ft

MARICOPA ASSOCIATION of GOVERNMENTS

PARTIAL CLOVERLEAF (65 MPH)

I-10 EB ON RAMP
I-10 WB OFF RAMP
I-10 WB ON RAMP CLOVERLEAF
PLAN SHEET
SHEET 02

Baker

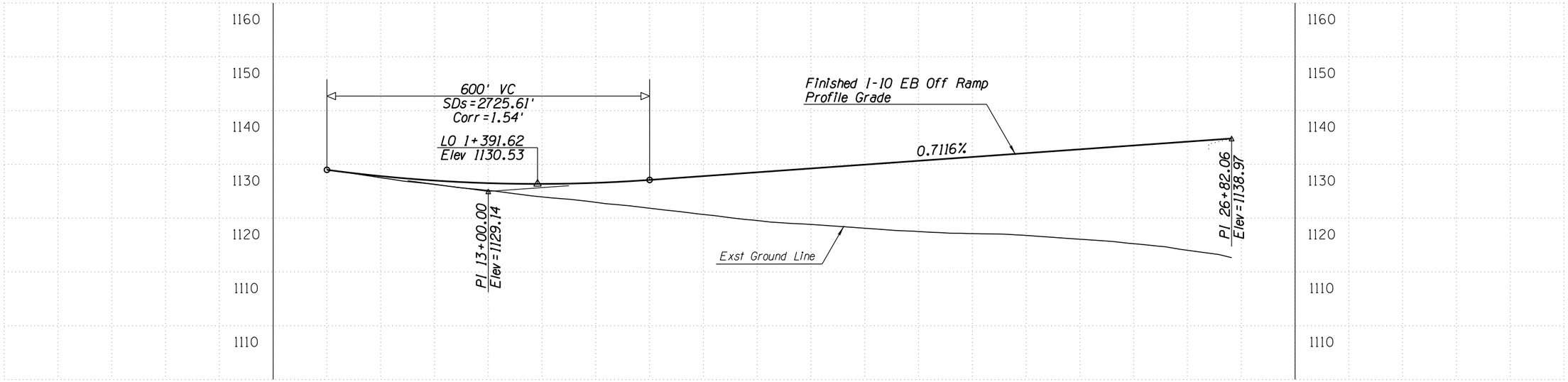


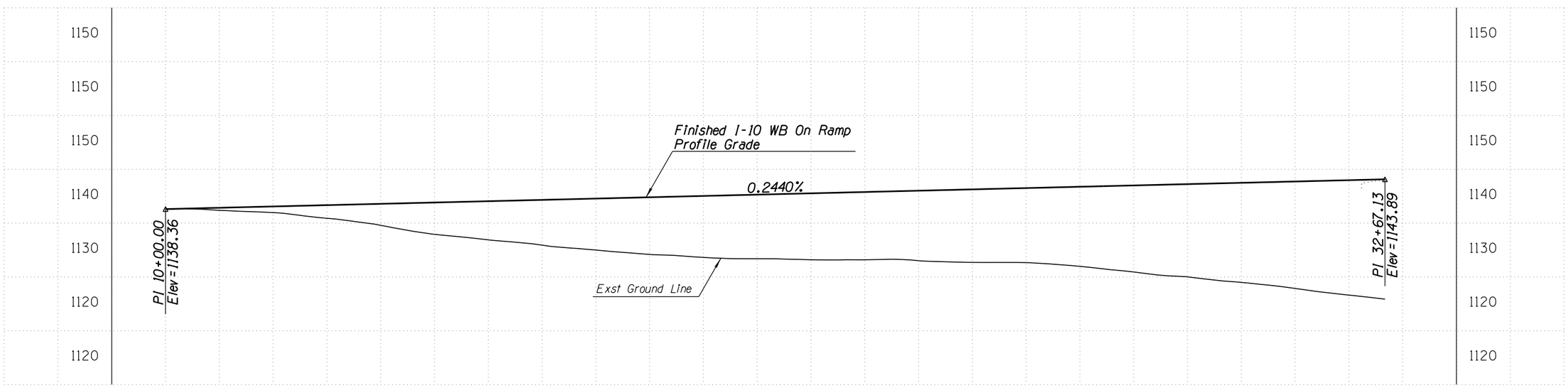
MARICOPA ASSOCIATION of GOVERNMENTS

PARTIAL CLOVERLEAF (65 MPH) DEAN ROAD

DEAN ROAD
PLAN SHEET
STA 2+06.61 TO STA 29+00
SHEET 03

Baker





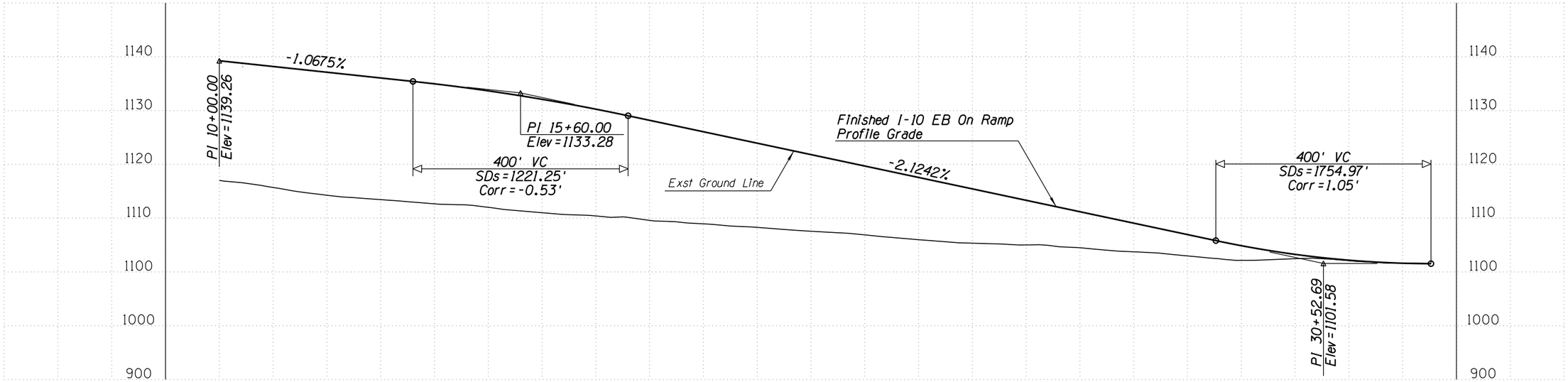
MARICOPA ASSOCIATION of GOVERNMENTS

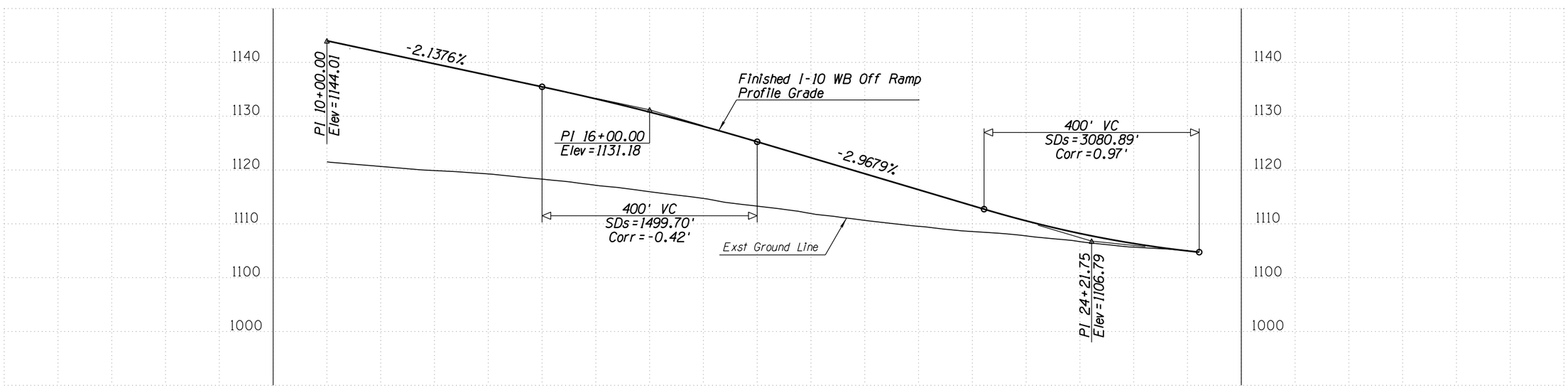
PARTIAL CLOVERLEAF (65 MPH)

I–10 EB OFF RAMP
& I–10 WB ON RAMP
PROFILE SHEET

SHEET 04

Baker





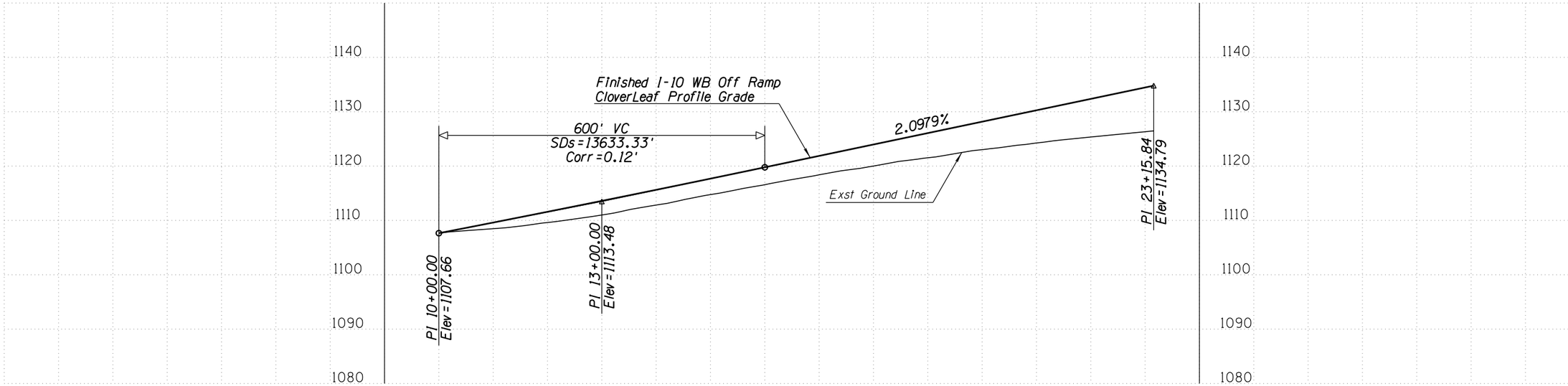
MARICOPA ASSOCIATION of GOVERNMENTS

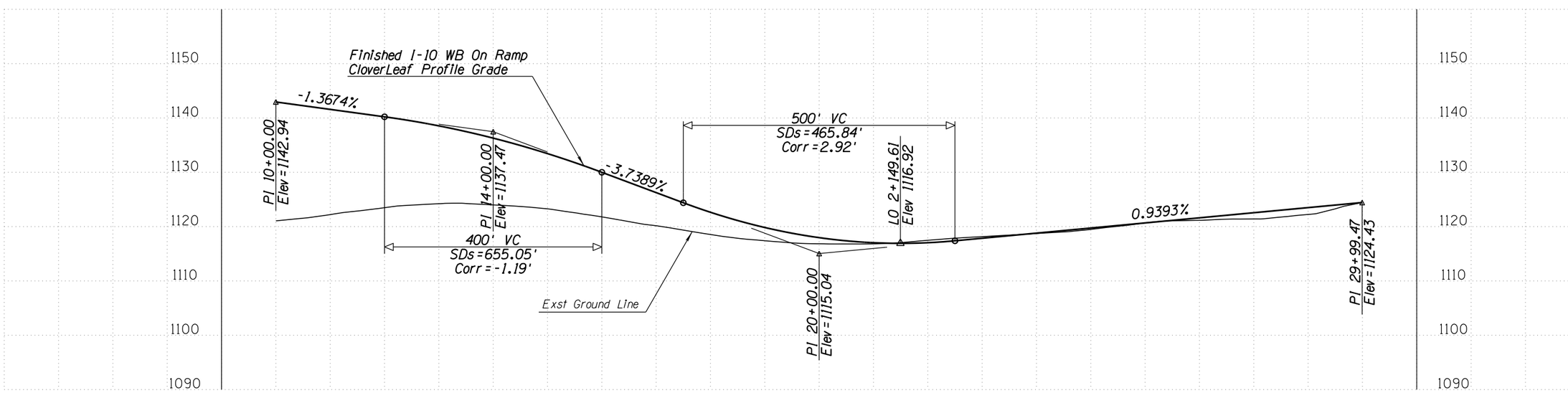
PARTIAL CLOVERLEAF (65 MPH)

I–10 EB ON RAMP
& I–10 WB OFF RAMP
PROFILE SHEET

SHEET 05

Baker





MARICOPA ASSOCIATION of GOVERNMENTS

PARTIAL CLOVERLEAF (65 MPH)

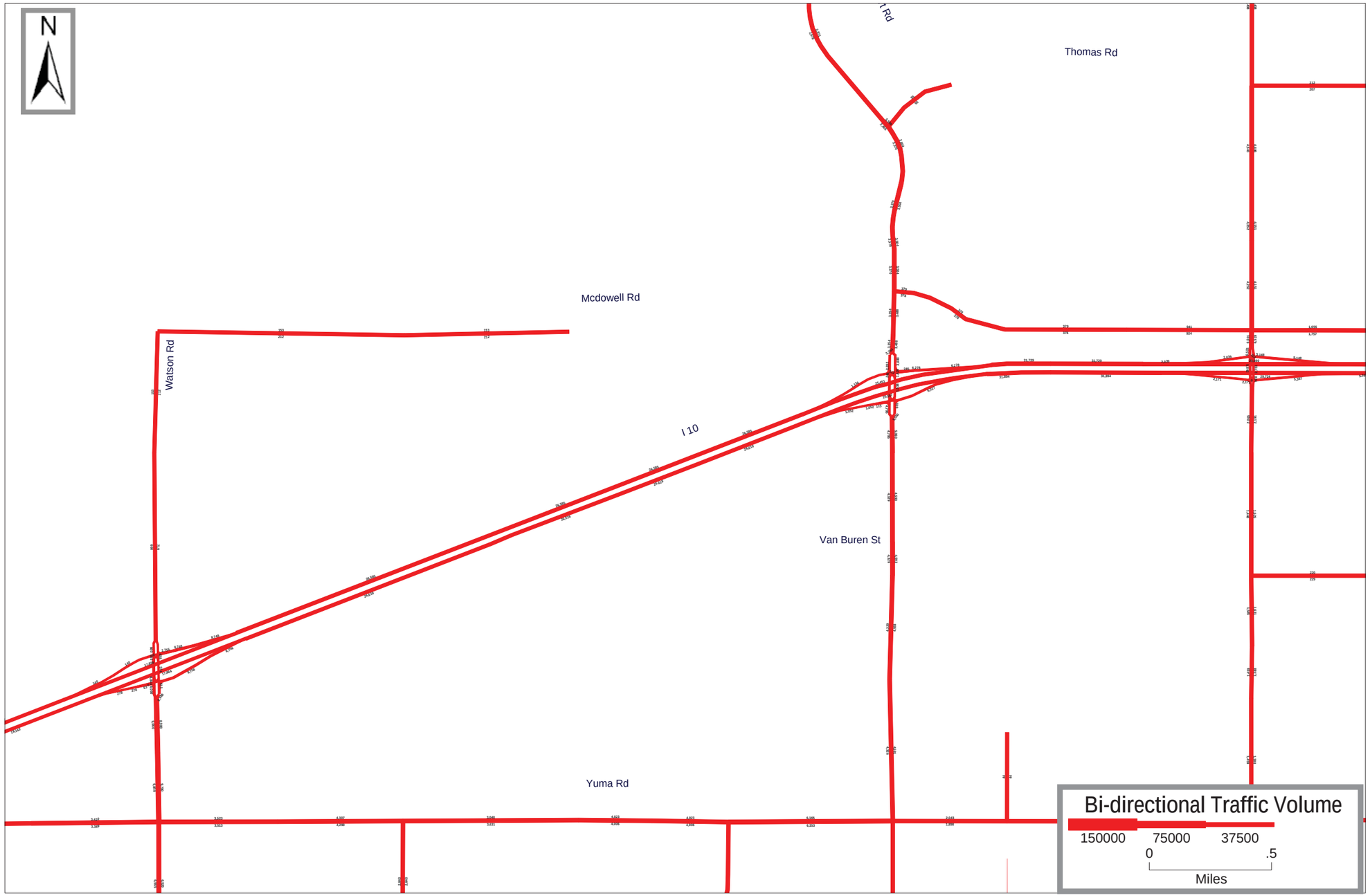
I-10 WB OFF RAMP CLOVERLEAF
I-10 EB ON RAMP CLOVERLEAF
PROFILE SHEET

SHEET 06

Baker

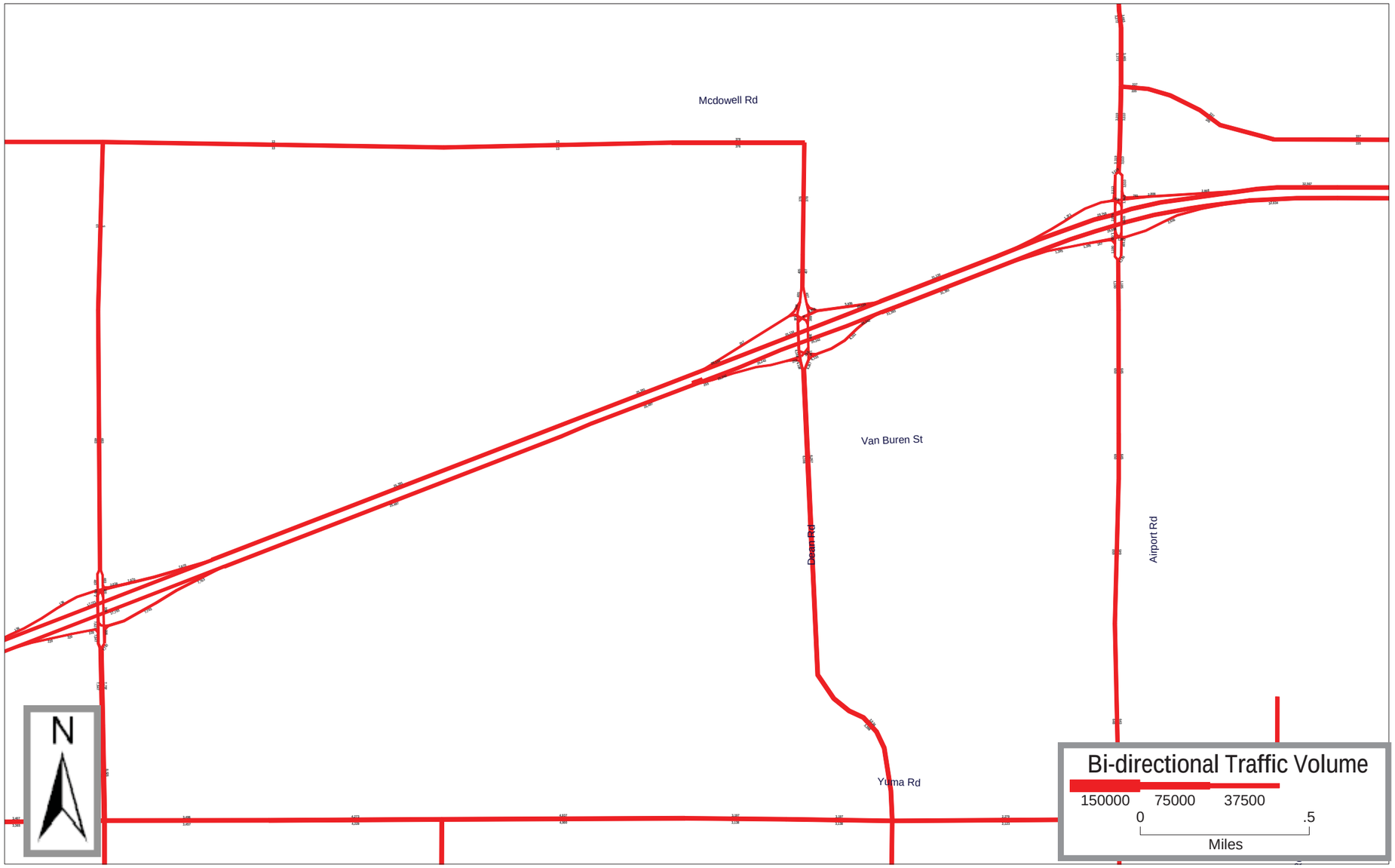
APPENDIX 2
Traffic Counts

2011 Average Daily Traffic Volumes-- No Build Scenario



Shuo Wang, Mon Apr 21 10:39:44 2014

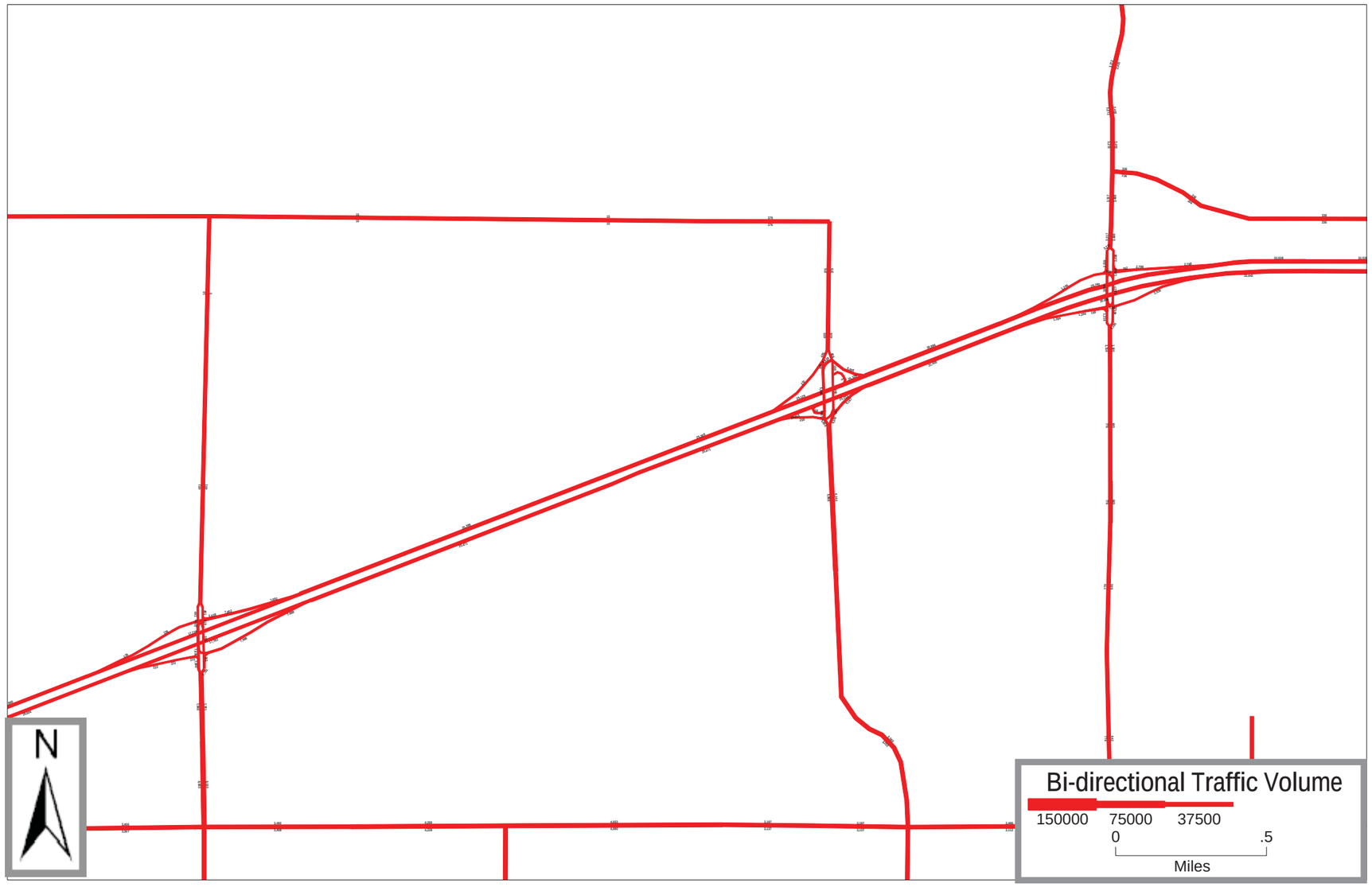
2011 Average Daily Traffic Volumes - S1 Diamond Interchange



Shuo Wang, Wed May 14 09:18:29 2014

Source: D:\1SWANG\5.Requests\2014_Requests\TR_1237\2011\S1_2011

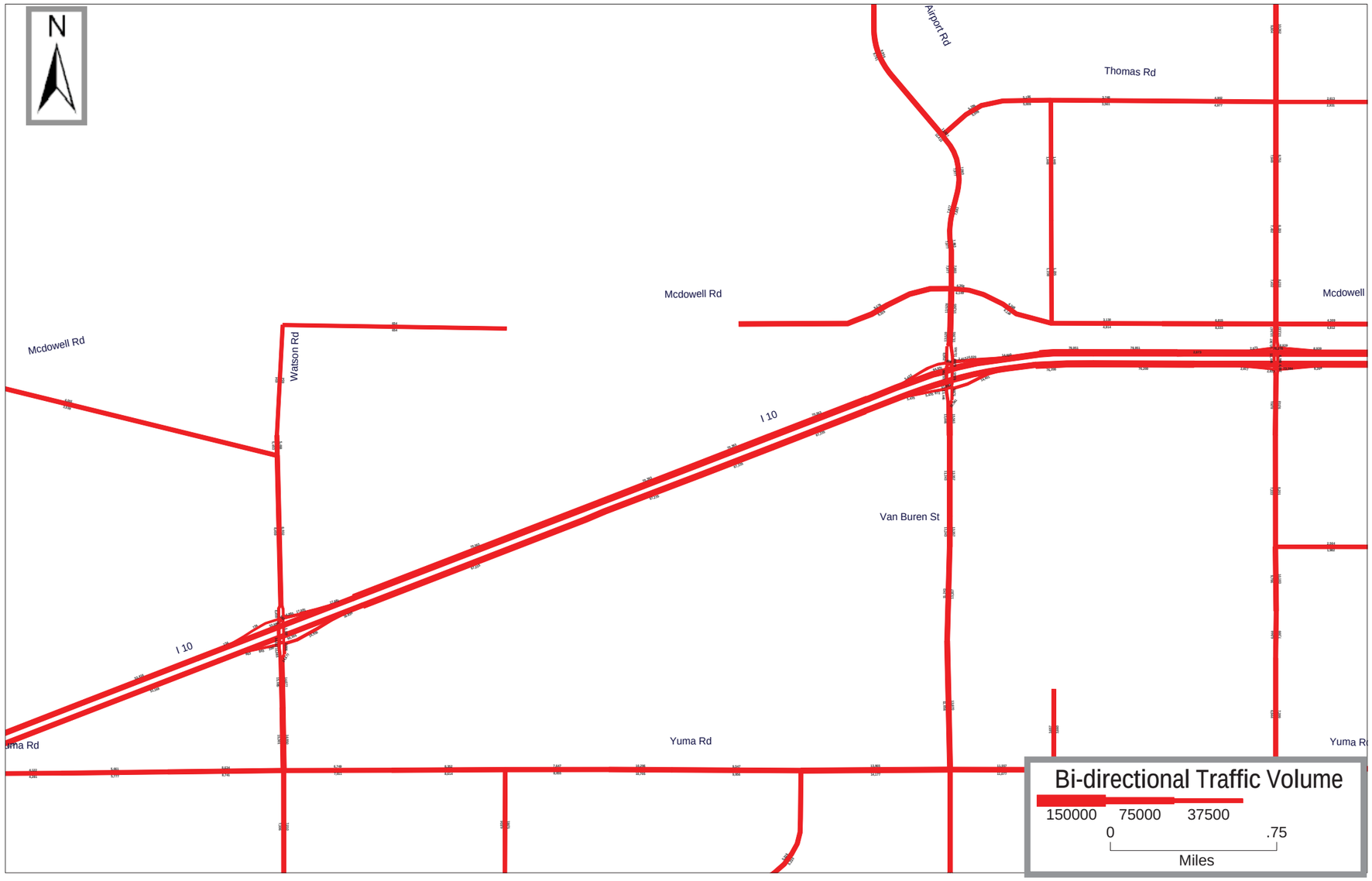
2011 Average Daily Traffic Volumes - S2 Partial Cloverleaf



Shuo Wang, Wed May 14 09:41:04 2014

Source: D:\1SWANG\5.Requests\2014_Requests\TR_1237\2011\S2_2011

2035 Average Daily Traffic Volumes-- No Build Scenario



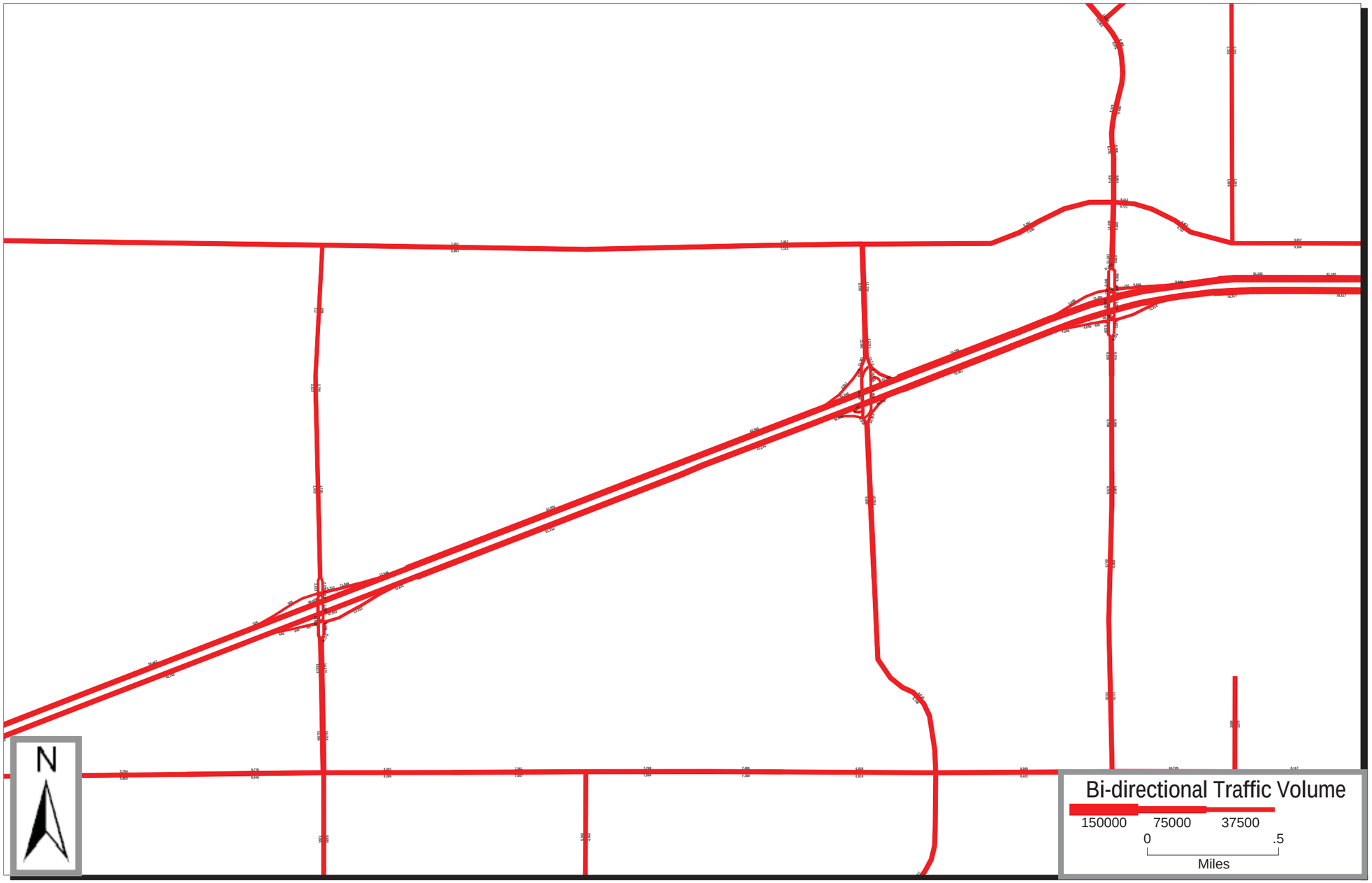
Shuo Wang, Wed Apr 23 09:28:36 2014

2035 Average Daily Traffic Volumes -- S1 Diamond Interchange

Shuo Wang, Wed May 14 09:50:01 2014

Source: D:\1SWANG\5.Requests\2014_Requests\TR_1237\2035\S1_2035

2035 Average Daily Traffic Volumes -- S2 Partial Cloverleaf



Shuo Wang, Wed May 14 10:04:53 2014

Source: D:\1SWANG\5.Requests\2014_Requests\TR_1237\2035\S2_2035

APPENDIX 3
2035 LOS Analysis

HCM Signalized Intersection Capacity Analysis
1: Dean Rd & WB Ramp 7/7/2014

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	629	0	673	33	585	0	0	932	236
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.97	0.95	0.95	1.00	0.91			0.91	1.00
Frpb, ped/bikes				1.00	0.96	0.96	1.00	1.00			1.00	0.93
Flpb, ped/bikes				1.00	1.00	1.00	1.00	1.00			1.00	1.00
Frt				1.00	0.85	0.85	1.00	1.00			1.00	0.85
Flt Protected				0.95	1.00	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				3433	1442	1442	1770	5085			5085	1474
Flt Permitted				0.95	1.00	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				3433	1442	1442	1770	5085			5085	1474
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	684	0	732	36	636	0	0	1013	257
RTOR Reduction (vph)	0	0	0	0	211	211	0	0	0	0	0	192
Lane Group Flow (vph)	0	0	0	684	155	155	36	636	0	0	1013	65
Confl. Peds. (#/hr)						20						20
Turn Type				Perm	NA	Perm	Prot	NA			NA	Perm
Protected Phases					4 12		1	2 1			2	
Permitted Phases				4 12		4 12						2
Actuated Green, G (s)				22.0	22.0	22.0	25.7	50.0			20.3	20.3
Effective Green, g (s)				22.0	22.0	22.0	25.7	50.0			20.3	20.3
Actuated g/C Ratio				0.28	0.28	0.28	0.32	0.62			0.25	0.25
Clearance Time (s)							4.0				4.0	4.0
Vehicle Extension (s)							4.7				4.7	4.7
Lane Grp Cap (vph)				944	396	396	568	3178			1290	374
v/s Ratio Prot					0.11		0.02	c0.13			c0.20	
v/s Ratio Perm				c0.20		0.11						0.04
v/c Ratio				0.72	0.39	0.39	0.06	0.20			0.79	0.17
Uniform Delay, d1				26.3	23.6	23.6	18.8	6.4			27.8	23.3
Progression Factor				1.00	1.00	1.00	0.27	0.17			1.00	1.00
Incremental Delay, d2				2.8	0.6	0.6	0.1	0.0			4.9	1.0
Delay (s)				29.0	24.2	24.2	5.1	1.1			32.7	24.3
Level of Service				C	C	C	A	A			C	C
Approach Delay (s)		0.0			26.5			1.3			31.0	
Approach LOS		A			C			A			C	

Intersection Summary			
HCM 2000 Control Delay	23.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	68.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Dianmond Interchange Synchro 8 Report
Page 1

HCM Signalized Intersection Capacity Analysis
2: Dean Rd & EB Ramp 7/7/2014

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	233	0	39	0	0	0	0	385	661	571	990	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0						4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00						0.86	0.86	0.97	0.91	
Frpb, ped/bikes	1.00	0.96						0.98	0.96	1.00	1.00	
Flpb, ped/bikes	1.00	1.00						1.00	1.00	1.00	1.00	
Frt	1.00	0.85						0.93	0.85	1.00	1.00	
Flt Protected	0.95	1.00						1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1518						4387	1305	3433	5085	
Flt Permitted	0.95	1.00						1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1518						4387	1305	3433	5085	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	253	0	42	0	0	0	0	418	718	621	1076	0
RTOR Reduction (vph)	0	29	0	0	0	0	0	194	287	0	0	0
Lane Group Flow (vph)	253	13	0	0	0	0	0	583	72	621	1076	0
Confl. Peds. (#/hr)			20						20			
Turn Type	Perm	NA						NA	Perm	Prot	NA	
Protected Phases		8 16						6		5	5 6	
Permitted Phases	8 16								6			
Actuated Green, G (s)	24.0	24.0						16.0	16.0	28.0	48.0	
Effective Green, g (s)	24.0	24.0						16.0	16.0	28.0	48.0	
Actuated g/C Ratio	0.30	0.30						0.20	0.20	0.35	0.60	
Clearance Time (s)								4.0	4.0	4.0		
Vehicle Extension (s)								4.7	4.7	4.7		
Lane Grp Cap (vph)	531	455						877	261	1201	3051	
v/s Ratio Prot		0.01						c0.13		c0.18	0.21	
v/s Ratio Perm	c0.14								0.06			
v/c Ratio	0.48	0.03						0.66	0.28	0.52	0.35	
Uniform Delay, d1	22.9	19.8						29.5	27.1	20.6	8.1	
Progression Factor	1.00	1.00						1.00	1.00	0.03	0.01	
Incremental Delay, d2	0.7	0.0						2.4	1.1	0.4	0.1	
Delay (s)	23.5	19.8						31.9	28.2	1.1	0.2	
Level of Service	C	B						C	C	A	A	
Approach Delay (s)		23.0			0.0			30.7			0.5	
Approach LOS		C			A			C			A	

Intersection Summary			
HCM 2000 Control Delay	13.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	68.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Dianmond Interchange Synchro 8 Report
Page 2

HCM Signalized Intersection Capacity Analysis
6: EB Off Ramp & Dean Rd

7/7/2014

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	232	32	0	376	955	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		0.91	0.91	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		5085	5085	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		5085	5085	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	252	35	0	409	1038	0
RTOR Reduction (vph)	0	21	0	0	0	0
Lane Group Flow (vph)	252	14	0	409	1038	0
Turn Type	Prot	Perm		NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4				
Actuated Green, G (s)	37.0	37.0		45.0	45.0	
Effective Green, g (s)	37.0	37.0		45.0	45.0	
Actuated g/C Ratio	0.41	0.41		0.50	0.50	
Clearance Time (s)	4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)	727	650		2542	2542	
v/s Ratio Prot	c0.14			0.08	c0.20	
v/s Ratio Perm		0.01				
v/c Ratio	0.35	0.02		0.16	0.41	
Uniform Delay, d1	18.2	15.7		12.2	14.1	
Progression Factor	1.00	1.00		1.00	0.71	
Incremental Delay, d2	1.3	0.1		0.1	0.4	
Delay (s)	19.5	15.8		12.4	10.4	
Level of Service	B	B		B	B	
Approach Delay (s)	19.1			12.4	10.4	
Approach LOS	B			B	B	

Intersection Summary			
HCM 2000 Control Delay	12.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	38.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Partial Cloverleaf

Synchro 8 Report
Page 1

HCM Signalized Intersection Capacity Analysis
11: Dean Rd & WB Off Ramp

7/7/2014

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	600	793	579	0	0	871
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	0.97	0.91	0.91			0.91
Frt	0.94	0.85	1.00			1.00
Flt Protected	0.97	1.00	1.00			1.00
Satd. Flow (prot)	3310	1441	5085			5085
Flt Permitted	0.97	1.00	1.00			1.00
Satd. Flow (perm)	3310	1441	5085			5085
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	652	862	629	0	0	947
RTOR Reduction (vph)	97	97	0	0	0	0
Lane Group Flow (vph)	934	386	629	0	0	947
Turn Type	Prot	Perm	NA			NA
Protected Phases	8		2			6
Permitted Phases		8				
Actuated Green, G (s)	41.0	41.0	41.0			41.0
Effective Green, g (s)	41.0	41.0	41.0			41.0
Actuated g/C Ratio	0.46	0.46	0.46			0.46
Clearance Time (s)	4.0	4.0	4.0			4.0
Lane Grp Cap (vph)	1507	656	2316			2316
v/s Ratio Prot	c0.28		0.12			c0.19
v/s Ratio Perm		0.27				
v/c Ratio	0.62	0.59	0.27			0.41
Uniform Delay, d1	18.6	18.2	15.2			16.4
Progression Factor	1.00	1.00	0.75			1.00
Incremental Delay, d2	1.9	3.8	0.3			0.5
Delay (s)	20.5	22.1	11.6			16.9
Level of Service	C	C	B			B
Approach Delay (s)	21.0		11.6			16.9
Approach LOS	C		B			B

Intersection Summary			
HCM 2000 Control Delay	17.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	50.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Partial Cloverleaf

Synchro 8 Report
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HCM Unsignalized Intersection Capacity Analysis
3: Dean Rd & N - EB On Ramp

7/7/2014

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations			↑↑↑	↱		↑↑↑
Volume (veh/h)	0	0	376	703	0	987
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	409	764	0	1073
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						193
pX, platoon unblocked	0.87					
vC, conflicting volume	766	136			1173	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	232	136			1173	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	100			100	
cM capacity (veh/h)	644	887			591	

Direction, Lane #	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3
Volume Total	136	136	136	764	358	358	358
Volume Left	0	0	0	0	0	0	0
Volume Right	0	0	0	764	0	0	0
cSH	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.08	0.08	0.08	0.45	0.21	0.21	0.21
Queue Length 95th (ft)	0	0	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS							
Approach Delay (s)	0.0				0.0		
Approach LOS							

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	46.9%	ICU Level of Service	A
Analysis Period (min)	15		

Partial Cloverleaf

Synchro 8 Report
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HCM Unsignalized Intersection Capacity Analysis
7: Dean Rd & S - EB On Ramp

7/7/2014

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations				↑↑↑	↑↑↑	↱
Volume (veh/h)	0	0	0	607	955	517
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	0	660	1038	562
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				543	935	
pX, platoon unblocked	0.98	1.00	1.00			
vC, conflicting volume	1258	346	1600			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1169	338	1594			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	100			
cM capacity (veh/h)	182	657	406			

Direction, Lane #	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3	SB 4
Volume Total	220	220	220	346	346	346	562
Volume Left	0	0	0	0	0	0	0
Volume Right	0	0	0	0	0	0	562
cSH	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.13	0.13	0.13	0.20	0.20	0.20	0.33
Queue Length 95th (ft)	0	0	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS							
Approach Delay (s)	0.0			0.0			
Approach LOS							

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	38.0%	ICU Level of Service	A
Analysis Period (min)	15		

Partial Cloverleaf

Synchro 8 Report
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HCM Unsignalized Intersection Capacity Analysis
9: Dean Rd & N - WB On Ramp 7/7/2014

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	0	579	29	0	1471
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	629	32	0	1599
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)			1096			382
pX, platoon unblocked	0.88					
vC, conflicting volume	1178	226			661	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	726	226			661	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	100			100	
cM capacity (veh/h)	317	778			923	

Direction, Lane #	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	252	252	157	533	533	533
Volume Left	0	0	0	0	0	0
Volume Right	0	0	32	0	0	0
cSH	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.15	0.15	0.09	0.31	0.31	0.31
Queue Length 95th (ft)	0	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS						
Approach Delay (s)	0.0			0.0		
Approach LOS						

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	50.6%	ICU Level of Service	A
Analysis Period (min)	15		

Partial Cloverleaf
Synchro 8 Report
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HCM Unsignalized Intersection Capacity Analysis
13: S - WB On Ramp & Dean Rd 7/7/2014

Movement	NBL	NBT	SBT	SBR	NEL	NER
Lane Configurations						
Volume (veh/h)	0	1372	871	236	0	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	1491	947	257	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		254				
pX, platoon unblocked					0.93	
vC, conflicting volume	1203				1444	316
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1203				1206	316
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	576				163	680

Direction, Lane #	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3	SB 4
Volume Total	497	497	497	316	316	316	257
Volume Left	0	0	0	0	0	0	0
Volume Right	0	0	0	0	0	0	257
cSH	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.29	0.29	0.29	0.19	0.19	0.19	0.15
Queue Length 95th (ft)	0	0	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS							
Approach Delay (s)	0.0			0.0			
Approach LOS							

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	29.8%	ICU Level of Service	A
Analysis Period (min)	15		

Partial Cloverleaf
Synchro 8 Report
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APPENDIX 4
Right Turn and Left Turn Storage Lengths

Diamond Interchange Turn Lanes

LEFT-TURN STORAGE LANE LENGTH [(VEHICLES PER CYCLE) x 25 FEET]
DEAN ROAD AND WB I-10 RAMPS - NORTHBOUND LEFT

TIME PERIOD	LEFT TURN VOLUME	LEFT TURN LANES	CYCLE LENGTH	LEFT TURN QUEUE ACTUAL	LEFT TURN QUEUE ROUNDED	STORAGE LENGTH (FT)	Breaking Distance	Gap	Total (Storage+Breaking)
Peak Hour	33	1	80	0.73	1	25	50	60	75

LEFT-TURN STORAGE LANE LENGTH [(VEHICLES PER CYCLE) x 25 FEET]
DEAN ROAD AND EB I-10 RAMPS - SOUTHBOUND LEFT

TIME PERIOD	LEFT TURN VOLUME	LEFT TURN LANES	CYCLE LENGTH	LEFT TURN QUEUE ACTUAL	LEFT TURN QUEUE ROUNDED	STORAGE LENGTH (FT)	Breaking Distance	Gap	Total (Storage+Breaking)
Peak Hour	571	2	80	6.34	7	175	50	60	225

LEFT-TURN STORAGE LANE LENGTH [(VEHICLES PER CYCLE) x 25 FEET]
DEAN ROAD AND EB I-10 RAMPS - EASTBOUND LEFT

TIME PERIOD	LEFT TURN VOLUME	LEFT TURN LANES	CYCLE LENGTH	LEFT TURN QUEUE ACTUAL	LEFT TURN QUEUE ROUNDED	STORAGE LENGTH (FT)	Breaking Distance	Gap	Total (Storage+Breaking)
Peak Hour	233	1	80	5.18	6	150	40	40	190

LEFT-TURN STORAGE LANE LENGTH [(VEHICLES PER CYCLE) x 25 FEET]
DEAN ROAD AND WB I-10 RAMPS - WESTBOUND LEFT

TIME PERIOD	LEFT TURN VOLUME	LEFT TURN LANES	CYCLE LENGTH	LEFT TURN QUEUE ACTUAL	LEFT TURN QUEUE ROUNDED	STORAGE LENGTH (FT)	Breaking Distance	Gap	Total (Storage+Breaking)
Peak Hour	629	2	80	6.99	7	175	40	40	215

Diamond Interchange Turn Lanes

RIGHT-TURN STORAGE LANE LENGTH [(VEHICLES PER CYCLE) x 25 FEET]
DEAN ROAD AND EB I-10 RAMPS - NORTHBOUND RIGHT

TIME PERIOD	RIGHT TURN VOLUME	RIGHT TURN LANES	CYCLE LENGTH	RIGHT TURN QUEUE ACTUAL	RIGHT TURN QUEUE ROUNDED	STORAGE LENGTH (FT)	Breaking Distance	Gap	Total (Storage+Breaking)
Peak Hour	661	1.5	80	9.79	10	250	50	60	300

RIGHT-TURN STORAGE LANE LENGTH [(VEHICLES PER CYCLE) x 25 FEET]
DEAN ROAD AND WB I-10 RAMPS - SOUTHBOUND RIGHT

TIME PERIOD	RIGHT TURN VOLUME	RIGHT TURN LANES	CYCLE LENGTH	RIGHT TURN QUEUE ACTUAL	RIGHT TURN QUEUE ROUNDED	STORAGE LENGTH (FT)	Breaking Distance	Gap	Total (Storage+Breaking)
Peak Hour	236	1	80	5.24	6	150	50	60	200

RIGHT-TURN STORAGE LANE LENGTH [(VEHICLES PER CYCLE) x 25 FEET]
DEAN ROAD AND WB I-10 RAMPS - WESTBOUND RIGHT

TIME PERIOD	RIGHT TURN VOLUME	RIGHT TURN LANES	CYCLE LENGTH	RIGHT TURN QUEUE ACTUAL	RIGHT TURN QUEUE ROUNDED	STORAGE LENGTH (FT)	Breaking Distance	Gap	Total (Storage+Breaking)
Peak Hour	673	1.5	80	9.97	10	250	40	40	290

Partial Cloverleaf Turn Lanes

LEFT-TURN STORAGE LANE LENGTH [(VEHICLES PER CYCLE) x 25 FEET]
DEAN ROAD AND EB I-10 OFF-RAMP - EASTBOUND LEFT

TIME PERIOD	LEFT TURN VOLUME	LEFT TURN LANES	CYCLE LENGTH	LEFT TURN QUEUE ACTUAL	LEFT TURN QUEUE ROUNDED	STORAGE LENGTH (FT)	Breaking Distance	Gap	Total (Storage+Breaking)
Peak Hour	232	1	90	5.80	6	150	40	40	190

LEFT-TURN STORAGE LANE LENGTH [(VEHICLES PER CYCLE) x 25 FEET]
DEAN ROAD AND WB I-10 OFF-RAMP - WESTBOUND LEFT

TIME PERIOD	LEFT TURN VOLUME	LEFT TURN LANES	CYCLE LENGTH	LEFT TURN QUEUE ACTUAL	LEFT TURN QUEUE ROUNDED	STORAGE LENGTH (FT)	Breaking Distance	Gap	Total (Storage+Breaking)
Peak Hour	600	1.5	90	10.00	10	250	40	40	290

Partial Cloverleaf Turn Lanes

RIGHT-TURN STORAGE LANE LENGTH [(VEHICLES PER CYCLE) x 25 FEET]
NB DEAN ROAD AND EB I-10 ON-RAMP - NORTHBOUND RIGHT

TIME PERIOD	RIGHT TURN VOLUME	RIGHT TURN LANES	CYCLE LENGTH	RIGHT TURN QUEUE ACTUAL	RIGHT TURN QUEUE ROUNDED	STORAGE LENGTH (FT)	Breaking Distance	Gap	Total (Storage+Breaking)
Peak Hour	703	1	120	23.43	24	600	50	60	650

RIGHT-TURN STORAGE LANE LENGTH [(VEHICLES PER CYCLE) x 25 FEET]
SB DEAN ROAD AND EB I-10 ON-RAMP - SOUTHBOUND RIGHT

TIME PERIOD	RIGHT TURN VOLUME	RIGHT TURN LANES	CYCLE LENGTH	RIGHT TURN QUEUE ACTUAL	RIGHT TURN QUEUE ROUNDED	STORAGE LENGTH (FT)	Breaking Distance	Gap	Total (Storage+Breaking)
Peak Hour	517	1	120	17.23	18	450	50	60	500

RIGHT-TURN STORAGE LANE LENGTH [(VEHICLES PER CYCLE) x 25 FEET]
SB DEAN ROAD AND WB I-10 ON-RAMP - SOUTHBOUND RIGHT

TIME PERIOD	RIGHT TURN VOLUME	RIGHT TURN LANES	CYCLE LENGTH	RIGHT TURN QUEUE ACTUAL	RIGHT TURN QUEUE ROUNDED	STORAGE LENGTH (FT)	Breaking Distance	Gap	Total (Storage+Breaking)
Peak Hour	236	1	120	7.87	8	200	50	60	250

Partial Cloverleaf Turn Lanes

RIGHT-TURN STORAGE LANE LENGTH [(VEHICLES PER CYCLE) x 25 FEET]
DEAN ROAD AND WB I-10 OFF-RAMP - WESTBOUND RIGHT

TIME PERIOD	RIGHT TURN VOLUME	RIGHT TURN LANES	CYCLE LENGTH	RIGHT TURN QUEUE ACTUAL	RIGHT TURN QUEUE ROUNDED	STORAGE LENGTH (FT)	Breaking Distance	Gap	Total (Storage+Breaking)
Peak Hour	793	1.5	90	13.22	14	350	40	40	390

RIGHT-TURN STORAGE LANE LENGTH [(VEHICLES PER CYCLE) x 25 FEET]
NB DEAN ROAD AND WB I-10 ON-RAMP - NORTHBOUND RIGHT

TIME PERIOD	RIGHT TURN VOLUME	RIGHT TURN LANES	CYCLE LENGTH	RIGHT TURN QUEUE ACTUAL	RIGHT TURN QUEUE ROUNDED	STORAGE LENGTH (FT)	Breaking Distance	Gap	Total (Storage+Breaking)
Peak Hour	29	1	120	0.97	1	25	50	60	75

LEFT-TURN STORAGE LANE LENGTH [(VEHICLES PER CYCLE) x 25 FEET]
DEAN ROAD AND EB I-10 OFF-RAMP - EASTBOUND RIGHT

TIME PERIOD	LEFT TURN VOLUME	LEFT TURN LANES	CYCLE LENGTH	LEFT TURN QUEUE ACTUAL	LEFT TURN QUEUE ROUNDED	STORAGE LENGTH (FT)	Breaking Distance	Gap	Total (Storage+Breaking)
Peak Hour	32	1	90	0.80	1	25	40	40	65