Supplement #1

Travel Demand Modeling Report

Alabama 2040 Statewide Transportation Plan

Prepared for

Alabama Department of Transportation
Bureau of Transportation Planning and Modal Programs

Prepared by
J. R. Wilburn and Associates, Inc.

J.R. WILBURN AND ASSOCIATES, INC.

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1. Introduction

Alabama's statewide travel demand model is an important tool for determining existing and future congestion levels. To project overall travel demand, the travel demand model assigns trips to a statewide model roadway network based on existing and projected socioeconomic data related to population and employment. In urbanized areas of the state witin the boundaries of a Metropolitan Planning Organization (MPO), the socioeconomic data from the MPO's travel demand model is incorporated into the statewide model as appropriate. The information derived from the statewide model is key to identifying projected needs and developing an overall statewide investment strategy.

This supplemental report presents the methodology and activities undertaken to update the statewide travel demand model as a part of the 2040 update to the Alabama Statewide Transportation Plan (SWTP) for the Alabama Department of Transportation (ALDOT). As such, it provides a discussion on:

- Development of the base year zone structure and highway network
- Process of aggregating socioeconomic data and developing trip generation
- Integration of freight values into the model
- Travel demand model development, calibration and validation
- Sources for population and employment projections
- Modeling scenarios tested for the plan
- Methodology and results for testing the performance of planned improvements

In addition, the model was used to conduct a funding gap analysis. The analysis compared identified capacity needs against projected funding to determine the shortfall in funding for capacity improvements to address congestion needs through 2040.

2. Travel Demand Modeling Methodology

2.1 Base Year Zone Structure and Highway Network

The first task associated with the travel demand modeling effort was to update the zone structure and roadway network to reflect the new base year. The previous model used 2005 as the base year for the roadway conditions and the 2000 Census Tracts as the basis for the zone structure. The updated version uses the 2010 Census Tracts as the base year zone structure and either 2010 or 2015 as the year for the data and roadway estimates, depending on the data availability and quality.

The Census Tract numbers for Alabama changed between the 2000 and 2010 Census, with the addition of nearly 100 Census Tracts statewide, bringing the total to 1,179 zones. This resulted in the need to update the zone structure and corresponding centroid connector placements across the state to allow for the use of all the new Census Tracts. The Census Tract locations were downloaded from the Census website in ArcGIS format and the population and households were obtained with the data. Figure 1 shows the zones.

The statewide model's roadway network includes Interstates, US routes, and State routes, as shown in Figure 2, and was developed through coordination between ALDOT and the state's MPOs and Regional Councils (RCs). The National Highway System (NHS) is an important roadway network component maintained by ALDOT and is also contained within the statewide model. Where necessary to allow for connectivity between roadway links and centroids, some additional roadways were inserted, primarily in urban areas. The model network, shown in Figure 3, also includes roadways needed for connectivity.

Figure 1: Zone Structure Using Census Tracts

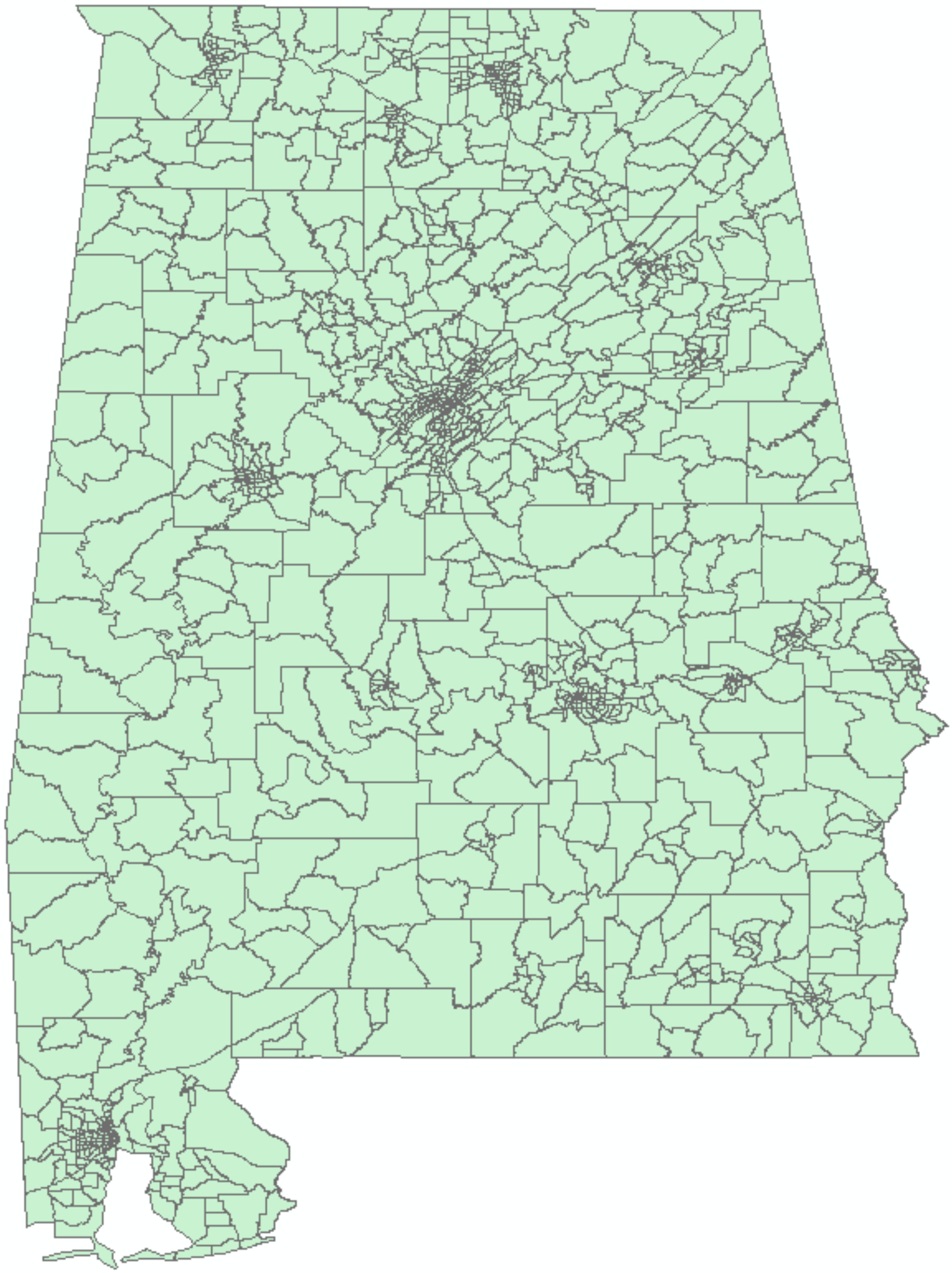


Figure 2: State Roadway System

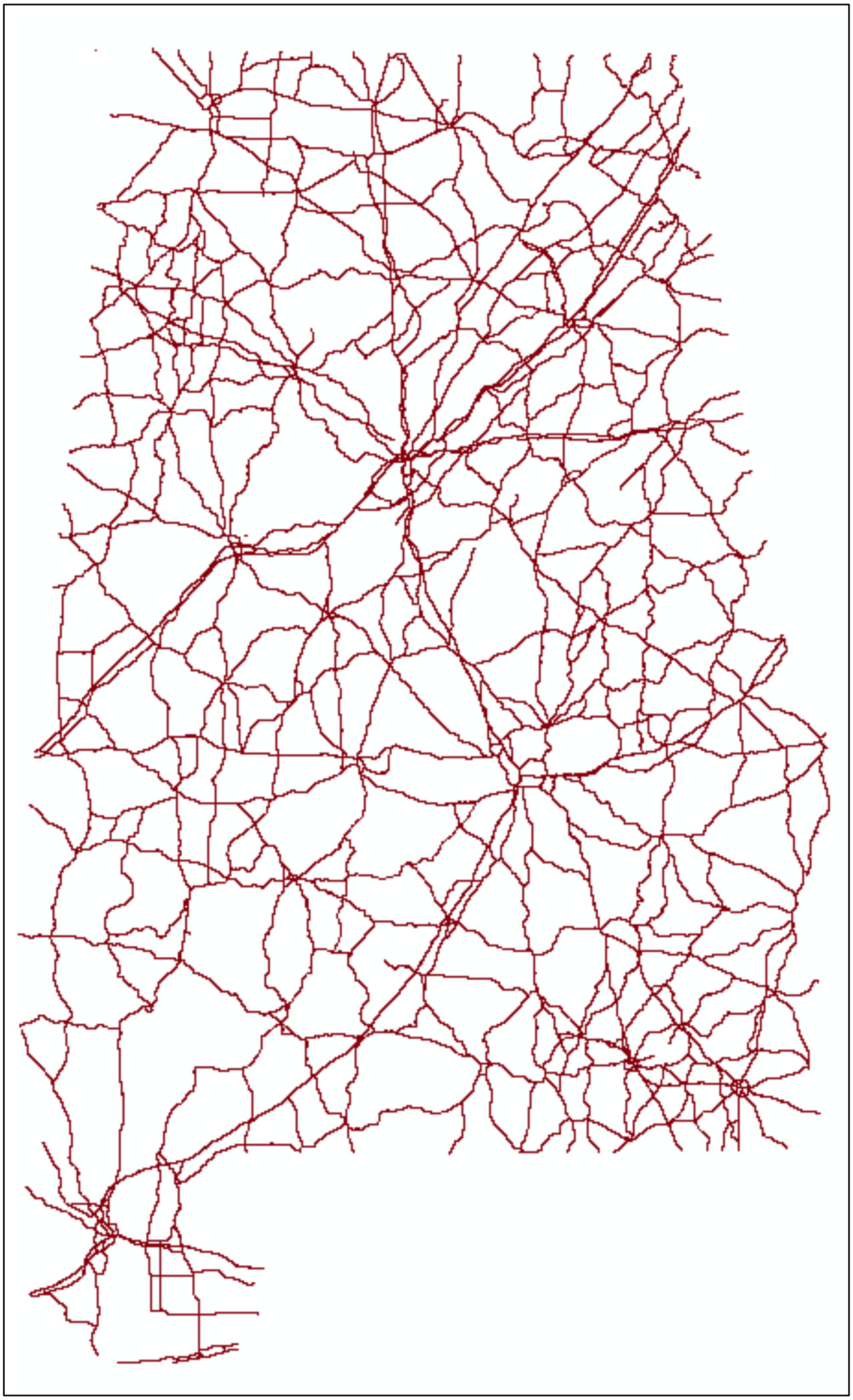
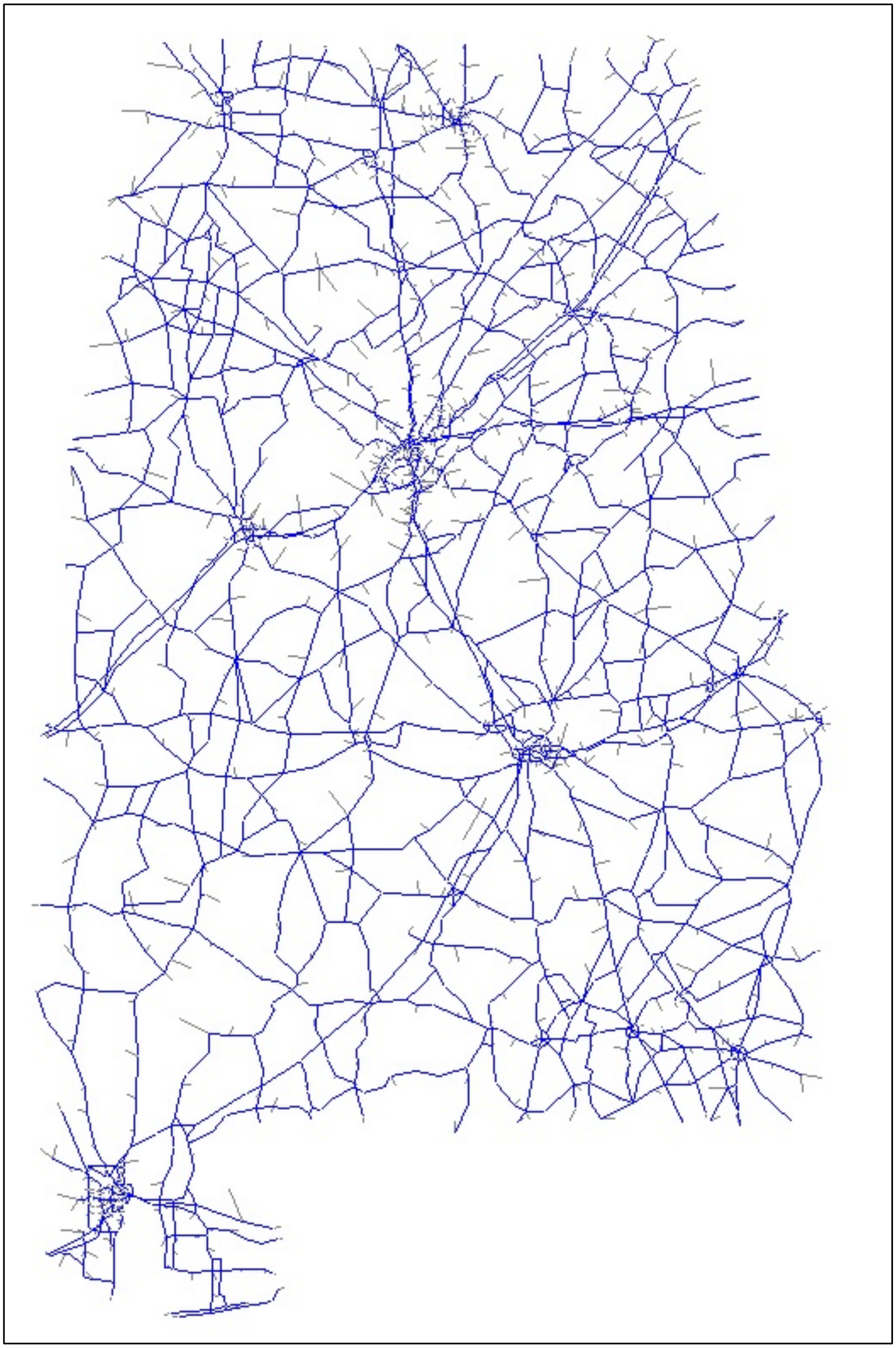


Figure 3: Model Roadway Network



It should be noted that the urbanized area MPO models present information at a finer level of detail than the statewide travel demand model. This is arrived at by splitting the larger Census Tract based zones into smaller, more numerous TAZ (traffic analysis zones). This is appropriate to their regional planning needs as the MPO models are designed to assess regional characteristics of a particular urbanized area rather than at a statewide level.

The model network is attributed with distance, posted speed limit, number of lanes, travel time, average daily traffic, percent trucks, and roadway names. The distance was obtained from CUBE voyager software when the network was digitized. The posted speed limit and number of lanes were obtained using the State's CARE crash database, in which crashes are attributed with these values by the officers inspecting the crashes for crash analysis. Traffic and percent trucks were taken from a database provided by ALDOT, while travel time was calculated using the program.

2.2 Socioeconomic Data Aggregation and Trip Generation

The socioeconomic data was collected using the US Census population and household numbers for 2010 and the Longitudinal Employer-Household Dynamics data set available from the US Census for the employment data. The data collected included the number of households, average income for the households, retail employment and non-retail employment.

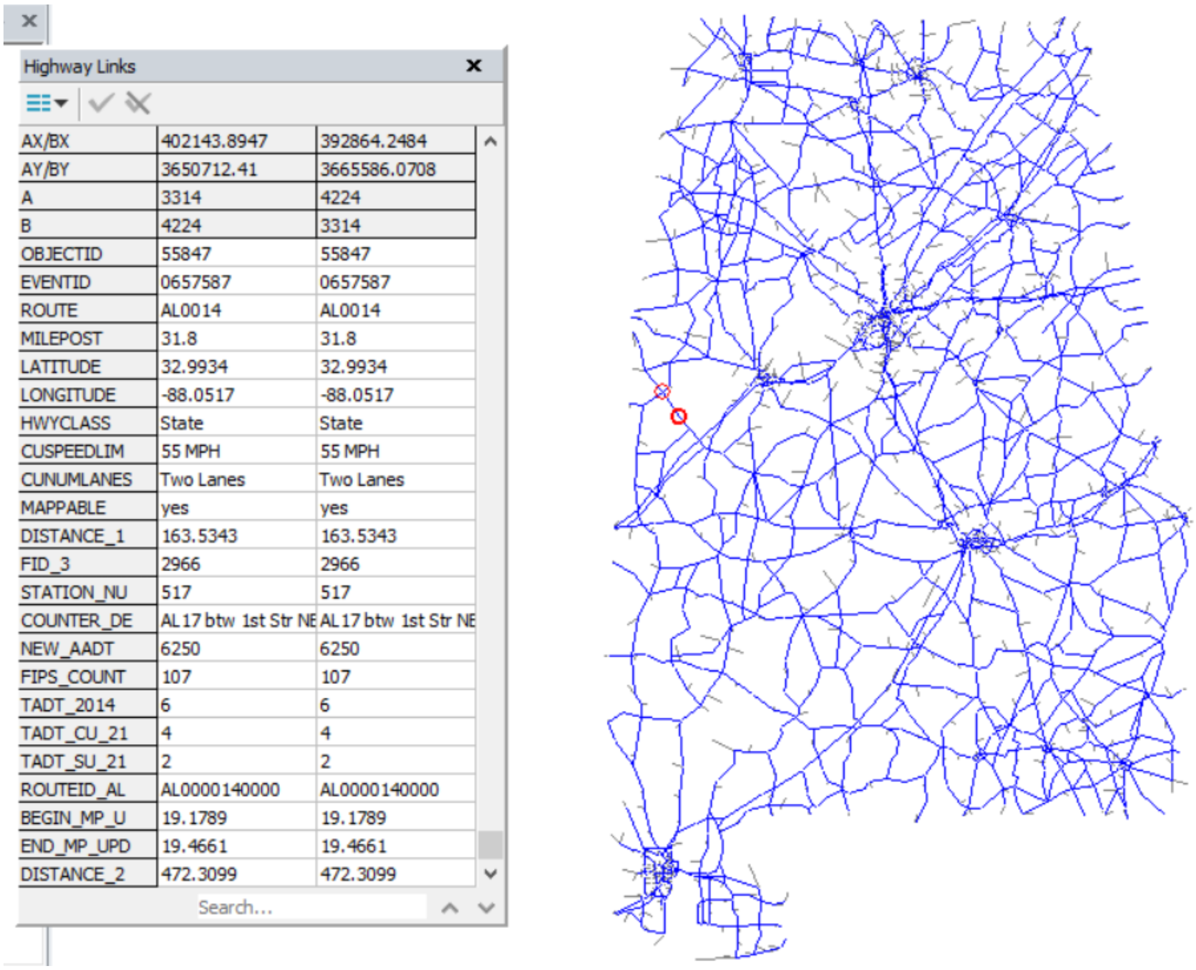
The external count data were collected from the statewide traffic count database at the state line to allow for the external traffic numbers. The external road type, taken from functional classification, was used to determine the percent pass-through trips at the external location. The percentages used in the model were the same as those used in the previous statewide model to remain consistent.

The Alabama Trip Generation program was run for the data collected. The results included the number of productions and attractions expected for each zone and external station for the six different trip purposes: home-based-work, home-based-other, non-home-based, truck-taxi, external-internal, and external-external.

2.3 Freight Values

The freight values for the model roadways were collected from the state. The process used the counted truck percent for each roadway. The freight flows and truck percentages were compared to ensure compatibility later in the update process. A spatial join was performed to attribute the roadways in the model with the appropriate truck percent from the statewide database. An example for one particular location in the central western portion of the state (designated by the red circles) is shown in Figure 4.

Figure 4: Roadway Network Attributes for Freight



AX/BX	402143.8947	392864.2484
AY/BY	3650712.41	3665586.0708
A	3314	4224
B	4224	3314
OBJECTID	55847	55847
EVENTID	0657587	0657587
ROUTE	AL0014	AL0014
MILEPOST	31.8	31.8
LATITUDE	32.9934	32.9934
LONGITUDE	-88.0517	-88.0517
HWYCLASS	State	State
CUSPEEDLIM	55 MPH	55 MPH
CUNUMLANES	Two Lanes	Two Lanes
MAPPABLE	yes	yes
DISTANCE_1	163.5343	163.5343
FID_3	2966	2966
STATION_NU	517	517
COUNTER_DE	AL 17 btw 1st Str NE	AL 17 btw 1st Str NE
NEW_AADT	6250	6250
FIPS_COUNT	107	107
TADT_2014	6	6
TADT_CU_21	4	4
TADT_SU_21	2	2
ROUTEID_AL	AL0000140000	AL0000140000
BEGIN_MP_U	19.1789	19.1789
END_MP_UPD	19.4661	19.4661
DISTANCE_2	472.3099	472.3099

2.4 Travel Demand Model Development, Calibration and Validation

The travel demand model was developed in CUBE Voyager format. The process used the roadway network and results from the trip generation program as inputs to the model. The steps in the model process included trip distribution and traffic assignment; as a vehicle-only model, there were no other modes modeled in the process. The model in CUBE Voyager consists of a collection of modules that convert the model into assigned traffic volumes.

The calibration and validation of the travel demand model was performed using the Validation and Reasonableness Checking Manual. Initial validation statistics were developed. The model was tested using the statistical parameters identified, and the values were tested to ensure they met the thresholds identified.

2.5 Population and Employment Projections

The distribution of population and employment across the state is a key component to the travel demand model. Socioeconomic (SE) data for the statewide travel demand model was obtained for base year 2010 and the forecast year 2040. The base year 2010 SE data were obtained from the US Census Bureau and included households, household income, and employment (retail and non-retail). Forecast year 2040 projected household and employment values were developed using data from the MPOs (for urban areas only) and the University of Alabama Center for Business and Economic Research (CBER). County growth percentages were applied to each traffic analysis zone (TAZ) in the statewide model. In the urban areas, the growth percentages were matched with the MPO's projected growth on a percentage basis to allow for additional refinement based on the availability of more detailed local data and input.

2.6 Modeling Scenarios

Three scenarios were developed for the modeling process:

- Base year 2010 model with 2010 SE data and network. This model run reflects existing congestion and capacity needs.
- Future year 2040 No-Build Alternative, with the 2010 network and 2040 SE data. This model run reflects the baseline for future capacity needs.
- Future year 2040 with existing and committed (E+C) projects and 2040 SE data. This reflects capacity needs remaining after construction of capacity improvements through 2040.

The committed projects through year 2040 incorporated in the E+C modeling scenario include the major capacity improvoements in the ALDOT work program as of April 1, 2017. These projects are listed in Table 1 and shown in Figure 1.

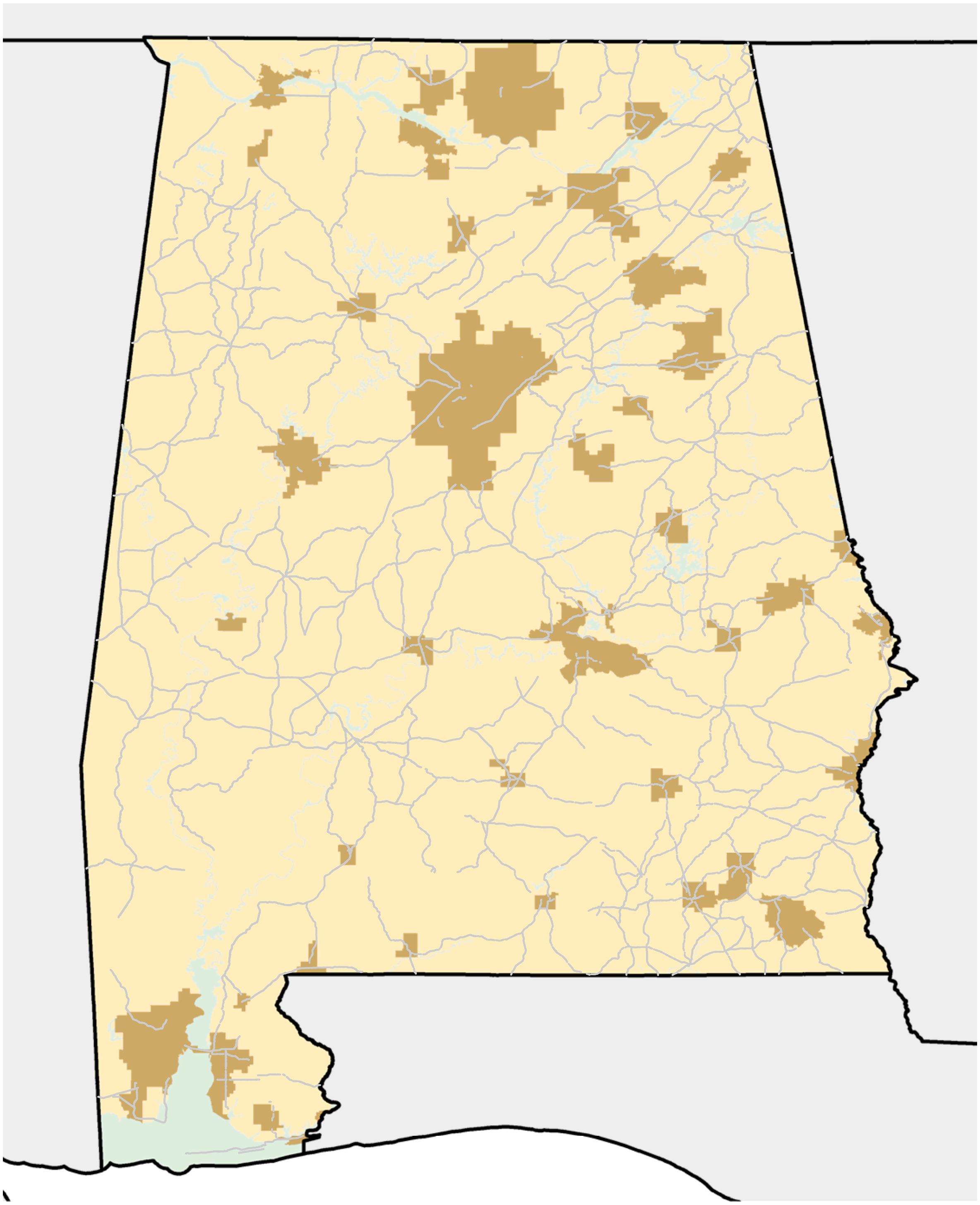
Table 1: Major Capacity Improvements Committed Through 2040

Map ID	Description (Planned Construction Years in Parentheses)
1	Widening of US 72 from Indian Springs Road to East of Harris Road from 4 to 7 lanes in Lauderdale County (2027)
2	Widening of US 72 East of the intersection of CR-528 (Jefferson Street) to beneath the CSX railroad from 4 to 6 lanes in Limestone County (2019)
3	Widening of US 72 from County Line Road to Providence Main from 4 to 6 lanes in Madison County (2019)
4	Widening of SR 53 from North of Taurus Lane to Harvest Road from 2 to 5 lanes in Madison County (2024)
5a	Widening of Memorial Parkway (US 231) from South of CR 75 (Mastin Lake Road) to CR 65 (Winchester Road) from 4 to 8 lanes in Madison County (2018)
5b	Widening of Memorial Parkway (US 231) from Lakewood Drive to Hollow Road from 4 to 6 lanes in Madison County (2038)
6	Widening of SR 35 from William Street to the Tennessee River from 2 to 4 lanes in Jackson County (2021)
7	Relocation of SR 69 from US 231 to Main Street in Arab to a new 5-lane facility in Marshall County (2023)
8a	Widening of SR 157 from SR 69 to US 31 from 2 to 5 lanes in Cullman County (2020)
8b	Widening of SR 69 from 4th Avenue to US 278 from 2 to 4 lanes in Cullman County (2026)
9	Widening of SR 13 in Haleyville from 2 to 3 lanes in Winston County
10	Widening of SR 13 from Walker County line to US 278 from 2 to 4 lanes in Winston County (2022)
11	Widening of I-65 from Blount County line to south of SR 69 from 4 to 6 lanes in Cullman County (2025)

Map ID	Description (Planned Construction Years in Parentheses)
12	Construction of Birmingham Northern Beltline, a new 6-lane facility from SR 79 to SR 75 in Jefferson County (2036)
13a	Widening of SR-77 from I-59 to US 11 from 2 to 5 lanes in Etowah County (2022)
13b	Widening of SR-77 from US 11 to US 431 from 2 to 3 lanes in Etowah County (2025)
14	Widening of SR 200 from SR 21 to US 278 from 2 to 4 lanes in Calhoun County (2030)
15	Widening of US 231 from Cropwell Road to SR 34 from 2 to 5 lanes in St. Clair County (2020)
16	Widening of I-59 from I-459 to Chalkville Mountain Road from 4 to 6 lanes in Jefferson County (2022)
17	Construction of I-22 as a 4-lane facility from I-65 to US 31 in Jefferson County (2025)
18	Widening of US 78 from Finley Boulevard to Pratt Highway from 5 to 7 lanes in Jefferson County (2027)
19a	Widening of I-59 from US 11 (1st Avenue North) to I-459 from 4 to 6 lanes in Jefferson County (2023)
19b	Widening of I-59 from 18th/19th Street (Exit 112) to Valley Road (Exit 118) from 4 to 6 lanes in Jefferson County (2025)
20	Widening of US 280 over I-459 from Summit Boulevard to Blue Lake Drive from 2 to 3 lanes in Jefferson County (2022)
21	Widening of SR 150 from Parkwood Drive to west of Shades Creek from 2 to 4 lanes in Jefferson County (2020)
22	Construction of a 4-lane Helena Bypass from CR 52 west of Helena to SR 261 north of Helena in Shelby County (2022)
23	Widening of SR 261 from Bearden Road to US 31 from 2 to 5 lanes in Shelby County (2020)
24	Widening of SR 119 from CR 80 to CR 26 from 2 to 4 lanes in Shelby County (2017)
25	Widening of I-65 from US 31 to CR 52 from 4 to 8 lanes in Shelby County (2021)
26	Construction of a 4-lane Calera Bypass from SR 25 west of Calera to US 31 north of Helena in Shelby County (2022)
27	Bridge widenings on I-65 from Exit 228 to Exit 231 near Calera from 4 to 6 lanes in Shelby County (2022)
28	Widening of US 82 from west of Gordo to Tuscaloosa County line from 2 to 4 lanes in Pickens County (2019)
29a	Widening of US 11 from Lower Coaling Road to Haglar Coaling Road from 2 to 3 lanes in Tuscaloosa County (2023)
29b	Widening of US 11 from I-59 to Kepple Loop Road from 2 to 3 lanes in Tuscaloosa County (2033)
30	Widening of SR 215 from SR 216 to US 11 from 2 to 4 lanes in Tuscaloosa County (2019)
31	Widening of I-59 from Black Warrior Parkway to south of Buttermilk Road from 4 to 6 lanes in Tuscaloosa County (2017,2018)
32	New 2-lane segment of SR 22 from (Roanoke) Main Street to US 431 in Randolph County (2020)
33	Widening of SR 21 from Sylacauga to CR 213 from 2 to 4 lanes in Talladega County (2030, 2031)
34	Relocation of 2-lane SR 77 from CR 35 to CR 31 in Clay County (2017)
35	Widening of US 31 at I-65 in Clanton from 2 to 3 lanes in Chilton County (2018)
36	Widening of SR 22 from 2 to 4 lanes in Dallas County (2021)
37	Widening of US 82 from SR 14 to US 31 from 2 to 4 lanes in Autauga County (2023)

Map ID	Description (Planned Construction Years in Parentheses)
38a	Widening of SR 14 from Ingram Road to Coosada Parkway from 2 to 4 lanes in Elmore County (2019)
38b	Widening of SR 14 from Lucytown Road to Calloway Creek from 2 to 4 lanes in Elmore County (2021)
39	Extension of 2-lane service roads along Northern Boulevard in Montgomery County (2025)
40	Widening of SR 110 from Vaughn Road to proposed Outer Loop location from 2 to 5 lanes in Montgomery County (2021)
41	Widening of I-85 from Taylor Road to Jenkins Creek (east of Chantilly Parkway) from 4 to 6 lanes in Montgomery County (2030)
42	Extension of acceleration lanes along I-85 at Exits 26, 38, and 42 in Macon County (2018)
43	Widening of I-85 from Mile Post 58.6 to Mile Post 62.45 from 4 to 6 lanes in Lee County (2030)
44	Addition of a truck climbing lane on SR 21 at Falkenberry Hill in Monroe County (2025)
45	Widening of US 84 from Monroe County to I-65 from 2 to 4 lanes in Conecuh County (2030-2032)
46	Widening of US 331 from CR 17 to CR 5 from 2 to 4 lanes in Crenshaw County (2023)
47	Widening of SR 167 from US 84 to north of Salem Road from 2 to 5 lanes in Coffee County (2026)
48a	Widening of Ross Clark Circle from Bauman Drive to Cherokee Avenue from 4 to 6 lanes (2018)
48b	Widening of Ross Clark Circle from US 231 South to Bauman Drive from 4 to 6 lanes (2028)
49a	Widening of US 98 from Mississippi State Line to 0.5 mile east of Glenwood Road from 2 to 4 lanes in Mobile County (2019)
49b	SR 158 Extension as 4-lane facility from Glenwood Road to Schillenger Road in Mobile County (2017-2026)
49c	Widening of SR 158 from I-65 to US 43 from 2 to 4 lanes in Mobile County (2025)
50	Widening of I-10 from CR 39 to Carol Plantation Road form 4 to 6 lanes in Mobile County (2023)
51	Widening of US 90 from CR 39 to 4-lane segment south of Theodore from 4 to 6 lanes in Mobile County (2031)
52a	Widening of I-10 and bridges from Broad Street to the Mobile County Line from 4 to 8 lanes in Mobile County (2020)
52b	Widening of I-10 and bridges from the Mobile County Line to US 90 from 4 to 8 lanes in Baldwin County (2020)
52c	Widening of I-10 from east of the Bayway Bridge to east of SR 181 from 4 to 6 lanes in Baldwin County (2020)
53	Widening of US 31 from Spanish Fort to SR 181 from 2 to 5 lanes in Baldwin County (2017)
54a	Widening of SR 181 from SR 104 to CR 64 from 2 to 5 lanes in Baldwin County (2017)
54b	Widening of SR 181 from US 98 to SR 104 from 2 to 4 lanes in Baldwin County (2023, 2024)
55	Widening of SR 180 from SR 59 to SR 161 from 2 to 4 lanes in Baldwin County (2021,2022)

Figure 5: Major Capacity Improvements Committed Through 2040



2.7 Testing the Performance of the Improvements Program

A key benchmark of any improvement program measures the overall benefits of the projects within the work program. This task utilized the statewide travel demand model to compare the base year 2010 conditions to projected conditions under the 2040 No-Build and 2040 E+C scenarios. It should be noted that this analysis was conducted for the major roadways included in the model network and therefore did not include any county or local roads, some of which carry significant volumes, particularly in urban areas.

Table 2 presents the conditions under each of the three modeling scenarios. In addition to socioeconomic data related to population and employment, three additional factors were compared:

- Vehicle Miles Traveled (VMT) – Miles traveled by all vehicles on the roadway network in a given year. This is a good measure of the overall utilization of the network.
- Vehicle Hours Traveled (VHT) – Hours spent traveling by all vehicles on the roadway network in a given year. This is a good indicator of overall delay when compared to different scenarios.
- Truck VMT – Miles traveled by trucks in a given year. This is good reflection of the overall utilization of the roadway network by truck freight.

Table 2: Projected Conditions Comparison – 2040 No-Build vs. 2040 E+C

	2010 Base	2040 No-Build	2040 E+C
Households	1,883,791	2,110,572	2,110,572
Population	4,803,667	5,381,960	5,381,960
Employment	1,844,995	3,250,061	3,250,061
Emp/HH Ratio	0.979	1.540	1.540
VMT	450,554,946	523,328,110	560,947,038
VHT	58,816,469	125,770,826	104,653,242
VMT/VHT	7.7	4.2	5.4
Truck VMT	97,382,214	114,057,538	122,470,824

Several key observations of the analysis include:

- A 16 percent increase in VMT is projected under the 2040 No-Build scenario, rising to 25 percent, or approximately 561 million miles of travel, under the E+C scenario. Construction of planned improvements under the E+C scenario are projected to result in an additional 38 million miles of travel compared to the No-Build scenario.
- A 113 percent increase in VHT, to almost 126 million hours of travel, is projected under the 2040 No-Build scenario. In contrast, the increase under the E+C scenario is less, at 78 percent or a total of approximately 105 million hours. This reflects an overall reduction of 21 million hours in congestion related delay throughout the state with the planned improvements.
- When comparing VMT to VHT, the ratio of miles traveled to hours traveled reduces significantly under both the No-Build and E+C scenarios. This indicates a significant increase in congestion statewide through 2040 regardless of improvements.
- As with overall traffic, reduced congestion due to improvements through 2040 will result in more truck miles traveled throughout the state. Increases in truck travel indicate a more favorable environment for economic development.

As previously noted, congestion throughout the state in 2040 is projected to increase under both future scenarios. A standard measure of congestion, Level of Service (LOS) is a function of travel speeds and delay. It is organized on an A to F grading scale in accordance with these general descriptions:

- LOS A-C: Little to no congestion
- LOS D: Mildly congested
- LOS E: At capacity and congested
- LOS F: Over-capacity and heavily congested

Table 3 compares levels of service for each of the three scenarios, as derived from the statewide travel demand model. Under projected 2040 conditions, the total miles in each category and their relative distributions are similar between the No-Build and E+C scenarios. Approximately 16 percent of the state's major roadways are projected to operate under LOS F conditions in 2040, even with the addition of planned capacity improvements. This indicates that:

- The capacity added by the improvements through 2040 will be absorbed by additional trips that result from the increased convenience.
- Given the increased travel yet reduced delay projected under the E+C scenario (as seen in Table 1), the severity of congestion on LOS F segments will be less, even if the number of miles of congested segments is projected to remain more or less comparable.

Table 3: Projected Congested Segments Comparison – 2040 No-Build vs. 2040 E+C

	2010 (Existing)		**2040 (No-Build)**		**2040 (E+C)**	
	Miles	%	Miles	%	Miles	%
LOS A-C	103,594	78.1%	99,482	75.0%	99,977	75.3%
LOS D	6,353	4.8%	6,000	4.5%	6,044	4.6%
LOS E	5,306	4.0%	4,995	3.8%	5,016	3.8%
LOS F	17,335	13.1%	22,111	16.7%	21,765	16.4%

2.8 Issues with Model Methodology and US 280

One issue identified during the statewide modeling process relates to the high traffic volumes between Auburn, AL and Columbus, GA on US 280. A function of how travel demand models operate, this particular issue occurs because the travel situation between Phenix City, AL and Columbus, GA violates traditional modeling practice. Essentially, the model attempts to use external traffic originating from household locations and distribute it toward zones with high employment. From the model perspective, external trips originating in Columbus (households) are destined for employment or to purchase goods and services in the high-employment locations in Auburn. However, in actuality, the trips that occur in this area travel from Phenix City (household origins) into Columbus (employment destinations), not Auburn. This results in the model assigning more trips than occur in actuality.

3. Capacity Funding Gap Analysis

The congested locations and conditions currently experienced on Alabama's State-maintained network are projected to continue increasing statewide through 2040, even with the construction of planned projects. An analysis of the funding "gap" between projected revenues and the financial investment needed to provide for relatively uncongested conditions across the entire network (and thus avoid worsening congestion at more locations) was completed. The analysis considered two primary factors: the number of lane-miles of congested facilities, and the cost of capacity improvements. The derived cost was based on high-level cost estimates per lane-mile using historic information from ALDOT in current dollars. The congestion levels were derived from two travel demand model runs:

- Base Year (2010) – to determine current congestion levels
- Existing plus Committed (E+C) (2040) – to determine future congestion levels

The gap analysis methodology consisted of four steps:

1. Identify the number of additional lane-miles of capacity necessary to alleviate congestion. Lane-miles were noted by area type (urban or rural) and facility type (freeway or arterial).
2. Develop an estimated total cost per lane-mile for capacity improvements based on ALDOT standards and historical information.
3. Calculate the total cost to add capacity to all identified lane-miles of need.
4. Compare the cost of the identified capacity investments against the projected revenues to determine the funding gap.

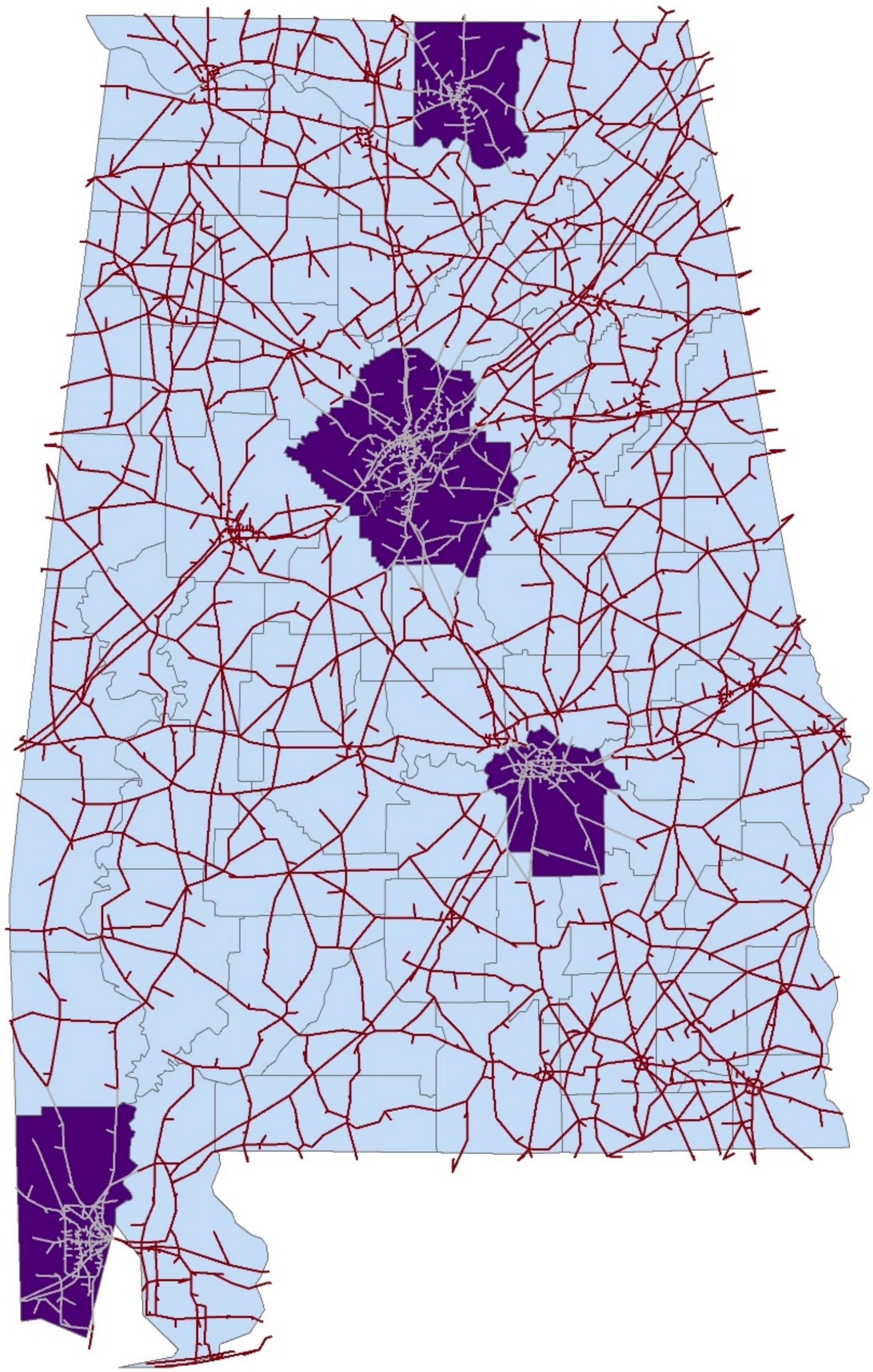
It should be noted that this is a macro-level statewide analysis to determine capacity needs. In reality, many of these congested corridors may not be suitable for widening projects due to corridor constraints that would be determined through a more detailed corridor analysis during project development. Given corridor constraints, other improvements such as signal enhancements, turn lane modifications, or improvements to parallel facilities may be appropriate.

3.1 Determining the Lane-Miles Needed to Address Congestion

The roadway network and congestion data was derived from the travel demand model. A daily volume-to-capacity (V/C) ratio of 1.0 was determined as the threshold for acceptable congestion. For each given facility in the travel demand model network, the traffic volumes were subtracted from the facility capacity to determine the number of excess trips. Then, the number of additional lanes needed to serve these excess trips, and thereby bring the roadway within the volume-to-capacity threshold of 1.0, was determined. The number of additional lanes was multiplied by the length of the segment to derive the total number of lane-miles for a given facility. The resulting lane-miles needed along the entire network were added together to determine the statewide total of needed lane-miles. It should be noted that this analysis was conducted by directional lane-miles and not centerline miles. Within any given centerline mile, a need for multiple lane miles to accommodate additional congestion on both directions would be needed. The actual length of deficient segments collectively represents the number of deficient centerline miles throughout the state.

The congested roadway lane-miles were categorized by location (urban or rural) and facility type (freeway or arterial) due to the differences inherent in their construction costs. For the purposes of this analysis, roadways within five counties were categorized as urban: Jefferson, Madison, Mobile, Montgomery and Shelby, as shown in Figure 6.

Figure 6: Gap Analysis Urban Areas



The analysis results indicate that significant investments in additional capacity would be required to alleviate existing congestion across Alabama. As Table 4 shows, more than 11,800 lane-miles of additional capacity is needed to address current congestion. Even with the construction of planned capacity improvements through 2040, this will increase to more than 13,200 lane-miles by 2040. The need for additional lane-miles is significantly greater on arterial facilities in both urban and rural locations than for freeways under both current and future conditions.

Table 4: Number of Additional Lane-Miles Needed to Address Congestion

Facility Type	2010 Base Year	2040 E+C	Difference
Urban Freeway	814	1,003	189
Urban Arterial	5,340	5,894	554
Rural Freeway	208	520	312
Rural Arterial	5,492	5,851	359
TOTAL	**11,854**	**13,268**	**1,414**

Given the extensive needs in additional lane-miles of capacity indicated by this analysis, it is important to consider the growth in needed lane-miles between now to 2040. As shown in Table 3, approximately 1,400 lane-miles of additional capacity would be required by 2040 to simply maintain current conditions and mitigate worsening congestion.

3.2 Developing Cost Estimates to Construct the Additional Lane-Miles

Unit costs from ALDOT (based on historical information) were used to develop estimated per lane-mile costs by facility type and location. The notably higher cost for urban improvements is attributable to a number of factors, including increased costs for right-of-way acquisition, utilities relocation, and the asphalt pavement densities necessitated by greater traffic volumes. The estimated cost per additional lane-mile by facility location and type is:

- Urban Freeway $5,301,455
- Urban Arterial $4,348,185
- Rural Freeway $3,191,455
- Rural Arterial $2,238,185

Table 5 presents a breakdown of the total investment cost (in current dollars) required to construct the additional lane-miles of needed capacity identified in Table 2. The cost to address current congestion needs totals approximately $40.5 billion. The total need jumps to $45.7 billion by 2040, even after the construction of planned improvements in the ALDOT work program. The larger portion of costs allocated to arterial facilities (approximately 85 percent) corresponds to the significantly greater need for lane-miles along the state's arterial facilities. Similarly, given that per lane-mile capacity improvements in urban areas cost substantially more than those in rural areas, it is not unexpected that more of the spending would be used for facilities in urban areas. Urban area facilities account for approximately two-thirds of total costs.

Table 5: Cost to Construct the Additional Lane-Miles

2010 Base Year Needed Costs				
Facility Type	**Centerline Miles of Needed Improvements**	**Lane Miles of Capacity Needed**	**Improvement Cost per Lane-Mile (Current $)**	**Total Cost for Improvements**
Urban Freeway	346	814	$5,301,455	$4,315,384,000
Urban Arterial	1,464	5,340	$4,348,185	$23,219,310,000
Rural Freeway	86	208	$3,191,455	$663,823,000
Rural Arterial	2,200	5,492	$2,238,185	$12,292,114,000
TOTAL	**4,096**	**11,854**	**N/A**	**$40,490,631,000**
2040 E+C Needed Costs				
Facility Type	**Centerline Miles of Needed Improvements**	**Lane Miles of Capacity Needed**	**Improvement Cost per Lane-Mile (Current $)**	**Total Cost for Improvements**
Urban Freeway	393	1,003	$5,301,455	$5,317,359,000
Urban Arterial	1,453	5,894	$4,348,185	$25,628,205,000
Rural Freeway	234	520	$3,191,455	$1,659,556,000
Rural Arterial	2,850	5,851	$2,238,185	$13,095,623,000
TOTAL	**4,929**	**13,268**	**N/A**	**$45,700,743,000**

The cost to respond only to worsening congestion between 2010 and 2040 totals $5.2 billion for the approximately 1,400 lane-miles of additional capacity indicated in Table 4. The largest portion (nearly half, or $2.4 billion) would be allocated to urban arterial facilities.

3.3 Gap in Available Funding to Meet Projected Capacity Needs

Any discussion of ALDOT funding expenditures must be preceded by noting that a foremost priority of the Department is on maintaining previous infrastructure investments. Therefore, maintenance projects (including resurfacing) account for a significant portion of ALDOT's expenditures, and are projected to continue to do so through 2040. Furthermore, the exact programming of maintenance funds to specific projects cannot be done more than several years in advance given the shorter-term nature of maintenance needs and project types.

Based on information provided by ALDOT for 2017-2020 funding and expenditures, roughly 7 percent of available funding revenues, or $391 million, is projected to be spent on capacity improvements. To extend revenue and expenditure projections to the years 2021-2040, the following steps were taken:

1. A two percent annual inflation rate was applied to the amount of federal funding through 2040. This is consistent with the inflation rate provided by FHWA for the FAST Act.
2. State funding was increased by $5 million annually through 2040, as was assumed in the short-term projections through the FAST Act provided by ALDOT.
3. The same distribution of expenses for capacity improvements provided in the short-term projections by ALDOT (7 percent) was assumed to remain constant from 2021 through 2040, as shown in Table 6.

As Table 6 shows, ALDOT is projected to have over $2.6 billion for capacity improvements through 2040.

Table 6: Projected Funding for Capacity Improvements

2017-2020	$ 391,473,000
2021-2040	$ 2,251,242,558
TOTAL	**$ 2,642,715,558**

Given the funding projections, the $2.6 billion available for capacity improvements through 2040 is $37.8 billion less than what is needed to alleviate current congestion needs ($40.5 billion). While planned improvements through 2040 will help address congestion needs, approximately $45.7 billion in additional capacity improvements is needed to alleviate projected congestion.

3.4 Alternative Urban Scenarios

Given that most urban areas are projected to have more severe levels of congestion, two alternative analyses were developed:

- Alternative Urban Scenario #1 – that increased acceptable V/C ratios to 1.15 in urban areas while maintaining a V/C of 1.0 in rural areas.
- Alternative Urban Scenario #2 – that increased acceptable V/C ratios to 1.30 in urban areas while maintaining a V/C of 1.0 in rural areas.

Alternative Urban Scenario #1 Analysis

As Table 7 shows, by increasing acceptable V/C ratios to 1.15 in urban areas, the number of lane-miles needed to alleviate existing congestion under this scenario drops slightly to approximately 11,300 lane-miles (versus 11,800 lane-miles in the original scenario). Similarly, a reduction is projected in the lane-miles needed to address congestion in 2040, decreasing to approximately 12,900 lane-miles under Alternative Urban Scenario #1 (versus 13,200 lane-miles in the original scenario).

Table 7: Number of Additional Lane-Miles Needed to Address Congestion – Alternative Urban Scenario #1

Facility Type	2010 Base Year	2040 E+C	Difference
Urban Freeway	621	896	275
Urban Arterial	4,974	5,597	623
Rural Freeway	208	520	312
Rural Arterial	5,492	5,851	359
TOTAL	**11,295**	**12,864**	**1,569**

It should be noted that, even though the total lane-miles of congestion decreases in both 2010 and 2040 when using the higher V/C threshold of 1.15, the number of additional lane-miles that must be improved by 2040 to maintain current conditions actually increases under the alternative urban scenario. Shown in Tables 4 and 7 as the "difference" in lane-miles between 2010 and 2040, the original scenario resulted in a total of an additional 1,414 lane-miles as compared to 1,569 lane-miles under Alternative Urban Scenario #1. This greater difference results because more roadways are in 1.0-1.15 V/C range in 2010 than in 2040. When the threshold is increased to a V/C of 1.15, a significant number of lane-miles are removed in the 2010 scenario; however, fewer lane-miles fall within the 1.0-1.15 V/C range in 2040. Essentially, there are a large number of miles between 1.0 and 1.15 in 2010, but not as many within that range in 2040, so the reduction is smaller. Stated another way, the proportion of roadways only slightly congested (1.0-1.15 V/C) is greater in 2010 than 2040, and conversely the proportion of roadways with more severe congestion (V/C greater than 1.15) is greater in 2040 than 2010. Specifically, under Alternative Urban Scenario #1, the total lane-miles over the threshold decreases by 559 in 2010 (11,854 vs. 11,295) and by 404 in 2040 (13,268 vs. 12,864), resulting in a net difference of 155 lane-miles (559 vs. 404).

Table 8 presents a breakdown of the total investment cost (in current dollars) required to construct the additional lane-miles of needed capacity under Alternative Urban Scenario #1. The cost to address current congestion needs decreases $2.6 billion to approximately $37.9 billion. Similarly, the total need in 2040 decreases by roughly $1.9 billion to approximately $43.8 billion. The larger allocation of costs to arterials and urban areas remains under Alternative Urban Scenario #1. Similarly, the urban/rural split remains constant, with two-thirds of expenditures going to facilities in urban areas.

Table 8: Cost to Construct the Additional Lane-Miles – Alternative Urban Scenario #1

2010 Base Year Needed Costs				
Facility Type	**Centerline Miles of Needed Improvements**	**Miles of Capacity Needed**	**Improvement Cost per Lane-Mile (Current $)**	**Total Cost for Improvements**
Urban Freeway	249	621	$5,301,455	$3,292,203,000
Urban Arterial	1,281	4,974	$4,348,185	$21,627,874,000
Rural Freeway	86	208	$3,191,455	$663,823,000
Rural Arterial	2,200	5,492	$2,238,185	$12,292,114,000
TOTAL	**3,816**	**11,295**	**N/A**	**$37,876,014,000**
2040 E+C Needed Costs				
Facility Type	**Centerline Miles of Needed Improvements**	**Miles of Capacity Needed**	**Improvement Cost per Lane-Mile (Current $)**	**Total Cost for Improvements**
Urban Freeway	339	896	$5,301,455	$4,750,103,000
Urban Arterial	1,305	5,597	$4,348,185	$24,336,794,000
Rural Freeway	234	520	$3,191,455	$1,659,556,000
Rural Arterial	2,850	5,851	$2,238,185	$13,095,623,000
TOTAL	**4,727**	**12,864**	**N/A**	**$43,842,076,000**

The cost to respond only to worsening congestion between 2010 and 2040 under Alternative Urban Scenario #1 totals $6.0 billion for the 1,569 lane-miles of additional capacity indicated in Table 7. This corresponds to an additional $756 million beyond the original scenario. Again, the largest portion (nearly half, or $2.7 billion) would be allocated to urban arterial facilities. Together, the urban freeway and arterial facilities would still amount for roughly two-thirds of the costs.

Alternative Urban Scenario #2 Analysis

As Table 9 shows, the number of lane-miles needed to alleviate existing congestion under this scenario drops to approximately 10,700 lane-miles (versus 11,800 lane-miles in the original scenario). A reduction is projected in the lane-miles needed to address congestion in 2040, decreasing to approximately 12,400 lane-miles under Alternative Urban Scenario #2 (versus 13,200 lane-miles in the original scenario).

Table 9: Number of Additional Lane-Miles Needed to Address Congestion – Alternative Urban Scenario #2

Facility Type	2010 Base Year	2040 E+C	Difference
Urban Freeway	462	741	279
Urban Arterial	4,618	5,329	711
Rural Freeway	208	520	312
Rural Arterial	5,492	5,851	359
TOTAL	**10,780**	**12,441**	**1,661**

As is the case with Alternative Urban Scenario #1, the number of additional lane-miles that must be improved by 2040 to maintain current conditions also increases under the Alternative Urban Scenario #2 when using the higher V/C threshold of 1.30. Shown in Tables 4 and 9 as the "difference" in lane-miles between 2010 and 2040, the original scenario resulted in a total of an additional 1,414 lane-miles as compared to 1,661 lane-miles under Alternative Urban Scenario #2. As is the case with Urban Scenario #1, this greater difference results because more roadways are in 1.0-1.3 V/C range in 2010 than in 2040. Specifically, under Alternative Urban Scenario #2, the total lane-miles over the threshold decreases by 1,074 in 2010 (11,854 vs. 10,780) and by 827 in 2040 (13,268 vs. 12,441), resulting in a net difference of 247 lane-miles (1,074 vs. 827).

Table 10 presents a breakdown of the total investment cost (in current dollars) required to construct the additional lane-miles of needed capacity under Alternative Urban Scenario #2. The cost to address current congestion needs decreases by approximately $5 billion to approximately $35.5 billion. Similarly, the total need in 2040 decreases by roughly $3.8 billion to approximately $41.9 billion. The larger allocation of costs to arterials and urban areas still remains under Alternative Urban Scenario #2. Similarly, the urban/rural split remains constant, with two-thirds of expenditures going to facilities in urban areas.

Table 10: Cost to Construct the Additional Lane-Miles – Alternative Urban Scenario #2

2010 Base Year Needed Costs				
Facility Type	**Centerline Miles of Needed Improvements**	**Miles of Capacity Needed**	**Improvement Cost per Lane-Mile (Current $)**	**Total Cost for Improvements**
Urban Freeway	170	462	$5,301,455	$2,449,272,000
Urban Arterial	1,103	4,618	$4,348,185	$20,079,920,000
Rural Freeway	86	208	$3,191,455	$663,823,000
Rural Arterial	2,200	5,492	$2,238,185	$12,292,114,000
TOTAL	**3,559**	**10,780**	**N/A**	**$35,485,129,000**
2040 E+C Needed Costs				
Facility Type	**Centerline Miles of Needed Improvements**	**Miles of Capacity Needed**	**Improvement Cost per Lane-Mile (Current $)**	**Total Cost for Improvements**
Urban Freeway	262	741	$5,301,455	$3,928,378,000
Urban Arterial	1,171	5,329	$4,348,185	$23,171,480,000
Rural Freeway	234	520	$3,191,455	$1,659,556,000
Rural Arterial	2,850	5,851	$2,238,185	$13,095,623,000
TOTAL	**4,516**	**12,441**	**N/A**	**$41,855,037,000**

3.5 Funding Needed to Maintain Current Conditions

Projections in Table 6 indicated that ALDOT is estimated to have a total of $2.6 billion for capacity improvements through 2040. Furthermore, it is assumed that all available funding for planned projects included in the 2040 E+C would be completely expended. Given these factors, and assuming the original 1.0 V/C threshold scenario, ALDOT would need approximately $7.8 billion through 2040 to maintain conditions at 2010 levels, as shown in Table 11. Under the alternative urban scenarios, that cost would increase to $8.6 billion under Alternative Urban Scenario #1 and to over $9 billion under Alternative Urban Scenario #2.

Table 11: Total Funding Required Through 2040 to Maintain Conditions at 2010 Levels (V/C at 1.0)

Capacity Funding	
Projected Capacity Funding - 2017-2020	$ 391,473,000
Projected Capacity Funding - 2021-2040	$ 2,251,243,000
TOTAL	**$ 2,642,716,000**
Cost of Additional Lane Miles Needed beyond Committed Projects	$5,210,112,000
Total Cost to Maintain 2010 Needed Lane Miles	**$ 7,852,828,000**