



LSC TRANSPORTATION CONSULTANTS, INC.
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MEMORANDUM

DATE: December 28, 2020

TO: Jeff Rice, P.E.

CC: Jim Byers

FROM: Jeffrey C. Hodsdon, P.E.

SUBJECT: Golden Sage Road and Woodmen Road
LSC #194460

This memorandum contains the following:

- The results of manual intersection turning movement counts at the intersection of Golden Sage Road and Woodmen Road in January and December 2020;
- A warrant analysis for the addition of a protected phase for the eastbound left-turn movement at the intersection of Golden Sage Road and Woodmen Road;

Existing Traffic Volumes

LSC Transportation Consultants, Inc conducted manual intersection turning-movement counts at the intersection of Woodmen/Golden Sage in January 2020 and again in December 2020. Note that the January 2020 counts were conducted prior to the completion of Bent Grass Meadows Drive between the Woodmen frontage road and Meridian Road, but before effects of the COVID-19 pandemic. The December 2020 counts were conducted following the completion of Bent Grass Meadows Drive between the Woodmen frontage road and Meridian Road, but during the COVID-19 pandemic. The traffic count reports are attached.

Left Turn Phase Analysis

The intersection of Golden Sage Road and Woodmen Road is currently traffic-signal controlled. The existing signal timing plan has two phases, namely a northbound/southbound phase and an eastbound/westbound phase with no protected phasing for any of the left-turn movements. LSC has analyzed the need to add an additional protected phase for the eastbound left-turn movement based on the criteria found in Exhibit 11-6 from the Federal Highway Administration Report *Signalized Intersections: Informational Guide* Publication Number: FHWA-SA-13-027 dated July 2013 copied below with our analysis.

Exhibit 11-6 Guidelines for use of left-turn phasing

Left-turn phasing (protected-permissive, permissive-protected, or protected-only) should be considered if any one of the following criteria is satisfied:

1. *A minimum of 2 left-turning vehicles per cycle and the product of opposing and left-turn hourly volumes exceeds the appropriate following value:*
 - a. *Random arrivals (no other traffic signals within 0.8 km (0.5 mi))*
One opposing lane: 45,000 Two opposing lanes: 90,000
 - b. *Platoon arrivals (other traffic signals within 0.8 km (0.5 mi))*
One opposing lane: 50,000 Two opposing lanes: 100,000

Table 1 shows the results of the analysis based on criterion “b” Platoon arrivals with two opposing lanes. As shown in Table 1, the existing traffic volumes do not currently meet this criterion. This criterion is projected to be met following buildout of Bent Grass Residential Filing No. 2, based on the January 2020 afternoon peak-hour traffic volumes but not the December 2020 afternoon peak-hour traffic volumes. Following buildout of both Bent Grass Residential Filing No. 2 and Falcon Meadows at Bent Grass, the criterion is projected to be met during the morning peak hour, based on the January 2020 existing afternoon peak-hour traffic volumes and based on both the January and December 2020 existing morning peak-hour traffic volumes. The analysis assumes **no** growth of through traffic on Woodmen Road and **no** additional traffic on Golden Sage Road due to any other future area developments. The known projects in the area that could potentially add traffic to this intersection in the short-term include the initial phase of Banning Lewis Ranch North located northeast of the intersection of Golden Sage Road/Woodmen Road, buildout of the Bent Grass East Commercial development located southwest of the intersection of Meridian Road/Bent Grass Meadows Drive, and Falcon Marketplace located northwest of the intersection of Woodmen Road/Meridian Road. Development of any of these projects or increases in through traffic on Woodmen Road could potentially trigger the need for an eastbound left-turn protected phase prior to buildout of Bent Grass Residential 2.

2. *The left-turning movement crosses 3 or more lanes of opposing through traffic.*

This criterion is not currently applicable to the intersection of Golden Sage/Woodmen.

- 3. The posted speed of opposing traffic exceeds 45 mph.*

This criterion is currently met.

- 4. Recent crash history for a 12-month period indicates 5 or more left-turn collisions that could be prevented by the installation of left-turn signals.*

Traffic crash history for the intersection of Golden Sage Road and Woodmen Road has been requested from the Colorado Highway Patrol but has not yet been received.

- 5. Sight distances to oncoming traffic are less than the minimum distances in Exhibit 11-7.*

This criterion is not applicable to the intersection of Golden Sage/Woodmen.

- 6. The intersection has unusual geometric configurations, such as five legs, when an analysis indicates that left-turn or other special traffic-signal phases would be appropriate to provide positive direction to the motorist.*

This criterion is not applicable to the intersection of Golden Sage/Woodmen.

- 7. An opposing left-turn approach has a left-turn signal or meets one or more of the criteria in this table.*

This criterion is not currently applicable to the intersection of Golden Sage/Woodmen.

- 8. An engineering study indicates a need for left-turn signals. Items that may be considered include, but are not necessarily limited to, pedestrian volumes, traffic-signal progression, freeway interchange design, maneuverability of particular classes of vehicles, and operational requirements unique to preemption systems.*

As criterion 1b is projected to be met in the short-term and criterion 3 is currently met, an additional engineering study was not completed at this time. Note: should a study be requested, a key component of that study would likely include analysis of the “maneuverability of particular classes of vehicles” (i.e., school buses) due to the location of the Academy School District 20 Transportation Department just northeast of the study intersection and would therefore need to be delayed until the district returns to in-person instruction and regular bus service is resumed so that field observations could be conducted.

* * * * *

Attachments: Table 1
Traffic Count Data

Table 1

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**Table 1
Left-Turn Signal Phase Warrant Analysis
Golden Sage Road/Woodmen Road
Bent Grass Residential Filing No. 2**

Date	Time	Existing Traffic Volumes ⁽¹⁾					Following Buildout of Bent Grass Residential Filing No. 2				Following Buildout of Falcon Meadows at Bent Grass			
		Eastbound Left-Turn Volume (vph)	Westbound Through and Right-Turn (vph)	Product	Threshold ⁽³⁾	Met?	Projected Additional Eastbound Left-Turn Traffic ⁽³⁾	Product	Threshold	Met?	Projected Additional Eastbound Left-Turn Traffic ⁽⁴⁾	Product	Threshold	Met?
1/21/2020	6:45 AM - 7:45 AM	47	1,558	73,226	100,000	NO	12	91,922	100,000	NO	25	130,872	100,000	YES
1/21/2020	4:45 PM - 5:45 PM	88	942	82,896	100,000	NO	52	131,880	100,000	YES	83	210,066	100,000	YES
12/8/2020	7:15 AM - 8:15 AM	41	1,063	43,583	100,000	NO	12	56,339	100,000	NO	25	82,914	100,000	NO
12/3/2020	4:45 PM - 5:45 PM	60	868	52,080	100,000	NO	52	97,216	100,000	NO	83	169,260	100,000	YES

Notes:

- (1) Based on manual turning movement counts by LSC in January and December 2020. The January 2020 counts were conducted prior to the completion of Bent Grass Meadows Drive between the Woodmen frontage road and Meridian Road, but before impacts of the COVID-19 pandemic. The December 2020 counts were conducted following the completion of Bent Grass Meadows Drive between the Woodmen frontage road and Meridian Road, but during the COVID-19 pandemic.
- (2) Based on the criteria contained in Exhibit 11-6 from the Federal Highway Administration Report *Signalized Intersections: Informational Guide* Publication Number: FHWA-SA-13-027 dated July 2013
- (3) Taken from Figure 7 of the *Bent Grass Residential Filing No. 2 Traffic Impact Analysis* dated April 17, 2020
- (4) Taken from Figure 8 of the *Falcon Meadows at Bent Grass Updated Traffic Impact Analysis* dated December 11, 2020

Source: LSC Transportation Consultants, Inc.

Traffic Counts



LSC Transportation Consultants, Inc.

545 E Pikes Peak Ave, Suite 210
 Colorado Springs, CO 80905
 719-633-2868

File Name : Golden Sage Rd - Woodmen Rd AM 1-20
 Site Code : 00194460
 Start Date : 1/21/2020
 Page No : 1

Groups Printed- Unshifted

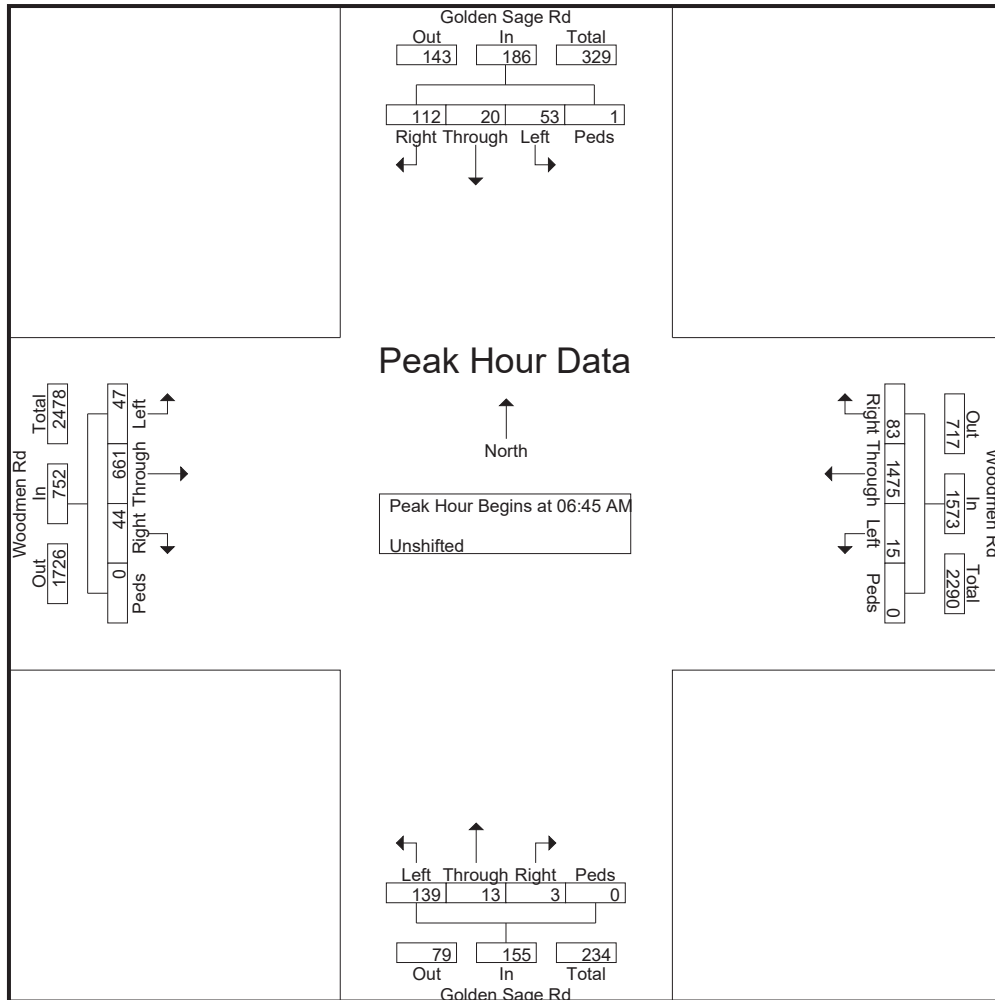
Start Time	Golden Sage Rd Southbound					Woodmen Rd Westbound					Golden Sage Rd Northbound					Woodmen Rd Eastbound					Int. Total
	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	
06:30 AM	5	1	25	0	31	0	195	48	1	244	20	2	0	0	22	10	107	0	0	117	414
06:45 AM	12	5	28	0	45	4	355	30	0	389	24	4	0	0	28	14	151	9	0	174	636
Total	17	6	53	0	76	4	550	78	1	633	44	6	0	0	50	24	258	9	0	291	1050
07:00 AM	17	7	29	0	53	2	340	25	0	367	42	2	1	0	45	13	158	13	0	184	649
07:15 AM	8	4	30	0	42	3	424	16	0	443	44	3	1	0	48	12	171	11	0	194	727
07:30 AM	16	4	25	1	46	6	356	12	0	374	29	4	1	0	34	8	181	11	0	200	654
07:45 AM	7	1	7	0	15	2	293	17	0	312	13	5	0	0	18	16	209	20	0	245	590
Total	48	16	91	1	156	13	1413	70	0	1496	128	14	3	0	145	49	719	55	0	823	2620
08:00 AM	9	1	14	0	24	3	239	12	1	255	18	0	0	0	18	16	165	13	1	195	492
08:15 AM	13	2	12	0	27	2	267	19	1	289	18	3	2	0	23	28	142	6	1	177	516
Grand Total	87	25	170	1	283	22	2469	179	3	2673	208	23	5	0	236	117	1284	83	2	1486	4678
Apprch %	30.7	8.8	60.1	0.4		0.8	92.4	6.7	0.1		88.1	9.7	2.1	0		7.9	86.4	5.6	0.1		
Total %	1.9	0.5	3.6	0	6	0.5	52.8	3.8	0.1	57.1	4.4	0.5	0.1	0	5	2.5	27.4	1.8	0	31.8	

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Start Time	Golden Sage Rd Southbound					Woodmen Rd Westbound					Golden Sage Rd Northbound					Woodmen Rd Eastbound					Int. Total
	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	
Peak Hour Analysis From 6:30:00 AM to 8:15:00 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 6:45:00 AM																					
6:45:00 AM	12	5	28	0	45	4	355	30	0	389	24	4	0	0	28	14	151	9	0	174	636
7:00:00 AM	17	7	29	0	53	2	340	25	0	367	42	2	1	0	45	13	158	13	0	184	649
7:15:00 AM	8	4	30	0	42	3	424	16	0	443	44	3	1	0	48	12	171	11	0	194	727
7:30:00 AM	16	4	25	1	46	6	356	12	0	374	29	4	1	0	34	8	181	11	0	200	654
Total Volume	53	20	112	1	186	15	1475	83	0	1573	139	13	3	0	155	47	661	44	0	752	2666
% App. Total	28.5	10.8	60.2	0.5		1	93.8	5.3	0		89.7	8.4	1.9	0		6.2	87.9	5.9	0		
PHF	.779	.714	.933	.250	.877	.625	.870	.692	.000	.888	.790	.813	.750	.000	.807	.839	.913	.846	.000	.940	.917



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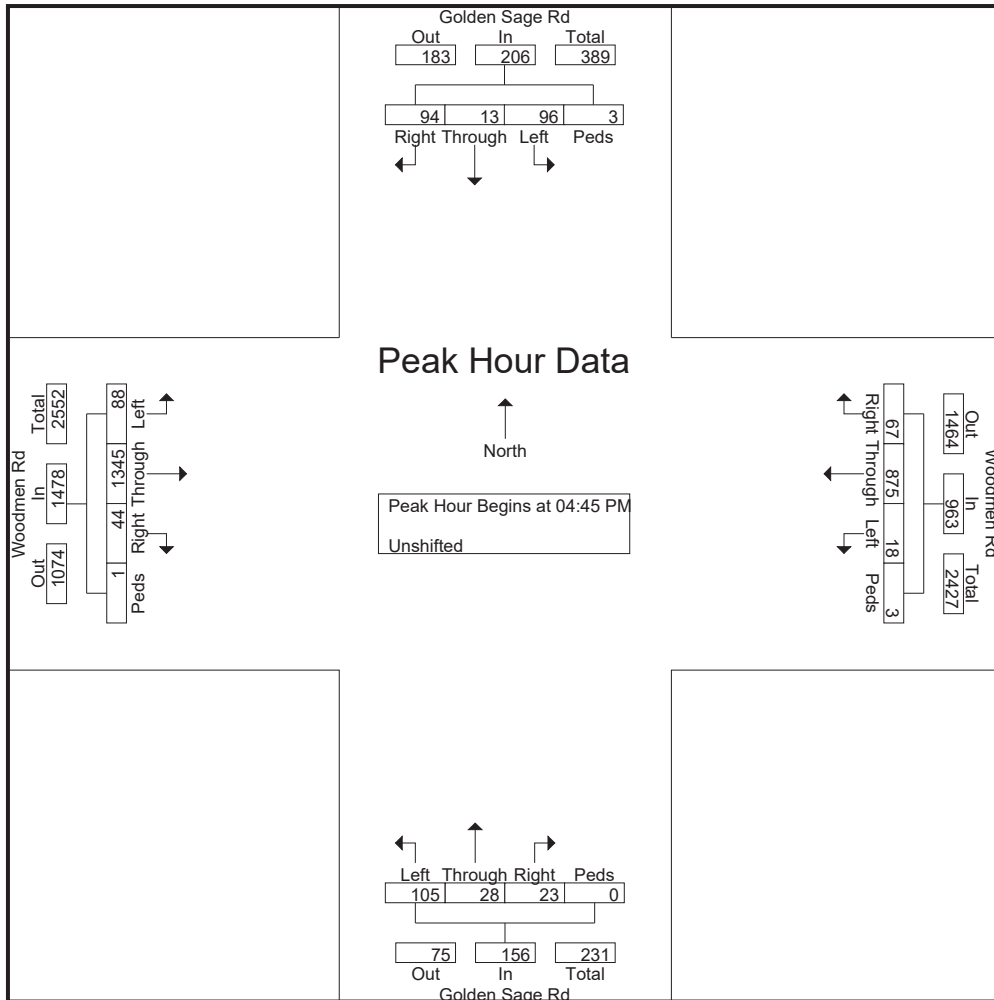
Start Time	Golden Sage Rd Southbound					Woodmen Rd Westbound					Golden Sage Rd Northbound					Woodmen Rd Eastbound					Int. Total
	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	
04:00 PM	17	2	26	0	45	7	205	16	0	228	23	9	5	0	37	21	272	23	2	318	628
04:15 PM	7	1	22	0	30	5	241	26	0	272	26	5	6	0	37	28	325	12	1	366	705
04:30 PM	21	4	24	0	49	1	241	20	1	263	26	8	4	0	38	24	313	3	1	341	691
04:45 PM	29	3	19	2	53	1	202	24	0	227	16	4	0	0	20	18	341	10	1	370	670
Total	74	10	91	2	177	14	889	86	1	990	91	26	15	0	132	91	1251	48	5	1395	2694
05:00 PM	18	1	27	0	46	2	254	11	2	269	27	7	1	0	35	19	328	11	0	358	708
05:15 PM	7	2	6	0	15	8	192	9	1	210	32	10	12	0	54	23	340	17	0	380	659
05:30 PM	42	7	42	1	92	7	227	23	0	257	30	7	10	0	47	28	336	6	0	370	766
05:45 PM	21	1	18	0	40	1	180	12	1	194	19	5	5	0	29	18	326	9	0	353	616
Total	88	11	93	1	193	18	853	55	4	930	108	29	28	0	165	88	1330	43	0	1461	2749
Grand Total	162	21	184	3	370	32	1742	141	5	1920	199	55	43	0	297	179	2581	91	5	2856	5443
Apprch %	43.8	5.7	49.7	0.8		1.7	90.7	7.3	0.3		67	18.5	14.5	0		6.3	90.4	3.2	0.2		
Total %	3	0.4	3.4	0.1	6.8	0.6	32	2.6	0.1	35.3	3.7	1	0.8	0	5.5	3.3	47.4	1.7	0.1	52.5	

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	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	
Peak Hour Analysis From 4:00:00 PM to 5:45:00 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 4:45:00 PM																					
4:45:00 PM	29	3	19	2	53	1	202	24	0	227	16	4	0	0	20	18	341	10	1	370	670
5:00:00 PM	18	1	27	0	46	2	254	11	2	269	27	7	1	0	35	19	328	11	0	358	708
5:15:00 PM	7	2	6	0	15	8	192	9	1	210	32	10	12	0	54	23	340	17	0	380	659
5:30:00 PM	42	7	42	1	92	7	227	23	0	257	30	7	10	0	47	28	336	6	0	370	766
Total Volume	96	13	94	3	206	18	875	67	3	963	105	28	23	0	156	88	1345	44	1	1478	2803
% App. Total	46.6	6.3	45.6	1.5		1.9	90.9	7	0.3		67.3	17.9	14.7	0		6	91	3	0.1		
PHF	.571	.464	.560	.375	.560	.563	.861	.698	.375	.895	.820	.700	.479	.000	.722	.786	.986	.647	.250	.972	.915



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Start Time	Golden Sage Rd Southbound					Woodmen Rd Westbound					Golden Sage Rd Northbound					Woodmen Rd Eastbound					Int. Total
	L	T	R	U	App. Total	L	T	R	U	App. Total	L	T	R	U	App. Total	L	T	R	U	App. Total	
07:00 AM	17	1	13	0	31	1	242	5	0	248	13	4	0	0	17	7	127	6	0	140	436
07:15 AM	8	0	20	0	28	4	289	7	0	300	20	2	1	0	23	7	138	4	0	149	500
07:30 AM	8	2	30	0	40	3	318	7	0	328	29	3	2	0	34	10	138	11	1	160	562
07:45 AM	7	0	21	0	28	4	211	3	0	218	11	2	2	0	15	8	133	17	0	158	419
Total	40	3	84	0	127	12	1060	22	0	1094	73	11	5	0	89	32	536	38	1	607	1917
08:00 AM	3	1	18	0	22	2	224	4	2	232	12	3	3	0	18	16	144	8	1	169	441
08:15 AM	10	2	23	0	35	3	210	6	0	219	14	2	3	0	19	18	165	4	0	187	460
08:30 AM	6	0	22	0	28	1	247	6	0	254	16	0	1	0	17	7	161	9	0	177	476
08:45 AM	10	3	12	0	25	3	170	8	0	181	19	2	0	0	21	12	142	14	0	168	395
Total	29	6	75	0	110	9	851	24	2	886	61	7	7	0	75	53	612	35	1	701	1772
Grand Total	69	9	159	0	237	21	1911	46	2	1980	134	18	12	0	164	85	1148	73	2	1308	3689
Apprch %	29.1	3.8	67.1	0		1.1	96.5	2.3	0.1		81.7	11	7.3	0		6.5	87.8	5.6	0.2		
Total %	1.9	0.2	4.3	0	6.4	0.6	51.8	1.2	0.1	53.7	3.6	0.5	0.3	0	4.4	2.3	31.1	2	0.1	35.5	

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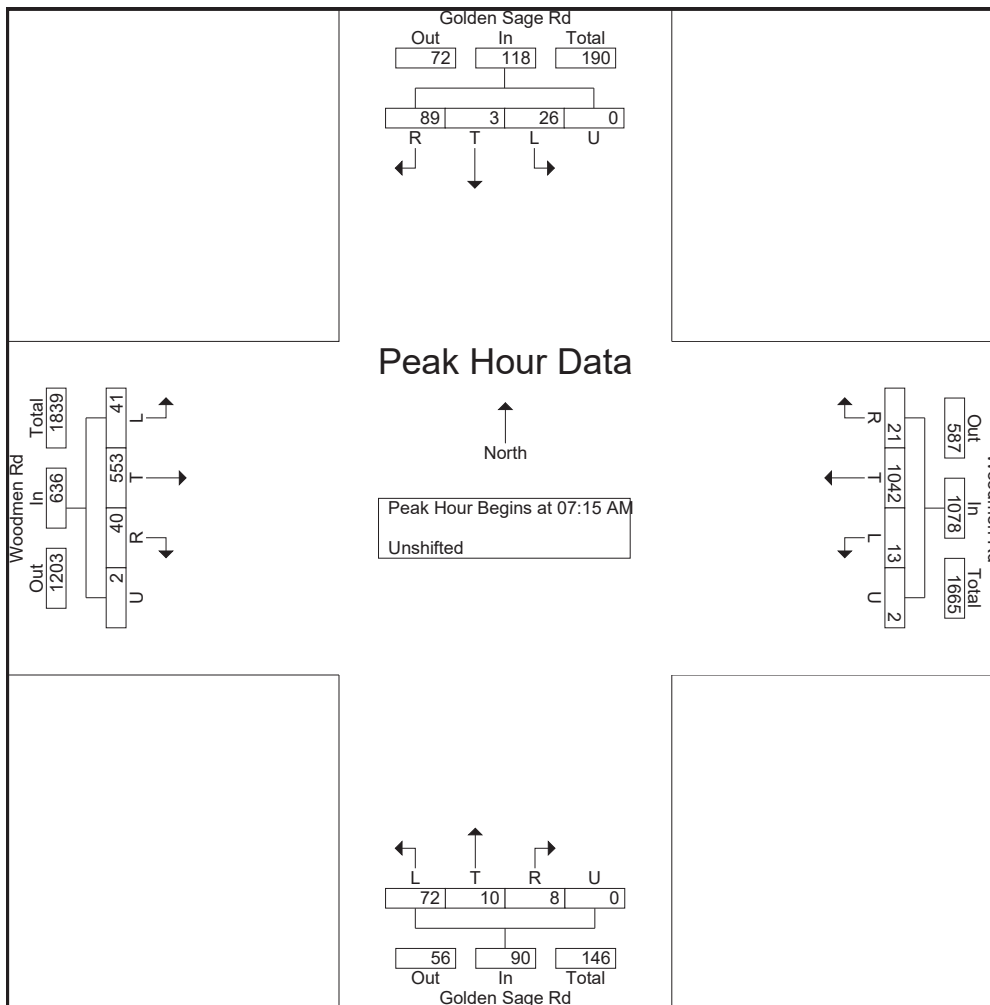
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Start Time	Golden Sage Rd Southbound					Woodmen Rd Westbound					Golden Sage Rd Northbound					Woodmen Rd Eastbound					Int. Total
	L	T	R	U	App. Total	L	T	R	U	App. Total	L	T	R	U	App. Total	L	T	R	U	App. Total	
04:00 PM	23	0	12	0	35	8	260	13	0	281	18	3	7	0	28	13	279	30	1	323	667
04:15 PM	13	1	15	0	29	4	220	8	0	232	16	2	4	0	22	16	332	19	0	367	650
04:30 PM	15	1	17	0	33	1	245	10	0	256	14	4	2	0	20	14	316	16	0	346	655
04:45 PM	11	0	13	0	24	2	223	12	2	239	21	2	3	0	26	10	335	8	1	354	643
Total	62	2	57	0	121	15	948	43	2	1008	69	11	16	0	96	53	1262	73	2	1390	2615
05:00 PM	9	3	16	0	28	2	225	8	0	235	27	3	2	0	32	15	336	17	0	368	663
05:15 PM	7	4	12	0	23	5	190	13	2	210	32	4	11	0	47	18	325	19	0	362	642
05:30 PM	17	2	28	0	47	15	192	5	0	212	24	2	3	0	29	17	378	10	0	405	693
05:45 PM	10	2	5	0	17	3	145	9	1	158	12	4	2	0	18	15	278	16	1	310	503
Total	43	11	61	0	115	25	752	35	3	815	95	13	18	0	126	65	1317	62	1	1445	2501
Grand Total	105	13	118	0	236	40	1700	78	5	1823	164	24	34	0	222	118	2579	135	3	2835	5116
Aprch %	44.5	5.5	50	0		2.2	93.3	4.3	0.3		73.9	10.8	15.3	0		4.2	91	4.8	0.1		
Total %	2.1	0.3	2.3	0	4.6	0.8	33.2	1.5	0.1	35.6	3.2	0.5	0.7	0	4.3	2.3	50.4	2.6	0.1	55.4	

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