APPENDICES

APPENDIX A
USA Parkway Traffic Forecast Memorandum

Technical Memorandum

TO:	Randy Travis, Traffic Information, NDOT	**DATE:**	July 11, 2012
FROM:	John Karachepone, Jacobs		
SUBJECT:	USA Parkway - Traffic Forecasts		
COPIES:	Pedro Rodriguez, NDOT; Hoang Hong, NDOT; Bryan Gant, Jacobs		

1. INTRODUCTION AND BACKGROUND

USA Parkway (SR 439) begins at I-80 about 10 miles east of Reno at the USA Parkway Interchange. Currently, approximately six miles of the USA Parkway alignment within Storey County has been paved and the remaining is graded to the Lyon County line. The paved section is a four-lane divided arterial with open median. Extension of the USA Parkway southeast from Storey County into Lyon County to tie into US 50 in Silver Springs is proposed.

USA Parkway (SR 439) has been envisioned as an important link between US 50 and I-80. Currently, US 395 through Carson City, SR 341 through Virginia City and US 95A through Fernley are used to connect the Reno metro area with points south and east. A complete USA Parkway between US 50 and I-80 will improve that connectivity. In addition, the development of the Tahoe-Reno Industrial Center (TRIC) along USA Parkway continues to change the employment and transportation character of the region. The TRIC is planned to become a large industrial park. Figure 1-1 illustrates the proposed project in relation to surrounding roadways and land use.

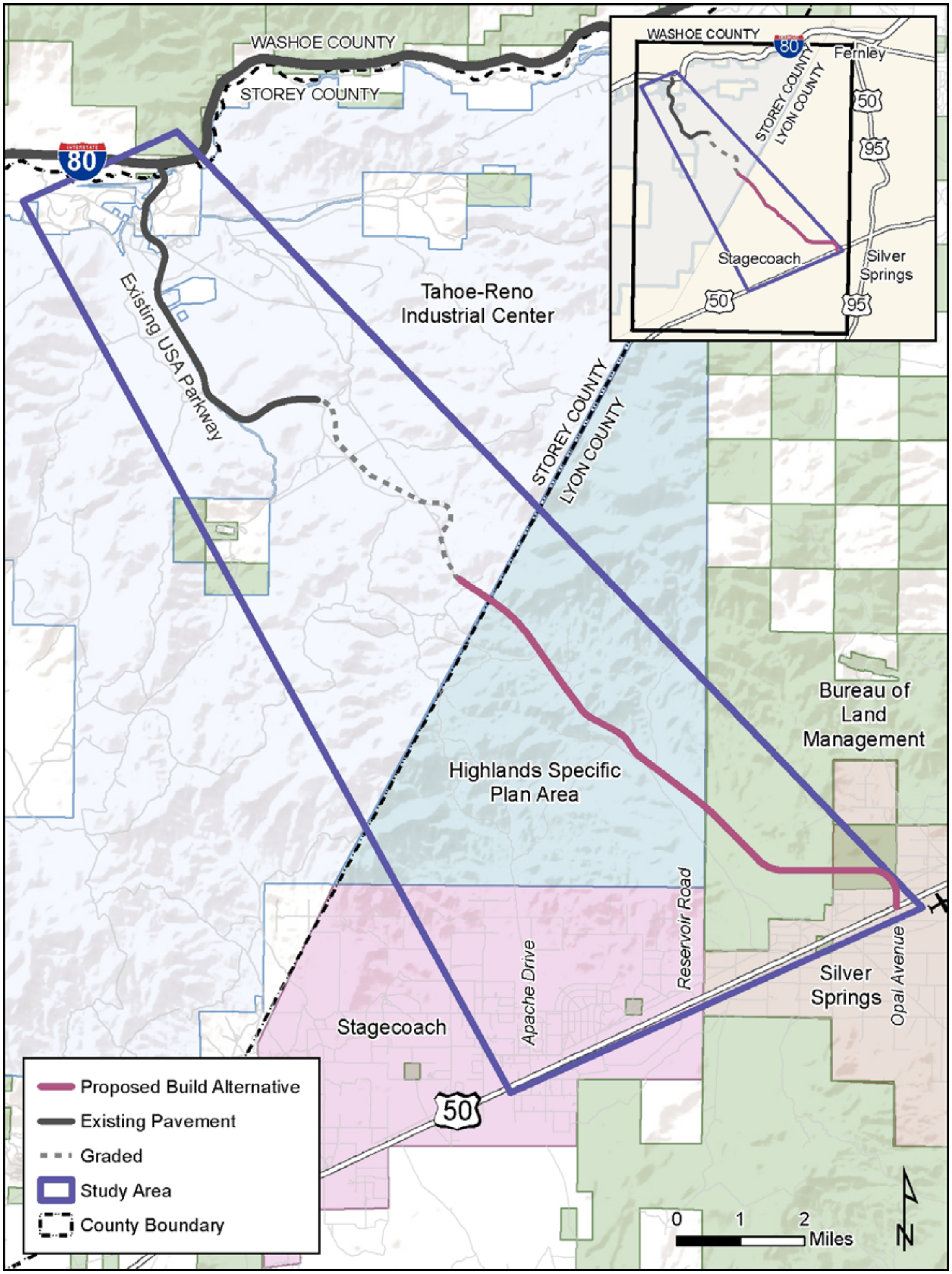
Jacobs is retained by the Nevada Department of Transportation (NDOT) to provide environmental and preliminary engineering services for the proposed project. At the present time, it appears that an Environmental Assessment (EA) will be the appropriate class of action for National Environmental Policy Act (NEPA) conformance. The lead agency is the Federal Highway Administration (FHWA) with joint NDOT and Bureau of Land Management (BLM) participation. The anticipated opening year for the proposed project is 2017. The design year is 2037, consistent with NDOT's and FHWA's 20 year beyond opening year policy.

To support the USA Parkway EA, a Traffic Study will be completed. The purpose of this memorandum is to present the design year 2037 traffic volumes that have been estimated for use in the Traffic Study. Additionally, opening year 2017 traffic volume estimates are presented.

Figure 1-1 shows an area called "Highlands Specific Plan Area" south of the county line along USA Parkway (referred to as Highlands herein). Highlands was originally proposed as a mixed-use development planned to open in year 2020. At the present time it is uncertain if the site would indeed be developed. Lyon County has not heard from the developer in several years. Concerns were expressed regarding the likelihood of the fruition of the Highlands development, especially due to economic uncertainties; and the question has arisen as to whether the Highlands development should be included in the traffic forecasts. The answer is not clear at this time; therefore the project team decided to develop traffic forecasts for two scenarios: 1) Highlands gets built ("with Highlands"); and 2) Highlands does not get built ("No-Highlands").

With this approach, forecasts will be ready for whichever development scenario is selected as the most likely scenario to go into the EA document.

Figure 1-1: Proposed Project



The basis of the traffic forecasts are the travel demand models developed specifically for the USA Parkway EA. The preparation of the traffic forecast, including travel demand model development, assumptions, data sources and refinements are documented. In all, the following travel demand models were developed specifically for the USA Parkway EA:

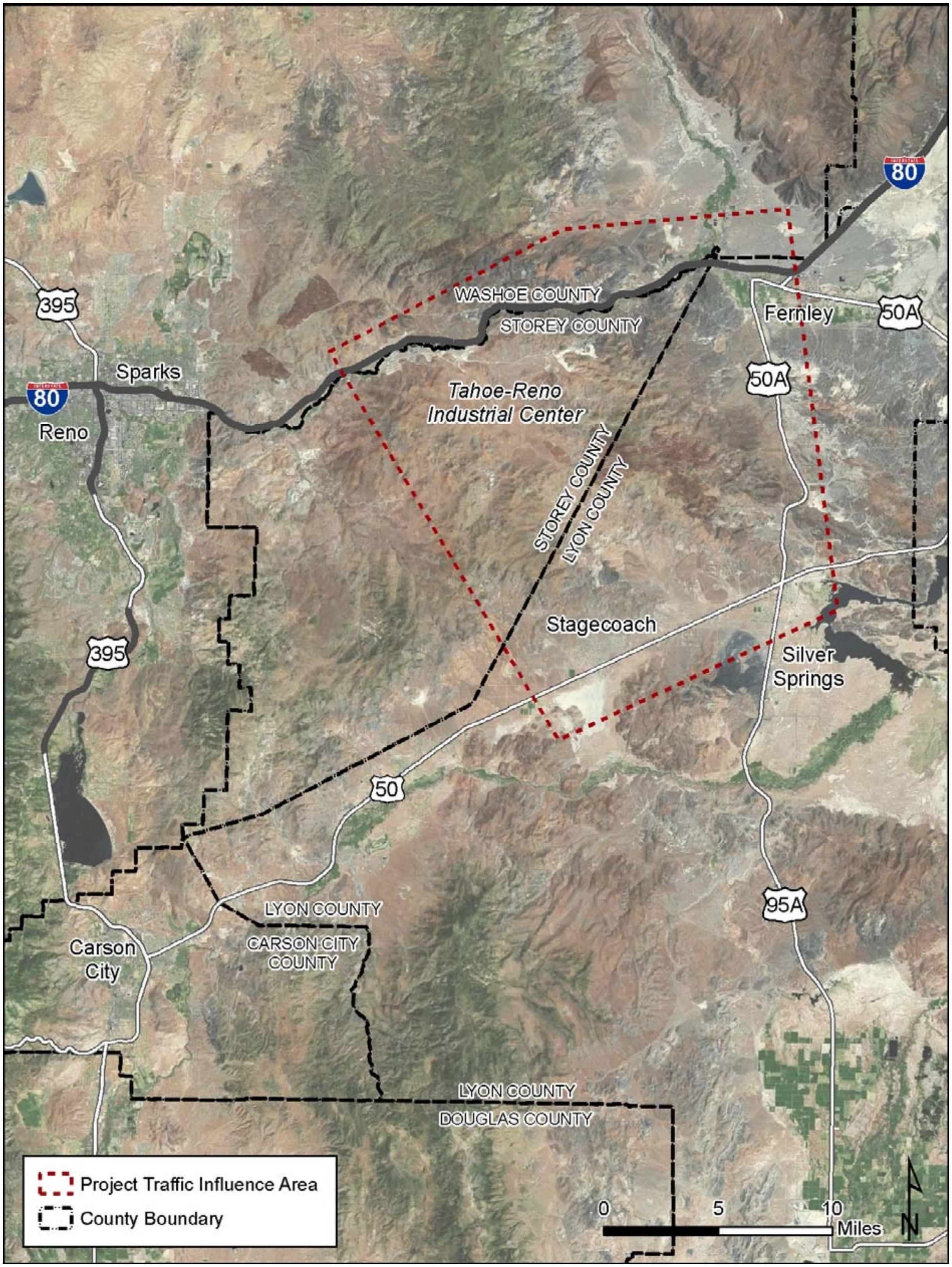
- Year 2010 Base Year Model
- Year 2035 No-Action Model (with-Highlands)
- Year 2035 Build Model (with-Highlands)
- Year 2035 No-Action Model (No-Highlands)
- Year 2035 Build Model (No-Highlands)
- Year 2017 No-Action Model
- Year 2017 Build Model

The methodologies used are consistent with the *Draft NDOT Traffic Forecasting Guidelines* and the previously approved USA Parkway Traffic Analysis Methodology, dated December 28, 2011. The Traffic Forecasting Guidelines Checklist was completed as explained in the *Draft NDOT Traffic Forecasting Guidelines* and is provided in Appendix A.

Figure 1-2 shows the general traffic study area within the regional context. This is the project traffic influence area; specifically the area bounded by I-80 to the north, US 50 to the south, US 95A to the east and USA Parkway to the west. Traffic operations analysis will be performed according to the design year development scenario identified by the project team. A traffic operations analysis of the existing USA Parkway with I-80 Interchange will also be completed for existing conditions.

This Traffic Forecast Memorandum is consistent with the *Approved USA Parkway Traffic Analysis Methodology* dated December 28, 2011, and included in Appendix B.

Figure 1-2: General Traffic Study Area



2. TRAVEL DEMAND MODEL

A travel demand modeling effort is needed to provide a regional understanding of the future traffic demand for the proposed USA Parkway.

A travel demand model does not exist for Storey County. For Lyon County, a TransCAD travel demand model was developed by Fehr & Peers in 2008 and calibrated and validated to year 2005 conditions. This model was initially developed for the US 50 Corridor Study and expanded to the rest of the County by Fehr & Peers, but was not formally adopted by the County. It had also not been maintained or updated since 2008, when Fehr & Peers turned over the network files and results to Lyon County. Fehr & Peers provided the most current version of the 2005 and 2030 travel model networks and input files to the project team. Appendix C contains the *Preliminary Modeling Report* from Fehr & Peers describing the original development and validation of the model.

It was recognized that the Lyon County model, by expanding it into Storey County, would be the best available planning tool to accomplish the forecasting needs for the USA Parkway EA. A travel demand model has the capability to demonstrate the change in travel patterns due to the addition of new capacity to a transportation network. The model modification and revalidation effort was focused on the USA Parkway area, and specifically was not an update of the entire regional model.

This section provides a description of the original Lyon County model, and documents the expansion of the original Lyon County model to cover the project area and the validation of its reasonableness in the project area.

2.1. Original Lyon County Model

The Lyon County Travel Demand Model was developed for a base year of 2005 and follows the four-step modeling procedure. Figure 2-1 displays the Lyon County Model in a regional context; the study area is in the northern half of the model, which is where the travel demand modeling effort was focused. Figure 2-2 displays the model Traffic Analysis Zone (TAZ) system,

Figure 2-3 displays the model roadway network and Figure 2-4 displays the location of the proposed USA Parkway within the model framework.

2.1.1. Model Structure and Operation

The original model is performed in TransCAD Version 4.8, Build 393 or higher. The model resource code (US50_2005.rsc) contains the GISDK code used to perform the model and was compiled using TransCAD's GISDK utility. This code utilizes the following input files:

- Trip Generation – a Microsoft Excel file consisting of worksheets to produce demographics, trip generation rates, productions and attractions, and through trips.
  - Demographics.dbf
  - Crossclasspa.bin (from "TO_CROSSCLASS" worksheet)
  - Through_trips.mtx

Figure 2-1: Lyon County Model in Regional Context

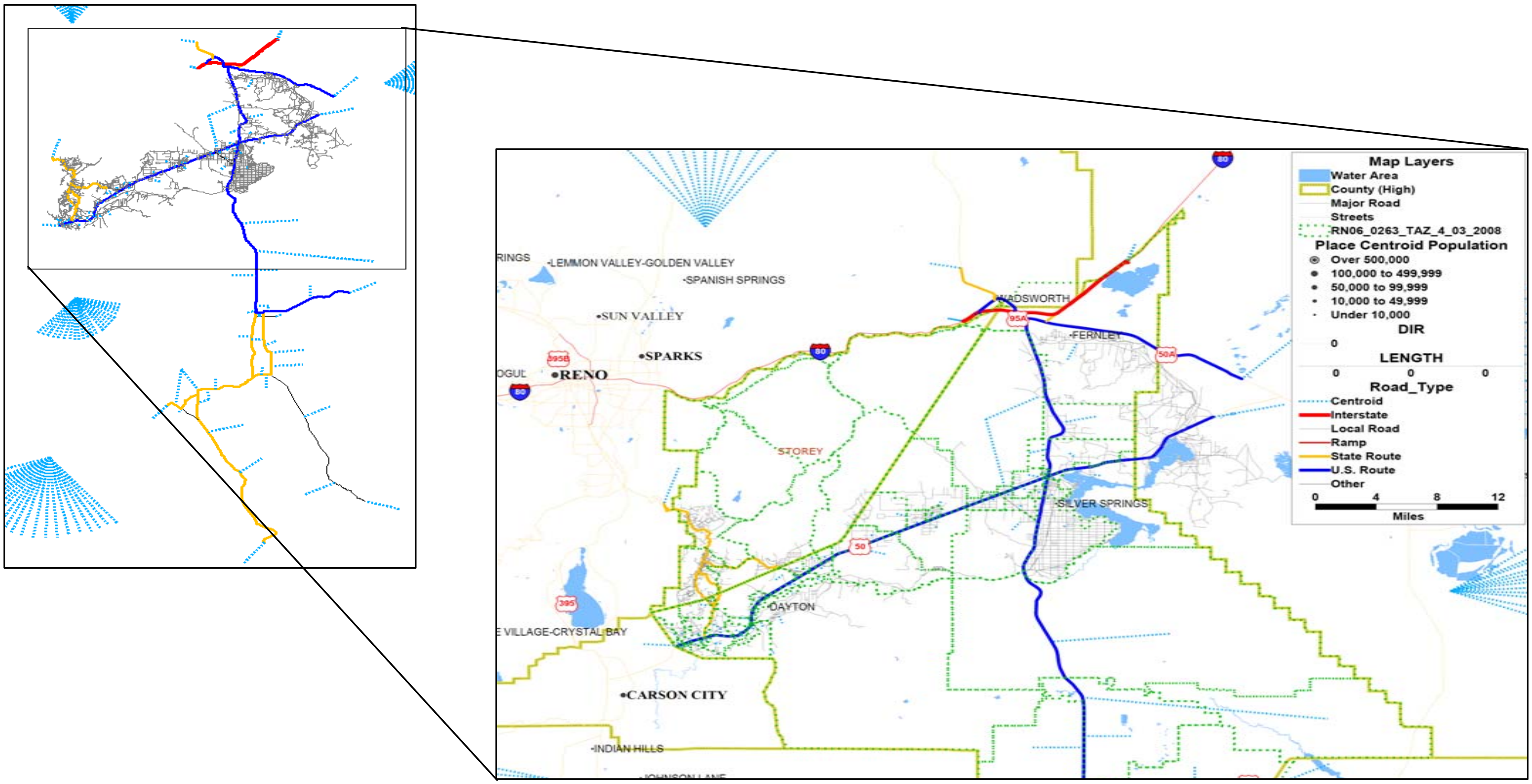
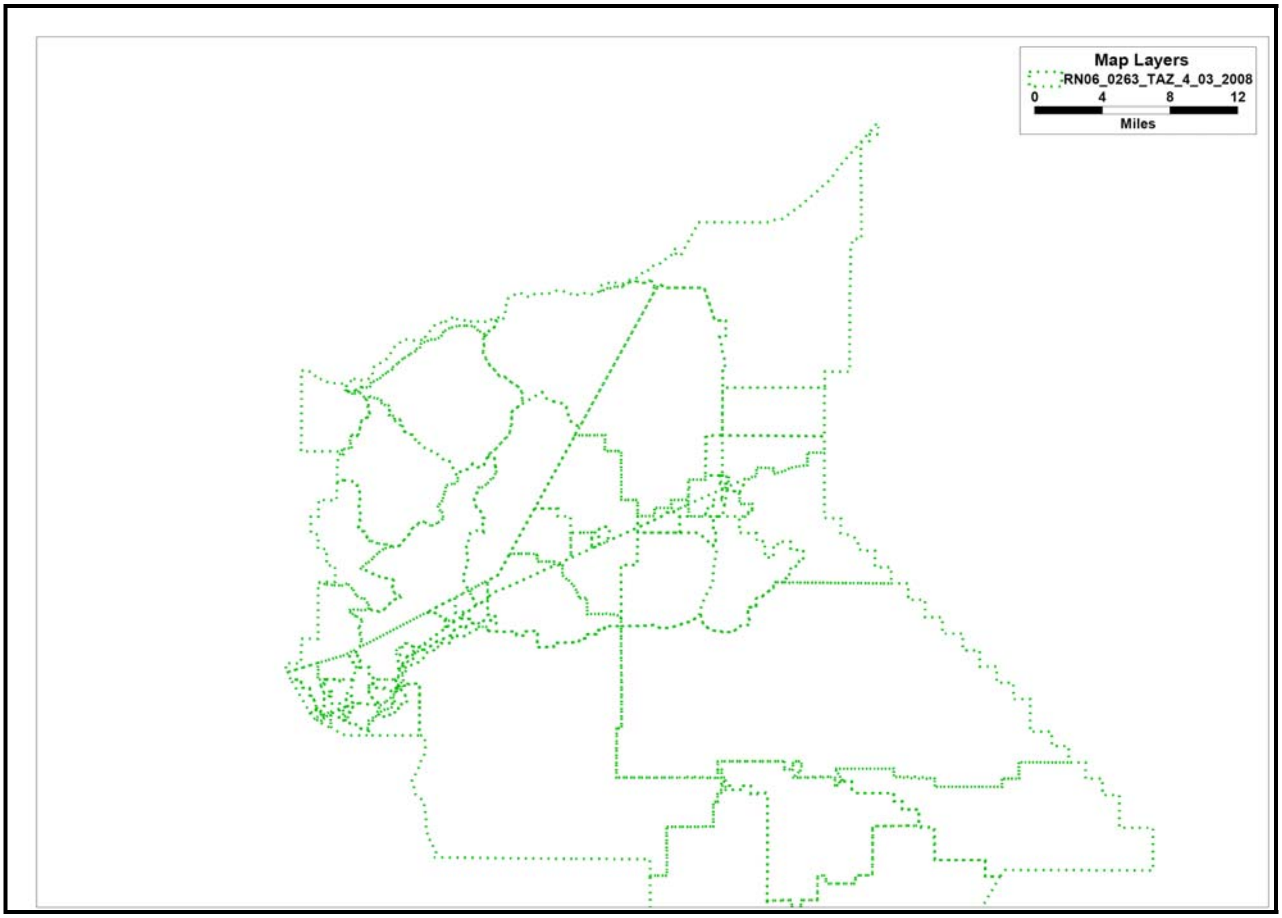
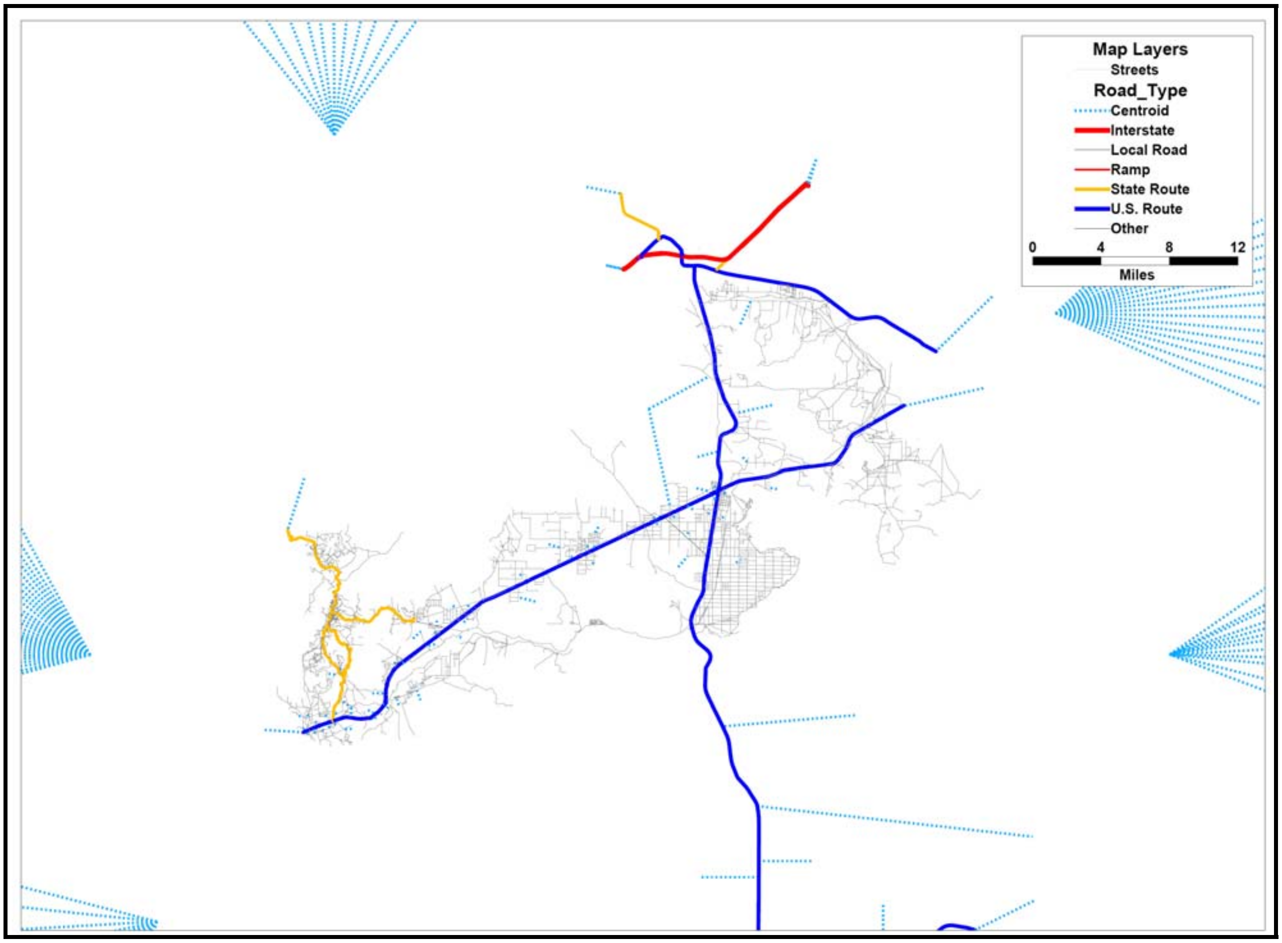


Figure 2-2: Lyon County Model TAZ System (North Area)



- Geographic File – the TransCAD network was provided for the 2005 base year. The model uses these parameters within the network:
  - Length (auto-filled)
  - Dir – direction of the link (0 = bi-directional, 1 and -1 = one-way)
  - AB_Speed, BA_Speed – free-flow or posted speed
  - AB_Lane, BA_Lane – number of lanes by direction
  - LANE_CAPACITY – hourly lane capacity
  - ALPHA, BETA – speed curve function parameters
- TAZ System – the model area was divided into 98 Traffic Analysis Zones (TAZs) and 10 External stations.
- Friction Factors – a dbf file containing friction factors is used for Trip Distribution.
- Hourly Assignment – a bin file depicting the traffic assignment values for peak hours and off-peak hours.

Figure 2-3: Lyon County Model Roadway Network (North Area)



2.1.2. Model Base and Future Years

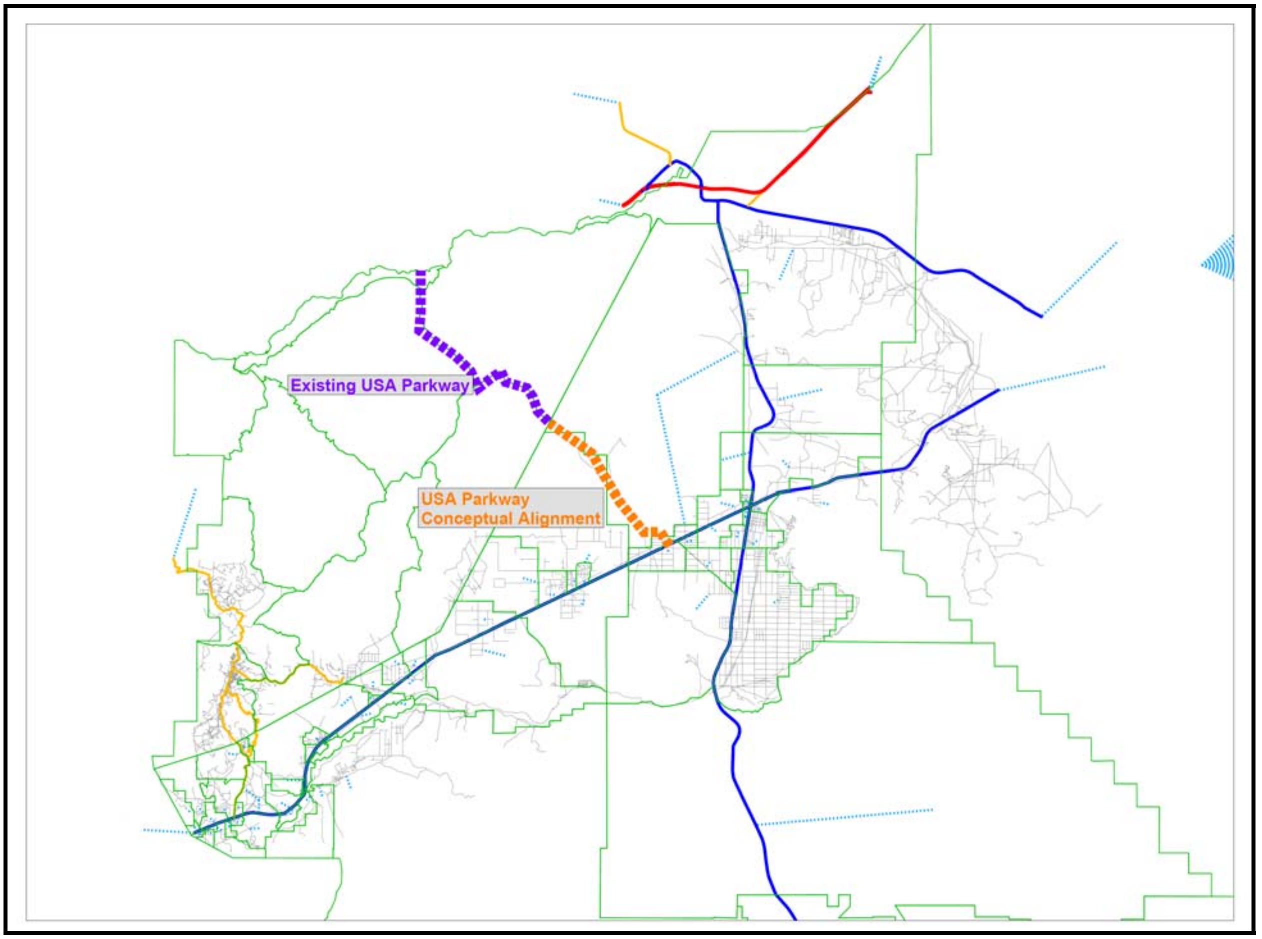
The original models provided by Fehr & Peers were calibrated and validated to a 2005 base year model and a 2030 future year.

2.1.3. Trip Purposes

There are four trip purposes in the original travel demand model:

- Home-based-work (HBW)
- Home-based other (HBO)
- Non-home-based (NHB)
- School

Figure 2-4: USA Parkway Location within Lyon County Model Network



2.1.4. Trip Generation

A primary input of the model is future estimates of population and employment socio-economic data, distributed geographically by TAZ. Table 2-1 displays the totals of population and employment in Lyon County for the base year 2005 and future year 2030. As noted in the Lyon County model *Preliminary Modeling Report* in Appendix C, the socio-economic data were not field-verified, and were last reviewed in 2008. Details can be found in Appendix C.

Table 2-1: Socio-economic Data from Lyon County Model

	Year 2005	Year 2030
Households	24,693	40,003
Employees	12,627	13,938

The Lyon County model utilizes trip generation rates compiled from a variety of sources:

- The Institute of Transportation Engineers (ITE) Trip Generation Manual
- The California Statewide Household Survey for Sierra Nevada Counties
- The Sacramento Area Council of Governments

These are shown in Table 2-2 for the different geographic areas of the model. These trip generation rates resulted in approximately five daily trips per household.

Table 2-2: Trip Generation Rates

Land Use Type	Unit	Lyon County	Dayton	Fernley	Silver Springs	Yerington	External
SFR	DU	2.56	6.40	3.84	4.22	3.20	6.40
MFR	DU	1.40	3.50	2.10	2.31	1.75	3.50
MH	DU	1.40	3.50	2.10	2.31	1.75	3.50
RURAL Residential	DU	2.56	6.40	3.84	3.20	3.20	6.40
ELEM	Students	1.29	1.29	1.29	1.29	1.29	1.29
HIGHSCH	Students	1.71	1.71	1.71	1.71	1.71	1.71
Retail	Jobs	12.20	24.40	12.20	18.30	18.30	24.40
Non-Retail	Jobs	2.00	4.00	2.00	3.00	3.00	4.00

2.1.5. External Stations

There are 11 external stations in the original model:

- Node 200: I-80 West of Fernley
- Node 202: I-80 East of Fernley
- Node 204: SH 341 North of Dayton
- Node 206: US 50 West of Dayton
- Node 208: CR 208 West of Wellington
- Node 800: CR 338 South of Wellington
- Node 201: CR 447 North of Wadsworth
- Node 203: US 50 East of Fernley
- Node 205: US 50 East of Silver Springs
- Node 207: US 95A East of Yerington
- Node 209: Pine Grove Road South of Yerington

2.1.6. Trip Distribution

The model utilizes a standard gravity model procedure to distribute trips. The friction factor table is used to determine impedances. The friction factors for the original model are shown in Figure 2-5.

The original model produced trips that were somewhat skewed toward very short trips, but otherwise reasonably-well distributed. Seventy percent of all trips were less than 30 minutes long and 40 percent of all trips were to locations within 10 minutes. Figure 2-6 displays the trip length distribution for the original 2005 base year model.

2.1.7. Auto Occupancy

A flat auto-occupancy rate of 1.5 people per vehicle is used for all trip types.

2.1.8. Traffic Assignment

The model performs traffic assignment for daily, AM peak hour, and PM peak hour. The hourly capacity and alpha and beta fields determine speed curves and the model performs a maximum of 10 speed-balancing iterations for each assignment period.

Figure 2-5: Friction Factors for the Original Model

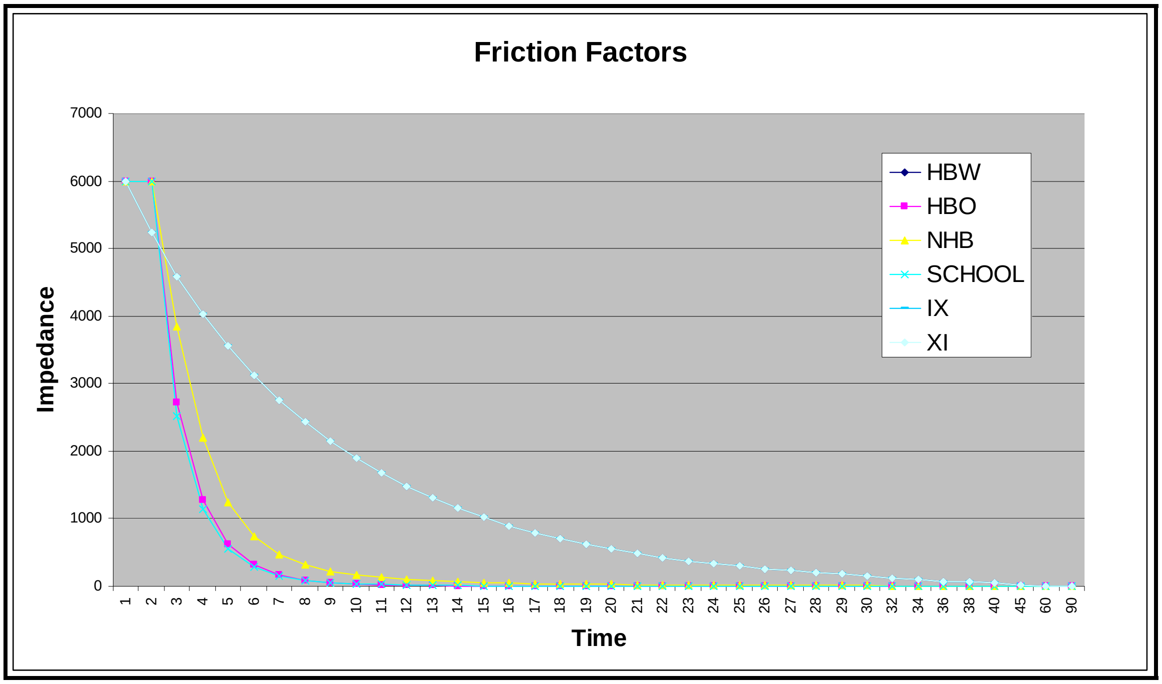
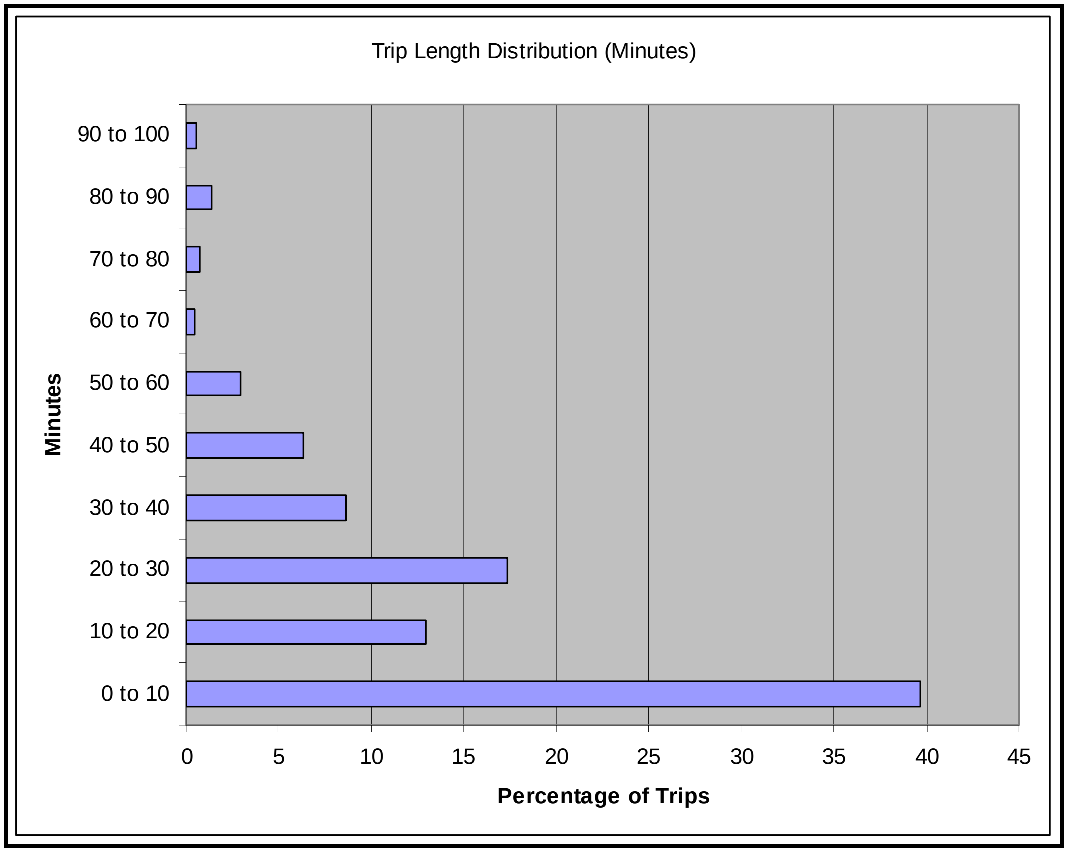


Figure 2-6: Trip Length Distribution for the Original Model



2.2. USA Parkway EA Model Development

For the USA Parkway EA travel demand modeling, the project team made several updates and modifications to the original Lyon County Model. The improvements were focused on the project traffic influence area, specifically, the area bounded by I-80 to the north, US 50 to the south, US 95A to the east and USA Parkway to the west. A region-wide model update was not performed. The updates and modifications are described in the following sections.

2.2.1. Updated Network

The project team extended the boundaries of the base year model into Storey County to include the USA Parkway Interchange at I-80. Also, the existing USA Parkway segment through the TRIC was added to the network as well as some local road connections in the area. The updated network is displayed in Figure 2-7.

2.2.2. Updated TAZ System

The TAZ system was modified to better reflect development areas for both existing areas and future development patterns. This included modifying the Fernley area, where originally only one TAZ was coded into the original structure. Some additional zones near US 95A were also included in the new TAZ system. These additional zones allowed an improved distribution of trips. Also, zones representing the TRIC and the Highlands development were added in the project area. Centroid connectors were provided for each new or modified TAZ. Figure 2-8 displays the additional/modified TAZs in red.

2.2.3. Base Year 2010

The project team updated the base year for the model to 2010. This allowed the team to validate the model results to more recent counts and to include the USA Parkway / I-80 interchange in the base year network. A review of the demographics file revealed an over estimation of the number of households in the county in the original model. According to the United States Census, Lyon County had 17,800 households in the year 2010. The original model demographic file for 2005 contained 24,700 households. The number of households in each geographic sub-area in the original model data was also higher than the corresponding US Census number, with the exception of Dayton. Therefore, adjustments were made to each geographic area in the demographics file to better reflect the number of households in the county. The US Census data was used to make these adjustments, which are shown in Table 2-3 in comparison to original 2005 model.

The project team also reviewed the number of jobs in the model area, which were found to be reasonable for the 2010 base year. However, the original file did not include the TRIC. In 2010, the businesses operating in the TRIC employed approximately 2,500 workers. The addition of these jobs to the original model employment resulted in 15,900 for the 2010 employment for the model area. This represents a jobs-to-households ratio of 0.89. Detailed demographic data can be found in Appendix D.

Figure 2-7: Updated 2005 Model Network

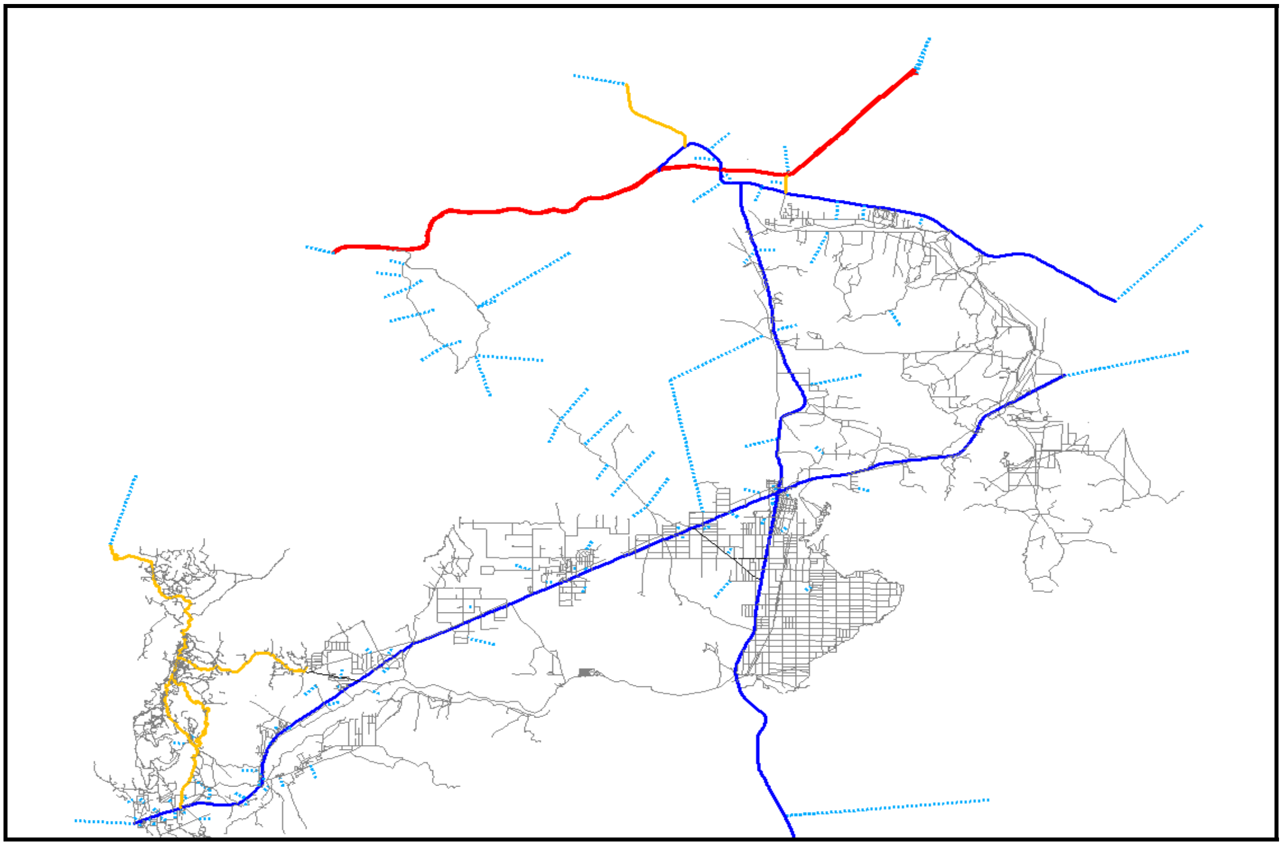


Table 2-3: Households by Type – Base Year

Geographic Area		Original 2005					Census (2010)	Updated to 2010			
		Single Family	Multi-Family	Mobile Home	Rural	Total		Single Family	Multi-Family	Mobile Home	Rural
1	Lyon County*	179	974	2,301	5,397	8,843	5,200	102	571	1,354	3,173
2	Dayton	1,622	348	494	434	2,899	3,100	1,736	372	527	462
3	Fernley	3,311	1,075	2,235	1,656	8,278	6,400	2,559	834	1,729	1,279
4	Silver Springs	-	25	2,051	587	2,662	1,800	-	16	1,386	396
5	Yerington	40	221	523	1,227	2,011	1,300	26	143	338	793
	Total	**5,152**	**2,643**	**7,604**	**9,301**	**24,693**	**17,800**	**4,423**	**1,936**	**5,335**	**6,104**

* Note that Highlands development is a proposed development, and did not exist in the year 2005 and year 2010

2.2.4. Future Year 2035 – with-Highlands Models

The project team updated the model forecast year to 2035. The demographics file was extended from 2030 to 2035 by applying the growth rates in the original model files to 2035 by TAZ. In addition, the Highlands development is projected to have approximately 1,300 single family homes and 1,300 multi-family homes by 2035. However, the same adjustments applied to 2010 to control for US Census figures were applied to the 2030 data, meaning that the number of households in 2035 is projected to be lower than the number in the original 2030 model. The resulting number of households by type is provided in Table 2-4 in comparison to original 2030 model.

Figure 2-8: Updated TAZ System

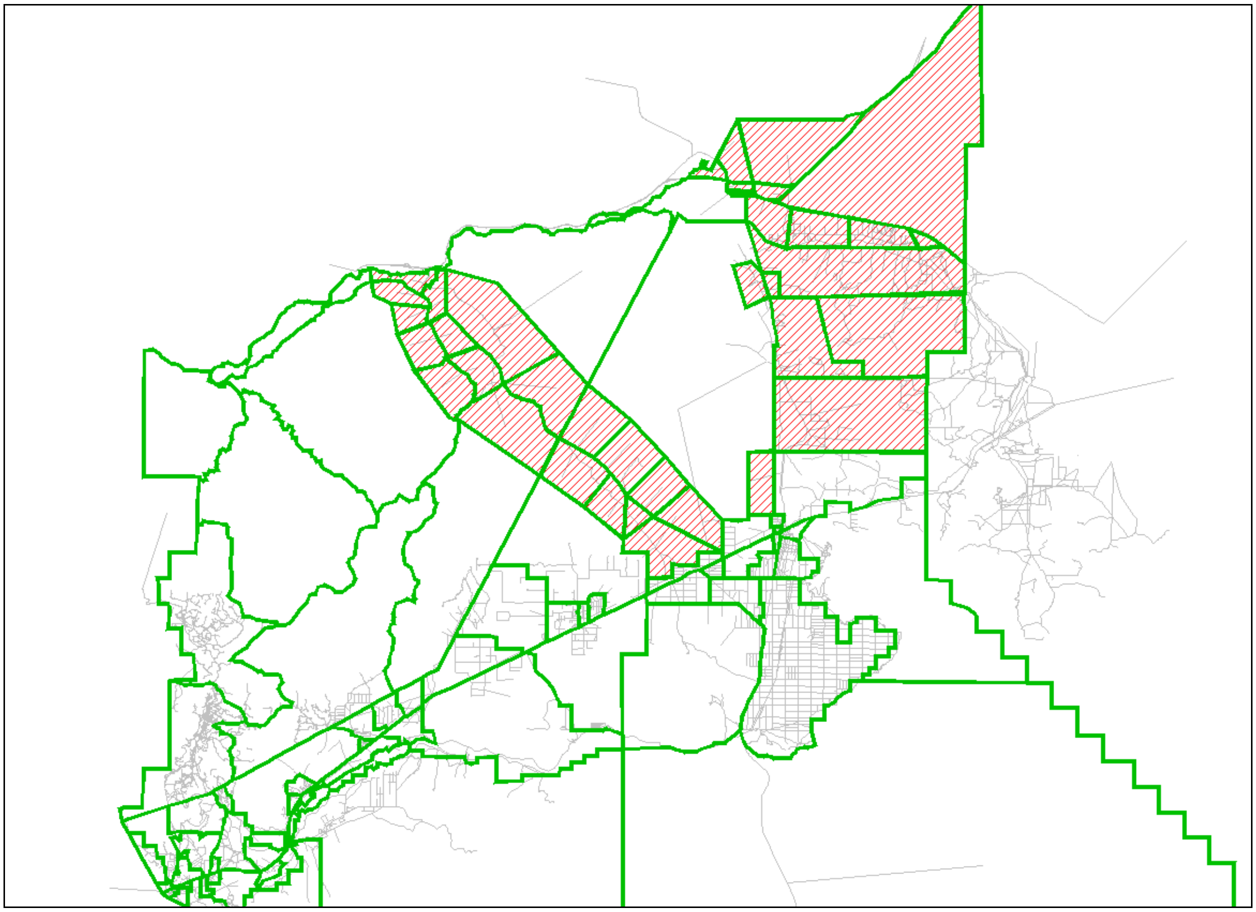


Table 2-4: Households by Type – Year 2035 with-Highlands Models

Geographic Area		Original 2030 – without Census Adjustment					Updated to 2035 – with Census Adjustment and Highlands Development				
		Single Family	Multi-Family	Mobile Home	Rural	Total	Single Family	Multi-Family	Mobile Home	Rural	Total
1	Lyon County	284	1,586	3,752	8,800	14,422	1,482	2,036	1,749	4,111	9,378
2	Dayton	2,267	487	690	609	4,053	2,504	538	764	674	4,480
3	Fernley	5,947	1,931	4,014	2,973	14,865	4,891	1,587	3,300	2,445	12,222
4	Silver Springs	-	45	3,371	963	4,379	-	27	2,136	603	2,766
5	Yerington	46	251	594	1,393	2,284	75	415	981	2,317	3,787
	Total	**8,544**	**4,300**	**12,421**	**14,738**	**40,003**	**8,952**	**4,603**	**8,929**	**10,150**	**32,633**

The number of households in Lyon County in the 2035 demographic file includes the projected number of households in the Highlands development and this is reflected in Table 2-4. The number of households for Lyon County shown in Table 2-4 reflects both the census adjustment and the projected number of households for year 2035. Note that the original 2030 model did not include the Highlands development.

Highlands development's share of household numbers in relation to the number of households for the entire Lyon County is shown in Table 2-5.

Table 2-5: Households by Type – Lyon County – Year 2035 with-Highlands Models

Geographic Area	Year 2035				
	Single Family	Multi-Family	Mobile Home	Rural	Total
Lyon County – excluding Highlands development	132	740	1,749	4,111	6,732
Highlands development	1,350	1,296	-	-	2,646
Lyon County – including Highlands development	1,482	2,036	1,749	4,111	9,378

Employment projection data were limited for the area. The jobs-to-households ratio was relatively low in the original 2030 demographic file at 0.45. However, the TRIC (not part of the original model) is projecting substantial growth over the next 25 years. The report, *USA Parkway State Route 805, A Piece of Nevada's Future*, by Storey County, projects jobs growth at the TRIC to result in the employment of approximately 19,500 workers within the TRIC by 2030. Applying this growth rate to 2035 would result in approximately 23,500 employees at the TRIC in the forecast year. These jobs were added to the demographic file for 2035. Jobs in the Highlands development were also included in the forecast. The Highland development is proposed to be a mixed-use development. The project team estimated that the development would add approximately 900 jobs in 2035. The resulting number of jobs in the model area for 2035 is 38,900. This represents a jobs-to-households ratio of 1.19, indicating that the number of jobs in the area is projected to grow at a faster rate than the number of households. This is expected with the rapid development of the TRIC in the near future and results in a more reasonable forecast of socio-economic conditions for the model area. Detailed demographic data can be found in Appendix D.

2.2.5. Future Year 2035 – No-Highlands Models

The year 2035 No-Highlands models were also developed as per the procedures explained in Section 2.2.4. But, in the No-Highlands models, the projected households due to the Highlands development were not added to the TAZs corresponding to the Highlands development. The number of households by type in the No-Highlands models for the different geographical areas in comparison to original 2030 model is provided in Table 2-6.

Table 2-6: Households by Type – Year 2035 No-Highlands Models

Geographic Area		Original 2030 – without Census Adjustment					Updated to 2035 – with Census Adjustment				
		Single Family	Multi-Family	Mobile Home	Rural	Total	Single Family	Multi-Family	Mobile Home	Rural	Total
1	Lyon County	284	1,586	3,752	8,800	14,422	132	740	1,749	4,111	6,732
2	Dayton	2,267	487	690	609	4,053	2,504	538	764	674	4,480
3	Fernley	5,947	1,931	4,014	2,973	14,865	4,891	1,587	3,300	2,445	12,222
4	Silver Springs	-	45	3,371	963	4,379	-	27	2,136	603	2,766
5	Yerington	46	251	594	1,393	2,284	75	415	981	2,317	3,787
	Total	**8,544**	**4,300**	**12,421**	**14,738**	**40,003**	**8,952**	**4,603**	**8,929**	**10,150**	**29,987**

In the No-Highlands scenario, the total number of jobs in the demographics file is approximately 38,000 (in comparison to the with-Highlands model, the jobs corresponding to the Highlands development do not exist). The number of households is 29,987 as shown in Table 2-6. This represents a jobs-to-households ratio of 1.27.

2.2.6. Opening Year 2017

In addition to the base and future years, opening year 2017 travel demand models were developed. The demographic data for the opening year 2017 were developed by applying a linear growth rate. The household adjustments for all years are summarized in Table 2-7.

Table 2-7: Household Data Summary

Geographic Area		2005 Original	2010 Adjusted	2017 Final	2030 Original	2030 Adjusted	2035 Final (With-Highlands)	2035 Final (No-Highlands)
1	Lyon County	8,843	5,200	6,038	14,422	8,863	9,378[1]	6732
2	Dayton	2,899	3,097	3,484	4,053	4,525	4,480	4,480
3	Fernley	8,278	6,401	8,033	14,865	12,012	12,222	12,222
4	Silver Springs	2,662	1,798	2,070	4,379	3,091	2,766	2,766
5	Yerington	2,011	1,300	1,675	2,284	1,543	3,787	3,787
	Total	**24,693**	**17,796**	**21,300**	**40,003**	**30,034**	**32,633**	**29,987**

[1] This includes growth to 2035 and the addition of the Highlands Development

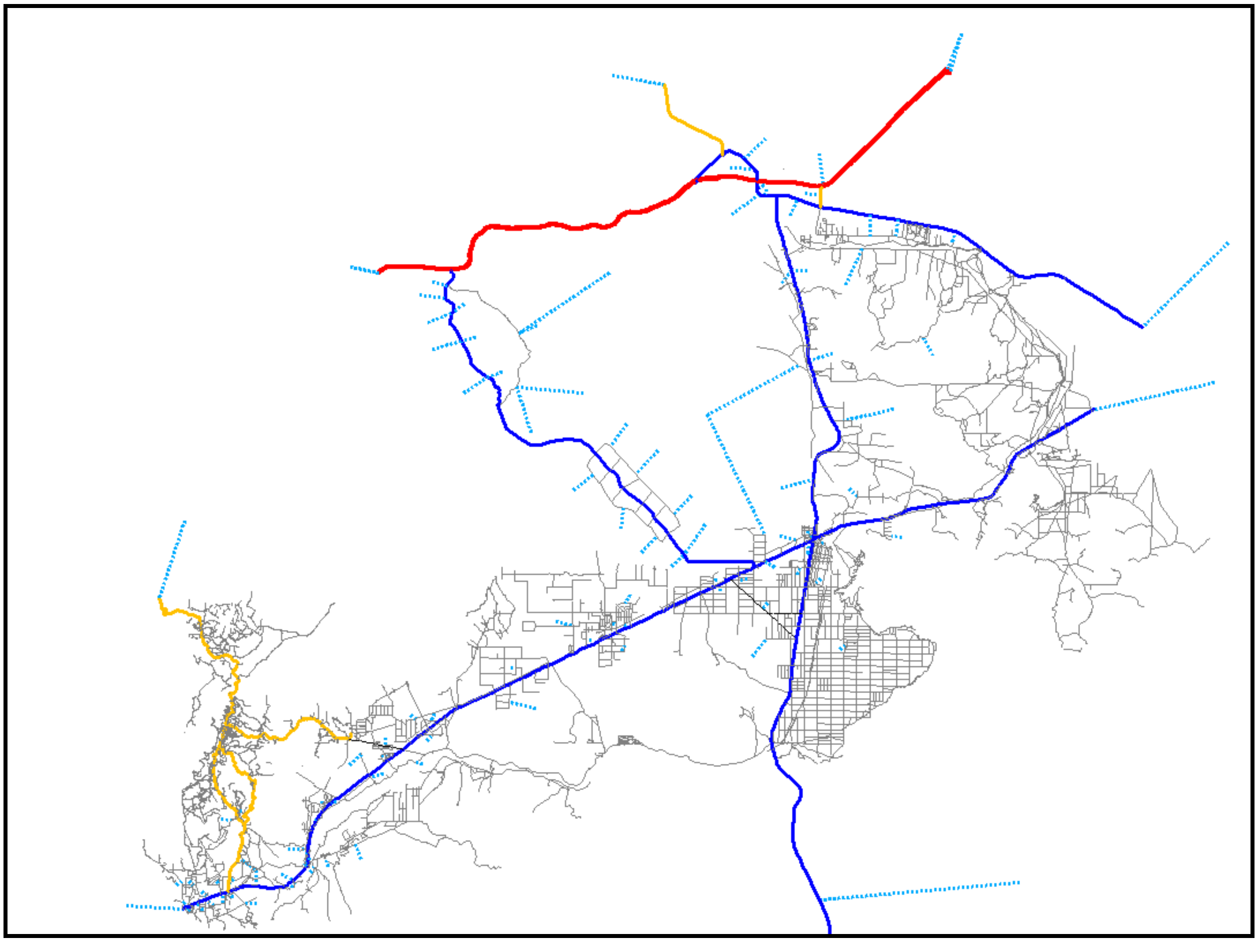
2.2.7. Future Roadway Network (No-Action and Build)

No-Action network models are used as a baseline to compare Build Alternative(s). No-Action represents the future conditions without the proposed project. Typically, a No-Action network is defined to be the existing roadway system, together with committed improvement projects as planned in state, regional and local plans. For the USA Parkway EA, no changes were made to the base year 2010 network for the No-Action network; as there are no planned/programmed improvements in the vicinity of the Traffic Study Area. The No-Action network includes local arterial road connections to US 50 for the Highlands development. The proposed USA Parkway extension (i.e. the proposed project) is not included.

The build network includes the USA Parkway extension (i.e. the proposed project) as a four-lane minor arterial facility with a 1,500 vph lane capacity and 45 mph free flow speed.

Figure 2-9 displays the 2035 Build (with-Highlands and No-Highlands) roadway network.

Figure 2-9: Updated 2035 Model Build Network



2.2.8. Trip Generation

Trip generation rates were adjusted to better reflect real-world conditions for both home based and other trips in the model. The original rates used by the model were under-producing trips from each household; several TAZs that contained only households (no jobs) were producing just one trip per household. Several adjustments were tested for the base year, and trip generation rates that produced the best combination of TAZ-generated traffic and daily volumes on major facilities were determined. Further, some minor formula corrections were made to the trip generation spreadsheet.

The trip generation rates shown in Table 2-8 produced a reasonable number of trips for the model – 6.57 daily trips per household and 3.66 home-based trips per household.

Table 2-8: Updated Trip Generation Rates

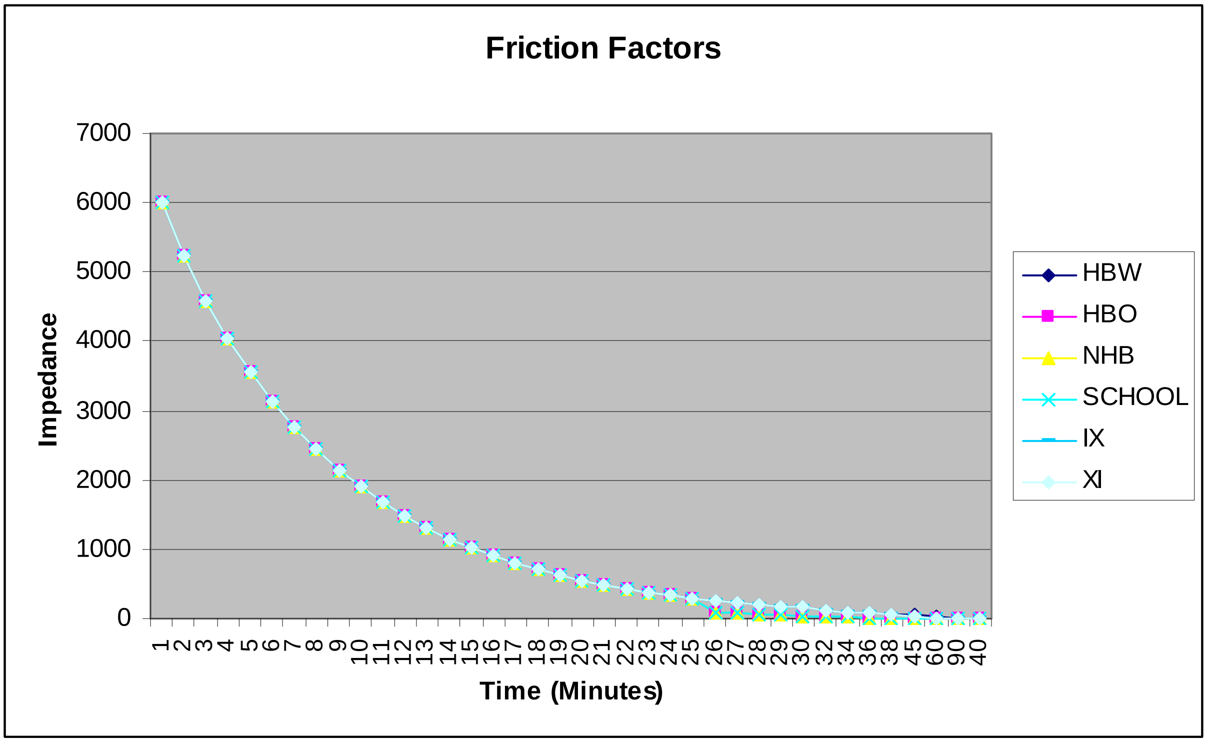
Land Use Type	Unit	Lyon County	Dayton	Fernley	Silver Springs	Yerington	External
SFR	DU	4.80	4.80	4.80	4.80	1.60	6.40
MFR	DU	2.63	2.63	2.63	2.63	0.88	3.50
MH	DU	2.63	2.63	2.63	2.63	0.88	3.50
RURAL Residential	DU	4.80	4.80	4.80	4.80	1.60	6.40
ELEM	Students	1.29	1.29	1.29	1.29	0.32	1.29
HIGHSCH	Students	1.71	1.71	1.71	1.71	0.43	1.71
Retail	Jobs	12.20	12.20	12.20	12.20	6.10	24.40
Non-Retail	Jobs	3.00	3.00	3.00	3.00	3.00	4.00

External station adjustments were also necessary for the base and future years. Trips to and from external stations are input directly into the demographics file, and are based on traffic counts in 2010. These were obtained from NDOT count stations where available and were retained from the original model if not. The future year values were determined by applying growth rates to base year volumes based on data from NDOT, RTC Washoe County, CAMPO, and the original model files. On I-80 west of USA Parkway, RTC Washoe County's travel demand model output files were obtained to determine an appropriate growth rate. The 2018 and 2030 models revealed a projected annual growth rate of approximately 2.4 percent. This amount of growth would result in approximately 50,000 vpd on I-80 in 2035, up from 28,000 vpd in 2010. The same growth rate was applied to the US 50 link near Dayton, which would grow to 42,000 vpd by 2035. This is consistent with the *US 50 East Corridor Study*, November 2007, which projects volumes above 35,000 vpd in the area. Note that the Capitol Area MPO travel demand model does not project a similar level of growth for US 50 and projects 1.0 percent annual growth in this location. The other external links were assigned growth between 1.0 percent per year and 2.4 percent per year, based on planning judgment. These data are included in the model inputs; the model subsequently performs its traffic distribution and assignment procedures, which results in slightly different volumes on these roadways, depending on the number of internal and external trips produced by the rest of the model area.

2.2.9. Trip Distribution

The friction factors from the original model seemed to produce too many short trips. Some major production and attraction areas of the model were too far away to be connected with the original friction factors. Adjustments were made to the friction factors to decrease the impedance for medium-length trips. The updated frictions factors are displayed in Figure 2-10. These friction factors allow longer trips between activity centers in the model, and produced volumes on key roadways that better matched traffic counts.

Figure 2-10: Updated Friction Factors



2.3. Base Year Model Validation

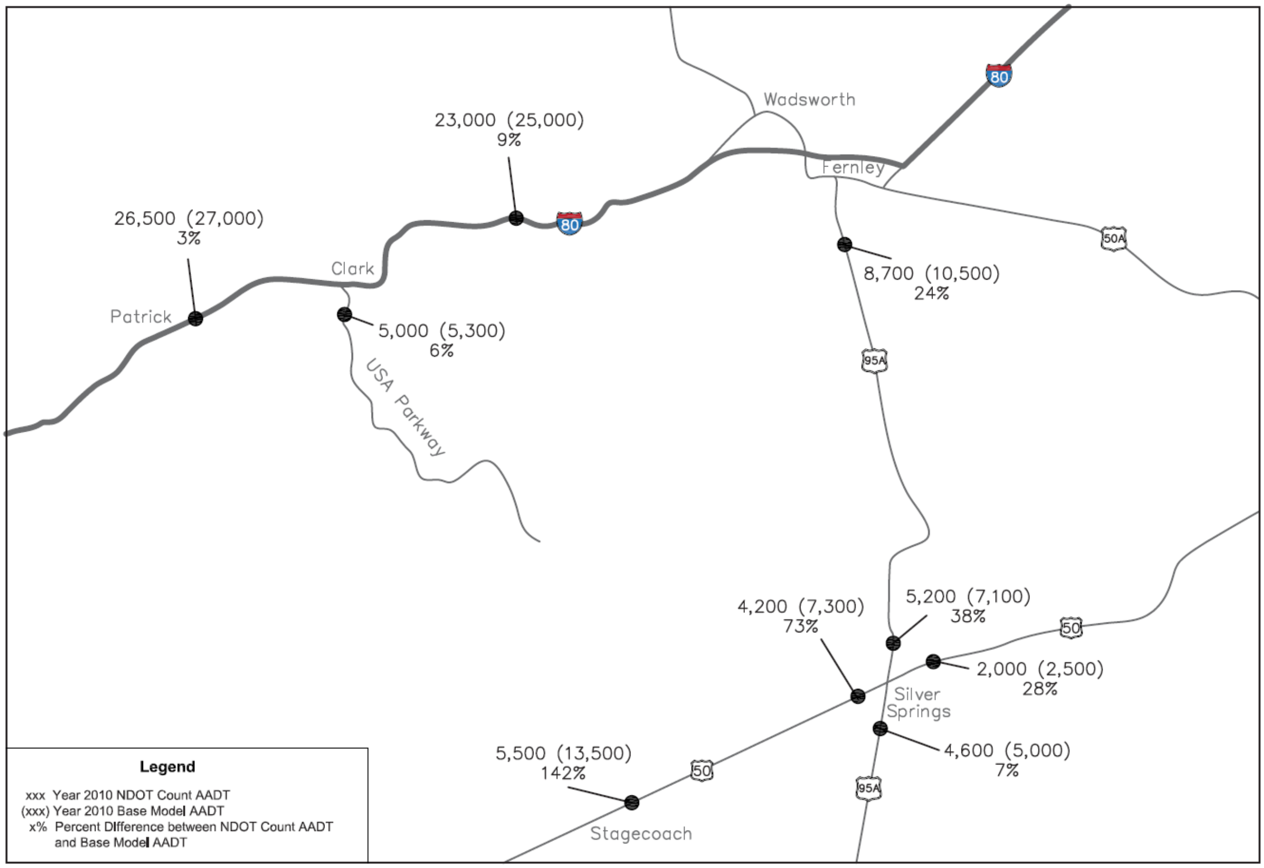
The existing year model was validated to 2010 conditions for the study area. Figure 2-11 contains counts from NDOT count locations and results from the final 2010 Base Year Model. As shown, the model performs reasonably well in the study area; however model projections are high along US 50 west of the Study Area. The reason for this is probably due to an over-estimation of the trips to/from Dayton. After some testing, the high volumes persisted. A larger scale refinement would be necessary than was feasible for this project; therefore further refinements were decided to be performed through model output post-processing. See Chapter 5 and Chapter 6 for detailed explanation of how the model output is post-processed.

2.4. Sensitivity Tests

The project team performed several sensitivity tests with the model to ensure it was reacting reasonably to changes in land use, network, and other changes to input files. The sensitivity tests that provided confirmation of reasonableness are described below.

For the base year 2010 model, a test run was performed that included the Build scenario with a completed USA Parkway. This model run resulted in approximately 3,500 vehicles per day utilizing USA Parkway between US 50 and I-80, hypothetically in 2010. A similar magnitude of traffic was reduced along US 95A and I-80 east of the USA Parkway Interchange. This volume estimation seemed reasonable to the project team given current awareness of traffic patterns and volumes in the study area.

Figure 2-11: Comparison of 2010 Base Model vs. Ground Counts at Study Area Roadway Network



In 2035, several land use scenarios were tested. A scenario with zero growth in the TRIC was tested. This model run reacted reasonably with much lower volumes than the final build scenario. USA Parkway would carry the traffic necessary to serve the existing TRIC (approximately 5,500 trips per day) plus additional through traffic (approximately 4,500 trips per day), for a total of approximately 10,000 vpd.

A scenario with a high level of growth in the TRIC was tested; this model run assumed 37,000 employees in the TRIC by 2035, based on the pro-rated full build-out scenario. This run resulted in approximately 30 to 35 percent higher trips than the final land use scenario with 23,500 employees.

These sensitivity tests confirmed that the model was performing properly and that the final base year and future year model runs were producing reasonable results.

2.5. Model Application

For the purposes of traffic forecasting for the USA Parkway EA, seven model runs were developed and fully analyzed by the project team:

- Year 2010 Base Year Model
- Year 2035 No-Action Model (with-Highlands)
- Year 2035 Build Model (with-Highlands)

- Year 2035 No-Action Model (No-Highlands)
- Year 2035 Build Model (No-Highlands)
- Year 2017 No-Action Model
- Year 2017 Build Model

These runs provide the basis for the traffic forecasting to be used in the traffic operations analysis. Volume plots of the area are available in Appendix E.

Vehicle Miles Traveled (VMT) and Vehicle Hours Traveled (VHT) are standard measures of the level of mobility in a region. Table 2-9 shows the total model-area VMT and VHT for each of the seven model runs. As shown, VMT and VHT are both more than double in the 2035 No-Action (with-Highlands), compared to the 2010 Base Year. Also, the Build Alternative (with-Highlands and No-Highlands) reduces VMT and VHT by providing a more direct route for many trips compared to the No-Action alternative (with-Highlands and No-Highlands). The average speed is also increased with the Build Alternative (with-Highlands and No-Highlands) compared to the No-Action alternative (with-Highlands and No-Highlands). In 2017 opening year, the build model reduces both VMT and VHT, compared to the No-Action.

Table 2-9: Model Area VMT and VHT

Model Run	Daily VMT	Daily VHT	Average Speed
Year 2010 Base Year	2,075,000	47,900	43
Year 2035 No-Action (with-Highlands)	4,724,000	126,100	38
Change from 2010	2,649,000	78,200	-5
Percentage	128%	163%	-12%
Year 2035 Build (with-Highlands)	4,168,000	105,200	40
Change from No-Action	-556,000	-20,900	2
Percentage	-12%	-17%	5%
Year 2035 No-Action (No-Highlands)	4,450,000	112,900	38
Change from 2010	2,375,000	65,000	-5.8
Percentage	114%	136%	-13%
Year 2035 Build (No-Highlands)	3,999,000	98,700	40
Change from No-Action	-451,000	-14,200	2.1
Percentage	-10%	-13%	6%
Year 2017 No-Action	2,625,000	62,600	42
Change from 2010	550,000	14,700	-1
Percentage	27%	31%	-2%
Year 2017 Build	2,495,000	60,100	42
Change from No-Action	-130,000	-2,500	0
Percentage	-5%	-4%	0%

The travel demand model produces daily and peak hour volumes. The calibration is performed based on the daily volumes; hence the peak hour volumes from the model are not necessarily reliable and not used for traffic forecasts.

At specific road segment locations, travel demand models may or may not accurately estimate traffic. For this reason, adjustments to travel demand model output prior to use in traffic operations analysis is necessary. The primary reference for traffic model volume adjustments is the National Cooperative Highway Research Program Report (NCHRP) 255: *Highway Traffic Data for Urbanized Area Project Planning and Design*. The subsequent chapters of this memorandum explain the post-processing of model output for use in traffic operations analysis using NCHRP Report 255 techniques.

3. TRAFFIC STUDY AREA NETWORK

Existing USA Parkway (SR 439) begins at I-80 about 10 miles east of Reno at the USA Parkway Interchange. Currently, approximately six miles of the USA Parkway alignment within Storey County has been paved and the remaining is graded to the Lyon County line. The paved section is a four-lane divided arterial with open median.

The proposed project is the extension of the existing USA Parkway to US 50; therefore the main focus of the traffic analysis is the proposed extension of USA Parkway. The Traffic Study will also evaluate the major roadways within the project traffic influence area; specifically I-80 to the north, US 50 to the south, and US 95A to the east.

Figure 3-1 illustrates the general study area roadway network. Existing number of lanes, planned number of lanes and the NDOT functional classification are shown. The following is a general description of the study area roadways:

- Existing USA Parkway is a four-lane rural minor arterial. The extension is proposed as a rural minor arterial as well.
- I-80 within the general study area is a four-lane rural interstate. I-80 is planned to be widened to six lanes west of USA Parkway. Widening is not planned for I-80 east of the USA Parkway Interchange.
- US 50 within the project influence area is a two-lane rural principal arterial with wide shoulders. In Silver Springs, US 50 intersects with US 95A at a four-way stop controlled intersection. US 50 is planned to be widened to four lanes west of US 95A. Widening is not planned for US 50 east of US 95A.
- US 95A is a two-lane rural minor arterial between US 50 and I-80; and currently is one of the roads that connect the Reno/Sparks metropolitan area with points south and east. Widening is not planned for US 95A within the study area.
- Ramsey-Weeks Cut-off is two-lane rural minor collector that provides diversion for trips between US 50 to the west and US 95A to the south. Widening is not planned for Ramsey-Weeks cut-off.

Traffic operations analysis will be performed for year 2037 depending on the development scenario that is identified by the project team to be the most likely development scenario for the Highlands development.

In the with-Highlands scenario, intersections and roadway segments along the proposed USA Parkway extension between Storey/Lyon County line and US 50 and the interchange at I-80 will be evaluated. Figure 3-2 shows the study intersections and roadway segments for the traffic operations analysis of this scenario. Based on the available development data[1], seven (7) intersections along the USA Parkway extension will be analyzed. Six (6) of these intersections are along the proposed Highlands development (Intersections 1 through 6 in Figure 3-2). The seventh intersection is at US 50 (Intersection 7). Traffic operations analysis of the existing USA Parkway Interchange with I-80 will also be completed (Intersections 8 and 9) for both existing and future conditions.

[1] Highlands Master Streets and Highway Plan

Daily and peak hour traffic forecasts are developed for all nine (9) study intersections and adjacent roadway segments. In addition, daily traffic forecasts are developed for the roadways within the general study area network. Final traffic forecasts are presented in Chapter 5 and Chapter 6.

In the No-Highlands scenario, since the Highlands development does not exist, intersections 1 through 6 shown in Figure 3-2 do not exist. Hence, the traffic operations analysis will be performed only for the other intersections accordingly. Daily and peak hour traffic forecasts are developed for the relevant study intersections and adjacent roadway segments. In addition, daily traffic forecasts are developed for the roadways within the general study area network. Final traffic forecasts for the No-Highlands scenario are presented in Chapter 7.

Figure 3-1: General Study Area Roadway Network

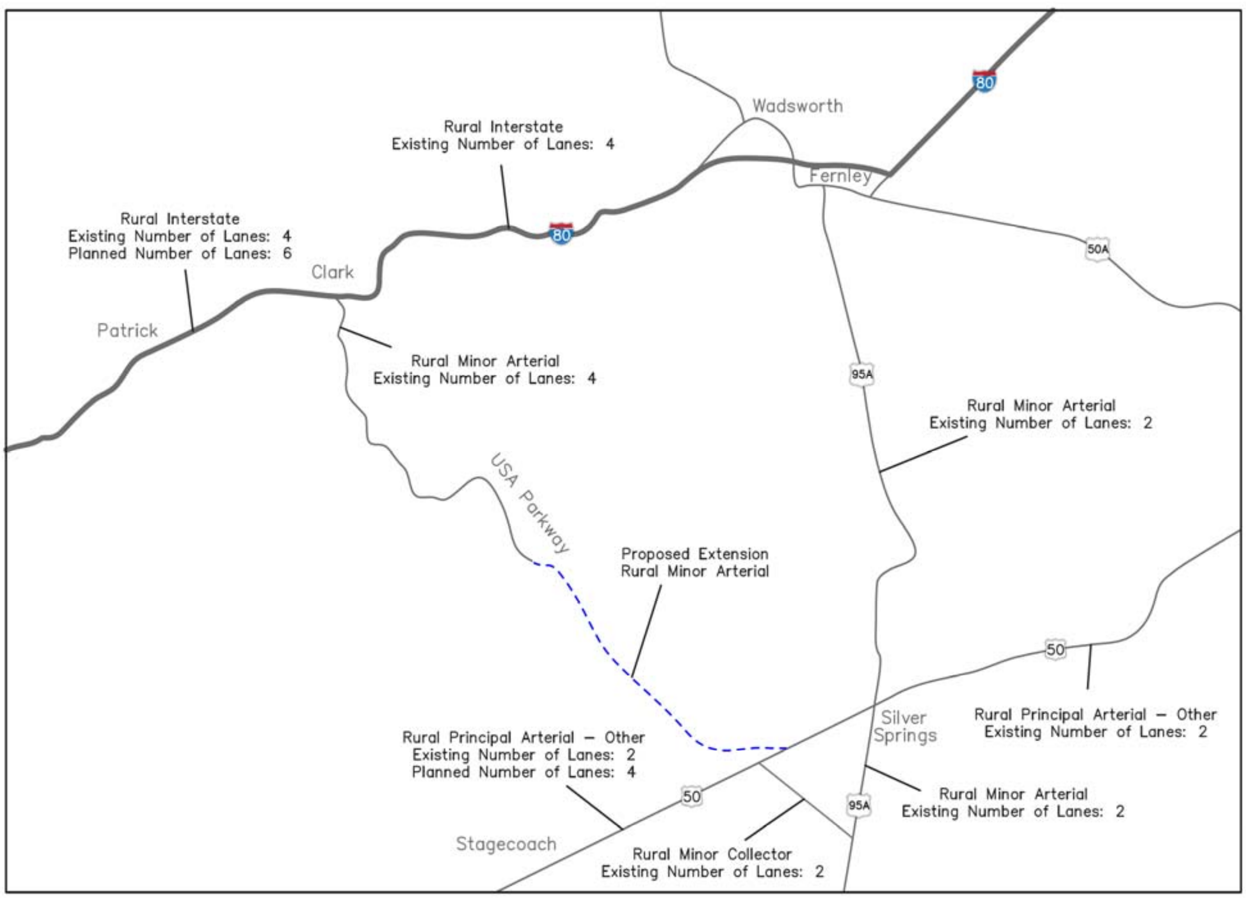
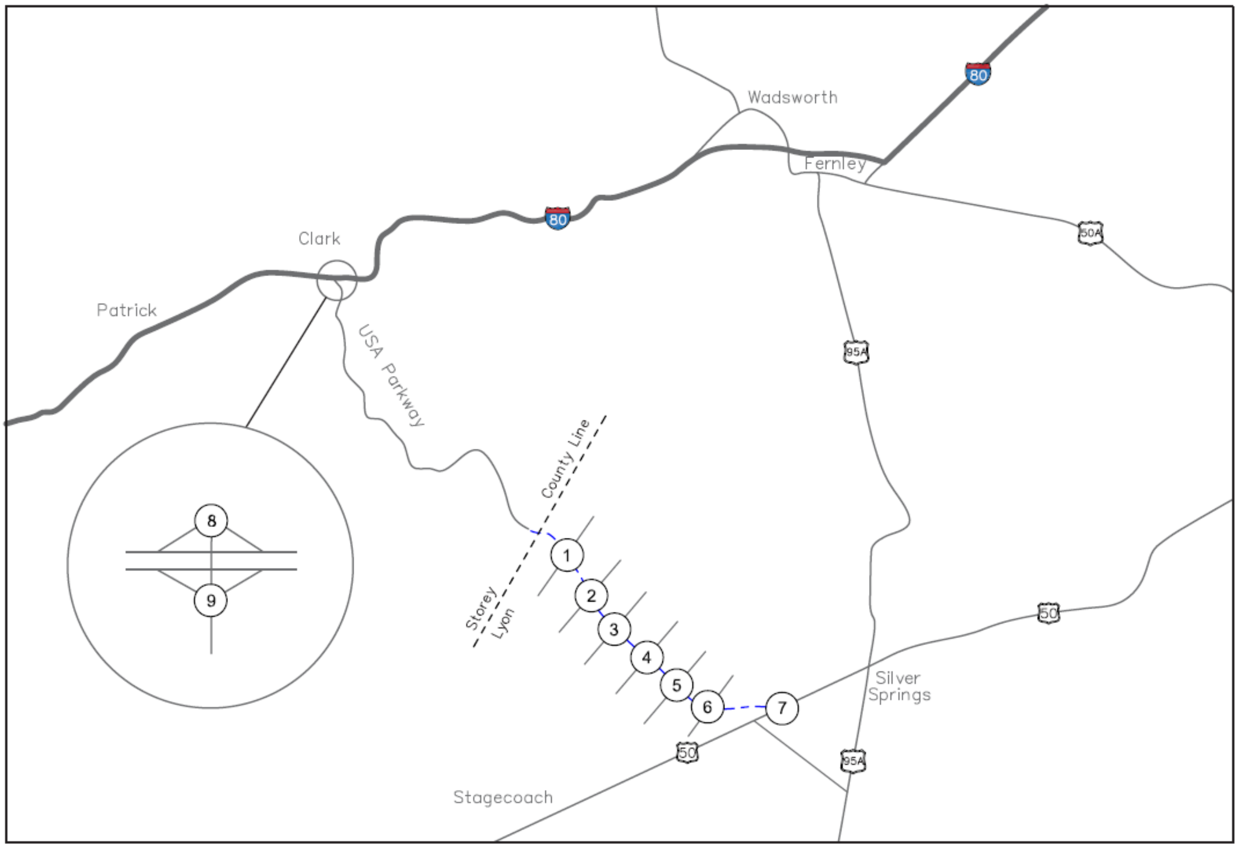


Figure 3-2: Study Intersections for Traffic Operations Analysis



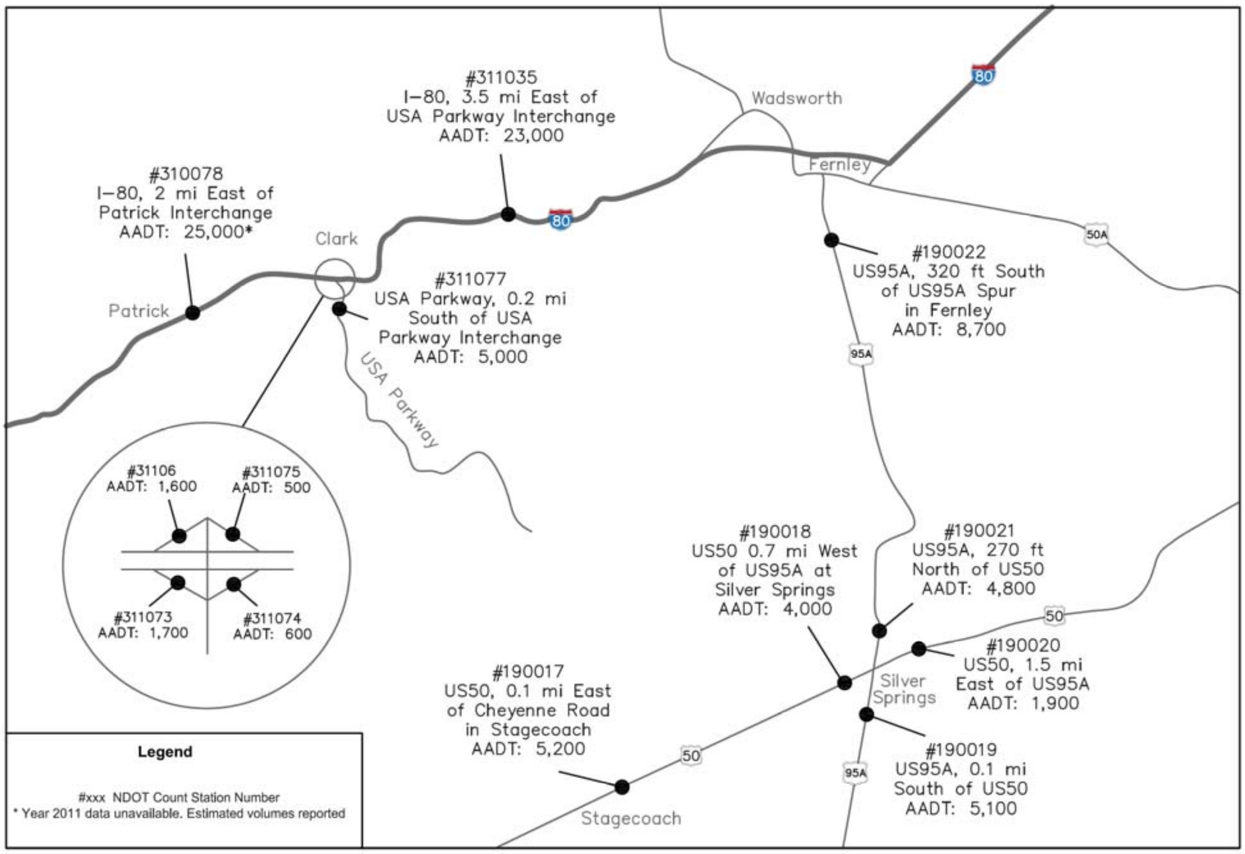
4. TRAFFIC COUNTS

Traffic counts for the study area roadway network are available from NDOT count stations. Figure 4-1 shows the selected NDOT count locations along with the existing (year 2011) daily volumes in terms of Annual Average Daily Traffic (AADT).

Figure 4-2 shows the year 2011 peak hour volumes at the USA Parkway/I-80 interchange to be used for existing conditions operations analysis. The volumes are based on average AM and PM peak hour counts for Tuesday, Wednesday and Thursday and are seasonally adjusted to reflect typical weekday peak hour volumes.

Appendix F contains all the traffic count data used for development of this memorandum.

Figure 4-1: Selected NDOT Count Locations and Year 2011 AADTs



4.1. Truck Traffic

For **USA Parkway**, the peak hour truck percentage to be used in traffic operations analysis is **12 percent**. This is as per the approved *USA Parkway Traffic Analysis Methodology* dated December 28, 2011 (see Appendix B). The daily truck percentage is 24 percent.

Current truck traffic on I-80 mainline east and west of USA Parkway Interchange and on US 50 in the vicinity of the proposed project is calculated based on the truck AADT data published in the NDOT's 2010 Vehicle Classification Distribution Report and are shown in Table 4-1.

Figure 4-2: I-80 and USA Parkway Interchange Year 2011 Peak Hour Volumes

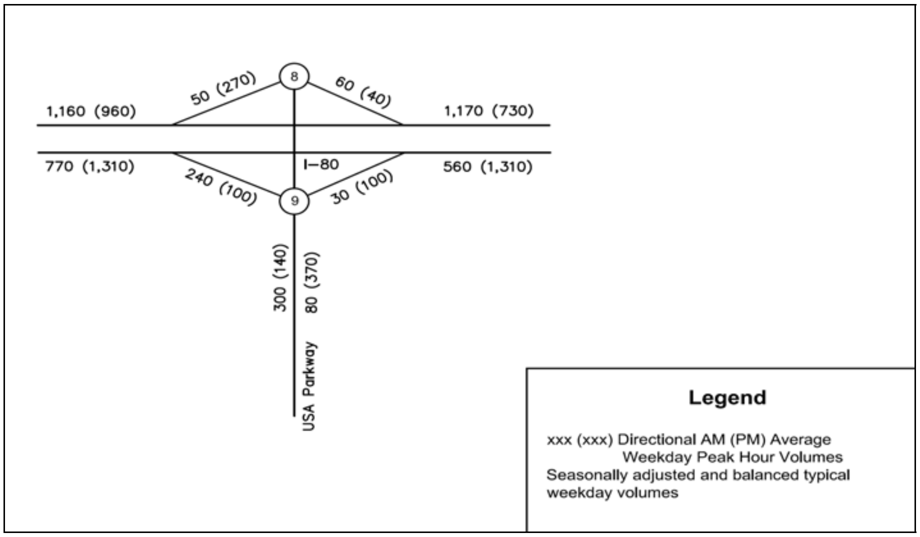


Table 4-1: Truck Traffic on I-80 and US 50

Truck AADT Location	Truck AADT	Representative NDOT Count Station for Total AADT	Total AADT	Daily Truck %
I-80 from Sparks Boulevard to USA Pkwy	5,880	312290[1]	26,000	22.6%
I-80 from USA Pkwy to Fernley	5,960	311035[2]	25,000	23.8%
US 50 from Dayton to US 95A	320	190017[3] 190018[4]	4,850	6.6%*

1. I-80 0.25 mile west of the USA Parkway Interchange
2. I-80 east of the USA Parkway Interchange
3. US 50 8.2 miles west of US 95A
4. US 50 0.7 mile west of US 95A

*US 50 is a Rural Principal Arterial. Average statewide daily truck percentage on rural principal arterials is 12.79%

On I-80 the daily truck percentage is approximately 24 percent both west and east of USA Parkway (22.6% and 23.8%). Peak hour truck percentages are typically half of the daily truck percentages. Therefore, a **12 percent** peak hour truck percentage is proposed for **I-80** mainline to be used in traffic operations analysis.

On US 50, the calculated daily truck percentage is 6.6 percent. US 50 is a Rural Principal Arterial in NDOT's functional classification. Average daily truck percentage on all rural principal arterials is 12.79% per NDOT's 2009 Annual Traffic Report. Since 12.79 percent is more conservative than 7 percent, 12.79 percent is selected as the daily truck percentage on US 50. Peak hour truck percentage on US 50 is proposed to be half of this daily truck percentage; hence **6 percent** is used as the peak hour truck percentage for **US 50.**

Truck AADT forecasts for design year 2037 (with-Highlands) are provided in Chapter 6 and for design year 2037 (No-Highlands) are provided in Chapter 7.

5. DAILY TRAFFIC (AADT) FORECASTS – WITH-HIGHLANDS SCENARIO

The travel demand models developed for the project produces Annual Average Typical Weekday Daily Traffic (AATWDT). Typical weekdays are defined as Tuesday, Wednesday and Thursday. AATWDT estimates from the model are used to obtain AADT estimates.

5.1. Model Output (AATWDT) Conversion to AADT

Model daily volumes needs to be converted to AADTs prior to estimating hourly volumes. To convert the model output (AATWDT) to AADT, a Model Output Conversion Factor (MOCF) was estimated according to guidance in the *Draft NDOT Traffic Forecasting Guidelines*. The MOCF for the project was estimated based on the year 2010 NDOT counts. AADT and AATWDT from NDOT counts were obtained for the short-term count stations shown in Figure 4-1 and listed in Table 5-1. The NDOT count AATWDT for each of these stations was estimated as the seasonally adjusted average of daily counts of typical weekdays (Tuesday, Wednesday, and Thursday). From the AATWDT and AADT values, the MOCF was calculated as

$$\text{MOCF} = \frac{\text{NDOT Count AADT}}{\text{NDOT Count AATWDT}}$$

The final MOCF for the project was the average of all the values calculated for each of the short term count stations. This MOCF was subsequently applied to each model output value to obtain AADT values.

Table 5-1: Estimation of MOCF

Location of NDOT Count Station	NDOT Count Station	2010 NDOT Count AADT	2010 Count AATWDT***	MOCF
I-80 West of USA Parkway Interchange	310078**	26,388	28,832	0.915
I-80 East of USA Parkway Interchange	311035*	22,982	24,363	0.943
US95 South of Fernley	190022	8,667	9,553	0.907
US95 North of Silver Springs	190021	5,181	5,251	0.987
US50 East of Silver Springs	190020	1,987	1,841	1.080
US95 South of Silver Springs	190019	4,634	4,588	1.010
US50 West of Silver Springs	190018	4,238	4,151	1.021
US50 near Stagecoach	190017	5,522	5,717	0.966
USA Parkway North Segment	311077*	4,975	5,949	0.836
Project MOCF				**0.963**

* Year 2010 data was unavailable, year 2011 data was used
** Year 2010 data was unavailable, year 2009 data was used
*** Seasonally adjusted from NDOT short-term counts

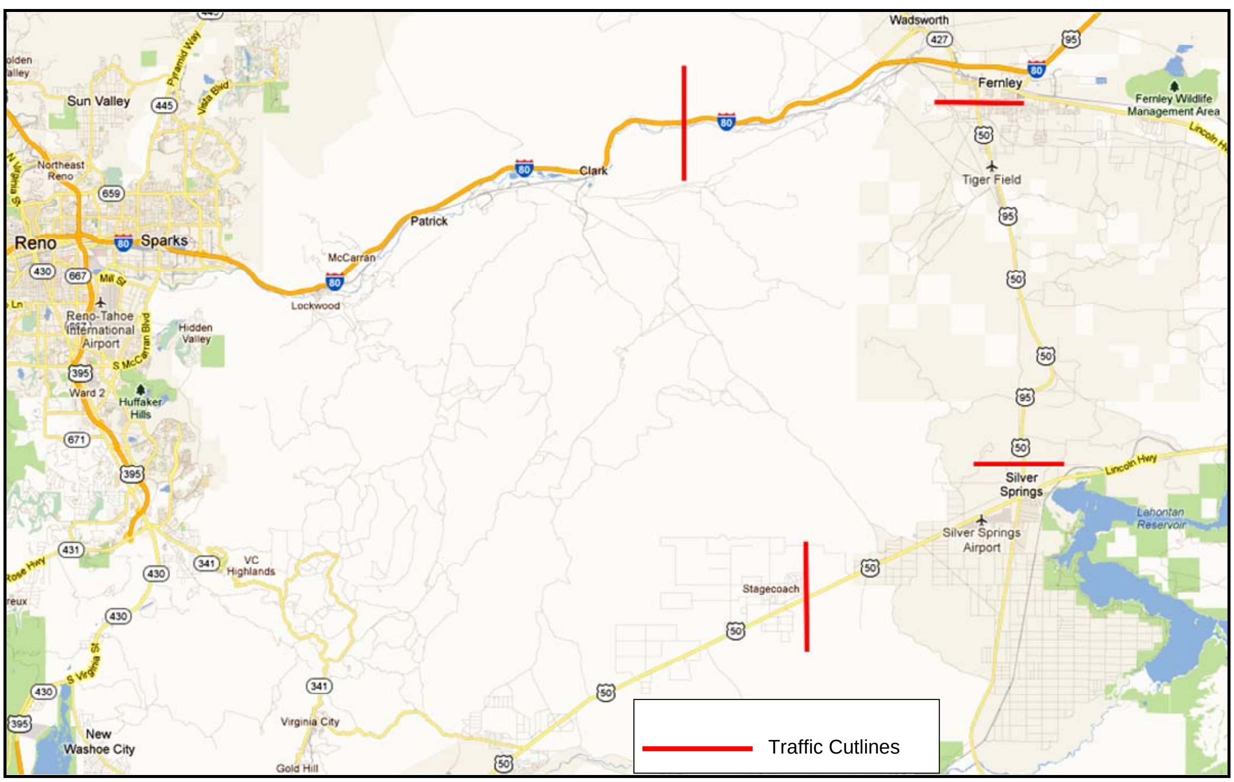
5.2. Determination of Model Output Adjustment Requirement

At specific road segment locations, the travel demand models may or may not accurately estimate traffic. For this reason, there may be a necessity to apply adjustments to the model output prior to use in traffic operations analysis. The primary reference for travel demand model volume adjustments is the NCHRP Report 255: *Highway Traffic Data for Urbanized Area Project Planning and Design*.

Base year 2010 model results were compared to the year 2010 NDOT counts to determine whether the model outputs satisfy the "consistency thresholds" stipulated in the *Draft NDOT Traffic Forecasting Guidelines.* The comparison of model output volumes and NDOT counts was made for all links along the project corridor (for which existing NDOT counts were available) and at cutlines in the model, in accordance with the *Draft NDOT Traffic Forecasting Guidelines.* The selected cutline locations are illustrated in Figure 5-1. Both the *Percent Deviation* comparisons and the *Coefficient of Variation of Root Mean Square Error* (CV[RMSE]) comparisons were made. The results of these comparisons are shown in Table 5-2 and Table 5-3.

It was determined that not all links satisfy the consistency thresholds stipulated in the *Draft NDOT Traffic Forecasting Guidelines.* As explained in Chapter 2, the base year model was adjusted during the validation process; however further adjustments to the model were deemed infeasible. Therefore it was determined that NCHRP Report 255 adjustments were needed to adjust the model output volumes to enhance the accuracy of the model results in forecasting future year traffic.

Figure 5-1: Cutline Locations



Source: Google Maps

Table 5-2: Percent Deviation & CV(RMSE) Comparison at Links along Cutlines

Location	NDOT Count Station	2010 NDOT Count AADT	2010 Model AATWDT	2010 Model AADT	Percent Deviation	Percent Deviation meets consistency thresholds?	CV(RMSE)	CV(RMSE) meets thresholds?
I-80 East of USA Parkway Interchange	311035	22,982	25,206	24,273	6%	Yes	6%	Yes
US 50 0.1 miles east of Cheyenne Rd in Stagecoach	190017	5,522	13,882	13,368	142%	No	75%	No
US 95A 270 ft north of US 50	190021	5,181	7,422	7,147	38%	No		No
US 95A 320ft S of US-95A Spur in Fernley	190022	8,667	11,146	10,734	24%	No		No

Draft NDOT Traffic Forecasting Guidelines define the maximum allowable Percent Deviation threshold as ± 10% for AADT < 50,000 AADT.
Draft NDOT Traffic Forecasting Guidelines define the maximum allowable CV(RMSE) threshold as ± 35% for AADT between 5,000 and 9,999 and ± 20% for AADT between 20,000 and 49,999.

Table 5-3: Percent Deviation & CV(RMSE) Comparison at Links along Project Corridor

Location	NDOT Count Station	2010 NDOT Count AADT	2010 Model AATWDT	2010 Model AADT	Percent Deviation	Percent Deviation meets consistency thresholds?	CV(RMSE)	CV(RMSE) meets consistency thresholds?
0.2 miles south of USA Parkway Interchange	311077	4,975	5,470	5,268	6%	Yes	6%	Yes

Draft NDOT Traffic Forecasting Guidelines define the maximum allowable Percent Deviation threshold as ± 10% for AADT < 50,000 AADT.
Draft NDOT Traffic Forecasting Guidelines define the maximum allowable CV(RMSE) threshold as ± 45% for AADT < 5,000

5.3. Model Output Adjustments (Post-Processing)

5.3.1. Re-assignment of Raw Model Volumes

Prior to applying the NCHRP Report 255 adjustments, the No-Action and Build model volume outputs were examined for general reasonableness in reflecting the regional trip patterns. It was determined that both the models underestimated the trips on I-80 west of USA Parkway and overestimated the trips on US 50 west of USA Parkway. This is attributable to the fact that the model does not include the Reno/Sparks metropolitan area. Therefore, in both the No-Action and Build networks, trips from the Reno/Sparks metropolitan area (i.e. trips on I-80) were underestimated and trips from Carson City area (i.e. trips on US 50) were overestimated.

Furthermore, in the No-Action network, trips from Carson City destined to TRIC were found to be assigned along US 95A and US 50 instead of along I-80 and US 395, because the model does not include US 395[2].Therefore, adjustments to raw model outputs were made by re-assigning portion of the trips on US 50 to I-80 for both No-Action and Build networks. Following this re-assignment of raw model volumes, further post-processing following NCHRP Report 255 methodologies and engineering judgment were performed as explained in the next section.

5.3.2. NCHRP Report 255 Adjustments

In general, there are three procedures described in NCHRP Report 255 for adjustment of link volumes obtained from travel demand models. These three methods can be described as Ratio Adjustments, Difference Adjustments and Combination Adjustments. The purpose of these adjustments is to adjust the future year link assignments to account for possible assignment errors. The underlying assumption is that errors in assignment that occur in base year model are carried through to future year forecasts.

The Ratio Adjustment method can also be described as a growth factor method where the growth between the base and future years in the travel demand model realm is applied to the field measured traffic counts.

The Difference Adjustment method provides future volumes on each link by the addition of the difference (or increment) between the base year model and future year model to the field measured traffic volume.

Combination Adjustment method takes the average of the values obtained by the Ratio Adjustment and the Difference Adjustment methods.

For the proposed project, all three NCHRP Report 255 methods were applied appropriately, in a manner that results in the most balanced traffic projections. At certain locations, where NCHRP Report 255 adjustments were not available or the adjusted volumes resulted in unbalanced projections; either the volumes from the model were directly used (if reasonable) or a more appropriate value was selected based on engineering judgment.

The proposed USA Parkway extension does not exist in the base model; hence it is not possible to directly apply NCHRP Report 255 adjustments to segment volumes along the extension. For the proposed extension, the volumes were adjusted based on the NCHRP ratio adjustments applied to the existing portion of USA Parkway.

The resulting adjusted year 2035 AADTs are shown in Figure 5-2 and Figure 5-3 for the general study area network; and in Figure 5-4 and Figure 5-5 for study roadway segments.

[2] This does not happen in the Build Network, since trips from Carson City destined for USA Parkway would in fact use US 50 to get to TRIC due to the proposed USA Parkway extension to US 50.

Figure 5-2: Year 2035 No-Action AADTs at General Study Area Roadway Network

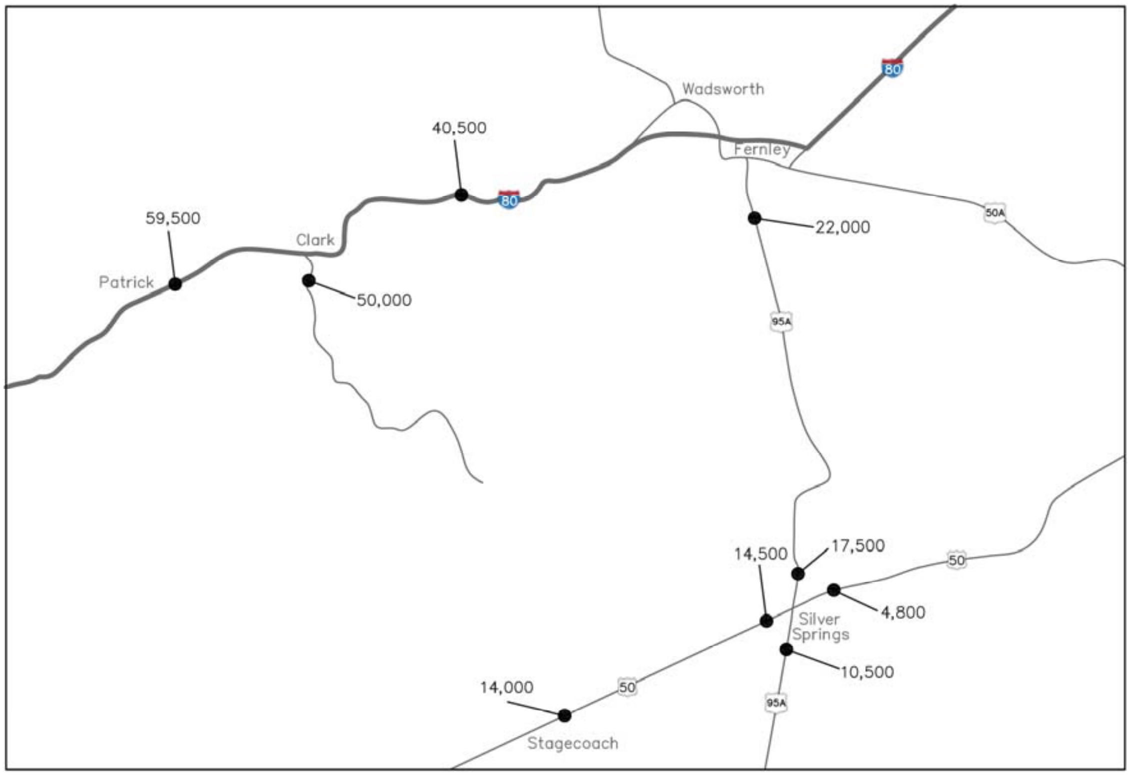


Figure 5-3: Year 2035 Build AADTs at General Study Area Roadway Network

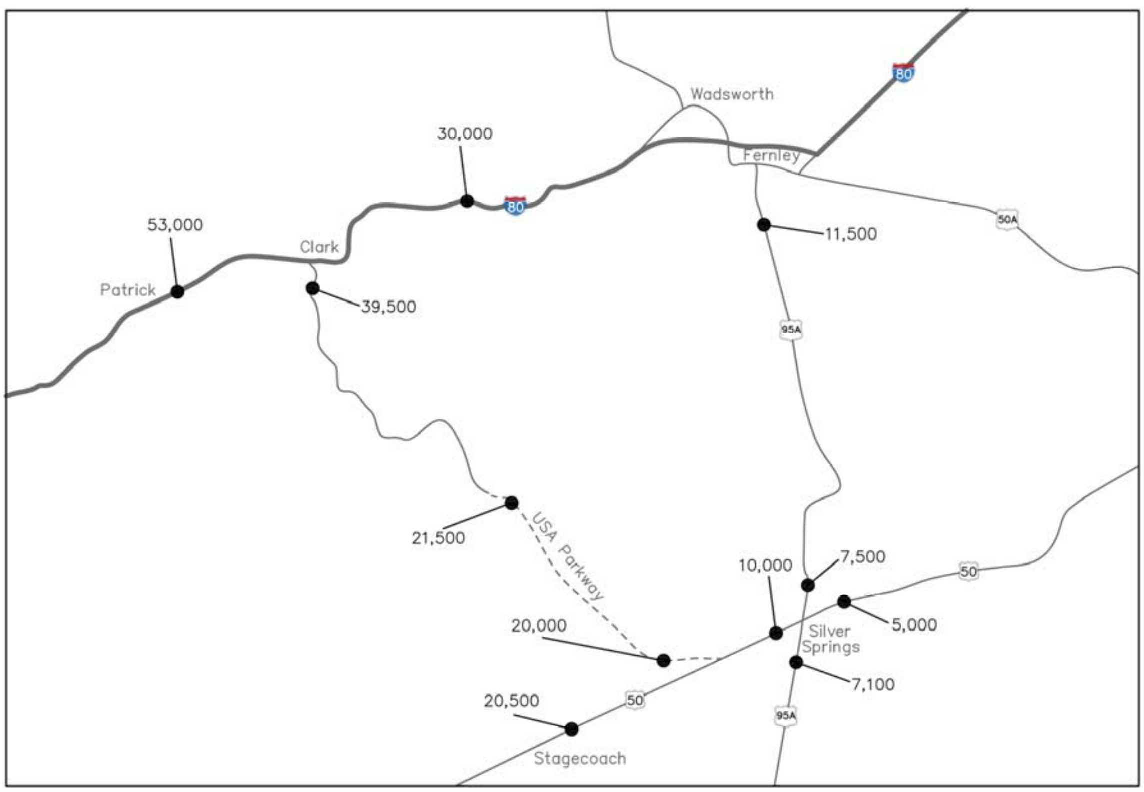
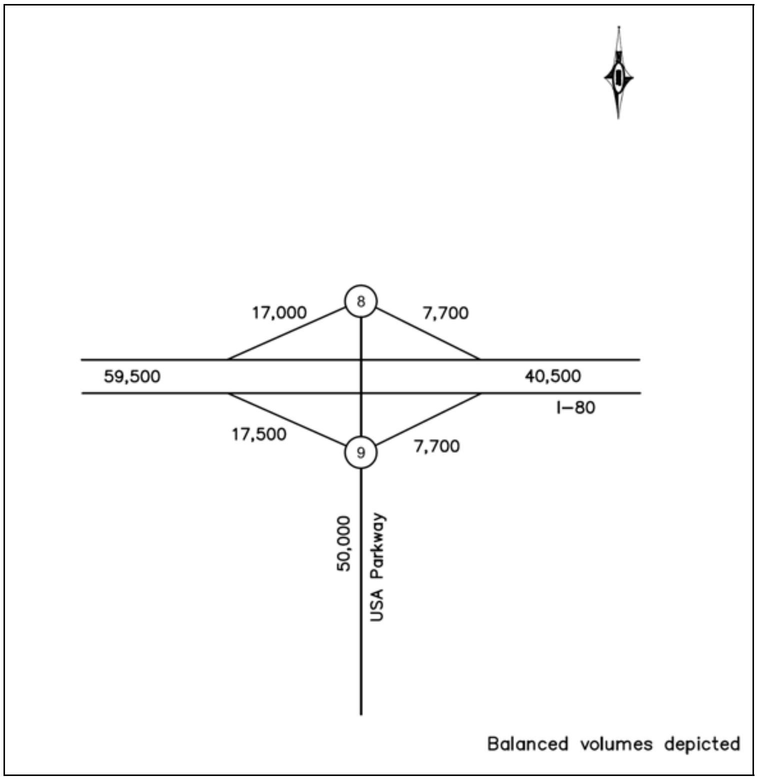


Figure 5-4: Year 2035 No-Action AADTs at Study Roadway Segments



5.4. Comparison of year 2035 AADT estimates with Historical Trend Projections

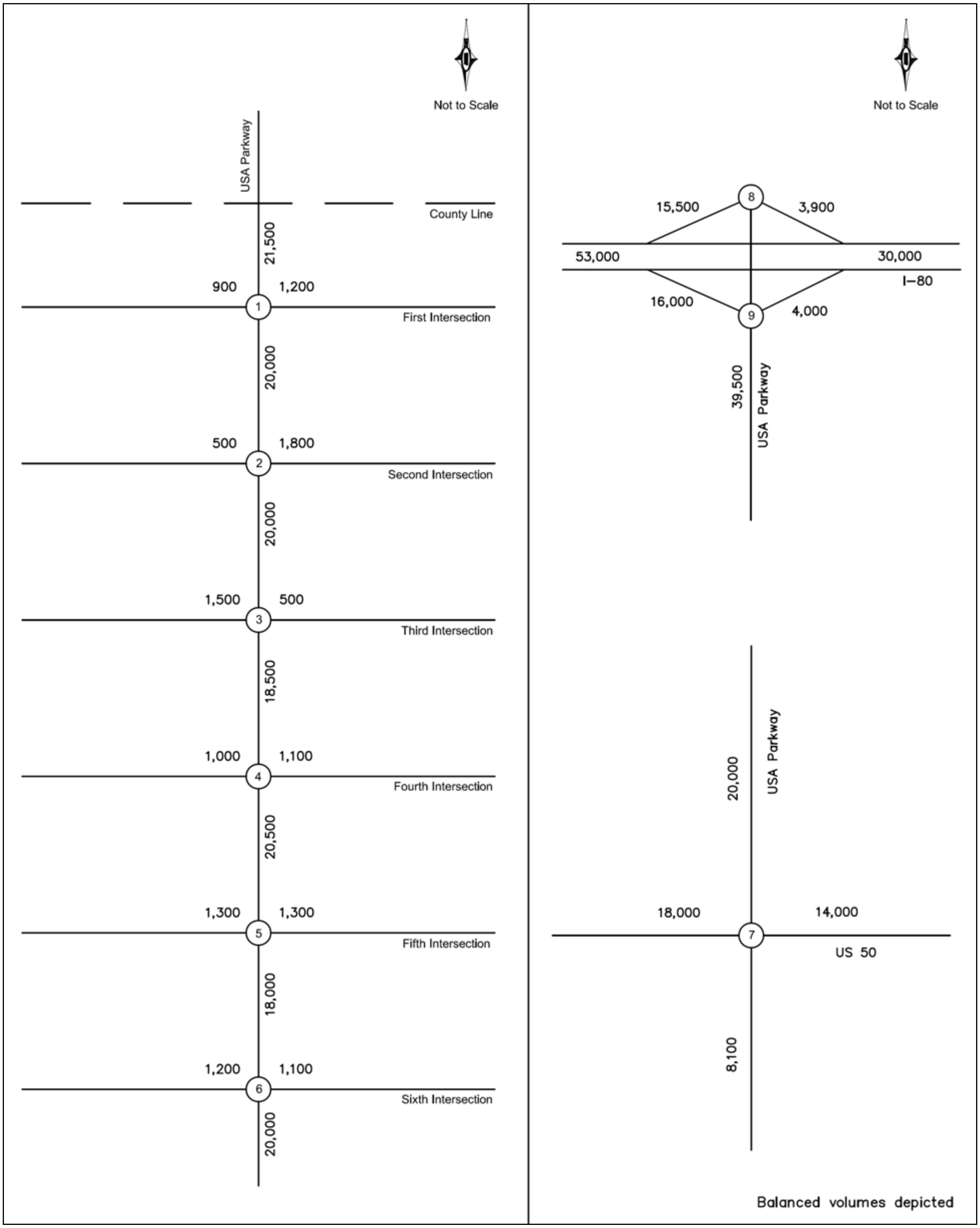
As recommended in the *Draft NDOT Traffic Forecasting Guidelines*, the reasonableness of the AADT forecasts from the travel demand model was verified by comparisons with historical trend projection of AADT. Historical AADT values extending from the year 2010 back to year 1990 were obtained for selected NDOT short-term count stations (illustrated in Figure 5-6) within the project influence area. For the historical data from each of the selected stations, either one of logarithmic trend, linear trend or exponential trend projection was performed depending upon the existing and expected land use and traffic characteristics of the location. Figure 5-6 shows the comparison of year 2035 Build Alternative model forecast AADT and the historical trend projections. The following paragraphs explain the details of the historical trend projection for each selected location and Appendix G provides the outputs of the analysis.

I-80 West of USA Parkway – Station # 310078

Type of trend projection performed: A linear trend projection was performed for the historical data at this location.

Rationale: The existing traffic at this location is fairly high and can be characterized as “mature”. Hence, a linear or a logarithmic growth trend would be suitable, depending on the expected amount of traffic growth. It is known that the TRIC and Highlands development would have a significant impact on the traffic at this location; a majority of the traffic generated due to these developments is expected to travel through this location. Hence a linear trend was found to be more appropriate than a logarithmic trend.

Figure 5-5: Year 2035 Build AADTs at Study Roadway Segments



I-80 East of USA Parkway – Station # 310811

Type of trend projection performed: A logarithmic trend projection was performed for the historical data at this location.

Rationale: The existing traffic at this location is fairly high and can be characterized as "mature". Hence, a linear or a logarithmic growth trend would be suitable, depending on the expected amount of traffic growth. The traffic generated from the TRIC and Highlands development is mostly expected to travel to Reno or Carson City; therefore the impact on traffic at this location is expected to be minimal. The future traffic growth is likely to be stable, following a logarithmic growth trend.

US 95A South of Fernley – Station # 190022

Type of trend projection performed: A linear trend projection was performed for the historical data at this location.

Rationale: The existing traffic at this location is low; hence an exponential or a linear growth trend would be suitable, depending on the expected amount of traffic growth. The TRIC and Highlands development are not expected to contribute a lot of traffic to this location, so a linear trend is more appropriate.

US 95A North of Silver Springs – Station # 190021

Type of trend projection performed: A linear trend projection was performed for the historical data at this location.

Rationale: The existing traffic at this location is low; hence an exponential or a linear growth trend would be suitable, depending on the expected amount of traffic growth. The TRIC and Highlands development are not expected to contribute a lot of traffic to this location, so a linear trend is more appropriate.

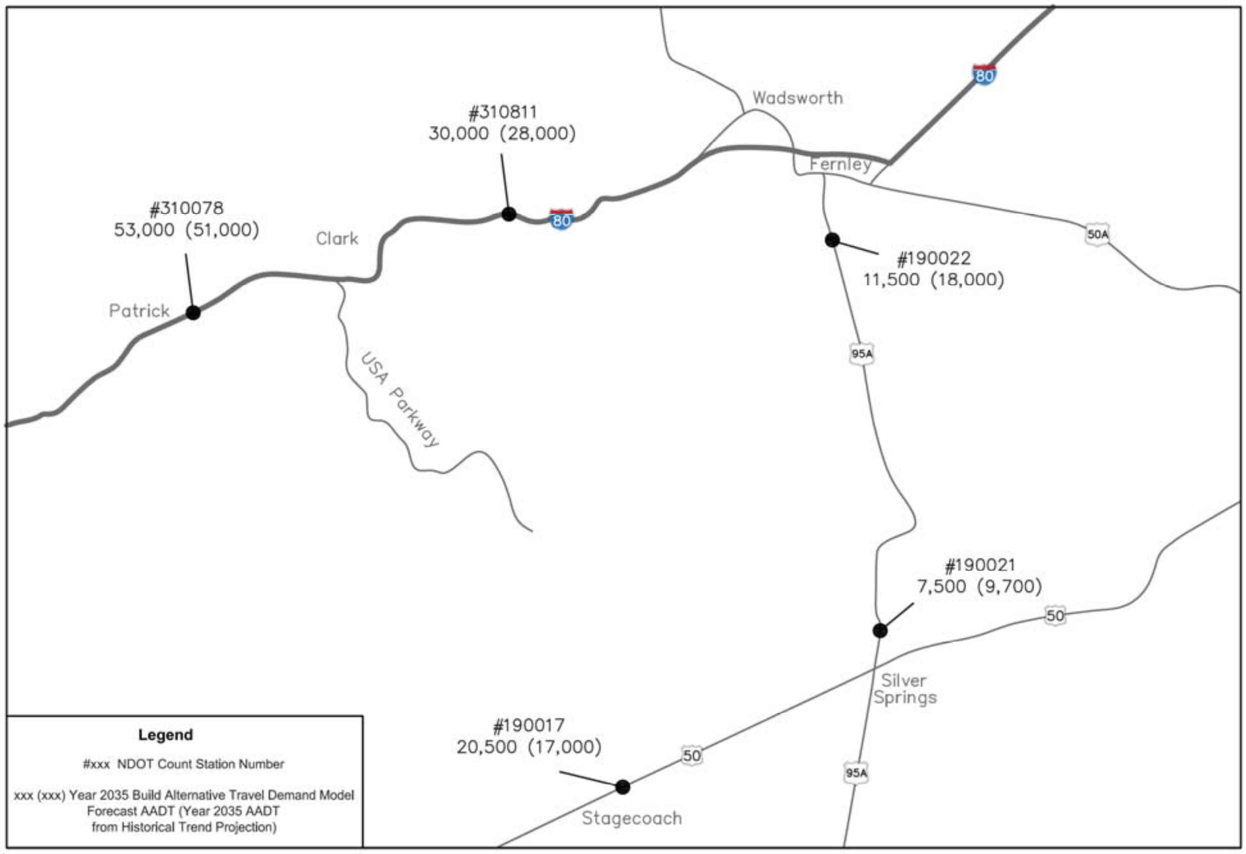
US 50 East of Stagecoach – Station # 190017

Type of trend projection performed: An exponential trend projection was performed for the historical data at this location.

Rationale: The existing traffic at this location is low; hence an exponential or a linear growth trend would be suitable, depending on the expected amount of traffic growth. A considerable portion of the traffic generated by the TRIC and Highlands development is expected to travel through this location, causing significant growth in traffic, so an exponential trend was found to be more appropriate.

From these reasonableness checks, it was found that the growth in traffic obtained from the travel demand model outputs follow a similar trend as predicted by the historical trend projection analysis. In most cases, the model forecast volumes were found to be very similar to the volumes projected by the historical trend projection analysis. Hence, model forecast volumes are determined to be reasonable and are used in developing the forecast.

Figure 5-6: Comparison of 2035 Forecasts with Historical Trend Projections



5.5. Design Year 2037 AADT Forecasts

The design year of the proposed project is 2037; therefore year 2037 volumes need to be projected from year 2035 volumes for use in the traffic operations analysis. The projections were performed separately for the No-Action Alternative and the Build Alternative.

To obtain the 2037 AADT from 2035 AADT, the compound annual growth rates between year 2010 and year 2035 were estimated. Since the initial traffic (2010 AADT) was very low compared to the 2035 AADT along USA Parkway and at the ramps of the I-80/USA Parkway Interchange, the resulting growth rates were found to be unreasonably high. Linear traffic growth was deemed more appropriate and the average annual increase in traffic for each of the study locations was estimated assuming linear growth as follows,

$$\text{Annual Increase in Traffic} = \frac{\text{Final Year AADT} - \text{Initial Year AADT}}{(\text{Final Year} - \text{Initial Year})}$$

Once the annual increase in traffic was estimated, this value was used to estimate the increase in traffic in two years (i.e. between 2035 and 2037). The increase in traffic over two years was added to the 2035 AADT to obtain the 2037 AADT.

5.5.1. Projection of Year 2037 AADTs – No-Action Alternative

The average annual increase in traffic between 2010 and 2035 was estimated for each of the project study locations for the No-Action alternative. The annual increase was used to obtain the increase in traffic over two years and was used to obtain 2037 AADT from 2035 AADT as shown in Table 5-4. The estimated 2037 AADT was appropriately balanced and rounded to obtain the final 2037 AADT values shown in Figure 5-7

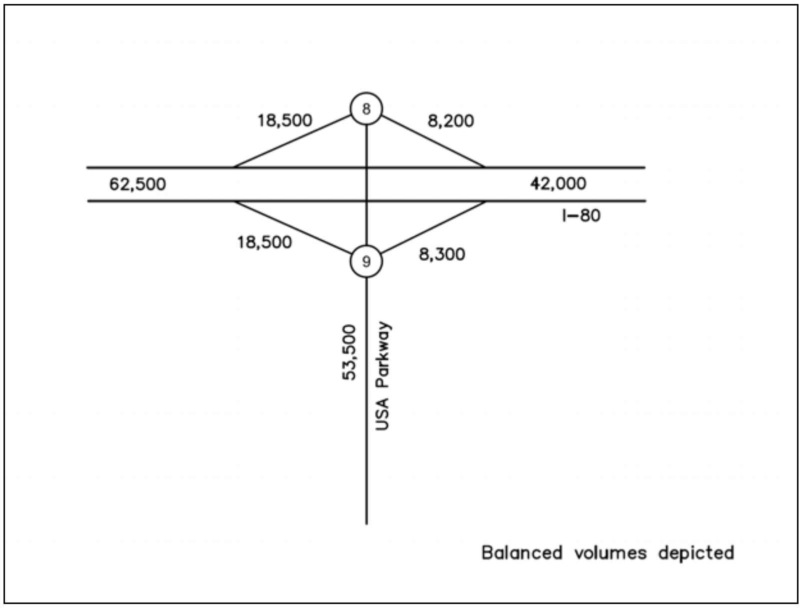
Rounding of AADT was done as per *Draft NDOT Traffic Forecasting Guidelines*.

Table 5-4 Projection of Year 2037 Volumes – No-Action Alternative

Location	2010 AADT	2035 AADT	Annual Increase in Traffic between 2010 and 2035	2037 AADT
E/B off-ramp at USA Parkway Interchange	1,660	17,187	621	18,429
E/B on-ramp at USA Parkway Interchange	707	7,733	281	8,295
W/B off-ramp at USA Parkway Interchange	582	7,656	283	8,221
W/B on-ramp at USA Parkway Interchange	1,301	16,992	628	18,247
I-80 East of USA Parkway Interchange	22,982	39,295	653	40,600
I-80 West of USA Parkway Interchange	26,388	59,739	1,334	62,407
USA Parkway North Segment	4,975	50,027	1,802	53,631

The 2037 AADT was balanced and rounded as needed to arrive at the Year 2037 AADT reported in Figure 5-7

Figure 5-7: Design Year 2037 No-Action AADTs at Study Roadway Segments



5.5.2. Projection of Year 2037 AADTs – Build Alternative

The 2037 AADT for the Build Alternative was estimated using the same procedure used for the No-Action Alternative. The projected 2037 AADTs are shown in Table 5-5 for all study segments except for USA Parkway along Highlands development.

Table 5-5: Projection of Year 2037 AADTs – Build Alternative near I-80 and US 50

Location	2010 AADT	2035 AADT	Annual Increase in Traffic between 2010 and 2035	2037 AADT
E/B off-ramp at USA Parkway Interchange	1,660	15,763	564	16,891
E/B on-ramp at USA Parkway Interchange	707	3,960	130	4,220
W/B off-ramp at USA Parkway Interchange	582	3,883	132	4,147
W/B on-ramp at USA Parkway Interchange	1,301	15,567	571	16,709
I-80 East of USA Parkway Interchange	22,982	30,088	284	30,656
I-80 West of USA Parkway Interchange	26,388	53,115	1,069	55,253
USA Parkway North Segment	4,975	39,632	1,386	42,405
US 50 west of USA Parkway	5,522	18,200	507	19,214
US 50 east of USA Parkway	4,238	14,111	395	14,901
USA Parkway South of US50 (Ramsey Cutoff)	1,905	8,127	249	8,625

The 2037 AADT was balanced and rounded as needed to arrive at the Year 2037 AADT reported in Figure 5-8

USA Parkway along the proposed Highlands development does not exist today and the anticipated opening year of the USA Parkway extension is 2017. The Highlands development along USA Parkway is expected to start development from 2020; so the traffic on the side streets and the traffic on USA Parkway generated from Highlands is expected to start growing from 2020. As an approximation, it was assumed that traffic along USA Parkway due to TRIC would also start to grow from 2020 instead of 2017. This eliminates the need to identify the proportion of traffic along USA Parkway due to TRIC and Highlands. The resulting estimate of the 2037 AADT is also on the conservative side because a faster growth is assumed. The projected 2037 AADT for USA Parkway segments along Highlands is shown in Table 5-6.

The estimated 2037 AADT was appropriately balanced and rounded to obtain the final 2037 AADT values shown in Figure 5-8.

Table 5-6: Projection of Year 2037 AADTs – Build Alternative along Highlands Development

Location	2020 AADT	2035 AADT	Annual Increase in Traffic between 2020 and 2035	2037 AADT
North of First Intersection	0	21,714	1,448	24,610
Between First and Second Int.	0	20,215	1,348	22,910
Between Second and Third Int.	0	19,825	1,322	22,468
Between Third and Fourth Int.	0	18,509	1,234	20,976
Between Fourth and Fifth Int.	0	20,612	1,374	23,360
Between Fifth and Sixth Int.	0	17,959	1,197	20,353
South of Sixth Int.	0	19,942	1,329	22,601
East leg of First Int.	0	1,203	80	1,364
West leg of First Int.	0	932	62	1,056
East leg of Second Int.	0	1,789	119	2,027
West leg of Second Int.	0	533	36	604
East leg of Third Int.	0	500	33	567
West leg of Third Int.	0	1,452	97	1,645
East leg of Fourth Int.	0	1,120	75	1,269
West leg of Fourth Int.	0	983	66	1,115
East leg of Fifth Int.	0	1,336	89	1,515
West leg of Fifth Int.	0	1,316	88	1,492
East leg of Sixth Int.	0	1,142	76	1,294
West leg of Sixth Int.	0	1,213	81	1,374

The 2037 AADT was rounded as needed to arrive at the Year 2037 AADT reported in Figure 5-8

Based on the daily truck percentages provided in Section 4-1 (Truck Traffic), the truck AADTs for the Build Alternative are shown in Table 5-7.

Figure 5-8: Design Year 2037 Build AADTs at Study Roadway Segments

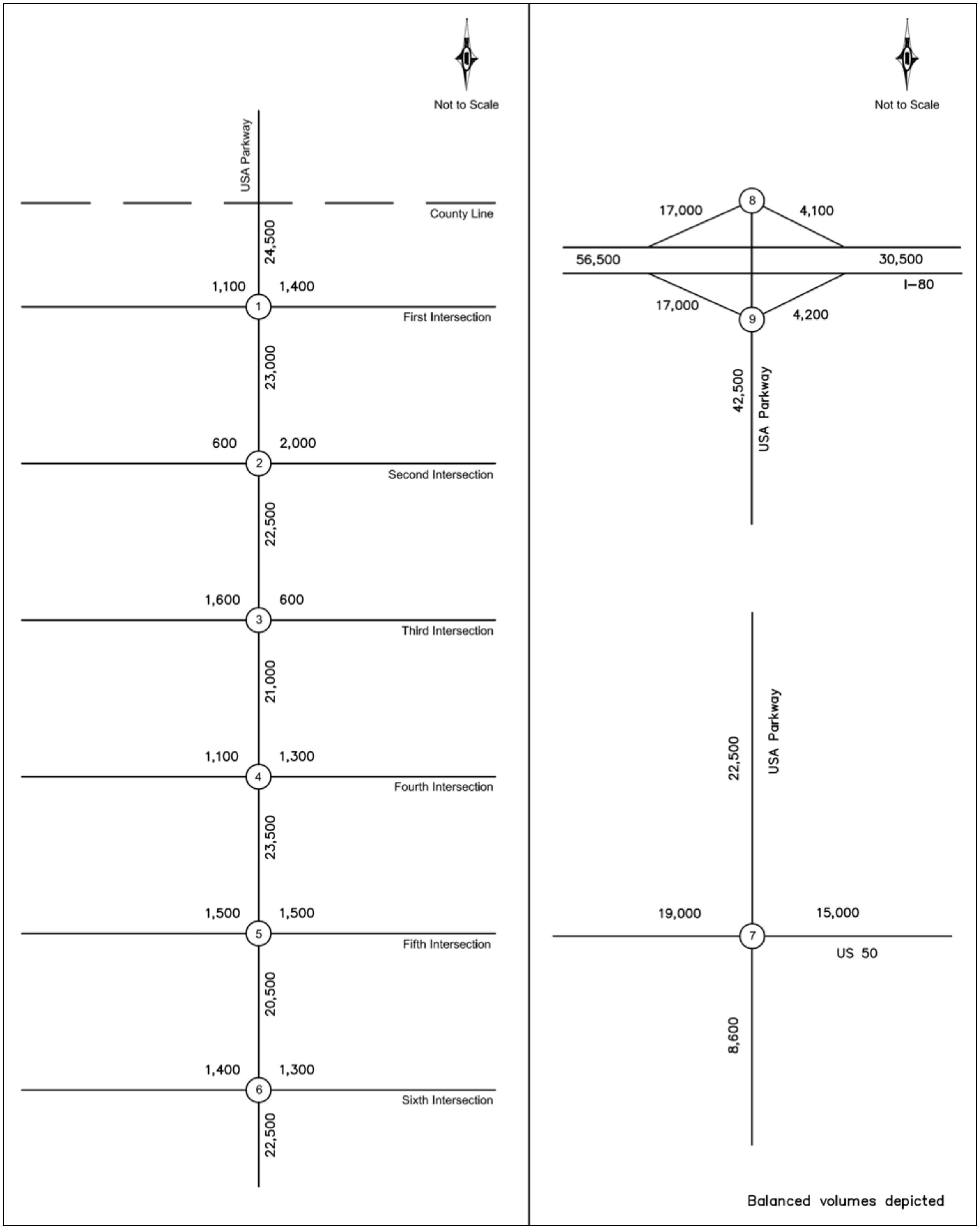


Table 5-7: Design Year 2037 Build Truck AADTs at Study Roadway Segments

Location	Year 2037 Build Total AADT	Year 2037 Build Truck AADT
I-80 West of USA Parkway Interchange	56,500	13,000
E/B off-ramp at USA Parkway Interchange	17,000	3,800
E/B on-ramp at USA Parkway Interchange	4,200	1,000
W/B off-ramp at USA Parkway Interchange	4,100	1,000
W/B on-ramp at USA Parkway Interchange	17,000	3,800
I-80 East of USA Parkway Interchange	30,500	7,300
USA Parkway North Segment	42,500	10,000
USA Parkway North of the First Intersection at Highlands	24,500	5,900
USA Parkway South of the Sixth Intersection at Highlands	22,500	5,400
USA Parkway South of US50 (Ramsey Cutoff)	8,600	2,100
US 50 west of USA Parkway	19,000	2,400
US 50 east of USA Parkway	15,000	1,900

6. PEAK HOUR TRAFFIC FORECASTS – WITH-HIGHLANDS SCENARIO

The next step in the traffic forecasting process was to obtain the Directional Design Hour Volumes (DDHV) from the 2037 AADTs. The DDHVs are the basis for the AM and PM peak hour volume estimates for use in traffic operations analysis.

6.1. Estimating K_{30} and D_{30}

For the study roadway segments, K_{30} and D_{30} values were obtained from ATRs in the vicinity and with similar characteristics as that of the study segments. The K_{30} and D_{30} values obtained from the ATRs were then adjusted to obtain the design year K_{30} and D_{30} depending on the expected land use and traffic characteristics of the study segments following the guidance offered in the *Draft NDOT Traffic Forecasting Guidelines*.

NDOT ATR # 0312350 (SR-430/US-395 1.4 miles of East Lake Blvd Jct) was chosen to represent the USA Parkway segments. This ATR was chosen because,

- Both USA Parkway and the road segment corresponding to the ATR come under the same NDOT functional classification – Rural Minor Arterial
- The expected design year AADT of USA Parkway is similar to the current AADT of the road segment corresponding to the ATR
- Both USA Parkway and the road segment corresponding to the ATR are North-South in direction

NDOT ATR # 0312290 (I-80 0.25 mile west of the USA Parkway Interchange) was chosen to represent the I-80 segment as this ATR is located at the project location.

NDOT ATR # 0012120 (US-50 0.4 mile west of US-50A) was chosen to represent the US 50 segments because this ATR is located on the same corridor as the study segment.

6.1.1. Estimating K_{30} and D_{30} for the No-Action Alternative

The K_{30} and D_{30} values from the ATRs for the study segments, the adjusted K_{30} and D_{30} values for the design year and the peak direction of traffic are listed in Table 6-1 for the No-Action Alternative.

USA Parkway near the I-80 and USA Parkway Interchange:

The K_{30} and D_{30} values for the USA Parkway segment were obtained from NDOT ATR # 0312350. These values were compared against the recommended K_{30} and D_{30} values from the *Draft NDOT Traffic Forecasting Guidelines*. The K_{30} was found to reasonably represent the design year conditions at the study segment. The median K_{30} for the Rural Minor Arterial functional class from the *Draft NDOT Traffic Forecasting Guidelines* is 11.6%. But the development at TRIC is not expected to have standard work hours; rather employees are expected to arrive at work throughout the day. This pattern (employees arriving and departing at various times of the day) was also observed on a field visit to the existing portion of the USA Parkway on April 11, 2012. Hence a K_{30} of 10.4% was found to be reasonable. The D_{30} value was adjusted to match the median D_{30} for the Rural Minor Arterial functional class from the *Draft NDOT Traffic Forecasting Guidelines*. In the No-Action Alternative, all trips travelling to/from TRIC would be forced to travel along I-80 and the USA Parkway segment near the I-80 and USA Parkway Interchange. The D_{30} value is therefore expected to be a value higher than 51.4%

as obtained from the ATR. In the design year, trips are expected to predominantly travel to TRIC during the AM peak period and away from TRIC during the PM peak period. Hence, the southbound direction would be the direction of peak traffic in the AM period and the northbound direction would be the direction of peak traffic in the PM period; this is similar to the existing conditions at this location.

Table 6-1: Estimation of K_{30} and D_{30} – No-Action Alternative

Segment	Parameter	Value from the chosen ATR	Adjusted/Estimated Design Year Value
USA Parkway near the I-80/USA Parkway Interchange	K_{30}	10.4%	10.4%
	D_{30}	51.4%	61%
	Current year AM Peak direction		SB
	Current year PM Peak direction		NB
	Design year AM Peak direction		SB
	Design year PM Peak direction		NB
I-80 near USA Parkway	K_{30}	9.5%	10.3%
	D_{30}	53.1%	57%
	Current year AM Peak direction		WB
	Current year PM Peak direction		EB
	Design year AM Peak direction (west of USA Pkwy)		EB
	Design year PM Peak direction (west of USA Pkwy)		WB
	Design year AM Peak direction (east of USA Pkwy)		WB
	Design year PM Peak direction (east of USA Pkwy)		EB

<u>I-80 near USA Parkway:</u>

The initial K_{30} value for I-80 was obtained from NDOT ATR # 0312290; this K_{30} value was adjusted to obtain the design year K_{30} value. The K_{30} value from the ATR was 9.5% and was determined to be low from a future design year perspective. Hence, the K_{30} value was increased to 10.3% which is the median value of K_{30} for the Rural Principal Arterial – Interstate functional class. The additional traffic travelling to TRIC is expected to have an impact on the directionality of the traffic and the D_{30}. Hence, based on engineering judgment, a higher D_{30} of 57% was assumed for I-80 east of the USA Parkway. At this location, the design year peak period directionality is expected to stay the same as the existing directionality, because vehicles are expected to travel away from TRIC in the PM peak period. The peak hour volumes for I-80 west of the USA Parkway were balanced from the volumes on I-80 east of the USA Parkway and the peak volumes of the ramps.

6.1.2. Estimating K_{30} and D_{30} for the Build Alternative

The K_{30} and D_{30} values from the ATRs for the study segments, the adjusted K_{30} and D_{30} values for the design year and the peak direction of traffic are listed in Table 6-2.

Table 6-2: Estimation of K_{30} and D_{30} – Build Alternative

Segment	Parameter	Value from the chosen ATR	Adjusted/Estimated Design Year Value
USA Parkway near the I-80/USA Parkway Interchange	K_{30}	10.4%	10.4%
	D_{30}	51.4%	57%
	Current year AM Peak direction		SB
	Current year PM Peak direction		NB
	Design year AM Peak direction		SB
	Design year PM Peak direction		NB
USA Parkway along Highlands Development	K_{30}	10.4%	10.4%
	D_{30}	51.4%	57%
	Current year AM Peak direction		N/A
	Current year PM Peak direction		N/A
	Design year AM Peak direction		NB
	Design year PM Peak direction		SB
I-80 near USA Parkway	K_{30}	9.5%	10.3%
	D_{30}	53.1%	55%
	Current year AM Peak direction		WB
	Current year PM Peak direction		EB
	Design year AM Peak direction (west of USA Pkwy)		EB
	Design year PM Peak direction (west of USA Pkwy)		WB
	Design year AM Peak direction (east of USA Pkwy)		WB
	Design year PM Peak direction (east of USA Pkwy)		EB
US 50 near USA Parkway	K_{30}	10.8%	10.8%
	D_{30}	52.5%	52.5%
	Current year AM Peak direction		WB
	Current year PM Peak direction		EB
	Design year AM Peak direction (west of USA Pkwy)		EB
	Design year PM Peak direction (west of USA Pkwy)		WB
	Design year AM Peak direction (east of USA Pkwy)		WB
	Design year PM Peak direction (east of USA Pkwy)		EB

USA Parkway near the I-80 and USA Parkway Interchange:

Similar to the No-Action Alternative, the K_{30} and D_{30} values for the USA Parkway segments (both for the segment near the I-80 and USA Parkway Interchange and the segments along Highlands development) were obtained from NDOT ATR # 0312350. These values were again compared against the recommended K_{30} and D_{30} values from the *Draft NDOT Traffic Forecasting Guidelines*. The K_{30} was found to reasonably represent the design year conditions at the study segments because of the reasons explained previously. The D_{30} from the ATR was adjusted to better reflect design year conditions. In the Build Alternative, USA Parkway would connect I-80 and US 50, passing through TRIC and the Highlands development. Trips from Carson City are expected to travel along US 50 and north along USA Parkway to reach TRIC whereas trips from Reno are expected to travel along I-80 and south along USA Parkway to reach TRIC. The D_{30} is therefore expected to be less than the D_{30} value estimated for the No-Action Alternative but still higher than the D_{30} value from the ATR; hence a D_{30} value of 57%

was selected as a reasonable value. Trips are expected to predominantly travel to TRIC during the AM peak period and away from TRIC during the PM peak period. Hence, at this location the southbound direction would be the direction of peak traffic in the AM period and the northbound direction would be the direction of peak traffic in the PM period; this is similar to the existing conditions at this location.

USA Parkway along Highlands Development:

The K_{30} and D_{30} values estimated for the USA Parkway North segment were determined to be reasonable for the segments along Highlands development also. Trips are expected to predominantly travel to TRIC during the AM peak period and away from TRIC during the PM peak period. Hence, for the USA Parkway segments along the Highlands development, the northbound direction would be the direction of peak traffic in the AM period and the southbound direction would be the direction of peak traffic in the PM period.

I-80 near USA Parkway:

The initial K_{30} value for I-80 was obtained from NDOT ATR # 0312290; this K_{30} value was adjusted to obtain the design year K_{30} value. The K_{30} value from the ATR was 9.5% and was determined to be low from a future design year perspective. Hence, the K_{30} value was increased to 10.3% which is the median value of K_{30} for the Rural Principal Arterial – Interstate functional class. The additional traffic travelling to TRIC is expected to have an impact on the directionality of the traffic and the D_{30}. Hence, based on engineering judgment, a higher D_{30} of 55% was assumed for I-80 east of the USA Parkway. At this location, the design year peak period directionality is expected to stay the same as the existing directionality, because vehicles are expected to travel away from TRIC in the PM peak period. The peak hour volumes for I-80 west of the USA Parkway were balanced from the volumes on I-80 east of the USA Parkway and the peak volumes of the ramps.

US 50 near USA Parkway:

The K_{30} and D_{30} values for US 50 were obtained from NDOT ATR # 0012120 and these values were compared against the recommended K_{30} and D_{30} values from the *Draft NDOT Traffic Forecasting Guidelines*. Both the K_{30} and D_{30} values were within the recommended range of values and were chosen to represent the design year conditions. Along US 50 during both the AM and PM peak period, traffic is expected to travel to Carson City/Dayton from Highlands, Silver Springs and other regions to the east and also from Carson City to TRIC. So, a uniform directional distribution is expected; hence a D_{30} of 52.5% was found to be reasonable. The peak period direction of traffic was determined during the balancing of volumes along USA Parkway and at the intersection of USA Parkway and US 50.

6.2. Design Year 2037 Peak Hour Traffic Forecasts

The K_{30} and D_{30} values were applied to the AADTs to obtain DDHVs. The AM and PM peak hour volumes were identified from the DDHV as follows.

6.2.1. Peak Period Identification and Ratio of AM Peak to PM Peak Hour Volume

The procedure recommended in the *Draft NDOT Traffic Forecasting Guidelines* was followed to identify the peak hour volumes from the DDHV. The annual hourly report of the chosen ATRs and the short term count stations corresponding to the study segments were analyzed to identify the typical peak periods prevalent at that location. Based on this, it was determined that the PM peak period peak direction is critical, with a higher volume than that during the AM peak period peak direction for all study segments. Hence, the DDHV for all the study segments were taken to correspond to the PM peak hour peak direction volume. In addition, the ratio of the AM peak hour peak direction volume to the PM peak hour peak direction volume for the typical weekdays (Tuesday, Wednesday and Thursday) was estimated from the annual hourly report of each ATR. Based on this, the most conservative value among all the AM to PM peak hour peak direction volume ratios (0.9) was chosen to be applied to the PM peak hour peak direction volumes to obtain the AM peak hour peak direction volumes. This ratio of 0.9 was applied consistently at all project segments.

$$\text{AM Peak Hour Peak Direction Volume} = \text{PM Peak Hour Peak Direction Volume} \times 0.9$$

The PM peak period off-peak direction volume was estimated in the conventional manner as,

$$\text{PM Peak Period Offpeak Direction Volume} = \text{Design Hour Volume (DHV)} \times (1 - D_{30})$$

The AM peak period off-peak direction volume was estimated by applying the ratio of 0.9 to the PM peak period off-peak direction volume. This was found to be more conservative than applying the field measured AM directional factor to obtain the AM off-peak directional volume.

This procedure was applied to all the study segments; a summary of the estimation of AM and PM period volumes and their relation to DDHV is given in Table 6-3.

Table 6-3: Estimation of AM and PM peak period volumes

	Peak Direction	Off-Peak Direction
PM Peak Period	DHV x D_{30} (This corresponds to DDHV)	DHV x (1-D_{30})
AM Peak Period	0.9 x DHV x D_{30} (This corresponds to 0.9 x DDHV)*	0.9 x DHV x (1-D_{30})**

* 0.9 is the ratio of the AM to PM peak hour peak direction volumes from NDOT's short term counts for typical weekdays
** This was found to be more conservative than applying the AM peak period D factor for all study segments

6.2.2. Design Year 2037 Peak Hour Traffic Forecasts for the No-Action Alternative

<u>Estimation of peak hour volumes at ramps of I-80 and USA Parkway Interchange:</u>

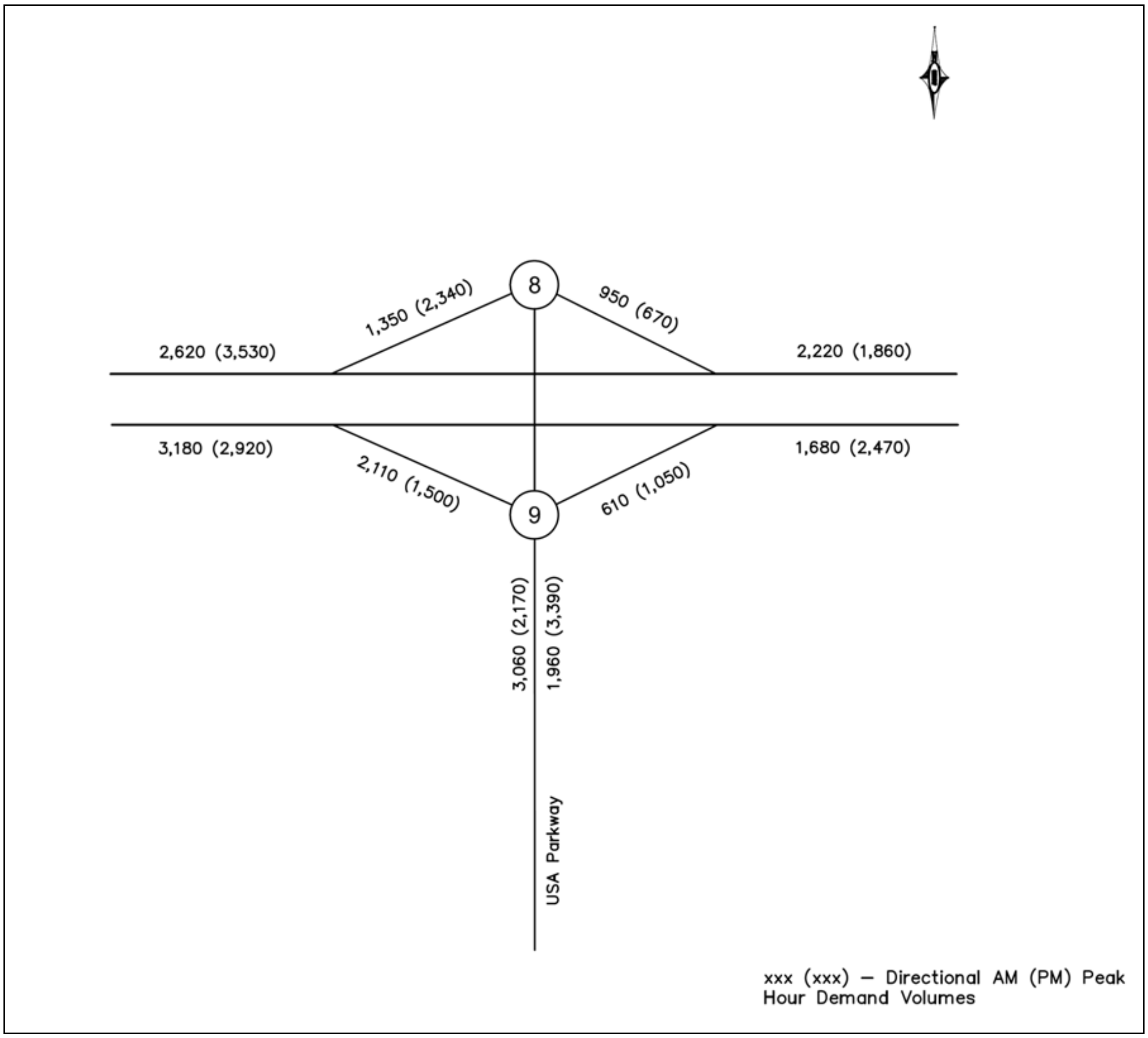
Based on the ratio of the AM to PM peak period volumes, and the estimated K_{30} and D_{30}, the peak period volumes were estimated for USA Parkway just south of I-80 (USA Parkway North Segment). The peak hour volumes at the ramps of the I-80 and USA Parkway Interchange were estimated from the volumes on the USA Parkway North segment. The sum of the EB on-ramp volumes and WB on-ramp volumes should equal the northbound volume of the USA Parkway North segment. Similarly, the sum of the EB off-ramp volumes and WB off-ramp volumes should equal the southbound volume of the USA Parkway North segment. The ramp volumes were estimated based on this condition and based on the relative distribution of 2037 AADT on the ramps.

Estimation of peak hour volumes along I-80:

As previously explained in Section 6.1.1, a D_{30} value of 57% was assumed for the I-80 segment east of the I-80 and USA Parkway Interchange. For this segment, the direction of traffic in the PM peak period was assumed to be eastbound, away from TRIC because traffic is generally expected to travel from TRIC to other destinations in the PM peak period. Based on this D_{30} and the estimated K_{30} for I-80, the peak period volumes were calculated for the I-80 segment east of USA Parkway. The peak hour volumes for the I-80 segment west of the I-80 and USA Parkway Interchange was then calculated based on the volumes from the I-80 segment east of the I-80 and USA Parkway Interchange and subtracting and adding ramp volumes.

The estimated peak period volumes for the study segments are shown in Figure 6-1 for the No-Action Alternative.

Figure 6-1: Design Year 2037 No-Action AM/PM Volume Estimates at Study Roadway Segments



6.2.3. Design Year 2037 Peak Hour Traffic Forecasts for the Build Alternative

Estimation of peak hour volumes at ramps of I-80 and USA Parkway Interchange:

The peak hour volumes at the ramps of the I-80 and USA Parkway Interchange for the Build Alternative were also calculated following the procedure explained previously in the calculation of volumes for the No-Action Alternative.

Estimation of peak hour volumes along I-80:

As previously explained in Section 6.1.2, a D_{30} value of 55% was assumed for the I-80 segment east of the I-80. Following this, the procedure explained in the calculation of volumes for the No-Action Alternative was used to determine the peak hour volumes along I-80.

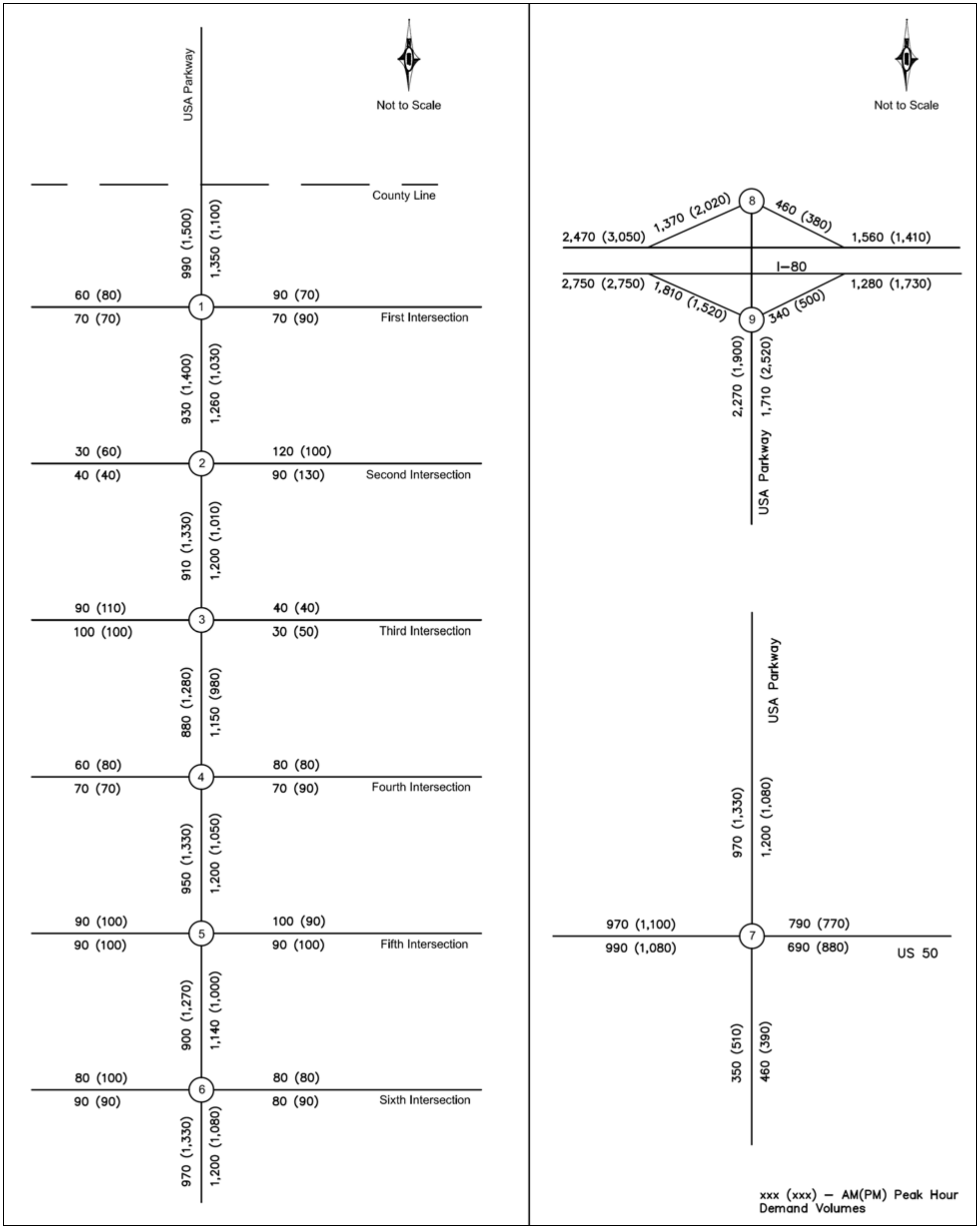
Estimation of peak hour volumes on USA Parkway along Highlands Development

Based on the ratio of the AM to PM peak period volumes, and the estimated K_{30} and D_{30}, all the peak period volumes were estimated for the USA Parkway segments along the Highlands development.

Estimation of peak hour volumes on US 50 at USA Parkway:

The peak period volumes for the segments along US 50 were also calculated based on the estimated K_{30} and D_{30} and the ratio of the AM to PM peak period volumes. The initial direction of the peak period traffic, both at the segments east and west of USA Parkway, was assumed to be eastbound in the PM period and westbound in the AM period. This assumed directionality is consistent with the existing traffic conditions. These values were used in the process of balancing the volumes along the USA Parkway corridor at Highlands in conjunction with the intersection of USA Parkway and US 50. The resulting balanced volumes are shown in Figure 6-2. The directionality of the balanced AM and PM peak hour volumes along US 50 west of USA Parkway and along US 50 east of USA Parkway is shown in Table 6-2.

Figure 6-2: Design Year 2037 Build AM/PM Volume Estimates at Study Roadway Segments



6.2.4. Intersection Turning Movement Forecasts

Design year 2037 turning movement volumes at the study intersections are derived from the directional peak hour volumes shown in Figure 6-1 and Figure 6-2 consistent with the iterative method of NCHRP Report 255. TurnsW32 software was utilized for the turning movement estimates. Figure 6-3 and Figure 6-4 show the resulting design year 2037 intersection turning movement volumes.

Figure 6-3: Design Year 2037 No-Action AM/PM Turning Movement Volumes at Study Intersections

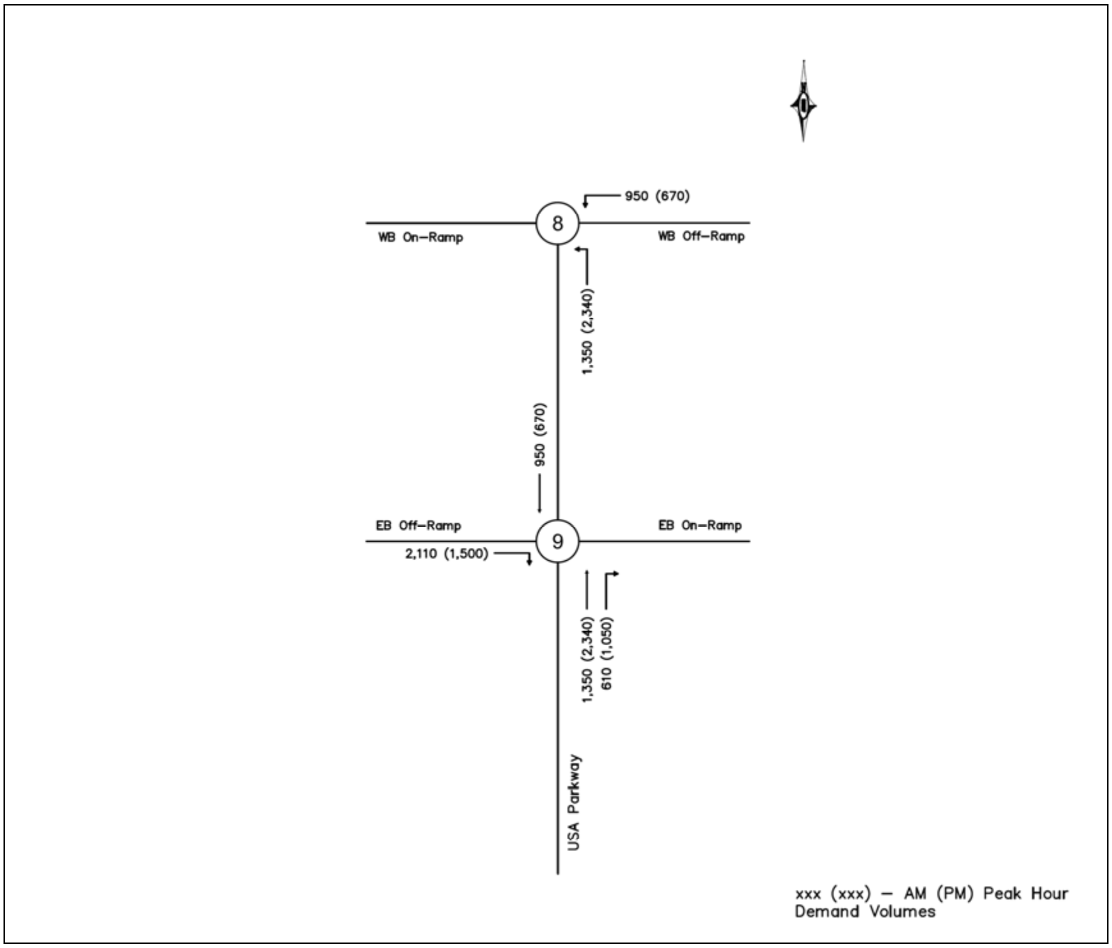
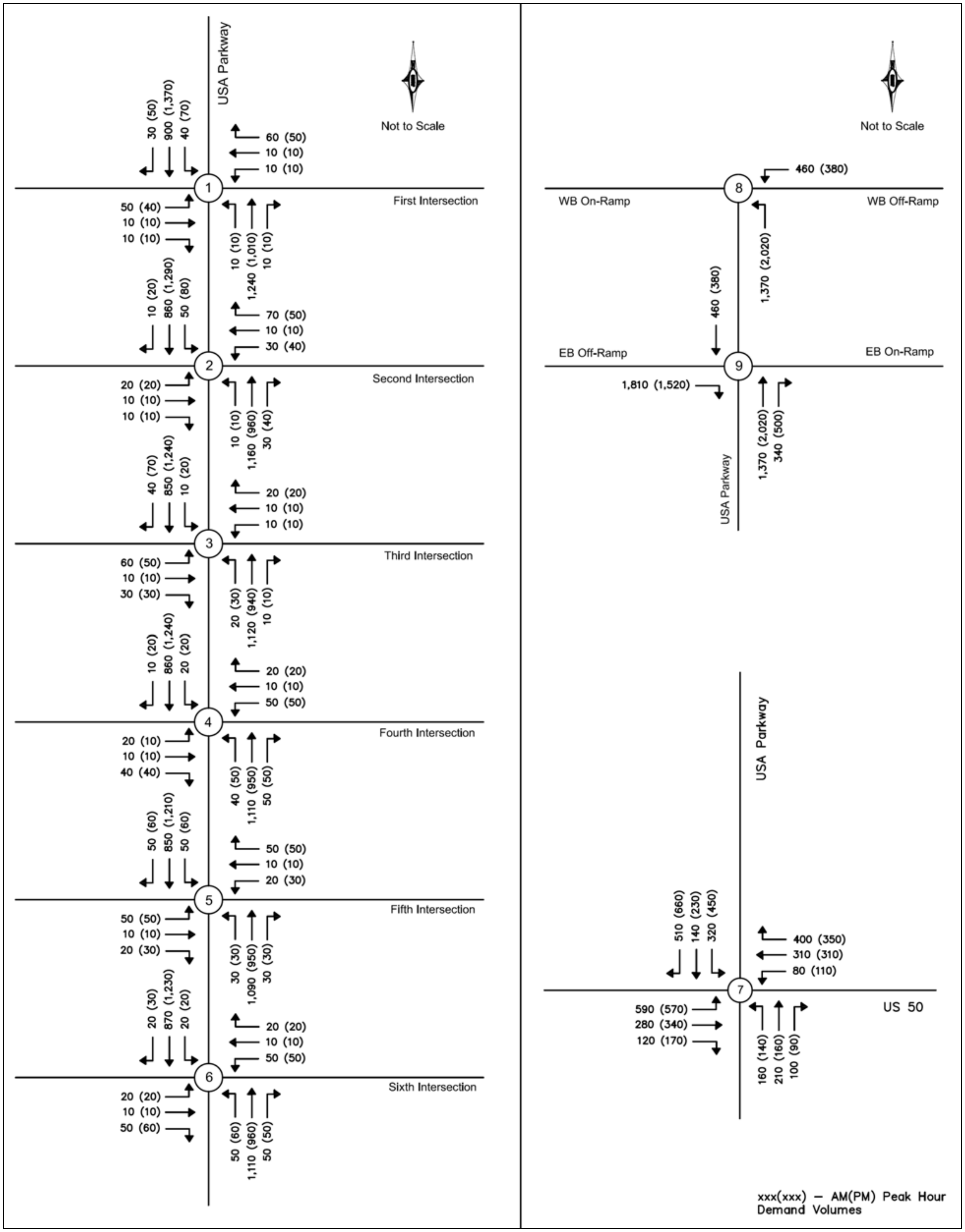


Figure 6-4: Design Year 2037 Build AM/PM Turning Movement Volumes at Study Intersections



7. YEAR 2035 AND YEAR 2037 NO-HIGHLANDS SCENARIO – TRAFFIC FORECASTS

The year 2035 and year 2037 No-Highlands scenario traffic volumes are estimated following the same methodologies used for year 2035 and year 2037 with-Highlands scenario projections as detailed in Chapters 5 and 6. The procedure can be summarized as follows:

> Similar to the methodology used for forecasting the year 2035 and year 2037 with-Highlands scenario volumes, the raw daily model volumes were first investigated for reasonableness; and necessary adjustments were made (re-assignment of raw model volumes and NCHRP 255 adjustments). Once the year 2035 AADTs were estimated (see through Figures 7-1 through Figure 7-4), they were compared with historical trend projections for reasonableness (see Figure 7-5 and Appendix G). This comparison showed that the growth obtained from the travel demand outputs follow a similar trend as predicted by the historical trend projection analysis. Year 2037 AADTs were estimated from year 2035 AADTs using the same methodology as explained in Section 5.5 (see Figure 7-6 and Figure 7-7). Peak hour traffic forecasts (both DDHVs and turning movement volumes) were estimated from the AADTs following the same methodology explained for the year 2037 with-Highlands scenario projections. Figure 7-8 through Figure 7-11 present the year 2037 No-Highlands scenario peak hour traffic forecasts.

Figure 7-1: Year 2035 No-Highlands No-Action AADTs at General Study Area Roadway Network

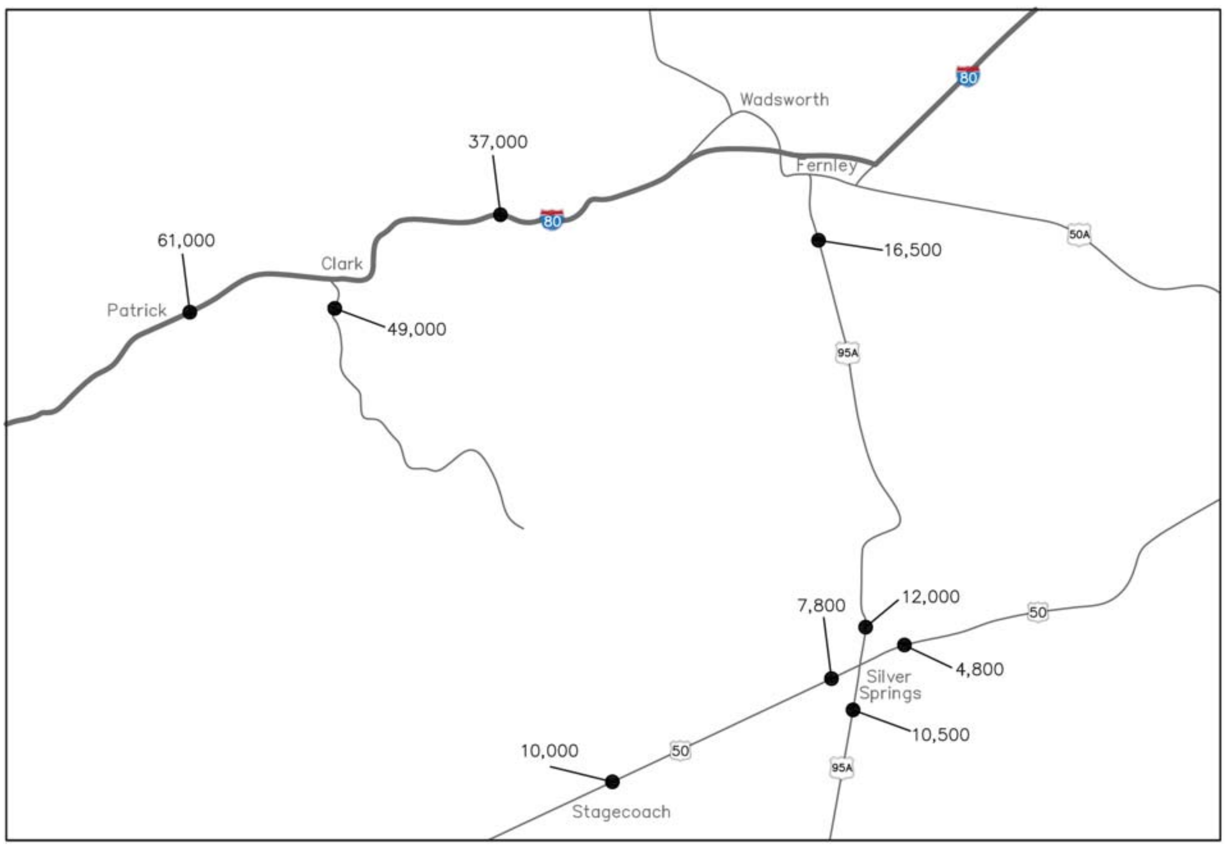


Figure 7-2: Year 2035 No-Highlands Build AADTs at General Study Area Roadway Network

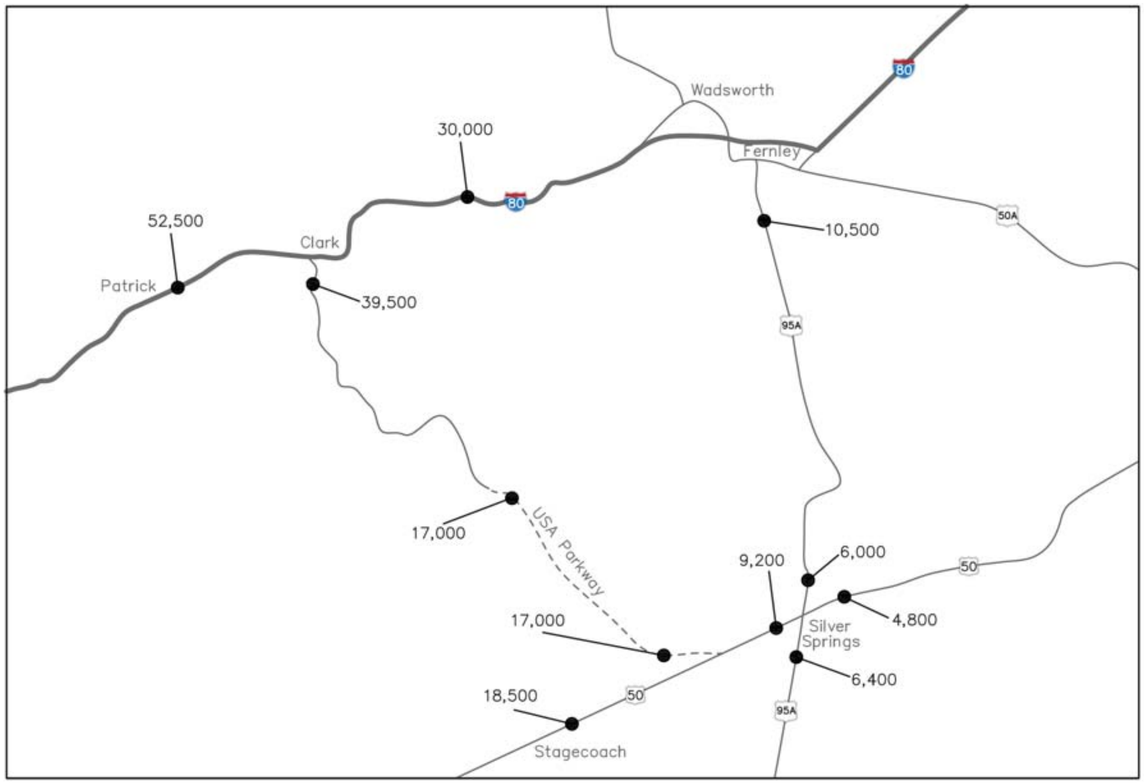


Figure 7-3: Year 2035 No-Highlands No-Action AADTs at Study Roadway Segments

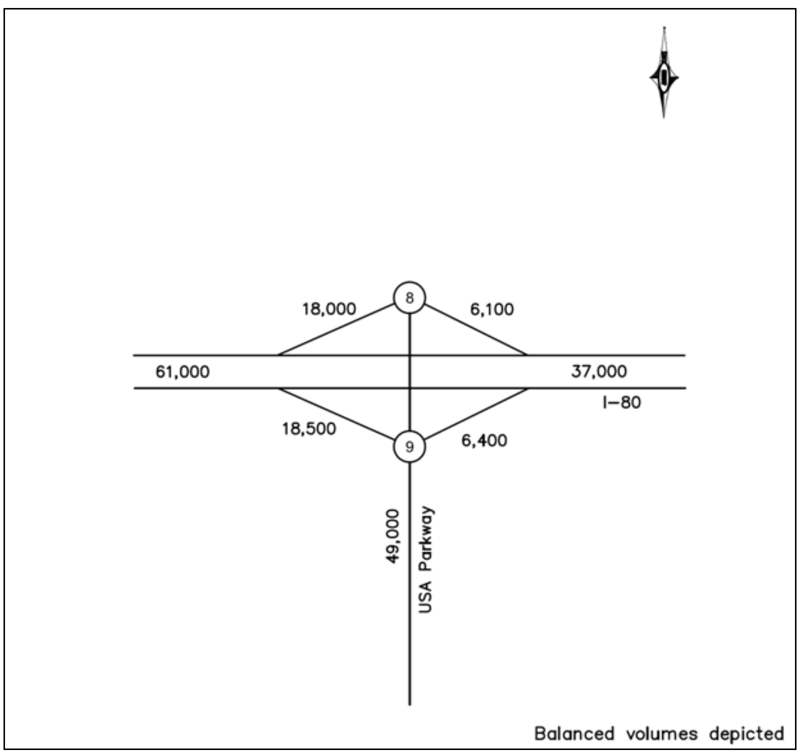


Figure 7-4: Year 2035 No-Highlands Build AADTs at Study Roadway Segments

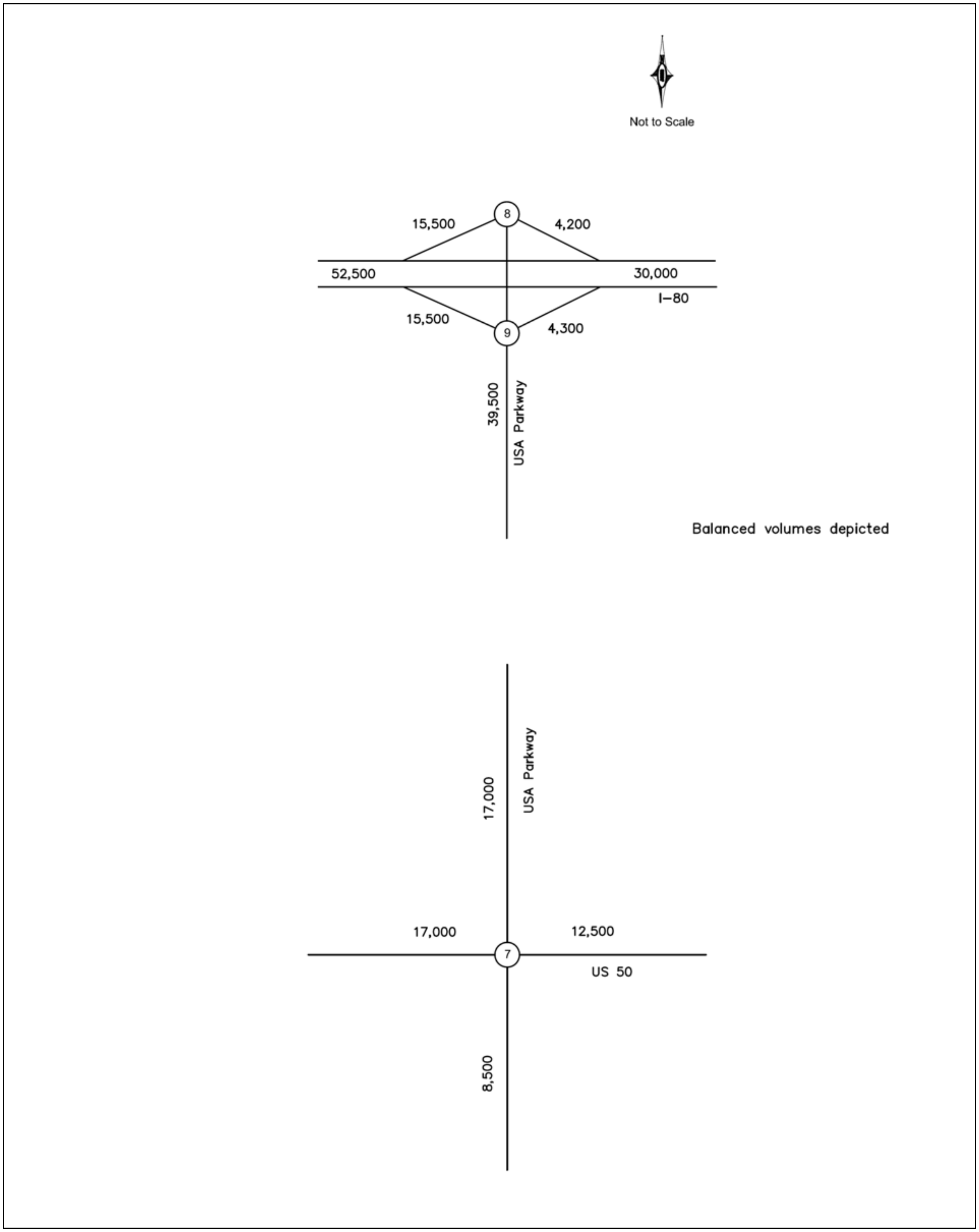


Figure 7-5: Comparison of year 2035 No-Highlands Build Forecasts with Historical Trend Projections

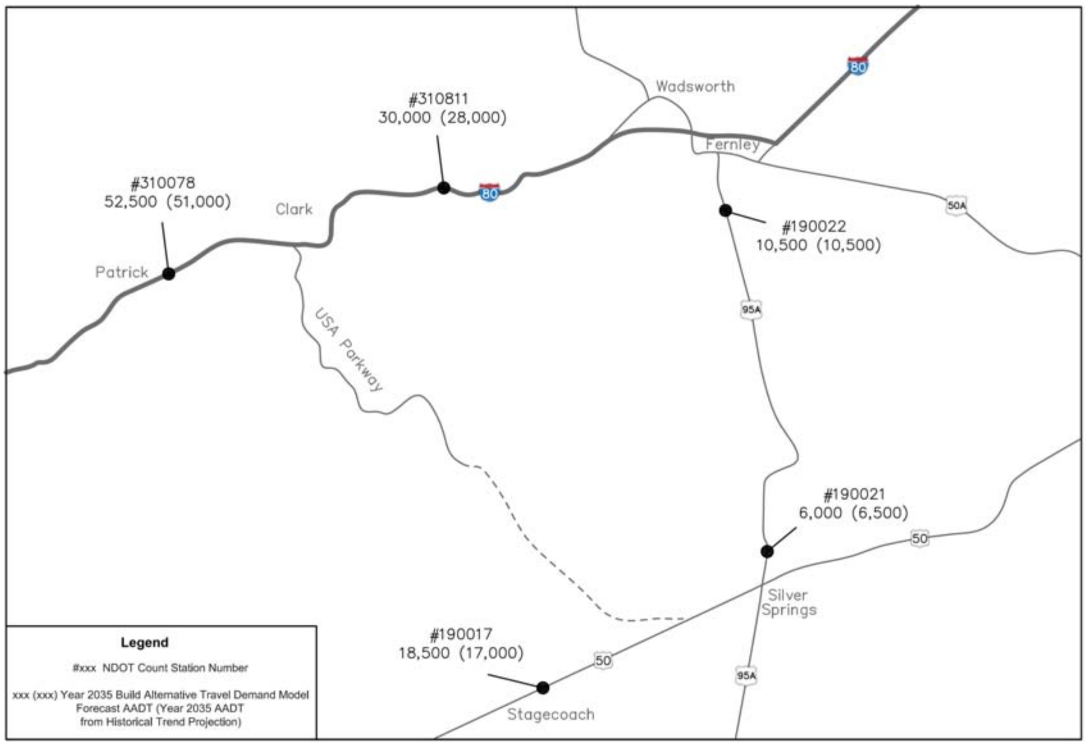


Figure 7-6: Design Year 2037 No-Highlands No-Action AADTs at Study Roadway Segments

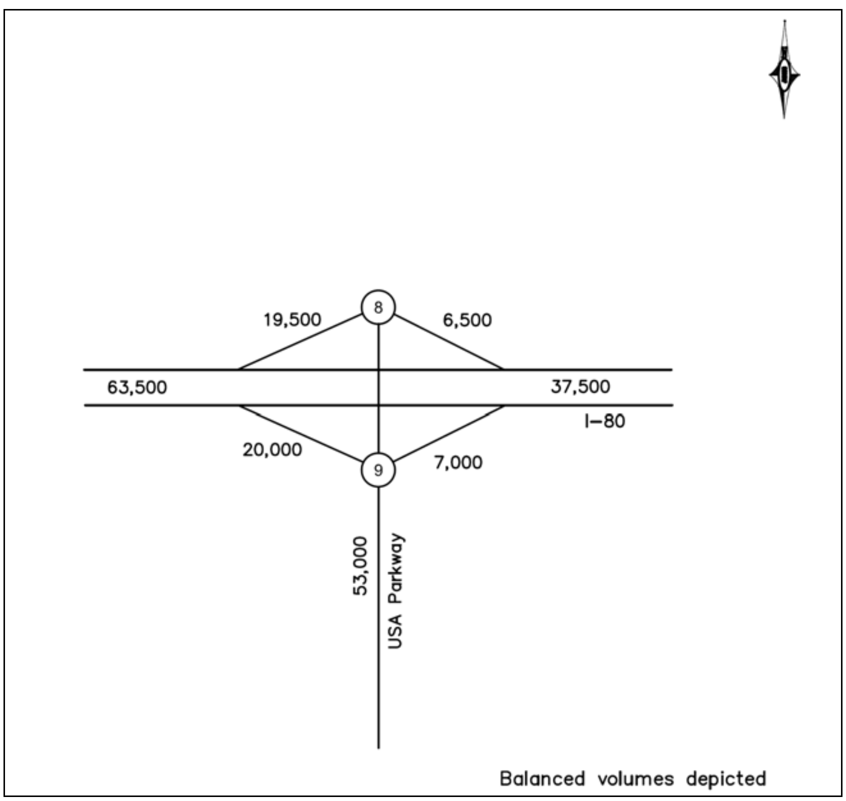


Figure 7-7: Design Year 2037 No-Highlands Build AADTs at Study Roadway Segments

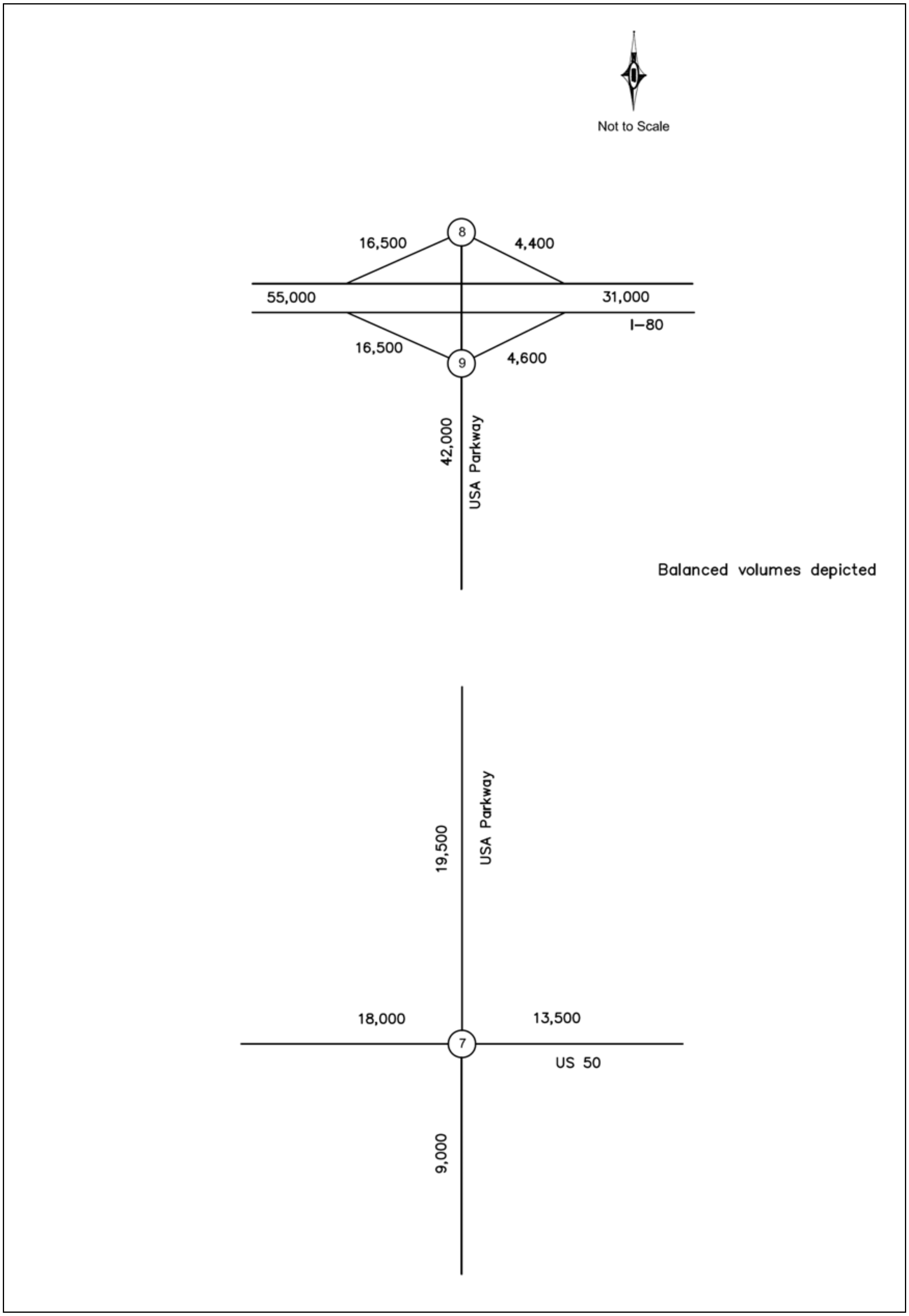


Figure 7-8: Design Year 2037 No-Highlands No-Action AM/PM Volume Estimates at Study Roadway Segments

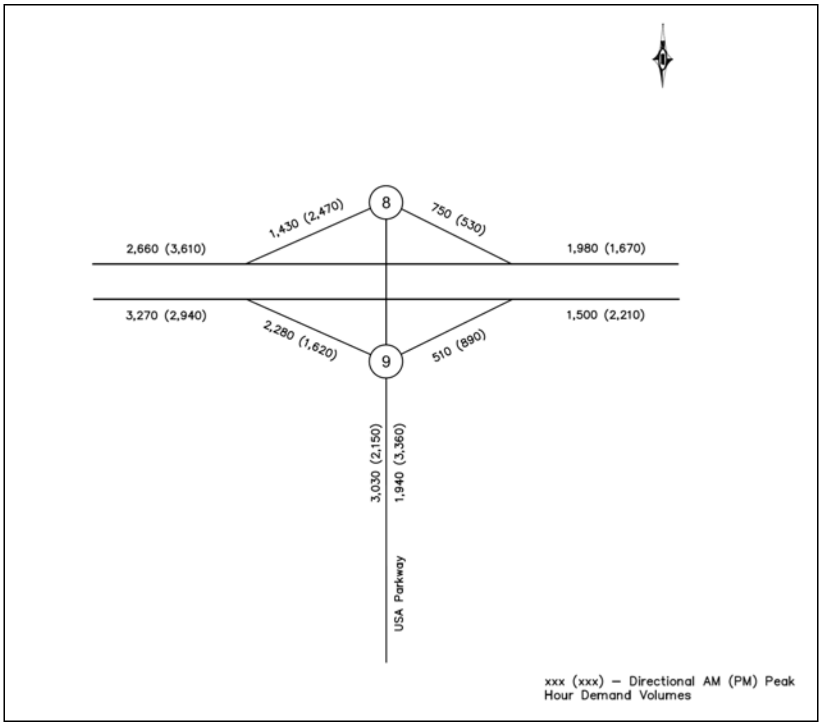


Figure 7-9: Design Year 2037 No-Highlands Build AM/PM Volume Estimates at Study Roadway Segments

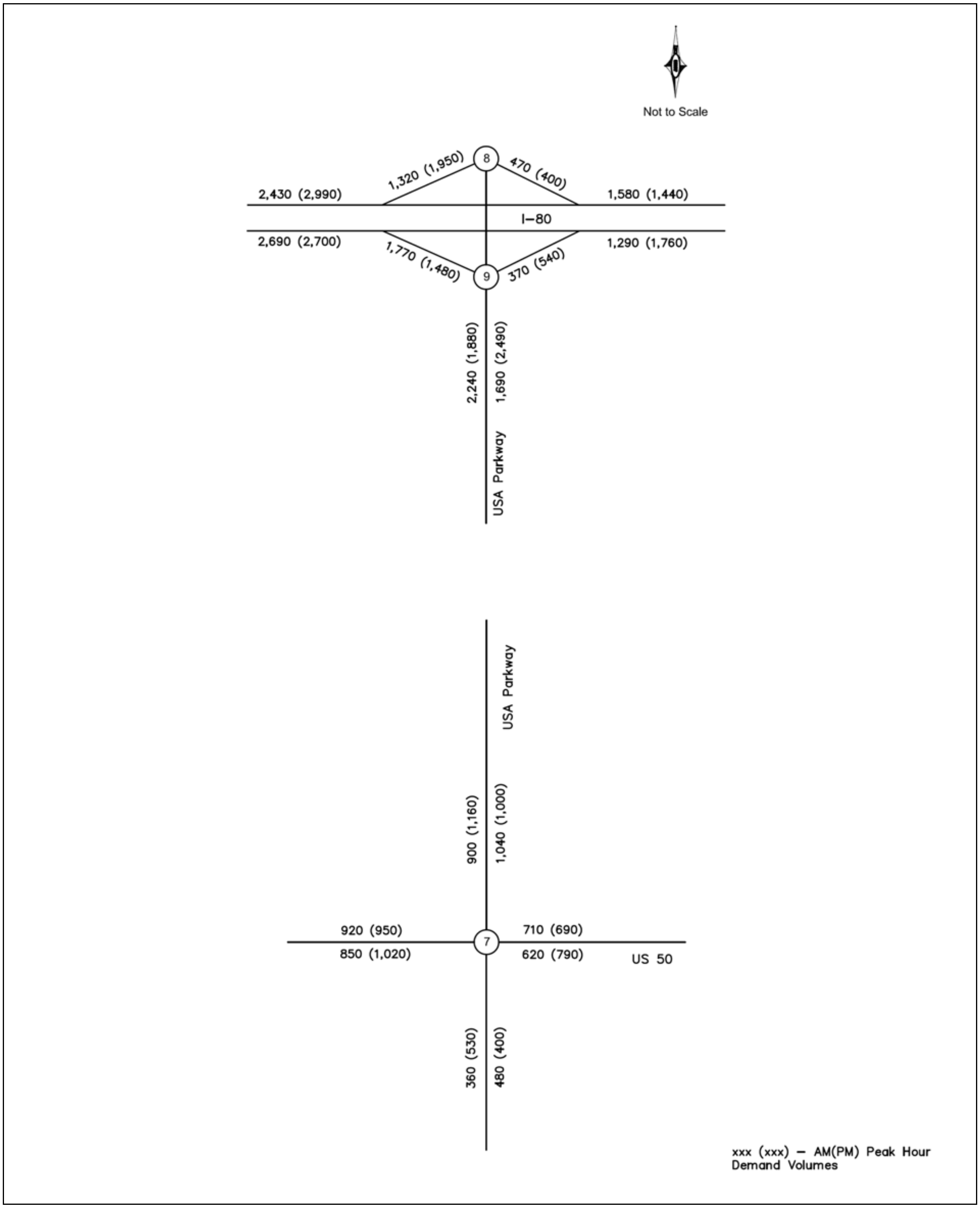


Figure 7-10: Design Year 2037 No-Highlands No-Action AM/PM Turning Movement Volumes at Study Intersections

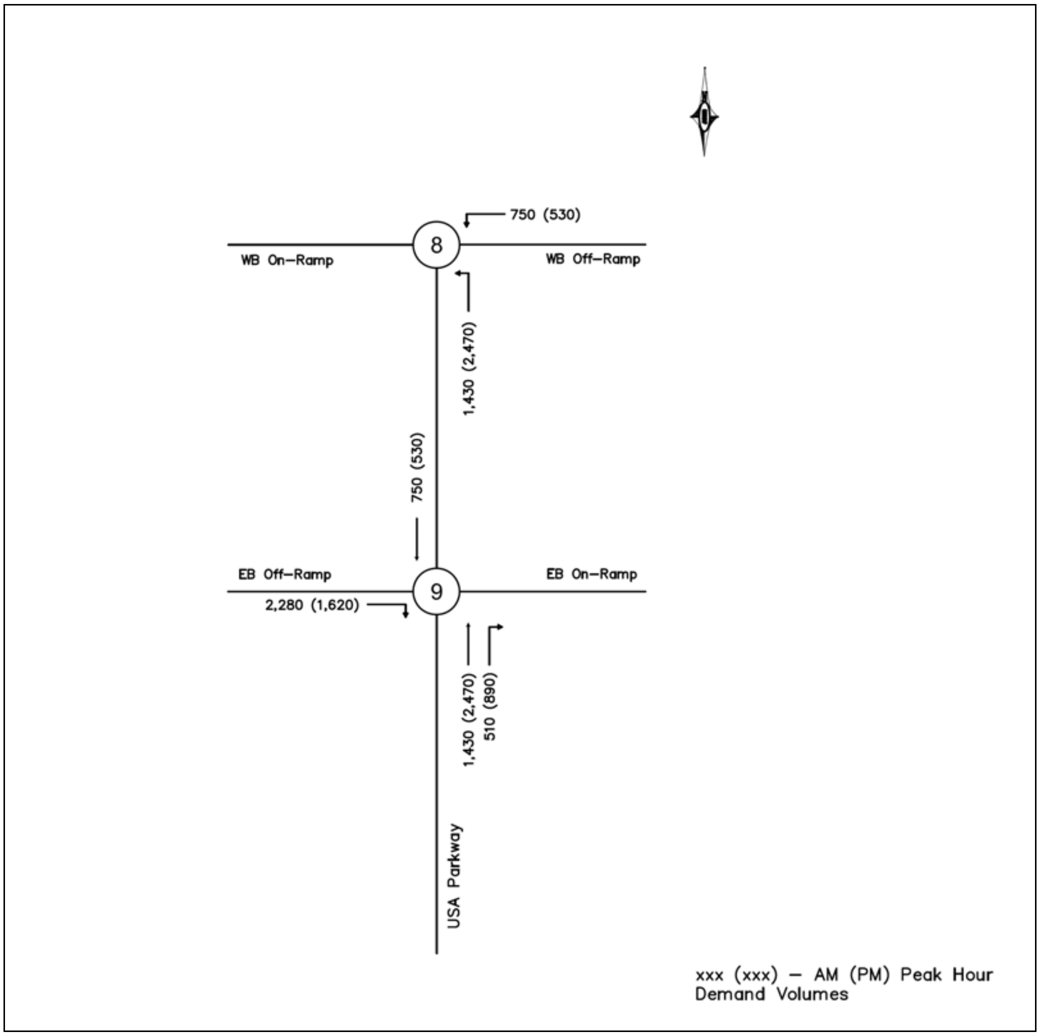
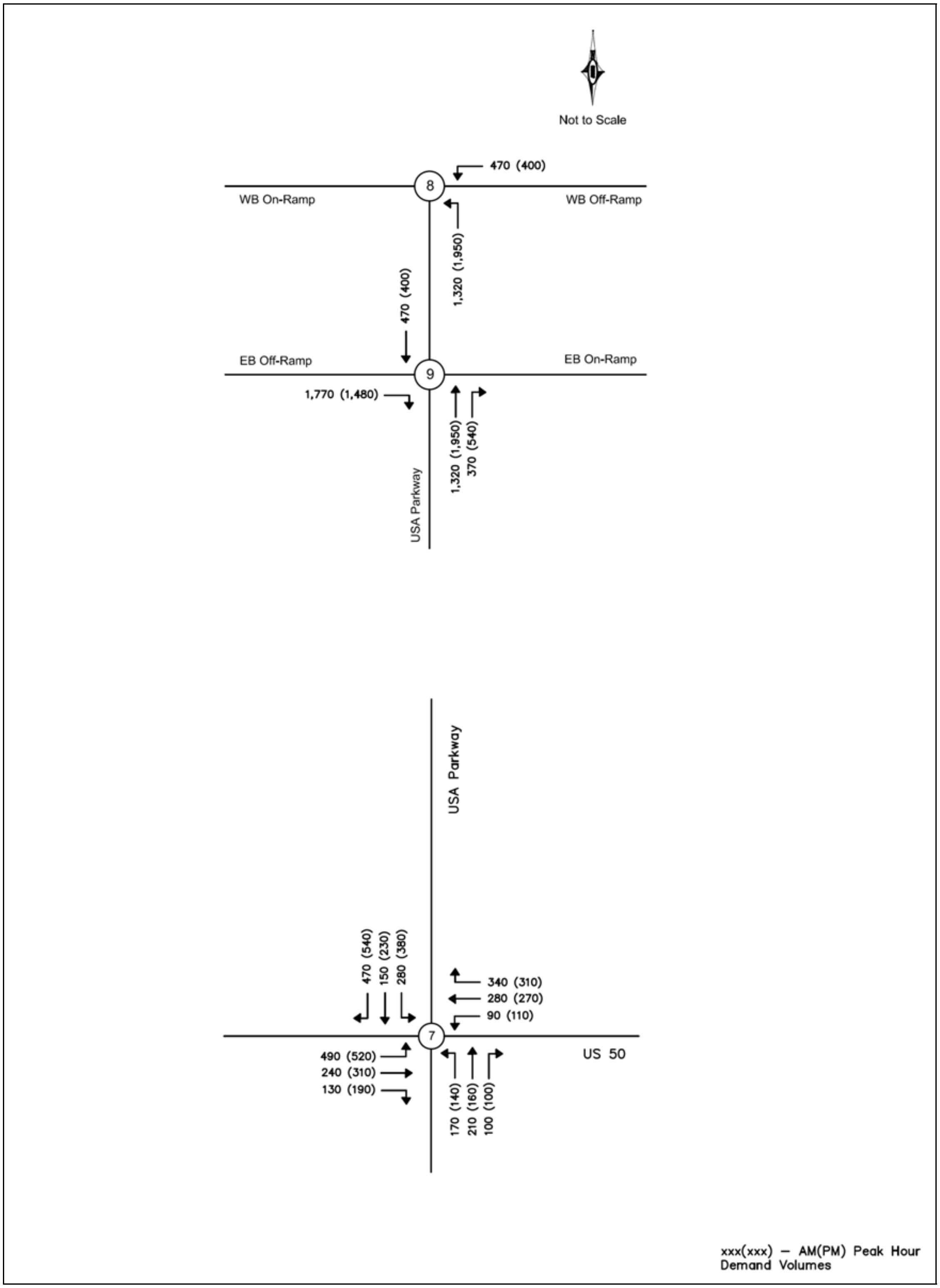


Figure 7-11: Design Year 2037 No-Highlands Build AM/PM Turning Movement Volumes at Study Intersections



Based on the daily truck percentages provided in Section 4-1 (Truck Traffic) and the forecast AADT, the truck AADTs for the design year 2037 No-Highlands scenario is shown in Table 7-1.

Table 7-1: Design Year 2037 No-Highlands Build Truck AADTs at Study Roadway Segments

Location	Year 2037 Build No-Highlands Total AADT	Year 2037 Build No-Highlands Truck AADT
I-80 West of USA Parkway Interchange	55,000	12,500
E/B off-ramp at USA Parkway Interchange	16,500	3,700
E/B on-ramp at USA Parkway Interchange	4,600	1,100
W/B off-ramp at USA Parkway Interchange	4,400	1,000
W/B on-ramp at USA Parkway Interchange	16,500	3,700
I-80 East of USA Parkway Interchange	31,000	7,400
USA Parkway North Segment	42,000	10,000
USA Parkway North of the First Intersection at Highlands	19,500	4,700
USA Parkway South of the Sixth Intersection at Highlands	19,500	4,700
USA Parkway South of US50 (Ramsey Cutoff)	9,000	2,200
US 50 west of USA Parkway	18,000	2,300
US 50 east of USA Parkway	13,500	1,700

8. YEAR 2017 – OPENING YEAR TRAFFIC FORECASTS

Since the proposed project will be designed to year 2037 conditions and built in one phase, an opening year traffic operations analysis will not be performed as part of the USA Parkway EA. Geometry and improvements will be identified based on year 2037 volumes. This means the proposed design will accommodate opening year conditions. Nonetheless, opening year 2017 traffic is estimated for the USA Parkway EA. The year 2017 forecasts will be the input for environmental air quality and noise analysis. Furthermore, the projections may be used for a potential change in control of access request (CCAR) for the US 50/USA Parkway intersection/interchange. It is noted that a CCAR is not part of the USA Parkway EA scope and will be completed (if needed) later by NDOT.

The south leg of the USA Parkway and US 50 intersection might not be completed as part of the year 2017 Build scenario. Hence, forecasts were developed for both a T-intersection configuration and a four-legged intersection configuration for the intersection of USA Parkway and US 50.

Year 2017 traffic volumes are estimated following the same methodologies as detailed in Chapters 5 and 6. A year 2017 travel demand model is developed and is the basis for the opening year projections. The procedure can be summarized as follows:

Similar to the methodology used for forecasting design year 2035 volumes, the raw daily model volumes were first investigated for reasonableness; and necessary adjustments were made (re-assignment of raw model volumes and NCHRP 255 adjustments). Once the AADTs were estimated (see Figures 8-1 through Figure 8-4), they were compared with historical trend projections for reasonableness (see Figure 8-5 and Appendix G). This comparison showed that the growth obtained from the travel demand outputs follow a similar trend as predicted by the historical trend projection analysis.

Peak hour traffic forecasts (both DDHVs and turning movement volumes) were estimated from the AADTs following the same methodology explained for year 2037 projections. Figure 8-6 through Figure 8-9 present the opening year 2017 peak hour traffic forecasts.

Figure 8-1: Year 2017 No-Action AADTs at General Study Area Roadway Network

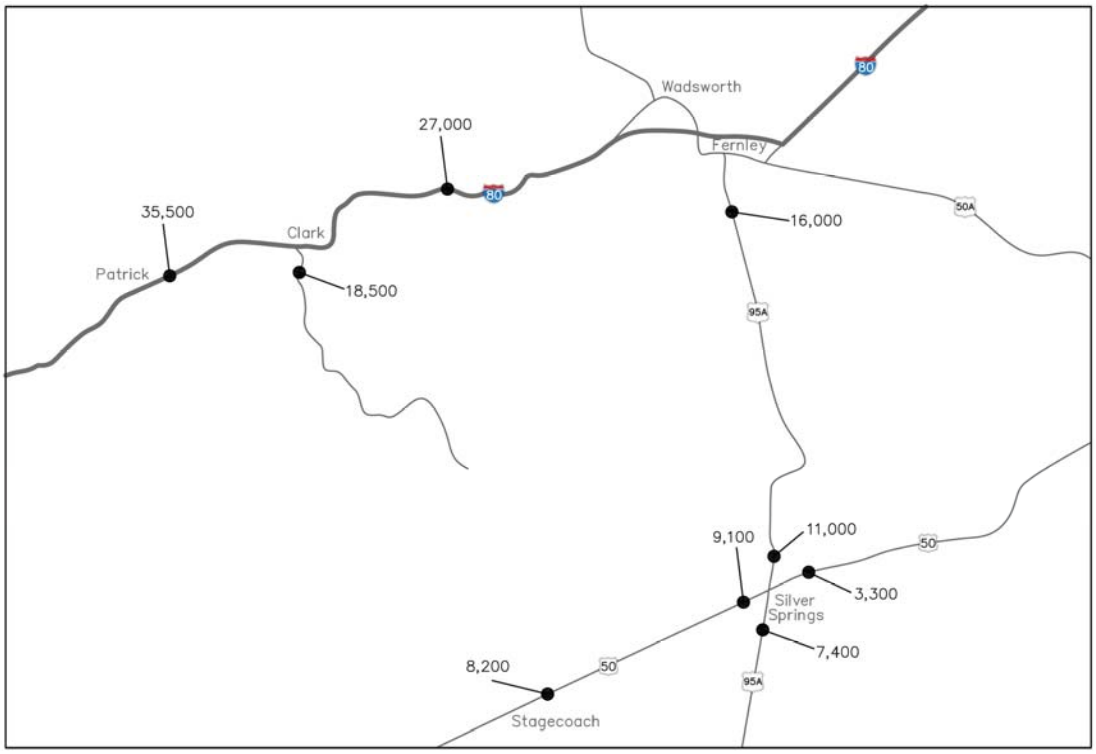


Figure 8-2: Year 2017 Build AADTs at General Study Area Roadway Network

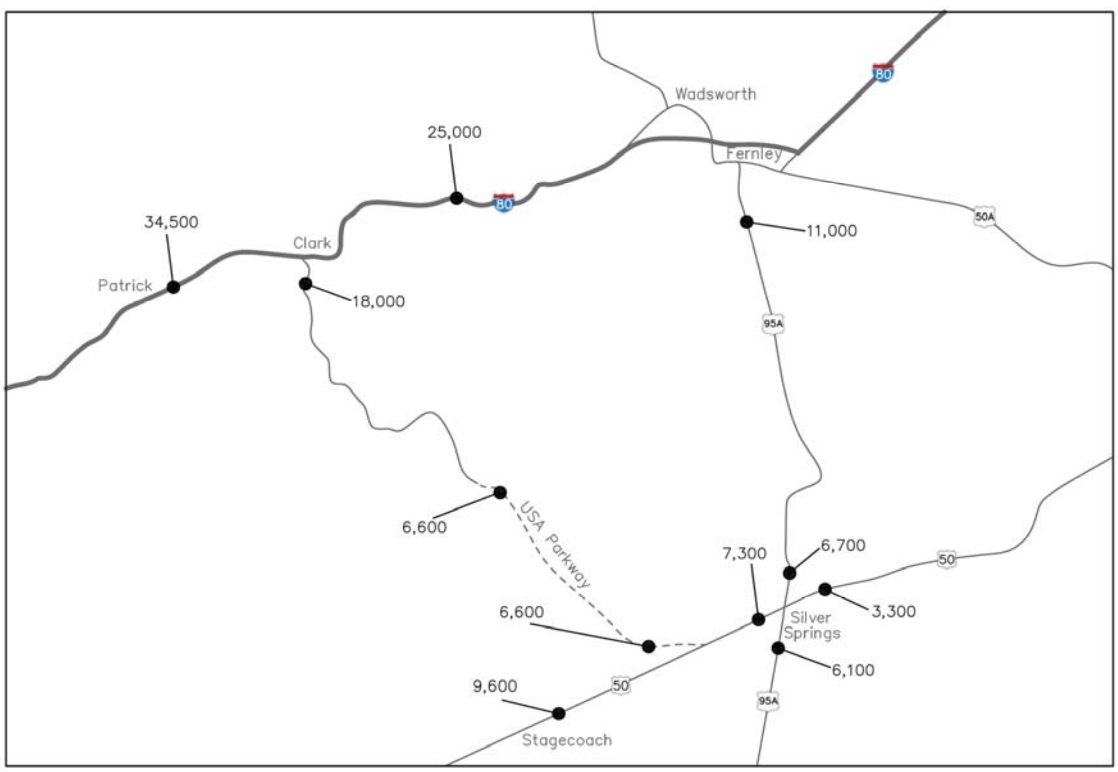


Figure 8-3: Year 2017 No-Action AADTs at Study Roadway Segments

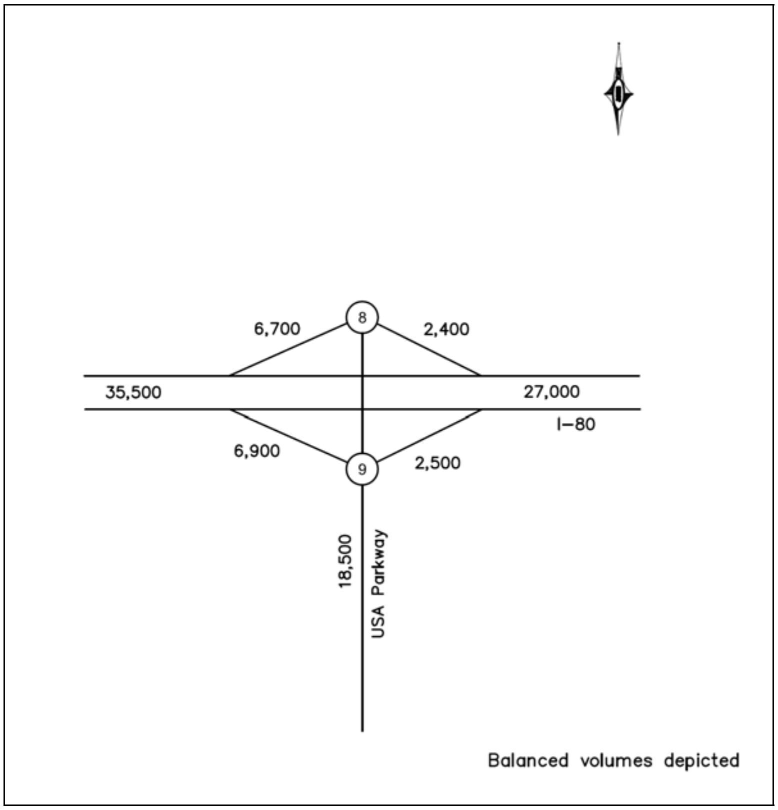


Figure 8-4: Year 2017 Build AADTs at Study Roadway Segments

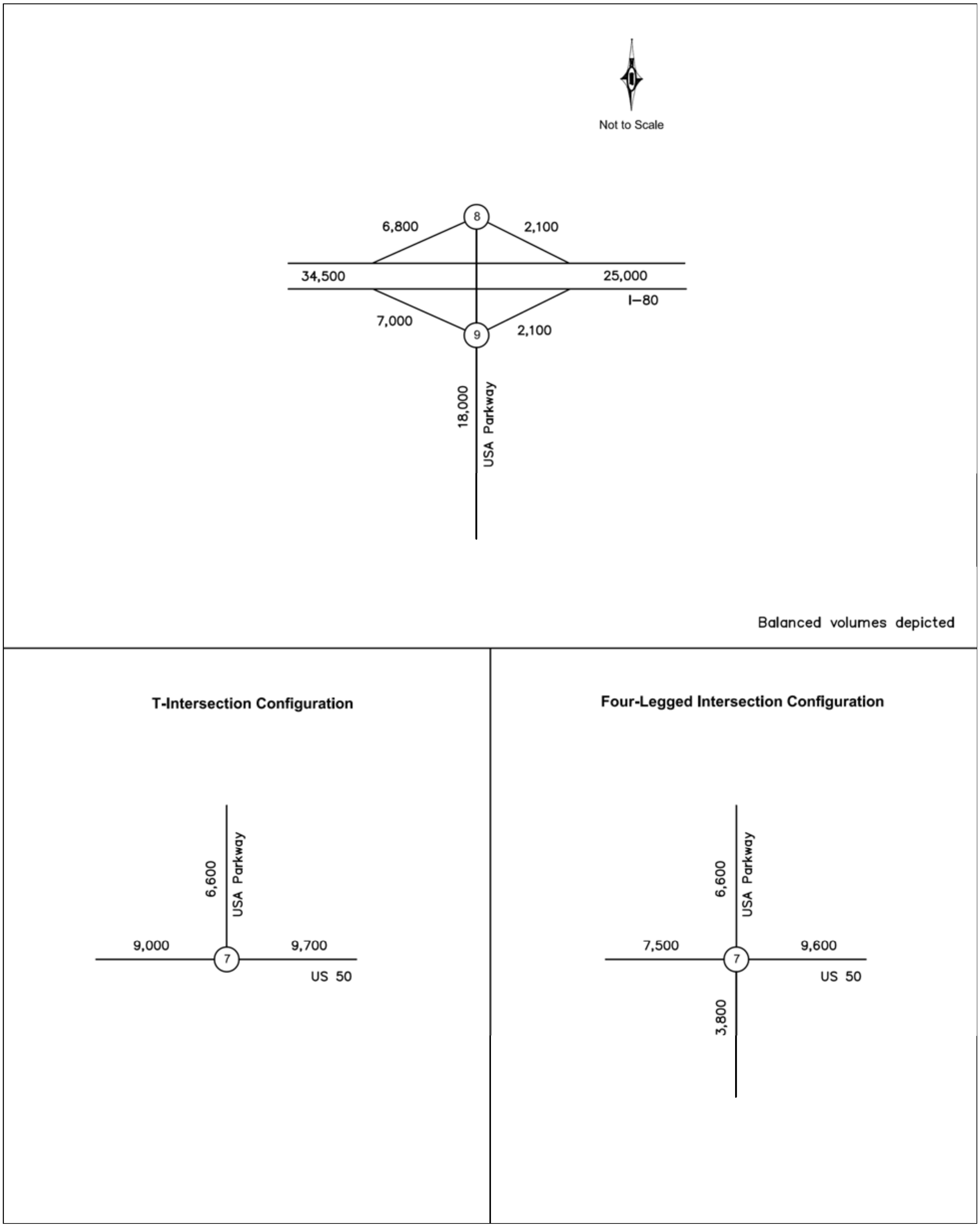


Figure 8-5: Comparison of 2017 AADT Forecasts with Historical Trend Projections

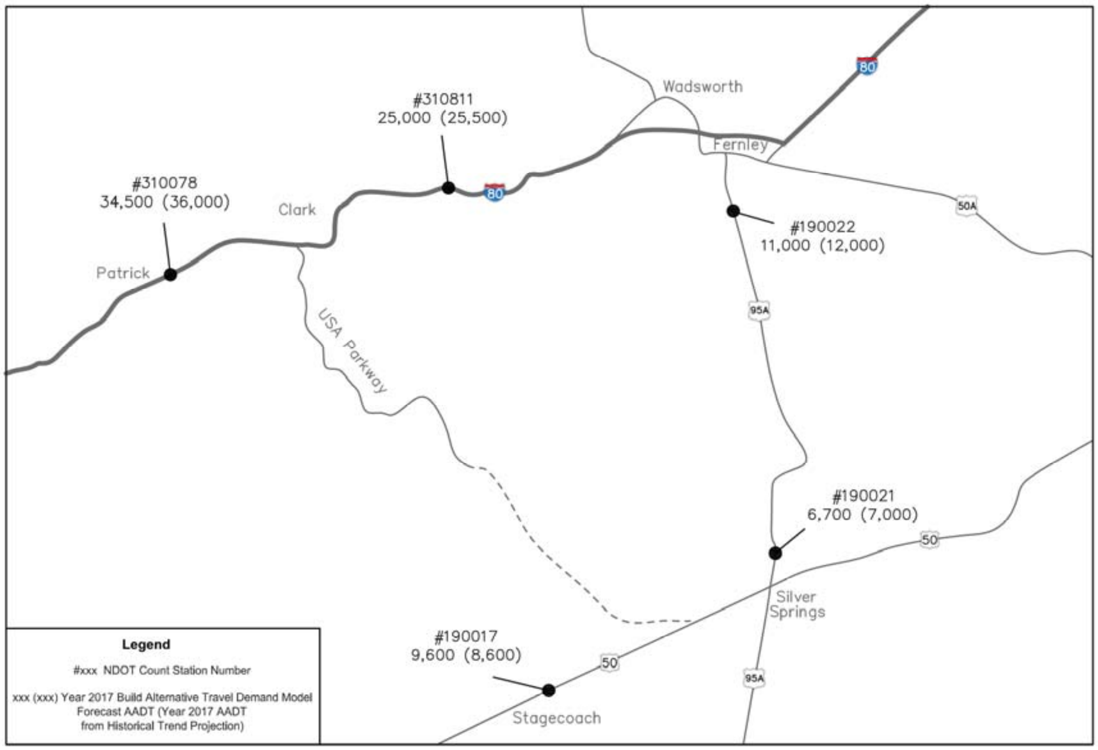


Figure 8-6: Opening Year 2017 No-Action AM/PM Volume Estimates at Study Roadway Segments

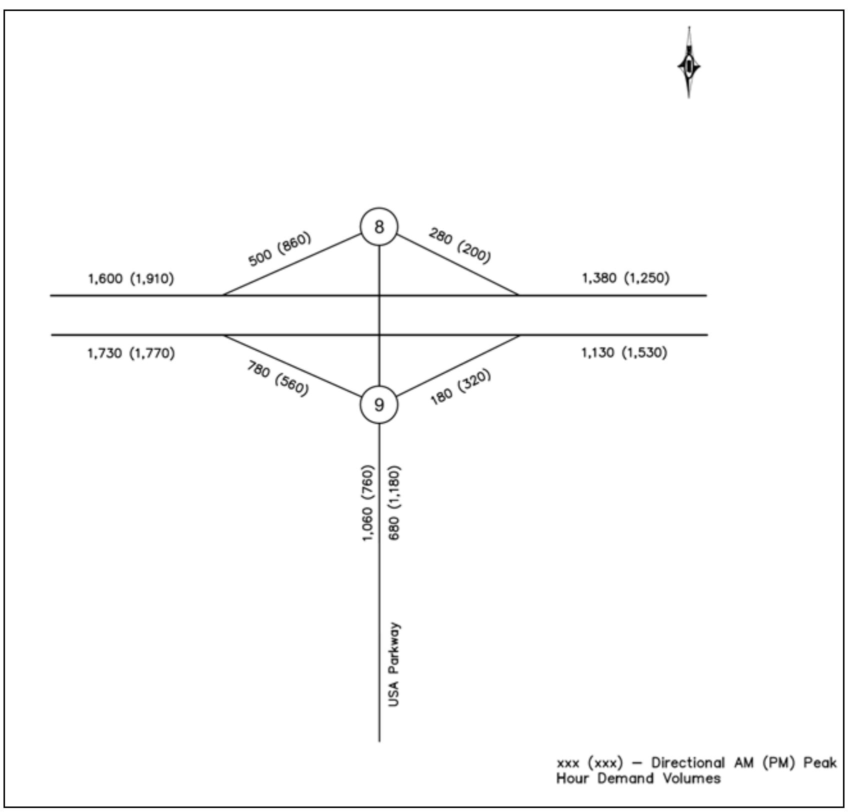


Figure 8-7: Opening Year 2017 Build AM/PM Volume Estimates at Study Roadway Segments

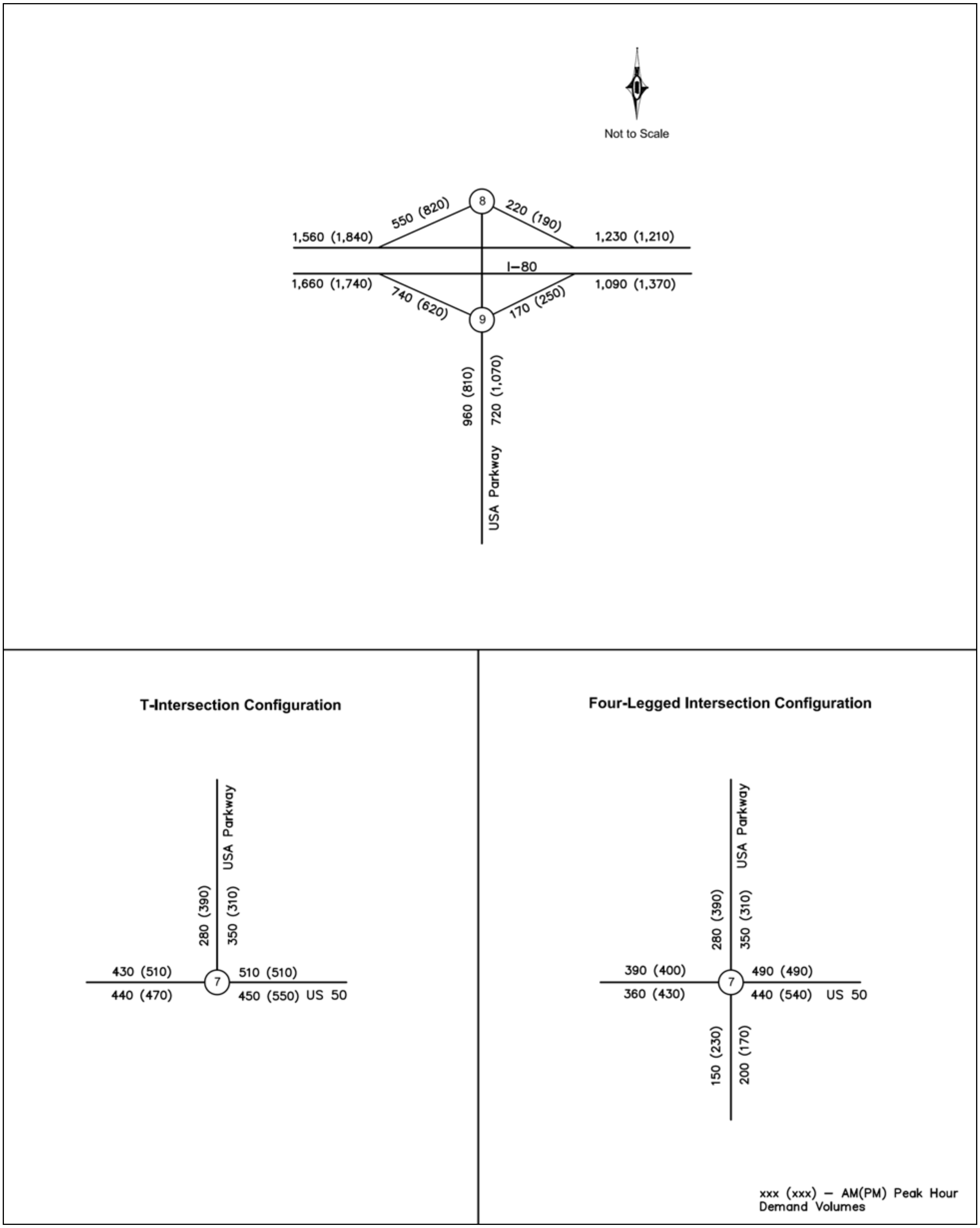


Figure 8-8: Opening Year 2017 No-Action AM/PM Turning Movement Volumes at Study Intersections

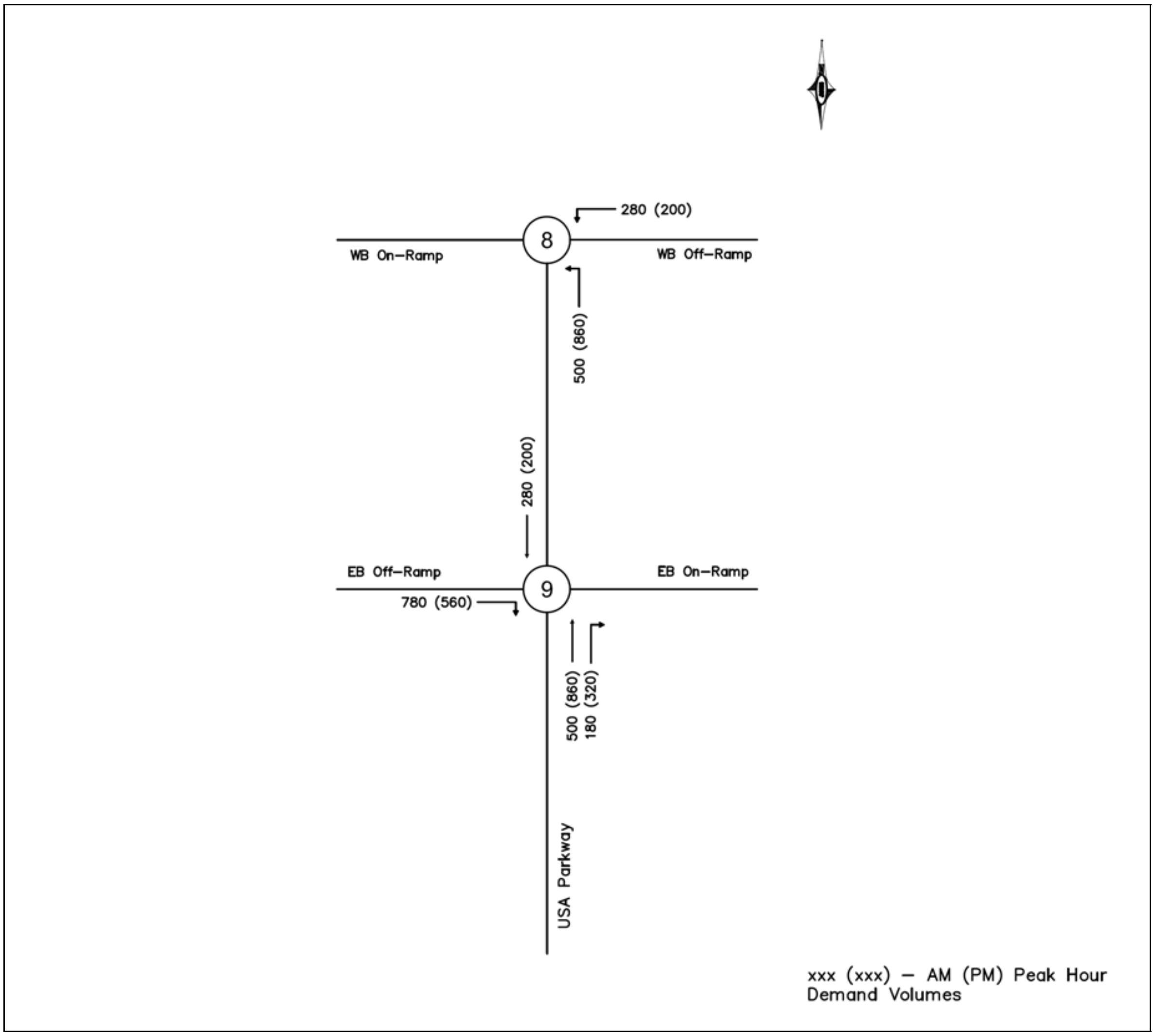
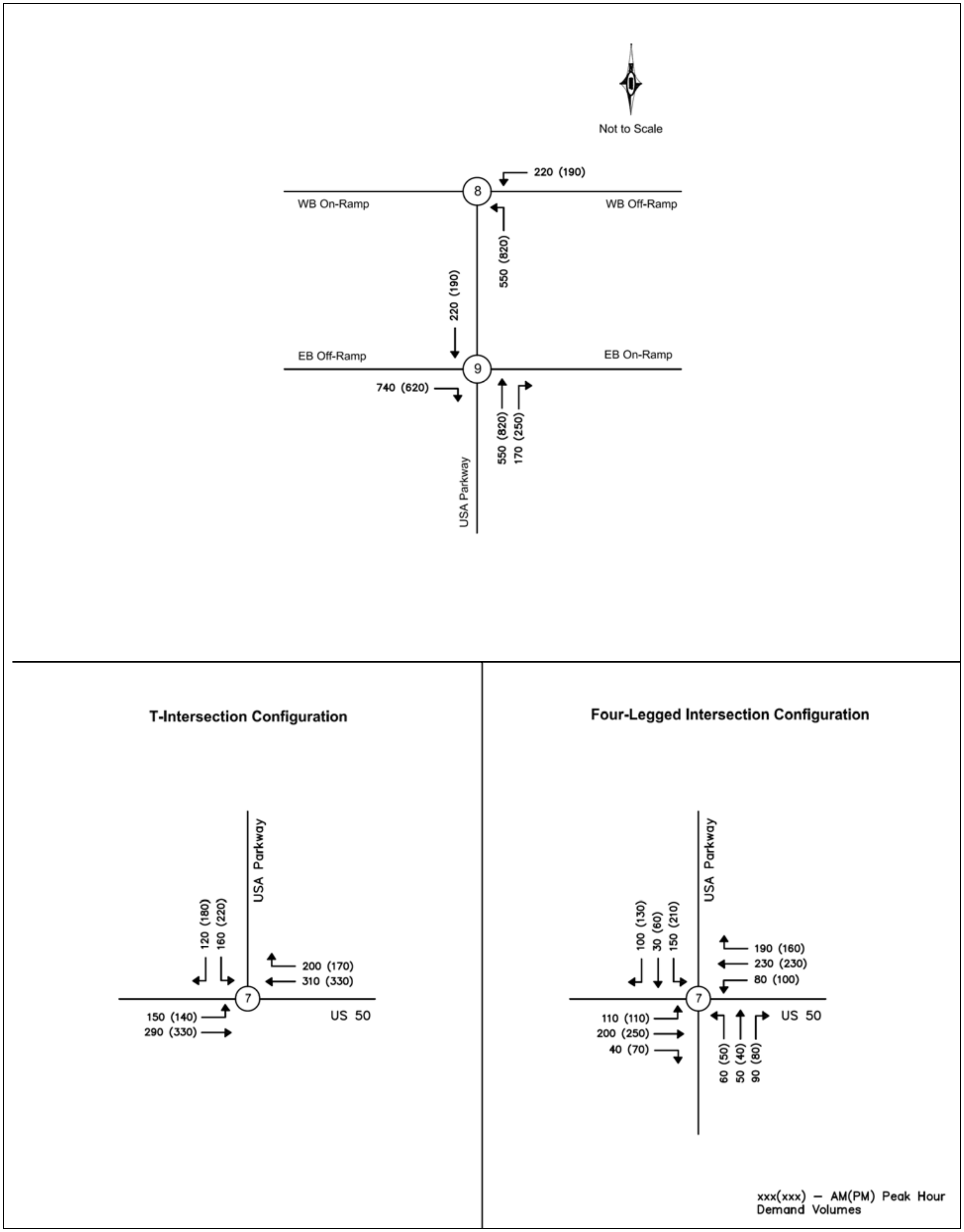


Figure 8-9: Opening Year 2017 Build AM/PM Turning Movement Volumes at Study Intersections



Based on the daily truck percentages provided in Section 4-1 (Truck Traffic) and the forecast AADT, the truck AADTs for the opening year 2017 is shown in Table 8-1.

Table 8-1: Opening Year 2017 Build Truck AADTs at Study Roadway Segments

Location	Year 2017 Build Total AADT	Year 2017 Build Truck AADT
I-80 West of USA Parkway Interchange	34,500	7,800
E/B off-ramp at USA Parkway Interchange	7,000	1,600
E/B on-ramp at USA Parkway Interchange	2,100	500
W/B off-ramp at USA Parkway Interchange	2,100	500
W/B on-ramp at USA Parkway Interchange	6,800	1,500
I-80 East of USA Parkway Interchange	25,000	6,000
USA Parkway North Segment	18,000	4,300
USA Parkway Mid Segment	6,600	1,600
USA Parkway South Segment	6,600	1,600
USA Parkway South of US50 (Ramsey Cutoff)	3,800	900
US 50 west of USA Parkway - Four-legged intersection configuration	7,500	950
US 50 east of USA Parkway - Four-legged intersection configuration	9,600	1,200
US 50 west of USA Parkway - T-intersection configuration	9,000	1,200
US 50 east of USA Parkway - T-intersection configuration	9,700	1,200

9. CONCLUSION

The travel demand forecasts documented in this memorandum are developed from the travel demand model developed specifically for the USA Parkway EA. The raw model volumes were post-processed using nationally accepted practices including ones explained in the NCHRP Report 255, to produce travel demand forecasts for the USA Parkway EA. These travel demand forecasts documented in this memorandum are reasonable; and recommended for use in traffic operations analysis for the USA Parkway EA.

APPENDIX B
USA Parkway Traffic Operations Analysis Memorandum

USA Parkway
SR 439

Traffic Operations Analysis Memorandum

August 2012

PROFESSIONAL ENGINEER—STATE OF NEVADA
JOHN S G KARACHEPONE
Exp: 06/30/13
CIVIL
No. 18112

08/28/2012

JACOBS

319 E. Warm Springs Road
Suite 200
Las Vegas, Nevada 89119
Phone: (702) 938-5400

Technical Memorandum

TO:	Hoang Hong, NDOT	**DATE:**	August 28, 2012
FROM:	John Karachepone, Jacobs		
SUBJECT:	USA Parkway – Traffic Operations Analysis		
COPIES:	Pedro Rodriguez, NDOT; Bryan Gant, Jacobs; Randy Travis, NDOT		

1. INTRODUCTION AND BACKGROUND

USA Parkway (SR 439) is a minor rural arterial that begins at I-80 about 10 miles east of Reno, Nevada, at the USA Parkway Interchange. Currently, approximately six miles of the USA Parkway alignment within Storey County has been paved and the remaining is graded to the Lyon County line. The paved section is a four-lane divided arterial with open median and limited shoulders. Extension of USA Parkway southeast from Storey County into Lyon County to tie into US 50 in Silver Springs is proposed.

USA Parkway has been envisioned as an important link between US 50 and I-80. Currently, US 395 through Carson City, SR 341 through Virginia City and US 95A through Fernley are used to connect the Reno metro area with points south and east. A complete USA Parkway between US 50 and I-80 will improve that connectivity. In addition, the development of the Tahoe-Reno Industrial Center (TRIC) along USA Parkway continues to change the employment and transportation character of the region. The TRIC is planned to become a large industrial park. Figure 1-1 illustrates the proposed project in relation to surrounding roadways and land use.

Figure 1-2 shows the general traffic study area within the regional context. This is the project traffic influence area; specifically the area bounded by I-80 to the north, US 50 to the south, US 95A to the east and USA Parkway to the west.

Jacobs is retained by the Nevada Department of Transportation (NDOT) to provide environmental and preliminary engineering services for the proposed USA Parkway project. At the present time, it appears that an Environmental Assessment (EA) will be the appropriate class of action for National Environmental Policy Act (NEPA) conformance. The lead agency is the Federal Highway Administration (FHWA) with joint NDOT and Bureau of Land Management (BLM) participation. The anticipated opening year for the proposed project is 2017. The design year is 2037, consistent with NDOT and FHWA's 20-year beyond opening year policy.

As part of the EA, traffic operations analyses were performed to determine required improvements to existing geometry and traffic control, and to evaluate proposed roadway geometry and traffic control for new facilities. The operations analysis will assist in determining the appropriate mobility and safety improvements needed.

Traffic forecasts documented in this memorandum (and used for traffic operations analyses) were developed and presented in the *"USA Parkway Traffic Forecast Memorandum"* dated July 11, 2012. The traffic forecast memorandum was approved by NDOT on August 1, 2012 (see Appendix A). The study area exhibit (Figure 1-1) shows a "Highlands Specific Plan Area" (Highlands) south of the county line along USA Parkway. At the time of the preparation of the

Figure 1-1: Proposed Project

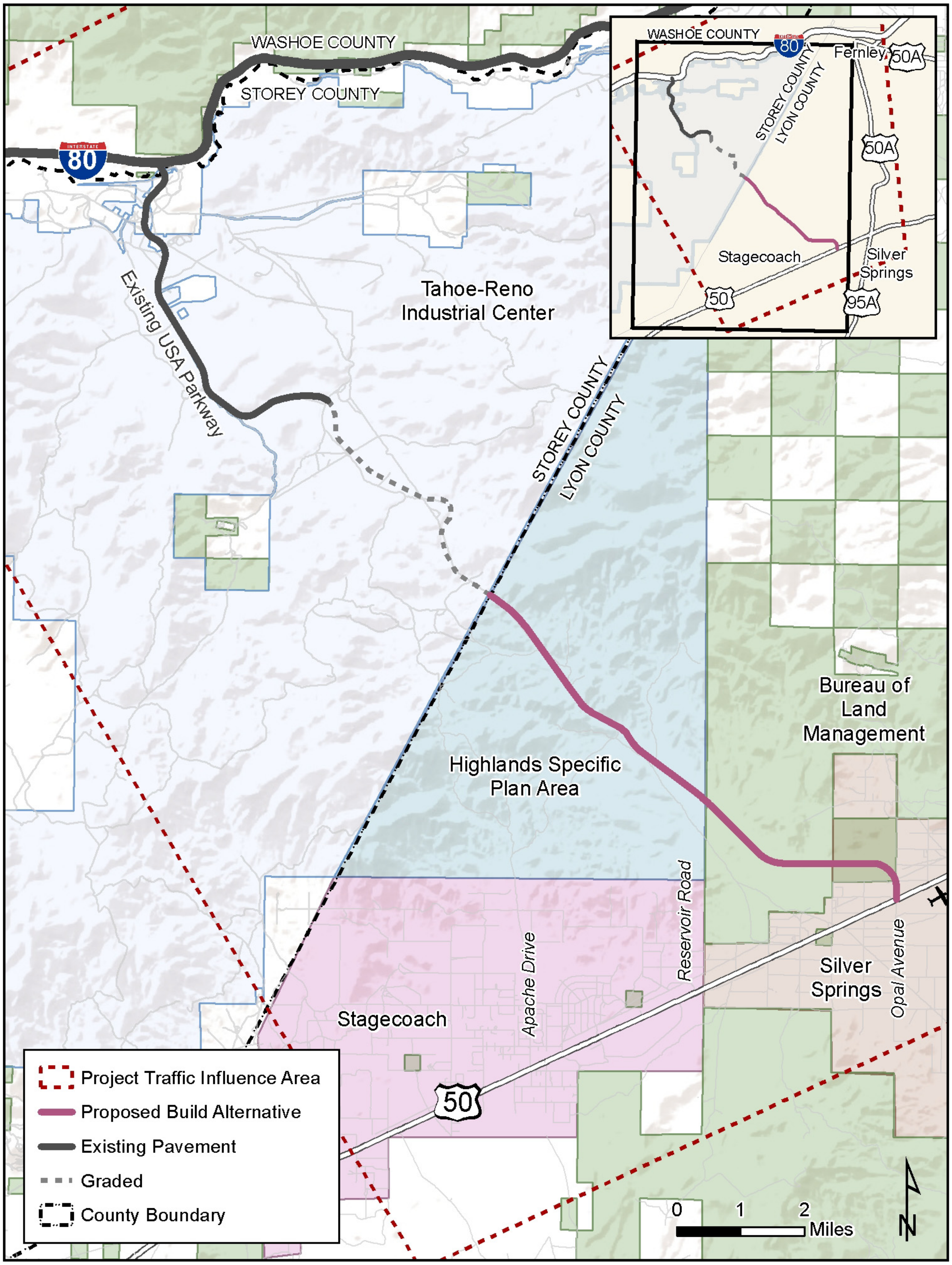
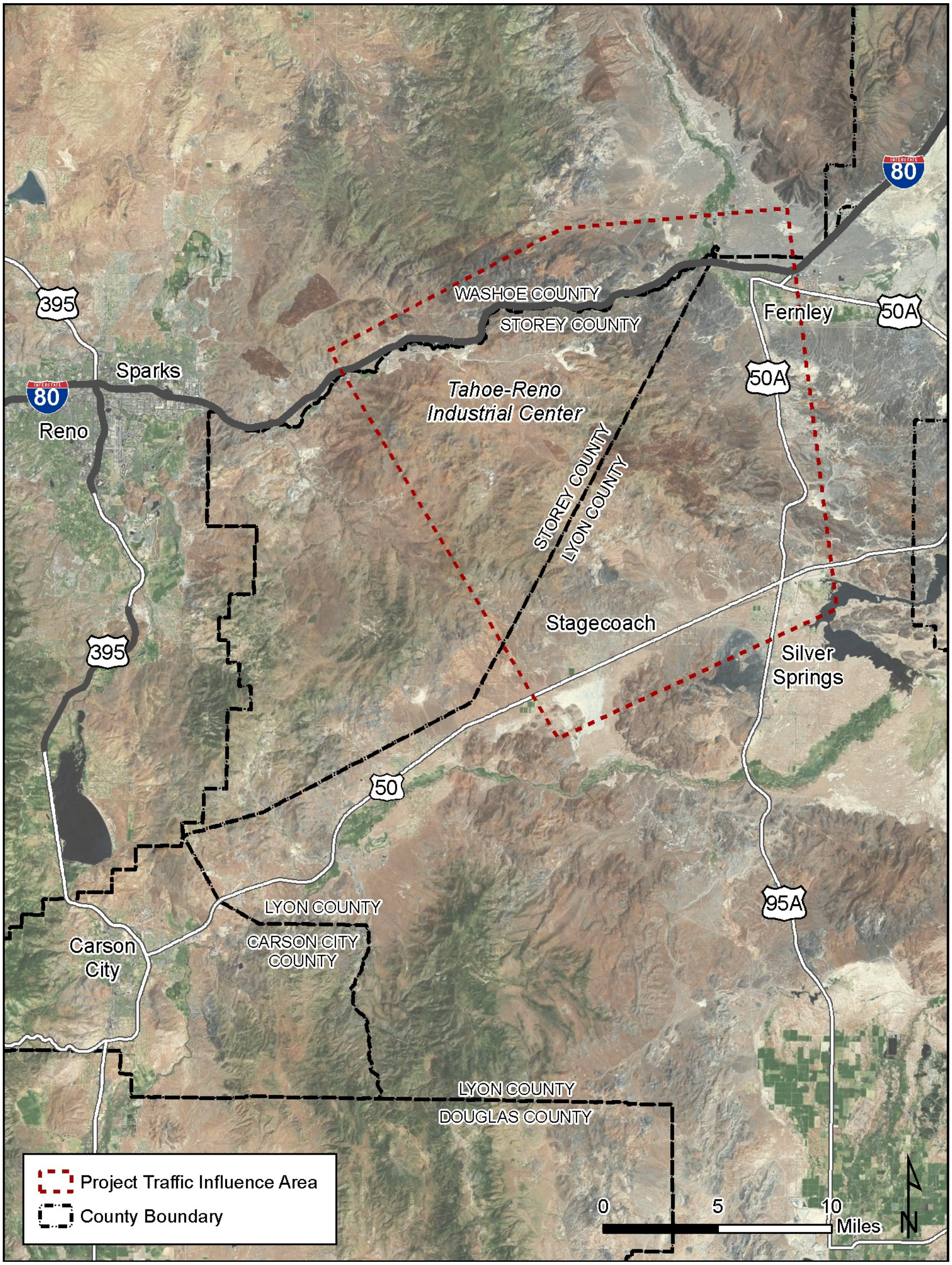


Figure 1-2: General Traffic Study Area



traffic forecasts for USA Parkway EA, it was uncertain if Highlands would be developed. Hence, the project team developed traffic forecasts for two scenarios: "With Highlands" (i.e. Highlands is built) and "No-Highlands" (Highlands does not develop). Subsequently, the No-Highlands scenario was determined to be the most likely scenario of development in the study area by the stakeholders. Furthermore, the Highlands development is not included in future land use plan of Lyon County. Hence, the traffic operations analyses conducted and reported in this traffic operations memorandum corresponds to the forecast volumes for the "No-Highlands" scenario in the *USA Parkway Traffic Forecast Memorandum*.

Methodologies used in this memorandum are consistent with the previously approved "*USA Parkway Traffic Analysis Methodology*" (Methodology Memorandum), dated December 28, 2011 and approved in January 5, 2012 (see Appendix B).

This technical memorandum reports traffic operations analyses for the following:

- Year 2011 Existing Conditions
- Design Year 2037 No-Action Alternative
- Design Year 2037 Build Alternative
- Opening Year 2017 No-Action Alternative
- Opening Year 2017 Build Alternative

The main focus of the traffic operations analysis is the proposed extension of USA Parkway to US 50, as the subject extension is what constitutes the project. However, an analysis of the USA Parkway Interchange with I-80 is also completed to identify potential impacts of the proposed project on this existing interchange. Furthermore, an evaluation of the impacts of USA Parkway on major roadways within the traffic influence area (US 50, US 95A, I-80) is presented.

2. TECHNICAL GUIDANCE AND TRAFFIC ANALYSIS TOOLS

The analyses documented in this memorandum were completed according to the following technical documents and guidelines:

- Highway Capacity Manual (HCM), Transportation Research Board, 2010
- A Policy on Geometric Design of Highways and Streets, AASHTO, 2011
- Manual on Uniform Traffic Control Devices, FHWA, 2009

In addition, the analyses were conducted in accordance to the approved “USA Parkway Traffic Analysis Methodology”, and the “USA Parkway Traffic Forecast Memorandum”.

Highway Capacity Software (HCS) 2010 Version 6.3 was used for the analyses documented in this memorandum.

3. ANALYSIS METHODOLOGY & ASSUMPTIONS

The traffic operations analyses documented in this memorandum were conducted with the following general methodology/assumptions:

- Analysis periods are the AM and PM design hours.
- Peak Hour Factor of 0.90 was used as per the approved *USA Parkway Traffic Analysis Methodology Memorandum*.
- Peak hour truck percentage of 12% was used for I-80 and USA Parkway, peak hour truck percentage of 6% was used for US 50, as per the approved *USA Parkway Traffic Forecast Memorandum*.
- Existing geometry, traffic control and speed limit information was obtained from Google Maps and field visits.
- Free flow speed of “posted speed + 5 mph” was used in the analyses.
- For signalized intersections, yellow time of 4s and all red time of 1s was chosen as clearance times.
- The proposed signalized intersections for the opening year 2017 and design year 2037 were analyzed as actuated intersections. Optimized traffic signal cycle lengths and splits were used. Phasing was based on most reasonable phasing scenario.
- Analysis of intersections was completed using HCS 2010 Version 6.3, following HCM 2010 methodology.
- Analysis of freeway merge and diverge segments was completed using HCS 2010 Version 6.3, following HCM 2010 methodology.

Additional details on the methodology and assumptions are provided in the subsequent chapters of this memorandum.

4. EXISTING CONDITIONS TRAFFIC OPERATIONS ANALYSIS

Existing USA Parkway begins at I-80 about 10 miles east of Reno at the USA Parkway Interchange. Currently, approximately six miles of the USA Parkway alignment within Storey County has been paved and the remaining is graded to the Lyon County line. The paved section is a four-lane divided arterial with open median and limited shoulders.

An existing operations analysis could not be performed for the proposed USA Parkway extension, as it currently does not exist. Existing conditions on the USA Parkway Interchange at I-80 were analyzed. Additionally, existing conditions on the major roadways within the project traffic influence area; specifically I-80 to the north, US 50 to the south, and US 95A to the east; were evaluated. Existing conditions analysis year is year 2011.

Figure 4-1 illustrates the existing conditions on the general project influence area roadway network. Existing number of lanes, NDOT functional classification and existing (year 2011) AADT, level of service (LOS) and volume to capacity ratios (V/C) are shown. LOS for the general project influence area roadway network were estimated (see Appendix C 1) based on generalized daily service volumes guidelines provided in HCM 2010. NDOT's policy LOS for rural roadways is LOS C. The following is a description of the existing conditions on these study area roadways:

- Existing USA Parkway is a four-lane rural minor arterial. LOS is B.
- I-80 within the project influence area is a four-lane rural interstate. I-80 is planned to be widened in the future to six lanes west of USA Parkway. Widening is not planned for I-80 east of the USA Parkway Interchange. LOS is B, both west and east of USA Parkway.
- US 50 within the project influence area is a two-lane rural principal arterial with wide shoulders. In Silver Springs, US 50 intersects with US 95A at a four-way stop controlled intersection. US 50 is planned to be widened in the future to four lanes west of US 95A. Widening is not planned for US 50 east of US 95A. LOS along US 50 is C west of US 95A and B east of US 95A.
- US 95A is a two-lane rural minor arterial between US 50 and I-80; and currently is one of the roads that connect the Reno/Sparks metropolitan area with points south and east. Widening is not planned for US 95A within the study area. LOS is D on US 95A, south of Fernley and C north of Silver Springs.
- Ramsey-Weeks Cut-off is a two-lane rural minor collector that provides diversion for trips between US 50 to the west and US 95A to the south. Widening is not planned for Ramsey-Weeks cut-off. LOS is B.

Analysis of I-80/USA Parkway Interchange: A traffic operations analysis of the existing USA Parkway Interchange with I-80 was completed as detailed in Section 4.1 and Section 4.2. Figure 4-2 shows the year 2011 peak hour traffic volumes used for the existing conditions analysis at I-80/USA Parkway Interchange. Figure 4-3 shows the existing intersection geometry and traffic control. The ramp terminal intersections at this interchange are both currently unsignalized (stop-controlled).

Figure 4-1: Existing Conditions on the General Project Influence Area Roadway Network

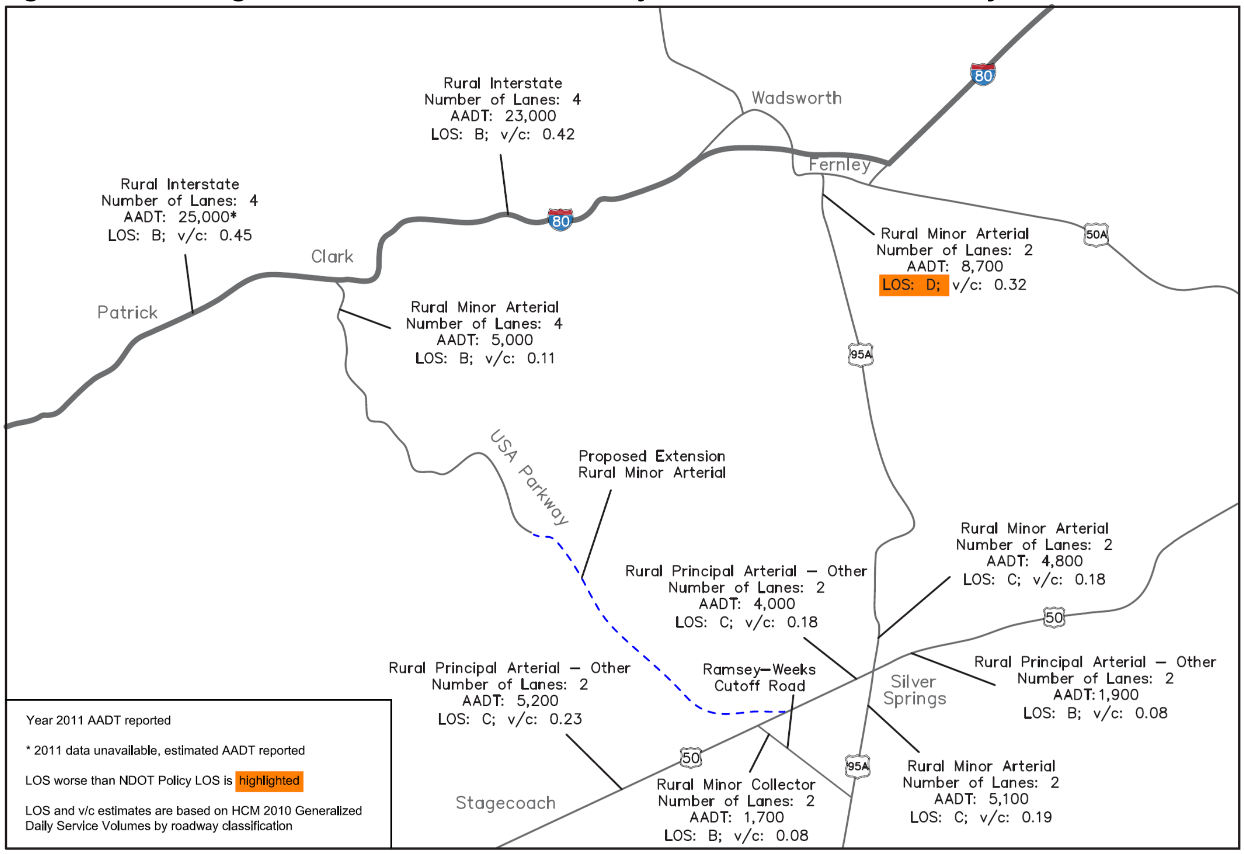


Figure 4-2: Existing Conditions - Year 2011 Peak Hour Volumes

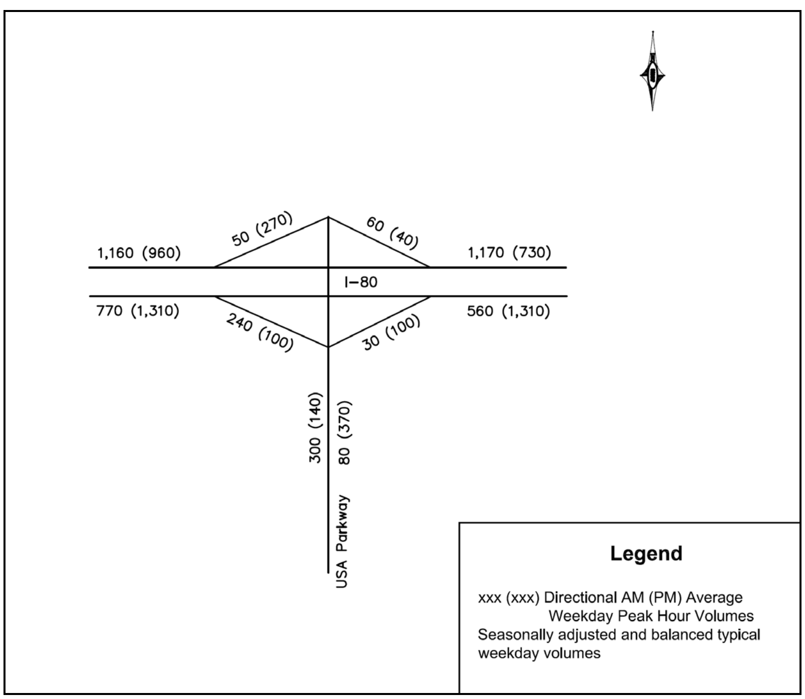
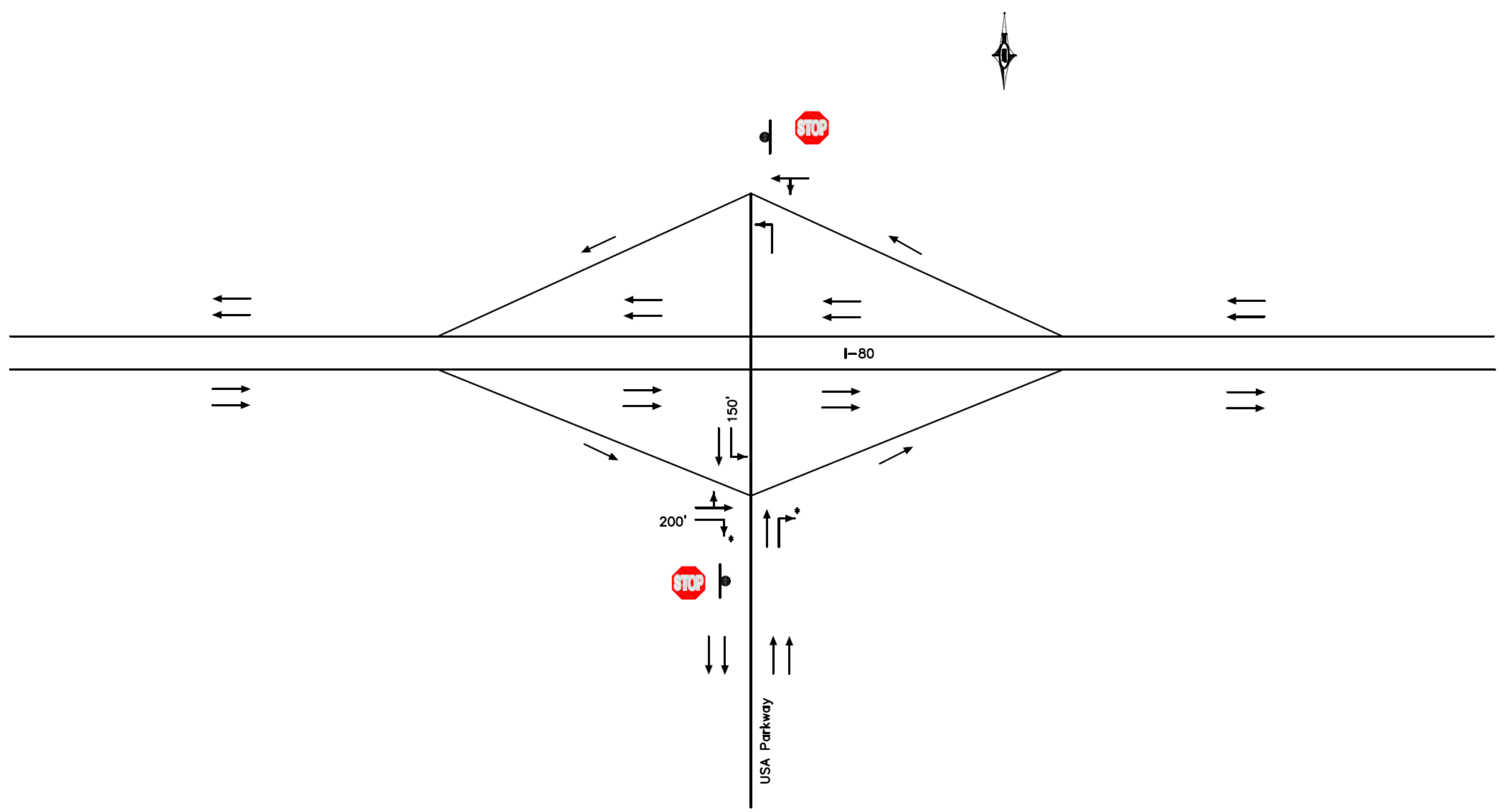


Figure 4-3: Existing Conditions Geometry and Control at the I-80/USA Parkway Interchange



Legend

Stop Sign Intersection

Stop Sign

* Channelized Right Turn (Free)

xxx' - Storage Bay Length

4.1. Intersection Analysis of I-80/USA Parkway Interchange

Analysis of the ramp terminal intersections of I-80/USA Parkway Interchange was completed using HCS 2010 software Version 6.3 following HCM 2010 methodology.

HCM LOS criteria for intersections are shown in Table 4-1.

Table 4-1: HCM LOS Criteria for Intersections

LOS	Control Delay per Vehicle (in seconds)	
	Signalized Intersections	Unsignalized Intersections
A	0-10	0-10
B	>10-20	>10-15
C	>20-35	>15-25
D	>35-55	>25-35
E	>55-80	>35-50
F	>80	>50
Source: Highway Capacity Manual 2010, Transportation Research Board		

The results of the existing conditions intersection traffic operations analysis are shown in Table 4-2. HCS analysis worksheets are provided in Appendix D 1.

Table 4-2: Existing Conditions Intersection Analysis Results

Study Intersection Name and Number	Traffic Control	AM Peak Hour			PM Peak Hour		
		Control Delay (s)	HCM LOS	V/C	Control Delay (s)	HCM LOS	V/C
USA Parkway & WB On-Ramp/WB Off-Ramp	Stop	9.7	A	0.08	16.5	C	0.13
USA Parkway & EB Off-Ramp/EB On-Ramp	Stop	9.6	A	0.01	11.1	B	0.01
The worst movement delay and the corresponding LOS and V/C are reported.							
Source: Jacobs, 2012							

4.2. Freeway Merge and Diverge Analysis of I-80/USA Parkway Interchange

The freeway merge and diverge analysis of I-80/USA Parkway Interchange was completed using HCS 2010 Version 6.3, following HCM 2010 guidelines.

HCM LOS criteria for freeway merge and diverge segments are shown in Table 4-3.

Table 4-3: HCM LOS Criteria for Freeway Merge and Diverge Segments

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	Demand exceeds capacity

Source: Highway Capacity Manual 2010, Transportation Research Board

The results of the existing conditions freeway merge and diverge analysis are shown in Table 4-4. HCS analysis worksheets are provided in Appendix E 1.

Table 4-4: Existing Conditions Merge & Diverge Analysis Results

Ramp Name	AM Peak Hour		PM Peak Hour	
	Density (pc/mi/ln)	HCM LOS	Density (pc/mi/ln)	HCM LOS
I-80 EB Off-Ramp at USA Parkway	10.2	B	16.3	B
I-80 EB On-Ramp at USA Parkway	8.4	A	16.7	B
I-80 WB Off-Ramp at USA Parkway	14.7	B	9.8	A
I-80 WB On-Ramp at USA Parkway	13.7	B	13.8	B

Source: Jacobs, 2012

Analysis results indicate that USA Parkway Interchange at I-80 currently operates satisfactorily as per NDOT's policy LOS.

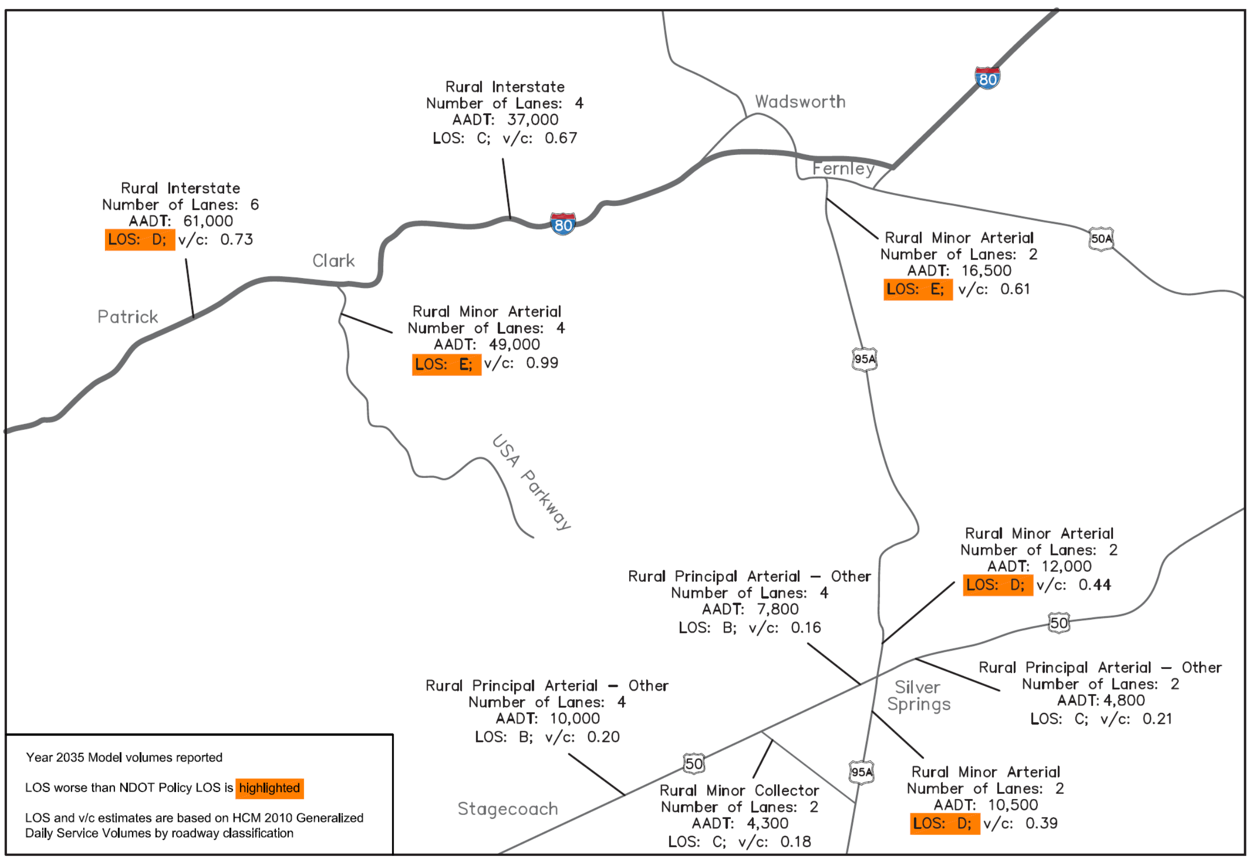
5. DESIGN YEAR 2037 NO-ACTION ALTERNATIVE ANALYSIS

No-Action alternative represents the future conditions without the proposed project (i.e. no extension of USA Parkway). Typically, a No-Action network is defined to be the existing roadway system, together with committed improvement projects as planned in state, regional and local plans. For the USA Parkway EA, the design year 2037 No-Action network is same as existing roadway network, as there are no planned/programmed new roads. However, the following two improvements are planned:

- I-80 is planned to be widened to a six-lane section west of USA Parkway.
- US 50 is planned to be widened to a four-lane section west of US 95A.

Figure 5-1 illustrates the conditions on the general project influence area roadway network for the No-Action alternative. Future number of lanes, NDOT functional classification, future year AADT, LOS and V/C are shown. LOS for the general project influence area roadway network were estimated (see Appendix C 2) based on generalized daily service volumes guidelines provided in HCM 2010. NDOT's policy LOS for rural roadways is LOS C; hence, LOS worse than C are highlighted.

Figure 5-1: No-Action Alternative - Conditions on the General Project Influence Area Roadway Network



Without the proposed project, LOS substantially degrades compared to the existing conditions. The TRIC development is expected to attract a significant number of vehicles to the overall road network in the study area and the impact due to these additional vehicles are clearly seen in Figure 5-1. In the No-Action alternative, the absence of the proposed project leads to a deterioration in the performance of the area roadways. The following is a description of the conditions on the project influence area roadways for the No-Action alternative:

- A significant deterioration in the LOS along USA Parkway near the I-80 interchange is anticipated; this is attributable to the large increase in traffic along this segment due to the expected growth of TRIC. LOS is anticipated to be E, very close to F.
- Along I-80 west of USA Parkway, road improvements are planned and I-80 is planned to be widened to six lanes, whereas no improvements are planned for I-80 east of USA Parkway. Despite the planned improvement on I-80, LOS is anticipated to be D, west of USA Parkway due to the increase in traffic. On I-80 east of USA Parkway, LOS is anticipated to be C, approaching D.
- Along US 50 west of US 95A, LOS is anticipated to be B. On US 50 east of US 95A, LOS is anticipated to be C.
- No improvements are planned along US 95A; the LOS is anticipated to degrade to LOS E on US 95A south of Fernley and LOS D north and south of Silver Springs.
- Ramsey-Weeks Cut-off is anticipated to operate at LOS C.

In the No-Action alternative, USA Parkway is not extended, and hence I-80 and US 50 are not connected. There are no major north-south routes for approximately 30 miles between US 395, which connects the City of Reno to Carson City, and US 95A, which connects the communities of Fernley, Silver Springs, and Yerington. The lack of north-south routes connecting I-80 and US 50 results in out-of-direction travel for trips between the US 50 corridor communities (Stage Coach and Silver Springs) and major job centers in the cities of Reno and Sparks and TRIC. Vehicles travelling to TRIC from the southern region of the study area are forced to travel east along US 50, north along US 95A and west along I-80 to reach the TRIC. This is reflected by the deterioration in LOS along these road segments. Table 5-1 illustrates the additional travel distance and travel time incurred by travelers between select origin-destination pairs if USA Parkway does not get extended to US 50. From Table 5-1 it can be seen that the presence of USA Parkway would greatly reduce the travel distance for travelers in the region.

Table 5-1: Comparison of Travel Distances and Travel Times between Select Origin-Destination Pairs - No-Action Alternative vs. Build Alternative

Origin-Destination	Travel Distance No-Action Alternative (miles)	Travel Distance Build Alternative (miles)	Percent Reduction in Travel Distance	Travel Time No-Action Alternative (minutes)	Travel Time Build Alternative (minutes)	Percent Reduction in Travel Time
Silver Springs to Reno	49	42	14%	45	42	7%
Silver Springs to TRIC	32	19	41%	32	20	38%
Stagecoach to TRIC	42	23	45%	40	25	38%

The travel time estimates are approximate values based on the travel distance and the posted speed limit, calculated without consideration of the impact of congestion.

Analysis of I-80/USA Parkway Interchange: A traffic operations analysis of the I-80/USA Parkway Interchange was completed for the No-Action alternative as detailed in Section 5.1 and Section 5.2. Figure 5-2 shows the design year 2037 peak hour volumes; and Figure 5-3 shows the design year 2037 turning movement volumes at the I-80/USA Parkway interchange. Figure 5-4 shows the year 2037 No-Action alternative intersection geometry and traffic control at the I-80/USA Parkway interchange.

Figure 5-2: No-Action Alternative – Year 2037 Peak Hour Volumes

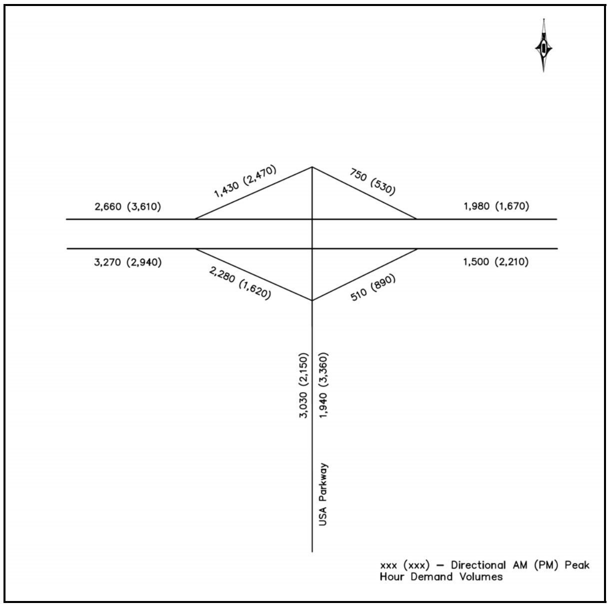


Figure 5-3: No-Action Alternative – Year 2037 Turning Movement Volumes

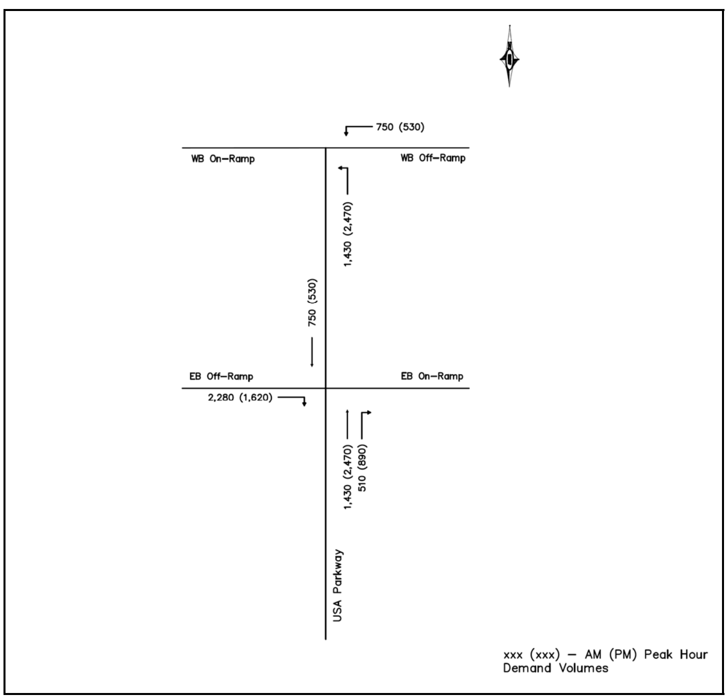
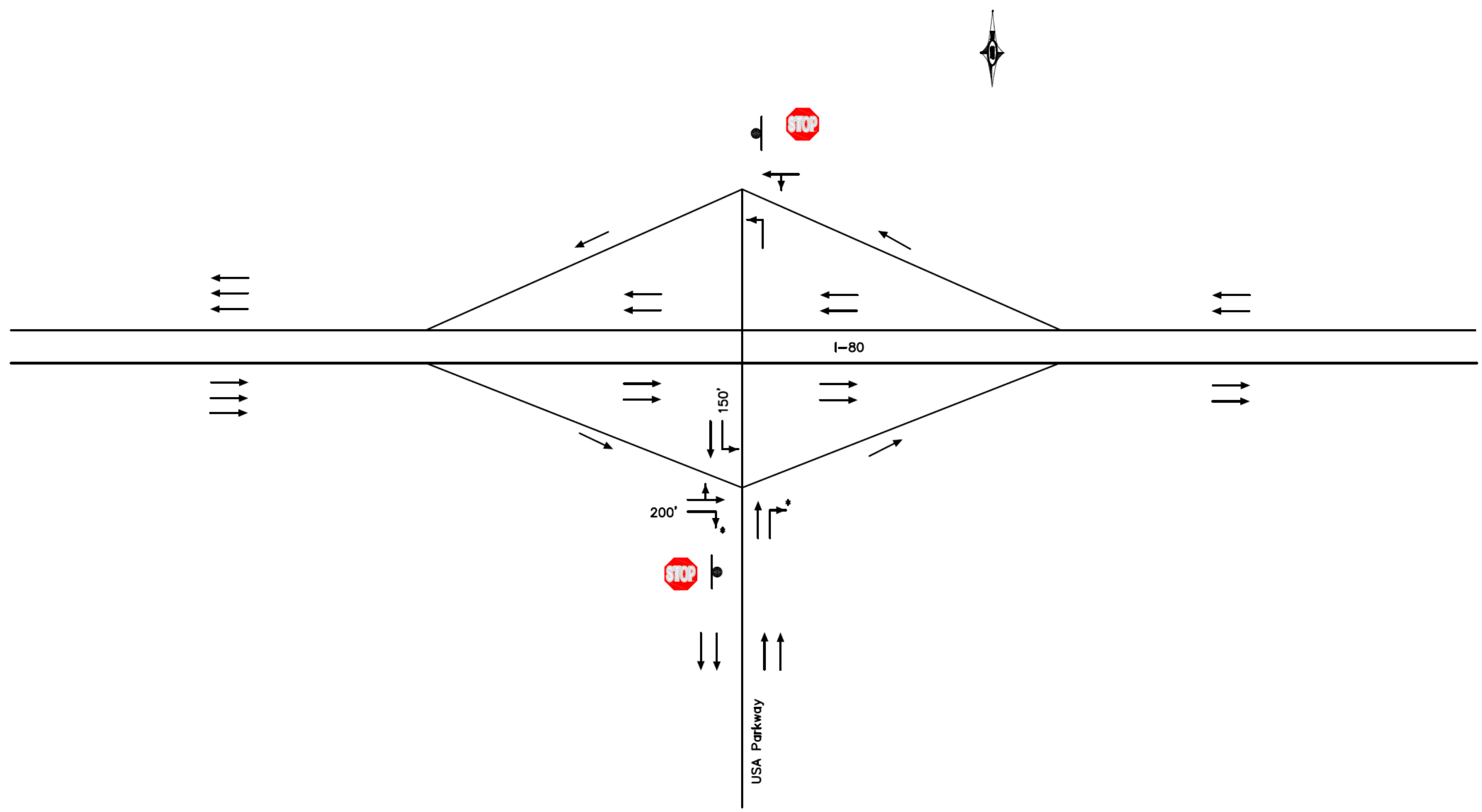


Figure 5-4: No-Action Alternative Geometry and Control at the I-80/USA Parkway Interchange



Legend

Stop Sign Intersection	Stop Sign	* Channelized Right Turn (Free)	xxx' - Storage Bay Length

5.1. Intersection Analysis of I-80/USA Parkway Interchange

Analysis of the ramp terminal intersections of I-80/USA Parkway Interchange was completed using HCS 2010 Version 6.3 software following HCM 2010 methodology. The results of the intersection traffic operations analysis are shown in Table 5-2. HCS analysis worksheets are provided in Appendix D 2.

Table 5-2: Year 2037 No-Action Alternative Intersection Analysis Results

Study Intersection Name and Number	Traffic Control	AM Peak Hour			PM Peak Hour		
		Control Delay (s)	HCM LOS	V/C	Control Delay (s)	HCM LOS	V/C
USA Parkway & WB On-Ramp/WB Off-Ramp	Stop	>1,000	F	>1	>1,000	F	>1
USA Parkway & EB Off-Ramp/EB On-Ramp	Stop	137.6	F	0.13	799.1	F	0.57

The worst movement delay and the corresponding LOS and V/C are reported.

Source: Jacobs, 2012

Similar to the anticipated LOS in the general roadway network, the LOS at the study intersections are also anticipated to be worse in the design year 2037. The ramp terminal intersections are anticipated to operate at LOS F during both the AM and PM peak periods in the No-Action alternative.

5.2. Freeway Merge and Diverge Analysis of I-80/USA Parkway Interchange

The freeway merge and diverge analysis of I-80/USA Parkway Interchange was completed using HCS 2010 Version 6.3, following HCM 2010 guidelines. The results of the No-Action alternative freeway merge and diverge analysis are shown in Table 5-3. HCS analysis worksheets are provided in Appendix E 2.

Table 5-3: Year 2037 No-Action Alternative Merge & Diverge Analysis Results

Ramp Name	AM Peak Hour		PM Peak Hour	
	Density (pc/mi/ln)	HCM LOS	Density (pc/mi/ln)	HCM LOS
I-80 EB Off-Ramp at USA Parkway	22.2	F*	17.4	F*
I-80 EB On-Ramp at USA Parkway	22.6	C	33.5	D
I-80 WB Off-Ramp at USA Parkway	23.9	C	20.4	C
I-80 WB On-Ramp at USA Parkway	26.7	C	42.7	F

* As per the HCM 2010 methodology, even though the density in the ramp influence area is less than the LOS F threshold, the demand flow rate on the ramp is greater than the capacity, resulting in LOS F.

Source: Jacobs, 2012

From Table 5-3, it can be seen that the I-80 EB off-ramp is anticipated to operate at LOS F during both the AM and PM peak periods, and I-80 WB on-ramp is anticipated to operate at LOS F during the PM peak period. These are the critical ramps carrying the most traffic during the peak periods. In addition, the I-80 EB on-ramp is anticipated to operate at LOS D. All these ramps are anticipated to operate at an LOS less than the desired operating level.

6. DESIGN YEAR 2037 BUILD ALTERNATIVE ANALYSIS

Build alternative represents the future conditions with the proposed project (extension of USA Parkway to US 50). The Build alternative also includes the planned improvements previously listed under the No-Action alternative to the general road network in the study area.

A brief description of the design year 2037 Build alternative is as follows:

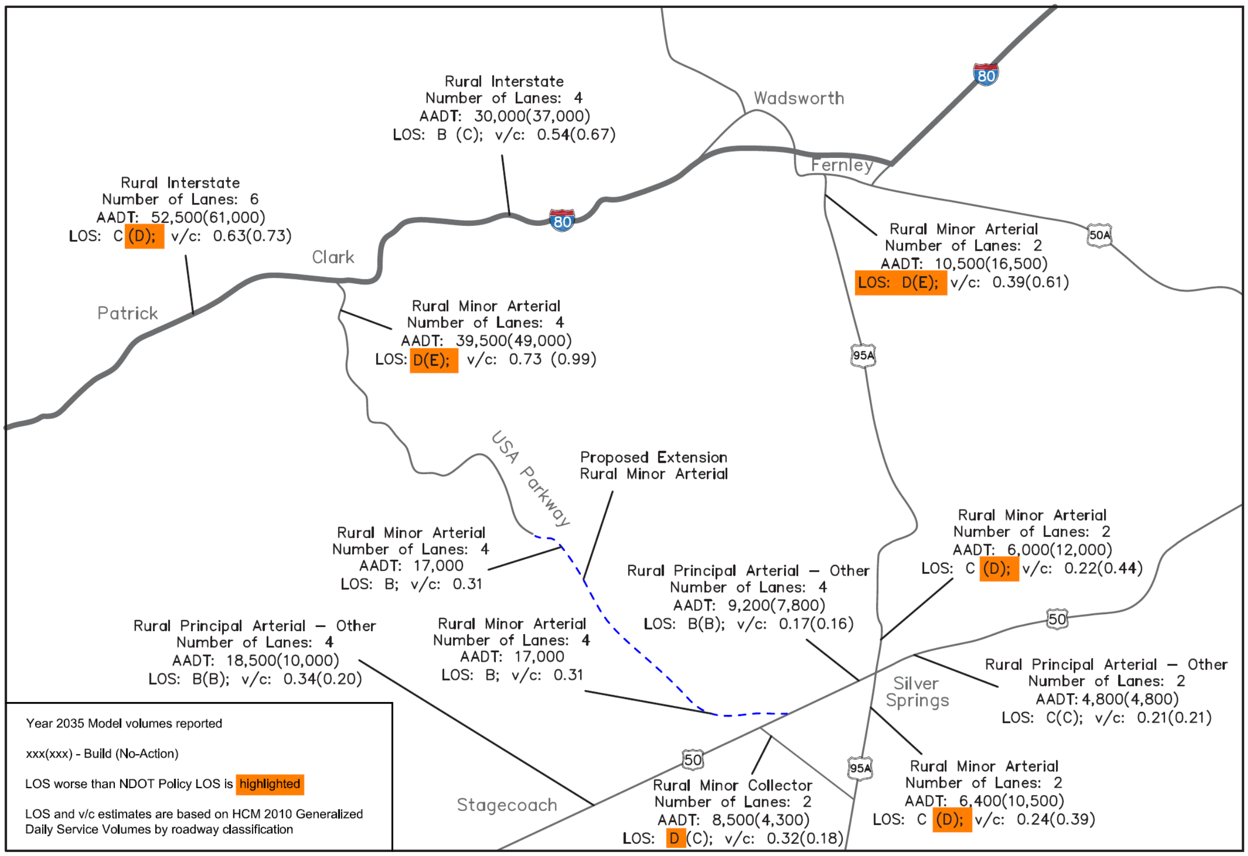
- Extension of the USA Parkway, southeast from Storey County into Lyon County to tie into US 50 in Silver Springs.
- I-80 is planned to be widened to a six-lane section west of USA Parkway.
- US 50 is planned to be widened to a four-lane section west of US 95A.

Figure 6-1 illustrates the conditions on the general project influence area roadway network for the Build alternative. Future number of lanes, NDOT functional classification, future year AADT, LOS and V/C are shown. LOS for the general project influence area roadway network was estimated (see Appendix C 3) based on generalized daily service volumes guidelines provided in HCM 2010. NDOT's policy LOS for rural roadways is LOS C; hence, LOS worse than C are highlighted.

Compared to the No-Action alternative, in the Build alternative, the roadways in the general study area operate at LOS C or better except for USA Parkway near the I-80/USA Parkway interchange, US 95A south of Fernley and Ramsey-Weeks Cutoff Road, all of which operate at LOS D. The presence of the proposed project in the Build alternative alleviates the problem of congestion on the area roadways. The following is a description of the conditions on the project influence area roadways for the Build alternative:

- USA Parkway near the I-80/USA Parkway interchange is anticipated to operate at an LOS of D in the Build alternative, compared to LOS E of the No-Action alternative. To achieve an LOS of C at this location, USA Parkway would need to be improved to a six-lane arterial (widen from the existing four-lane configuration) would be needed.
- Along I-80 west of USA Parkway, LOS is anticipated to be C and along I-80 east of USA Parkway, LOS is anticipated to be B (an improvement over the No-Action alternative LOS of D and C respectively).
- Along US 50 west of US 95A, LOS is anticipated to be B and along US 50 east of US 95A, LOS is anticipated to be C.
- Along US 95A south of Fernley, LOS is anticipated to be D and along US 95A north of Silver Springs, LOS is anticipated to be C. At both these locations, the LOS is expected to be better than the No-Action alternative. It should be noted that US 95A south of Fernley currently operates at LOS D as shown in Figure 4-1.
- Ramsey-Weeks Cut-off is anticipated to operate at LOS D compared to the LOS of C in the No-Action alternative. This is due to an increase in the number of through vehicles because of the USA Parkway connection between I-80 and US 50.

Figure 6-1: Build Alternative - Conditions on the General Project Influence Area Roadway Network



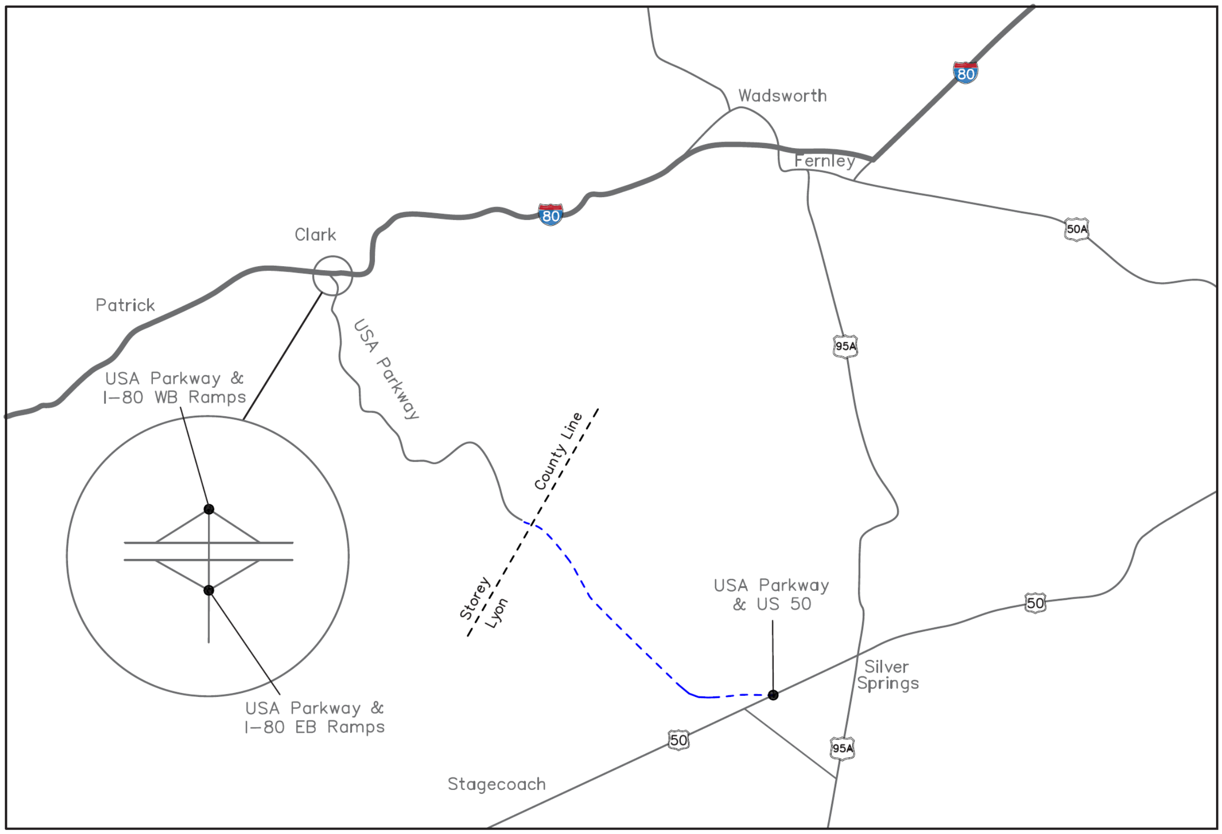
In the Build alternative, USA Parkway connects I-80 and US 50. This enables vehicles travelling to TRIC from the southern region of the study area to use USA Parkway instead of travelling east along US 50, north along US 95A and west along I-80 to reach the TRIC. This is reflected by the comparatively better LOS along these road segments in the Build alternative. Table 5-1 showed the reduction in travel distance and travel time with the Build alternative compared to the No-Action alternative.

The following analyses were completed for the Build alternative:

- Intersection traffic operations analysis of
  - Ramp terminal intersections at the I-80/USA Parkway interchange
  - USA Parkway and US 50 intersection
- Freeway merge and diverge analysis along I-80 for segments near USA Parkway
- Multilane highway analysis of proposed USA Parkway extension

Figure 6-2 shows the study intersections for the intersection analysis of the Build alternative. Figure 6-3 shows the design year 2037 peak hour volumes; and Figure 6-4 shows the design year 2037 turning movement volumes.

Figure 6-2: Study Intersections for Build Alternative Traffic Operations Analysis



As per the approved USA Parkway Traffic Analysis Methodology, LOS thresholds are defined as:

- HCM LOS D or better for the intersection of USA Parkway at US 50. It is noted that LOS C is desired for this intersection.
- LOS C or better at USA Parkway/I-80 Interchange.
- LOS E or better for each movement at intersections.
- Intersection V/C, including each movement, less than 1.0

6.1. Intersection Analysis

Analysis of the signalized intersections was completed using HCS 2010 Version 6.3 software following HCM 2010 methodology. The results of the intersection traffic operations analysis are shown in Table 6-1. The recommended geometry and traffic control to achieve these LOS is shown in Figure 6-5 and Figure 6-6. The proposed geometry and traffic control for new facilities and the proposed improvements to geometry and traffic control for existing facilities are listed in Section 6.4. For signalized intersections, the overall intersection control delay and intersection LOS are reported. HCS analysis worksheets are provided in Appendix D 3.

Figure 6-3: Build Alternative – Year 2037 Peak Hour Volumes

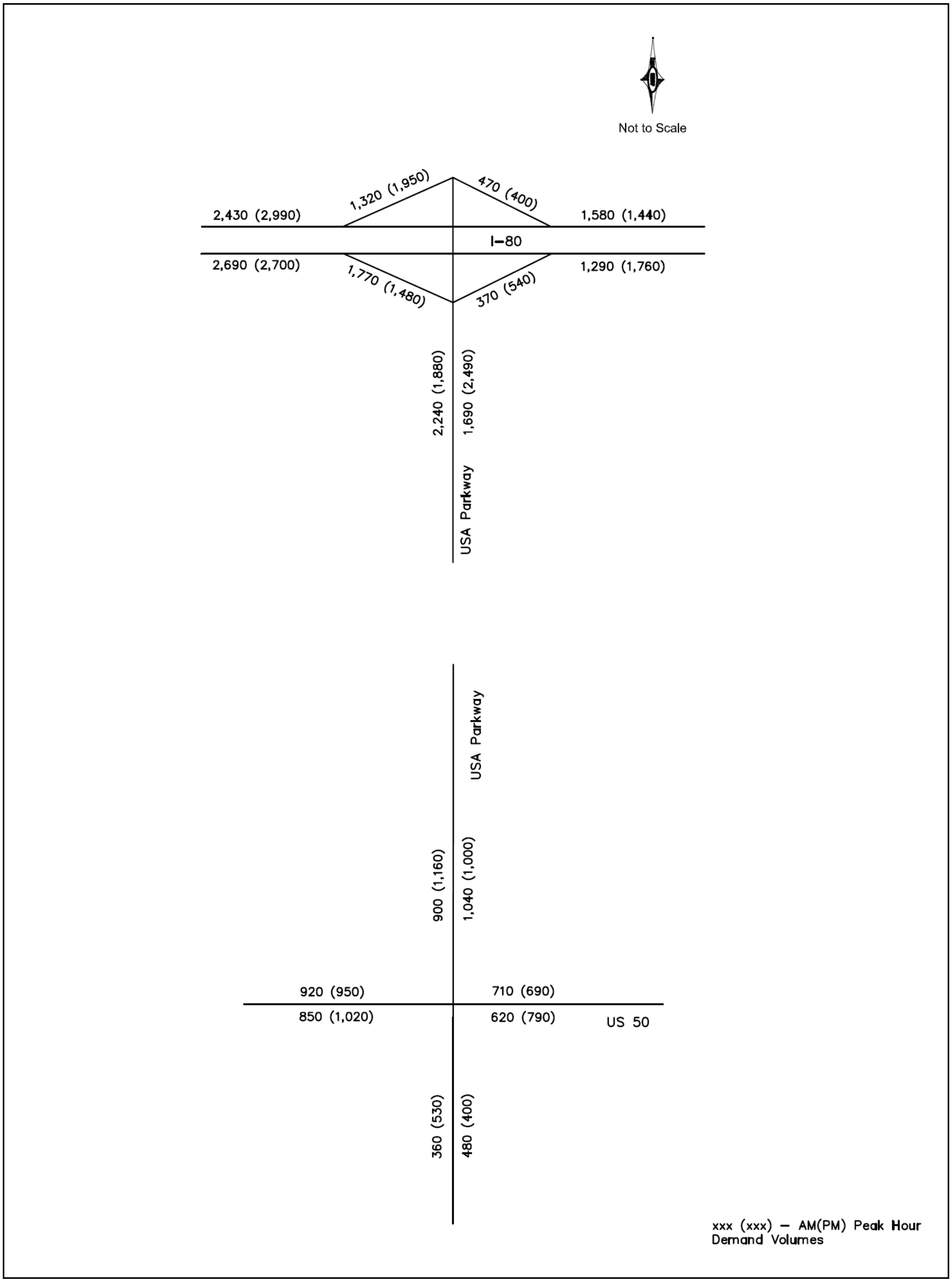


Figure 6-4: Build Alternative – Year 2037 Turning Movement Volumes

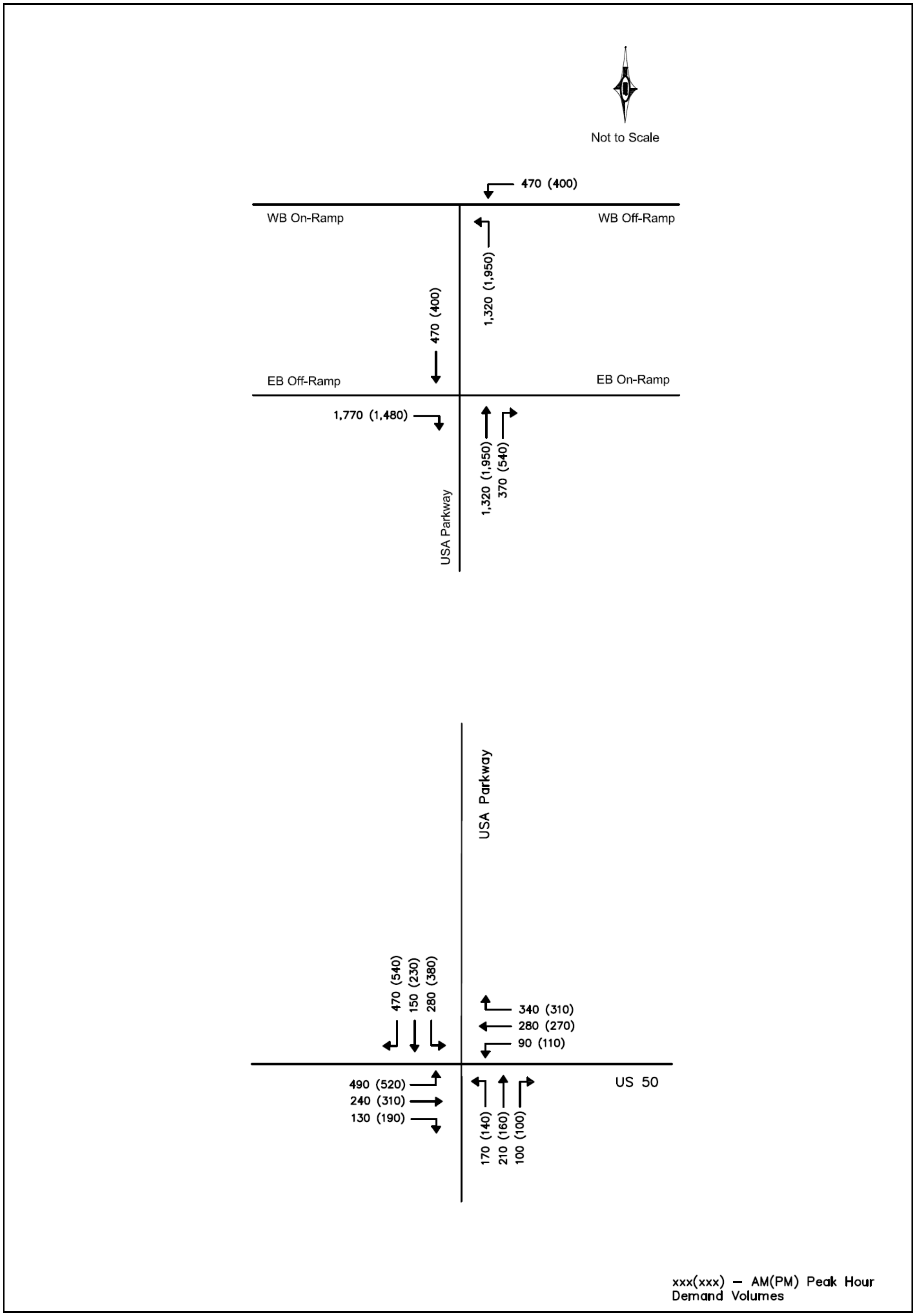
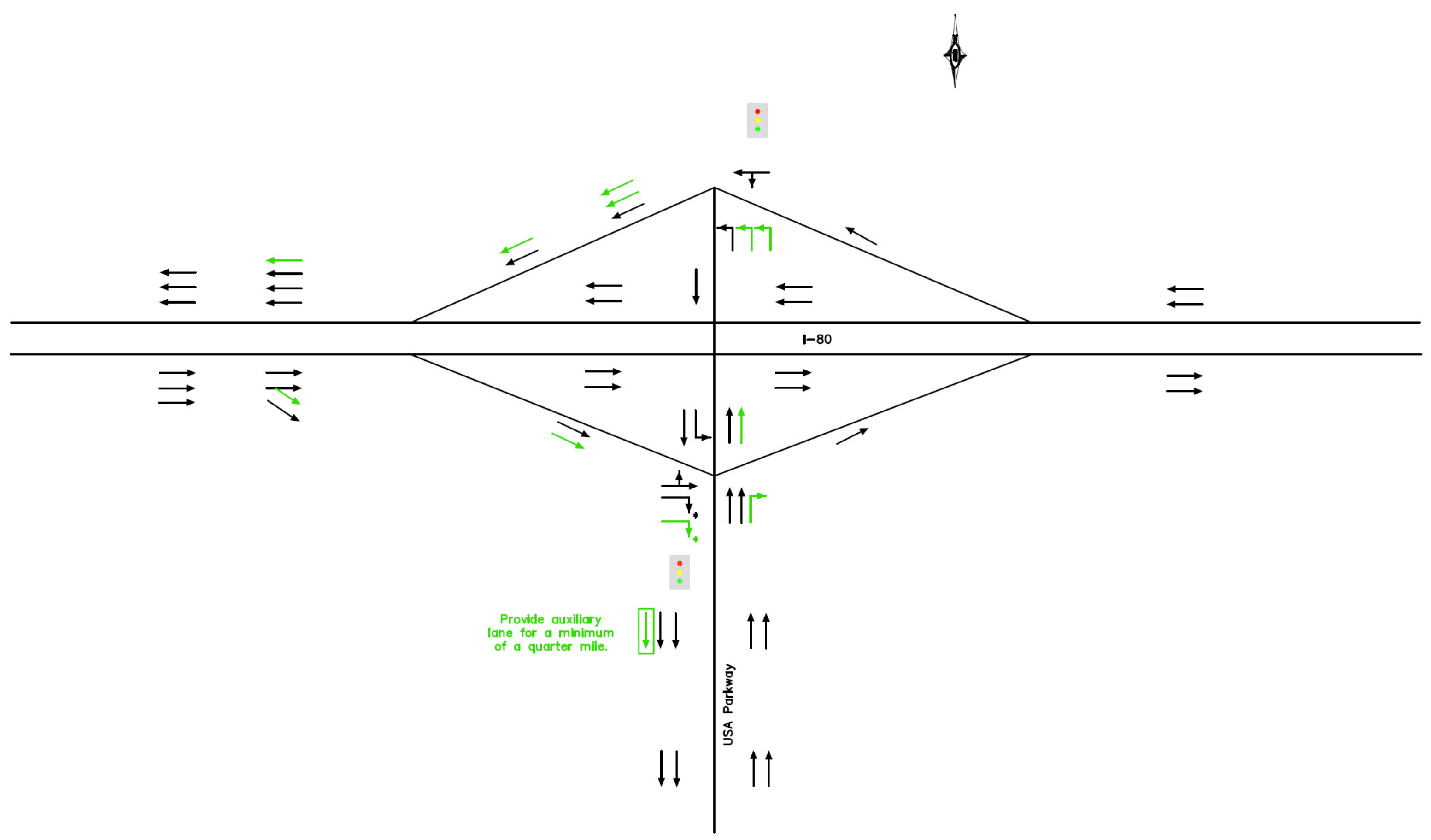


Figure 6-5: Build Alternative Recommended Geometry and Control at the I-80/USA Parkway Interchange



Legend

Signalized Intersection

* Channelized Right Turn (Free)

Proposed changes from existing conditions are shown in green color.

Figure 6-6: Recommended Geometry and Control along USA Parkway and at intersection of USA Parkway/US 50

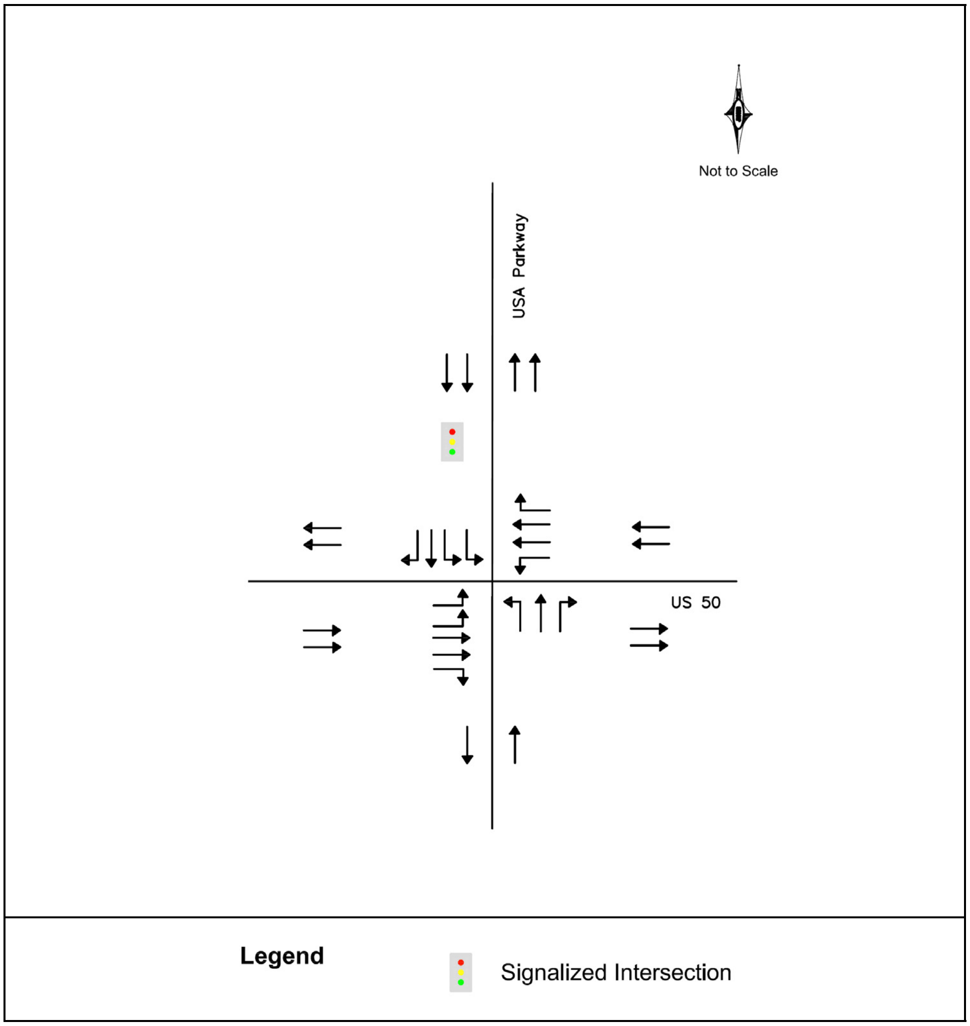


Table 6-1: Year 2037 Build Alternative Intersection Analysis Results

Study Intersection Name and Number	Traffic Control	AM Peak Hour		PM Peak Hour	
		Control Delay (s)	HCM LOS	Control Delay (s)	HCM LOS
USA Parkway & US50	Signal	26.0	C	26.5	C
USA Parkway & WB On-Ramp/WB Off-Ramp	Signal	18.7	B	21.8	C
USA Parkway & EB Off-Ramp/EB On-Ramp	Signal	6.6	A	9.9	A

Control delay and LOS are reported for the overall intersection. HCM 2010 methodology does not provide an overall intersection V/C (HCM critical V/C), hence not reported. It was ensured that V/C for each movement is less than 1.0.

Source: Jacobs, 2012

Ramp terminal intersections of the I-80/USA Parkway interchange: The proposed improvements to geometry at these intersections resulted in an overall intersection LOS equal to or better than LOS C during both the AM and PM peak periods. LOS is E or better for each movement and V/C is less than 1.0.

Intersection of USA Parkway and US 50: The proposed geometry at this intersection resulted in an overall intersection LOS of C during both the AM and PM peak periods. LOS is E or better for each movement and V/C is less than 1.0. The traffic signal phasing and timing at this intersection accommodates anticipated pedestrian activity.

Table 6-2 gives the calculated length of the queues at the study intersections for the Build alternative. These queue lengths should be considered during the design of the storage bays.

Table 6-2: Year 2037 Build Alternative Intersection Queue Lengths

Intersection	Movements with storage bays	Number of lanes	95th Percentile Queue length (ft/ln) from HCS
USA Parkway and US 50	Southbound Left	2	210
	Northbound Right	1	105
	Northbound Left	1	175
	Westbound Right	1	245
	Westbound Left	1	140
	Eastbound Right	1	140
	Eastbound Left	2	245
USA Parkway & WB On-Ramp/WB Off-Ramp	Northbound Left	3	560
USA Parkway & EB Off-Ramp/EB On-Ramp	Southbound Left	1	35
	Northbound Right	1	105
	Eastbound Left/Through	1	35

Deceleration length and taper length should be added to the queue length for storage bay design. NDOT's typical lengths should be provided if the calculated total storage length is less than the typical.

A vehicle length of 35 ft was used to convert the HCS 2010 queue length result (veh/ln) to the reported queue length (ft/ln). 35 feet is higher than the typical lengths used to calculate storage lengths, which are 25 ft and 30 ft, however a higher value was selected due to high truck percentages.

Source: Jacobs, 2012

6.2. Freeway Merge and Diverge Analysis

The freeway merge and diverge analysis was completed using HCS 2010 Version 6.3, following HCM 2010 guidelines. The results of the freeway merge and diverge analysis are shown in Table 6-3. HCS analysis worksheets are provided in Appendix E 3.

From Table 6-3, it can be seen that all the merge and diverge segments operate satisfactorily for the proposed geometry and traffic control.

Table 6-3: Year 2037 Build Alternative Merge & Diverge Analysis Results

Ramp Name	AM Peak Hour		PM Peak Hour	
	Density (pc/mi/ln)	HCM LOS	Density (pc/mi/ln)	HCM LOS
I-80 EB Off-Ramp at USA Parkway	1.9	A	0.1	A
I-80 EB On-Ramp at USA Parkway	19.1	B	25.5	C
I-80 WB Off-Ramp at USA Parkway	19.4	B	17.8	B
I-80 WB On-Ramp at USA Parkway	14.8	B	24.2	C

Source: Jacobs, 2012

6.3. Multilane Highway Analysis

The forecast traffic volume suggests a four-lane arterial for the proposed USA Parkway extension. A multilane highway analysis of the proposed four-lane roadway was completed using HCS 2010 Version 6.3, following HCM 2010 guidelines. HCM LOS criteria for multilane highway analysis are shown in Table 6-4.

Table 6-4: HCM LOS Criteria for Multilane Highways

LOS	FFS (mi/h)	Density (pc/mi/ln)
A	All	>0-11
B	All	>11-18
C	All	>18-26
D	All	>26-35
E	60 55 50 45	>35-40 >35-41 >35-43 >35-45
F	Demand exceeds capacity	
	60 55 50 45	>40 >41 >43 >45

Source: Highway Capacity Manual 2010, Transportation Research Board

The following are the results of this analysis. HCS analysis worksheets are provided in Appendix F 1. The roadway is being designed to 60 mph. The proposed speed limit is 55 mph, therefore a 60 mph free flow speed was assumed for the analysis.

- During the AM analysis period, SB USA Parkway operates at LOS A (density of 9.8 pc/mi/ln) and the NB USA Parkway operates at LOS B (11.4 pc/mi/ln)
- During the PM analysis period, SB USA Parkway operates at LOS B (density of 12.7 pc/mi/ln) and the NB USA Parkway operates at LOS A (10.9 pc/mi/ln)

For the proposed geometry, USA Parkway operates satisfactorily within the desired thresholds of multilane highway operation.

6.4. Proposed Geometry and Improvements

The following is a description of the proposed geometry for new facilities and the proposed improvements to the existing geometry for existing facilities:

Proposed geometry for new facilities:

- Extension of USA Parkway, south through Lyon County is proposed to be completed as a four-lane rural arterial with a posted speed limit of 55mph.
- At the intersection of USA Parkway and US 50, an at-grade signalized intersection with the geometry shown in Figure 6-6 is proposed to be provided to achieve LOS C.

Recommended improvements to the existing geometry for existing facilities:

- EB off-ramp of the I-80/USA Parkway interchange is recommended to be improved to two lanes (widen from the existing one lane configuration).
- WB on-ramp of the I-80/USA Parkway interchange is recommended to be improved to two lanes (widen from the existing one lane configuration). Three receiving lanes need to be provided for the triple left turn lanes from the ramp terminal intersection.
- At the intersection of EB ramps and USA Parkway:
    - An EB free right-turn lane is to be added.
    - The existing NB free right turn-lane is to be converted to a through lane to provide two NB through lanes.
    - A NB right-turn lane is to be added.
- At the intersection of WB ramps and USA Parkway, two NB left turn lanes are proposed to be added to the existing single left-turn lane.

Figure 6-5 showed an illustration of these improvements.

7. OPENING YEAR 2017 NO-ACTION ALTERNATIVE ANALYSIS

A traffic operations analysis of the I-80/USA Parkway Interchange was completed for the year 2017 No-Action alternative as detailed in Section 7.1 and Section 7.2. Figure 7-1 shows the year 2017 peak hour volumes; and Figure 7-2 shows the year 2017 turning movement volumes at the I-80/USA Parkway interchange. The opening year 2017 intersection geometry and traffic control at the I-80/USA Parkway interchange is the same as the existing geometry and traffic control; Figure 4-3 shows this intersection geometry and traffic control.

Figure 7-1: No-Action Alternative – Year 2017 Peak Hour Volumes

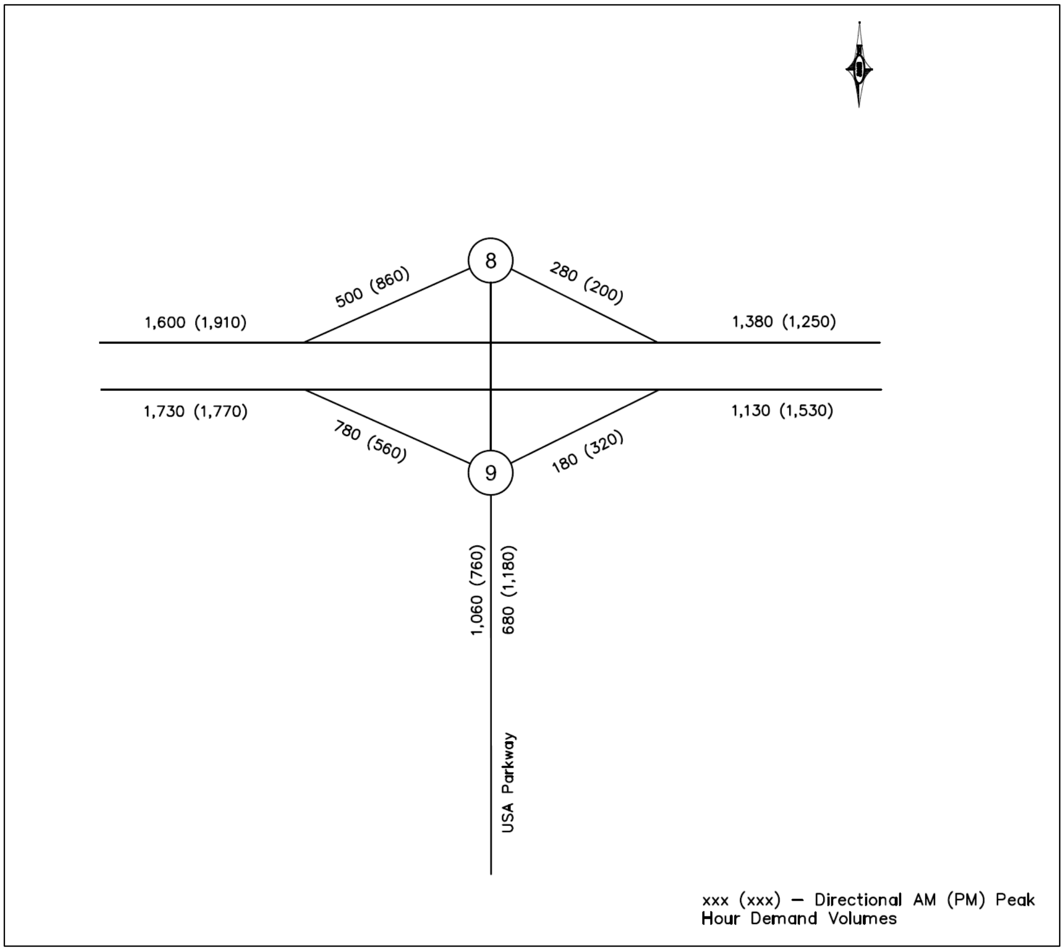
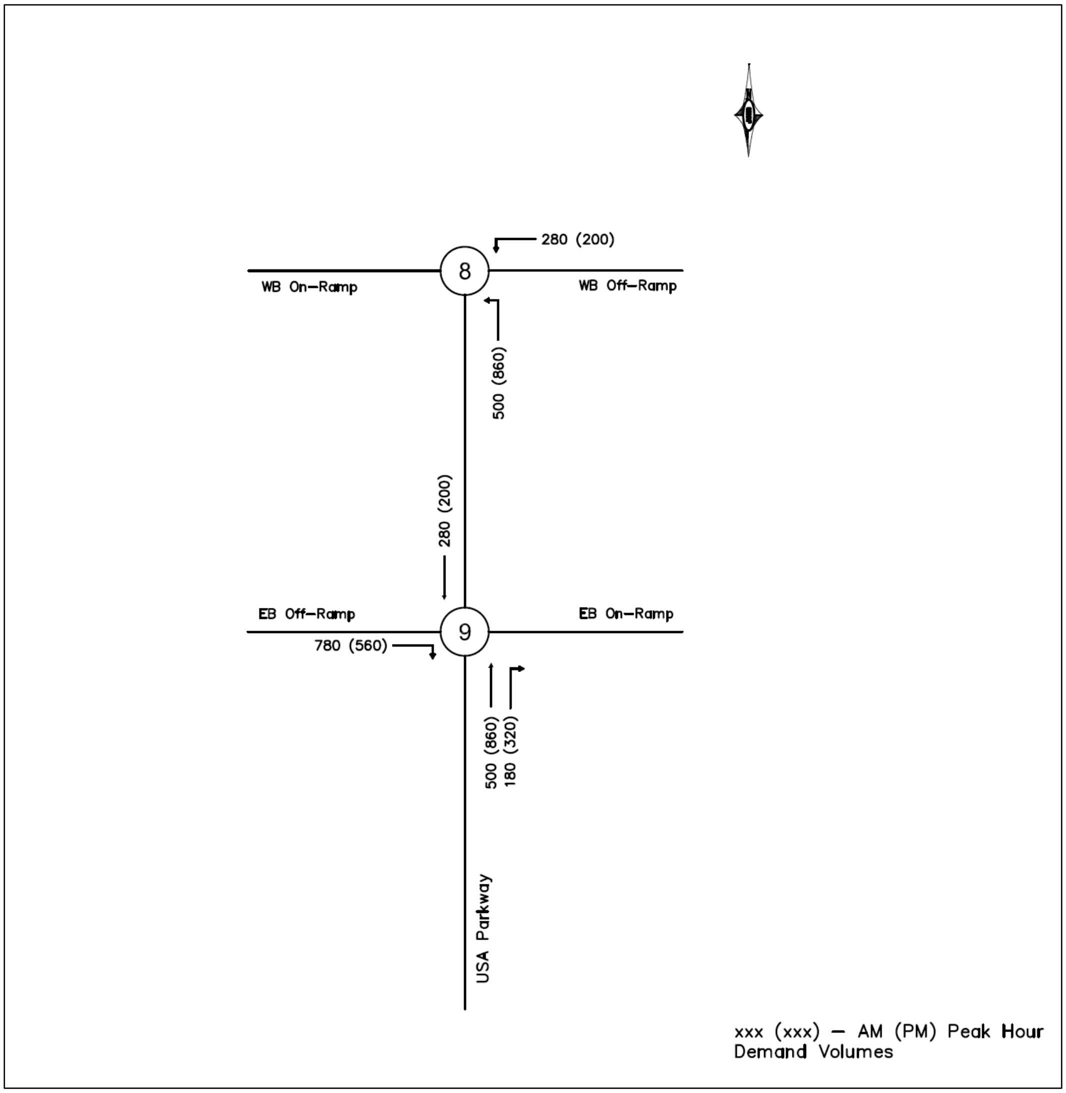


Figure 7-2: No-Action Alternative – Year 2017 Turning Movement Volumes



7.1. Intersection Analysis of I-80/USA Parkway Interchange

Analysis of the ramp terminal intersections of I-80/USA Parkway Interchange was completed using HCS 2010 Version 6.3 software following HCM 2010 methodology. The results of the intersection traffic operations analysis are shown in Table 7-1. HCS analysis worksheets are provided in Appendix D 4. The LOS at the study intersections are anticipated to be worse in the No-Action alternative of the year 2017 compared to existing conditions.

Table 7-1: Year 2017 No-Action Alternative Intersection Analysis Results

Study Intersection Name and Number	Traffic Control	AM Peak Hour			PM Peak Hour		
		Control Delay (s)	HCM LOS	V/C	Control Delay (s)	HCM LOS	V/C
USA Parkway & WB On-Ramp/WB Off-Ramp	Stop	615.2	F	>1	>1000	F	>1
USA Parkway & EB Off-Ramp/EB On-Ramp	Stop	17.5	C	0.01	27.0	D	0.02

The worst movement delay and the corresponding LOS and V/C are reported.

Source: Jacobs, 2012

7.2. Freeway Merge and Diverge Analysis of I-80/USA Parkway Interchange

The freeway merge and diverge analysis of I-80/USA Parkway Interchange was completed using HCS 2010 Version 6.3, following HCM 2010 guidelines. The results of the No-Action alternative freeway merge and diverge analysis are shown in Table 7-2. HCS analysis worksheets are provided in Appendix E 4.

Table 7-2: Year 2017 No-Action Alternative Merge & Diverge Analysis Results

Ramp Name	AM Peak Hour		PM Peak Hour	
	Density (pc/mi/ln)	HCM LOS	Density (pc/mi/ln)	HCM LOS
I-80 EB Off-Ramp at USA Parkway	21.1	C	21.5	C
I-80 EB On-Ramp at USA Parkway	15.6	B	21.1	C
I-80 WB Off-Ramp at USA Parkway	17.1	B	15.6	B
I-80 WB On-Ramp at USA Parkway	22.6	C	29.2	D

Source: Jacobs, 2012

From Table 7-2, it can be seen that the I-80 WB On-Ramp is anticipated to operate at LOS D during the PM peak period, which is worse than the desired operating level.

8. OPENING YEAR 2017 BUILD ALTERNATIVE ANALYSIS

A traffic operations analysis was completed for the opening year 2017 Build alternative. US 50 is planned to be widened to a four-lane section west of US 95A by year 2017. USA Parkway is proposed to be constructed to the design year conditions; hence USA Parkway would be a four lane roadway in the opening year.

The following analyses were completed for the opening year 2017 Build alternative:

- Intersection traffic operations analysis of
  - Ramp terminal intersections at the I-80/USA Parkway interchange
  - USA Parkway and US 50 intersection (a T-intersection configuration and a four-legged intersection configuration were analyzed)
- Freeway merge and diverge analysis along I-80 for segments near USA Parkway
- Multilane highway analysis of the proposed USA Parkway extension

Figure 8-1 shows the opening year 2017 peak hour volumes; and Figure 8-2 shows the opening year 2017 turning movement volumes.

As per the approved USA Parkway Traffic Analysis Methodology, LOS thresholds are defined as:

- HCM LOS D or better for the intersection of USA Parkway at US 50. It is noted that LOS C is desired for this intersection.
- LOS C or better at USA Parkway/I-80 Interchange.
- LOS E or better for each movement at intersections.
- Intersection V/C, including each movement, less than 1.0

8.1. Intersection Analysis

Intersection analysis was completed using HCS 2010 Version 6.3 software following HCM 2010 methodology. The results of the intersection traffic operations analysis are shown in Table 8-1. The recommended geometry and traffic control to achieve these LOS is shown in Figure 8-3 and Figure 8-4. The proposed geometry and traffic control for new facilities and the proposed improvements to geometry and traffic control for existing facilities are listed in Section 8.4. For unsignalized intersections, the worst movement delay and the corresponding LOS and V/C are reported. For signalized intersections, overall intersection control delay and intersection LOS are reported. HCS analysis worksheets are provided in Appendix D 5.

Figure 8-1: Build Alternative – Year 2017 Peak Hour Volumes

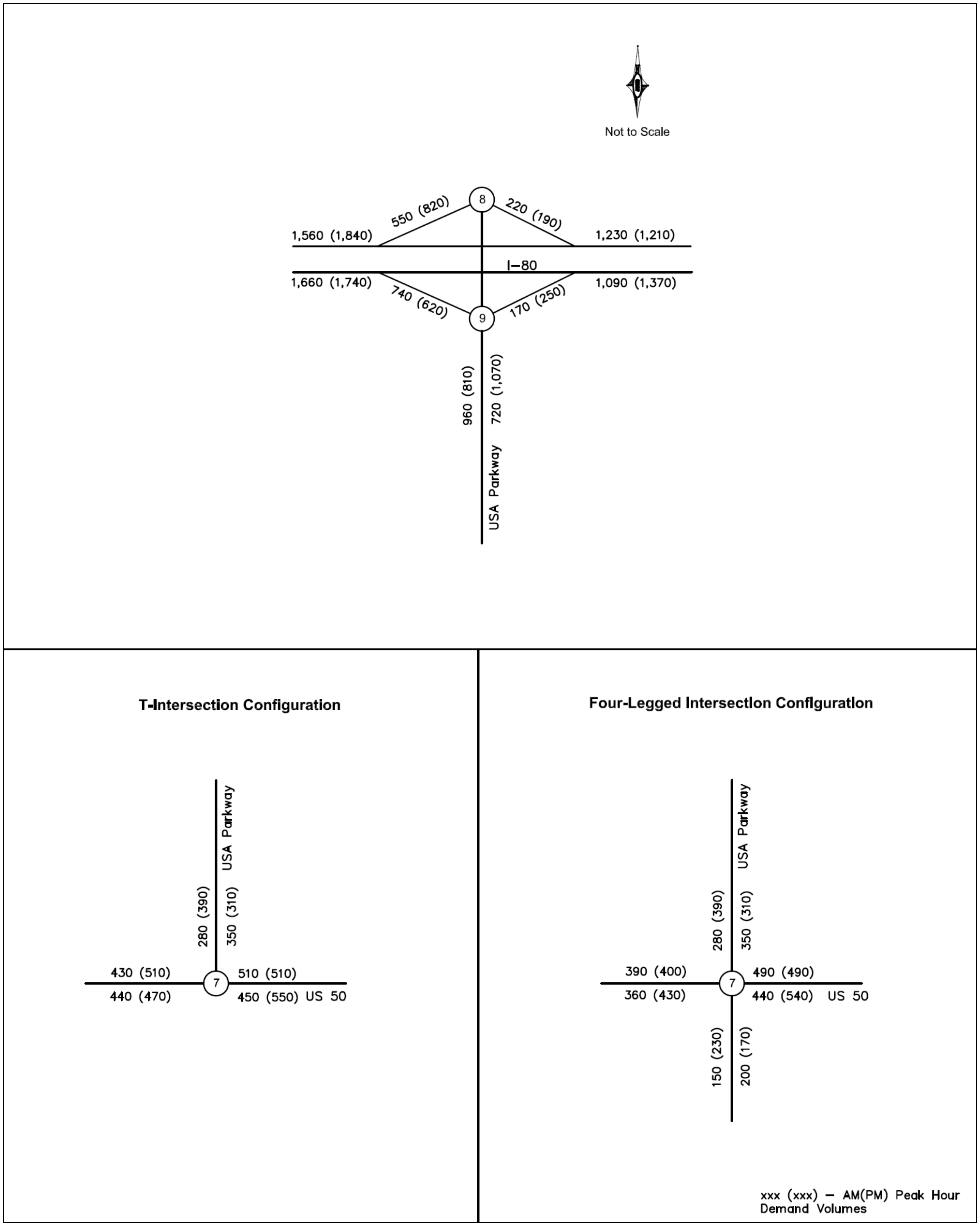


Figure 8-2: Build Alternative – Year 2017 Turning Movement Volumes

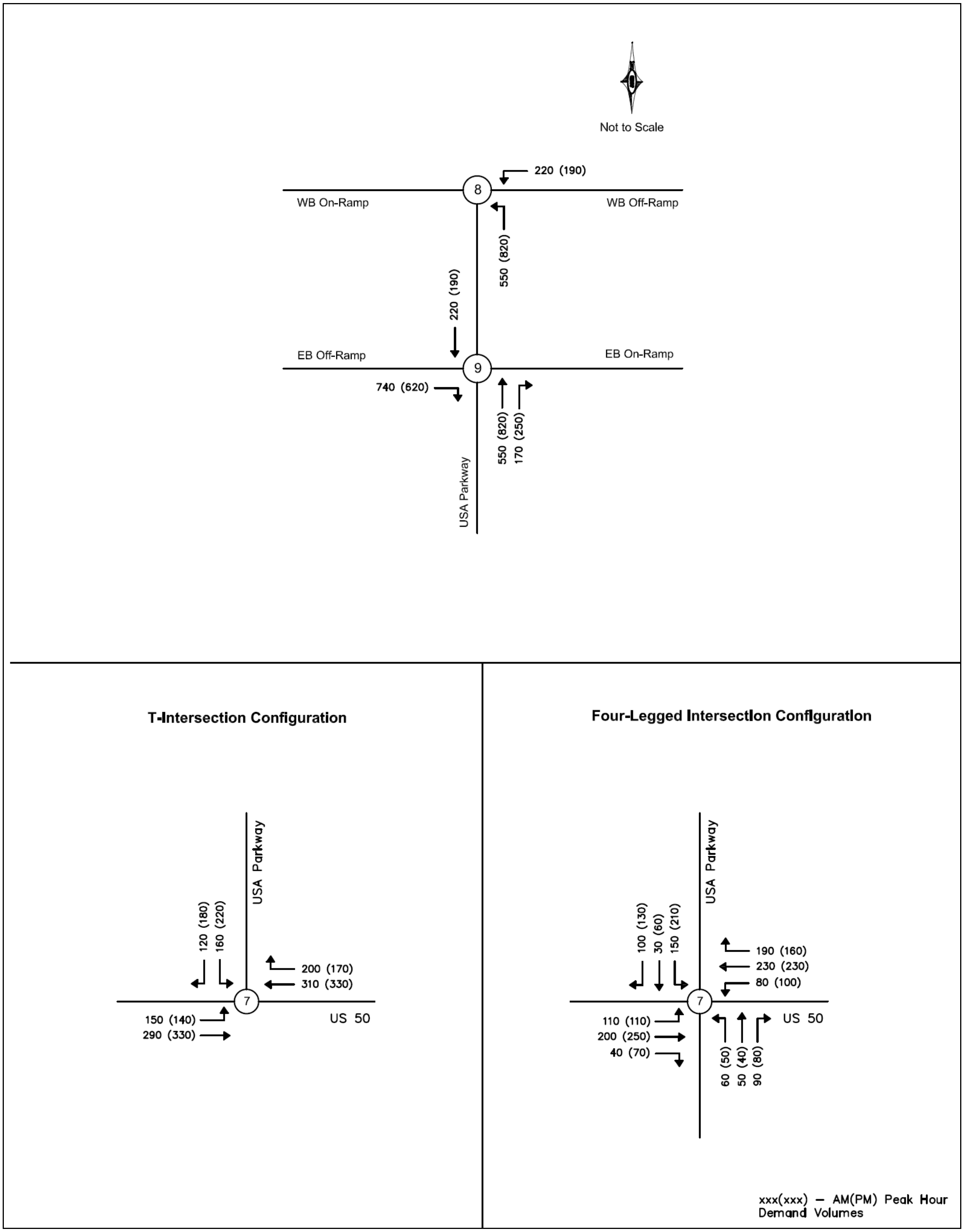
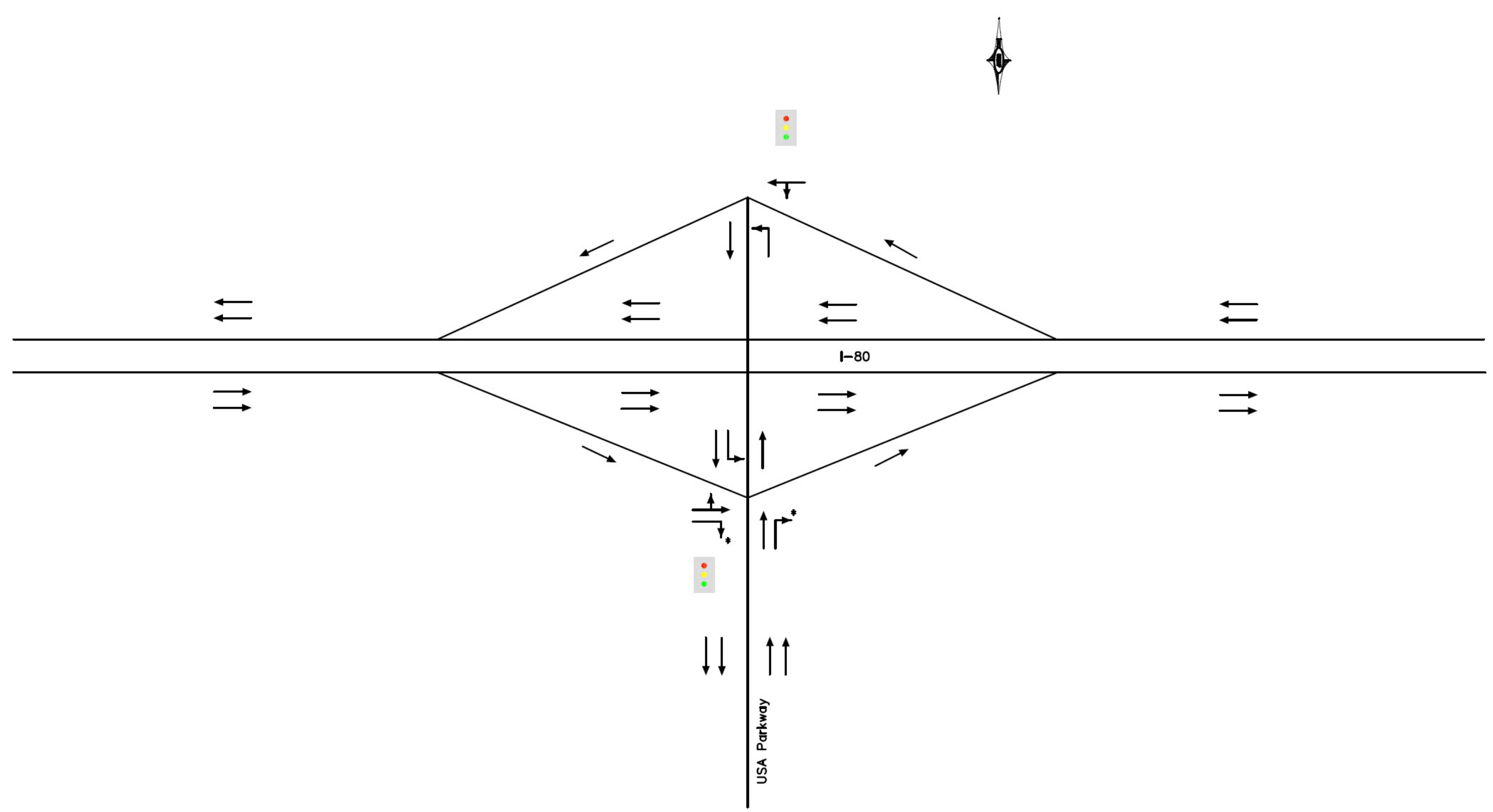


Figure 8-3: Build Alternative Recommended Geometry and Control at the I-80/USA Parkway Interchange



Legend

Signalized intersection

* Channelized Right Turn (Free)

Figure 8-4: Recommended Geometry and Control along USA Parkway and at intersection of USA Parkway/US 50

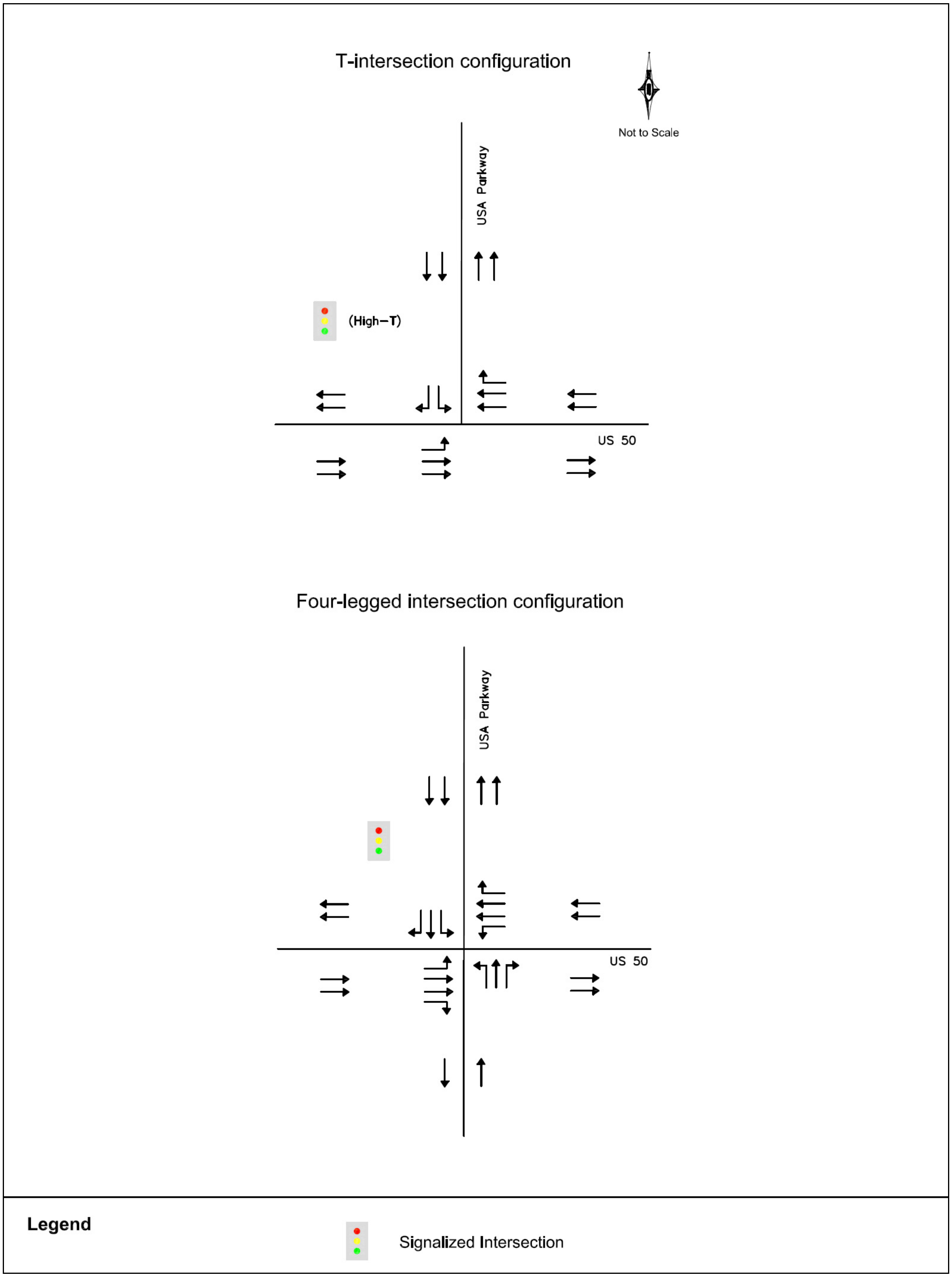


Table 8-1: Year 2017 Build Alternative Intersection Analysis Results

Study Intersection Name and Number	Traffic Control	AM Peak Hour			PM Peak Hour		
		Control Delay (s)	HCM LOS	V/C	Control Delay (s)	HCM LOS	V/C
USA Parkway & US50 (T-intersection configuration)	Signal (High-T)	15.4	B	-	15.8	B	-
	Stop (High-T)	27.0	D	0.53	38.1	E	0.72
USA Parkway & US50 (Four-legged intersection configuration)	Signal	20.8	C	-	21.9	C	-
USA Parkway & WB On-Ramp/WB Off-Ramp	Signal	17.5	B	-	23.5	C	-
USA Parkway & EB Off-Ramp/EB On-Ramp	Signal	6.8	A	-	12.8	B	-

For unsignalized intersections, the worst movement delay and the corresponding LOS and V/C are reported.

For signalized intersections, control delay and LOS are reported for the overall intersection. HCM 2010 methodology does not provide an overall intersection V/C (HCM critical V/C), hence not reported. It was ensured that V/C for each movement is less than 1.0.

Source: Jacobs, 2012

Ramp terminal intersections of the I-80/USA Parkway interchange: The proposed improvements to geometry at these intersections resulted in an overall intersection LOS equal to or better than LOS C during both the AM and PM peak periods. LOS is E or better for each movement and V/C is less than 1.0.

Intersection of USA Parkway and US 50: Both a T-intersection configuration and a four-legged intersection configuration were analyzed.

For the T-intersection configuration, a stop controlled High-T intersection is expected to operate at LOS E or better for all movements. Alternately, this intersection (T-intersection configuration) may be signalized to operate as a signalized High-T intersection or as a signalized regular T-intersection. Among the three T-intersection options, the recommended traffic control and configuration is the signalized High-T for the following reasons:

1. A signalized High-T intersection is expected to meet signal warrants,
2. A large proportion of vehicles on USA Parkway is anticipated to be trucks (24%) and trucks require additional room to accelerate and merge, and
3. A signalized intersection is likely to operate more safely than an unsignalized intersection under the given conditions

For the four-legged intersection configuration, a two-way stop controlled intersection was found to operate at an LOS worse than the desired threshold; hence this intersection is proposed to be signalized. The proposed geometry and traffic control resulted in an overall intersection LOS of C during both the AM and PM peak periods. LOS is E or better for each movement. The traffic signal phasing and timing at this intersection accommodates anticipated pedestrian activity.

8.2. Freeway Merge and Diverge Analysis

The freeway merge and diverge analysis was completed using HCS 2010 Version 6.3, following HCM 2010 guidelines. The results of the freeway merge and diverge analysis are shown in Table 8-2. HCS analysis worksheets are provided in Appendix E 5.

From Table 8-2, it can be seen that all the merge and diverge segments, except the I-80 WB on-ramp at USA Parkway (during the PM period), operate at LOS C or better. During the PM period, the operations at the I-80 WB on-ramp at USA Parkway are expected to be at the transitional phase between LOS C and LOS D. The LOS is anticipated to be just over the LOS C threshold.

8.3. Multilane Highway Analysis

A multilane highway analysis of the proposed four-lane roadway was completed using HCS 2010 Version 6.3, following HCM 2010 guidelines. HCS analysis worksheets are provided in Appendix F 2.

- During the AM analysis period, SB USA Parkway operates at LOS A (density of 3.0 pc/mi/ln) and the NB USA Parkway operates at LOS A (3.8 pc/mi/ln)
- During the PM analysis period, SB USA Parkway operates at LOS A (density of 4.3 pc/mi/ln) and the NB USA Parkway operates at LOS A (3.4 pc/mi/ln)

It should be noted that the proposed four-lane configuration is based on the design year conditions. The proposed USA Parkway extension is planned to be constructed in one phase to design-year conditions.

Table 8-2: Year 2017 Build Alternative Merge & Diverge Analysis Results

Ramp Name	AM Peak Hour		PM Peak Hour	
	Density (pc/mi/ln)	HCM LOS	Density (pc/mi/ln)	HCM LOS
I-80 EB Off-Ramp at USA Parkway	20.3	C	21.2	C
I-80 EB On-Ramp at USA Parkway	15.1	B	18.8	B
I-80 WB Off-Ramp at USA Parkway	15.4	B	15.2	B
I-80 WB On-Ramp at USA Parkway	22.6	C	28.1	D*

* The I-80 WB On-Ramp at USA Parkway operates at a LOS just over the LOS C threshold

Source: Jacobs, 2012

8.4. Proposed Geometry and Improvements

The following is a description of the proposed geometry for new facilities and the proposed improvements to the existing geometry for existing facilities. These proposed improvements ensure that the desired LOS thresholds are met in the opening year 2017.

Proposed geometry for new facilities:

- Extension of USA Parkway, south through Lyon County is proposed to be completed as a four-lane rural arterial with a posted speed limit of 55mph.
- At the intersection of USA Parkway and US 50, geometry and traffic control are proposed for both a T-intersection configuration and a four-legged intersection configuration. For the T-intersection configuration, a signalized High-T intersection is proposed, however a regular signalized T-intersection or a stop-controlled High-T intersection would also be an option. For the four-legged intersection configuration, the intersection is proposed to be signalized. The proposed geometry and traffic control for both these configurations are shown in Figure 8-4.

Recommended improvements to the existing geometry for existing facilities:

Both the ramp terminal intersections of the I-80/USA Parkway interchange are recommended to be signalized for opening year. Geometry improvements, however, are not required. Figure 8-3 illustrated these improvements.

9. CONCLUSION

This technical memorandum presented traffic operations analysis for the existing conditions, the design year 2037 No-Action alternative, the design year 2037 Build alternative, the opening year 2017 No-Action alternative and the opening year 2017 Build alternative of the USA Parkway extension project. This memorandum provides technical support for the USA Parkway EA.

The analysis showed that in the opening year, the No-Action alternative results in operations worse than desired for the study area roadways. The analysis also showed that in the design year, the No-Action alternative results in negative impacts to existing roadways in the vicinity and in operations worse than desired for the study area roadways. Section 6.4 identifies the geometry and improvements that are recommended for the design year 2037 Build alternative. Traffic operations analysis clearly indicates that the Build alternative is desirable to maintain the policy (and acceptable) LOS on study area roadways.

It is requested that NDOT approve the analysis documented in this memorandum. This will ensure that the analysis and methodologies that are acceptable to NDOT are incorporated in the USA Parkway EA document.

APPENDIX C
USA Parkway - Benefit-Cost Analysis (BCA)
List of Analysis Parameter Values and Assumptions

USA Parkway - Benefit-Cost Analysis (BCA)
List of Analysis Parameter Values and Assumptions

Serial Number	Parameter Name	Parameter Description	Parameter values to be used in the analysis		Reference/Justification for the assumption	Comments
1	Segment Data - Number of segments	Number of segments being analyzed	1			
2	Segment Data - Segment names	Name of the segments being analyzed	Segment 1	USA Parkway Extension		
3	Segment Data - USA Parkway - Functional classification	Subject segment's functional classification	Rural Minor Arterial			
4	Segment Data - USA Parkway - Length	Length of roadway being analyzed (centerline miles)	13			
5	Segment Data - USA Parkway - Improvement types	List of improvements being made to this segment	Additional Lanes	√		
			Traffic Control	√		
			Signal control systems			
			ITS			
			Geometric improvement	√		
			Intersection improvement	√		
			Roadside or lighting	√		
			Preservation or maintenance			
6	Analysis Period - Information about the period of time covered by the analysis	Year construction begins	2016			
		Year operation begins	2017			
		Last year of analysis period	2037			
		Base year	2011		This is the year for which existing year traffic volumes were obtained and also the year for which existing traffic operations analysis was conducted.	
7	User Class Data - User Class Names	Name for each user class being analyzed	All Cars			
			All Trucks			
8	User Class Data - Vehicle types	Vehicle type assigned to each user class	All Cars	Cars		
			All Trucks	Trucks		
9	User Class Data - Vehicle occupancy	Average number of vehicle occupants for each user class	All Cars	1.5	This is the auto-occupancy rate per vehicle used for all trips in the travel demand models.	
			All Trucks	1.05	Redbook benefit-cost analysis tool.	
10	User Class Data - Economic data	Value of an hour of time for the occupants of each vehicle class (in base year dollars)	All Cars	$10.61	NDOT's "Updates for 2012: Discussion of the Calculations of Costs and Benefits."	The "value of time" guidance for personal travel in Washoe county is used. All travel in cars is assumed to be personal travel; this results in a conservative estimate for the benefit-cost ratio.
			All Trucks	$25	USDOT's Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis.	$23.7 is recommended by "USDOT's Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis." But, FHWA's "The Economic Costs of Freight Transportation" mentions a rate of $26.7. So $25 has been used as a reasonable intermediate value; this is in the range of plausible values mentioned by the USDOT's guidance. (This value also accounts for the economic impacts of delays in cargo delivery).
11	User Class Data - Vehicle operating cost data	Cost per gallon of fuel for each user class (in base year dollars)	All Cars	$3.750	NDOT's "Updates for 2012: Discussion of the Calculations of Costs and Benefits."	Cost of Diesel is used for the cost of fuel for trucks.
			All Trucks	$3.920		

USA Parkway - Benefit-Cost Analysis (BCA)
List of Analysis Parameter Values and Assumptions

Serial Number	Parameter Name	Parameter Description	Parameter values to be used in the analysis		Reference/Justification for the assumption	Comments
12	User Class Data - Vehicle ownership cost data	Non-fuel operating costs $/VMT (in base year dollars) - All Cars	Tires	$0.0096	NDOT's "Updates for 2012: Discussion of the Calculations of Costs and Benefits."	
			Maintenance	$0.0444		
		Non-fuel operating costs $/VMT (in base year dollars) - All Trucks	Tires	$0.0230		
			Maintenance	$0.1030		
13	Economic data - Accident costs	Perceived user cost per accident for the following accident types (in base year dollars)	Property damage only ($)	$ 4,554	NDOT's "Updates for 2012: Discussion of the Calculations of Costs and Benefits."	
			Injury ($)	$ 92,202		
			Fatal ($)	$ 3,419,056		
14	Economic data - Economic and other parameters	Economic data used in the calculation of benefits and costs	Real discount rate (%)	7%	NDOT's "Updates for 2012: Discussion of the Calculations of Costs and Benefits."	
			Inflation rate (%)	2%	Congressional Budget Office's The Budget and Economic Outlook: Fiscal Years 2009 to 2019.	
15	Project costs - USA Parkway	Project costs by category (Construction year dollars)	Right of way ($)	$ 9,800,344	Jacobs' estimates.	Jacobs' cost estimates were updated to construction year (year 2016) dollars.
			Planning and preliminary engineering ($)	$ 6,153,291		
			Management and construction engineering ($)	$ 7,000,000		
			Construction ($)	$ 55,000,000		
16	Accident data - USA Parkway	Number of accidents by type, expected during construction	Property damage only	0		These are motor vehicle crashes in the construction zones. These are zero because during construction of USA Parkway extension, there is no traffic (new road).
			Injury	0		
			Fatal	0		
17	Construction delay - USA Parkway	Information about delay during construction	Total travel delay during construction (veh-hours)	0		These are motor vehicle delays in the construction zones. These are zero because during construction of USA Parkway extension, there is no traffic (new road).
			Total added VMT on detour (zero if no detour)	0		
			Vehicle speed on detour route (zero if no detour)	0		
18	Delay calculation method	Methodology used to calculate the change in user delay (Pick one option)	Based on travel times from an external model for two different years	√		The VHT from the USA Parkway EA travel demand models are used in the analysis.
			Based on travel times from an external model and a growth rate for delay			
			Estimated from v/c ratios using the Redbook method			
			Estimated from ADT (volume) using the Redbook method			
19	Travel demand model horizon years	Years for which travel demand model forecasts are available	Earlier model year	2017		
			Later model year	2035		
20	Year 2017 Vehicle Miles Travelled (VMT)	Daily VMT estimates from the year 2017 travel demand model (miles)	No-Action alternative	2,527,875	Approved USA Parkway Traffic Forecast Memorandum.	AATWDT-based VMT estimates from the travel demand model were converted to AADT-based estimates.
			Build alternative	2,402,685		

USA Parkway - Benefit-Cost Analysis (BCA) List of Analysis Parameter Values and Assumptions						
Serial Number	**Parameter Name**	**Parameter Description**	**Parameter values to be used in the analysis**		**Reference/Justification for the assumption**	**Comments**
21	Year 2017 Vehicle Hours Travelled (VHT)	Daily VHT estimates from the year 2017 travel demand model (hours)	No-Action alternative	60,284	Approved USA Parkway Traffic Forecast Memorandum.	AATWDT-based VHT estimates from the travel demand model were converted to AADT-based estimates.
			Build alternative	57,876		
22	Year 2035 Vehicle Miles Travelled (VMT)	Daily VMT estimates from the year 2035 travel demand model (miles)	No-Action alternative	4,285,350	Approved USA Parkway Traffic Forecast Memorandum.	AATWDT-based VMT estimates from the travel demand model were converted to AADT-based estimates.
			Build alternative	3,851,037		
23	Year 2035 Vehicle Hours Travelled (VHT)	Daily VHT estimates from the year 2035 travel demand model (hours)	No-Action alternative	108,723	Approved USA Parkway Traffic Forecast Memorandum.	AATWDT-based VHT estimates from the travel demand model were converted to AADT-based estimates.
			Build alternative	95,048		
24	Crash Rates (Motor Vehicle Accident Involvement)	Motor Vehicle Involvement (accidents per Million VMT)	Fatal Accidents	0.02	NDOT's year 2010 crash rate information for the road class "Rural Minor Arterial."	
			Injury (Non-Fatal) Accidents	0.35		
			Property Damage Only Accidents	0.71		
25	No-Action alternative user class data	Percentage of traffic volume composed of each user class	All cars	76%	Daily vehicle mix percentage values are used in the B/C analysis. Truck percent is assumed to remain constant over the years.	
			All trucks	24%		
26	Build alternative user class data	Percentage of traffic volume composed of each user class	All cars	76%	Daily vehicle mix percentage values are used in the B/C analysis. Truck percent is assumed to remain constant over the years.	
			All trucks	24%		
27	USA Parkway - No-Action alternative operating costs	Annual agency operating costs for the No-Action alternative (in base year dollars)	0		USA Parkway extension does not exist in the No-Action alternative.	
28	USA Parkway - Build alternative operating costs	Annual agency operating costs for the Build alternative	$	248,853	NDOT's estimates.	
		Rehabilitation costs (incurred every ten years) for the Build alternative	$	17,708,561	Jacobs' estimate produced using NDOT's Project Cost Estimation Wizard.	
29	USA Parkway - Terminal value	Terminal value (base year dollars)	0			
30	USA Parkway - Weekday-to-week factor	This factor converts daily volumes to weekly volumes	All cars	7		Since the model VMT and VHT estimates were converted to equivalent AADT level estimates, the average weekly volume would be 7 times the daily volume.
			All trucks	7		
31	USA Parkway - Volume conversion factors	These factors convert weekly volumes to annual volumes	Week-to-month expansion factor	4.348		Since AADT is used, the weekly volume is representative. (52.1775 weeks in a year/12 months in a year).
			Seasonality factor (ratio of peak month to average month)	1		
Non-User Benefits						
32	Non-user benefits	Non-user benefit components included in the benefit-cost analysis	Economic development			
			Construction spending			
			Vehicle emissions	√		
			Water runoff			
			Noise			
			Other			
33	Air pollution costs	Cost of air pollution by vehicle class per VMT for rural roads (base year dollars)	Cost of air pollution due to Average Car ($ per VMT)	$ 0.0225	Redbook.	Year 2005 value from the Redbook was used to estimate base year value.
			Cost of air pollution due to Truck ($ per VMT)	$ 0.0732	1. Redbook 2. Oregon's "Costs of Motor Vehicle Travel: White Paper for the purpose of modeling Statewide Transportation Strategy scenarios."	Both these sources are based on Delucchi et al (1996).

APPENDIX D
Estimation of Rehabilitation Costs
Output from NDOT’s “Estimate Preparation Assistance” Tool

ESTIMATED PROBABLE CONSTRUCTION COST

USA Parkway Extension

PREPARED BY THE NEVADA DEPARTMENT OF TRANSPORTATION

NOTE: Cells with bold blue letters are for user input. All other cells are protected, and cannot be changed.

ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL
ROADWAY RESURFACING				
ASPHALT PAVEMENT				
TYPICAL RESURFACING SECTION 1				
RESURFACING WIDTH	**67**	LF		
MILLING THICKNESS	**1.00**	IN		
PLANTMIX RESURFACING THICKNESS	**2.00**	IN		
OPEN GRADE PLANTMIX THICKNESS	**0.75**	IN		
TOTAL LANES	**5**	EA		
TOTAL LENGTH OF THIS TYPICAL SECTION	**1.723**	MI	$544,353	$938,183
TYPICAL RESURFACING SECTION 2				
RESURFACING WIDTH	**54**	LF		
MILLING THICKNESS	**1.00**	IN		
PLANTMIX RESURFACING THICKNESS	**2.00**	IN		
OPEN GRADE PLANTMIX THICKNESS	**0.75**	IN		
TOTAL LANES	**4**	EA		
TOTAL LENGTH OF THIS TYPICAL SECTION	**4.564**	MI	$437,013	$1,994,700
TYPICAL RESURFACING SECTION 3				
RESURFACING WIDTH	**78**	LF		
MILLING THICKNESS	**1.00**	IN		
PLANTMIX RESURFACING THICKNESS	**2.00**	IN		
OPEN GRADE PLANTMIX THICKNESS	**0.75**	IN		
TOTAL LANES	**5**	EA		
TOTAL LENGTH OF THIS TYPICAL SECTION	**0.502**	MI	$628,308	$315,344
TYPICAL RESURFACING SECTION 4				
RESURFACING WIDTH	**72**	LF		
MILLING THICKNESS	**1.00**	IN		
PLANTMIX RESURFACING THICKNESS	**2.00**	IN		
OPEN GRADE PLANTMIX THICKNESS	**0.75**	IN		
TOTAL LANES	**4**	EA		
TOTAL LENGTH OF THIS TYPICAL SECTION	**12.481**	MI	$578,320	$7,218,046
SUBTOTAL - ROADWAY			**$10,466,274**	

ESTIMATED PROBABLE CONSTRUCTION COST

USA Parkway Extension

PREPARED BY THE NEVADA DEPARTMENT OF TRANSPORTATION

NOTE: Cells with bold blue letters are for user input. All other cells are protected, and cannot be changed.

ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL
SECTION VIII - STANDARD PERCENTAGE ADDERS	Sub-total	for	3R	$ -
CLICK HERE FOR ADDER PERCENTAGE GUIDELINES				
SUB-TOTAL PRESENT DAY CONSTRUCTION COST				**$10,466,274**
EROSION CONTROL / TEMPORARY DRAINAGE	**0.50%**			$52,331
TRAFFIC CONTROL	**10.0%**			$1,046,627
ROADSIDE SAFETY	**3.0%**			$313,988
LANDSCAPING / AESTHETICS........	**0.0%**			$0
SUB-TOTAL				$11,879,221
MOBILIZATION	**5.0%**			$593,961
SUB-TOTAL				$12,473,182
TIME-RELATED OVERHEAD	**0.0%**			$0
SUB-TOTAL				$12,473,182
CONTINGENCY	**10.0%**			$1,247,318
SUB-TOTAL				$13,720,500
CONSTRUCTION ENGINEERING & INSPECTION	**15.0%**			$2,058,075
TOTAL PRESENT DAY CONSTRUCTION COST				**$15,778,575**
CONSTRUCTION ESCALATION TO YEAR - (projected start year)	**2011**	@	**0.00%**	$0
TOTAL CONSTRUCTION COST ESCALATED TO........	**2011**			**$15,778,575**
PRELIMINARY ENGINEERING (PRESENT DAY COST)	**3.0%**			$473,357
PRELIMINARY R/W ENGINEERING (PRESENT DAY COST)	**$5,000**			$5,000
FINAL ENGINEERING (PRESENT DAY COST)	**7.0%**			$1,104,500
ENVIRONMENTAL ASSESSMENT (PRESENT DAY COST)	**0.2%**			$31,557
ADMINISTRATION (PRESENT DAY COST)	**1.0%**			$157,786
LEGAL (PRESENT DAY COST)	**1.0%**			$157,786
TRIBAL EMPLOYMENT RIGHTS ORDINANCE (TERO) (PRESENT DAY COST - 0%-3%)	**0.0%**			$0
ENGINEERING AND ADMINISTRATION ESCALATION TO YEAR	**2011**	@	**0.00%**	$0
TOTAL ENGINEERING / ADMINISTRATION / LEGAL COSTS (ESCALATED)				$1,929,986
TOTAL CONSTRUCTION & ENGINEERING ESCALATED TO........	**2011**			**$17,708,561**