

Phase 3 TransModeler Settings and Parameters

*Carolina Crossroads
I-20/I-26/I-126 Corridor Project
Lexington and Richland Counties, South Carolina*

August 2022



Prepared for South Carolina Department of Transportation
and the Federal Highway Administration

Phase 3 TransModeler Settings and Parameters

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Prepared by



Microsimulation Network Study Area

1. Microsimulation Network General Information

The analysis of modifications to the Modified selected Alternative (MSA) will be based on the TransModeler network for the MSA and the associated Project and Scenario files. The primary analysis will make use of the 2040 morning and afternoon peak hour scenarios, but information will be provided should interim year analyses, such as for a ‘year of failure analysis’, of the MSA is necessary for the 2020, 2030, and 2035 scenarios.

The original I-20/I-26/I-126 System Interchange Modification Report (the System IMR), dated May 2019, presented the anticipated interchange modifications as depicted in the Final Environmental Impact Statement (FEIS) for the project. Since the approval of the System IMR, the Carolina Crossroads I-20/I-26/I-126 Corridor Improvement Project (Carolina Crossroads Program) has been separated into five construction phases. The first three phases of the Carolina Crossroads Program comprise most of the work documented in the System IMR. Improvements to the I-126 at Colonial Life Boulevard interchange are now part of Phase 1 of the Carolina Crossroads Project Delivery while the I-20 Exit 65 Interchange at Broad River Road is now part of Phase 2. Phases 1 and 2 are both underway as design-build projects and the design has been substantially completed. The improvements to I-20/I-26/I-126 system interchanges, along with I-20 Exit 63 (Bush River Road) and I-26 Exit 106 (St. Andrews Road) are now part of Phase 3, which will also be a design-build project. Traffic Technical Memoranda addressing changes to the I-126 Colonial Life Boulevard interchange and I-20 Exit 65 (Broad River Road) were submitted as part of the Phase 1 and Phase 2 design-build projects, ID P039718 and ID P039719, respectively. The project phasing is shown in **Figure 1**.

As the evolution of the Carolina Crossroads Program through the phased construction delivery is discussed, it is important to understand the key terms that define various milestones in the evolution of the design as it relates to the FEIS and the Record of Decision (ROD) for the Carolina Crossroads Program and the System IMR. The design concept depicted in the FEIS was referred to as the **Refined Recommended Preferred Alternative (RRPA)**, which as the name implies was a refinement to the Recommended Preferred Alternative (RPA) presented in the Draft EIS. Since the System IMR was developed in parallel with the EIS documents, the nomenclature associated with the design concept in the documents was consistent and therefore the System IMR refers to the design concept used in the “Build” analysis as the RRPA. Once the ROD was issued in May of 2019, the RRPA concept became known as the **Selected Alternative (SA)**; however, many of the reference documents to the FEIS/ROD were not updated to reflect this change in nomenclature, including the System IMR. *Therefore, the terms RRPA and SA are synonymous.*

As the Carolina Crossroads Program has advanced through the initial construction phases and right-of-way acquisition, the design concept has been updated periodically. These updates include changes to the design associated with the final design that have been developed during Phases 1 and 2 and changes made to the design concept outside of Phases 1 and 2 based on refinements made during right-of-way acquisition throughout the entire limits of the Carolina Crossroads Program. The version of the design concept that includes all of these changes is referred to as the **Modified Selected Alternative (MSA)**. The MSA is fluid and will continue to evolve as the Carolina Crossroads Program is constructed.

a. Microsimulation Network Limits

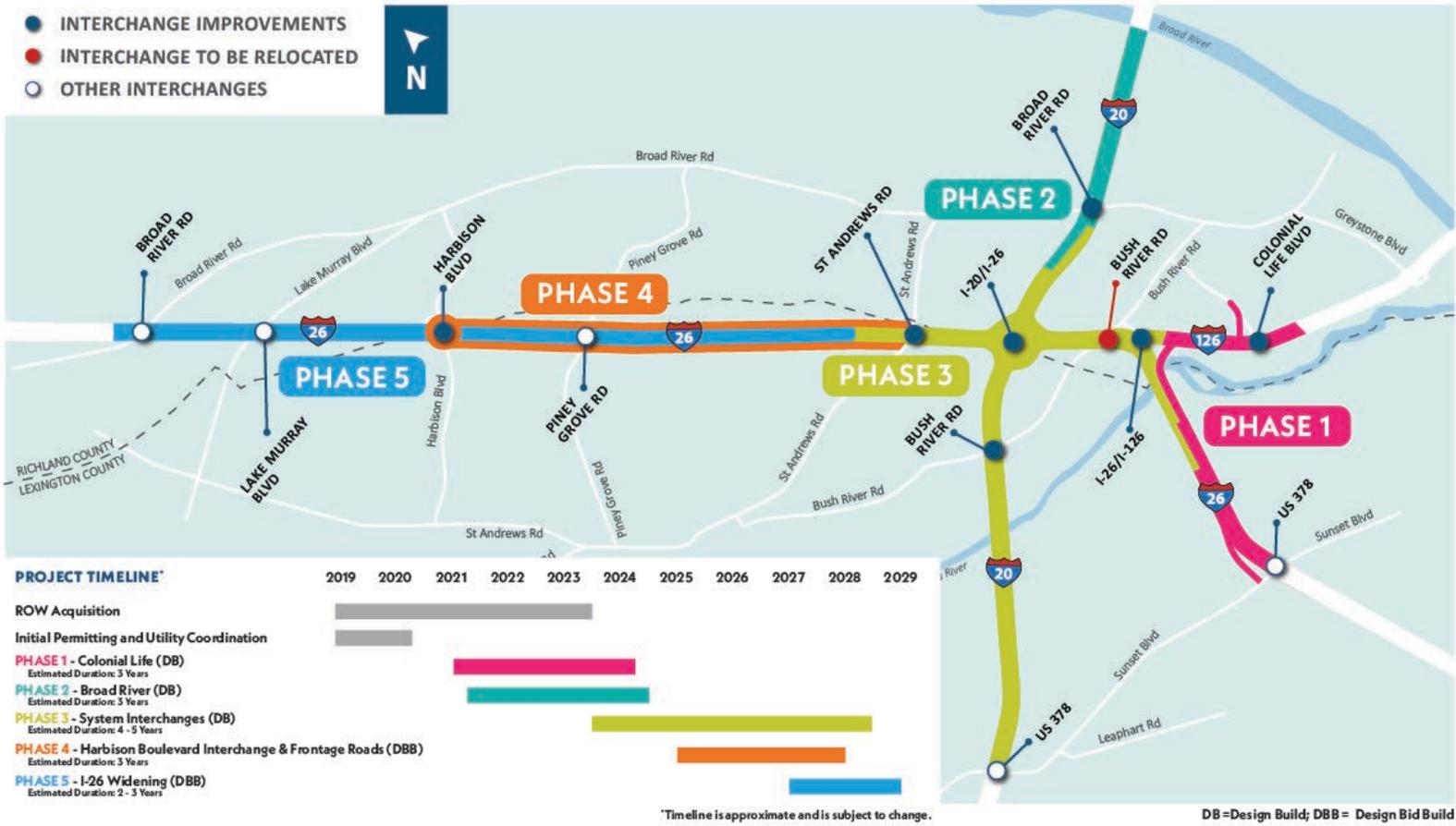
The project area is displayed on **Figure 2**. The microsimulation network includes the entire project area, and consists of Interstates 20, 26, and 126, their interchanges and ramps, arterial roadways, and several frontage roads.

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Figure 1. Carolina Crossroads Project Phasing

Phased Construction Map

March 23, 2022



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Figure 2. Project Area



For traffic simulation and analysis purposes, the portion of I-20 in the microsimulation network extends outside of the project area towards the US 378 interchange (Exit 61) to the west and to the Monticello Road interchange (Exit 68) to the east. The I-26 portion of the network extends from the west of the Broad River Road interchange (Exit 101) to the east of the US-378 (Exit 110) interchange. The I-26 portion of the network begins at I-26 and extends to the east past the project limits east of the Colonial Life Boulevard interchange to the Elmwood Avenue – Huger Street split.

Microsimulation network segments are organized based on their functional classification. The functional classification is important to the modeling of the network and the performance of the dynamic traffic assignment as each functional classification has specific speeds and capacities associated with them. Selection sets have been made within TransModeler to color code the functional classifications to facilitate the identification of the classification of the various links in the network.

There shall be no change to the existing functional classification of the MSA network segments. When modifications to the network are developed, the functional classification of links added to the network or modified within the network should be carefully considered and be consistent with comparable roadways in the network.

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b. Freeway Sections (Mainline Segments, Interchanges, and Ramps)

Mainline Segments

Within the MSA microsimulation network, the mainline freeway segments have the functional classification of *Freeway* and *Expressway*. The mainline freeway sections consist of one-way sections of interstates 20, 26, and 126 of various lengths. The number of lanes on the freeway segments vary from three (3) to seven (7) with speed limits of 55, 60, and 70 miles per hour. The three *Freeway* sub-classes are based on the coded speed limits and are identified as *Freeway (55)*, *Freeway (60)*, and *Freeway (70)*. There is a single *Expressway* link coded into the network: this is the connection from I-126 westbound to the I-26 westbound collector-distributor road leading to the I-20/I-26 system interchange.

Interchanges

The existing network consists of thirteen service Interchanges. The existing interchanges included on I-26 in the network are:

- Exit 101 - Broad River Road (US 176)
- Exit 102 - Lake Murray Boulevard (SC-60)
- Exit 103 - Harbison Boulevard (S-32-757/S-40-757)
- Exit 104 - Piney Grove Road (S-32-671/S-40-1280)
- Exit 106 - St Andrews Road (S-32-36/S-40-42)
- Exit 108 - Bush River Road (S-32-273/S-40-31)
- Exit 110 - Sunset Blvd (US 378)

The Exit 108 ramps to and from Bush River Road are removed in the MSA.

The existing service interchanges along I-20 are:

- Exit 61 – Sunset Boulevard (US 378)
- Exit 63 - Bush River Road (S-32-273)
- Exit 65 - Broad River Road (US 176)
- Exit 68 – Monticello Road (SC 215)

The existing service interchanges along I-126 are:

- Colonial Life Boulevard (S-40-2963)
- Greystone Boulevard (S-40-3020)

The eastern end of I-126 is the split for Elmwood Avenue (US 21/321) and Huger Street (US 21/321)

There are two system interchanges:

- Exit 107 - I-20/I-26
- Exit 108 - I-26/I-126

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Ramps

There are two functional classifications for the ramps in the MSA microsimulation network. The *Ramp* classification is assigned to links that connect the mainline freeway segments to arterial roadways at the service interchanges. The *System Ramp* classification is assigned to links connecting interstates either directly or indirectly through collector-distributor roads at the system interchange.

Merge/Diverge/Weaving Areas

Ramps also have an influence area for merge, diverge, and weaving segments. The influence area for each of the existing merge and diverge segments is 1500 feet and for each of the existing weave segments is 2500 feet. Any new merge, diverge, or weaving segment shall be coded with these influence areas.

c. Collector-Distributor Roads

The functional classification *Collector-Distributor (C-D)* is assigned in the MSA to roads that usually run parallel to the mainline *Freeway* links. *C-D* links are used to separate traffic traveling to and from the system interchanges from either the mainline freeway segments or from ramps at the service interchanges adjacent to the system interchange. *C-D* links were used in the MSA to reduce the number of merge, diverge, and weaving sections, and reduces or eliminates the existing complex weaving movements adjacent to the system interchanges, reducing traffic conflict points.

d. Arterial, Collectors, and Local Streets

The links not classified as *Freeway*, *Expressway*, *Ramp*, *System Ramp*, or *Collector-Distributor* represent surface streets connecting the traffic zones to the interchanges or connecting other surface streets. These links have the functional classification of *Major Arterial*, *Minor Arterial*, *Collector*, and *Local Street*.

Two types of *Major Arterial* links are present in the network based on their coded speeds: *Major Arterial (35)* and *Major Arterial (45)* are the functional classifications used for major arterial links with coded speed limits of 35 mph and 45 mph respectively. The following roadways are coded as either *Major Arterial (35)* or *Major Arterial (45)* in the MSA microsimulation network:

- Colonial Life Boulevard
- Elmwood Avenue
- Huger Street
- Monticello Road
- Sunset Boulevard

Links with the functional classification of *Minor Arterial* in the MSA network have a 35 mph coded speed. The following roadways are coded as *Minor Arterials* in the network:

- Broad River Road
- Bush River Road
- Greystone Boulevard
- Harbison Boulevard
- Lake Murray Boulevard
- Leaphart Road

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- Piney Grove Road
- St Andrews Road

Links with the *Collector* functional classification are used in the network to bring traffic to the *Major Arterial* and *Minor Arterial* links. *Collector* links can be found crossing Sunset Boulevard around Exit 61 on I-20, Broad River Road near the Greystone Boulevard interchange on I-126, across Broad River Road near Exit 65 on I-20, and across Monticello Road near Exit 68 on I-20. *Collector* links in the network have a 35 mph coded speed and a lower link capacity than the *Minor Arterial* links. The following links are coded with the *Collector* functional classification:

- Arrowwood Road
- Blue Ridge Terrace
- Buckner Road
- Corley Mill Road
- Cromer Road
- Davega Drive
- Dutch Square Boulevard
- Ginny Lane
- Longcreek Drive
- Stoneridge Drive
- Peeples Street

The *Local Street* functional classification is the most prevalent classification in the MSA network. *Local Street* links in the network have a 30 mph coded speed. The following links are coded with the *Local Street* functional classification.

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- Beatty Road
- Bower Parkway
- Briargate Circle
- Broad River Road
- Burning Tree Road
- Bush River Road
- Candi Lane
- Chartwell Road
- Club Road
- Chris Drive
- Crossbow Drive
- Colonial Life Boulevard W
- Columbiana Drive
- Columbiana Circle
- Elm Abode Terrace
- Fairlane Drive
- Fernandina Road
- Frontage Road
- Harbor Drive
- Hebron Drive
- Hospital Drive
- Independence Avenue
- Jamil Road
- Kay Street
- Kennerly Road
- Kinley Road
- Laurel Street
- Lawrence Street
- Lost Creek Drive
- Marley Drive
- Mcswain Drive
- Morninghill Drive
- Nottingwood Drive
- Nunamaker Drive
- Oakwood Drive
- Paisley Lane
- Parkridge Drive
- Park Terrace Drive
- Piney Woods Road
- Riverhill Circle
- Seminole Road
- St Andrews Parkway
- Summer Place Drive
- Sunset Court
- Tram Road
- Western Lane
- Woodcross Drive
- Woodland Hills Road
- Young Drive
- Zimalcrest Drive
-

There is one set of links coded with the *Roundabout* functional classification. These links are located in the network at the intersection of Piney Grove Road and Piney Woods Road.

e. Intersections

In the MSA network, intersections are formed where two links intersect. With a network as large as the MSA network, there will be a large number of intersections.

The key intersections associated primarily with the various service interchanges, and the type of traffic control used at each intersection are presented in **Table 1** and **Table 2**.

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Table 1. Intersection Analysis. Part 1

Interchange #	Intersection Name	Traffic Control
Exit 101	Broad River Road (US 176) at Columbiana Drive / Lordship Lane	Traffic Signal
	Broad River Road (US 176) at I-26 EB Off-ramp	1-Way Stop Control
	Broad River Road (US 176) at I-26 EB On-ramp	Traffic Signal
	Broad River Road (US 176) at I-26 WB On-ramp	No Control
	Broad River Road (US 176) at Western Lane	Traffic Signal
Exit 102	Lake Murray Boulevard (SC 60) at Columbiana Drive	Traffic Signal
	Lake Murray Boulevard (SC 60) at I-26 EB On-Ramp	No Control
	Lake Murray Boulevard (SC 60) at I-26 WB On-Ramp	No Control
	Lake Murray Boulevard (SC 60) at Parkridge Drive / Kinley Road	Traffic Signal
Exit 103	Harbison Boulevard (S-757) at Columbiana Drive	Traffic Signal
	Harbison Boulevard (S-757) at Park Terrace Drive / Columbiana Circle	Traffic Signal
	Harbison Boulevard (S-757) at Saturn Parkway	Traffic Signal
	Harbison Boulevard (S-757) at I-26 EB Ramps	Traffic Signal
	Harbison Boulevard (S-757) at I-26 WB Ramps	Traffic Signal
	Harbison Boulevard (S-757) at Woodcross Drive	Traffic Signal
Exit 104	Piney Grove Road at Bower Parkway / Jamil Road	Traffic Signal
	Piney Grove Road at I-26 EBR Off-ramp	No Control
	Piney Grove Road at I-26 EB Ramps	Traffic Signal
	Piney Grove Road at I-26 WB Ramps	Traffic Signal
	Piney Grove Road at I-26 WBR Off-ramp	No Control
	Piney Grove Road at Fernandina Road	Traffic Signal
Exit 106	St. Andrews Road at Jamil Road	Traffic Signal
	St. Andrews Road at Woodland Hills Road	Traffic Signal
	St. Andrews Road at I-26 SPUI Intersection	Traffic Signal
	St. Andrews Road at I-26 WBR Off-ramp	1-Way Stop Control
	St. Andrews Road at Fernandina Road/Burning Tree Drive	Traffic Signal
	St. Andrews Road at Kay Street / Chartwell Road	Traffic Signal
Exit 108	Bush River Road at Zimalcrest Drive	Traffic Signal
	Bush River Road at Driveway	Traffic Signal
	Bush River Road at Morninghill Drive	Traffic Signal
	Bush River Road at Arrowwood Road	Traffic Signal

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Table 2. Intersection Analysis. Part 2

Interchange #	Intersection Name	Traffic Control
Exit 110	Sunset Boulevard (US 378) at E. Hospital Drive / Harbor Drive	Traffic Signal
	Sunset Boulevard (US 378) at I-26 EBR Off-Ramp	Traffic Signal
	Sunset Boulevard (US 378) at I-26 Single Point Ramps Intersection	Traffic Signal
	Sunset Boulevard (US 378) at I-26 WBR Off-Ramp	Traffic Signal
	Sunset Boulevard (US 378) at Chris Drive / McSwain Drive	Traffic Signal
Exit 63	Bush River Road at Outlet Pointe Boulevard	Traffic Signal
	Bush River Road at Berryhill Drive	Traffic Signal
	Bush River Road at I-20 WB Ramps	Traffic Signal
	Bush River Road at I-20 EB Off-Ramp	Traffic Signal
	Bush River Road at Independence Avenue	Traffic Signal
Exit 65	Broad River Road at Marley Drive / Briargate Circle	Traffic Signal
	Broad River Road at I-20 WB Ramps / North Crossover	Traffic Signal
	Broad River Road at I-20 EB Ramps / South Crossover	Traffic Signal
	Broad River Road at Longcreek Drive	Traffic Signal
Additional Intersections	Broad River Road (US 176) at Kinley Road	Traffic Signal
	Broad River Road (US 176) at Harbison Boulevard	Traffic Signal
	Broad River Road (US 176) at Piney Woods Road / Lost Creek Drive	Traffic Signal
	Broad River Road (US 176) at Piney Grove Road	Traffic Signal
	Broad River Road (US 176) at St. Andrews Road	Traffic Signal
	Broad River Road (US 176) at St. Andrews Parkway	Traffic Signal
	Broad River Road (US 176) at Seminole Road / Young Drive	Traffic Signal
	Broad River Road (US 176) at Dutch Square Boulevard	Traffic Signal
	Broad River Road (US 176) at Bush River Road	Traffic Signal
	Broad River Road (US 176) at Greystone Boulevard	Traffic Signal
	Greystone Boulevard at Stoneridge Drive	Traffic Signal
	Greystone Boulevard at I-126 WB Ramps	1-Way Stop Control
	Greystone Boulevard at I-126 EB Ramps	1-Way Stop Control
	Colonial Life Boulevard at I-126 Crossover Ramps/W Colonial Life Road	Traffic Signal
	Bush River Road at Colonial Life Boulevard	Traffic Signal
	Colonial Life Boulevard at West Colonial Life Road	Traffic Signal
Park Terrance Drive at Bower Parkway	Traffic Signal	

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2. ATC Applicability (Locations)

The microsimulation network should not be extended behind the current limits in the MSA network. Any revisions to the limits of the microsimulation network shall be thoroughly documented and submitted along with the ATC.

Links associated with the interstate routes (mainline segments, interchanges, and ramps) and the C-D roads that are modified or created as part of the development of an ATC should be consistent with the coded segments in the MSA. For example, in an area of the MSA where freeway links are coded with the functional classification of *Freeway (55)*, any new or modified links should be coded with the *Freeway (55)* functional classification.

The coding of new and/or modified ramps, system ramps, and/or C-D roads in the ATC shall be documented and coded consistent with the coding of the comparable links in the MSA.

Modifications to the MSA network shall be limited to Phase 3 and not modify work done in previous phases outside of tie-in locations or work specified as part of the contract. The project phased construction map is displayed on **Figure 1**.

Modifications to the microsimulation network interchange configurations, aside from possible adjustments to merge and diverge locations with the mainline, should not be necessary at the following interchange locations:

I-26 service interchanges at

- Exit 101 - Broad River Road (US 176)
- Exit 102 - Lake Murray Boulevard (SC-60)
- Exit 104 - Piney Grove Road (S-32-671/S-40-1280)
- Exit 110 - Sunset Blvd (US 378)

I-20 service interchanges at:

- Exit 61 – Sunset Boulevard (US 378)
- Exit 65 – Broad River Road (US 176)
- Exit 68 – Monticello Road (SC 215)

I-126 service interchanges at:

- Colonial Life Boulevard (S-40-2963)
- Greystone Boulevard (S-40-3020)

Modifications to the microsimulation network links classified as *Major Arterial (35)*, *Major Arterial (45)*, *Minor Arterial*, *Collector*, *Local Street*, and *Roundabout* shall be limited to the network links directly affected by modifications made at specific service interchanges. All network surface street deletions, additions, and/or modifications shall be documented.

Signalized and unsignalized intersections already coded within the microsimulation network shall only be modified when directly affected by the modifications made at specific service interchanges. New and/or modified

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intersections controlled by traffic signals shall have appropriate signal phasing and timing settings consistent with SCDOT’s guidelines. The coded phasing and timing of existing signals should be used as a starting point for signals that are to be modified.

SCDOT guidelines shall be followed for the setting of minimum green times, vehicle extensions, clearance (yellow and all-red) times, recall modes, and left turn phasing (protected-only, permitted-only, and protected-permitted) and concurrent right turn phases. Pedestrian timings (Ped Walk+FDW) should be omitted except in cases where an exclusive pedestrian phase is included in the signal phasing.

In TransModeler, the lost time for each phase is calculated as the sum of the Yellow and Red Clearance timings. When these timings are modified for a phase, the lost time for that phase will automatically get updated.

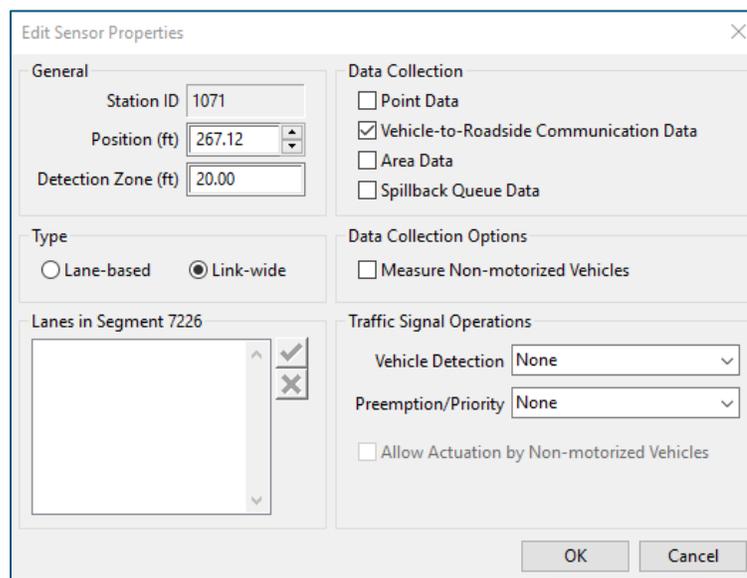
Vehicle detector placement, detector length, and detection delays, recall mode, and memory mode settings shall be consistent with SCDOT guidelines.

Signals placed within a coordinated signal system or placed within 1,500 feet of the end of a coordinated signal system shall be coded as a coordinated signal. Coordination settings, such as coordinating to the beginning of the phase 2 and/or phase 6 yellow interval, shall follow SCDOT guidelines

Coding Network Changes

Link-wide Sensors, twenty feet in length, shall be added to all ramps and mainline segments. These sensors will be identified as Vehicle-to-Roadside (VRC) Communication Data with vehicle detection set to “None”. Settings for the VRC Sensors shall be as shown in **Figure 2**. These sensors are used for the collection of truck classification volumes on the links.

Figure 3 – VRC Sensor Settings



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At revised/new merge locations (or the start of a weaving segment) for proposed designs, the combined link shall begin at the point where the full width of the approach ramp (or loop ramp) would intersect the edge of pavement for the mainline through lanes on the freeway. Similarly, the diverge (or end of freeway weave segment) for the proposed design should end at the point where the full width of the departing ramp (or loop ramp) would intersect the edge of pavement for the mainline. Merge and diverge segments shall be coded to have an influence area of 1,500 feet in length for the freeway analysis. Weaving segments shall be coded to have an influence area of 2,500 feet in length for the freeway analysis.

3. Analysis Scenarios in TransModeler

The following information relates to elements of creating and running the simulations for the MSA and any modified network to test alternative concepts to the MSA.

a. Version and Build

Caliper's microsimulation modeling software, **TransModeler** (version 4.0 build 6275 64-bit), shall be used for modeling the MSA and any alternative concepts, and for generating the reports of the simulation results. **No other version of TransModeler shall be accepted without written verification from Caliper that the version of TransModeler being used is compatible with version 4.0, build 6275, 64-bit.**

b. Project Files and Scenarios.

The following TransModeler files have been included to be used as a basis for future analysis:

- *CC_NB.smp* includes the 2040 no-build network, and the 2040 no-build morning peak hour (NB_AM) and 2040 no-build afternoon peak hour (NB_PM) scenario trip tables.
- (*CC_MSA.smp*) includes the MSA microsimulation network and 2020 AM, 2020 PM, 2025 AM, 2025 PM, 2030 AM, 2030 PM, 2040 AM, 2040 PM scenarios for the morning and afternoon peak hours.

These files include all associated files such as trip tables, signal timing controls and scenario specific parameters. The 2040 AM/PM scenarios shall be used to evaluate any alternative concept modifying the MSA. The remaining scenarios are provided for interim year and/or 'year of failure' assessments should they be required.

Alternative concepts shall be prepared by copying the MSA Project File and creating a separate, unique alternative Project File. It is recommended that concise, descriptive Project File names, such as *CC_ATC_01.smp* are used to help identify the alternative associated with the concept developed and submitted for review.

c. Simulation Project Settings.

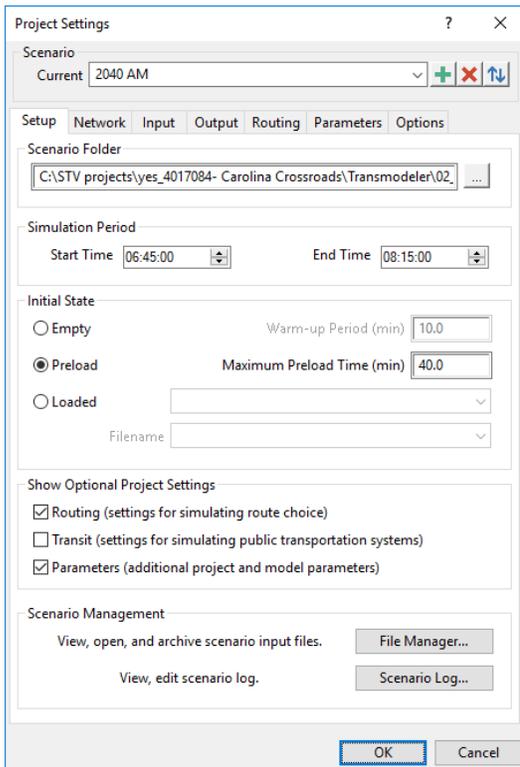
Settings for each Project File can be accessed by selecting Project->Settings from the menu.

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The specific Project Settings used in modeling the MSA are outlined in **Figure 4** to **Figure 18**. The figures include the Project Settings for the Setup, Network, Input, Output, Routing, Parameters, and Options tabs. The few settings that may be changed on these tabs are noted. **Most settings shall not be changed.** If the settings identified as those that shall not be changed are modified, valid results are not guaranteed and comparisons between the MSA and Alternative Concept outputs cannot be made.

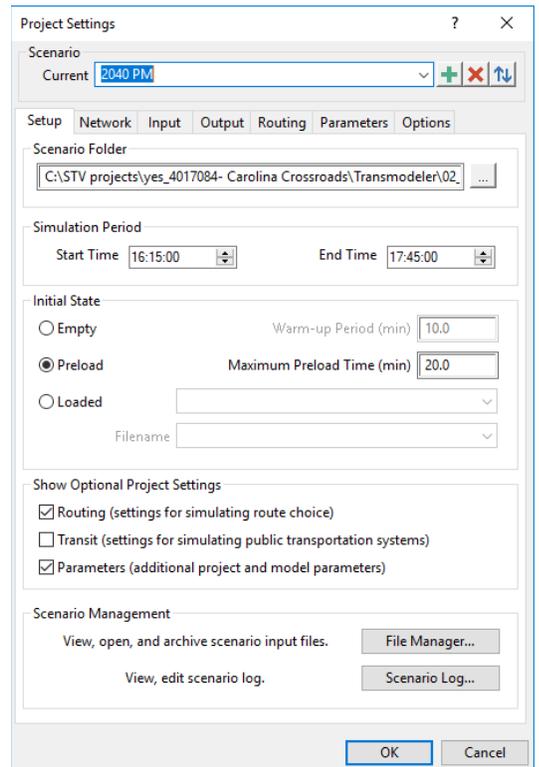
The Setup tab for the MSA AM and PM peak hour scenarios are shown in **Figure 4** and **5**. Aside from the Current Scenario and Scenario Folder Path, **these settings shall not be changed.** The Start Time and End Time of the Simulation Period, the Preload setting under the Initial State and its corresponding Maximum Preload Time, and the Optional Project Settings shall be consistent for the AM and PM peak hour scenarios as shown.

Figure 4 - Project Settings Setup Tab 2040 AM



The screenshot shows the 'Project Settings' dialog box for the '2040 AM' scenario. The 'Scenario' dropdown is set to 'Current' and '2040 AM'. The 'Setup' tab is selected. The 'Scenario Folder' is 'C:\STV projects\yes_4017084- Carolina Crossroads\Transmodeler\02...'. The 'Simulation Period' has a 'Start Time' of 06:45:00 and an 'End Time' of 08:15:00. Under 'Initial State', 'Preload' is selected with a 'Warm-up Period (min)' of 10.0 and a 'Maximum Preload Time (min)' of 40.0. The 'Show Optional Project Settings' section has 'Routing', 'Parameters', and 'Transit' checked. The 'Scenario Management' section has 'File Manager...' and 'Scenario Log...' buttons.

Figure 5 - Project Settings Setup Tab 2040 PM



The screenshot shows the 'Project Settings' dialog box for the '2040 PM' scenario. The 'Scenario' dropdown is set to 'Current' and '2040 PM'. The 'Setup' tab is selected. The 'Scenario Folder' is 'C:\STV projects\yes_4017084- Carolina Crossroads\Transmodeler\02...'. The 'Simulation Period' has a 'Start Time' of 16:15:00 and an 'End Time' of 17:45:00. Under 'Initial State', 'Preload' is selected with a 'Warm-up Period (min)' of 10.0 and a 'Maximum Preload Time (min)' of 20.0. The 'Show Optional Project Settings' section has 'Routing', 'Parameters', and 'Transit' checked. The 'Scenario Management' section has 'File Manager...' and 'Scenario Log...' buttons.

Figures 6 and **7** show the Network tab under Project Settings for the MSA AM and PM scenarios. The Road Network Database should show the appropriate network file. The MSA network database file *CC_MSA.dbd* is used in any simulation of the MSA.

When working in a Project File for an Alternative Concept, the Road Network Database entry should reference the appropriate file created for the roadway network for that alternative. For example, a

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modified Road Network Database file created for an alternative named *CC_ATC_01.dbd* would be shown in the Road Network Database.

The Speed and Capacity settings for Free Flow Speed, Capacity, Lane Capacity, Lane Sat. Flow (Lane Saturation Flow) were set as part of the calibration process and shall not be modified in future analyses.

Figure 6 - Project Settings Network Tab 2040 AM

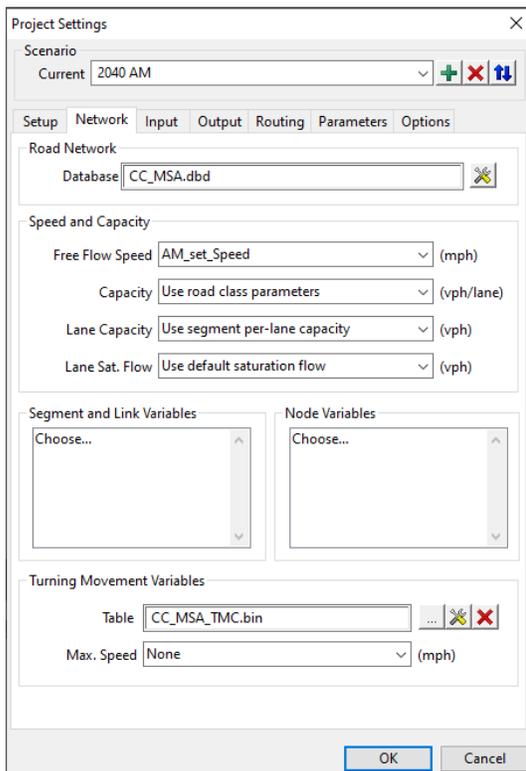
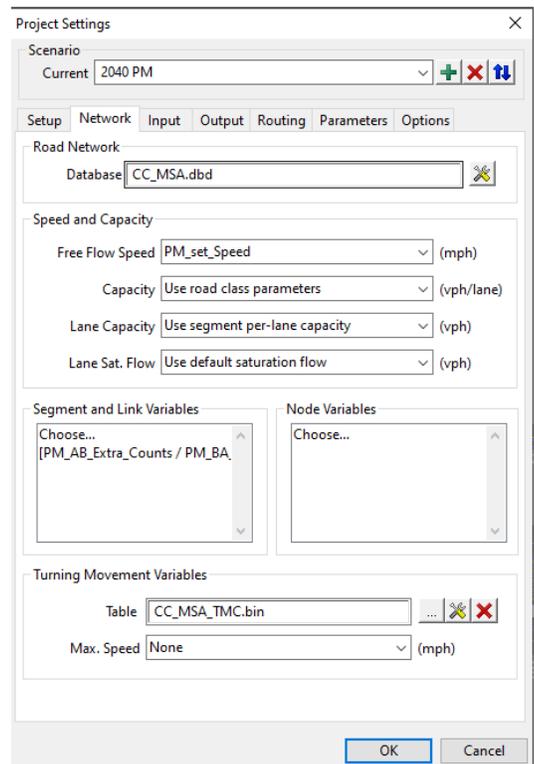


Figure 7 - Project Settings Network Tab 2040 PM



Figures 8 and 9 show the Input tab under Project Settings for the MSA AM and PM scenarios. The five files shown under the Trip Tables are selected based on the year of the scenario. The four individual trip matrix files and the file *CC_MSA_TMC.bin* shown under the Trip Tables shall not be modified.

There are separate matrices for automobile trips and for truck trips. The trip matrix files also contain the information concerning the peak-hour factor, terrain type, and other factors. This includes the vehicle composition/mix for autos and trucks. These elements of the trip matrix files shall not be modified.

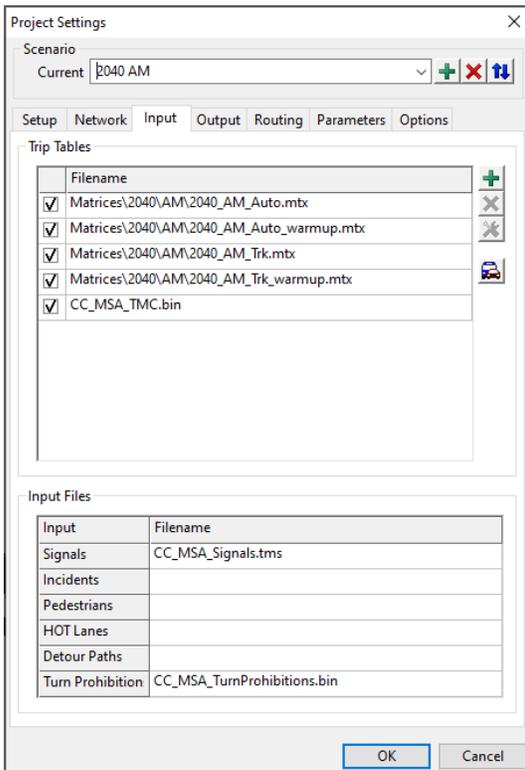
Traffic volume information for all existing and all future year scenarios is based on these trip tables. The trip tables are assigned through the network based on the origin-destination matrices using the Dynamic Traffic Assignment (DTA) feature in TransModeler.

Under the Input tab, the Signals file *CC_MSA_Signals.tms* and the Turn Prohibition file *CC_MSA_TurnProhibition.bin* are specific to the MSA. These files may be modified as necessary to account

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for changes in the coding of traffic signals in an Alternative Concept, and to add turn prohibitions as needed to prevent illegal or undesired turn movements. As described previously, the signal coding should be consistent with SCDOT guidelines. The files should have a file name consistent with the Alternative Concept name. All changes to the Signals and Turn Prohibition Input Files shall be documented to facilitate review.

Figure 8 - Project Settings Input Tab - 2040 AM



Project Settings

Scenario: Current 2040 AM

Setup Network **Input** Output Routing Parameters Options

Trip Tables

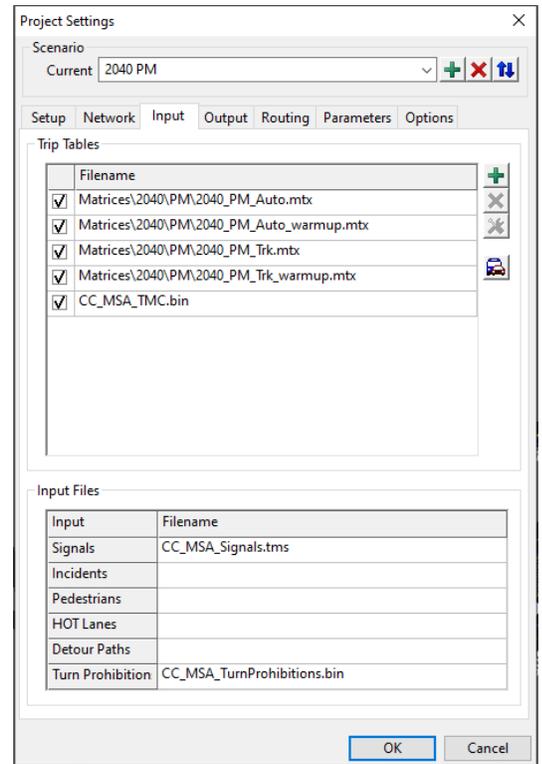
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<input checked="" type="checkbox"/> CC_MSA_TMC.bin	

Input Files

Input	Filename
Signals	CC_MSA_Signals.tms
Incidents	
Pedestrians	
HOT Lanes	
Detour Paths	
Turn Prohibition	CC_MSA_TurnProhibitions.bin

OK Cancel

Figure 9 - Project Settings Input Tab - 2040 PM



Project Settings

Scenario: Current 2040 PM

Setup Network **Input** Output Routing Parameters Options

Trip Tables

Filename	
<input checked="" type="checkbox"/> Matrices\2040\PM\2040_PM_Auto.mtx	
<input checked="" type="checkbox"/> Matrices\2040\PM\2040_PM_Auto_warmup.mtx	
<input checked="" type="checkbox"/> Matrices\2040\PM\2040_PM_Trk.mtx	
<input checked="" type="checkbox"/> Matrices\2040\PM\2040_PM_Trk_warmup.mtx	
<input checked="" type="checkbox"/> CC_MSA_TMC.bin	

Input Files

Input	Filename
Signals	CC_MSA_Signals.tms
Incidents	
Pedestrians	
HOT Lanes	
Detour Paths	
Turn Prohibition	CC_MSA_TurnProhibitions.bin

OK Cancel

The Trip Matrix settings are presented in **Table 3** below:

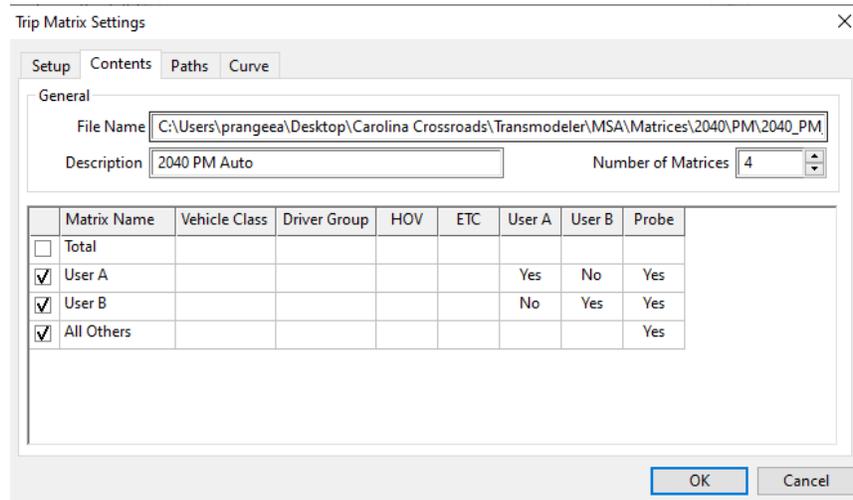
Phase 3 TransModeler Settings and Parameters

Table 3 - Trip Matrix Settings

Field	AM Peak		PM Peak	
	_AM_Warmup.mtx	_AM.mtx	_PM_Warmup.mtx	_PM.mtx
Time Interval: Start Time	6:45	7:15	16:15	16:45
Time Interval: End Time	7:15	8:15	16:45	17:45
Matrix Unit	Hourly Rate	Hourly Rate	Hourly Rate	Hourly Rate
Time Distribution	Constant Over Time	Curve-based	Constant Over Time	Curve-based
Unit Scaling Factor	0.370	1.00	0.400	1.00
Standard Deviation	0.00	0.00	0.00	0.00
Generate Departure Headways by	O-D	O-D	O-D	O-D
Departure Headways Distribution	Random (Negative Exponential)	Random (Negative Exponential)	Random (Negative Exponential)	Random (Negative Exponential)

Ensure the 'Probe' setting is set to 'Yes' in the Trip Content Matrix Settings for all matrices.

Figure 10 - Trip Matrix Settings



Trip Matrix Settings

Setup Contents Paths Curve

General

File Name: C:\Users\prangeea\Desktop\Carolina Crossroads\Transmodeler\MSA\Matrices\2040\PM\2040_PM

Description: 2040 PM Auto Number of Matrices: 4

Matrix Name	Vehicle Class	Driver Group	HOV	ETC	User A	User B	Probe
<input type="checkbox"/> Total							
<input checked="" type="checkbox"/> User A					Yes	No	Yes
<input checked="" type="checkbox"/> User B					No	Yes	Yes
<input checked="" type="checkbox"/> All Others							Yes

OK Cancel

The curve-based time distribution is displayed in **Table 4**.

Table 4 - Curve-Based Time Distribution

AM		PM	
Begin Time	Percentage	Begin Time	Percentage
7:15	24%	16:45	25%
7:30	26%	17:00	27%
7:45	27%	17:15	26%
8:00	23%	17:30	22%

Figures 11 and 12 show the Output tab under Project Settings for the MSA AM and PM scenarios. The Folder location shown under Output Selection should be located in the Project folder->Output folder. The first five Output Groups – Trip Statistics, Flow & Travel Time, Delay, Lane Queue, and Spillback Queue - shall be selected. The Step size shown for each of the Output Groups shall not be modified. VRC Sensor

Phase 3 TransModeler Settings and Parameters

Data may be checked to extract ATC specific truck percentages if necessary, such as for providing inputs to noise/air analyses.

Figure 11 - Project Settings Output Tab – 2040 AM

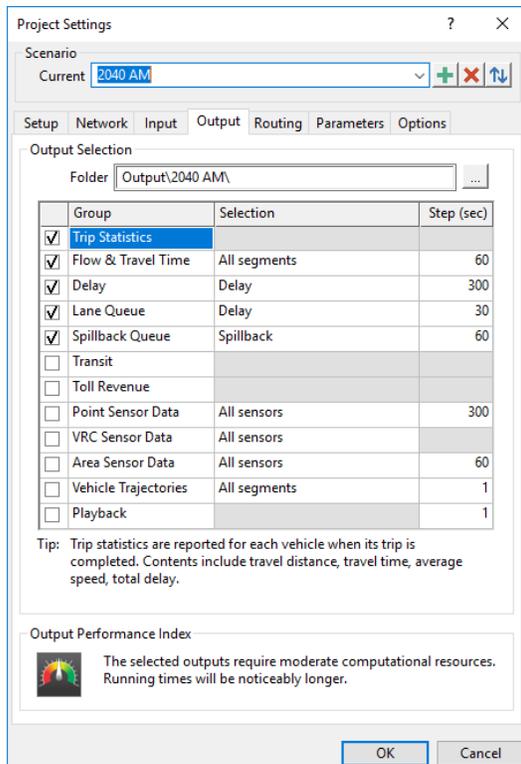
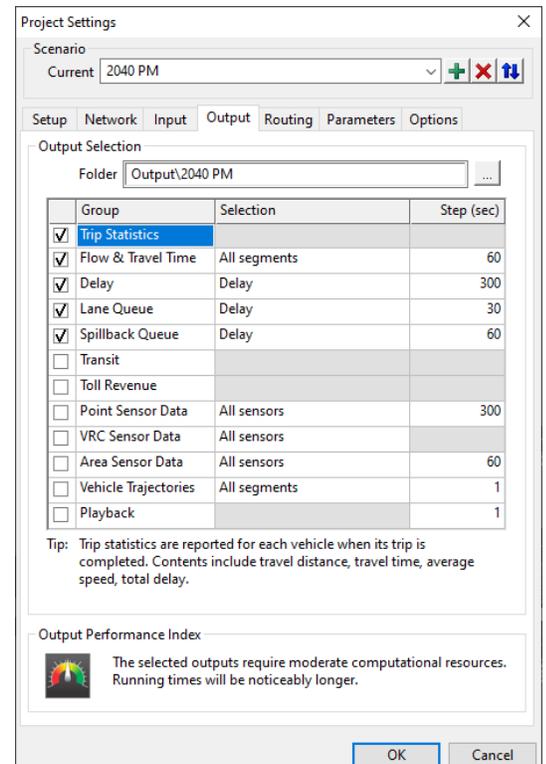


Figure 12 - Project Settings Output Tab - 2040 PM



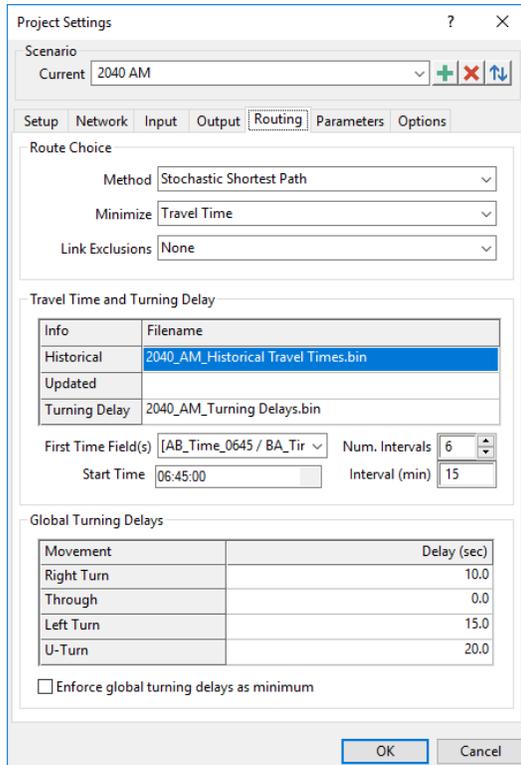
Figures 13 and 14 show the Routing tab under Project Settings for the MSA AM and PM scenarios. The Route Choice settings for “Method” and “Link Exclusions” shall be set to “Stochastic Shortest Path” and “None” respectively, and the box for “Use turning delays” shall be checked.

Under Travel Time and Turning Delay, the appropriate travel time files from the Project File and Simulation shall be used for the Historical and Turning Delay entries. The files shall not be modified. The “First Time Field(s)”, “Num. of Intervals”, “Start Time” and “Interval (min)” shall be set as shown.

Global Turning Delays shall be set as shown for Right Turn, Through, Left Turn, and U-Turn movements.

Phase 3 TransModeler Settings and Parameters

Figure 13 - Project Settings Routing Tab - 2040 AM



Project Settings

Scenario: Current 2040 AM

Setup Network Input Output **Routing** Parameters Options

Route Choice

Method: Stochastic Shortest Path

Minimize: Travel Time

Link Exclusions: None

Travel Time and Turning Delay

Info	Filename
Historical	2040_AM_Historical Travel Times.bin
Updated	
Turning Delay	2040_AM_Turning Delays.bin

First Time Field(s): [AB_Time_0645 / BA_Tir] Num. Intervals: 6

Start Time: 06:45:00 Interval (min): 15

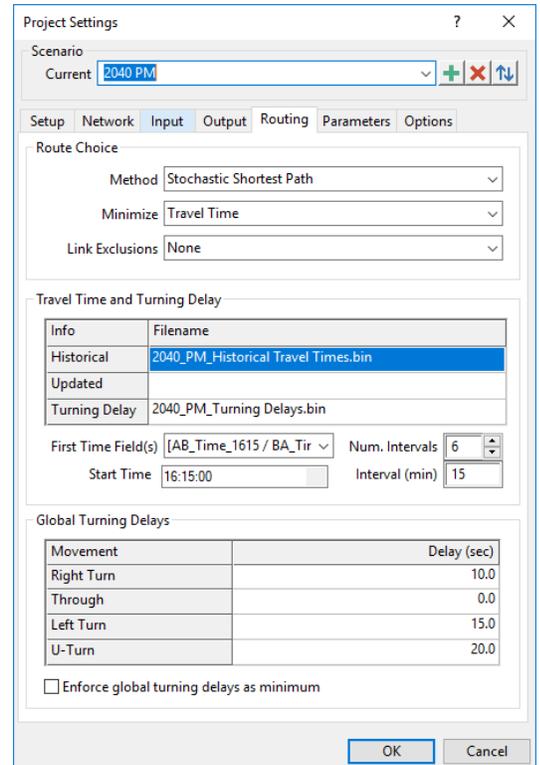
Global Turning Delays

Movement	Delay (sec)
Right Turn	10.0
Through	0.0
Left Turn	15.0
U-Turn	20.0

Enforce global turning delays as minimum

OK Cancel

Figure 14 - Project Settings Routing Tab - 2040 PM



Project Settings

Scenario: Current 2040 PM

Setup Network Input Output **Routing** Parameters Options

Route Choice

Method: Stochastic Shortest Path

Minimize: Travel Time

Link Exclusions: None

Travel Time and Turning Delay

Info	Filename
Historical	2040_PM_Historical Travel Times.bin
Updated	
Turning Delay	2040_PM_Turning Delays.bin

First Time Field(s): [AB_Time_1615 / BA_Tir] Num. Intervals: 6

Start Time: 16:15:00 Interval (min): 15

Global Turning Delays

Movement	Delay (sec)
Right Turn	10.0
Through	0.0
Left Turn	15.0
U-Turn	20.0

Enforce global turning delays as minimum

OK Cancel

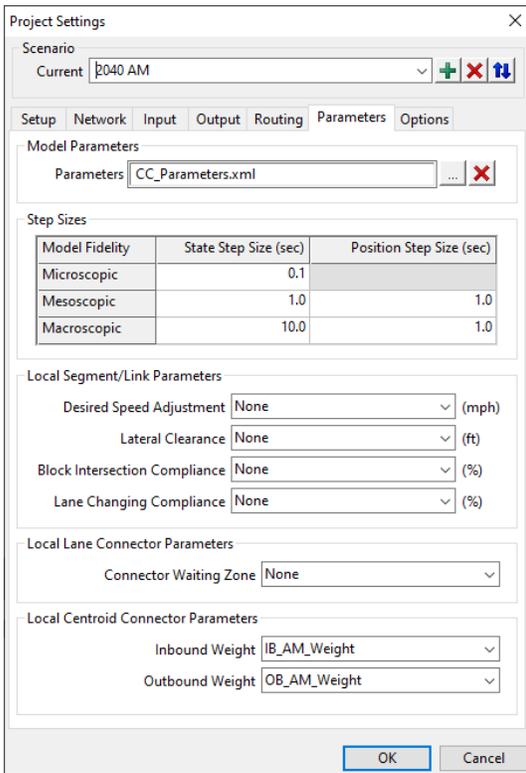
Phase 3 TransModeler Settings and Parameters

Figures 15 and 16 show the Parameters tab under Project Settings for the MSA AM and PM scenarios. The Parameters file *CC_Parameters.xml* under Model Parameters is Project based and will be the same in the AM and PM peak models. The parameter file name should remain the same and shall not be modified.

The Step Sizes shall be set for the AM and PM peak hour models as shown for the Microscopic, Mesoscopic, and Macroscopic Model Fidelity. The entries under Local Segment/Link Parameters – Desired Speed Adjustment, Lateral Clearance, Block Intersection Compliance, and Lane Changing Compliance – and the Connector Waiting Zone under Local Lane Connector Parameters shall all be set to “None”.

Under the Local Centroid Connector Parameters, the Inbound Weight and Outbound Weight parameters shall be set as shown. Those weight parameter files shall not be modified.

Figure 15 - Project Settings Parameters Tab - 2040 AM



Project Settings

Scenario: Current 2040 AM

Setup Network Input Output Routing Parameters Options

Model Parameters
Parameters: CC_Parameters.xml

Model Fidelity	State Step Size (sec)	Position Step Size (sec)
Microscopic	0.1	
Mesoscopic	1.0	1.0
Macroscopic	10.0	1.0

Local Segment/Link Parameters

Desired Speed Adjustment: None (mph)

Lateral Clearance: None (ft)

Block Intersection Compliance: None (%)

Lane Changing Compliance: None (%)

Local Lane Connector Parameters

Connector Waiting Zone: None

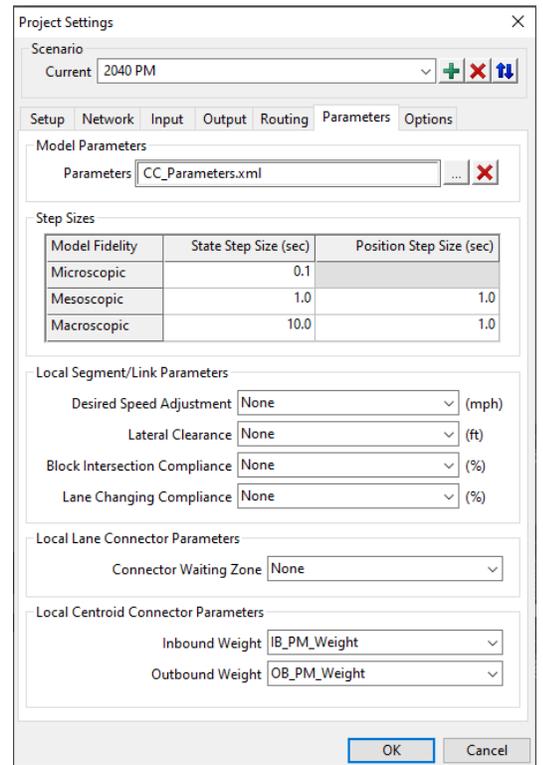
Local Centroid Connector Parameters

Inbound Weight: IB_AM_Weight

Outbound Weight: OB_AM_Weight

OK Cancel

Figure 16 - Project Settings Parameters Tab - 2040 PM



Project Settings

Scenario: Current 2040 PM

Setup Network Input Output Routing Parameters Options

Model Parameters
Parameters: CC_Parameters.xml

Model Fidelity	State Step Size (sec)	Position Step Size (sec)
Microscopic	0.1	
Mesoscopic	1.0	1.0
Macroscopic	10.0	1.0

Local Segment/Link Parameters

Desired Speed Adjustment: None (mph)

Lateral Clearance: None (ft)

Block Intersection Compliance: None (%)

Lane Changing Compliance: None (%)

Local Lane Connector Parameters

Connector Waiting Zone: None

Local Centroid Connector Parameters

Inbound Weight: IB_PM_Weight

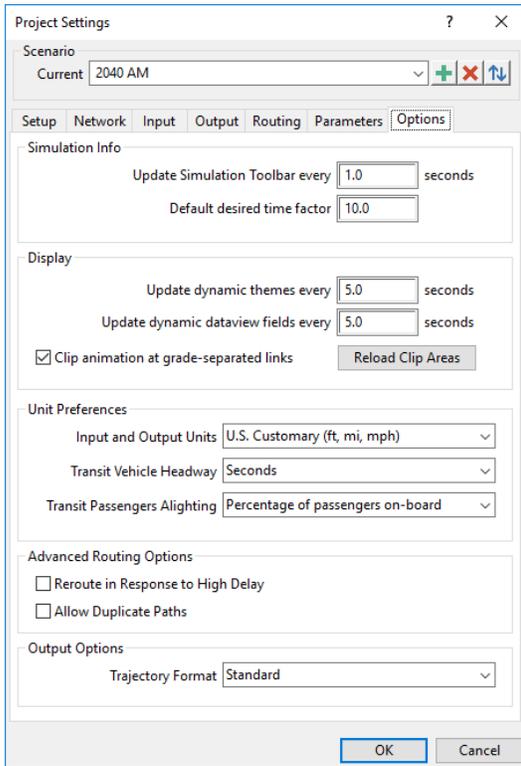
Outbound Weight: OB_PM_Weight

OK Cancel

Phase 3 TransModeler Settings and Parameters

Figures 17 and 18 show the Options tab under Project Settings for the MSA AM and PM scenarios. The Simulation Info, Display, Unit Preferences, and Advanced Routing Options shall be set as shown.

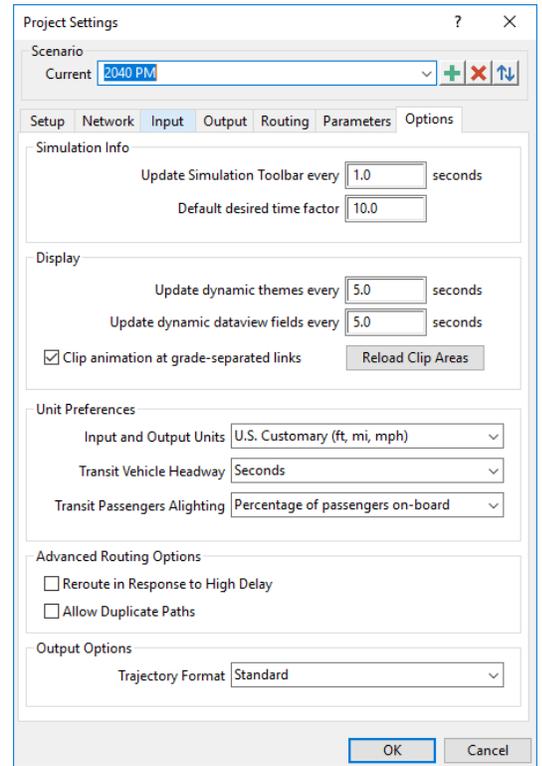
Figure 17 - Project Settings Options Tab - 2040 AM



The screenshot shows the 'Options' tab of the Project Settings dialog for the 2040 AM scenario. The 'Scenario' dropdown is set to '2040 AM'. The 'Options' tab is selected, showing the following settings:

- Simulation Info:** Update Simulation Toolbar every 1.0 seconds; Default desired time factor 10.0.
- Display:** Update dynamic themes every 5.0 seconds; Update dynamic dataview fields every 5.0 seconds; Clip animation at grade-separated links; Reload Clip Areas button.
- Unit Preferences:** Input and Output Units: U.S. Customary (ft, mi, mph); Transit Vehicle Headway: Seconds; Transit Passengers Alighting: Percentage of passengers on-board.
- Advanced Routing Options:** Reroute in Response to High Delay; Allow Duplicate Paths.
- Output Options:** Trajectory Format: Standard.

Figure 18 - Project Settings Options Tab - 2040 PM



The screenshot shows the 'Options' tab of the Project Settings dialog for the 2040 PM scenario. The 'Scenario' dropdown is set to '2040 PM'. The 'Options' tab is selected, showing the following settings:

- Simulation Info:** Update Simulation Toolbar every 1.0 seconds; Default desired time factor 10.0.
- Display:** Update dynamic themes every 5.0 seconds; Update dynamic dataview fields every 5.0 seconds; Clip animation at grade-separated links; Reload Clip Areas button.
- Unit Preferences:** Input and Output Units: U.S. Customary (ft, mi, mph); Transit Vehicle Headway: Seconds; Transit Passengers Alighting: Percentage of passengers on-board.
- Advanced Routing Options:** Reroute in Response to High Delay; Allow Duplicate Paths.
- Output Options:** Trajectory Format: Standard.

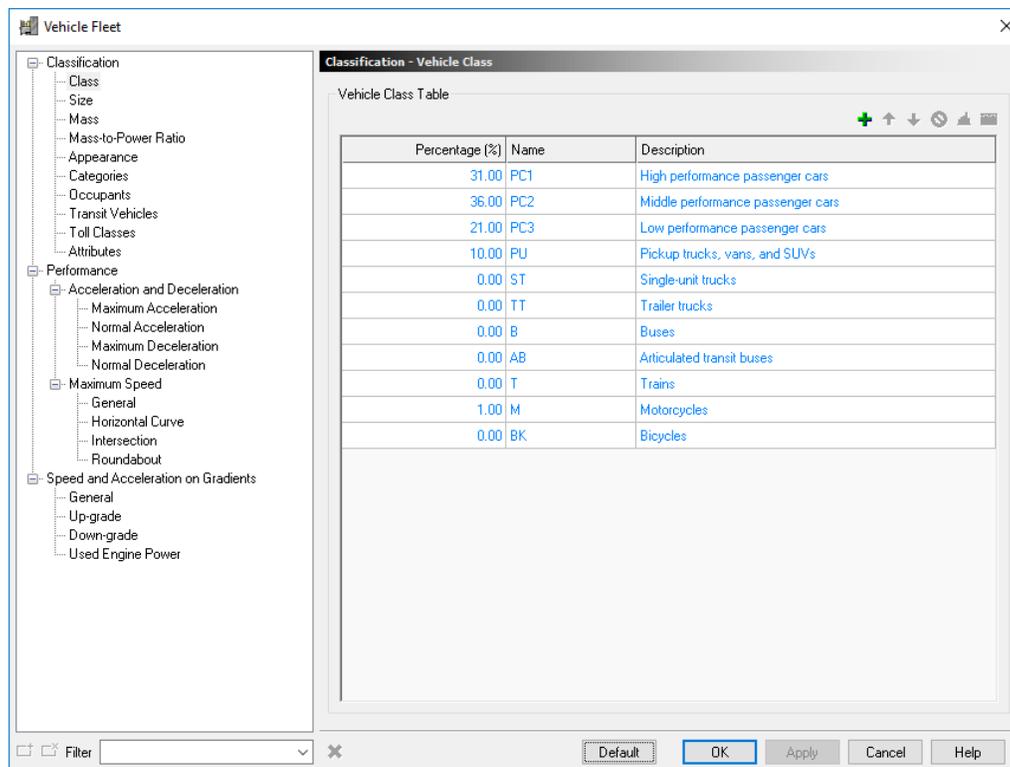
4. Simulation Parameter Settings

The simulation parameters can be accessed via the TransModeler menu via the Parameters tab. These settings shall not be changed. They are described here as a reference to the specific settings used in the MSA networks.

- a. The Vehicle Class table can be found by accessing Parameters->Vehicle Fleet->Class and is displayed in the **Figure 19**.

Phase 3 TransModeler Settings and Parameters

Figure 19 - MSA Vehicle Class Table Settings



As illustrated in **Figure 19**, five vehicle class percentages are defined. There are percentages included for the three passenger car classes (PC1, PC2, and PC3), the PU classification (which includes pickup trucks, vans, and SUVs); and the Motorcycle classification.

No percentages are shown for two classes of trucks, buses and articulated transit buses, trains, and bicycles. The truck class percentage information is provided separately in the truck trip matrices. Buses, articulated transit buses, trains, and bicycles are not used in the MSA vehicle classifications.

The Auto Matrices (Auto.mtx and Auto_warmup.mtx) include the vehicle composition as shown above. The Truck Matrices (Trk.mtx and Trk_warmup.mtx) are composed of ST (single truck) and TT (truck-trailer) vehicles. These parameters shall not be modified.

b. Driver Behavior

The driver behavior table can be found by accessing [Parameters->Driver Behavior](#). These parameters shall not be modified.

c. Simulation Options

The Simulation Options settings can be accessed by [Simulation->Options](#).

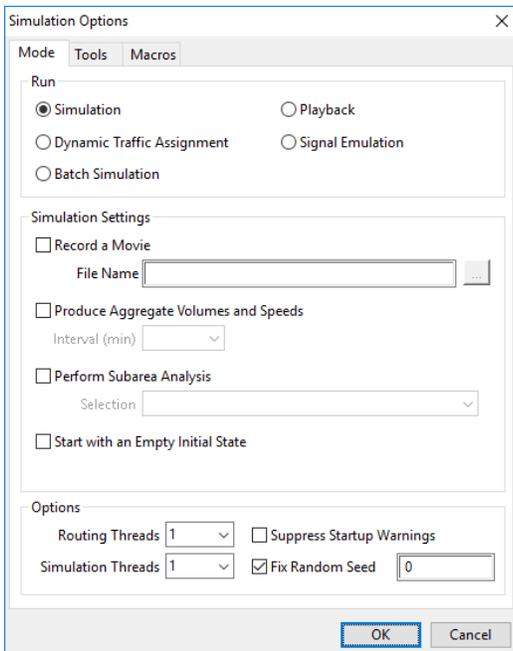
In the Mode tab in the Run section, there are several options for running the simulation. The options most applicable to developing and evaluating ATCs are the Simulation, Dynamic Traffic Assignment, and Batch Simulation options.

Phase 3 TransModeler Settings and Parameters

The Simulation button should be selected when it is desired to perform a visual check of the network operation. This is useful to verify network changes are functioning properly and to identify areas of congestion within the network. The settings that should be used when the Simulation button is selected are shown in **Figure 20**.

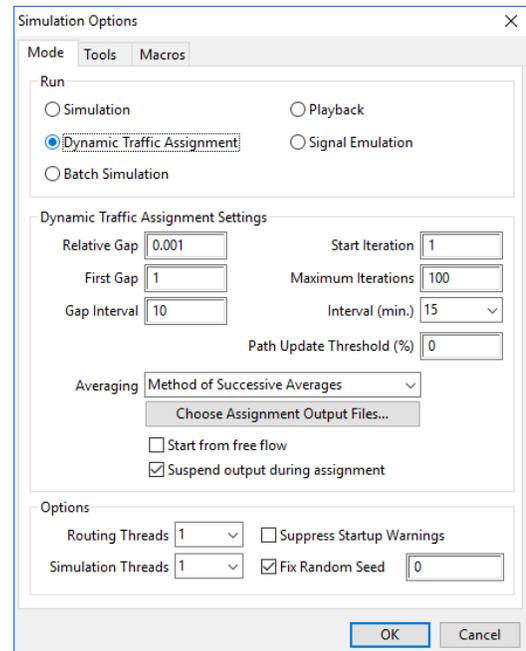
For ATC's which include changes to the roadway network, dynamic traffic assignment (DTA) will need to be completed in order to generate historical travel times and turning delay files. The settings used for running a Dynamic Traffic Assignment (DTA) are shown in **Figure 21**. These settings are established at the scenario level in the project and shall not be changed.

Figure 20 - Simulation Mode Settings



The screenshot shows the 'Simulation Options' dialog box with the 'Simulation' radio button selected. The 'Run' section includes options for Simulation, Playback, Dynamic Traffic Assignment, Signal Emulation, and Batch Simulation. The 'Simulation Settings' section includes checkboxes for 'Record a Movie', 'Produce Aggregate Volumes and Speeds', 'Perform Subarea Analysis', and 'Start with an Empty Initial State'. The 'Options' section includes 'Routing Threads' (1), 'Simulation Threads' (1), 'Suppress Startup Warnings', and 'Fix Random Seed' (checked).

Figure 21 - Dynamic Traffic Assignment Mode Settings



The screenshot shows the 'Simulation Options' dialog box with the 'Dynamic Traffic Assignment' radio button selected. The 'Dynamic Traffic Assignment Settings' section includes fields for 'Relative Gap' (0.001), 'Start Iteration' (1), 'First Gap' (1), 'Maximum Iterations' (100), 'Gap Interval' (10), 'Interval (min.)' (15), and 'Path Update Threshold (%)' (0). The 'Averaging' section includes a dropdown for 'Method of Successive Averages' and a 'Choose Assignment Output Files...' button. The 'Options' section includes 'Routing Threads' (1), 'Simulation Threads' (1), 'Suppress Startup Warnings', and 'Fix Random Seed' (checked).

After the completion of the DTA, historical travel time and turning delay files shall be added to the Routing Settings and visual checks of the paths shall be completed to ensure that appropriate paths are being utilized (for example vehicles are not going through multiple loops at an interchange), and volume is not being excessively re-routed to adjacent interchanges and arterials. Volumes at key locations should be checked to ensure they are relatively consistent with the MSA. If extraneous paths are found that are impacting the operations, they should be deleted from the path file. If the path file is altered, the path file shall be attached to each of the Input Matrices as shown in **Figure 22**.

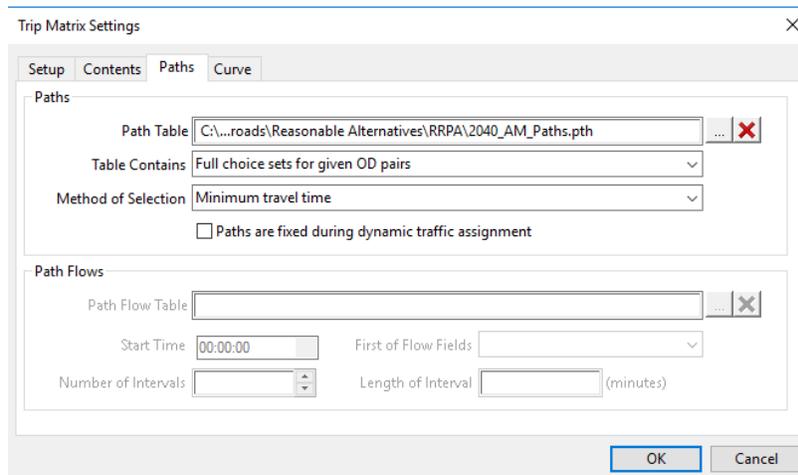
After the DTA and the visual check and adjustment of travel paths have been completed, a Batch Simulation shall be performed to generate the measures of effectiveness for the morning and afternoon peak hour conditions for the ATC. The settings used for running a Batch Simulation are shown in **Figure 23**.

Phase 3 TransModeler Settings and Parameters

These settings are established at the scenario level in the project. The Batch Simulation settings are used to generate 10 simulation runs which shall be averaged together to prepare the output measures of effectiveness.

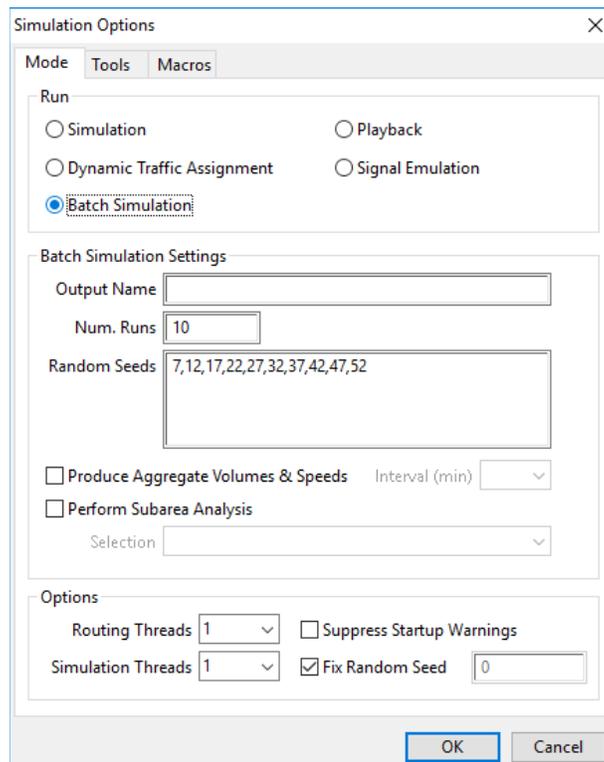
When the Batch Simulations are run, the random seeds shall be 7,12,17,22,27,32,37,42,47,52. Once the Batch Simulation is completed, outputs can be extracted and processed using the Output Template described below.

Figure 22 – Path File Settings



The screenshot shows the 'Trip Matrix Settings' dialog box with the 'Paths' tab selected. The 'Path Table' is set to 'C:\...roads\Reasonable Alternatives\RRPA\2040_AM_Paths.pth'. The 'Table Contains' dropdown is set to 'Full choice sets for given OD pairs' and the 'Method of Selection' dropdown is set to 'Minimum travel time'. There is an unchecked checkbox for 'Paths are fixed during dynamic traffic assignment'. The 'Path Flows' section has an empty 'Path Flow Table' field, a 'Start Time' of '00:00:00', and 'Number of Intervals' and 'Length of Interval' fields.

Figure 23 - Batch Simulation Mode Settings



The screenshot shows the 'Simulation Options' dialog box with the 'Mode' tab selected. Under the 'Run' section, 'Batch Simulation' is selected with a radio button. The 'Batch Simulation Settings' section includes 'Output Name' (empty), 'Num. Runs' (10), and 'Random Seeds' (7,12,17,22,27,32,37,42,47,52). There are checkboxes for 'Produce Aggregate Volumes & Speeds' (unchecked) and 'Perform Subarea Analysis' (unchecked). The 'Options' section includes 'Routing Threads' (1), 'Simulation Threads' (1), 'Suppress Startup Warnings' (unchecked), and 'Fix Random Seed' (checked) with a value of 0.

Phase 3 TransModeler Settings and Parameters

5. Outputs and Measures of Effectiveness

Output Template files have been provided to be used in the comparison of ATC results with the 2040 MSA results. These templates shall be used for freeway, arterial and intersection operations, as well as overall network performance. The templates provided include each set up for all data that is to be extracted from the output files.

a. Freeway Operations Performance

To assess the freeway operations, the output template file shall be used to obtain volume, speed, and density for the basic freeway, merge/diverge, and weave segments along I-26, I-20, and I-126 within the study area. Include segment numbers so that accurate comparisons can be made between models. Additional volume and queue data shall be provided for the ramps along the interstates within the study area. The following information shall be provided in the tables:

- AM and PM Mainline/Merge/Diverge/Weave Densities and LOS
- AM and PM Mainline and Ramp volumes
- AM and PM Ramp Queue Lengths
- AM and PM Mainline Speeds

Average freeway segment speeds shall be added to the segment database for the development of network speed figures. The Color Theme file provided with the MSA file shall be used to illustrate mainline speed and to facilitate comparison of the ATC to the 2040 MSA (similar to **Figure 24**).

b. Arterial Operations Performance

To assess the arterial operations, the output template file shall be used to compare the ATC to the 2040 MSA for the study area intersections outlined in **Table 1** and **Table 2**. The following information shall be provided in the tables:

- Intersection/Approach/Movement Delays and LOS
- Intersection Queue Lengths (95th Percentile, Average and Maximum Spillback)
- Arterial Travel Times
 - a. Broad River Road (Greystone Blvd to west of Exit 101)
 - b. Bush River Road (West of Exit 63 to Broad River Road)
 - c. Colonial Life Boulevard (I-126 Ramps to Bush River Road)

c. Network Performance

In addition to illustrating the freeway and arterial performances, network-wide performance measures shall be provided that compare the ATC and the 2040 MSA scenarios. The following performance measures have been identified for comparison purposes:

- AM and PM Vehicle Miles Traveled
- AM and PM Vehicle Hours Traveled
- AM and PM Total Completed Trips
- AM and PM Total Denied Entry
- AM and PM Interstate End to End Travel Times

Phase 3 TransModeler Settings and Parameters

d. Additional Potential Performance Measures

In addition to the previous performance measures, the following performance measures have been identified for as potential measures that may be useful for comparison purposes:

- Average peak hour speeds per segment (color coded table format)
- Mainline segment LOS (percent of total segments by LOS).
- Average Speed/Density by segment
- Speed by segment comparison to alternatives
- Freeway travel times bar charts
- Cumulative Travel Times for Freeways
- Vehicle Throughput (for major throughput routes)
- Throughput comparison in table with % change
- Ramp Queue Spillback
- TransModeler vs free-flow travel time comparison
- TransModeler volumes vs balanced count comparison
- Intersection LOS pie charts and tables

The output template files shall be used to compare the ATC to the 2040 MSA for each of the identified performance measures.

Figure 24 – Segment Speeds



Phase 3 TransModeler Settings and Parameters

6. Maintenance of Traffic Analysis

The following information relates to elements of creating and running the simulations for the Maintenance of Traffic Phases.

a. Transmodeler Network Coding

- The MOT analysis shall be completed in the same version of TransModeler with the version used for the MSA.
- The MOT network in the TransModeler network shall match the MOT alternative depicted in the plan submittal
- Code merge areas, link connectors, lane connectors and lane usage as described in the MSA guidelines
- Do not overlap links, such as ramp and mainline links
- Freeway crossover links (across a median) shall be coded as one-way, single lane links.
 - a. When freeway crossover links are used, two-way traffic shall be modeled using a pair of one-way segments in opposite directions on what was previously coded as a single one-way segment in a single direction. A two-way freeway link shall not be coded. For example, if westbound freeway traffic is to crossover to the eastbound side, the two-way crossover shall be coded as a pair of separate westbound and eastbound one-way segments. The original eastbound one-way segment shall not be converted to a two-way segment.
- Review and address error messages related to network coding
- Maintain segment numbers to the extent possible to facilitate comparisons to the base condition
- No clipping of the MOT area from the entire network model shall be permitted
 - a. The entire network model shall be used for the MOT analysis; using a subsection of the TransModeler network clipped to model just the MOT area shall not be permitted
 - b. Using the entire network model will indicate the impact of the MOT alternative on network performance and ensure that key structural elements of the network (lane connectors, etc.) remain present in the MOT network
- Appropriate adjustments in roadway class for the work zone shall be used
 - a. For example, speeds of 70 mph and link capacities of 2,400 vehicles per lane are not appropriate for freeway work zone conditions
 - b. Classes that incorporate appropriate work zone speeds and link capacities shall be required
 - c. This may require creating a new Road Class for 'Construction' under the microscopic tab
 - i. All links within the MOT construction area shall be included in the new Road Class

Phase 3 TransModeler Settings and Parameters

- ii. Speed distribution on these links shall be changed to 'Work Zone'
- b. Transmodeler Network Settings
 - AM and PM vehicle and truck matrices provided with the MSA network shall be used
 - Vehicle paths shall be present for all vehicle categories and O-D pairs
 - Vehicle paths shall be checked for reasonableness
 - a. For example, mainline traffic should remain on the freeway through an interchange area and not exit and re-enter at an interchange
 - AM and PM peak hours shall be analyzed separately using the appropriate matrices
 - Traffic signals and signal timings shall not be removed unless removed as part of the MOT/detour plan
 - Simulation warm-up times shall not be shortened or eliminated
 - Peak hour volume should be spread over the peak hour modeling period only, and not also in all or part in the warm-up period.
- c. Transmodeler Simulations and Outputs
 - Output summaries shall report the 60-minute peak hour results, and shall not include the warm-up period results
 - Simulation observations shall be completed to ensure effective operation of the MOT plan and to verify vehicles in the simulations are behaving properly. Improper behavior includes, but is not limited to, sudden appearance or disappearance of vehicles within the network or at crossovers, exiting and re-entering the mainline at an interchange, etc. Simulation observations for both peak hours shall be included as part of the MOT analysis operational reporting.