PHASE II

TRAFFIC IMPACT STUDY

FOR

WILD PLUM

Prepared For:

Town of Columbine Valley
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EXECUTIVE SUMMARY

The Town of Columbine Valley is contemplating a 105-acre residential development ("Wild Plum") in the Town of Columbine Valley, Colorado. The site is located east of Platte Canyon Road and south of Fairway Lane.

Stolfus & Associates, Inc. was retained by the Town of Columbine Valley to prepare a traffic impact study for the Wild Plum development. A summary of the study findings follows:

1. One hundred five (105) residential dwelling units generate approximately 1,100 vehicle trips per day, including approximately 83 and 110 trips during the weekday a.m. and p.m. peak hours, respectively.
2. The characteristics of Hunter Run Ln make it an appropriate access to Wild Plum: it is an underutilized access to Platte Canyon Rd; it functions as a collector roadway with few properties that directly access the roadway; and its proximity to Platte Canyon Rd minimizes out-of-direction travel and related impacts on neighboring properties. Fairway Ln and Middlefield Rd, other collector roadways in the Town, provide secondary access to the site as well as primary access for traffic to/from the east on Bowles Ave.
3. As a state highway, Platte Canyon Rd is under the jurisdiction of the Colorado Department of Transportation (CDOT). Wild Plum will increase the volume of traffic accessing the highway at Hunter Run Ln by more than 20%, therefore a State Highway Access Permit will be necessary. Traffic at the Fairway Ln access to Platte Canyon Rd will also increase; however, the magnitude of the increase is less than the 20% requiring a state highway access permit.
4. The intersection of Platte Canyon Rd and Hunter Run Ln warrants a southbound left turn deceleration lane upon development of Wild Plum. The existing southbound left turn lane does not meet current CDOT standards for a roadway with a NR-A access category. Platte Canyon Rd could be restriped to provide a longer deceleration lane; however this would impact the northbound left-turn lane for Coal Mine Rd which is a much more critical movement to overall traffic flow through the corridor. The study has concluded that vehicle queues for the southbound left turn movement will typically be one car length or less. For these reasons, no changes to existing left turn striping along Platte Canyon Rd is recommended.
5. Although the 20 northbound right turns per hour projected for Hunter Run Ln is less than the 26 needed to warrant a right-turn deceleration lane, it is recommended that construction of a right-turn lane be considered for safety purposes. In any event, improvements to the intersection of Platte Canyon Rd and Hunter Run Ln will be required to improve entering sight distance for Hunter Run Ln.
6. It is recommended that Hunter Run Ln be brought up to current Town standards between Platte Canyon Rd and the entrance to Wild Plum. This will enable the roadway to better accommodate its intended function as the primary access for Wild Plum.
7. The study has concluded that the potential traffic impacts of the Wild Plum development can be addressed by the transportation improvements outlined in this report.

EXISTING CONDITIONS

The Wild Plum site is located in the Town of Columbine Valley east of Platte Canyon Road and south of Fairway Lane. The site is approximately 100 acres of mostly undeveloped land. A vicinity map is provided in **Figure 1**.

Major roadways in the vicinity of the site are described below:

Platte Canyon Road is a two-lane roadway with a speed limit of 45 miles per hour in the vicinity of the site. Signalized intersections exist at the intersections with Bowles Ave, Ponds Cir, Fairway Ln, Coal Mine Ave, and Mineral Ave. Platte Canyon Rd is also a state highway (SH 75B). The traffic signals at Bowles Ave and at Mineral Ave are under the jurisdiction of the City of Littleton while the remaining signals are under the jurisdiction of the Colorado Department of Transportation (CDOT).

Bowles Avenue is a four-lane urban arterial located within the City of Littleton. Signalized intersections exist at the intersections with Platte Canyon Rd and Middlefield Rd. Traffic signals along Bowles Ave are part of a coordinated signal system maintained by the City of Littleton.

Mineral Avenue/Ken Caryl Road is a four-lane arterial west of Platte Canyon and a six-lane arterial to the east. A signal exists at the intersection with Platte Canyon Rd.

Hunter Run Lane is a two-lane collector roadway located within the Town of Columbine Valley. The posted speed limit is 25 MPH. Currently, Hunter Run Ln provides access to Polo Meadows, a residential development consisting of 18 homes; and to two additional homes located near the roadway's end. Hunter Run Ln will also provide access to the Wild Plum property. Hunter Run Ln intersects with Platte Canyon Rd at a full-movement, unsignalized t-intersection.

Fairway Lane is a two-lane residential collector roadway located within the Town of Columbine Valley. Fairway Ln borders the Wild Plum property to the north and intersects with Platte Canyon at a signalized intersection. Fairway Ln, along with Middlefield Rd, provides primary access to the Columbine Country Club. Fairway Ln will provide secondary access to the Wild Plum property.

Middlefield Road is a two-lane collector roadway located within the Town of Columbine Valley. Middlefield Rd intersects with Bowles Ave at a signalized intersection.

Weekday morning (7:00-9:00 a.m.) and afternoon (4:00-6:00 p.m.) turning movement counts were collected on Wednesday, March 12, 2014 at the following intersection locations:

- Platte Canyon Rd & Bowles Ave
- Platte Canyon Rd & Village Ct
- Platte Canyon Rd & Fairway Ln
- Platte Canyon Rd & Coal Mine Rd
- Platte Canyon Rd & Hunter Run Ln
- Platte Canyon Rd & Mineral Ave
- Bowles Ave & Middlefield Rd

Based on the traffic count results, the weekday a.m. peak hour is from 7:15 to 8:15 a.m. and the p.m. peak hour is between 5:00 and 6:00 p.m.

Figure 2 summarizes the peak hour traffic count results.

At the request of the Town of Columbine Valley, additional traffic counts were collected on Wednesday, March 26, 2014 at the following locations:

- Fairway Lane & Wedge Way
- Fairway Lane & Club Lane
- Fairway Lane & Driver Lane
- Fairway Lane (48-hour count by direction)

Subsequent to the data collection, it was realized that the Town counts were collected during Spring Break. For this reason, an additional count along Fairway Lane west of Club Lane was collected on Thursday, April 14, 2014. A count along Fairway Lane immediately east of the project site was collected on May 17, 2016.

TRIP GENERATION

Trip generation for Wild Plum was estimated using the industry-standard reference *ITE Trip Generation Manual, 9th edition*. Based upon the development proposal for Wild Plum submitted to the Town of Columbine Valley, a development of 105 single-family detached residential units was assumed. The results of the trip generation calculations are shown in **Table 1**.

Table 1: Wild Plum Trip Generation Estimate

ITE Code	Land Use	Units		Weekday Rate[1]	AM Peak Rate[1]	AM Peak Entering %	AM Peak Exiting %	PM Peak Rate[1]	PM Peak Entering %	PM Peak Exiting %	Weekday Total Trips	AM Peak Trips Entering	AM Peak Trips Exiting	PM Peak Trips Entering	PM Peak Trips Exiting
210	Single-Family Detached Housing	105	D.U.	10.46	0.79	25%	75%	1.05	63%	37%	1100	21	62	69	41
[1] Rates calculated from Fitted Curve Equations															

As shown above, 105 single-family detached residential units will generate approximately 1,100 vehicle trips per day. During the weekday a.m. peak hour, 21 entering and 62 exiting vehicle trips are expected. During the weekday p.m. peak hour, 69 entering and 41 exiting trips are anticipated.

TRIP DISTRIBUTION

Once the number of trips generated by the development are known, the trip distribution step determines the directions that they approach and depart the site. Development-generated traffic volumes are then assigned to the street system based upon the expected trip distribution.

Generally, the traffic generated by Wild Plum is expected to be similar to the distribution of the larger residential community (the Town of Columbine Valley). For this reason, the existing traffic counts were used to estimate the trip distribution for Wild Plum shown in **Figure 3**.

The results show that the majority of trips (70%) are expected to occur between Wild Plum and points north and east. A smaller percentage of trips will occur to/from the south and west.

TRAFFIC ASSIGNMENT

As currently planned, Wild Plum will access both Hunter Run Ln and Fairway Ln. How much Wild Plum traffic is assigned to these accesses depends on the site's trip distribution, the layout of the site, and the

available transportation routes. The specific route that traffic will follow between a particular origin and a particular destination depends on a number of factors; the most important of which is typically travel time. With the exception of the occasional recreational trip, most people will follow the route that minimizes their own personal travel time. In order to determine a reasonable split in traffic to the two Platte Canyon Road accesses, staff of the Town of Columbine Valley recorded the time required to travel Hunter Run Lane to Platte Canyon Road up to Bowles and compared it to the time required to travel Fairway Lane through Old Town to Platte Canyon and Bowles. The result showed that the travel times were relatively comparable from these two locations.

As described in the previous section and shown on Figure 3, most of the traffic from Wild Plum will be oriented to the north and east. Based on the site layout and the travel time comparison, it is estimated that 40% of the traffic destined for Bowles Ave west of Platte Canyon or Lowell Blvd north will utilize the Fairway Ln access to Platte Canyon Road. The remainder (60%) will use Hunter Run Ln. For traffic destined to the east along Bowles Ave, 70% will use Fairway Ln to Middlefield Ave and the remaining 30% will use Hunter Run Ln.

All of the Wild Plum traffic destined for Ken Caryl Ave, Mineral Ave or Platte Canyon Rd south of the site will use Hunter Run Ln to access Platte Canyon Rd.

The traffic generated by Wild Plum (shown in Table 1) was assigned to the street network according to the trip distribution shown in **Figure 3**. The resulting project trips are shown in **Figure 4**.

Project trips were combined with existing traffic volumes to determine the Existing w/Project traffic volumes shown in **Figure 5**. Although build-out of the site will likely occur in phases and take several years to complete, for the purposes of this study it has been assumed that all development occurs in a single phase.

FUTURE TRAFFIC FORECASTS

Over time, existing traffic volumes in the vicinity of the project may grow as a result of other area development. CDOT maintains a 20-year growth factor for all state highways, including SH 75B (Platte Canyon Rd). Because the immediate area is largely built out, CDOT's 20-year factor for Platte Canyon Rd is low and ranges from 1.04 near Bowles Ave to 1.06 near Coal Mine Avenue. This reflects a significant change to previous growth projections. Just two years ago, the 20-year growth factor for this segment of Platte Canyon Road ranged from 1.21 to 1.24.

Future (Year 2034) traffic volumes were estimated by increasing existing traffic volumes by CDOT's 20 year factor (1.06) at the two major intersections and by increasing through volumes along Platte Canyon Rd accordingly.

Over the past 10 or so years, Average Daily Traffic (ADT) volumes along Platte Canyon Rd have ranged from a low of 17,114 vehicles per day (in 2010) to a high of 21,607 vehicles per day (in 2007). The most recent data from 2014 indicates that the current ADT is approximately 18,000 vehicles per day.

In addition to applying the 20-year growth rate, development traffic from two additional developments were included in the future traffic forecasts. These include the KB Homes development located within unincorporated Arapahoe County, and the Wilder Lane development. These developments are located on either side of Platte Canyon Road between Village Court and Bowles Avenue.

Future (2034) Traffic Volumes are shown on **Figure 6**. Project trips were combined with future traffic volumes to derive the Future (2034) w/Project Traffic Volumes shown on **Figure 7**. Existing and projected traffic volumes over the course of an average weekday are presented in Table 2.

Table 2: Existing and Projected Traffic Volumes

ADT (Average Daily Trips)			
Scenario	Platte Canyon Rd	Hunter Run	Fairway Lane
Existing	18,000	210*	1,660
Existing w/Project	18,500	870	2,100
Future (2034)	19,080	210	1,660
Future w/Project	19,540	870	2,100

*Estimated using ITE Trip Generation Manual, 9th Edition (20 single-family dwelling units)

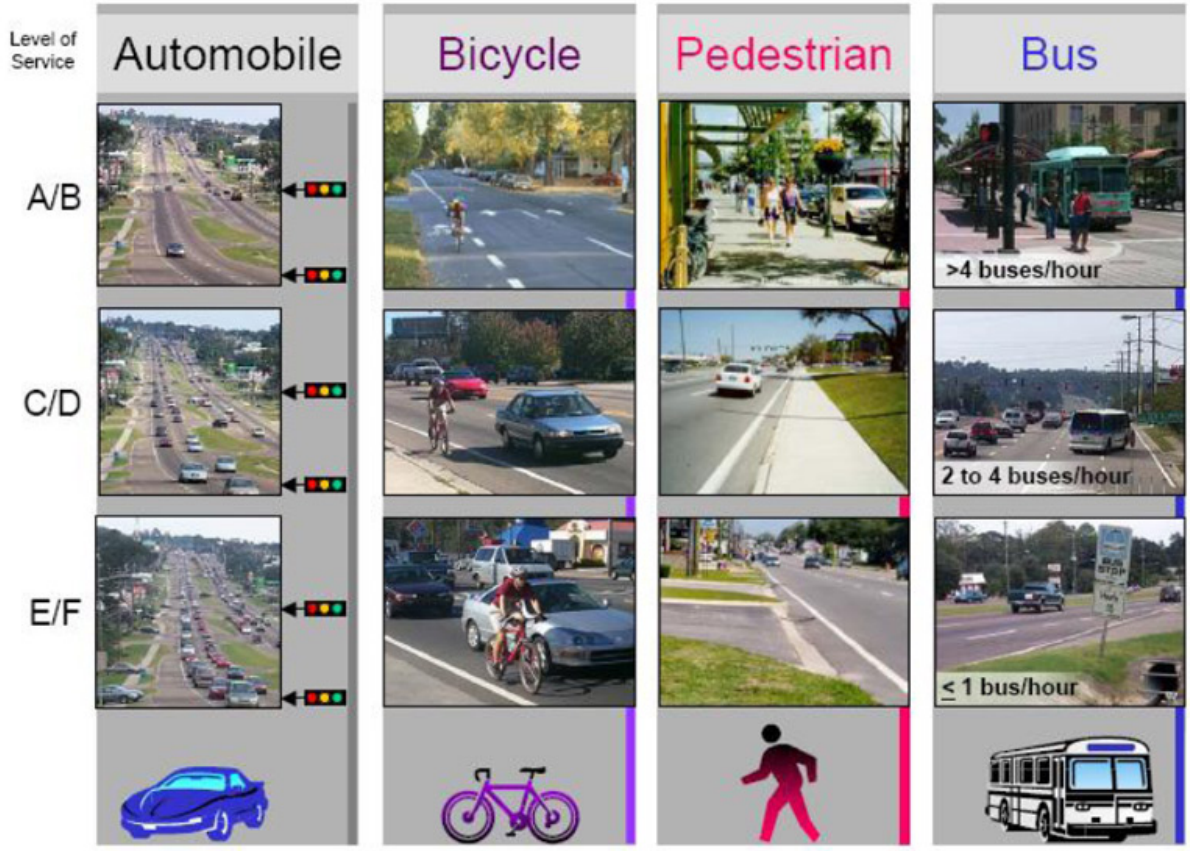
TRAFFIC ANALYSIS

Traffic analyses were conducted using industry standard *Highway Capacity Manual* methodologies as implemented by the SYNCHRO software program.

Analysis included intersection Level-of-Service (LOS), which is a measure of the quality of traffic flow. LOS ranges from LOS A (nearly ideal traffic conditions with very little delay for motorists) to LOS F (poor traffic conditions with long motorist delays). LOS C is typically considered a "good" traffic condition. LOS D or better conditions are typically desirable; however, LOS E conditions are not uncommon during peak periods. LOS F is also not uncommon for side street traffic movements at full movement, unsignalized intersections with high volume arterial roadways.

An illustration of LOS for various modes of travel is shown on the following page.

Level-of-Service (LOS) by Mode for Urban Roadways



Source: FDOT Quality/Level of Service Handbook

Table 3 provides a summary of the *Highway Capacity Manual's* LOS Criteria. **Tables 4A and 4B** provide a summary of the intersection LOS for the various intersections and traffic scenarios considered in this study.

Table 3: Level-of-Service (LOS) Criteria for Intersections

LOS	**Signalized Intersection** Average Delay (sec/veh)	**Unsignalized Intersection** Average Delay (sec/veh)
A	<=10	<=10
B	>10-20	>10-15
C	>20-35	>15-25
D	>35-55	>25-35
E	>55-80	>35-50
F	>80	>50

Table 4A: Level-of-Service (LOS) Summary for Platte Canyon Rd Intersections (AM Peak Hour / PM Peak Hour)

Scenario	Platte Canyon Rd Intersection					
	W Bowles Ave	Village Ct	Fairway Ln	Coal Mine Ave	Hunter Run Ln	Mineral Ave
Existing	E / E	E / F	B / A	F / D	C / B	D / C
Existing w/Project	E / E	F / F	B / A	F / D	C / D	D / C
Future (Year 2034)	E / D	F / F	B / B	D / D	C / B	D / C
Future w/Project	F / D	F / F	C / B	D / D	D / E	D / C

Table 4B: LOS Summary for Town Intersections (AM Peak Hour / PM Peak Hour)

Scenario	Town Intersection			
	W Bowles Ave at Middlefield Ln	Fairway Ln at Club Ln	Fairway Ln at Driver Ln	Fairway Ln at Wedge Ln
Existing	B / B	A / A	A / A	A / A
Existing w/Project	B / B	A / A	A / A	A / A
Future (Year 2034)	B / B	A / A	A / A	A / A
Future w/Project	B / B	A / A	A / A	A / A

Table 5 provides a summary of the 95th percentile queue length for intersections and movements potentially affected by Wild Plum traffic. The 95th percentile queue length is derived on a probability basis, and represents a length of queue that is exceeded only 5 percent of the time on average. In other words, for 95 percent of the time, the queue length will be less than the number reported in the table.

Table 5: Queue Length Summary (95th Percentile, in feet)

Location	Movement	Existing		Existing w/Project		Future		Future w/Project	
		AM	PM	AM	PM	AM	PM	AM	PM
Platte Canyon Rd / Mineral Ave	EB Left	91	60	91	61	109	#110	109	66
	SB Left	#288	#226	#298	#239	#342	124	#289	120
Platte Canyon Rd / Hunter Run Ln	WB Left	0	0	8	5	1	0	8	8
	WB Right	3	0	3	3	2	1	5	3
	SB Left	0	0	3	3	0	1	0	3
Platte Canyon Rd / Coal Mine Ave	NB Left	44	144	46	146	29	#205	46	#211
	NB Thru	502	314	525	325	#622	279	525	285
Platte Canyon Rd / Fairway Ln	WB Thru/Lt	31	79	#96	79	29	#108	31	#96
	WB Right	0	0	0	0	0	0	0	0
Bowles Ave / Middlefield Rd	WB Left	27	19	33	25	29	8	30	8
	NB Thru/Lt	28	53	28	53	36	29	37	29
	NB Right	41	41	45	45	#83	6	#70	6

#95th percentile volume exceeds capacity, queue may be longer

The following provides a summary of the LOS and queue length findings for each analysis scenario:

Existing Condition: Currently, traffic conditions within the study area are good; with the exception of the Coal Mine Ave, Village Ct, and Bowles Ave intersections along Platte Canyon Rd. The traffic signal at Coal Mine ave is currently "split phased" which means that eastbound and westbound directions have to occur sequentially rather than simultaneously; thereby reducing the efficiency of traffic flow. There is also a large eastbound to northbound movement that contributes to poor (LOS F) operations in the a.m. peak hour. CDOT is currently in process of upgrading the traffic signal at Coal Mine Ave and Platte Canyon Ave; however, the upgrade is not expected to materially change intersection operations.

Village Ct is an unsignalized intersection with relatively low side street volumes; however, volume along Platte Canyon Rd at this location is high enough that there are infrequent gaps for traffic from the side street resulting in LOS E to LOS F conditions.

The Bowles Ave intersection experiences a high volume of intersecting traffic from both Platte Canyon Rd and Bowles Ave. As result, a few of the intersection movements are over-capacity, meaning that traffic demands exceed the intersections ability to process that demand.

Existing w/Project: This scenario includes the additional traffic from Wild Plum, but assumes no changes to existing signal timings or physical improvements to the existing transportation system. Apart from the intersection of Platte Canyon Rd and Hunter Run Ln, very little changes with the addition of Wild Plum traffic. At the Hunter Run Ln intersection, the LOS changes from LOS B to LOS D in the p.m. peak hour. However, because side street volumes remain light, the 95th percentile queue lengths are less than one car length on average.

Otherwise, the addition of project traffic results in the 95th percentile queue lengths at other locations to increase by a car length or two on average. The 95th percentile queue lengths can be accommodated by existing storage.

Future (2034) Condition: For this scenario, no improvements were made to the existing transportation system; however, traffic signal timings were allowed to optimize. The LOS results indicate that growth in background traffic over time will understandably result in increased average delays at area intersections. In some cases, these delay increases result in changes to intersection LOS when compared to existing conditions. In the case of the Coal Mine Rd and Bowles Ave intersections, optimizing the existing signal timings resulted in improved operations when compared to existing conditions; generally suggesting that signal timing improvements would be beneficial to corridor traffic flow.

The 95th percentile queue lengths continue to be accommodated by existing storage.

Future (2034) w/Project: For this scenario, no improvements were made to the existing transportation system; however, traffic signal timings were allowed to optimize. Apart from the intersections of Platte Canyon Rd with Hunter Run Ln and Fairway Ln, very little changes with the addition of Wild Plum traffic. At the Hunter Run Ln intersection, the LOS changes from C to D in the A.M. and from LOS B to LOS E in the P.M. Peak. However, because volumes remain light, the 95th percentile queue lengths remain short; less than one car length on average. The unsignalized

intersection of Hunter Run Ln and Platte Canyon Rd does not meet Manual on Uniform Traffic Control Devices (MUTCD) traffic signal warrants.

The queue length results indicate that the addition of project traffic results in the 95th percentile queue lengths for other movements to increase by a car length or so on average.

STATE HIGHWAY ACCESS CODE

As a state highway (SH 75B), access to Platte Canyon Rd is governed by the *State Highway Access Code* (SHAC). The purpose of the SHAC is to provide procedures and standards to aid in the management of the State of Colorado's investment in the highway system and to protect the public health, safety and welfare, to maintain smooth traffic flow, and to protect the functional level of state highways while considering state, regional, and local transportation needs and interests.

The Wild Plum development will increase the volume of traffic accessing SH 75B by more than 20%, therefore in accordance with the SHAC an access permit application will be required. In this case, the Town of Columbine Valley will be the Permittee for the application.

State Highway 75B has an access category of Non-Rural Principal Highway (NR-A). For this category of roadway, the auxiliary lane warranting criteria are as shown in **Table 6**:

Table 6: State Highway Auxiliary Lane Criteria (Hunter Run Lane)

Auxiliary Lane	Warrant Criteria (NR-A Access Category)	Status w/Project
Southbound Left Turn Deceleration Lane and Taper with Storage Length	More than 10 left turning vehicles per hour	Met
Northbound Right Turn Deceleration Lane and Taper	More than 25 right turning vehicles per hour	Not Met
Westbound Right Turn Acceleration Lane and Taper	More than 50 right turning vehicles per hour, and posted speed limit greater than 40 mph	Not Met
Westbound Left Turn Acceleration Lane	Where it would benefit the safety and operation of the roadway	Not Met

A southbound left turn deceleration lane currently exists at Hunter Run Ln, although it does not meet the geometric design requirements of the SHAC. The existing lane is approximately 320-ft in length and consists of a 160-ft of taper and 160-ft of storage. SHAC requirements for a NR-A roadway and a 45 MPH posted speed are a total of 460-ft consisting of 435-ft of deceleration and 25-ft of storage. This length of lane would overlap with the existing left turn lane for Coal Mine Rd. Based on the queue length information provided previously, the storage length at Coal Mine Rd is more critical than is the storage for Hunter Run Ln. For this reason, no changes to the existing lane striping is recommended. Because the SHAC design criteria is not met, a design waiver request will need to be included as part of the access permit application.

The northbound right turn movement at Hunter Run Lane is currently projected to be approximately 20 vehicles per hour during the a.m. peak hour with the Wild Plum development. While this is less than the 26 vehicles per hour required to warrant a right turn deceleration lane, it is recommended that construction of a right-turn deceleration lane be considered to improve safety for turning traffic.

Construction of a right-turn deceleration lane will require improvements be made to the Platte Canyon Rd which will also provide an opportunity to improve the entering sight distance for Hunter Run Ln.

Regardless of whether a northbound right turn lane is provided, improvements will be needed to the intersection in order to provide adequate entering sight distance.

FINDINGS

The following summarizes the findings of the traffic impact study conducted for Wild Plum:

1. One hundred five (105) residential dwelling units generate approximately 1,100 vehicle trips per day, including approximately 83 and 110 trips during the weekday a.m. and p.m. peak hours, respectively.
2. The characteristics of Hunter Run Ln make it an appropriate access to Wild Plum: it is an underutilized access to Platte Canyon Rd; it functions as a collector roadway with few properties that directly access the roadway; and its proximity to Platte Canyon Rd minimizes out-of-direction travel and related impacts on neighboring properties. Fairway Ln and Middlefield Rd, other collector roadways in the Town, provide secondary access to the site as well as primary access for traffic to/from the east on Bowles Ave.
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4. The intersection of Platte Canyon Rd and Hunter Run Ln warrants a southbound left turn deceleration lane upon development of Wild Plum. The existing southbound left turn lane does not meet current CDOT standards for a roadway with a NR-A access category. Platte Canyon Rd could be restriped to provide a longer deceleration lane; however this would impact the northbound left-turn lane for Coal Mine Rd which is a much more critical movement to overall traffic flow through the corridor. The study has concluded that vehicle queues for the southbound left turn movement will typically be one car length or less. For these reasons, no changes to existing left turn striping along Platte Canyon Rd is recommended.
5. Although the 20 northbound right turns per hour projected for Hunter Run Ln is less than the 26 needed to warrant a right-turn deceleration lane, it is recommended that construction of a right-turn lane be considered for safety purposes. In any event, improvements to the intersection of Platte Canyon Rd and Hunter Run Ln will be required to improve entering sight distance for Hunter Run Ln.
6. It is recommended that Hunter Run Ln be brought up to current Town standards between Platte Canyon Rd and the entrance to Wild Plum. This will enable the roadway to better accommodate its intended function as the primary access for Wild Plum.
7. The study has concluded that the potential traffic impacts of the Wild Plum development can be addressed by the transportation improvements outlined in this report.

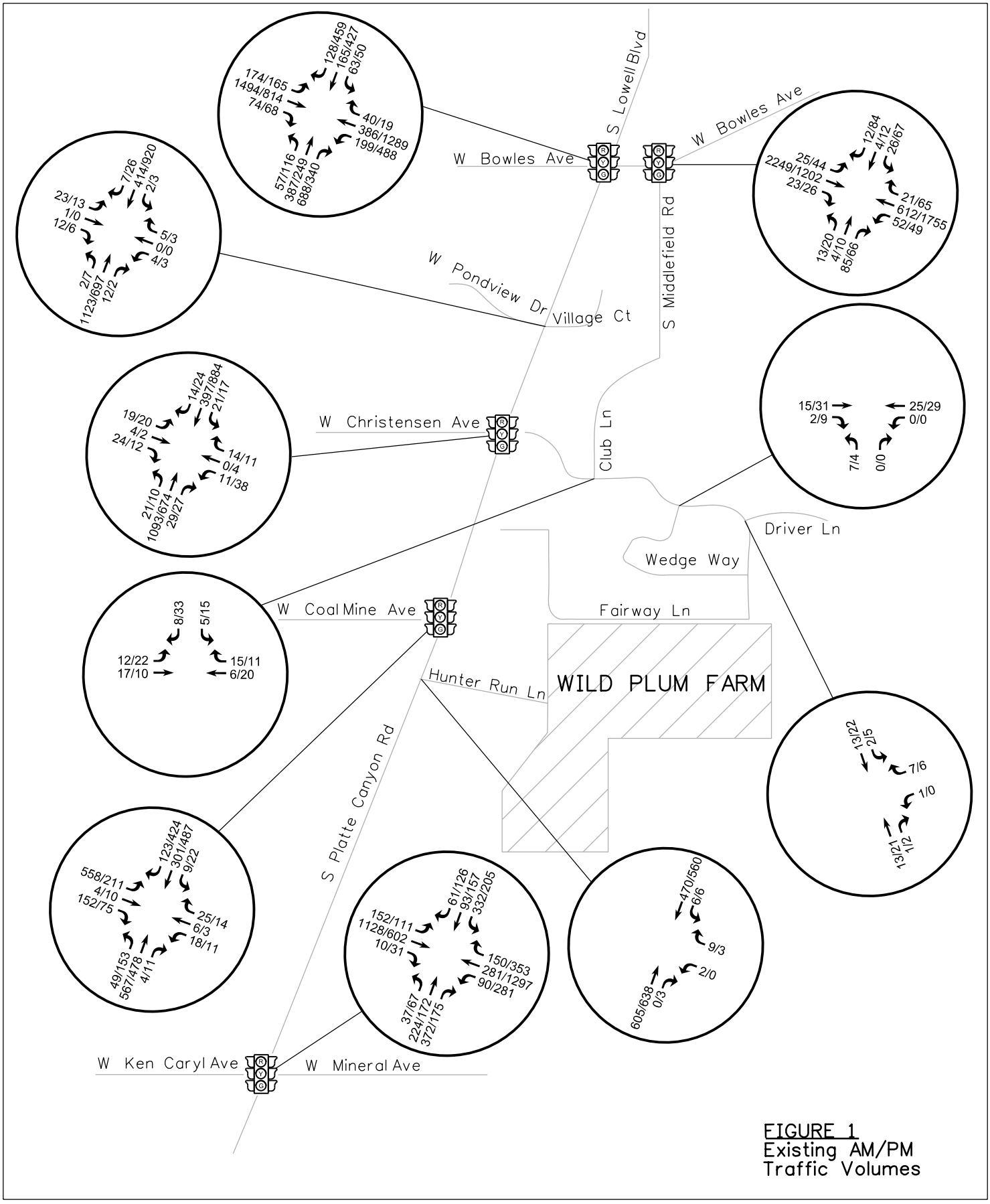

FIGURE 1
Existing AM/PM
Traffic Volumes

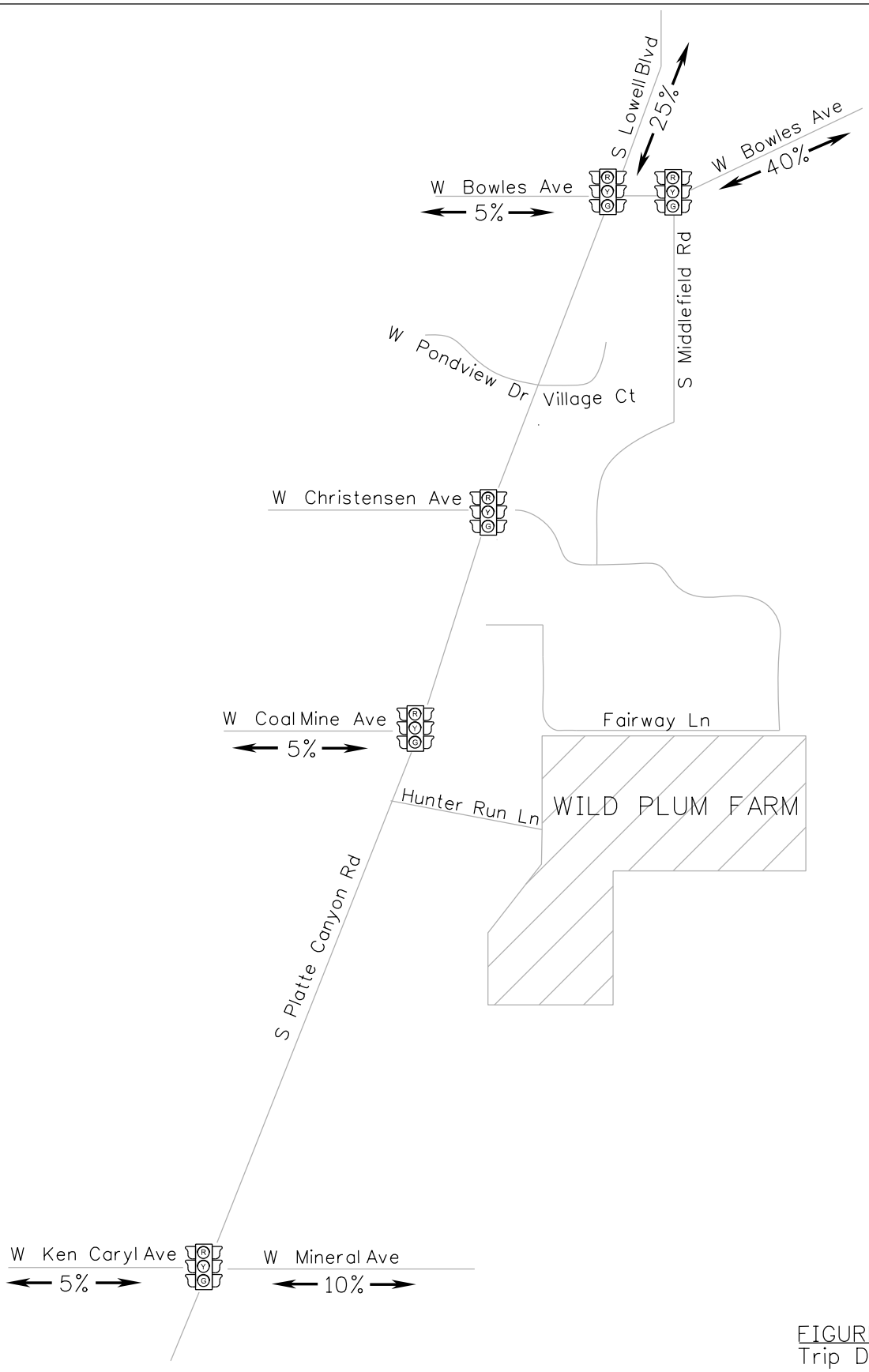

FIGURE 2
Trip Distribution

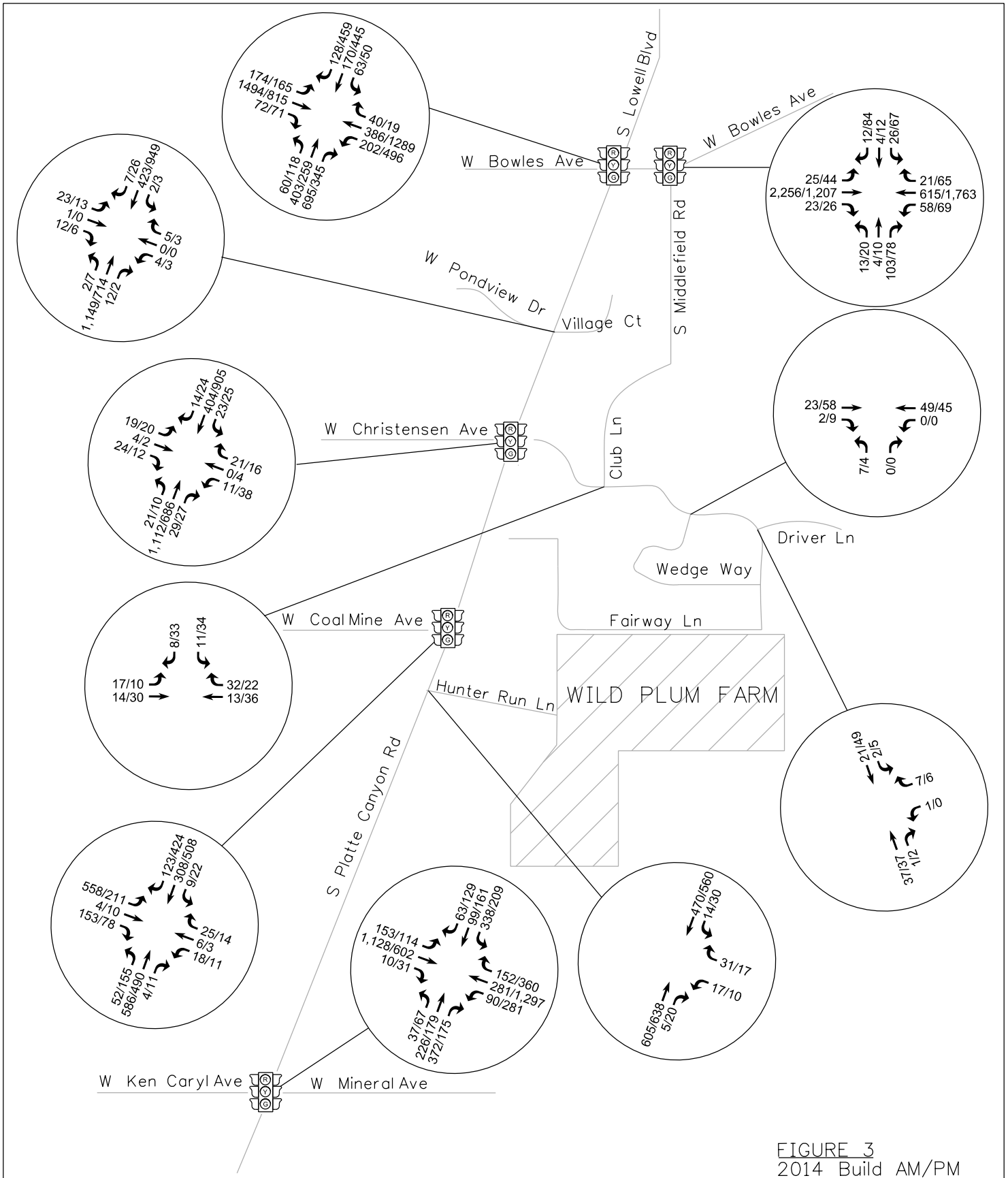

FIGURE 3
2014 Build AM/PM
Traffic Volumes

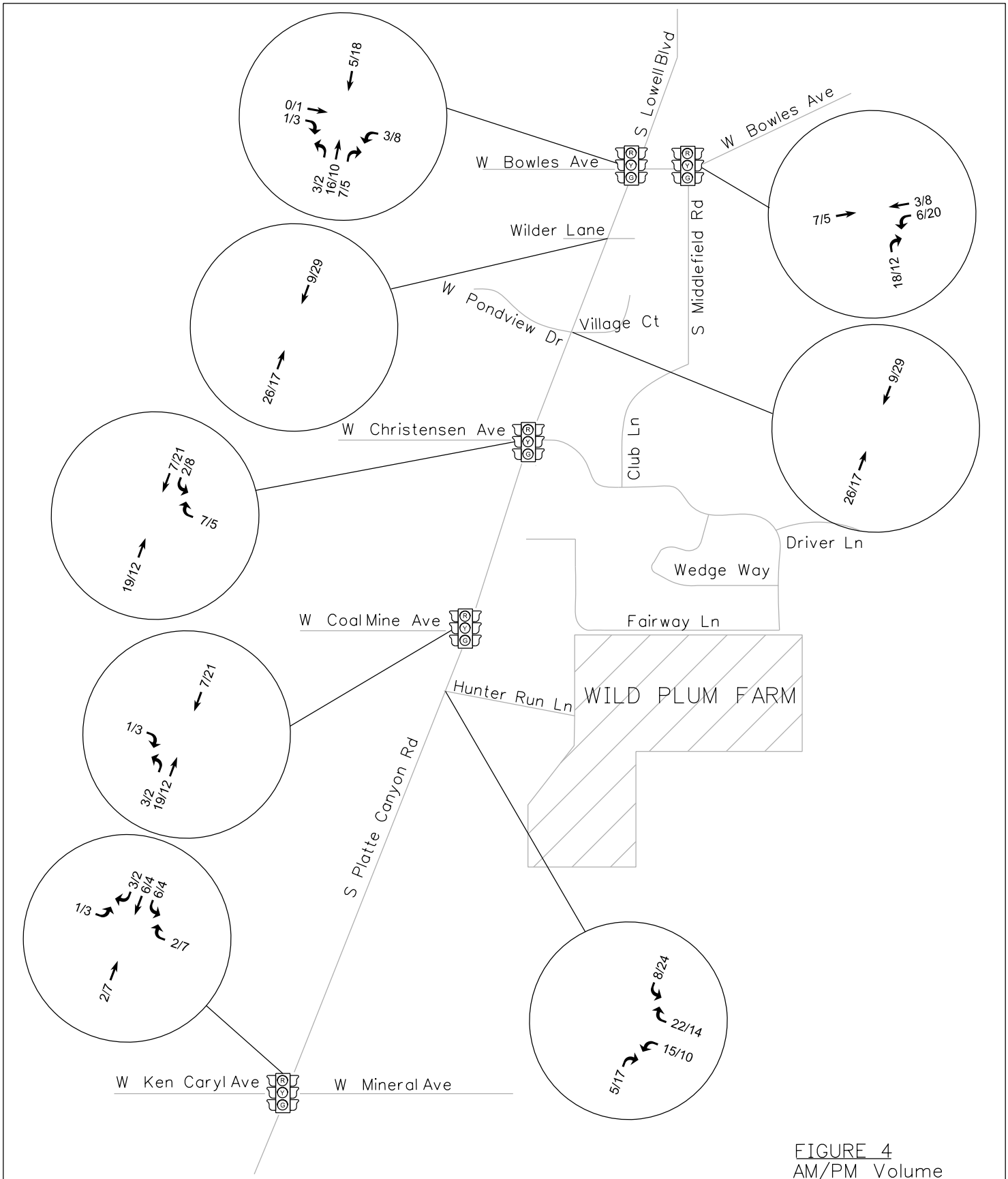

FIGURE 4
AM/PM Volume
Project Trips

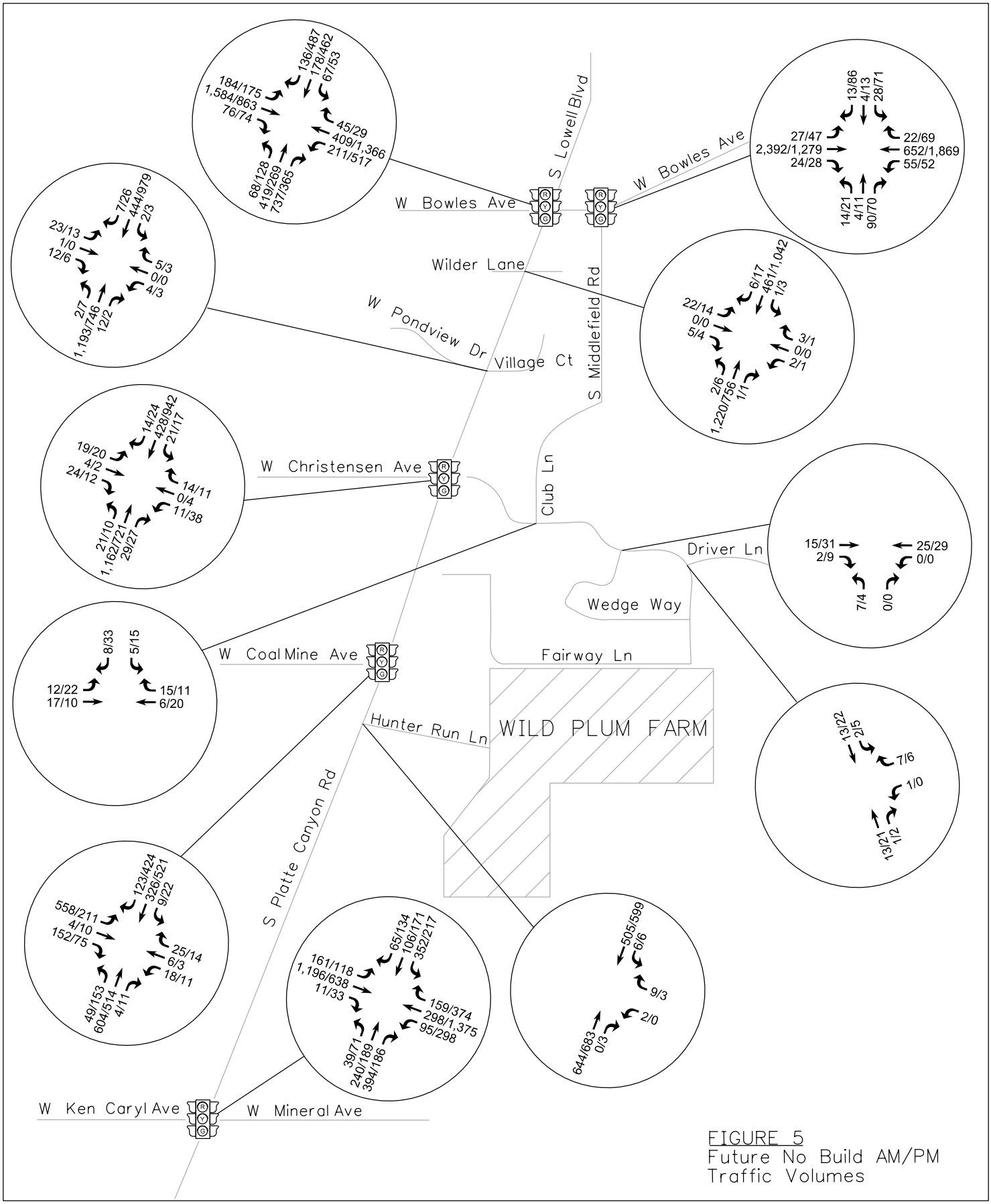

FIGURE 5
Future No Build AM/PM
Traffic Volumes

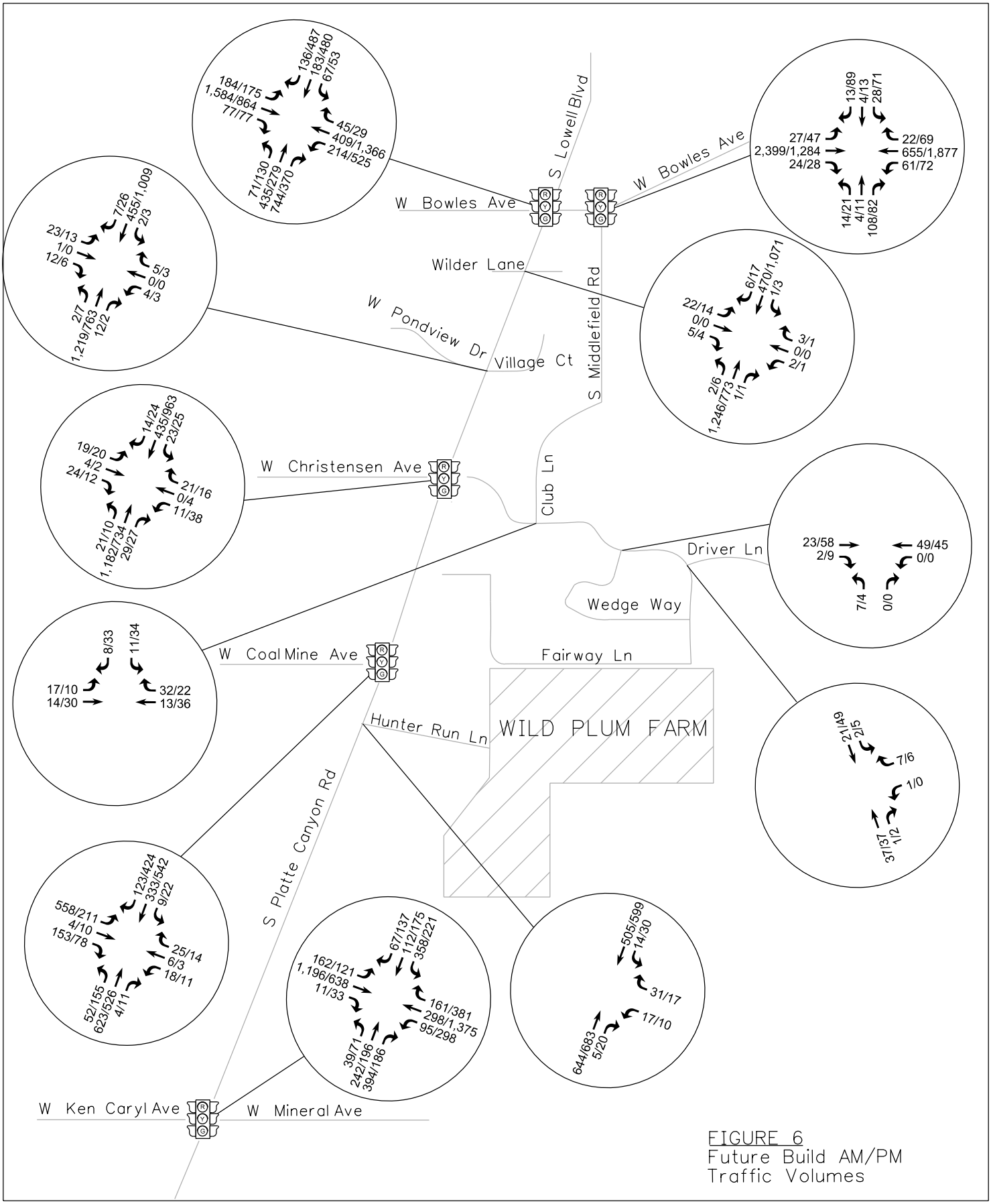

FIGURE 6
Future Build AM/PM
Traffic Volumes

APPENDIX

Traffic Volumes
Level-of-Service Worksheets