Chapter 7
Alternatives Analysis

ARRIVE 2045
Bismarck-Mandan MPO
Metropolitan Transportation Plan

ALTERNATIVE ANALYSIS

The alternatives analysis for this MTP was a multi-phased approach to assist in the identification of projects that should be evaluated and prioritized through 2045. This process included the following analyses:

- The Macro-Level Analysis evaluated large project concepts that would potentially address some of the most significant transportation issues, like new river crossings, interchanges, and other major connections.
- The Interstate Analysis completed a more detailed evaluation of the I-94 and I-194 mainline and existing interchanges.
- Smart Mobility workshop evaluated the impacts connected and autonomous vehicles and technology solutions could have on the transportation network.
- Project Evaluation and Prioritization scored and ranked the universe of projects included in this MTP.

Macro-Level Analysis

There are a series of major project concepts that would address some of the most significant transportation issues through the Bismarck-Mandan metro area. These concepts are "clusters" of individual projects representing a collection of generally coordinated improvements to the transportation system and designed to be constructed over time as funding is available. Many of these clusters were included in the Envision 2040 Long Range Transportation Plan and received support at the Futures Summit (the first public meeting). The alignments shown were identified from previous planning efforts, but any project that moves into programming will require additional planning and engineering to determine a final alignment.

This analysis focuses on technical information and does not consider any environmental or funding challenges. It is simply to help facilitate discussions of if, and when, these concepts should be programmed.

Methodology

Nine concept clusters were independently modeled, including various sub-options within each scenario and then analyzed and tested against the following methodology.

Each concept has a tabular summary of its impacts, as well as a graphical representation of the traffic impacts compared against the 2045 Existing + Committed (E+C) network.

Benefit/Cost Ratio

Benefit/cost ratios help establish whether a project provides more benefit to the transportation network than it costs over its entire lifetime. To identify the concept clusters that provide the most benefit for the Bismarck-Mandan MPO transportation network, the following process was used to establish a benefit/cost ratio.

- Determine network-wide Vehicle Miles Traveled (VMT) and Vehicle Hours Traveled (VHT). These elements are outputs of the travel demand model. VMT and VHT were calculated for the 2015 base model, 2030 Existing and Committed network (E+C) model, 2045 E+C model and the 2030 E+C and 2045 E+C models with each concept cluster. Using these outputs, the VHT and VMT reductions were calculated and monetized to determine total benefits. These benefits will assume construction in 2025 for 20 years of total benefits within the MTP's study horizon.
- Determine costs. The construction costs are based on the previous planning efforts. Annual maintenance costs were also be incorporated and compared to the base E+C network. The remaining capital value will be subtracted from the total cost based on the expected useful life (25 years for roadways, 50 years for bridges).
  - Monetization rates will be based on MnDOT recommended economic values.
  - Maintenance costs were extrapolated from the 2012-2015 MnDOT Statewide Highway Systems Operation Plan.
  - Cost estimates were developed and inflated to 2025, using a four percent inflation rate.

Any project with a benefit/cost ratio greater than one will be carried forward for further analysis.

Cost-Effectiveness

The cost-effectiveness analysis identifies when the projects' benefits outweigh its costs, similar to a benefit/cost ratio, but focuses on whether a project provides value within the planning horizon (by 2045). This analysis simply removes the remaining service life from the benefit/cost calculations.

Any project with a cost-effectiveness ratio greater than one will be carried forward for further analysis.

Returned Equity

The returned equity calculation identifies when the network-wide benefits of a project cluster can cover the infrastructure cost. It begins with construction costs, adding the net benefits from changes to VMT and VHT each year after construction minus the estimated maintenance cost. For example, if a project had a 2025 construction cost of $1 million and net benefits of $100,000 each year after, it would take 10 years for a project to breakeven and reach its returned equity point.

Concepts

Scenario 1: Southern Bridge Corridor

The Southern Bridge Corridor concept would establish an east-west corridor with a new river crossing on the south side of the metro area. This concept would start in Lincoln, following Lincoln Road, Airway Avenue, and 48th Avenue, include a new Missouri River bridge, and then connect to ND 1806 following an alignment developed from previous planning efforts.

A sub-option was also considered that added a connection between ND 1806 and ND 6.

Summary of Impacts: Southern Bridge Corridor to ND 1806 (Scenario 1a)

The travel demand model projects more than 6,600 vehicles per day would use a southern bridge corridor with a connection to ND 1806 in 2045, creating the following impacts:

- Attracts vehicles off I-94 and Memorial Highway.
- Creates additional/increased congestion on north-south corridors south of the Bismarck Expressway.
- Reduces vehicle hours traveled by 17.3 percent by 2045.
- Reduces vehicle miles traveled by 0.9 percent by 2045.
- Has a total estimated 2025 construction cost of $84.1 million.
- Has a benefit/cost ratio of 14.4.
- Has a cost-effectiveness ratio of 8.2.
- Returns equity in eight years.

The analysis summary for this scenario is shown in Table 7.1, with the impacts to average daily traffic shown in Figure 7.1. Ultimately, this scenario was not identified for further analysis due to changes in future land use plans and development capacity in the south metro and the significant environmental and archaeological constraints along the alignment.

Table 7.1: Summary of Scenario 1a: Southern Bridge Corridor to ND 1806

Scenario 1a	2030	2045
VHT Change	-5.2%	-17.3%
VMT Change	0.2%	-0.9%
AADT	6,509	8,374
% of Links Over Capacity	1.7%	6.9%
Construction Cost	$84.1 M	
Total Benefits	$619.1 M	
Benefit/Cost Ratio	14.4	
Cost-Effectiveness	8.2	
Returned Equity	8 Years	

Summary of Impacts: Southern Bridge Corridor to ND 6 (Scenario 1b)

The travel demand model projects nearly 8,800 vehicles per day would use a southern bridge corridor with a connection to ND 6 in 2045, creating the following impacts:

- Attracts vehicles off I-94.
- Creates additional/increased congestion on north-south corridors south of the Bismarck Expressway.
- Reduces vehicle hours traveled by 17.1 percent by 2045.
- Reduces vehicle miles traveled by 0.9 percent by 2045.
- Has a total estimated 2025 construction cost of $100.6 million.
- Has a benefit/cost ratio of 11.0.
- Has a cost-effectiveness ratio of 6.8.
- Returns equity in eight years.

The analysis summary for this scenario is shown in Table 7.2, with the impacts to average daily traffic shown in Figure 7.2. Ultimately, this scenario was not identified for further analysis due to changes in future land use plans and development capacity in the south metro and the significant environmental and archaeological constraints along the alignment.

Table 7.2: Summary of Scenario 1b: Southern Bridge Corridor to ND 6

Scenario 1b	2030	2045
VHT Change	-5.5%	-17.1%
VMT Change	0.2%	-0.9%
AADT	6,508	8,377
% of Links Over Capacity	1.6%	7.1%
Construction Cost	$100.6 M	
Total Benefits	$622.4 M	
Benefit/Cost Ratio	11.0	
Cost-Effectiveness	6.8	
Returned Equity	8 Years	

Scenario 2: Northern Bridge Corridor

The Northern Bridge Corridor concept would establish an east-west corridor with a new river crossing on the north side of the metro area. It would generally follow 71st Avenue in Bismarck, with the new river crossing connecting Burnt Creek Loop in Bismarck and 38th Street in Mandan, then following 37th Street, ending at ND 25 following an alignment developed from previous planning efforts.

Summary of Impacts: Northern Bridge Corridor Northern Alignment (Scenario 2a)

The travel demand model projects more than 11,400 vehicles per day would use a northern bridge corridor with a connection to ND 25 in 2045, creating the following impacts:

- Effectively creates a northern bypass, attracting vehicles off I-94, onto Centennial Road and then 71st Avenue to ND 1806 and I-94 on the western edge of Mandan.
- Reduces volume/capacity ratios on I-94 by six percentage points, on average.
- Adds significant congestion to Centennial Road and 71st Avenue corridors.
- Reduces vehicle hours traveled by 17.2 percent by 2045.
- Reduces vehicle miles traveled by 0.7 percent by 2045.
- Has a total estimated 2025 construction cost of $122.9 million.
- Has a benefit/cost ratio of 8.8.
- Has a cost-effectiveness ratio of 5.4.
- Returns equity in 10 years.

The analysis summary for this scenario is shown in Table 7.3, with the impacts to average daily traffic shown in Figure 7.3. Ultimately, this alignment was discarded in previous planning studies in favor of the southern alignment in previous planning and engineering efforts.

Table 7.3: Summary of Scenario 2a: Northern Bridge Corridor Northern Alignment

Scenario 2a	2030	2045
VHT Change	-5.2%	-17.2%
VMT Change	0.7%	-0.7%
AADT	6,539	8,391
% of Links Over Capacity	0.0%	8.4%
Construction Cost	$122.9 M	
Total Benefits	$596.2 M	
Benefit/Cost Ratio	8.8	
Cost-Effectiveness	5.4	
Returned Equity	10 Years	

Summary of Impacts: Northern Bridge Corridor Southern Alignment (Scenario 2b)

The travel demand model projects more than 11,000 vehicles per day would use a northern bridge corridor with a connection to ND 25 in 2045, creating the following impacts:

- Effectively creates a northern bypass, attracting vehicles off I-94, onto Centennial Road and then 71st Avenue to ND 1806 and I-94 on the western edge of Mandan.
- Reduces volume/capacity ratios on I-94 by five percentage points, on average.
- Adds significant congestion to Centennial Road and 71st Avenue corridors.
- Reduces vehicle hours traveled by 18.0 percent by 2045.
- Reduces vehicle miles traveled by 1.0 percent by 2045.
- Has a total estimated 2025 construction cost of $122.9 million.
- Has a benefit/cost ratio of 8.9.
- Has a cost-effectiveness ratio of 5.5.
- Returns equity in 10 years.

The analysis summary for this scenario is shown in Table 7.4, with the impacts to average daily traffic shown in Figure 7.4. Ultimately, this concept cluster was carried forward for additional analysis.

Table 7.4: Summary of Scenario 2b: Northern Bridge Corridor Southern Alignment

Scenario 2b	2030	2045
VHT Change	-4.9%	-18.0%
VMT Change	0.9%	-1.0%
AADT	6,551	8,370
% of Links Over Capacity	1.8%	8.1%
Construction Cost	$122.9 M	
Total Benefits	$607.7M	
Benefit/Cost Ratio	8.9	
Cost-Effectiveness	5.5	
Returned Equity	10 Years	

Figure 7.1: Scenario 1a 2045 Traffic Changes

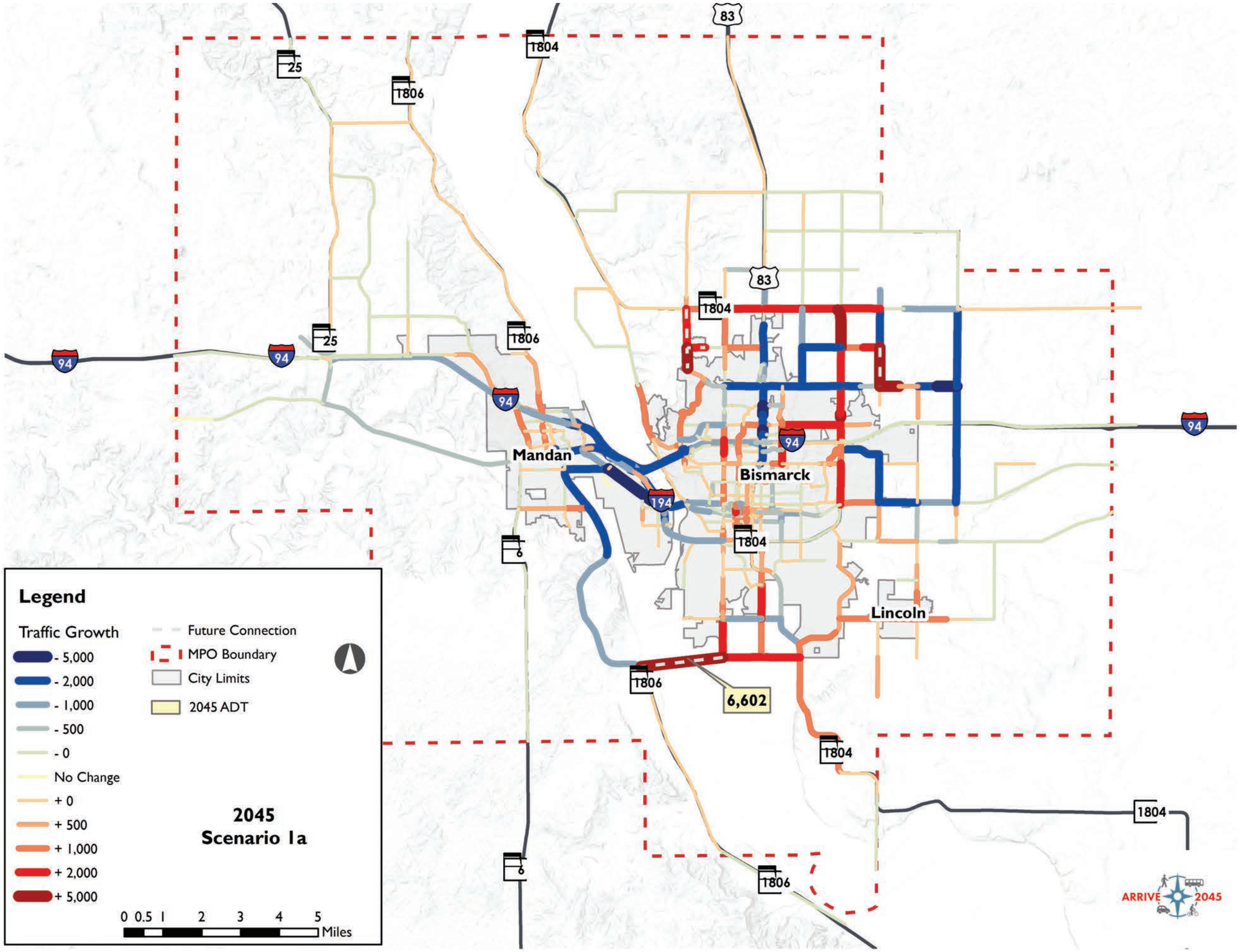

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Figure 7.2: Scenario 1b 2045 Traffic Changes

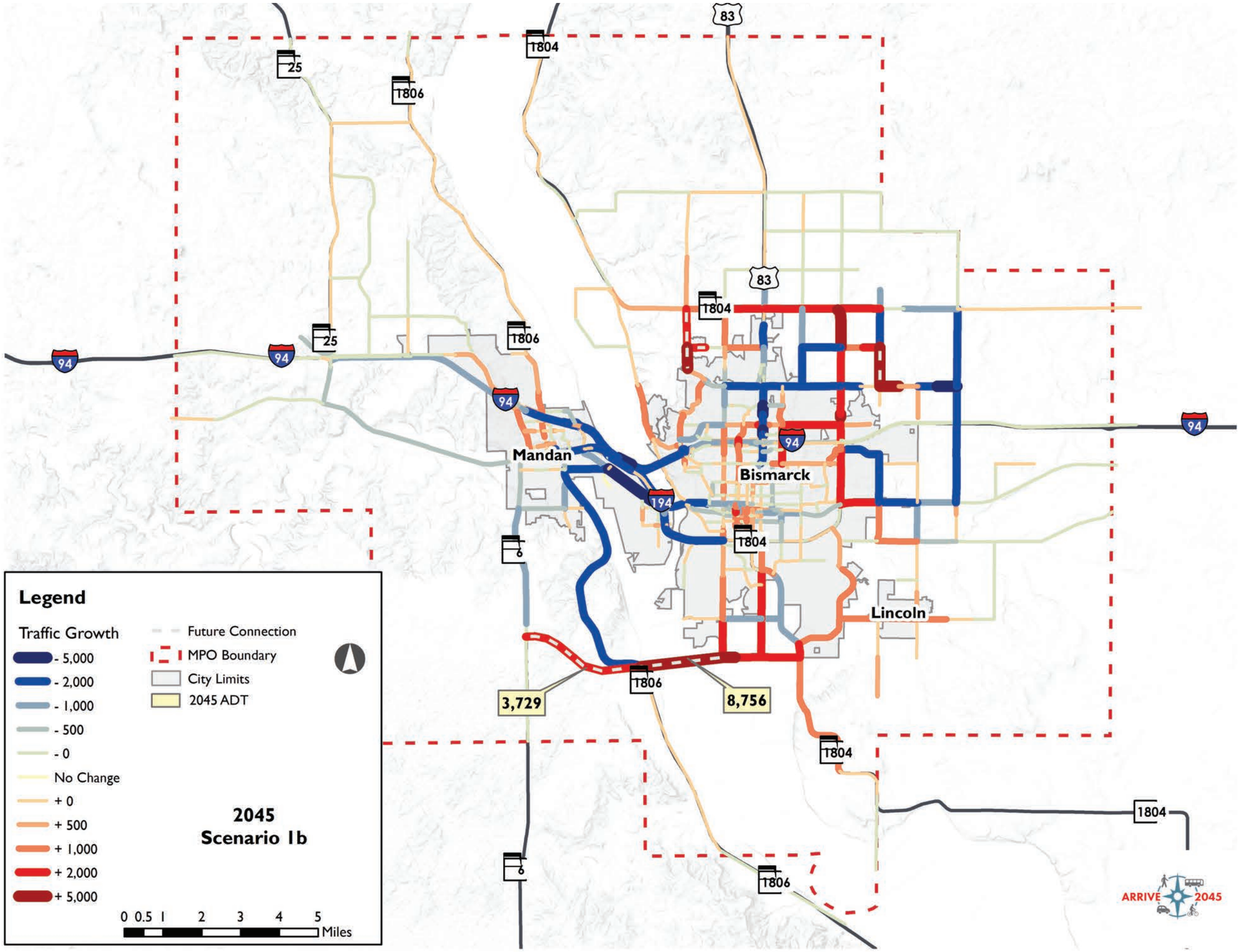

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Figure 7.3: Scenario 2a 2045 Traffic Changes

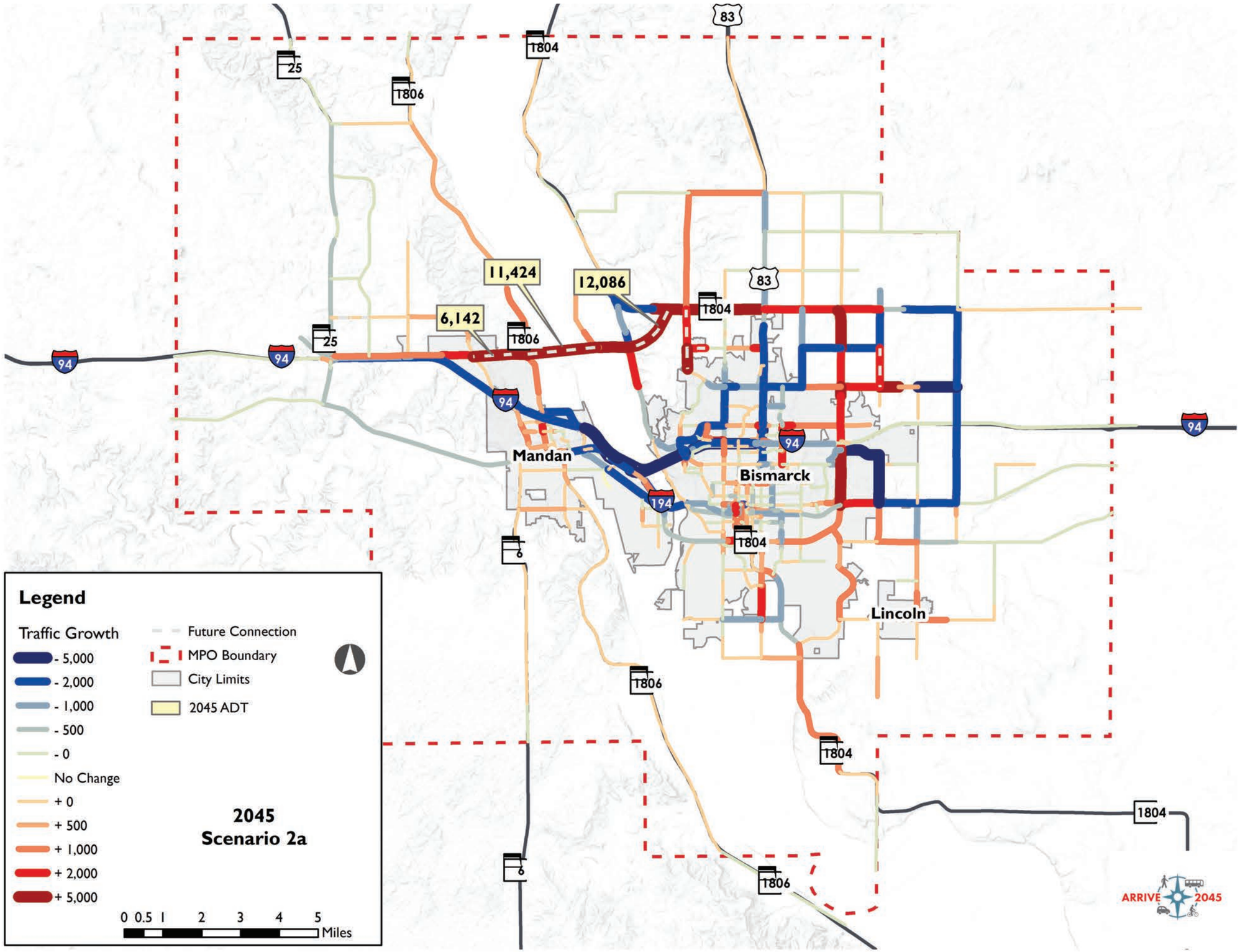

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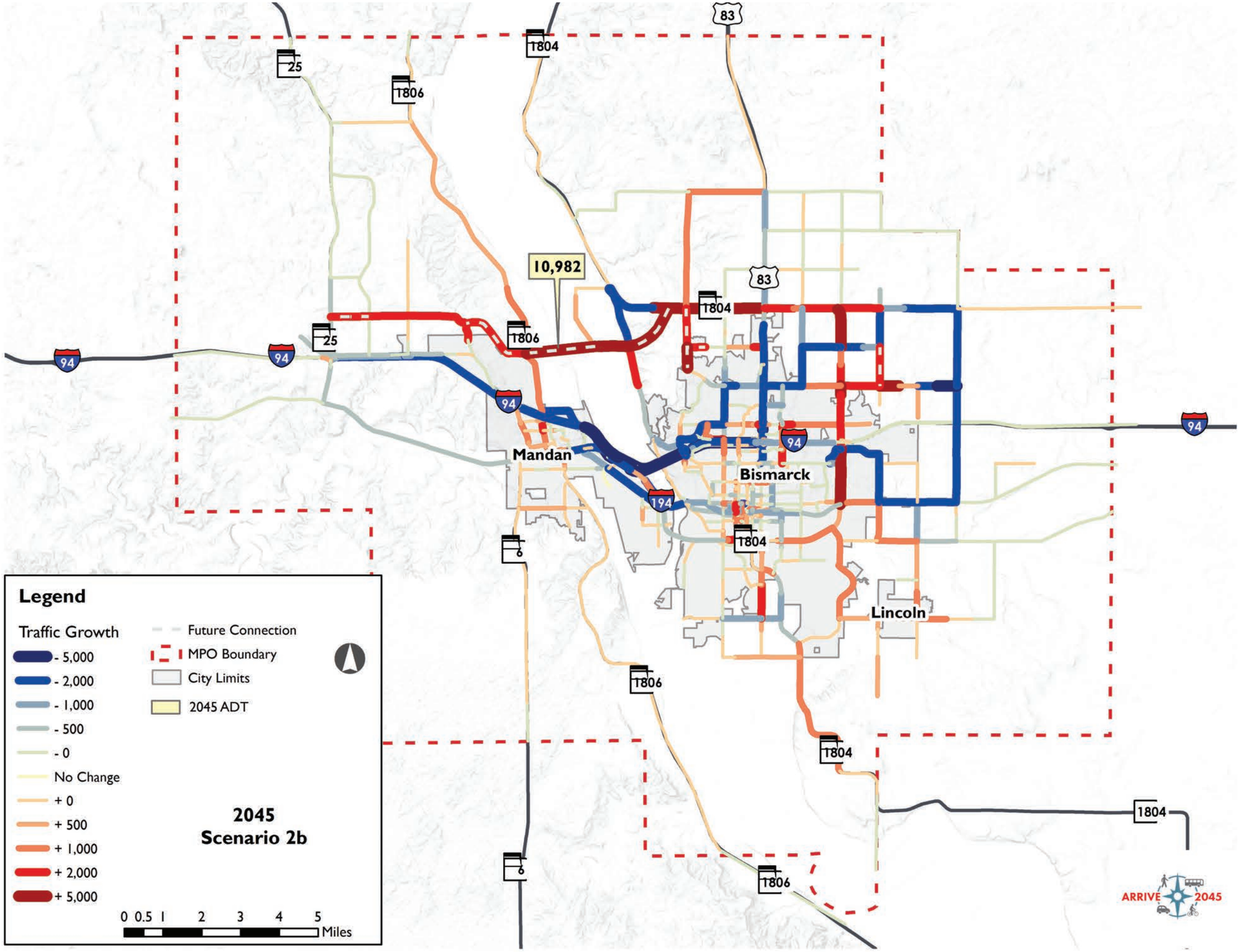
Figure 7.4: Scenario 2b 2045 Traffic Changes



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Scenario 3: South Mandan Arterial Corridor

The South Mandan Arterial Corridor concept would extend McKenzie Drive from I-194 to ND 6.

Summary of Impacts: South Mandan Arterial Corridor

The travel demand model projects13,500 vehicles per day would use a south Mandan arterial corridor in 2045, creating the following impacts:

- Alleviates emerging congestion on Mandan Memorial Highway/Grant Marsh Bridge and I-94 river crossings. Reduces average daily traffic on each river crossing around 2,800 vehicles per day.
- Worsens congestion on the Bismarck Expressway.
- Reduces vehicle hours traveled by 16.4 percent by 2045.
- Reduces vehicle miles traveled by 0.6 percent by 2045.
- Has a total estimated 2025 construction cost of $29.4 million.
- Has a benefit/cost ratio of 21.6.
- Has a cost-effectiveness ratio of 18.3.
- Returns equity in nine years.

The analysis summary for this scenario is shown in Table 7.5, with the impacts to average daily traffic shown in Figure 7.5. This concept cluster was carried forward for further analysis in part because of its low cost and expected impacts.

Table 7.5: Summary of Scenario 3: South Mandan Arterial Corridor

Scenario 3	2030	2045
VHT Change	-2.3%	-16.4%
VMT Change	0.4%	-0.6%
AADT	6,521	8,403
% of Links Over Capacity	1.6%	7.4%
Construction Cost	$29.4 M	
Total Benefits	$489.2 M	
Benefit/Cost Ratio	21.6	
Cost-Effectiveness	18.3	
Returned Equity	9 Years	

Scenario 4: Northeast Bismarck Arterial Improvements

The Northeast Bismarck Arterial Improvement Corridor concept would include improvements to multiple corridors in northeast Bismarck, including 66th Street, Century Avenue, 43rd Avenue, and 71st Avenue. Improvements include additional capacity on

- Century Avenue between Centennial Road and 66th Street
- 43rd Avenue between Centennial Road and 66th Street
- 71st Avenue between Centennial Road and 66th Street
- 66th Street between Centennial Road and Century Avenue (Scenario 4a)
- 66th Street between Centennial Road and Lincoln Road (Scenario 4b and Scenario 4c)
- Centennial Road from Jericho Road to 71st Avenue
- Two sub-options were also considered.
  - The first sub-option (4b) includes a 66th Street grade separation of I-94 with a continuous corridor to Lincoln Road.
  - The second sub-option (4c) includes a 66th Street interchange of I-94 with a continuous corridor to Lincoln Road.

Summary of Impacts: Northeast Bismarck Arterial Improvements (4a)

The travel demand model projects the following impacts with the Northeast Bismarck Arterial Improvements by 2045:

- Segments of 43rd Avenue, 71st Avenue, 66th Street, and 80th Street maintain acceptable volume/capacity ratios through 2045.
- Creates capacity constraints on Century Avenue.
- Reduces vehicle hours traveled by 15.8 percent by 2045
- Reduces vehicle miles traveled by 0.6 percent by 2045
- Has a total estimated 2025 construction cost of $131.6 million.
- Has a benefit/cost ratio of 4.8.
- Has a cost-effectiveness ratio of 4.1.
- Returns equity in 12 years.

The analysis summary for this scenario is shown in Table 7.6, with the impacts to average daily traffic shown in Figure 7.6. This concept cluster was carried forward for further analysis.

Table 7.6: Summary of Scenario 4a: Northeast Bismarck Arterial Improvements

Scenario 4a	2030	2045
VHT Change	-3.2%	-15.8%
VMT Change	0.6%	-0.6%
AADT	6,532	8,404
% of Links Over Capacity	2.0%	5.5%
Construction Cost	$131.6 M	
Total Benefits	$493.2 M	
Benefit/Cost Ratio	4.8	
Cost-Effectiveness	4.1	
Returned Equity	12 Years	

Summary of Impacts: Northeast Bismarck Arterial Improvements with I-94 Grade Separation (4b)

The travel demand model projects the following impacts with the Northeast Bismarck Arterial Improvements with an I-94 overpass by 2045:

- Reduces extreme capacity constraints on State Street/US 83 around 7.5 percentage points. Many of the links remain over capacity.
- Most of Centennial Road remains significantly over capacity.
- Nearly 15,000 vehicles per day would use an I-94 overpass at 66th Street.
- Reduces vehicle hours traveled by 14.3 percent by 2045.
- Vehicle miles are unchanged by 2045.
- Has a total estimated 2025 construction cost of $179.5 million.
- Has a benefit/cost ratio of 3.2.
- Has a cost-effectiveness ratio of 2.6.
- Returns equity in 14 years.

Table 7.7: Summary of Scenario 4b: Northeast Bismarck Arterial Improvements with I-94 Grade Separation

Scenario 4b	2030	2045
VHT Change	-3.1%	-14.3%
VMT Change	0.9%	0.0%
AADT	6,550	8,452
% of Links Over Capacity	2.0%	5.3%
Construction Cost	$179.5 M	
Total Benefits	$433.4 M	
Benefit/Cost Ratio	3.2	
Cost-Effectiveness	2.6	
Returned Equity	14 Years	

The analysis summary for this scenario is shown in Table 7.7, with the impacts to average daily traffic shown in Figure 7.7. This concept cluster was not carried forward for further analysis.

Summary of Impacts: Northeast Bismarck Arterial Improvements with I-94 Interchange (4c)

The travel demand model projects the following impacts with the Northeast Bismarck Arterial Improvements with an I-94 interchange by 2045:

- Estimates up to 21,000 vehicles per day would use the interchange.
- Reduces volume/capacity ratios for major east-west corridors including 43rd Avenue, Highway 10, and Apple Creek Road.
- Increases traffic on I-94 up to 14,300 vehicles per day (both directions) from 16,400 with the 2045 existing and committed network to 30,700 with this I-94 interchange. The increased volumes do not indicate any emerging congestion.
- Reduces vehicle hours traveled by 13.3 percent by 2045
- Vehicle miles traveled are nearly unchanged by 2045.
- Has a total estimated 2025 construction cost of $195.3 million.
- Has a benefit/cost ratio of 2.7.
- Has a cost-effectiveness ratio of 2.1.
- Returns equity in 15 years.

The analysis summary for this scenario is shown in Table 7.8, with the impacts to average daily traffic shown in Figure 7.8. This concept cluster was carried forward for further analysis due to the mobility it provides in northeast Bismarck, a primary growth area.

Table 7.8: Summary of Scenario 4c: Northeast Bismarck Arterial Improvements with I-94 Interchange

Scenario 4c	2030	2045
VHT Change	-2.4%	-13.3%
VMT Change	0.9%	0.1%
AADT	6,555	8,461
% of Links Over Capacity	1.8%	5.1%
Construction Cost	$195.3 M	
Total Benefits	$377.5 M	
Benefit/Cost Ratio	2.7	
Cost-Effectiveness	2.1	
Returned Equity	15 Years	

Figure 7.5: Scenario 3 2045 Traffic Changes

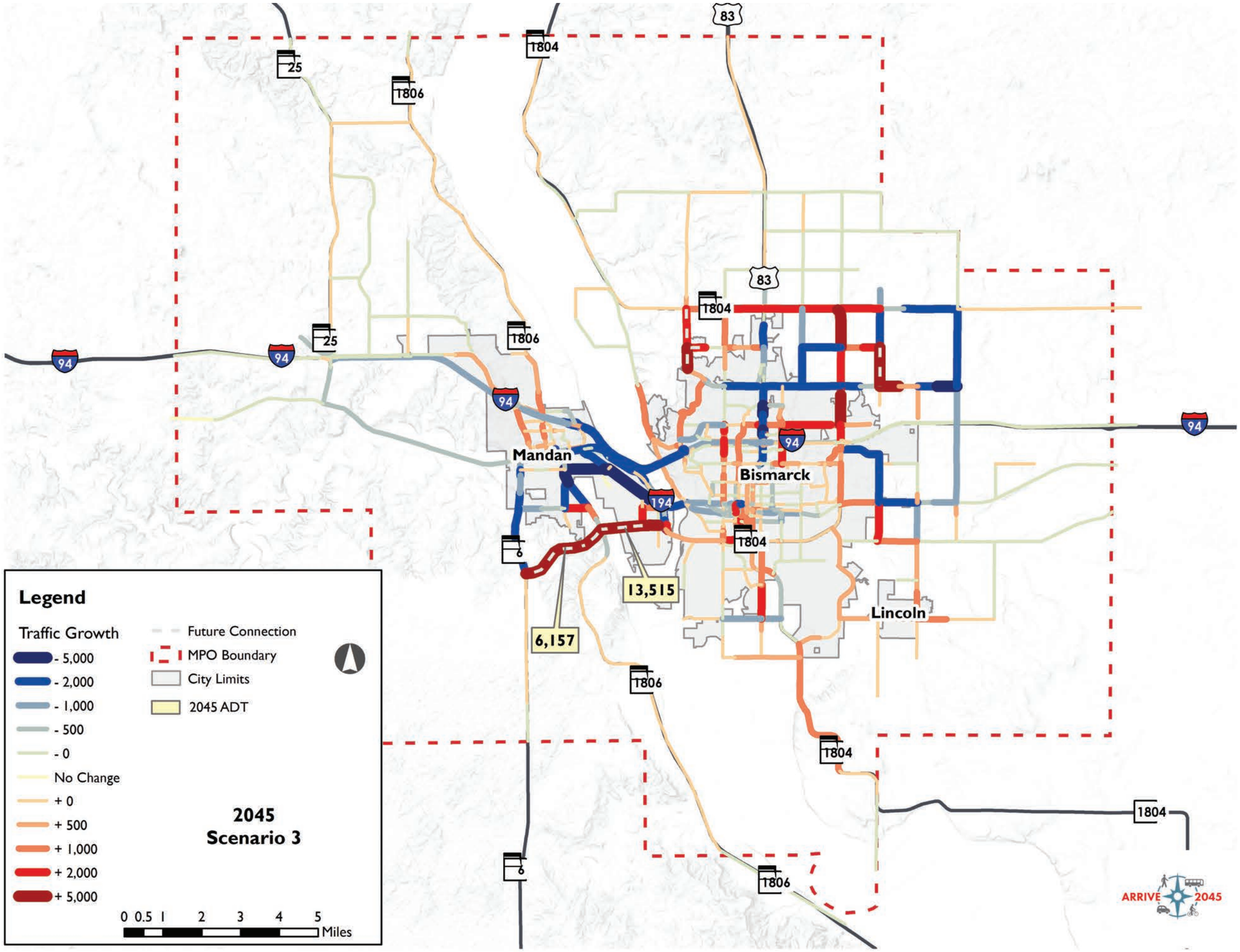

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Figure 7.6: Scenario 4a 2045 Traffic Changes

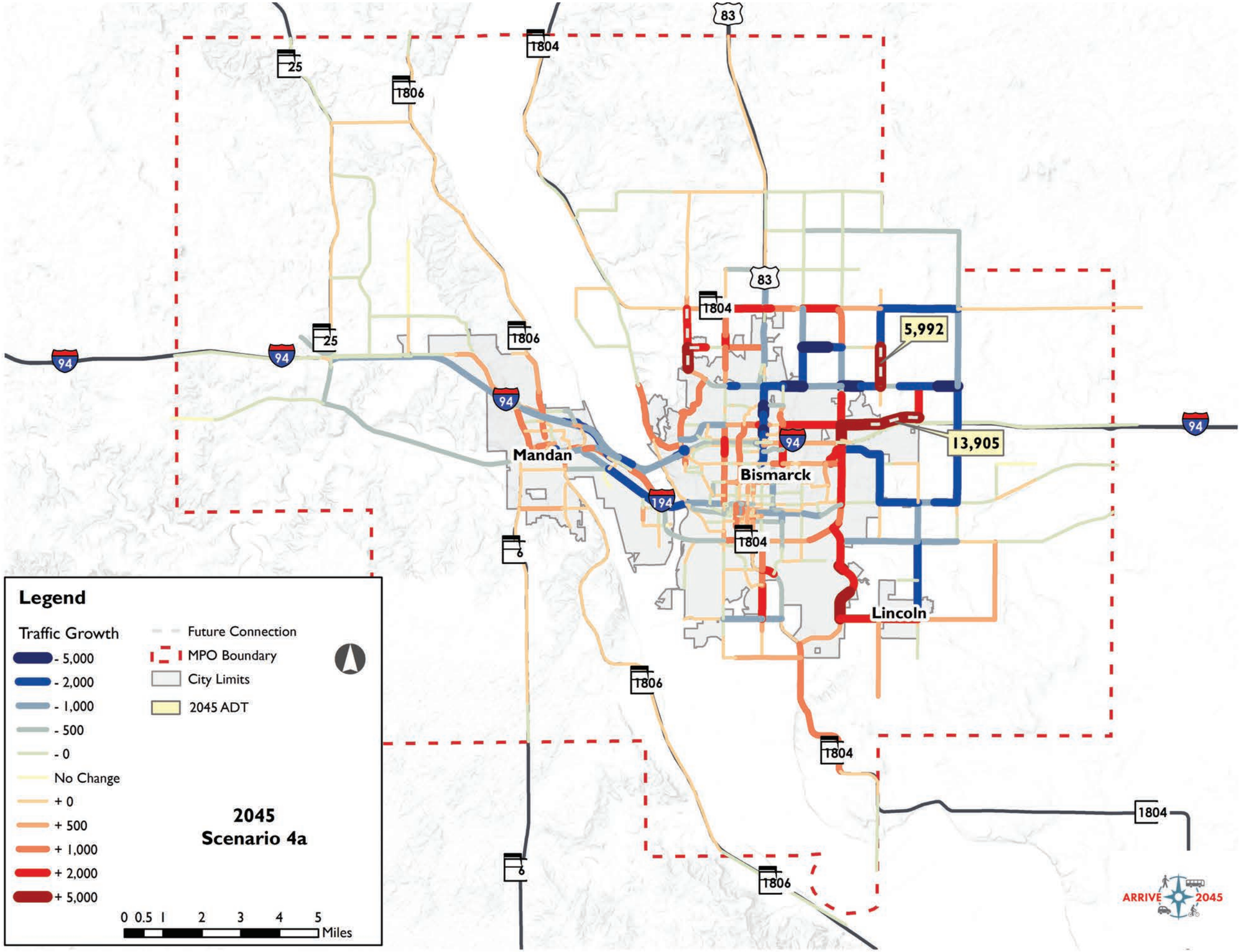

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Figure 7.7: Scenario 4b 2045 Traffic Changes

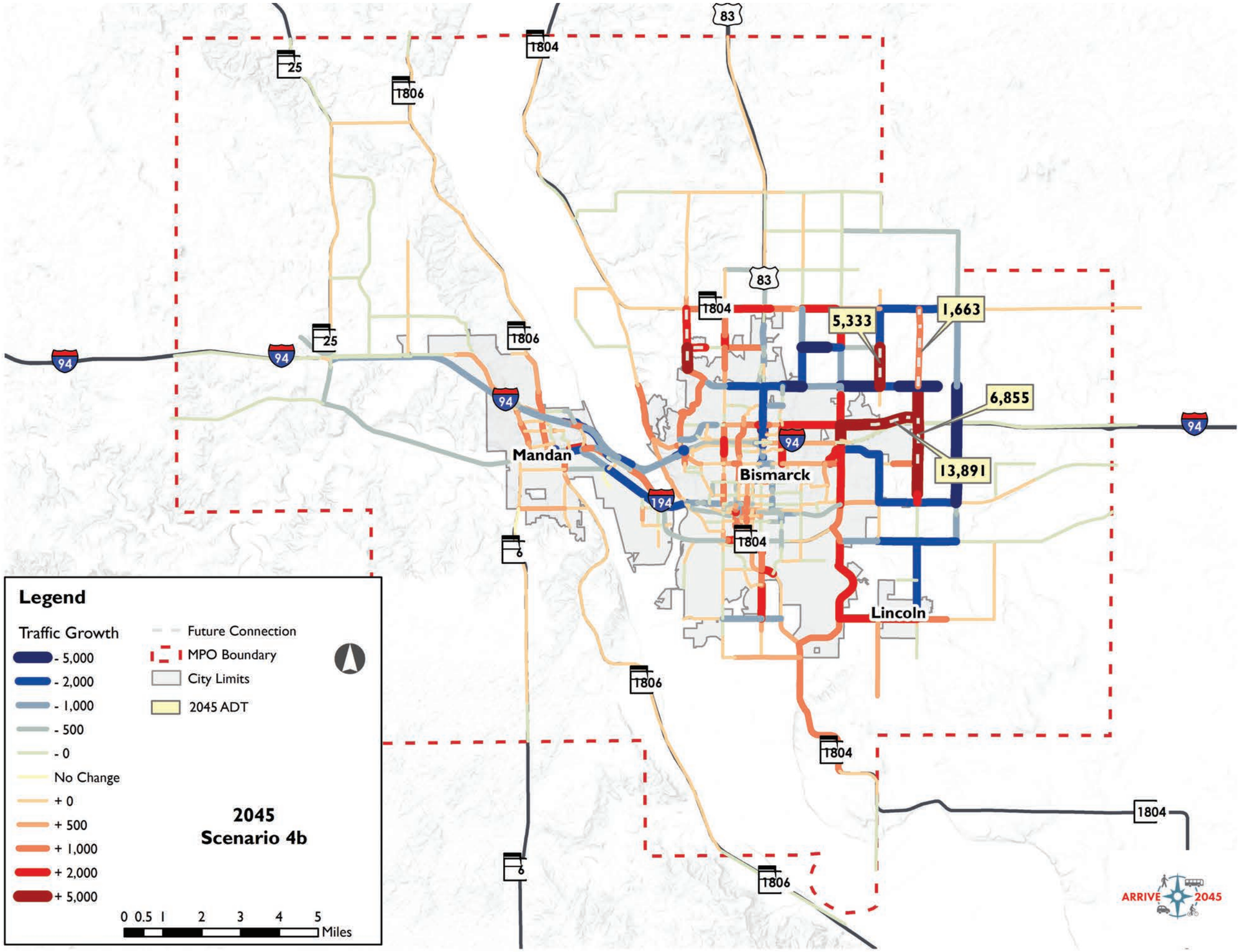

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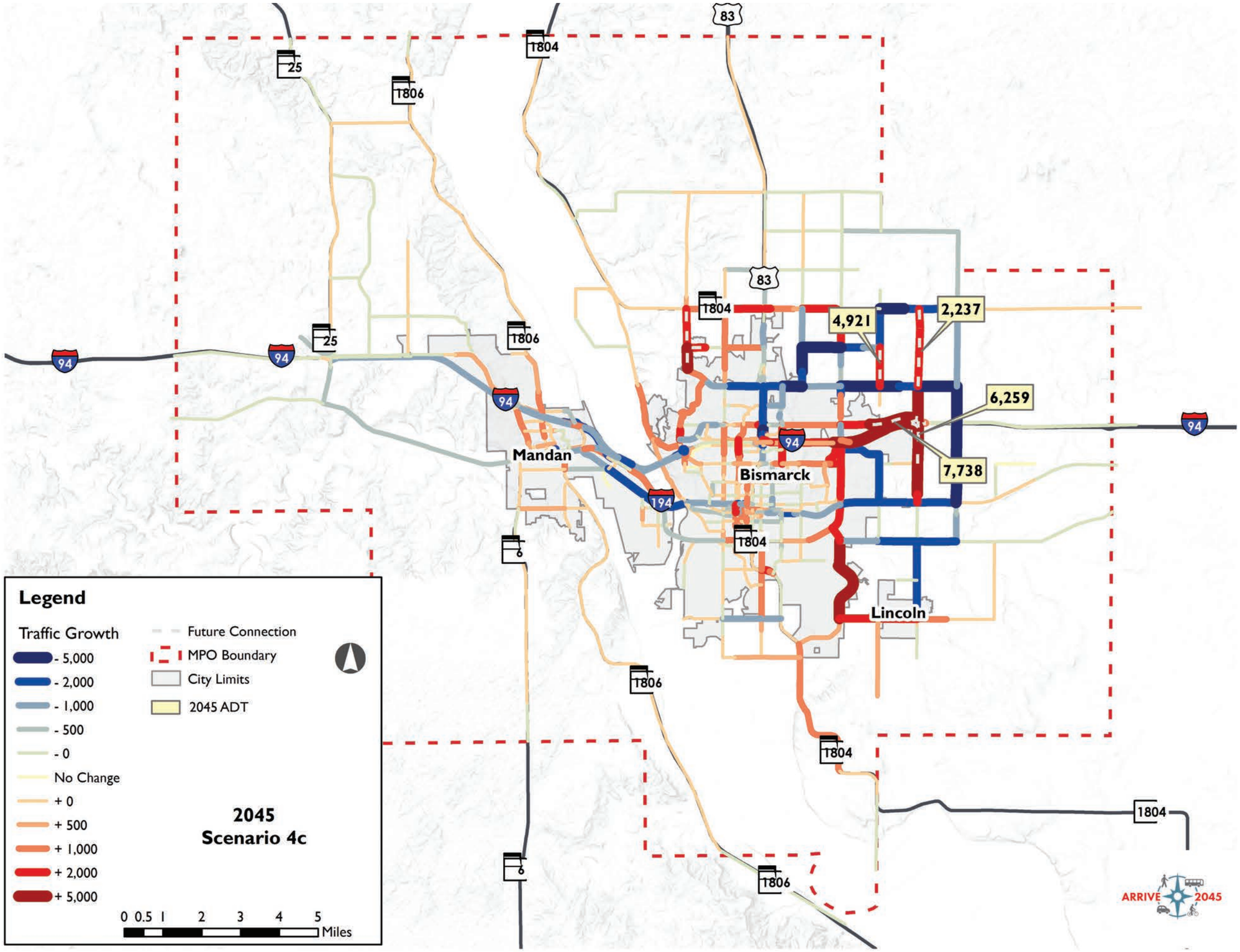
Figure 7.8: Scenario 4c 2045 Traffic Changes



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Scenario 5: West Mandan Interchange

The West Mandan Interchange concept includes a new interchange at 56th Avenue in Mandan with an extension of Division Street and extension of 56th Avenue to West Main Street. While this was modeled as an extension of Division Street, this would also likely be the same conditions for the extension of Boundary Road, which is a more logical east-west connector route.

Summary of Impacts: West Mandan Interchange

The travel demand model projects around 5,000 vehicles per day would use a west Mandan interchange in 2045, creating the following impacts:

- Does not have a significant impact on vehicle/capacity ratios in Mandan.
- Reduces vehicle hours traveled by 15.6 percent by 2045.
- Vehicle miles traveled are nearly unchanged by 2045.
- Has a total estimated 2025 construction cost of $79.6 million.
- Has a benefit/cost ratio of 10.1.
- Has a cost-effectiveness ratio of 7.1.
- Returns equity in nine years.

The analysis summary for this scenario is shown in Table 7.9, with the impacts to average daily traffic shown in Figure 7.9. This concept cluster was carried forward for further analysis.

Table 7.9: Summary of Scenario 5: West Mandan

Scenario 5	2030	2045
VHT Change	-4.4%	-15.6%
VMT Change	0.6%	-0.1%
AADT	6,534	8,441
% of Links Over Capacity	1.8%	7.2%
Construction Cost	$79.6 M	
Total Benefits	$518.5 M	
Benefit/Cost Ratio	10.1	
Cost-Effectiveness	7.1	
Returned Equity	9 Years	

Scenario 6: Transportation System Management and Operations Improvements

The Transportation System Management and Operations Improvements concept includes a collection of projects which are aimed at managing system operations through low-impact fixes. These projects include turn lanes, traffic control, and access management applied to roadways with deficient levels of service by 2030 and 2045, as shown in Figure 10.

Summary of Impacts: Transportation System Management and Operations Improvements

This concept has varying impacts across the transportation network through 2045, but does not change travel patterns significantly.

- Alleviates congestion on east-west corridors (43rd Avenue, 57th Avenue, 71st Avenue east of State Street/US 83) with modest volume/capacity reductions on I-94 and Mandan Memorial Highway.
- Congestion remains on most north-south corridors, especially around the I-94 interchange locations.
- Reduces vehicle hours traveled by 16.0 percent by 2045.
- Vehicle miles traveled are nearly unchanged by 2045.
- Has a total estimated 2025 construction cost of $41.5 million.
- Has a benefit/cost ratio of 16.0.
- Has a cost-effectiveness ratio of 13.5.
- Returns equity in eight years.

The analysis summary for this scenario is shown in Table 7.10, with the impacts to average daily traffic shown in Figure 7.10. This concept cluster was carried forward for further analysis.

Table 7.10: Summary of Scenario 6: Transportation System Management and Operations Improvements

Scenario 6	2030	2045
VHT Change	-4.0%	-16.0%
VMT Change	0.9%	0.1%
AADT	6,553	8,464
% of Links Over Capacity	1.7%	6.9%
Construction Cost	$41.5 M	
Total Benefits	$498.8 M	
Benefit/Cost Ratio	16.0	
Cost-Effectiveness	13.5	
Returned Equity	8 Years	

Scenario 7: I-94 Grade Separation at Hamilton Street

The I-94 grade separation at Hamilton Street would create a new grade separation (overpass or underpass) of I-94 at Hamilton Street in Bismarck between Century Avenue and Divide Avenue.

Summary of Impacts: I-94 Grade Separation at Hamilton Street

The travel demand model projects more than 7,200 vehicles per day would use a grade separation at Hamilton Street, creating the following impacts:

- Moderate traffic rerouting from State Street/ US 83 (between three and six percent) mitigates some congestion, but the interchange would still operate deficiently at LOS "E".
- The 19th Street grade separation would see a 20 percent reduction in traffic but would still operate deficiently at LOS "E".
- Traffic routes across the grade separation and then uses Centennial Road for north-south mobility outside of the interchange, increasing projected traffic up to 14 percent.
- Reduces vehicle hours traveled by 15.9 percent by 2045.
- Vehicle miles traveled are reduced slightly by 2045.
- Has a total estimated 2025 construction cost of $35.0 million.
- Has a benefit/cost ratio of 24.8.
- Has a cost-effectiveness ratio of 16.3.
- Returns equity in seven years.

The analysis summary for this scenario is shown in Table 7.11, with the impacts to average daily traffic shown in Figure 7.11. This concept cluster was carried forward for further analysis.

Table 7.11: Summary of Scenario 7: I-94 Grade Separation at Hamilton Street

Scenario 7	2030	2045
VHT Change	-4.2%	-15.9%
VMT Change	0.8%	-0.2%
AADT	6,545	8,431
% of Links Over Capacity	1.7%	7.2%
Construction Cost	$35 M	
Total Benefits	$515.8 M	
Benefit/Cost Ratio	24.8	
Cost-Effectiveness	16.3	
Returned Equity	7 Years	

Scenario 8: I-94 Grade Separation at 33rd Avenue

The I-94 grade separation at 33rd Avenue in Mandan would create a new grade separation (overpass or underpass) of I-94 at 33rd Avenue in Mandan between 37th Street and Boundary Road. Boundary Road would be extended to 33rd Avenue.

Summary of Impacts: I-94 Grade Separation at 33rd Street

- The direct connection to Mandan's western growth area reduces demand on the existing I-94 interchanges (Sunset Drive and Mandan Avenue) and improves their expected operations to LOS "D" or better through 2045.
- Reduces vehicle hours traveled by 15.4 percent by 2045.
- Vehicle miles traveled are reduced slightly by 2045.
- Has a total estimated 2025 construction cost of $26.5 million.
- Has a benefit/cost ratio of 31.5.
- Has a cost-effectiveness ratio of 18.7.
- Returns equity in nine years.

The analysis summary for this scenario is shown in Table 7.12, with the impacts to average daily traffic shown in Figure 7.12. This concept cluster was carried forward for further analysis.

Table 7.12: Summary of Scenario 8: I-94 Grade Separation at 33rd Street

Scenario 8	2030	2045
VHT Change	-4.4%	-15.4%
VMT Change	2.6%	-0.2%
AADT	6,661	8,438
% of Links Over Capacity	1.9%	7.3%
Construction Cost	$26.5 M	
Total Benefits	$446.5 M	
Benefit/Cost Ratio	31.5	
Cost-Effectiveness	18.7	
Returned Equity	9 Years	

Figure 7.9: Scenario 5 2045 Traffic Changes

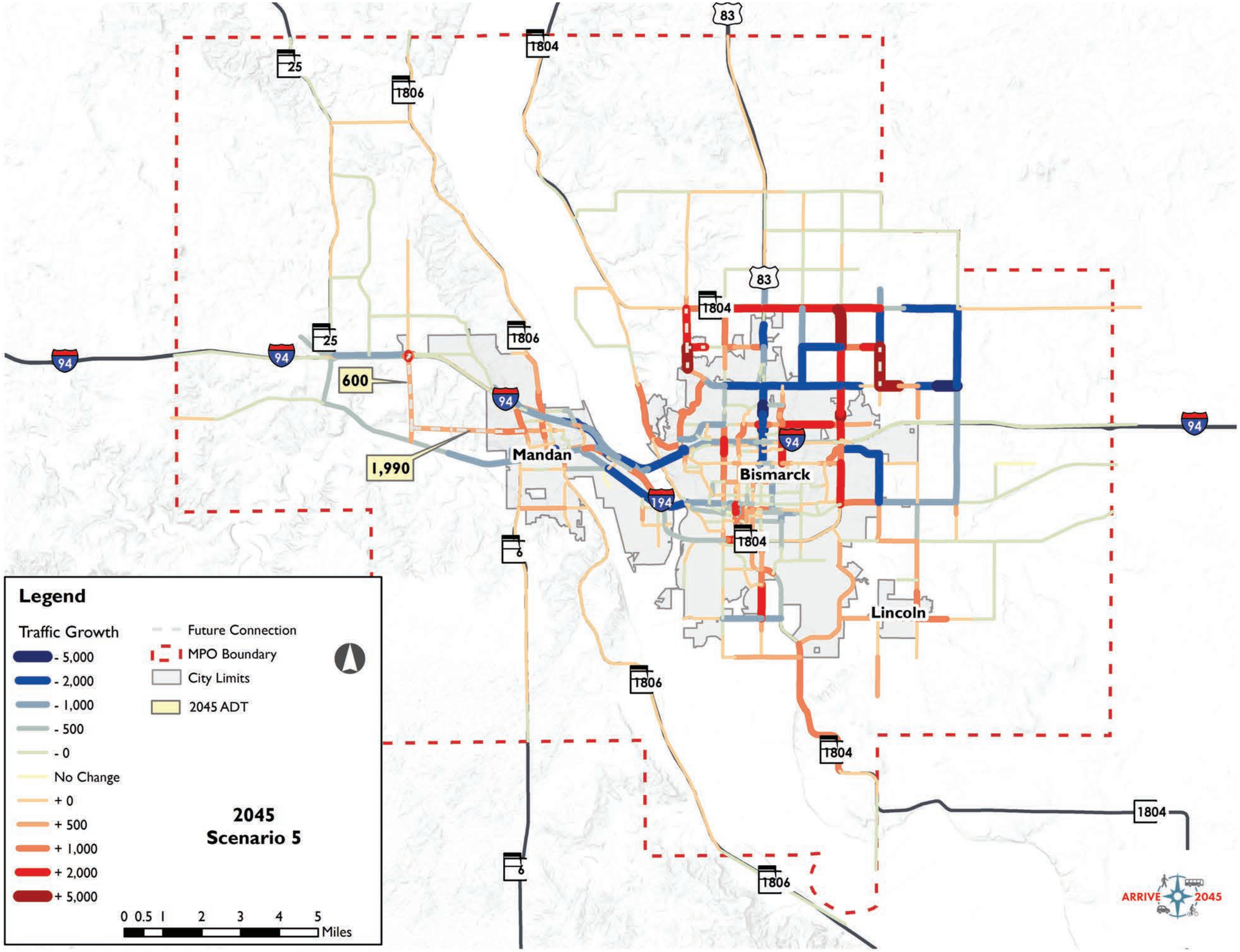

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Figure 7.10: Scenario 6b 2045 Traffic Changes

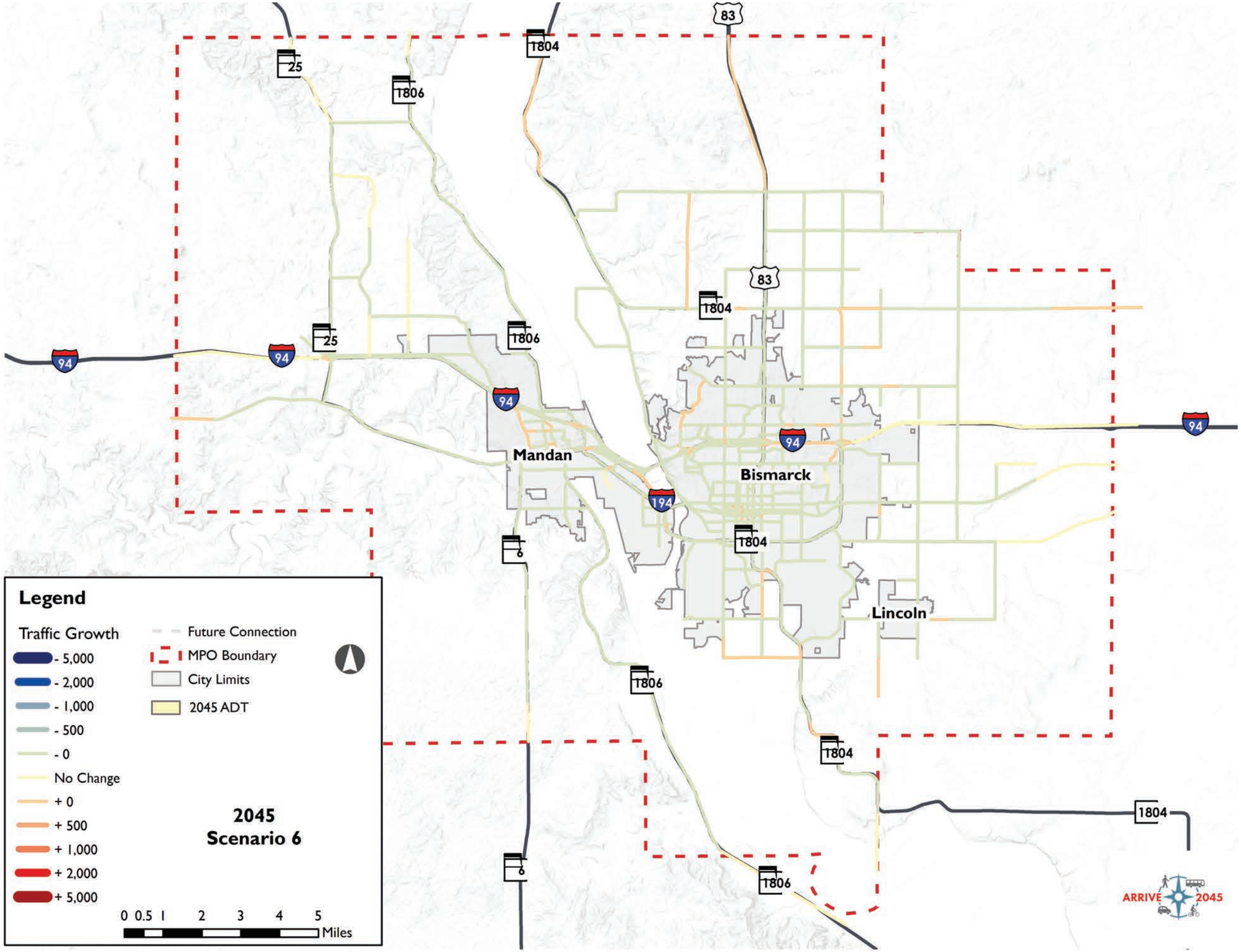

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Figure 7.11: Scenario 7 2045 Traffic Changes

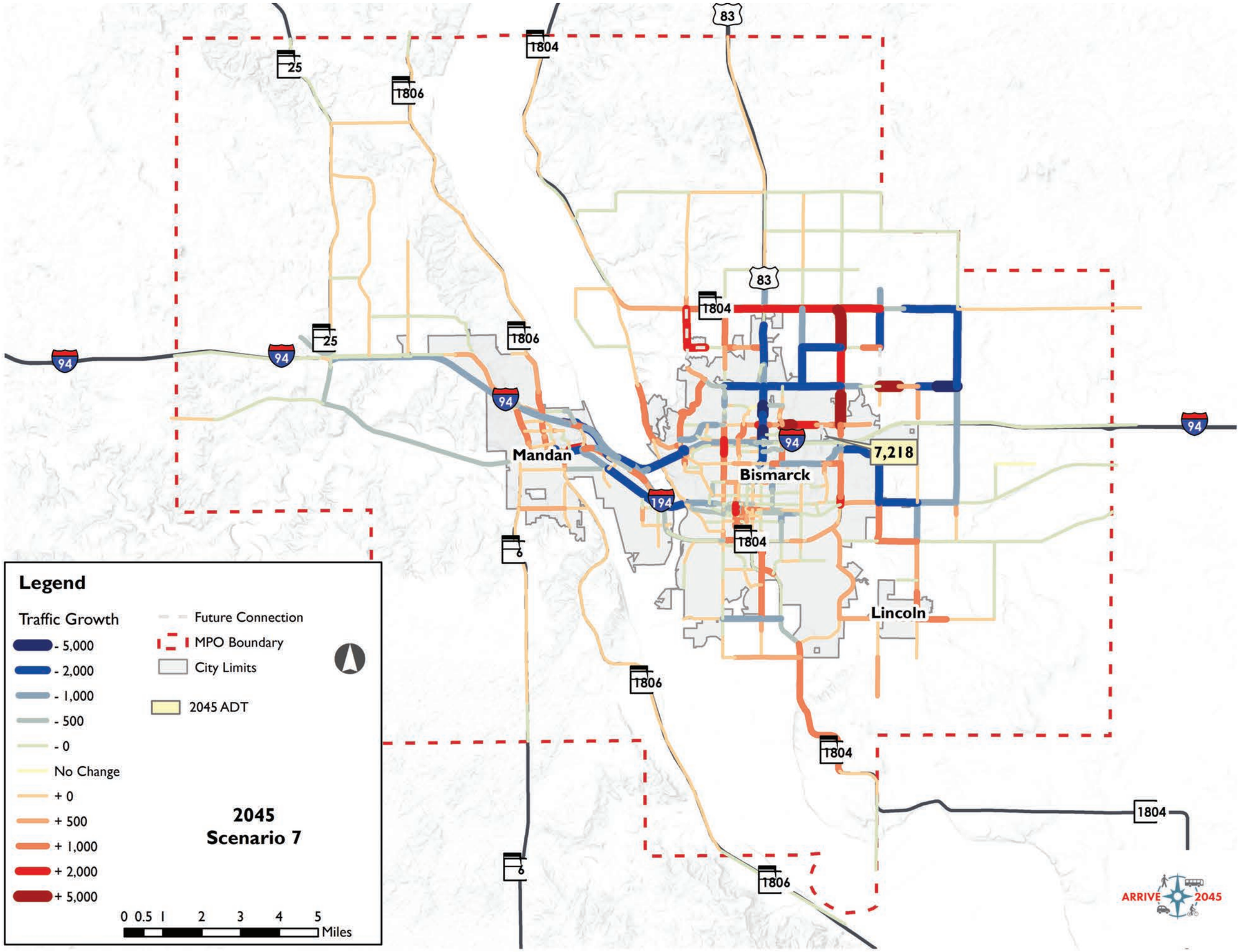

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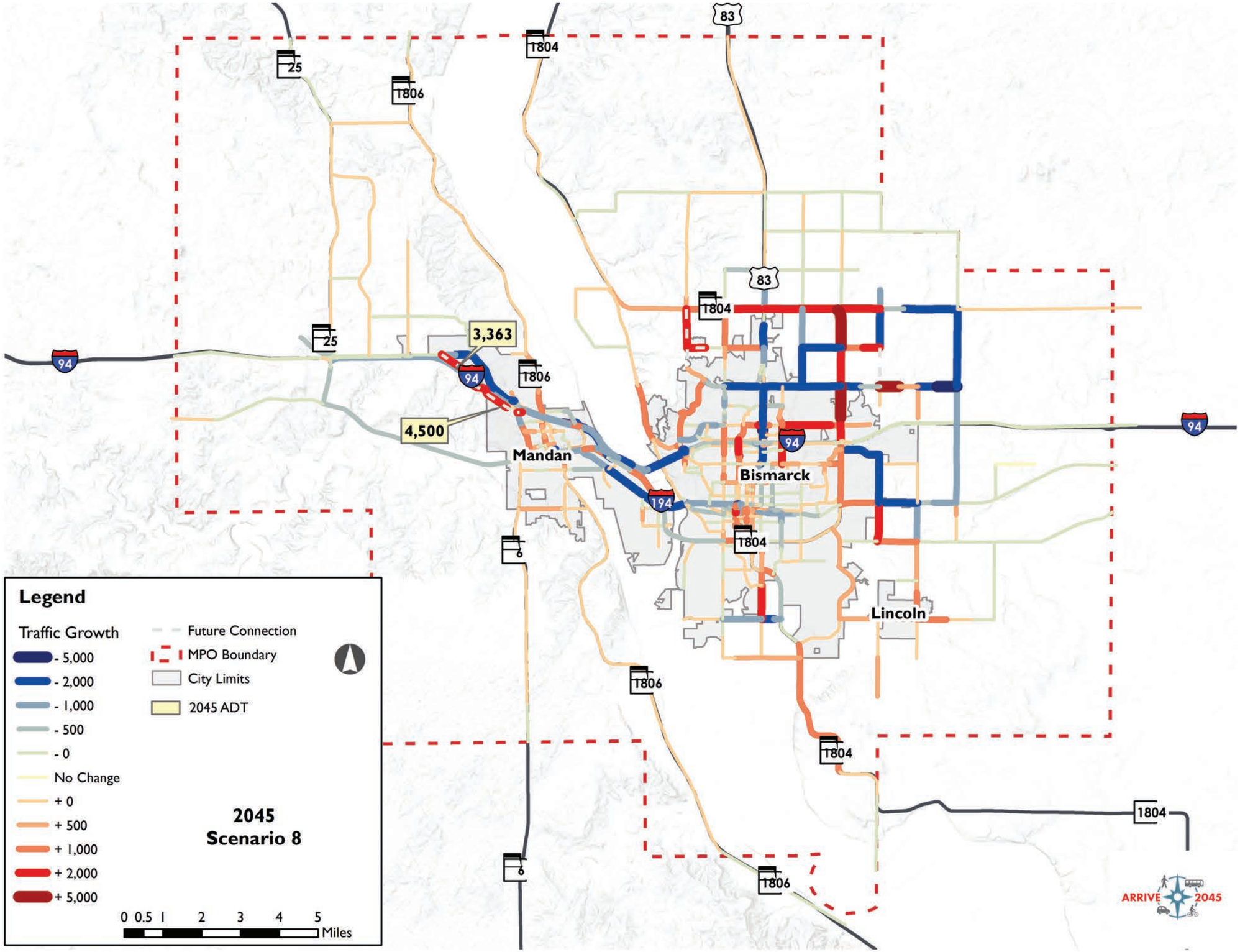
Figure 7.12: Scenario 8 2045 Traffic Changes



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Scenario 9: State Street Improvements

The MPO recently completed the US 83 Alternatives study which evaluated potential improvements for the State Street/US 83 corridor. Three alternatives were brought forward for further consideration in the Metropolitan Transportation process:

- Scenario 9a: 6-Lane Section: would reconstruct State Street as a six-lane section from Calgary Avenue to 71st Avenue and incorporate intersection improvements from I-94 to Calgary Avenue.
- Scenario 9b: 6-Lane Section with Interstate Avenue Grade Separation: would reconstruct State Street as a six-lane section from Calgary Avenue to 71st Avenue, with intersection improvements from I-94 to Calgary Avenue, and grade separate Interstate Avenue.
- Scenario 9c: Expressway: would convert State Street to an expressway, constructing interchanges at Interstate Avenue, 43rd Avenue, 71st Avenue. Intersection improvements, additional grade separations, and frontage/backage roads would be constructed to support the expressway concept.

Summary of Impacts: Scenario 9a: 6-Lane Section

The relatively minor improvements contained within Alternative B do not result in acceptable levels of service for the entire segment of State Street between I-94 and 71st Avenue but does produce the highest total benefits of the three State Street improvement scenarios.

- Reduces vehicle hours traveled by 16.8 percent by 2045.
- Vehicle miles traveled are increased slightly by 2045.
- Has a total estimated 2025 construction cost of $64.3 million.
- Has a benefit/cost ratio of 10.8.
- Has a cost-effectiveness ratio of 9.1.
- Returns equity in nine years.

The analysis summary for this scenario is shown in Table 7.13, with the impacts to average daily traffic shown in Figure 7.13. This concept cluster was carried forward for further analysis.

Table 7.13: Summary of Scenario 9a: 6-Lane Section

Scenario 9a	2030	2045
VHT Change	-4.2%	-16.8%
VMT Change	1.0%	0.1%
AADT	6,560	8,456
% of Links Over Capacity	1.7%	6.8%
Construction Cost	$64.3 M	
Total Benefits	$523.3 M	
Benefit/Cost Ratio	10.8	
Cost-Effectiveness	9.1	
Returned Equity	9 Years	

Summary of Impacts: Scenario 9b: 6-Lane Section with Interstate Avenue Grade Separation

The improvements contained within Alternative H1 do not mitigate all expected level of service deficiencies on the State Street corridor between I-94 and 71st Avenue.

- Reduces vehicle hours traveled by 16.3 percent by 2045.
- Vehicle miles traveled increases slightly by 2045.
- Has a total estimated 2025 construction cost of $89.3 million.
- Has a benefit/cost ratio of 8.5.
- Has a cost-effectiveness ratio of 6.2.
- Returns equity in 10 years.

The analysis summary for this scenario is shown in Table 7.14, with the impacts to average daily traffic shown in Figure 7.14. This concept cluster was carried forward for further analysis.

Table 7.14: Summary of Scenario 9b: 6-Lane Section with Interstate Avenue Grade Separation

Scenario 9b	2030	2045
VHT Change	-3.8%	-16.3%
VMT Change	1.1%	0.2%
AADT	6,564	8,468
% of Links Over Capacity	1.8%	7.0%
Construction Cost	$89.3 M	
Total Benefits	$495.2 M	
Benefit/Cost Ratio	8.5	
Cost-Effectiveness	6.2	
Returned Equity	10 Years	

Summary of Impacts: Scenario 9c: Expressway

The major improvements associated with the expressway would result in acceptable operations for most of the State Street corridor between I-94 and 71st Avenue. It has lower reductions to VHT change through 2045 because the expressway configuration requires more rerouting, adding 184 miles to the network each day. It would put additional traffic demand on parallel routes and be a barrier for bicyclists and pedestrians. This alternative produces the lowest benefits of the three State Street improvement scenarios.

- Reduces vehicle hours traveled by 14.0 percent by 2045.
- Vehicle miles traveled increase by 2.2 percent by 2045.
- Has a total estimated 2025 construction cost of $145.1 million.
- Has a benefit/cost ratio of 4.2.
- Has a cost-effectiveness ratio of 2.2.
- Returns equity in 16 years.

The analysis summary for this scenario is shown in Table 7.15 with the impacts to average daily traffic shown in Figure 7.15. This concept cluster was not carried forward for further analysis.

Table 7.15: Summary of Scenario 9c: Expressway

Scenario 9c	2030	2045
VHT Change	-2.3%	-14.0%
VMT Change	2.5%	2.2%
AADT	6,658	8,636
% of Links Over Capacity	1.6%	6.1%
Construction Cost	$145.1 M	
Total Benefits	$289.5 M	
Benefit/Cost Ratio	4.2	
Cost-Effectiveness	2.2	
Returned Equity	16 Years	

Summary of Project Concept Clusters

Each of the project concept clusters provides different benefits and impacts to the network, as summarized in Table 16, and below:

- The Southern Bridge Corridor to ND 6 (Scenario 1b) provides the highest total benefits. However, its inconsistency with future land use and development plans and significant environmental constraints resulted in its dismissal from further analysis.
- The Northern Bridge Corridor's Southern Alignment (Scenario 2b) provides the highest reduction in 2045 VHT and VMT change, while the Northern Bridge Corridor's Northern Alignment (Scenario 2a) results in the highest of 2045 links over capacity. The northern alignment of this bridge corridor was dismissed from further consideration.
- The Northeast Bismarck Arterial Improvements with I-94 Interchange (Scenario 4c) provides the greatest relief to network-wide congestion, reducing the percent of links over capacity in 2045 to 5.1 percent (from 13.6 in the 2045 E+C network), but comes with the highest construction cost, lowest benefit/cost ratio, and lowest cost-effectiveness ratio.
- The 33rd Avenue Grade Separation has the highest benefit/cost ratio and cost-effectiveness ratio, primarily due to its low construction costs.
- The US 83/State Street expressway concept results in the highest increase to VMT, provides the lowest total benefits, and the longest time to return equity. The 6-lane US 83/State Street concepts (9a and 9b) performed much better in this analysis and should be carried forward for further analysis.
- The Hamilton Street Grade Separation breaks even after just seven years. Providing a more direct connection to Mandan's growth areas and low construction cost results in this alternative performing well.

The summary of the concepts and all the analysis is shown in Table 7.16.

Table 7.16: Summary of Cluster Analysis

Scenario	2045 VHT Change	2045 VMT Change	2045 Links Over Capacity	Cost (M)	Benefits (M)	B/C Ratio	C/E	Returned Equity (Years)	Carried Forward
2045 E+C	-	-	13.6%	-	-	-	-	-	-
1a: Southern Bridge Corridor to ND 1806	-17.3%	-0.9%	6.9%	$84.1	$619.1	14.4	8.2	8	No
1b: Southern Bridge Corridor to ND 6	-17.1%	-0.9%	7.1%	$100.6	**$622.4**	11.0	6.8	8	No
2a: Northern Bridge Corridor Northern Alignment	-17.2%	-0.7%	**8.4%**	$122.9	$596.2	8.8	5.4	10	No
2b: Northern Bridge Corridor Southern Alignment	**-18.0%**	**-1.0%**	8.1%	$122.9	$607.7	8.9	5.5	10	Yes
3: South Mandan Arterial	-16.4%	-0.6%	7.4%	$29.4	$489.2	21.6	18.3	9	Yes
4a: NE Bismarck Arterials	-15.8%	-0.6%	5.5%	$131.6	$493.2	4.8	4.1	12	Yes
4b: NE Bismarck Arterials with I-94 Grade Separation	-14.3%	0.0%	5.3%	$179.5	$433.4	3.2	2.6	14	No
4c: NE Bismarck Arterials with I-94 Interchange	**-13.3%**	0.1%	**5.1%**	**$195.3**	$377.5	**2.7**	**2.1**	15	Yes
5: West Mandan Interchange	-15.6%	-0.1%	7.2%	$79.6	$518.5	10.1	7.1	9	Yes
6: TSMO Improvements	-16.0%	0.1%	6.9%	$41.5	$498.8	16.0	13.5	8	Yes
7: Hamilton Street Grade Separation	-15.9%	-0.2%	7.2%	$35.0	$515.8	24.8	16.3	**7**	Yes
8: 33rd Avenue Grade Separation	-15.4%	-0.2%	7.3%	**$26.5**	$446.5	**31.5**	**18.7**	9	Yes
9a: US 83 6-Lane Alternative	-16.8%	0.1%	6.8%	$64.3	$523.3	10.8	9.1	9	Yes
9b: US 83 6-Lane Alternative with Interstate Avenue Grade Separation	-16.3%	0.2%	7.0%	$89.3	$495.2	8.5	6.2	10	Yes
9c: US 83 Expressway	-14.0%	**2.2%**	6.1%	$145.1	**$289.5**	4.2	2.2	**16**	No

Figure 7.13: Scenario 9a 2045 Traffic Changes

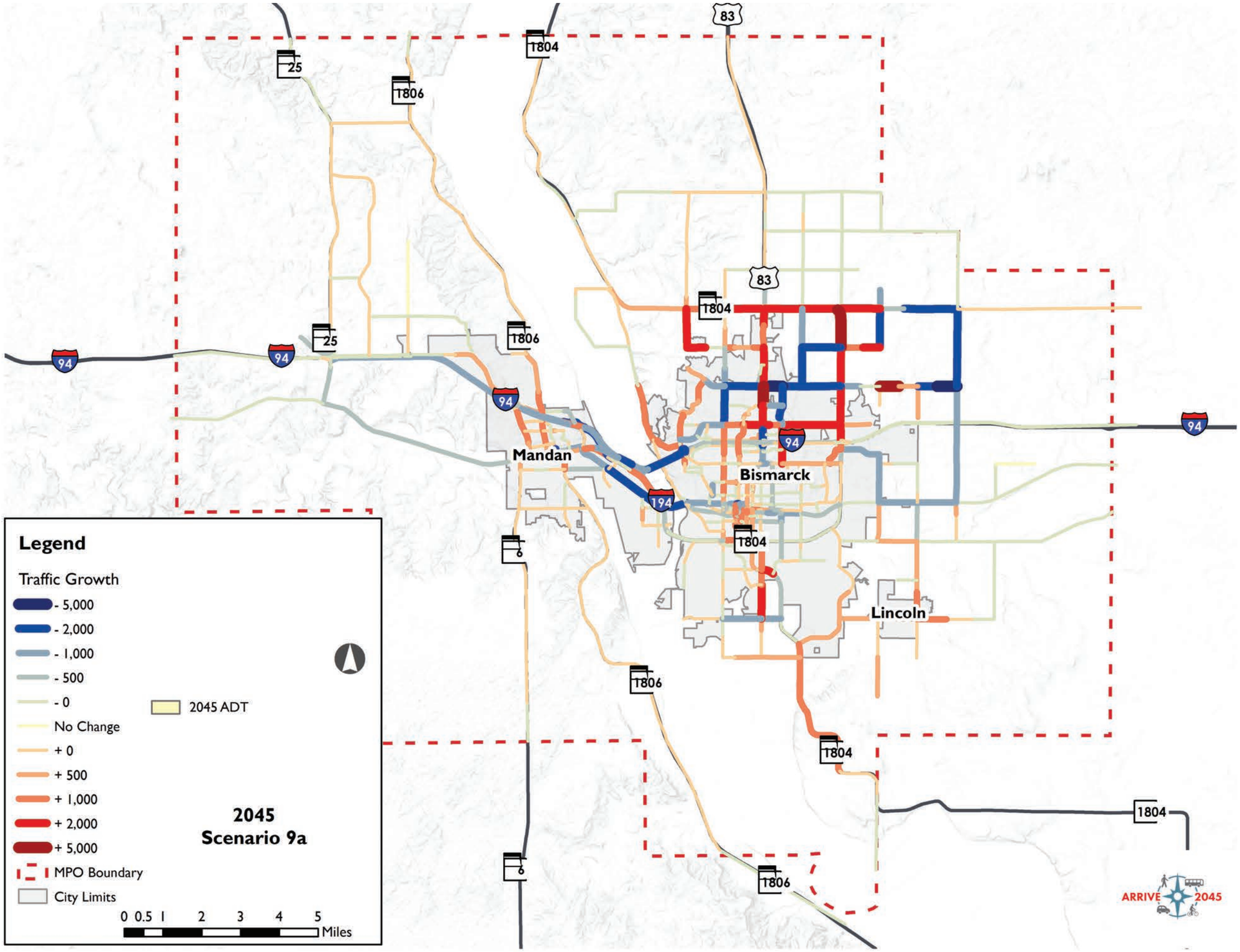

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Figure 7.14: Scenario 9b 2045 Traffic Changes

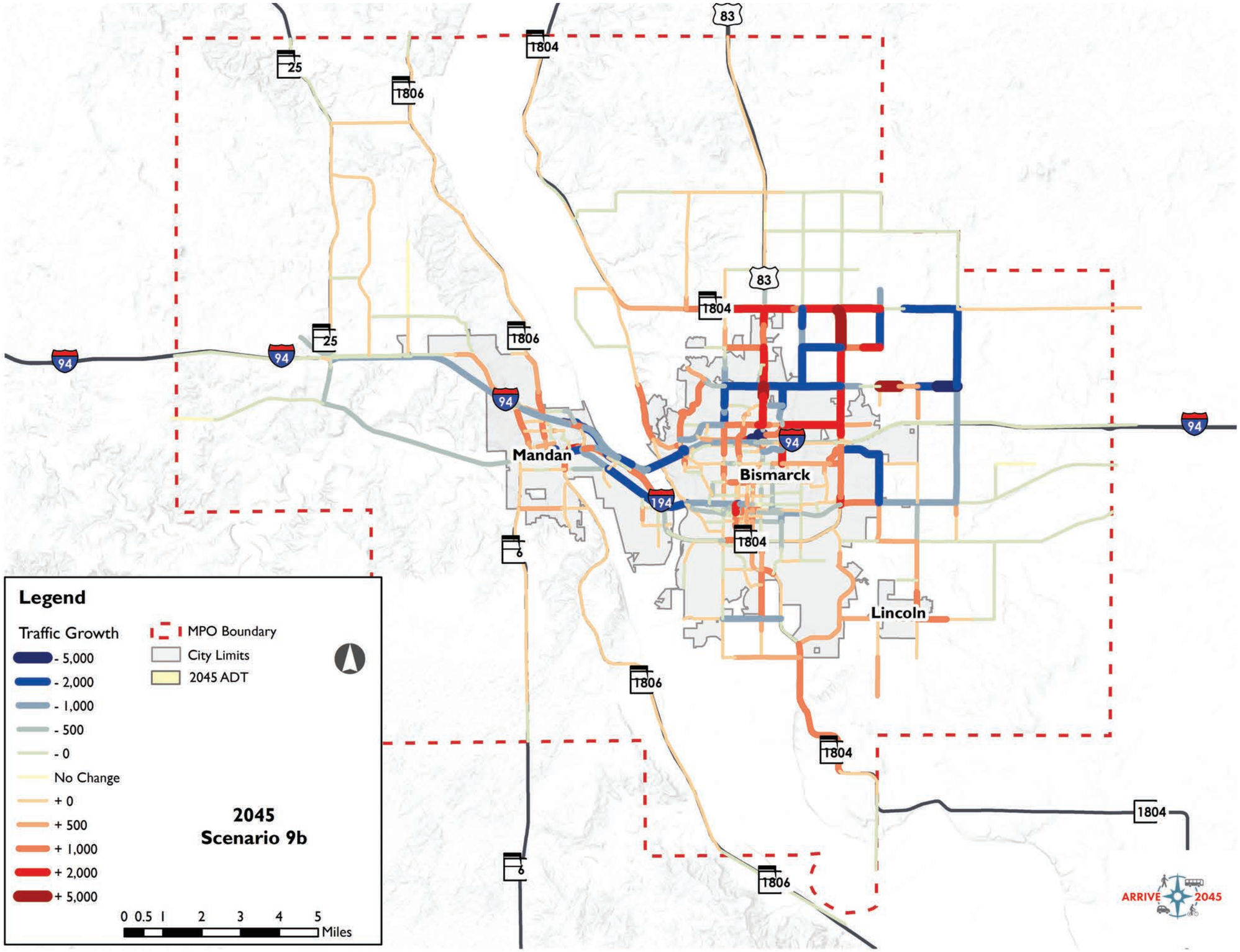

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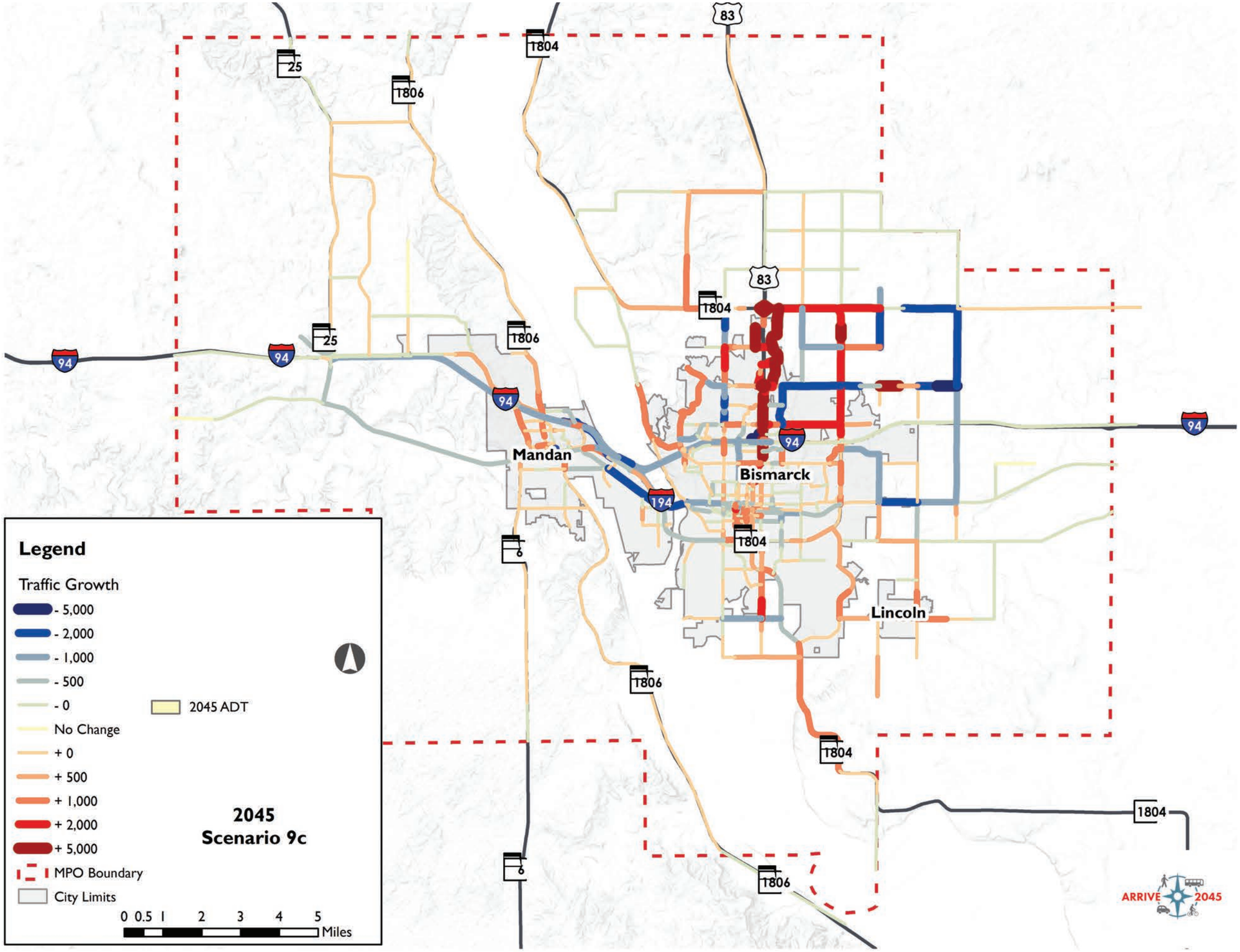
Figure 7.15: Scenario 9c 2045 Traffic Changes



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Interstate Analysis

The Metropolitan Transportation Plan has identified multiple transportation issues under existing and 2045 conditions. I-94 was selected for a more detailed review due to the regional significance, need for regional scenario analysis, and the long list of identified issues. I-94 is critical not only to the success of the Bismarck-Mandan metro area but the economic vitality of the State of North Dakota and the national success of the interstate system.

Interstate 94 was evaluated as part of the I-94 Corridor Study completed in 2014 which developed a variety of potential improvement strategies. This study was completed using a previous iteration of the MPO travel demand model (year 2040) which shows deviations up to 5,000 vehicles per day in several areas on I-94/I-194 when compared to the updated 2045 travel demand model. There were also several locations where 2016 turning movement counts yielded higher traffic volumes than 2040 projections. The updated model, along with the regional scenario analysis can have widespread impacts to I-94 and I-194. All these factors were considered in this Interstate analysis.

The existing, 2030, and 2045 daily traffic volumes with the existing and committed transportation network are shown in Figure 7.16

Approach

The interstate analysis was completed using a three-step process.

- Regional Project Impacts. The regional project impacts used the travel demand model to understand how new connections (Hamilton Street, McKenzie Drive extension, 33rd Avenue grade separation, 66th Street, North River corridor, etc.) impact travel patterns across the interstate system.
- Interstate Analysis. The interstate analysis used the 2045 existing plus committed project network to identify issues on mainline I-94 and I-194 and existing interchanges. The regional impacts analysis was incorporated to see if the travel pattern changes impact the needs at existing interchanges.
- Benefits Comparison. The benefits comparison looked at infrastructure and timing needs to identify the overall benefits to the interstate system and prioritize improvements.

This approach used a high-level analysis appropriate for a long-range plan so it does not incorporate environmental impacts, project-specific cost estimates, or public input.

ISSUES

Traffic operations issues were identified in two parts: mainline I-94 and I-194 and the interchanges. Interchanges included analysis at the closest upstream intersection in each direction. This approach matches FHWA guidance for interchange modifications.

Mainline Issues

Mainline I-94 and I-194 was modeled using Vissim microsimulation. This software tracks the movement of every vehicle throughout the network. The model included the mainline and on- and off-ramps to understand the merging, diverging, and weaving issues at the interchanges. The model did not include the ramp intersections on the crossroads but did incorporate signal timing at those intersections to more accurately estimate entering volumes and platooning effects. This was done to model the actual capacity and operations on the interstate in isolation from deficient intersection operations.

Operations analysis on the freeway evaluates level of service, a letter grade assigned based on density, or the number of passenger cars per lane per mile, as shown in Table 7.17. LOS "D" or better is considered acceptable by NDDOT.

Table 7.17: Freeway Level of Service Thresholds

Level of Service	Density (veh/lane/mi)
A	0-11
B	12-18
C	19-26
D	27-35
E	36-45
F	>45

Under existing traffic, the interstate operates very efficiently, at LOS "B" or better during both the AM and PM peak hours.

By 2045, the interstate still generally operates efficiently, at LOS "C" or better during both the AM and PM peak hours, meaning no additional capacity is necessary along mainline I-94/I-194 to accommodate forecasted traffic volumes through 2045. Links with deficient levels of service begin to emerge around several interchanges, specifically around merge (entrance) and diverge (exit) points. This type of congestion is caused by poor operations at the interchanges and not mainline capacity deficiencies other than the I-194 connections.

- Westbound: Centennial Road exit, Centennial Road entrance, Tyler Parkway exit, I-194/I-94 interchange, Mandan Avenue exit
- Eastbound: Tyler Parkway exit, State Street exit, Centennial Road exit, McKenzie Drive exit, Memorial Highway exit

Level of service for the mainline I-94 and I-194 under existing and 2045 conditions is shown in Figure 7.18 through Figure 7.20.

I-94 Corridor Study Results

The I-94 Corridor Study found deficient operations at the I-94 and I-194 interchange that primarily related to poor operations at the ramp intersections. The poor operations at the intersections resulted in long queues that extended onto the interstate and impacted mainline operations. This is comparable to the results of this analysis.

Interchange Issues

For the interchanges, Synchro software was used. Synchro applies deterministic equations published in the Highway Capacity Manual, which is an industry and NDDOT standard. Operations analysis at the interchange and adjacent intersections evaluates level of service, a letter grade assigned to an intersection based on total delay, as shown in Table 7.18. LOS "D" or better is considered acceptable.

Table 7.18: Intersection Level of Service Thresholds

Level of Service	Control Delay (sec/veh)	
	Unsignalized	Signalized
A	≤ 10	≤ 10
B	10-15	10-20
C	15-25	20-35
D	25-35	35-55
E	35-50	55-80
F	> 50	> 80

Existing Issues

Under current conditions, most of the existing interchanges have acceptable operations. The exceptions include many of the intersections with two-way stop control on the minor approaches (Boundary Road and Sunset Drive; Turnpike Avenue and Tyler Parkway; Interchange Avenue and State Street). This is common on stop-controlled intersections and does not necessarily indicate a need for improvements at that location.

2045 Issues

By 2045, most of the existing interchanges have deficient operations at one or more intersections. There are multiple intersections where the overall intersection operates at LOS "D" or better, but the minor approaches have deficient levels of service. This is common on stop-controlled intersections and does not necessarily indicate a need for improvements at that location.

The intersection levels of service are summarized in Table 7.19 and shown in Figure 7.21 through Figure 7.27.

Table 7.19: 2045 Interchange Intersection Deficiencies

Location	2045 AM Deficiencies	2045 PM Deficiencies
ND 25	» None	» None
Sunset Drive	» Boundary Road Intersection LOS "D" with approach LOS "F"	» Boundary Road intersection LOS "C" with approach LOS "F"
Mandan Avenue	» None	» None
Divide Avenue/ Tyler Parkway	» Burnt Boat Road intersection LOS "E" » Turnpike Avenue LOS "C" with approach LOS "F"	» Turnpike Avenue LOS "F" with approach LOS "F"
State Street	» Westbound Ramp intersection LOS "E" » Interchange Avenue intersection LOS "B" with approach LOS "F" » Spaulding Avenue intersection LOS "" with approach LOS "F" » Divide Avenue intersection LOS "E"	» Century Avenue intersection LOS "E" » Eastbound Ramp intersection OS "E" » Interchange Avenue intersection LOS "D" with approach LOS "F" » Spaulding Avenue intersection LOS "A" with approach LOS "F" » Divide Avenue intersection LOS "F"
Centennial Road	» Trenton Avenue intersection LOS "F" » Eastbound Ramp intersection LOS "E" » Miriam Avenue intersection LOS "E"	» Westbound Ramp intersection LOS "E" » Eastbound Ramp intersection LOS "F" » Miriam Avenue intersection LOS "E"
Memorial Highway	» None	» None
McKenzie Drive	» Westbound Ramp intersection LOS "E" with approach LOS "F"	» None

Figure 7.16: Existing, 2030, and 2045 Daily Traffic

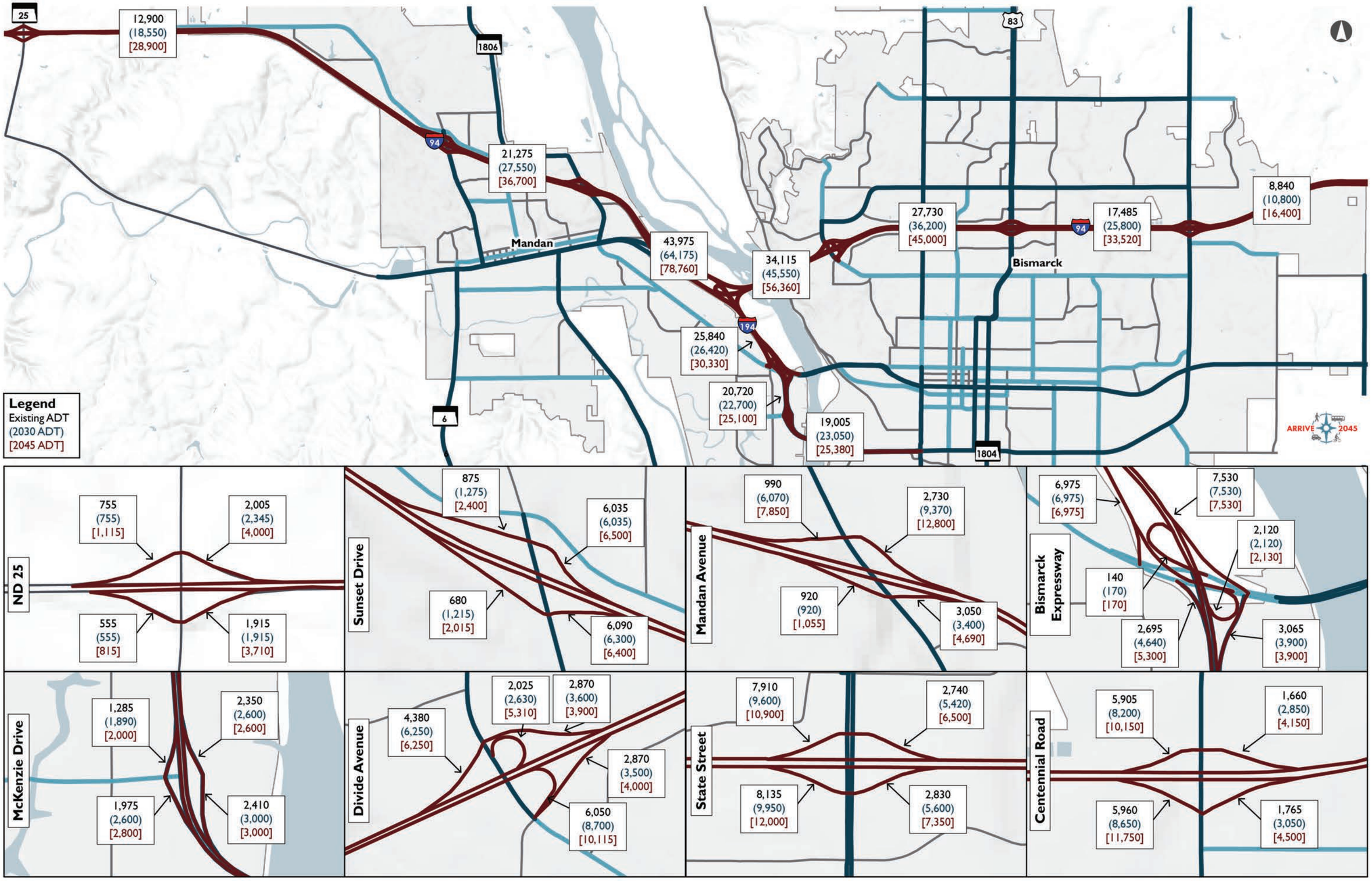

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Figure 7.17: 2016 AM Peak Mainline Operations

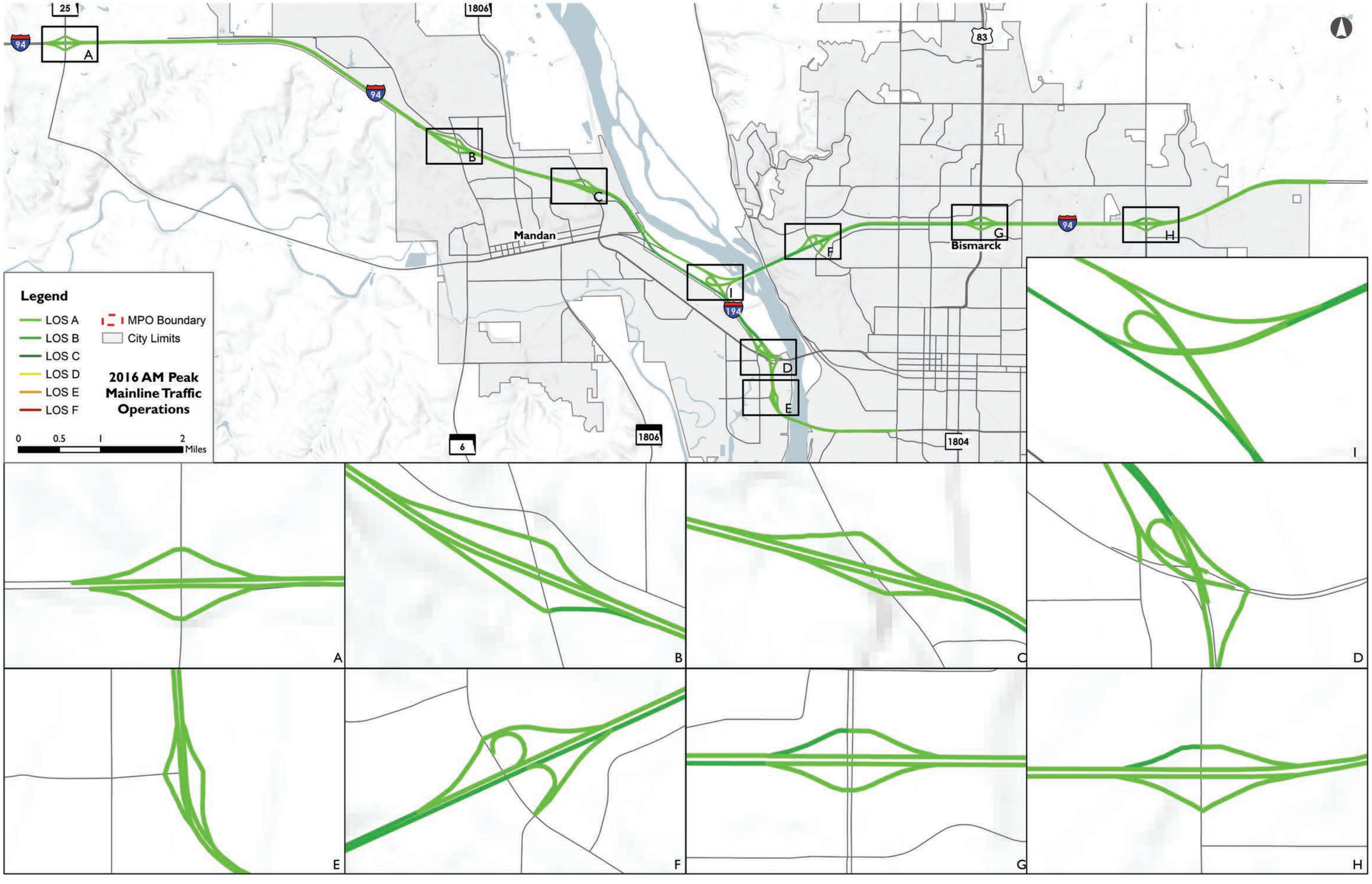

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Figure 7.18: 2016 PM Peak Mainline Operations

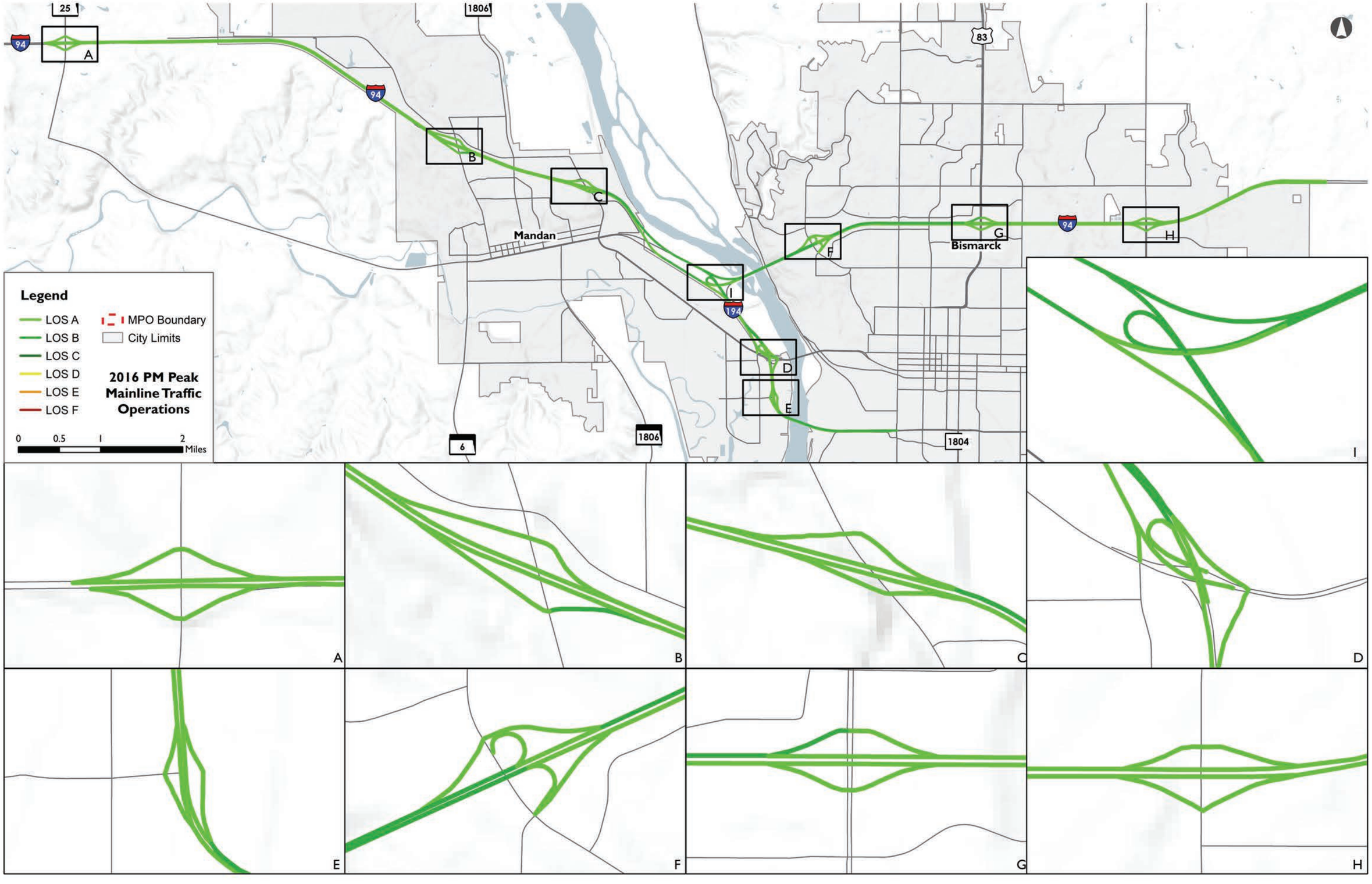

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Figure 7.19: 2045 AM Peak Mainline Operations

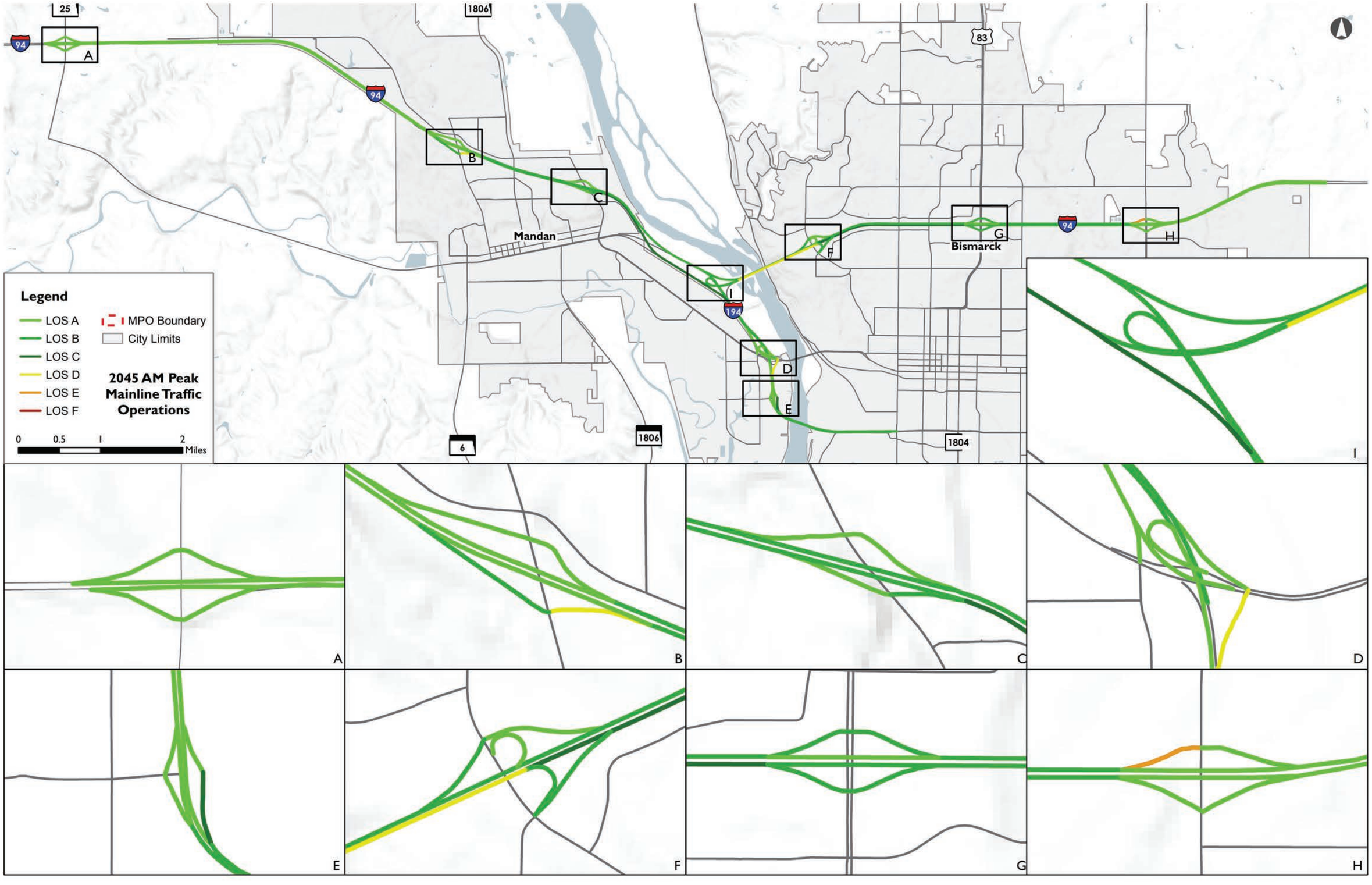

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Figure 7.20: 2045 PM Peak Mainline Operations

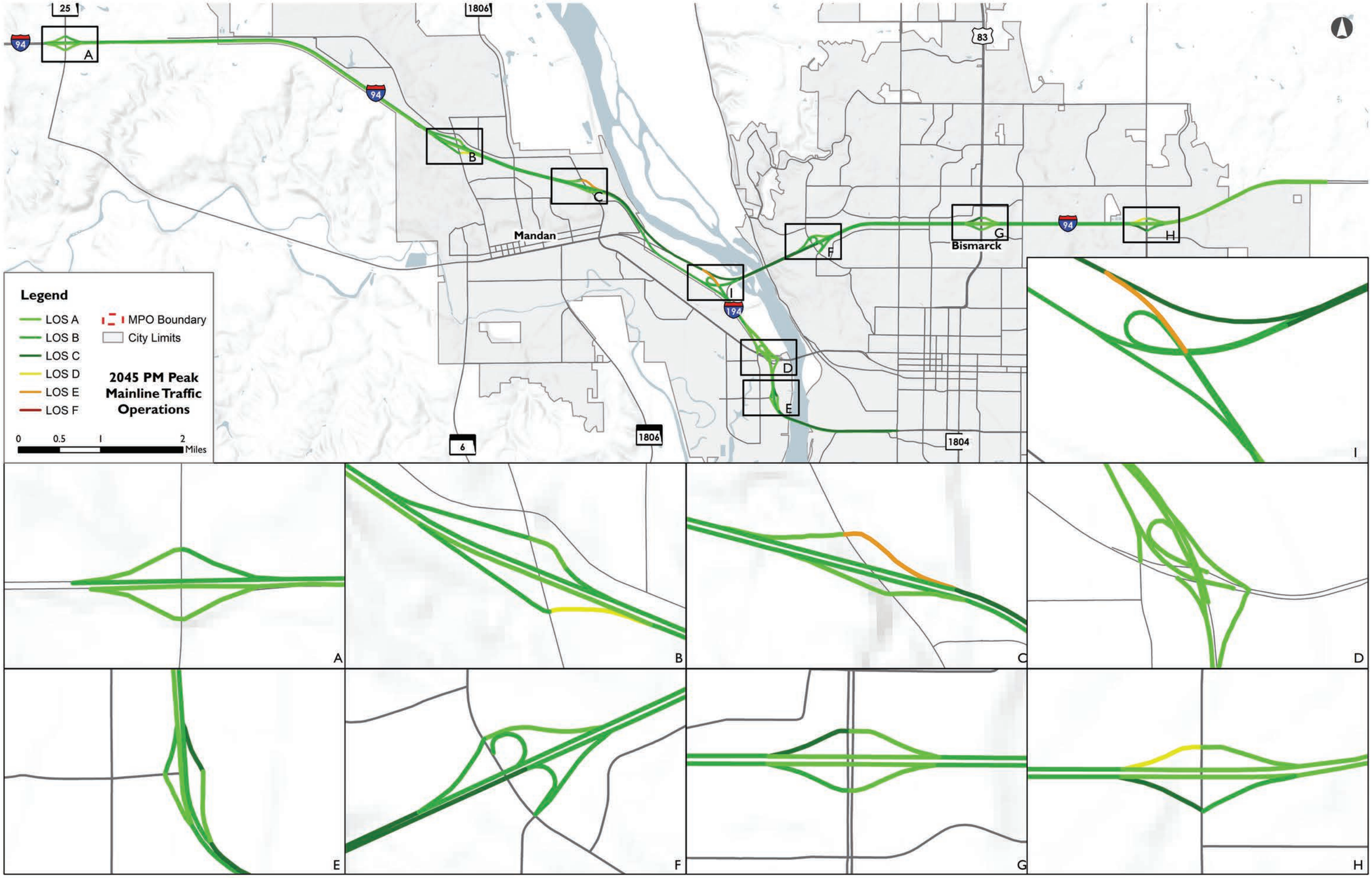

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Figure 7.21: ND 25 Interchange Intersection Level of Service

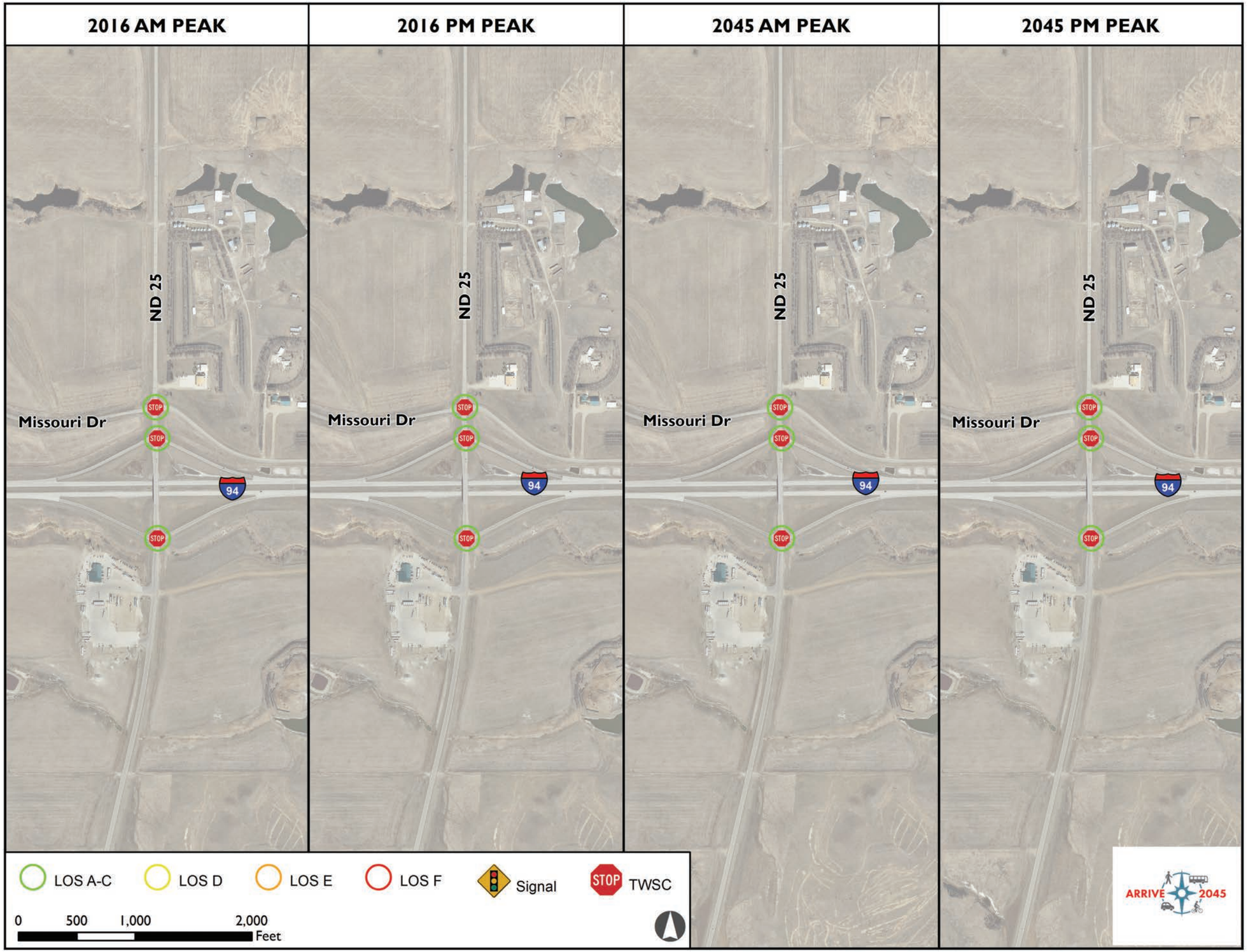

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Figure 7.22: Sunset Drive Interchange Intersection Level of Service

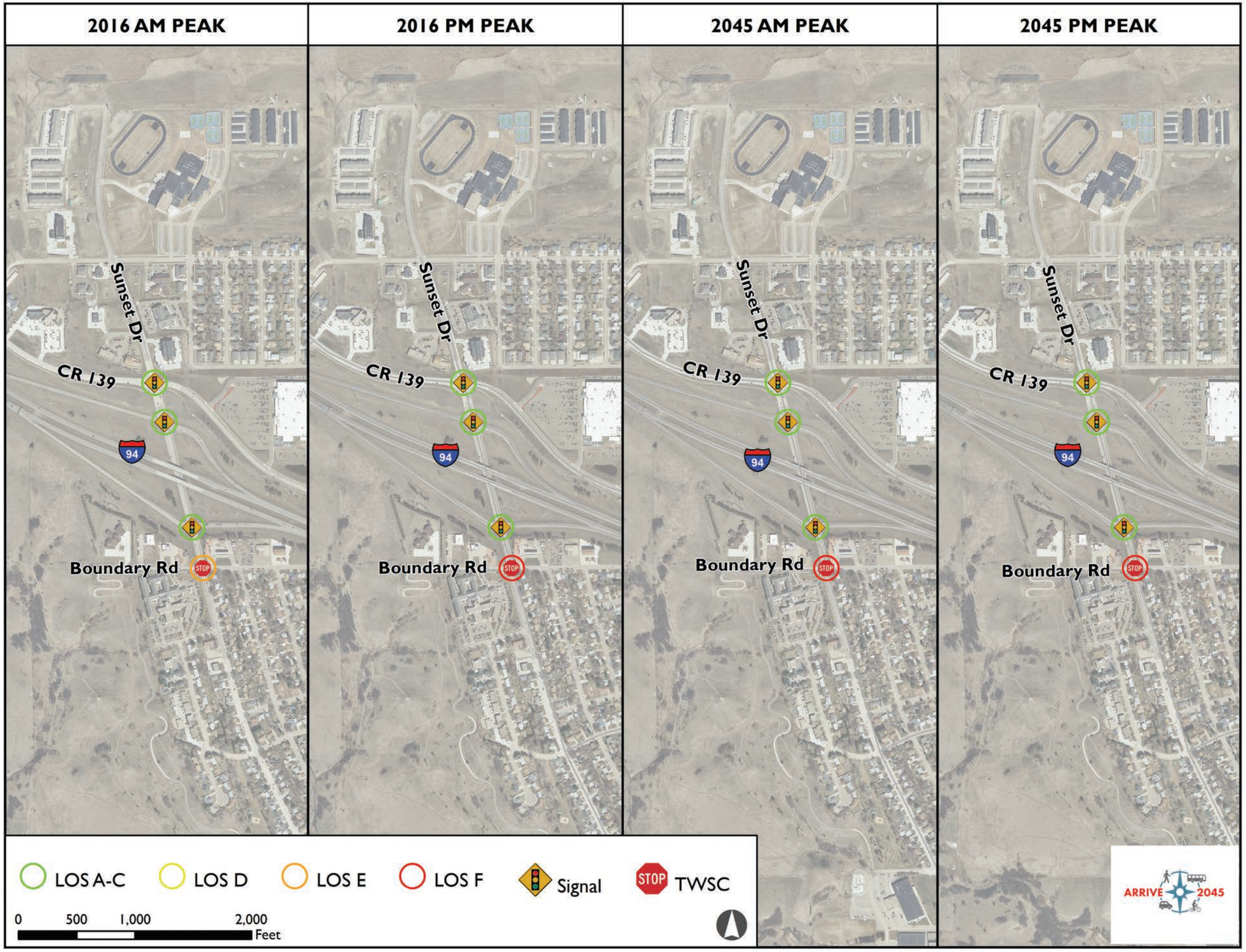

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Figure 7.23: Mandan Avenue Interchange Intersection Level of Service

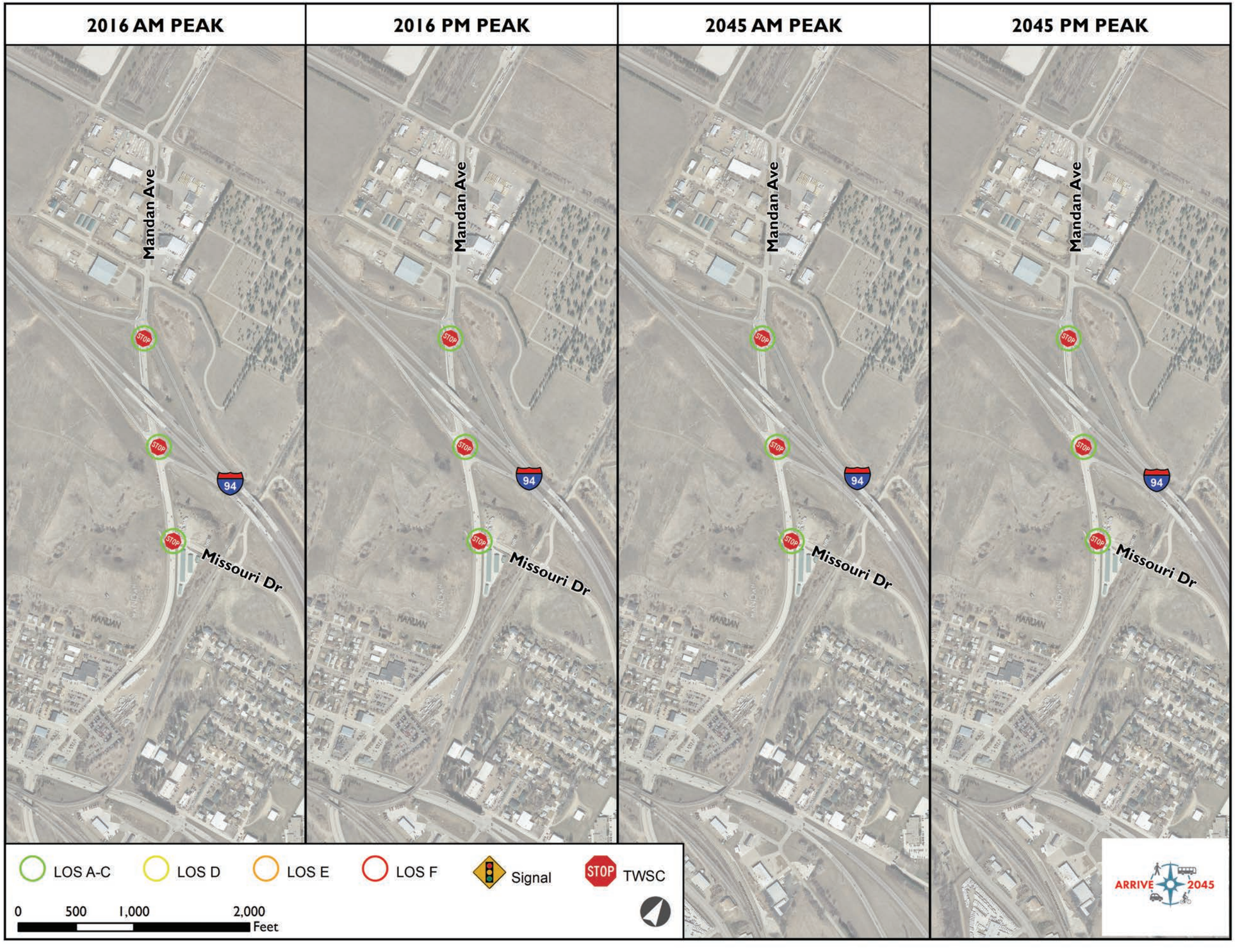

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Figure 7.24: Divide Avenue/Tyler Parkway Interchange Intersection Level of Service

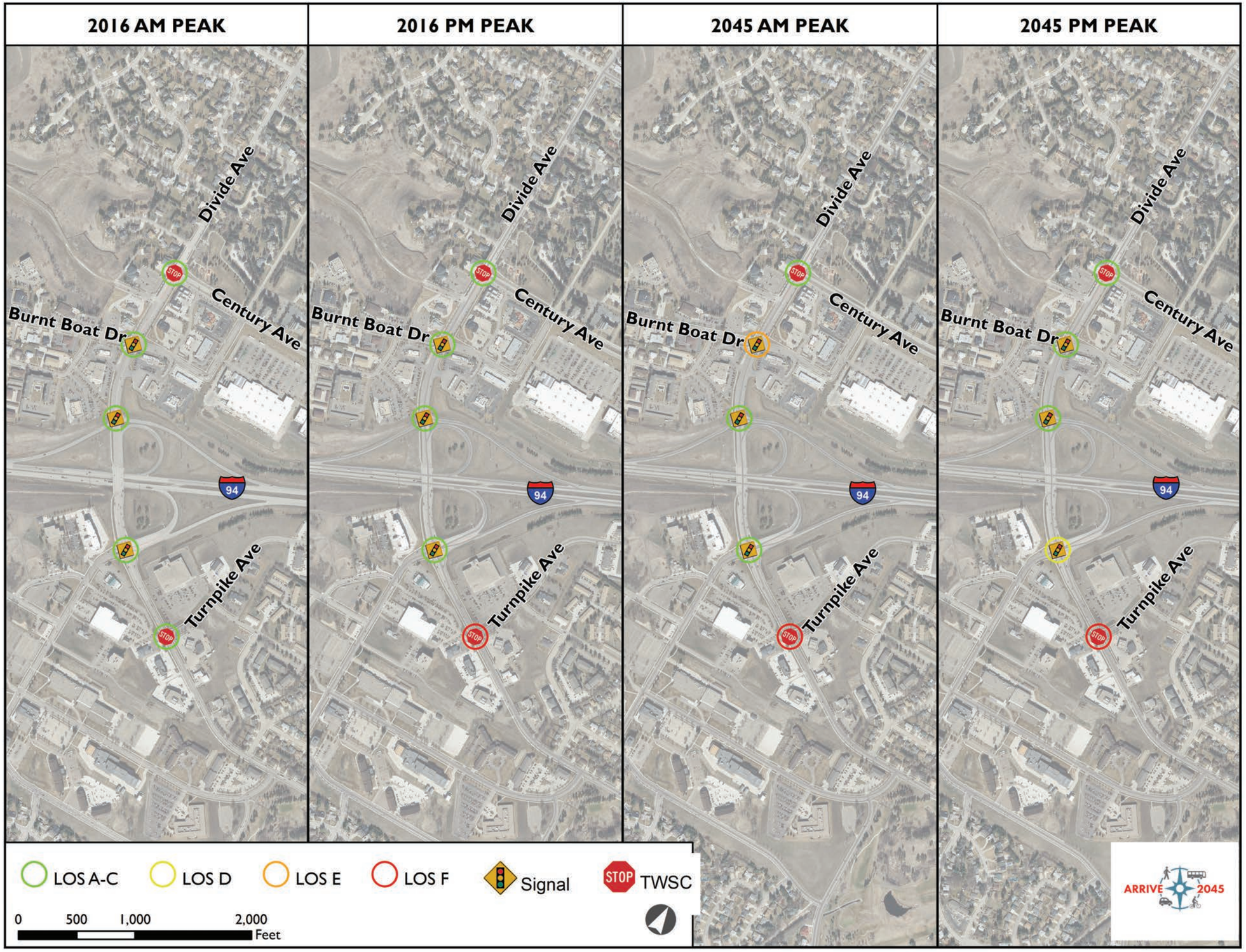

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Figure 7.25: State Street Interchange Intersection Level of Service

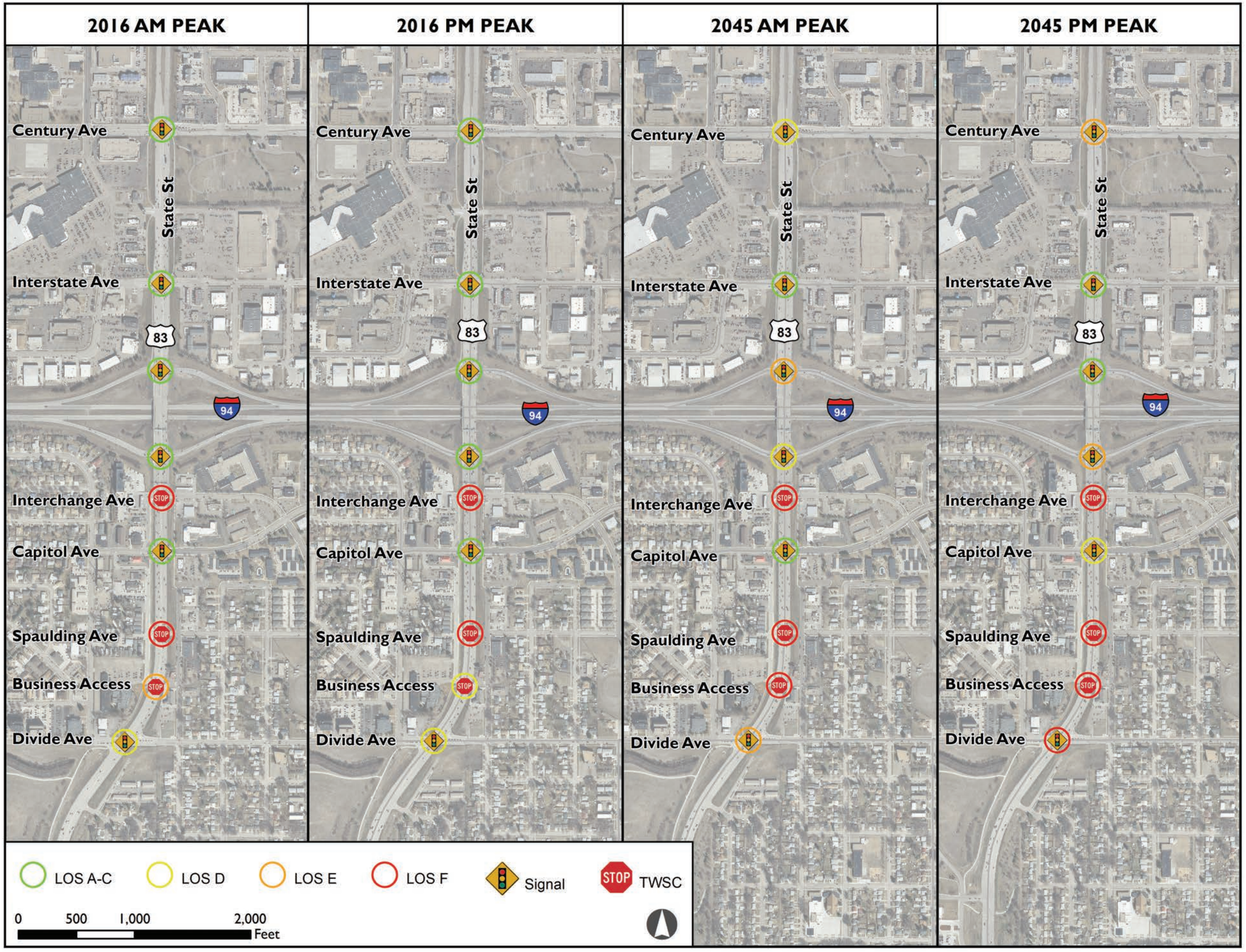

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Figure 7.26: Centennial Road Interchange Intersection Level of Service

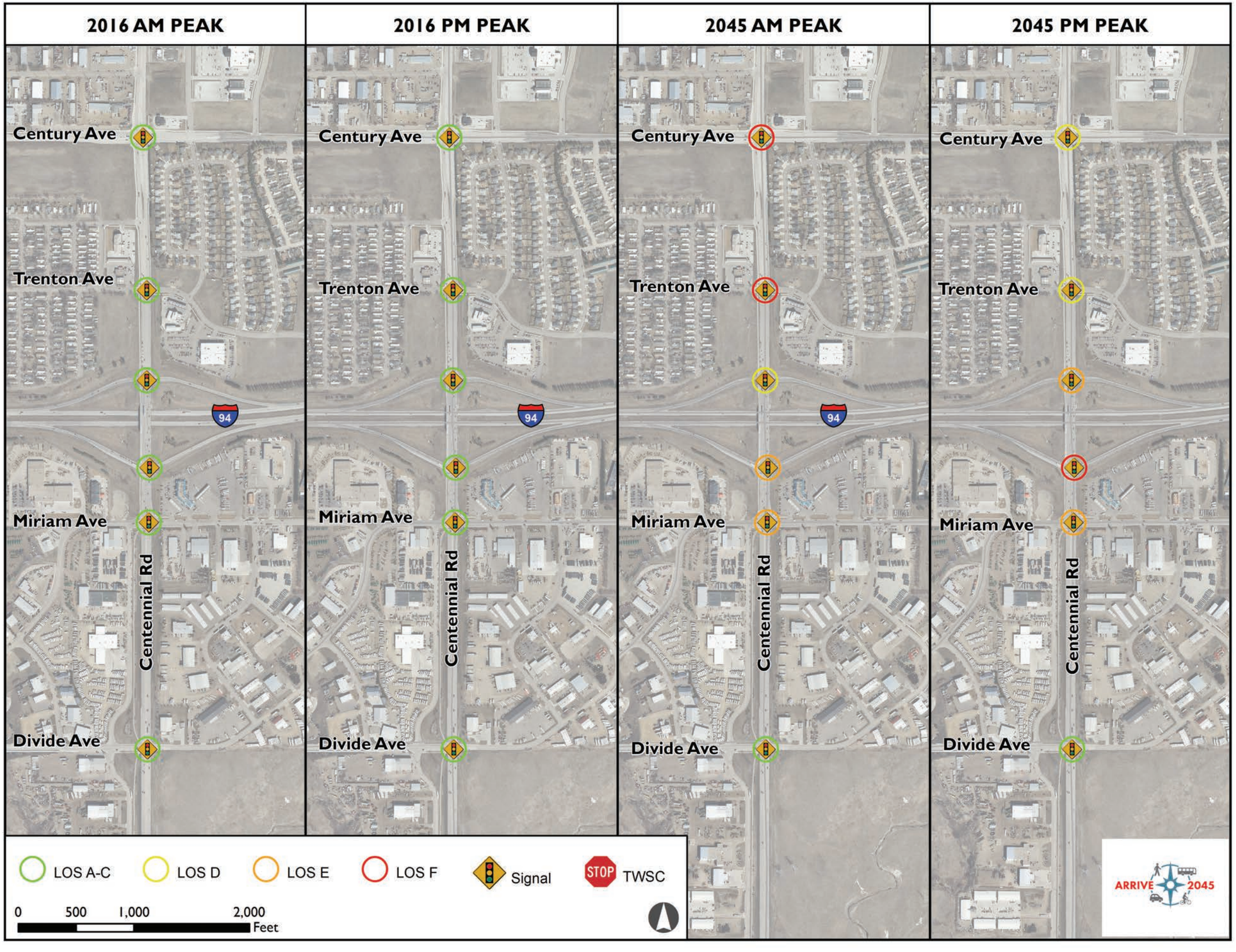

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Figure 7.27: Memorial Highway and McKenzie Drive Interchange Intersection Level of Service

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Previous Study Results

Bismarck Expressway/Centennial Road Interchange

NDDOT recently completed a left-turn phasing analysis on the Bismarck Expressway/Centennial Road interchange in response to a citizen request. This analysis found operations are acceptable under current conditions, operating at LOS "D" or better at the Westbound Ramps, Eastbound Ramps, and Miriam Avenue intersections. The analysis did identify queuing issues that block through lanes and extend into adjacent intersections:

- During the PM peak, the northbound queue at the Eastbound Ramp intersection is 425 feet, which extends into the Miriam Avenue intersection.
- During the PM peak, the eastbound to northbound left-turn volumes occasionally back up out of the turn bay and nearly onto interstate mainline.

The results completed for the left-turn phasing analysis are comparable to the results of this analysis. Traffic volumes and signal timing variations can explain the minor differences. More refined microsimulation analysis may identify further degraded operations resulting from the long queues interacting with adjacent intersection movements.

I-94 Corridor Study

The I-94 Corridor Study expected more deficient operations by 2040 at multiple interchange locations than this analysis identified. This can be explained by many factors including recent improvements, different forecasted volumes (higher or lower volumes, different directional splits depending on new growth areas), signal optimization reflective of different volumes, and the level of analysis (Synchro, SimTraffic, and microsimulation) used to report results.

The LOS differences are highlighted in Table 7.20.

Table 7.20: Comparison of MTP and I-94 Corridor Study Analysis Results

Location	Differences	Potential Explanations
ND 25	» None Identified	» NA
Sunset Drive	» MTP did not identify deficiencies, I-94 Corridor Study found deficient operations at all study intersections.	» Recently installed traffic signals result in acceptable operations.
Mandan Avenue	» None Identified	» NA
Divide Avenue/ Tyler Parkway	» Both the MTP and I-94 Corridor Study found deficient operations at most study intersections for one or both peak hours.	» Different analysis methodologies result in slightly different results.
State Street	» I-94 Corridor Study found most State Street intersections operate acceptably for both 2040 AM and PM, while the MTP analysis found most are deficient for at least one peak hour.	» The I-94 Corridor Study included some locations with significantly lower volumes. Different analysis methodologies result in slightly different results as well.
Centennial Road	» Both the MTP and I-94 Corridor Study found deficient operations at most study intersections for one or both peak hours.	» Different analysis methodologies result in slightly different results.
Memorial Highway	» The I-94 Corridor Study did not analyze this interchange.	» NA
McKenzie Drive	» The I-94 Corridor Study did not analyze this interchange.	» NA

2045 Travel Demand Model Comparison

The 2045 Existing plus Committed Projects travel demand model outputs found most of the mainline I-94 operates at LOS "D" or better through 2045, with localized operational deficiencies at the interchanges. The model found deficient operations at some crossroads, including State Street and Centennial Road. The more refined analysis completed with Synchro and Vissim more accurately identifies potential deficient traffic operations because they consider more than high-level capacity constraints and incorporate queueing impacts.

REGIONAL CONNECTIONS

New regional connections that provide alternative corridors through and around the Bismarck-Mandan metro can help mitigate some congestion at existing interchanges. As part of the project cluster concepts analysis completed for the MTP and discussed earlier in this chapter, certain cluster concepts provide benefit to the interstate and interchanges and were analyzed as part of this analysis as well. Their scenarios are noted in parenthesis for reference to that analysis.

66th Street Interchange (4c)

The 66th Street interchange would see around 21,000 vehicles per day, when combined with other Northeast Bismarck arterial roadway improvements and connections, including new east-west connections along Century Avenue, 43rd Avenue, and 71st Avenue. Building these connections has the following impacts:

- Increases traffic on I-94 between Centennial Road and State Street from 30,300 to 38,400 with the 66th Street interchange. This traffic would be local traffic using the Interstate for commuting. The increased volumes do not result in any deficient operations.
- Improves operations on east-west corridors as vehicles have improved access to I-94 for their east-west trips and use the Interstate for local trips. For example, segments of 43rd Avenue see a 25 percent decrease in projected ADTs to 2045, resulting in a LOS "A", compared to a LOS "D".
- The interchange, along with other Northeast Bismarck arterial improvements has a benefit/cost ratio of 2.7, indicating it is a cost-effective project.

Impacts to Existing Interchanges

The 2045 travel demand model used in this analysis does not include any major arterials in the northeast growth area. This makes it difficult for the model to assign trips to and from the northeast growth area. The 2045 travel demand model with the arterial improvements and interchange result in many more trips generated in the northeast growth area, indicating that without major infrastructure investments in the area, the growth is unlikely to occur. An additional comparison was made that incorporated the arterial improvements without the 66th Street interchange. The impacts to State Street, Centennial Road, 80th Street, and I-94 are shown in Table 7.21.

Table 7.21: Traffic Projections with 66th Street Interchange

	State Street	Centennial Road	80th Street	I-94 Between State Street and Centennial Road
2040 E+C	No: 54,000 So: 32,000	No: 41,000 So: 40,000	17,500	29,000
2045 E+C	No: 56,300 So: 41,100	No: 29,800 So: 33,900	10,500	30,300
NE Arterials	No: 53,860 So: 40,400	No: 40,000 So: 39,400	8,200	34,250
NE Arterials & 66th Street Interchange	No: 54,300 So: 41,800	No: 32,300 So: 38,500	5,300	38,400

The 2040 travel demand model found dramatically different results, as summarized in the I-94 corridor study. For example, that study found that without the 66th Street interchange, the 80th Street corridor would see volumes that approach 17,500 by 2040. The updated 2045 E+C travel demand model projects that corridor to carry just 10,500 vehicles per day without the 66th Street interchange.

Ultimately, the 66th Street interchange has no measurable impact to State Street but does reduce projected traffic on Centennial Road nearly 19 percent, when compared to the projections with the arterial improvements in the Northeast. This reduction is not enough to mitigate the projected capacity deficiencies on Centennial Road. The 66th Street interchange would keep the 80th Street overpass operating efficiently.

Summary

- The 66th Street Interchange will be an asset in future scenarios to mitigate congestion at the Centennial Road and 80th Street Corridors.
- For the 66th Street Interchange to be a viable option, substantial roadway and development investment is necessary, making this a long-term solution.
- Given the long-term timeline for the 66th Street Interchange, inability to outright mitigate congestion at the Centennial Road Interchange and minimal benefits to the State Street interchange, alternatives at these two interchange locations were evaluated without the 66th Street Interchange.
- Additional scenario analyses may be warranted prior to selecting a preferred alternative at the Centennial Road Interchange location. For example, there is the potential that the full-build solution at Centennial Road may not need to be quite as robust and need to consider more traffic flow to the east under a 66th Street interchange.

Northern Bridge Corridor (2a)

The Northern Bridge Corridor concept would establish an east-west corridor with a new river crossing on the north side of the metro area. It would generally follow 71st Avenue in Bismarck, with the new river crossing connecting Burnt Creek Loop in Bismarck and 38th Street in Mandan, then following 37th Street, ending at ND 25 following an alignment developed from previous planning efforts. More than 11,000 vehicles per day would use a northern bridge corridor, which effectively creates a northern bypass, attracting vehicles off I-94, onto Centennial Road and then 71st Avenue to ND 1806 and/or I-94 on the western edge of Mandan.

- All mainline I-94 and I-194 operate at LOS "C" or better with the Northern Bridge corridor.
- The Expressway Bridge operates at LOS "C" with the Northern Bridge corridor, a moderate improvement from LOS "D" without the northern bridge corridor. The Memorial Highway/ Main Avenue and Grant Marsh river crossings operate at LOS "C" or better through 2045.
- Adds significant congestion to Centennial Road and 71st Avenue corridors. Traffic is rerouted from 80th Street and Highway 10 onto Centennial Road. Centennial Road south of I-94 is projected to increase nearly 65 percent resulting in LOS "E" compared to LOS "B" without the northern bridge corridor.
- The northern bridge corridor and additional connections has a benefit/cost ratio of 8.8, indicating it is a cost-effective project.

Summary

The Northern Bridge corridor would be beneficial for the interstate but given the lack of needs along the interstate through 2045, should not be the driving force behind the improvement. This concept should be considered when evaluating the timing and need of potential small-scale improvements between the Grant Marsh Bridge and Main Street in Mandan.

Hamilton Street/ Channel Grade Separation (7)

The I-94 grade separation at Hamilton Street/ Channel would create a new grade separation (overpass or underpass) of I-94 at Hamilton Street (west of Centennial Road) and connect Century Avenue and Divide Avenue. This grade separation would see around 7,200 vehicles per day by 2045, with the following impacts:

- Moderate traffic rerouting from State Street/ US 83 (between three and six percent) mitigates some congestion, but the interchange would still operate deficiently at LOS "E".
- The 19th Street grade separation would see a 20 percent reduction in traffic but would still operate deficiently at LOS "E".
- Traffic routes across the grade separation and then uses Centennial Road for north-south mobility outside of the interchange, increasing projected traffic up to 14 percent.
- Moderate traffic rerouting off the Bismarck Expressway (around four percent) improves the Expressway Missouri River crossing to LOS "C" from LOS "D".
- The Hamilton Street/ Channel grade separation has a benefit/ cost ratio of 24.8 and is the fastest project cluster to return equity (seven years).

Summary

The Hamilton/Channel Grade Separation provides benefits to both the State Street and 19th Street I-94 grade crossings. The benefits alone are not enough to mitigate forecasted deficiencies but can be used in combination with other interchange specific improvements to solve overall north-south congestion issues. This concept should be considered if feasible improvements cannot be identified at State Street or Centennial Road or to extend the useful life of these interchanges.

McKenzie Drive Extension (3)

The extension of McKenzie Drive to ND 6 would see around 13,500 vehicles per day by 2045, with the following impacts:

- Alleviates emerging congestion on the Grant Marsh Bridge river crossing. Traffic is rerouted on the Bismarck Expressway and McKenzie Drive and away from I-94 and Mandan's Memorial Highway for a more direct connection. Traffic on the Grant Marsh Bridge is reduced 9.3 percent and is expected to operate at LOS "C" from LOS "D".
- Increases vehicles using the Bismarck Expressway and the McKenzie Drive interchange. Traffic using the westbound off- and eastbound on- ramps at McKenzie Drive doubles. This scenario should be considered when evaluating alternatives at this interchange.
- The McKenzie Drive extension has a benefit/cost ratio of 21.6.

Summary

Given the overwhelming benefit to cost ratio, regional benefits, and interstate benefits, this scenario should be factored into future interstate plans. Specifically, concepts at McKenzie Drive should consider or be compatible with forecasted traffic volumes under this scenario. Furthermore, timing and need of improvements on Mainline I-94 between the Grant Marsh Bridge and Mandan's Main Street should consider this improvement in the short to mid-term.

33rd Avenue Grade Separation (8)

The I-94 grade separation at 33rd Avenue in Mandan would create a new grade separation (overpass or underpass) of I-94 at 33rd Avenue in Mandan between 37th Street and Boundary Road. Boundary Road would be extended to 33rd Avenue. This grade separation would see around 3,600 vehicles per day by 2045, with the following impacts:

» The direct connection to Mandan's western growth area reduces demand on the existing I-94 interchanges (Sunset Drive and Mandan Avenue) and improves their expected operations to LOS "C" or better through 2045. It also provides acceptable operations (LOS "D") at Mandan's Main Street I-94 ramps through 2045.

» The 33rd Avenue grade separation has a benefit/cost ratio of 18.7.

Summary

The 33rd Avenue Grade Separation performs strongly in the cost-effectiveness and provides a more direct route to Mandan's growth areas, reducing travel demand on other congested corridors. However, it serves relatively few vehicles when compared to other clusters and does not mitigate any deficient areas. This project may be most appropriate as a long-term (or beyond) project to balance growth and traffic operations.

POTENTIAL IMPROVEMENTS

Improvements were considered at the following locations, based on the existing and 2045 analysis discussed above. The regional projects discussed above were not initially factored into the forecasts for this analysis for following reasons:

» This allowed for a comparative analysis of alternatives. For example, is it more cost effective to improve an interchange or to build a new grade separation or interchange to relieve pressure.

» Many regional projects above come at a high price tag and unquantified environmental impacts. This creates uncertainty in when or if these improvements can be implemented.

The last section of this memorandum will discuss implementation options that incorporates both regional concepts and spot improvements.

Mainline I-94 and I-194

The capacity analysis completed for 2045 AM and PM did not identify any mainline capacity needs, with all segments operating at LOS "C" or better. Any lowered levels of service at the ramps are concentrated at interchanges and would be addressed with interchange improvements.

Interchanges with No Deficiences

No alternatives were analyzed for these locations because they are expected to operate at LOS "D" or better through 2045:

» ND 25 Interchange in Mandan

» Sunset Drive Interchange in Mandan

» Memorial Highway Interchange in Mandan

I-94 and I-194 Interchange

The I-94 and I-194 interchange does operate deficiently at LOS "E" during the 2045 PM peak hour due to the lane drop. The I-94 corridor study evaluated three alternatives, two of which come with significantly higher costs ($37 to $40 million), than the alternative evaluated in this analysis. Given the cost and impacts and current crash rates, only the additional lane concept was analyzed.

The alternative evaluated in this analysis would maintain two lanes on I-194 and adding a fourth lane on westbound I-94. This alternative would ensure LOS "B" through the 2045 AM peak.

Estimated Cost: $15.2 M

Figure 7.28: Lane Drop on Westbound I-194 to I-94

Figure 7.29: I-94 and I-194 Alternative from I-94 Corridor Study

Tyler Parkway/Divide Avenue Interchange

At the Tyler Parkway/Divide Avenue interchange, the Burnt Boat Road intersection is expected to operate at LOS "E" during the 2045 AM peak with queues extending the full length of the turn lane. The Divide Avenue and Turnpike Avenue intersection is expected to operate at LOS "F" during the 2045 PM peak, with the eastbound approach projected to experience more than eight minutes of delay per vehicle. The ramp intersections operate effectively.

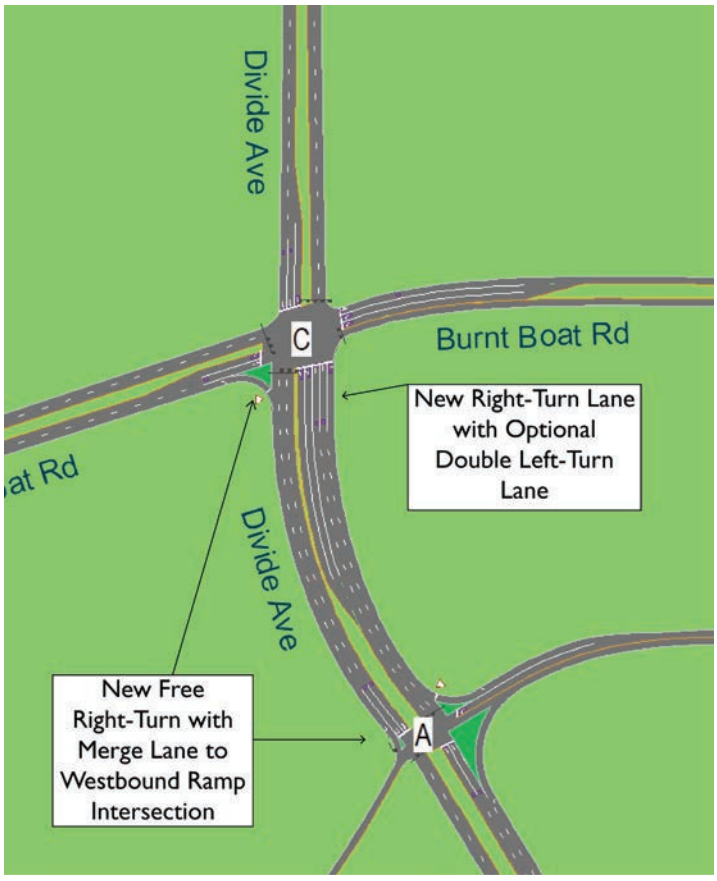
Burnt Boat Road Intersection Improvements

The I-94 Corridor Study recommended Burnt Boat Road intersection improvements, specifically a northbound right-turn lane, a free right-turn from the eastbound approach with a merge lane that continues to the Westbound Ramp intersection, as well as access closures/modifications on Burnt Boat road. Intersection improvements at this intersection can provide acceptable operations through 2045.

A northbound to westbound double left-turn lane would help ensure long queues do not interact with the interchange ramp intersections and may prove beneficial. Additional analysis would be necessary to evaluate the proper location to drop the second receiving lane on Burnt Boat Road west of Tyler Parkway.

Estimated Cost: $750,000

Figure 7.30: Burnt Boat Road Intersection Improvements and 2045 AM Peak Hour Operations



Turnpike Avenue Intersection Modifications

As traffic on Divide Avenue grows, vehicles on the minor approaches will find it difficult to find gaps to make their turning movements. This intersection may be too close to the Eastbound Ramp intersection for a traffic control signal, but major access modifications would result in rerouting through neighborhoods. Most vehicles exiting Turnpike Avenue from the east and west approaches are making right turns, so the impacts would be minimal.

Converting this full access to a ¾ access (right-in, left-in, right-out) would improve intersection operations to LOS "A" through the 2045 PM peak. The worst approach would operate at LOS "D". This may result in some minor rerouting through the neighborhoods adjacent to this intersection, however 80 percent of traffic at this intersection would still be accommodated with this solution. Additionally, as a collector, this is primarily local neighborhood traffic using this intersection. Regional traffic can easily relocate to Divide Avenue.

By 2045, this intersection would meet traffic control warrants and may benefit from signalization. However, more detailed analysis should be completed to ensure no negative impacts to the interstate ramp intersections.

State Street Interchange

By 2045, the Eastbound Ramps, Westbound Ramps, and Interchange Avenue intersections are expected to operate deficiently during the AM or PM peak hour.

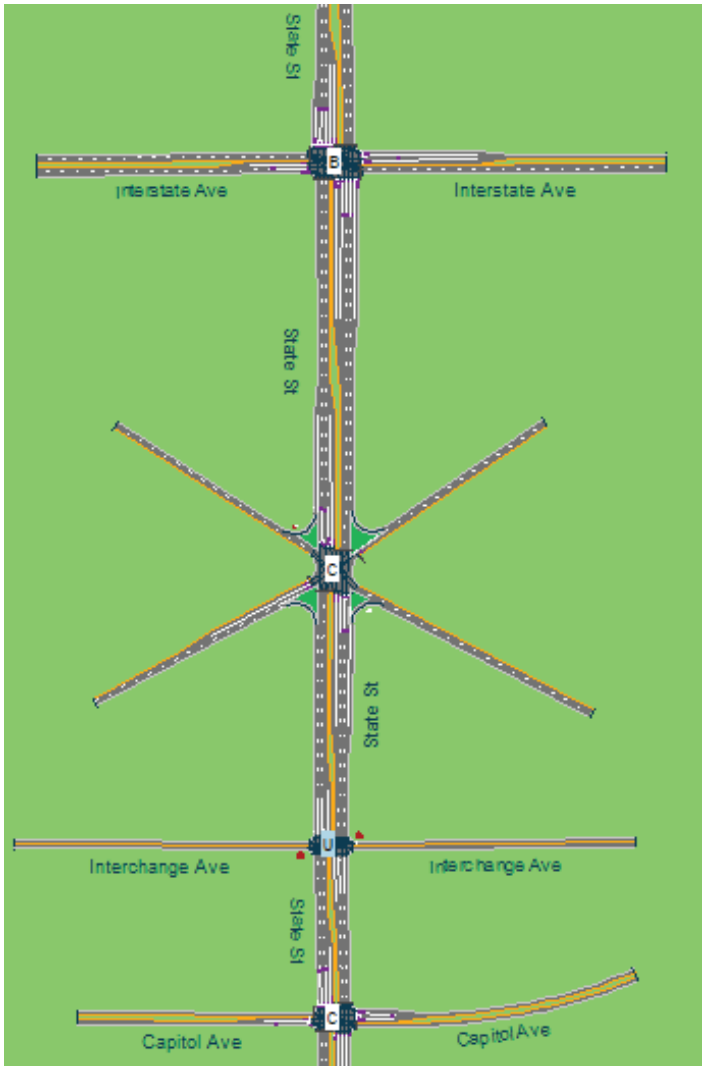
Single Point Urban Interchange Alternative

The I-94 Corridor Study recommended a Single Point Urban Interchange (SPUI) alternative at State Street to improve operations at the ramp intersections and increase spacing between access points along State Street. The SPUI would consolidate the ramp intersections into one single intersection, with free right-turns on all approaches. Operations with the SPUI configuration would be LOS "C" or better through 2045.

This alternative maintains the two-way stop control at Interchange Avenue, which would operate acceptably at LOS "D". Poor operations on the minor approaches may cause people to reroute to Capitol Avenue. This is not anticipated to result in deficient operations at that intersection. Access revisions to a ¾ intersection may improve safety at this intersection without significantly impacting operations.

Estimated Cost: $21.0 M

Figure 7.31: State Street Single Point Urban Interchange with 2045 PM Peak Hour Operations



Loop Ramps

The I-94 Corridor Study considered loop ramps as an alternative but was not analyzed due to potential business and ROW impacts. Adding a northeast and southeast loop ramp would ensure acceptable operations at LOS "D" or better through the 2045 PM peak. This alternative would not address the interactions between the closely spaced intersections along State Street. Microsimulation analysis of this alternative may provide more insight into queuing, merging, and diverging movements between these intersections.

This alternative maintains the two-way stop control at Interchange Avenue, which would operate acceptably at LOS "D". Poor operations on the minor approaches may cause people to reroute to Capitol Avenue. This is not anticipated to result in deficient operations at that intersection. Access revisions to a ¾ intersection may improve safety at this intersection without significantly impacting operations.

Estimated Cost: $21.0 M

Figure 7.32: State Street with Northeast and Southeast Loop Ramps and 2045 PM Peak Hour Operations

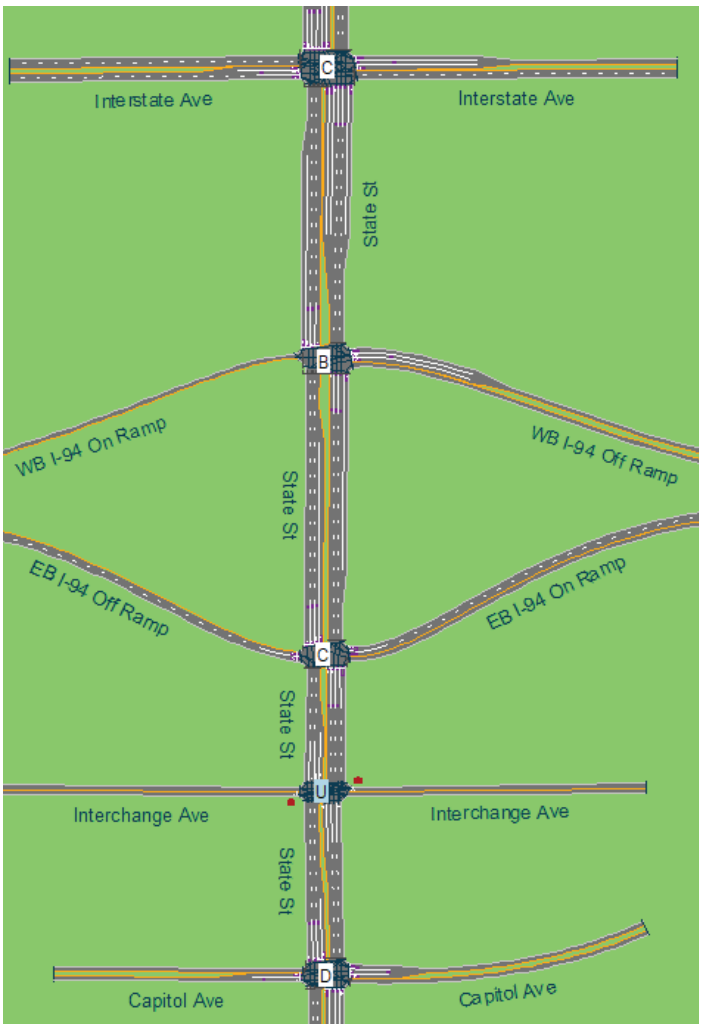
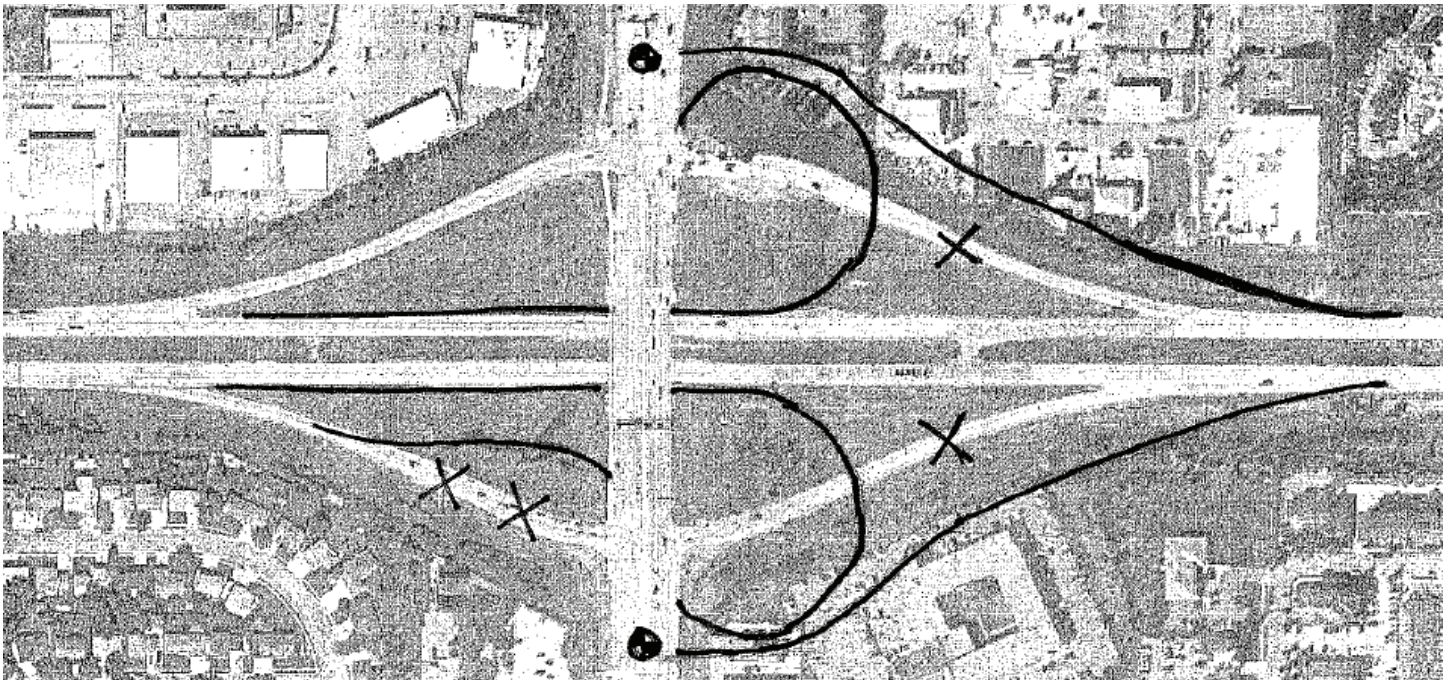


Figure 7.33: Northeast and Southeast Loop Ramp Alternative from I-94 Corridor Study



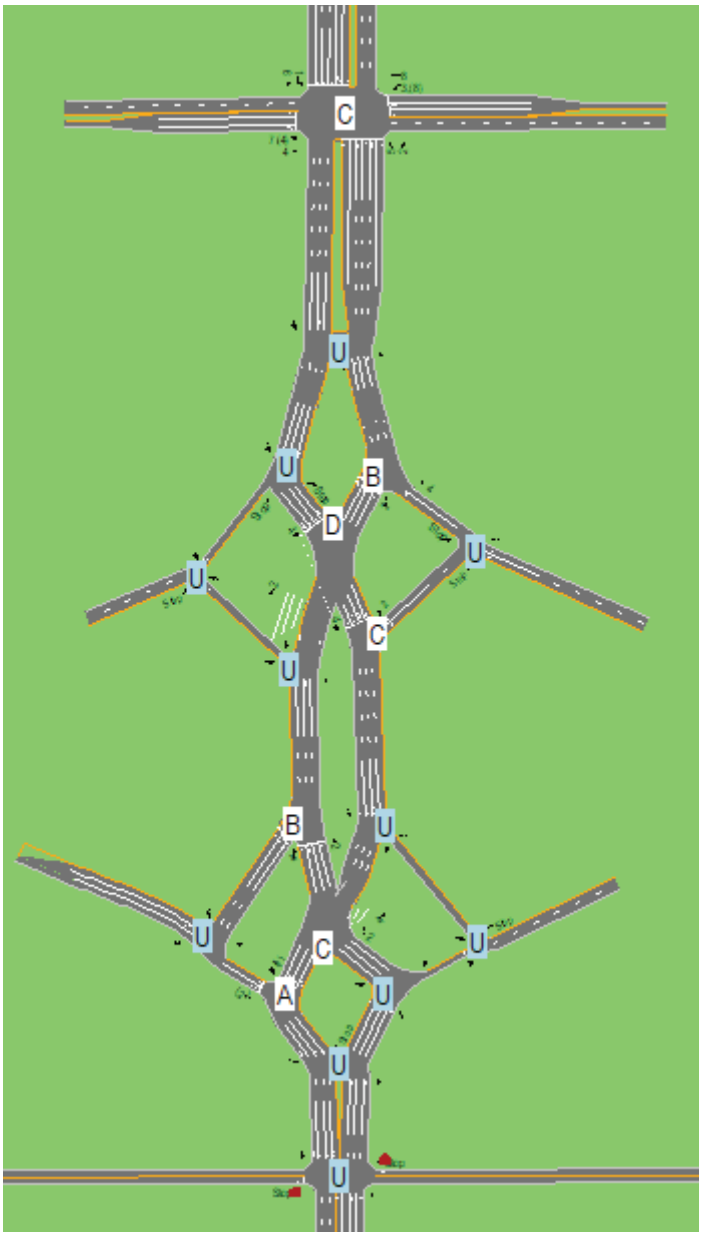
Diverging Diamond Interchange

The Diverging Diamond interchange would ensure all intersections operation at LOS "D" or better through the 2045 PM peak hour. This alternative was not carried forward for further analysis in the I-94 Corridor Study due to operational deficiencies. Using updated volumes, forecast volumes, and more detailed analysis of lane options yielded positive results for this concept. This concept provides the added benefit of limiting ROW impacts compared to the loop alternatives and ability to retrofit the existing bridge structures, reducing overall project cost compared to the SPUI.

Synchro can only provide preliminary operations results for complex interchange configurations like a Diverging Diamond Interchange, so additional analysis would be necessary.

Estimated Cost: $12.0 M

Figure 7.34:State Street Diverging Diamond Interchange with 2045 PM Peak Hour Operations



Summary

Preliminary analysis indicates a diverging diamond interchange would provide acceptable operations and minimal impacts. More detailed traffic analysis and cost estimating would be necessary to understand the full impacts for each alternative, but this preliminary diverging diamond cost could be used for programming purposes.

Table 7.22: Summary of State Street Alternatives

	Do Nothing	SPUI	Loops	DDI
Operations	-	-52%	-62%	-54%
Worst LOS	F	E	D	C
Cost	-	$21 M	$21 M	$12M
Impacts	None	Low	High	Low

Centennial Road Interchange

By 2045, the Centennial Road interchange, including the Trenton Avenue, Westbound Ramps, Eastbound Ramps, and Miriam Avenue intersections operate deficiently during the AM and/or PM peak hours. Two alternatives were evaluated in this analysis that were also evaluated in the I-94 Corridor Study, as well as one additional alternative.

Northeast and Southeast Loop Ramps

Adding a northeast and southeast loop with additional northbound through lanes between Miriam Avenue and Trenton Avenue would keep all intersections at LOS "D" or better during the 2045 PM peak. Miriam Avenue operates at LOS "D" with the southbound approach

Estimated Cost: $29.0 M

Figure 7.35: Centennial Road Northeast and Southeast Loop Ramps with 2045 PM Peak Hour Operations

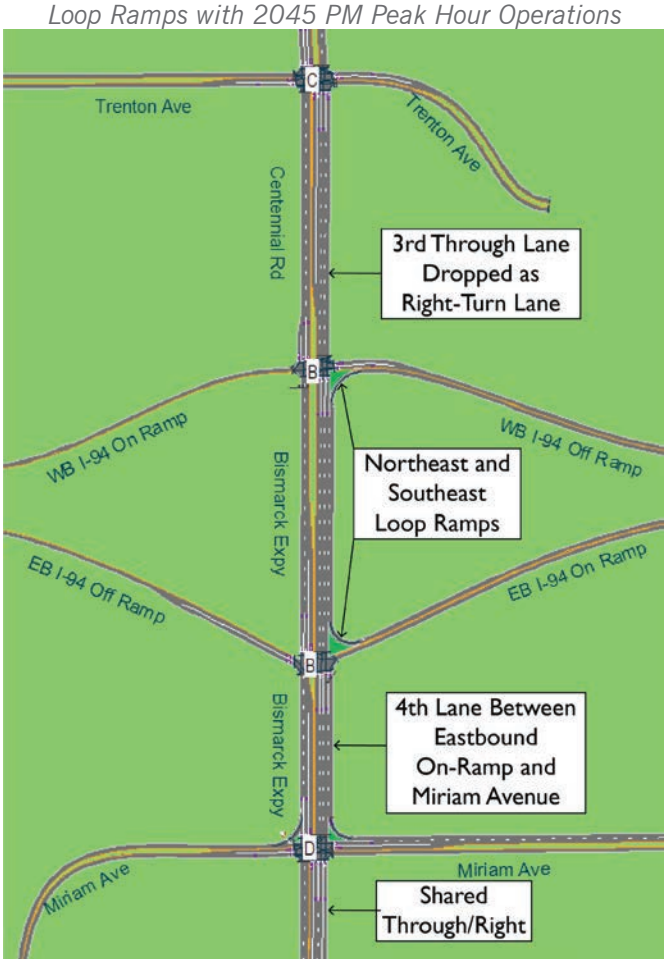
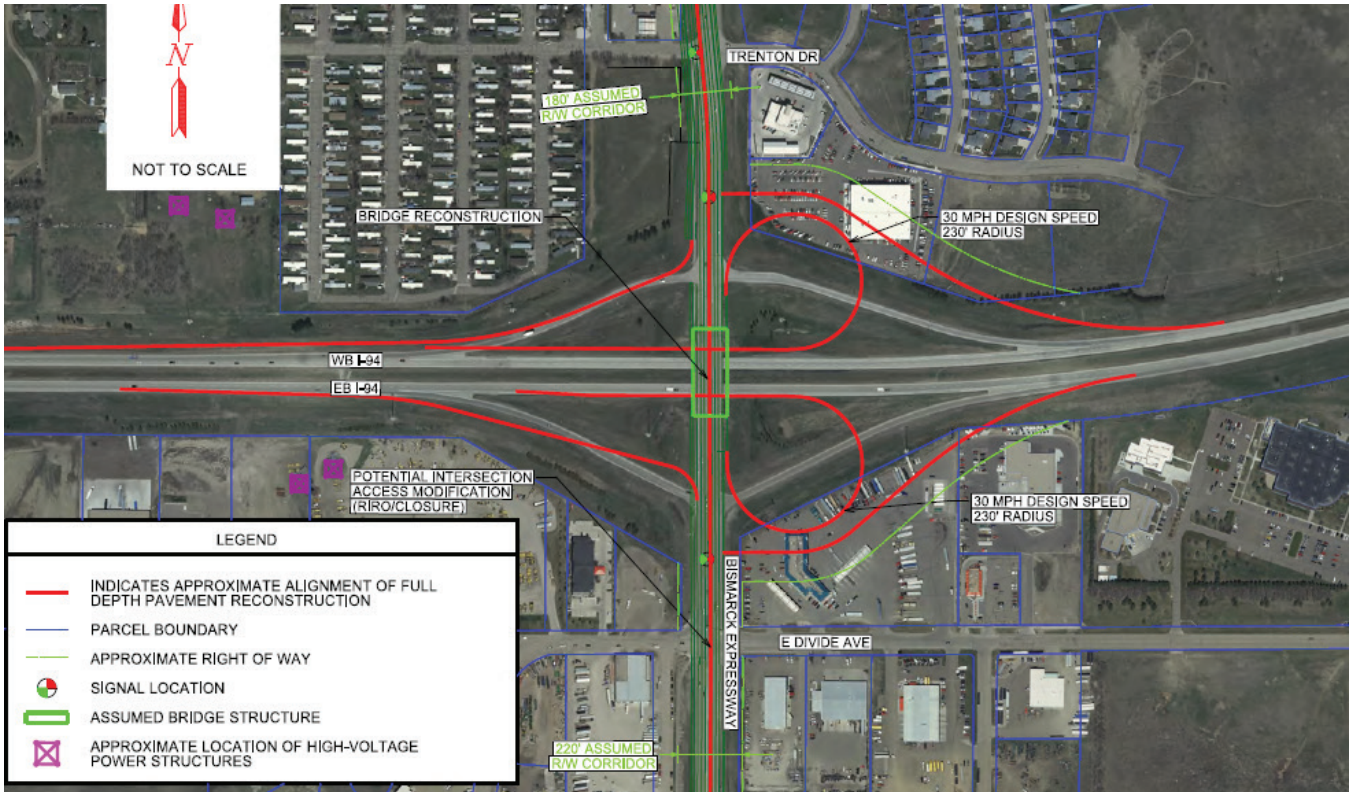


Figure 7.36: Northeast and Southeast Loop Ramp Alternative from I-94 Corridor Study



Single Point Urban Interchange

The Single Point Urban Interchange (SPUI) alternative would combine the two ramp intersections into one, increasing space between the adjacent intersections. This alternative would include three through lanes between the ramp intersection and Miriam Avenue and two between the ramp intersection and Trenton Drive.

The SPUI operates slightly worse than the loop configuration but does have clear benefits to signal spacing, particularly between Miriam Avenue and I-94 and has no ROW impacts.

This alternative would ensure acceptable operations at LOS "D" or better through the 2045 PM peak hour along the corridor with LOS "C" at the interchange.

Estimated Cost: $21.0 M

Figure 7.37: Centennial Road Single Point Urban Interchange with 2045 PM Peak Hour Operations

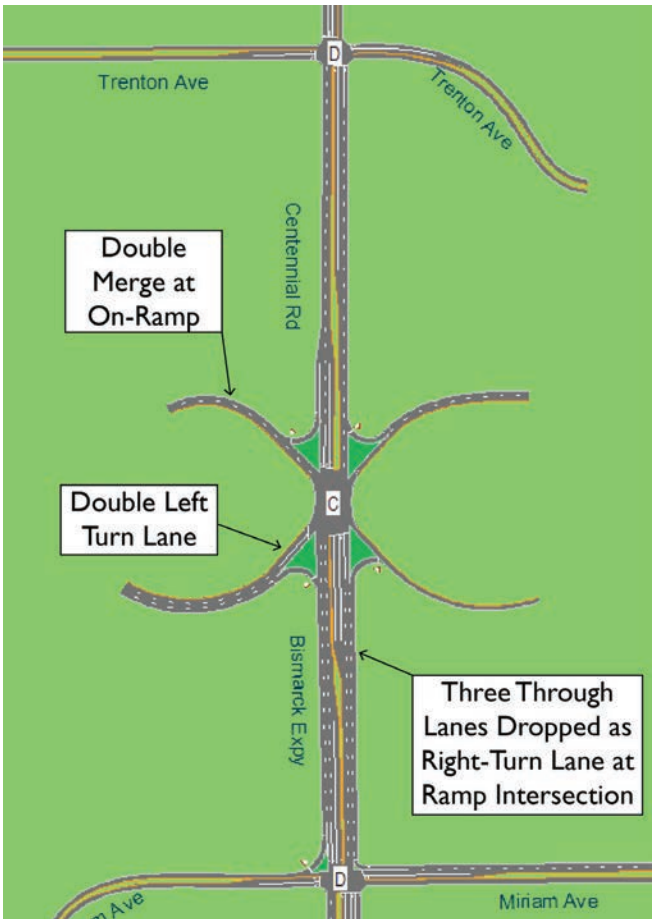
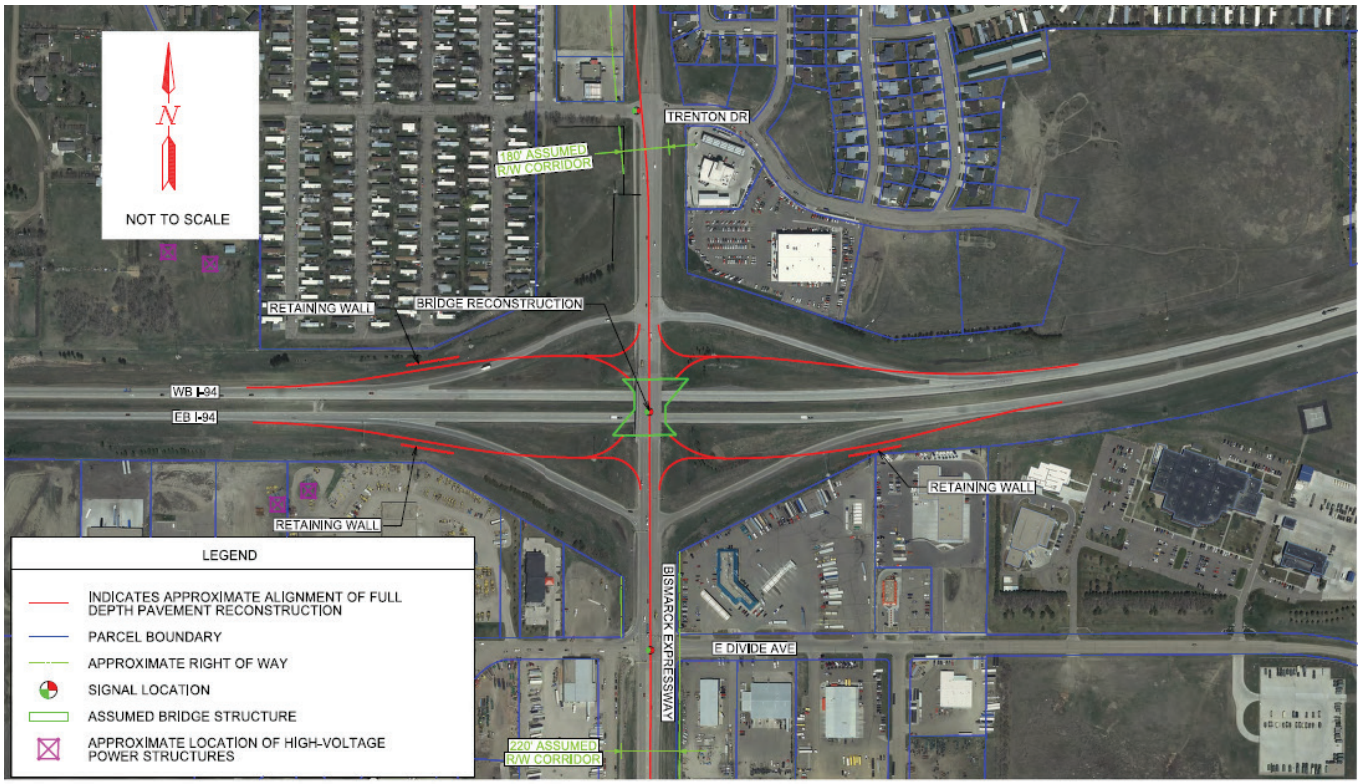


Figure 7.38: Single Point Urban Interchange Alternative from I-94 Corridor Study



Modified Single Point Urban Interchange

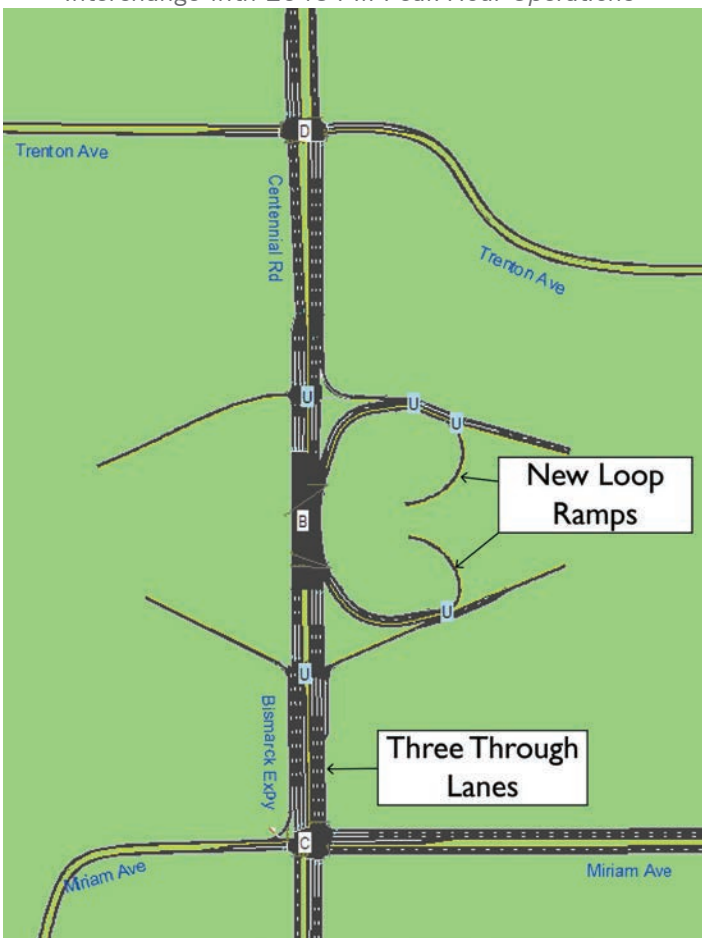
The Modified Single Point Urban Interchange (MSPUI) alternative would combine the two ramp intersections into one, increasing space between the adjacent intersections, as well as add loop ramps to reduce crossing conflicts and minimize delays.

This concept was recently constructed at Sheyenne Street in West Fargo. The design suggested at the Centennial Road interchange is slightly different from this design, operating more similarly to compressed version of the loops concept. This concept provides three key benefits:

- Efficiency. The interchange operates at LOS "B" in Synchro which is superior to the traditional SPUI due to the reduction in signal phases from six to four.
- Spacing. The centralized intersection creates increased spacing from adjacent congested intersection (i.e. Miriam Avenue) like the traditional SPUI but improved from the loop configuration.
- Impacts. The modified SPUI tightens the design of the loops to bring them into a central intersection minimizing impacts to surround properties. This is a benefit compared to the loop concept.

Estimated Cost: $25.0 M

Figure 7.39: Centennial Road Modified Single Point Urban Interchange with 2045 PM Peak Hour Operations



Summary

In summary, there are a variety of solutions that can improve operations each within the cost range of $21 M to $29M. Given the near-term need at this interchange, it is recommended that these alternatives advance into more detailed analysis that considers

- Better cost estimates and layouts
- Better environmental assessment
- More detailed operational and safety analysis
- Scenario analysis to factor in the 66th Avenue Interchange

At this time, it is recommended that the SPUI (either traditional or modified) concept be programmed into the MTP as these concepts provide the best separation between the south ramp and Miriam Avenue, allow for better accommodations to/from the east if a new interchange is built at 66th Street in the future. The MSPUI provides better operations under E+C traffic forecasts but the future scenario with the 66th Street interchange is expected to increase the draw to/from the east potentially making the SPUI a better fit for this location.

Table 7.23: Summary of Centennial Road Alternatives

	Do Nothing	Loops	SPUI	MSPUI
Operations	-	-70%	-98%	-92%
Worst LOS	F	E	C	B
Cost	-	$29M	$21M	$25M
Impacts	None	High	Low	Low

McKenzie Drive Interchange

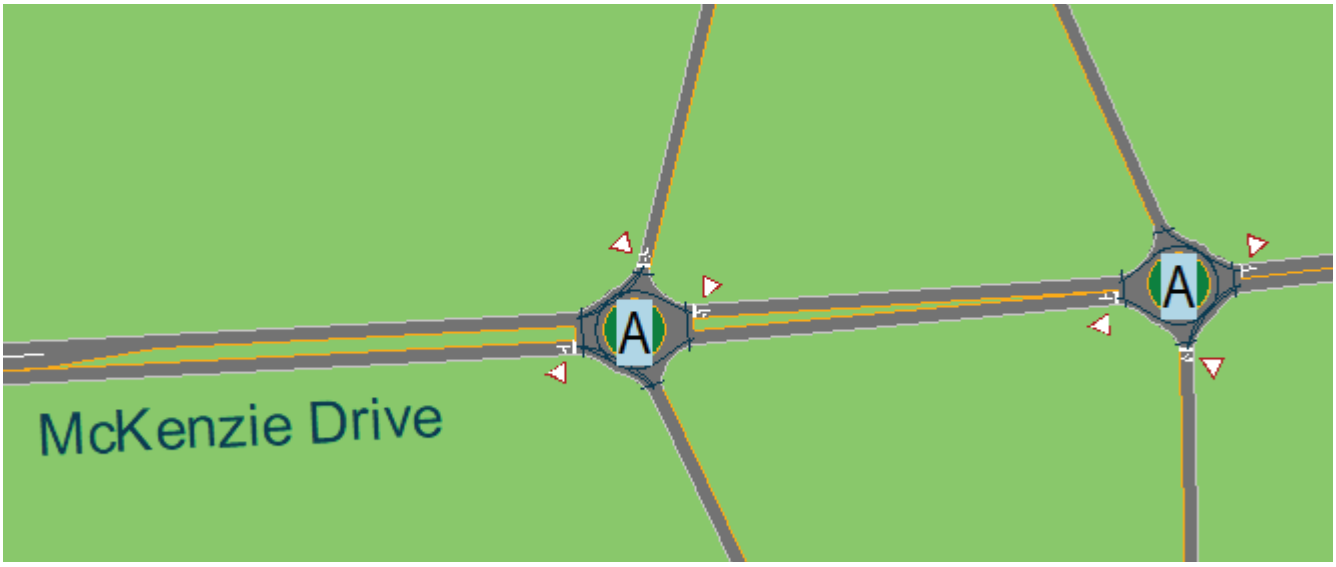
By 2045, the McKenzie Drive westbound ramp intersection operates at LOS "E" during the AM peak under two-way stop control. It is unlikely this intersection would meet traffic signal warrants. Roundabouts at this location would maintain intersection LOS "A" through 2045.

Estimated Cost: $2 M

McKenzie Drive with Extension to ND 6

With the McKenzie Drive extension, traffic along McKenzie Drive would nearly double from 7,875 (2045 E+C network) to 15,395. Roundabouts would provide LOS "C" at the interchange intersections. It is likely traffic signal warrants would also be met with the increase in traffic. Traffic signals would provide LOS "B" at the interchange intersections. The timing of the McKenzie Drive extension needs to be weighed heavily before determining a final solution at this interchange. However, because the roundabouts are expected to operate effectively under both scenarios, can be retrofitted to a widened cross-section and are not exorbitantly priced, it is recommended that they be used for programming purposes at this time.

Figure 7.40: McKenzie Drive Roundabout Alternative



TIMING NEEDS

Using the operational issues, identified best-fit solutions, and estimated costs identified above, the following implementation strategy by estimated year are shown in Table 6. These were calculated using linear growth rates between existing and 2045 traffic projections and delays.

Table 7.24: Timing Needs

Interchange Location	Regional Connection	Deficiencies	Timing	Estimated Cost
ND 25	E+C	None	NA	$0
Sunset Drive	E+C	None	NA	$0
Mandan Avenue	E+C	None	NA	$0
Tyler Parkway/ Divide Avenue	E+C	Burnt Boat Road Intersection	Long Term	$750,000
State Street	E+C	Most intersections deficient during one or both peak hours	Mid Term	$21 M
	66th Street	Limited impacts would not improve operations on State Street or change timing needs	Mid Term	$21 M
	Hamilton Street	Limited impacts would not improve operations on State Street or change timing needs.	Mid Term	$21 M
Centennial Road	E+C	Most intersections deficient during one or both peak hours	Short Term	$25 M
	66th Street	Mitigate some deficiencies but unlikely to be constructed before Centennial Road deficient	Short Term	$25 M
	Hamilton Street	No impacts to Centennial Road operations and would not change timing needs	Short Term	$25 M
Memorial Highway/ Bismarck Expressway	E+C	None	NA	$0
McKenzie Drive	E+C	Westbound Ramp Intersection	Short Term	$2 M
	McKenzie Drive Extension	Increase in traffic results in deficiencies at both ramp intersections	Short to Mid Term	$2 M
I-94/I-194 Interchange	E+C	Westbound Lane Drop	Mid Term	$15.2 M
	North Bridge Corridor	Reduces Traffic Along I-94	Beyond Long Term	$15.2 M
	McKenzie Road Extension	Reduces Traffic Along I-194	Beyond Long Term	$15.2 M

Mobility Futures

Transportation systems and travel behavior are both rapidly changing and unpredictable in response to autonomous vehicles, biking and walking trends, and ridesharing use. The way we plan for transportation in 10 years will undoubtedly look very differently than it does today.

While the outcomes are uncertain, connected and autonomous vehicles (CAV) will have significant impacts to how people travel and how efficient the system is:

- **Safety:** Studies anticipate a 90 percent reduction in collisions with a fully autonomous transportation fleet as driver error is mitigated. This makes the transportation network more reliable.
- **Vehicle Miles Traveled (VMT):** If travelers have convenient access to individual autonomous vehicles, estimates project that in such a scenario VMT could increase by five times over the next 30 years. Conversely, estimates project a 37 percent decrease in VMT if autonomous rapid transit (ART) is widely adopted. This means the transportation network could be grossly inadequate or way overbuilt.
- **Vehicle Hours Traveled (VHT):** Studies project that the reduced lane width requirements and vehicle headways can lead to reduced vehicle delays by as much as 45 percent.
- **Timeline of Autonomous Vehicle Adoption:** Some experts predict significant market penetration between 2020 and 2025, however there is not consensus for this timeline, with other experts thinking it may be closer to (or beyond) 2040. Most estimates of significant market penetration occur within the timeframe of this Metropolitan Transportation Plan.

Scenarios

To understand the potential impacts CAVs might have on the transportation network, three behavior scenarios were evaluated using the 2030 and 2045 E+C travel demand model.

- Conservative: Low AV adoption rate, some carpool/ ride-share, and moderate increase to walking, biking, and transit.
- Moderate: Moderate AV adoption rate, moderate carpool/ ride-share, and moderate increase to walking, biking, and transit.
- Aggressive: Aggressive AV adoption rate, lower carpool/ ride-share, lower increase in walking, biking, and transit.

A variety of assumptions were developed based on local trends and the latest national research and projections. These assumptions are detailed in Table 7.25.

Table 7.25: CAV Behavior Change Assumptions

Scenario	Year	CAV Population	Carpool/ Ride-Share	Walking, Biking, Transit	Interstate Capacity	Other Roadway Capacity	Trip Ends Change
Base	2030	0%	11%	3%	-	-	-
	2045	0%	11%	3%	-	-	-
Conservative AV Adoption	2030	10%	15%	5%	2%	No Change	-2.8%
	2045	20%	20%	7%	5%	1%	-3.0%
Moderate CAV Adoption	2030	25%	15%	5%	7%	2%	1.7%
	2045	50%	20%	7%	19%	7%	6.0%
Aggressive CAV Adoption	2030	50%	13%	4%	19%	7%	10.8%
	2045	75%	15%	5%	40%	18%	16.8%

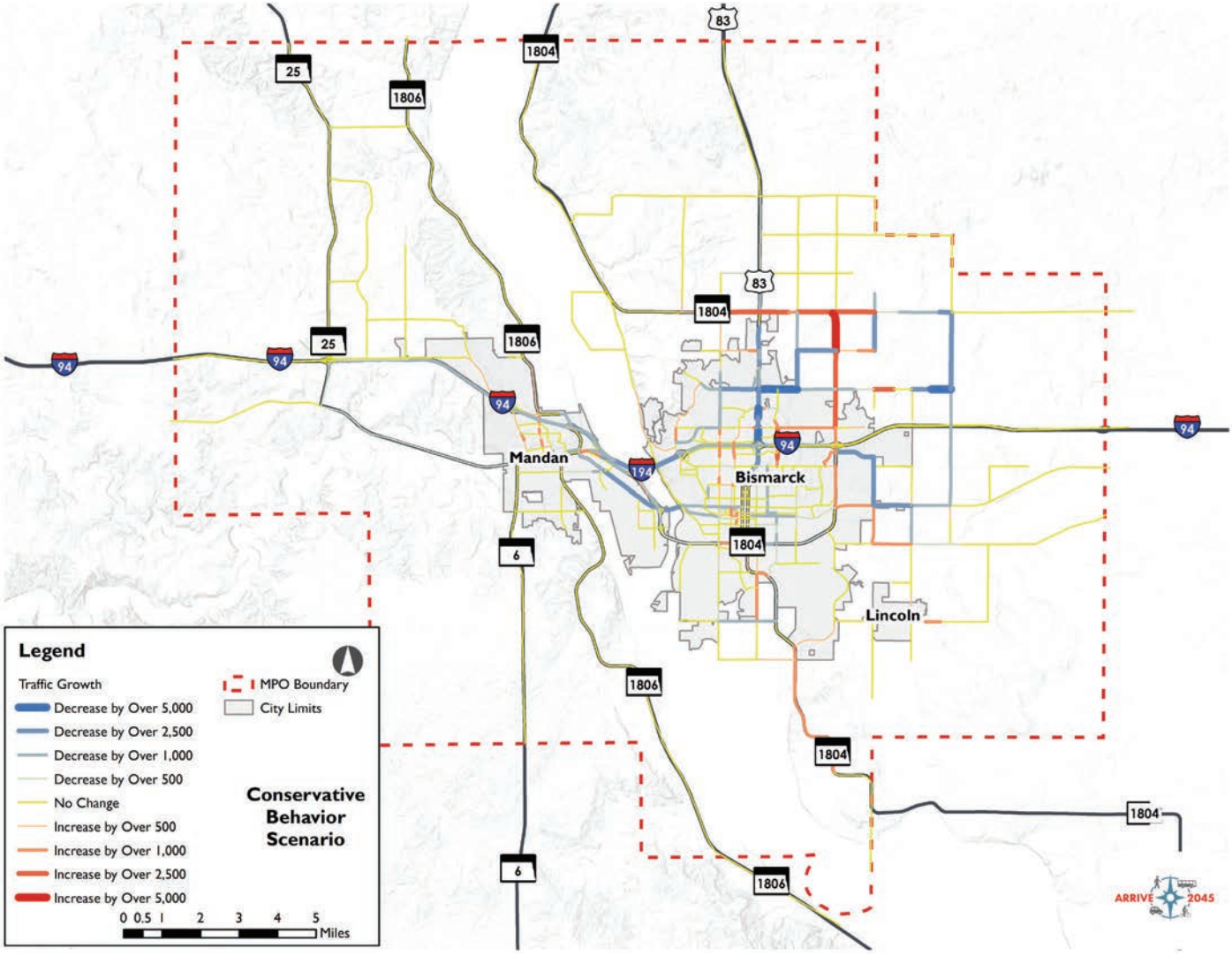
Conservative CAV Adoption

A conservative CAV adoption scenario would still have major impacts to the network, resulting in a 20.2 percent reduction in vehicle hours traveled and a 52 percent reduction in links over capacity. A conservative CAV adoption scenario mostly benefits continuing trends of more walking, biking, and ride-sharing.

Table 7.26: 2045 Conservative CAV Adoption Impacts

	2045 Base Scenario	2045 Conservative CAV Adoption	2015-2045 Percent Change
VHT	55,650	44,420	-20.2%
VMT	2,932,685	2,836,025	-3.3%
% of Links Over Capacity	13.6%	6.5%	-52.0%

Figure 7.41: 2045 Conservative CAV Adoption Impacts to Traffic



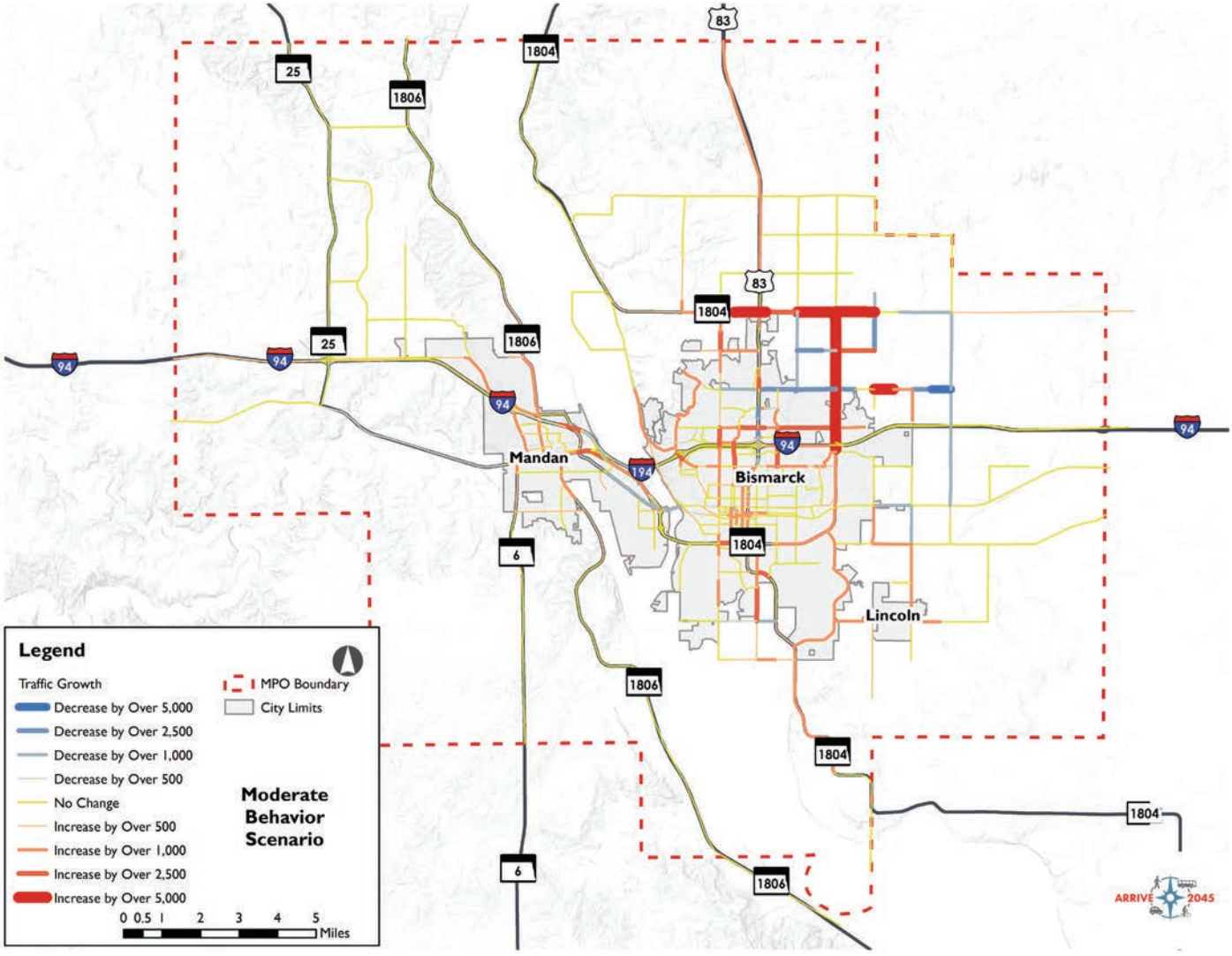
Moderate CAV Adoption

A moderate CAV adoption scenario increases trips, resulting in increased 6.4 percent more vehicle miles traveled. However, increases in roadway capacity still reduces delay through vehicle hours traveled and the percent of links over capacity. A moderate CAV adoption scenario starts to experience some of the network impacts (increased trips but more network efficiency), but other traditional modes (walking, biking, transit, ride-share) were still a large part of the overall benefits to the transportation system.

Table 7.27: 2045 Moderate CAV Adoption Impacts

	2045 Base Scenario	2045 Conservative CAV Adoption	2015-2045 Percent Change
VHT	55,650	50,550	-9.2%
VMT	2,932,685	3,119,300	6.4%
% of Links Over Capacity	13.6%	7.9%	-41.6%

Figure 7.42: 2045 Moderate CAV Adoption Impacts to Traffic



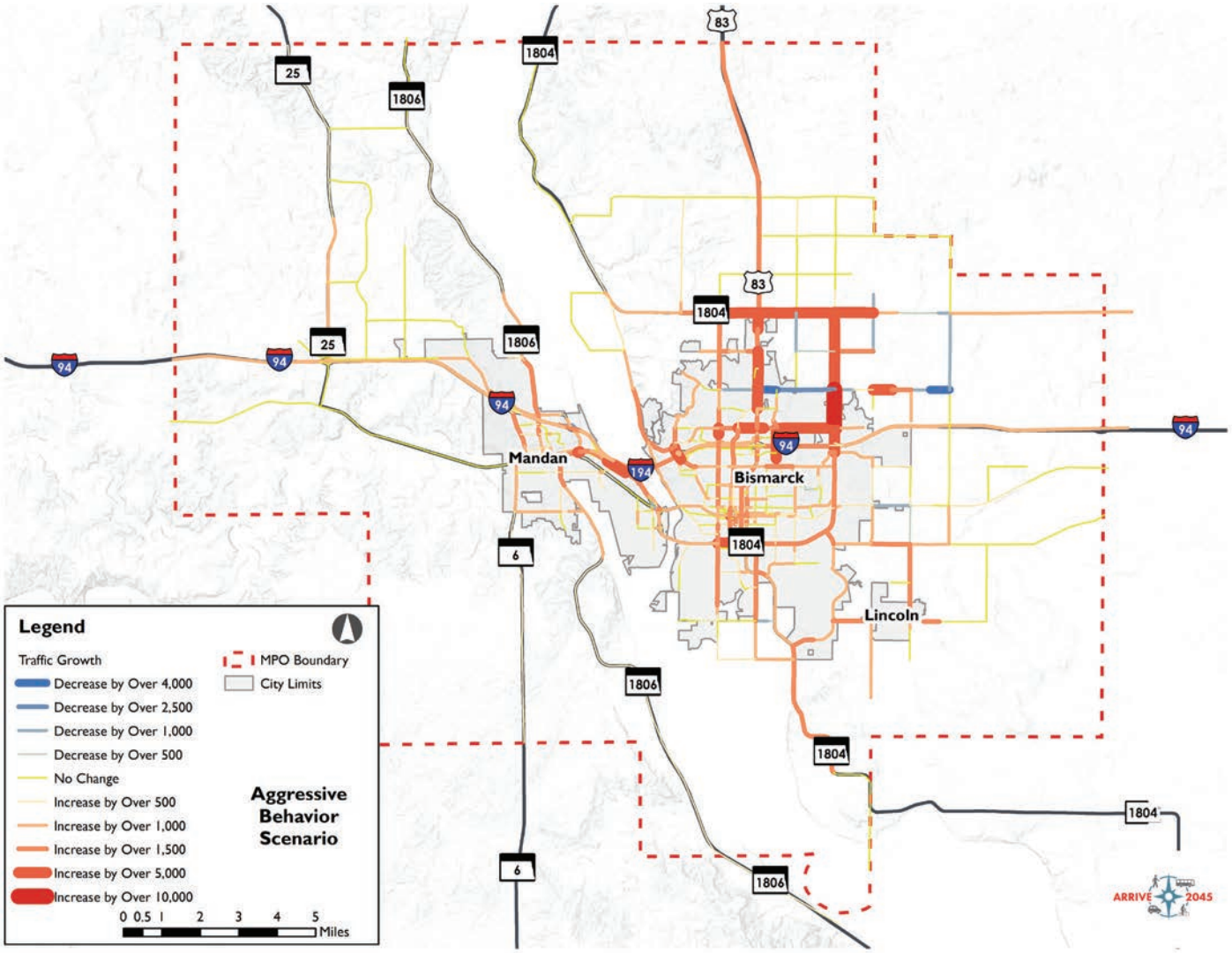
Aggressive CAV Adoption

An aggressive CAV adoption scenario increases trips, resulting in increased 17.3 percent more vehicle miles traveled. However, increases in roadway capacity still reduces delay through vehicle hours traveled and the percent of links over capacity. The aggressive CAV adoption scenario shows the full potential of CAV with major impacts to VMT, but no noticeable change in VHT. This scenario also minimized benefits to ride-sharing and modal split to put the impacts of CAV into greater focus.

Table 7.28: 2045 Aggressive CAV Adoption Impacts

	2045 Base Scenario	2045 Conservative CAV Adoption	2015-2045 Percent Change
VHT	55,650	55,475	-0.3%
VMT	2,932,685	3,441,340	17.3%
% of Links Over Capacity	13.6%	7.1%	-47.6%

Figure 7.43: 2045 Aggressive CAV Adoption Impacts to Traffic



Summary of Scenarios

The scenarios highlighted not only the impacts to transportation network due simply on increased CAV activity but how this increased CAV activity may impact modal split and ridesharing/carpooling. Analysis from these scenarios indicate that the VMT impacts from CAV can be mostly mitigated by the operational benefits from CAV both recurring and non-recurring (i.e. crashes) congestion. The greatest impacts came from potential impacts to reducing modal split and ridesharing. It is clear that even with CAV, focusing land use and design to accommodate alternatives modes of travel will be important for the sustainability of the transportation system. The purpose of this analysis is not to identify a most likely future, rather assist in understanding the futures that might be possible by 2045 and begin preparing for their impacts.

Chapter 8
Financial Plan

ARRIVE 2045
Bismarck-Mandan MPO
Metropolitan Transportation Plan

FINANCIAL PLAN

Fiscal Constraint Program Methods

Development of the project list for Arrive 2045 must be based on an established fiscal constraint agreed to between the Bismarck-Mandan MPO and NDDOT. Development of a fiscal constraint can be based on a variety of scenarios and data points regarding transportation funding programs and there are a range of best practices and techniques for developing a fiscal constraint. It is important that locally sourced and reliable data be used that show both historic and potential future funding trends when developing a fiscal constraint analysis.

Development of the fiscal constraint for Arrive 2045 is based on the following programming assumptions.

- National Highway Performance Program (NHPP): No specific NHPP sub target is assumed for the BMMPO for Arrive 2045. Rather, NHPP funds for the BMMPO are assumed to be allocated through constraints established for the Regional portion of the Urban/Regional funding. Additional NHPP funds allocated for Interstate related projects are assumed to come through the Interstate Maintenance constraint.
- Interstate Maintenance (IM): The Interstate Maintenance (IM) program was replaced by the NHPP program. However, NDDOT still tracks expenses to this program separately in the STIP. Therefore, it is assumed constraints established for the IM program are part of the NHPP funds allocated to the BMMPO for Arrive 2045.
- Urban/Regional: Funding for projects on either the NDDOT Urban or Regional system. The constraint for Arrive 2045 for this program will be split roughly 50/50 between the two programs. Future programming for the new NDDOT Urban Grant Program would come from the Urban share of these program funds, since eligibility requirements are nearly identical.
- Transportation Alternative & Recreational Trails Program (TA + RTP): Program funds awarded for the use of alternative transportation projects supporting bicycle, pedestrian, or recreational trail projects. This includes both Transportation Alternatives (TA) and Recreational Trails Program (RTP). For ease of project selection, these programs are combined.

Fiscal Constraint Scenarios

Working with the project Study Committee (SC), a total of five data points were established to develop a preliminary fiscal constraint for Arrive 2045, as shown in Table 8.1:

1. Revenue forecasts from Envision 2040 which used a TIP analysis for the year 2007 to 2014:
   a. Little additional substantiation is available on this data other that in Envision 2040 which assumes a general 8-year average of funds in the BMMPO TIP

2. Committed projects from the first year of the 2015, 2016, 2017 and 2018 TIP/STIP:
   a. Assumes first year of each TIP/STIP.
   b. Accounts for program variations with MAP-21 and FAST Act; and potential for delayed projects (e.g. project showing up in two consecutive years).

3. Committed projects from the 2019-2022 TIP/STIP.

4. Aggregate of from 2015-2018 and 2019-2022 TIP/STIP:
   a. Consider historic funding from the 2015-2018 TIP
   b. Consider programmed funds from the 2019-2022 TIP

5. Population/ratio formula based and programmatic assumptions using population related factors applied to various programs.
   a. Use population related factors and applies to various program assumptions.

Scenario 4 was ultimately selected for the development of the Arrive 2045 financial forecasts.

Table 8.1: Fiscal Constraint Scenarios

Program	Envision 2040	2015 - 2018 TIP/STIP	2019 - 2022 TIP/STIP	2015 - 2022 Existing + Committed	Population Based Ratio	Arrive 2045
Urban/Regional	$8,540,125	$4,875,000	$11,003,750	$7,939,375	$8,518,912	$8,518,912
Interstate	$3,738,125	$5,968,750	$4,272,750	$5,120,750	$2,505,957	$4,429,438
NHPP	Accounted for in IM + Urban/Regional					
Safety (State) Safety (Urban)	$1,562,125	$1,299,250 $1,128,000	$400,750 $1,020,500	$699,713 $651,250	$275,500 $761,250	$699,713 $651,250
TA + RTP	$1,377,355	$387,500	$80,000	$233,750	$192,000	$233,750
Total	$15,217,730	$13,658,500	$16,777,750	$14,644,838	$12,252,899	$14,532,342

Operations & Maintenance (O&M) Constraint

Pursuant to 23 CFR 450.324, Arrive 2045 contains a financial plan to account for required operations and maintenance (O&M) of the Federal aid highways as defined by 23 U.S.C. 101(a)(5). The Arrive 2045 O&M constraint extrapolates the BMMPOs O&M element established in the 2020-2023 TIP. O&M documents day-to-day maintenance actives (winter maintenance, street sweeping, crack seals, etc., and related labor). Daily O&M is locally funded. The development of an O&M constraint as show in Table 2 ensures that locally funded maintenance costs are accounted for prior to dedication of future local revenues to support transportation projects identified in Arrive 2045.

Table 8.2: Operations and Maintenance Costs

	Bismarck	Mandan	Morton County	Burleigh County	NDDOT
Base Year	$4,035,181	$367,750	$8,471,845	$7,585,541	$2,697,468
2024	$4,196,589	$382,460	$8,810,719	$7,888,962	$2,805,367
2025	$4,364,452	$397,759	$9,163,147	$8,204,521	$2,917,581
2026	$4,539,030	$413,669	$9,163,147	$8,204,521	$3,034,285
2027	$4,720,591	$430,216	$9,529,673	$8,532,701	$3,155,656
2028	$4,909,415	$447,424	$9,529,673	$8,532,701	$3,281,882
2029	$5,105,792	$465,321	$9,910,860	$8,874,009	$3,413,158
2030	$5,310,023	$483,934	$9,910,860	$8,874,009	$3,549,684
2031	$5,522,424	$503,292	$10,307,295	$9,228,970	$3,691,671
Subtotal	$38,668,316	$3,524,075	$76,325,374	$68,340,395	$25,849,284
2032	$5,743,321	$523,423	$10,719,586	$9,598,129	$3,839,338
2033	$5,973,054	$544,360	$11,148,370	$9,982,054	$3,992,912
2034	$6,211,976	$566,135	$11,148,370	$9,982,054	$3,992,912
2035	$6,460,455	$588,780	$11,594,305	$10,381,336	$4,152,628
2036	$6,718,873	$612,331	$11,594,305	$10,381,336	$4,152,628
2037	$6,987,628	$636,824	$12,058,077	$10,796,589	$4,318,733
2038	$7,267,133	$662,297	$12,058,077	$10,796,589	$4,318,733
Subtotal	$45,362,442	$4,134,151	$80,321,088	$71,918,087	$28,767,884
2039	$7,557,819	$688,789	$12,540,400	$11,228,453	$4,491,483
2040	$7,860,132	$716,341	$13,042,016	$11,677,591	$4,671,142
2041	$7,860,132	$744,995	$13,042,016	$11,677,591	$4,671,142
2042	$8,174,537	$774,794	$13,563,696	$12,144,695	$4,857,987
2043	$8,174,537	$805,786	$13,563,696	$12,144,695	$4,857,987
2044	$8,501,518	$838,018	$14,106,244	$12,630,483	$5,052,307
2045	$8,501,518	$871,538	$14,106,244	$12,630,483	$5,052,307
Subtotal	$56,630,192	$5,440,261	$93,964,313	$84,133,990	$33,654,355
Total	$140,660,950	$13,098,487	$250,610,775	$224,392,472	$88,271,522

Preservation & Maintenance (P&M) Constraint

Pursuant to 23 CFR 450.324, the Arrive 2045 MTP needs to contain a financial plan that accounts for required operations and maintenance of the Federal aid highways as defined by 23 U.S.C. 101(a)(5). For the purposes of Arrive 2045, the Federally defined O&M will be termed Preservation and Maintenance (P&M). This is to maintain consistent wording with the BMMPO's Transportation Improvement Program (TIP). Therefore, the MTP's P&M correlates to the TIP's 'Preservation' projects, as noted in the TIP's 4-year program of projects. Preservation, or P&M, is designed to note long-term maintenance activities. (I.e. reconstruction, mill and overlays, etc.). P&M is not intended to reflect the TIP's Operations and Maintenance costs which document day-to-day maintenance actives (winter maintenance, street sweeping, crack seals, etc., and related labor). Daily O&M in the TIP is primarily locally funded. Whereas the MTP's P&M reflects federally funded preservation projects. The P&M constraint of the MTP ensures P&M activities are considered prior to identifying capacity or expansion projects.

An evaluation of P&M related expenses was conducted for the year 2011-2023 to establish a future estimate of required P&M activities to set a future fiscal constraint for Arrive 2045. An annual average of preservation related costs was developed for the Urban, Regional and Interstate programs. This approach ensures consistency in long range assumptions developed for the MTP specifically related to cost take downs for P&M. This ensures P&M costs are established and accounted for within the fiscally constrained element of the MTP. These P&M costs do not include a range of locally funded P&M projects on the Federal aid highway system.

Table 8.3 shows total base year assumptions from an evaluation of the Urban, Regional and Interstate program for the year 2011-2023 for required investments in roadway systems in the BMMPO Study Area. Two key caveats are emphasized as follows:

1. Given the amount of Interstate related PM reported by NDDOT for the evaluation period, the average P&M was adjusted downward by a factor of 0.5.

2. To reflect the public sentiment for increased levels of system maintenance, the historic average of investment of Urban funds in P&M was doubled. This ensures Arrive 2045 would allow for at least twice the historic average in P&M investments.

Table 8.3: Estimated Annual P&M Expenses by Program Area

Program	Regional	Interstate	Urban
Total (2011 - 2023)	$31,915,114	$52,673,600	$3,540,000
Average	$2,455,009	$4,051,815	$272,308
Adjusted	$2,455,009	$2,025,908	$544,615

Table 8.4 demonstrates the P&M investment projection for major program areas for the Arrive 2045 MTP study area. Based on distributed P&M costs between major program area, these projected future costs will be subtracted from the projected future revenues available for constraining projects with in Arrive 2045. These funds are considered available to support P&M related costs and expenses, including system management and preservation. While many of those types of projects are not typically identified in an MTP, some may. Therefore, these funds would be considered available to support those kinds of activities. It is unlikely the balance of these funds would be identified in Arrive 2045.

Table 8.4: Distribution of Investment in P&M by Major Program Area

Program	Regional	Interstate	Urban
Base Year	**$2,455,009**	**$2,025,908**	**$544,615**
2024	$2,553,209	$2,106,944	$566,400
2025	$2,655,337	$2,191,222	$589,056
2026	$2,761,551	$2,278,871	$612,618
2027	$2,872,013	$2,370,025	$637,123
2028	$2,986,894	$2,464,826	$662,608
2029	$3,106,369	$2,563,420	$689,112
2030	$3,230,624	$2,665,956	$716,677
2031	$3,359,849	$2,772,595	$745,344
Subtotal	**$23,525,847**	**$19,413,859**	**$5,218,938**
2032	$3,494,243	$2,883,498	$775,158
2033	$3,634,013	$2,998,838	$806,164
2034	$3,779,373	$3,118,792	$838,410
2035	$3,930,548	$3,243,543	$871,947
2036	$4,087,770	$3,373,285	$906,825
2037	$4,251,281	$3,508,217	$943,098
2038	$4,421,332	$3,648,545	$980,822
Subtotal	**$27,598,560**	**$22,774,719**	**$6,122,422**
2039	$4,598,185	$3,794,487	$1,020,054
2040	$4,782,113	$3,946,267	$1,060,857
2041	$4,973,397	$4,104,117	$1,103,291
2042	$5,172,333	$4,268,282	$1,147,422
2043	$5,379,227	$4,439,013	$1,193,319
2044	$5,594,396	$4,616,574	$1,241,052
2045	$5,818,171	$4,801,237	$1,290,694
Subtotal	**$36,317,822**	**$29,969,977**	**$8,056,690**
Total	**$87,442,229**	**$72,158,554**	**$19,398,050**

Development of the Fiscal Constraint

Based on a review of all five potential scenarios, funding for each core program area was selected for Arrive 2045. Assumptions for Arrive 2045 were based as follows by major funding programs:

- Urban/Regional: Population/ratio formula and programmatic assumptions used to establish fiscal constraint. Total base assumptions were split between Urban and Regional Program as follows:
  - Urban – $3,936,368 (base)
  - Regional – $4,581,188 (base unadjusted); $2,981,734 (adjusted base 2024-2031); $5,471,074 (adjusted base 2032-2045)

The Urban program balance does account for the Urban Grant Program (UGP). Therefore, constraint analysis for Arrive 2045 can reflect projects which may be considered eligible for UGP. Those projects would be listed in the Urban program list; however, they could be denoted as specifically related to the UGP. The Urban program is further constrained in the base year to match anticipated future P&M costs of $544,615 annually (adjusted for inflation over the planning horizon).

To account for the three phased construction of Memorial Highway, the base allocation of Regional funds for the MTP was reduced by $15,000,000 (assumes 50 percent of the total project). This sum was prorated annually against the available Regional program for the years 2024-2031. This reduces the annual available constraint for Regional program funds by $1,875,000 for the short-range element of the MTP.

O&M assumptions for the years 2011-2023 were used to further reduce the available balance of Regional funds. Total base year estimates for the Regional program were further reduced by $2,455,009 (annually and then adjusted 4 percent for inflation) to account for P&M requirements on the Regional system.

- Interstate: Uses the 2015 through 2022 existing and committed project lists to set fiscal constraint. This assumption provides for a base year allocation of $5,120,750 (unadjusted) in Interstate program funds. To account for ongoing P&M needs on the Interstate system available Interstate system revenues were reduced to reflect a base year estimate of $2,025,908 in required P&M on the Interstate system through the BMMPO study area. Adjusted base year for Interstate program is proposed to be $3,321,051.
- Safety (both State and Urban): Sets the fiscal constraint based on the 2015 through 2022 existing and committed project lists. Based on approved assumptions for establishing the fiscal constraint for the safety program, the following year estimates of available revenue would be available for MTP development.
  - Urban – $651,250 – For ease of constraining safety projects, these funds are proposed to be added to the overall Urban constraint.
  - State – $699,713 – For ease of constraining safety projects, these funds are proposed to be split 75percent/25percent between the Regional and Interstate System.
- TA + RTP: Sets the fiscal constraint based on the 2015 through 2022 existing and committed project lists. Base year estimates for TA + RTP fiscal constraint would be $233,750. Projects will be extracted from the approved BMMPO Bike and Pedestrian Plan to establish a first round of potential constrained projects for these funds.

Table 8.5 shows projected fiscal constraint for Arrive 2045 for each Federal aid program. Because Arrive 2045 has accounted for a realistic program of P&M expenses, the balance of the funding available to support Arrive 2045 is considered relevant to both capacity and expansion related projects. It is likely these revenues will not be sufficient to address the full range of needs identified by Arrive 2045 in the areas of capacity and expansion.

Projected revenues are banded into three ranges:

- Short Range: Years 2024 to 2031
- Medium range: Years 2032 to 2038
- Long Range: Year 2039 to 2045

Table 8.5: Fiscal Constraint for Major Program Areas of Arrive 2045

Year	Urban	Regional	Interstate	Safety (State)	Safety (Urban)	TA + RTP
Base Year	**$3,936,368**	**$4,581,824**	**$5,120,750**	**$699,713**	**$651,250**	**$233,750**
2024	$4,172,550	$428,524	$3,321,051	$741,695	$690,325	$247,775
2025	$4,235,138	$399,247	$3,318,193	$752,821	$700,680	$251,492
2026	$4,298,666	$366,977	$3,313,186	$764,113	$711,190	$255,264
2027	$4,363,145	$331,568	$3,305,912	$775,575	$721,858	$259,093
2028	$4,428,593	$292,866	$3,296,250	$787,208	$732,686	$262,979
2029	$4,495,022	$250,712	$3,284,073	$799,016	$743,676	$266,924
2030	$4,562,447	$204,939	$3,269,248	$811,002	$754,831	$270,928
2031	$4,630,884	$155,372	$3,251,638	$823,167	$766,154	$274,992
Subtotal	**$29,967,507**	**$2,430,206**	**$26,359,550**	**$6,254,597**	**$5,821,400**	**$2,089,447**
2032	$4,700,347	$1,976,831	$3,231,098	$835,514	$777,646	$279,117
2033	$4,770,852	$1,919,128	$3,207,477	$848,047	$789,311	$283,303
2034	$4,842,415	$1,857,064	$3,087,523	$848,047	$789,311	$283,303
2035	$4,915,051	$1,790,436	$3,055,866	$860,768	$801,150	$287,553
2036	$4,988,777	$1,719,029	$2,926,125	$860,768	$801,150	$287,553
2037	$5,063,608	$1,642,620	$2,885,684	$873,679	$813,168	$291,866
2038	$5,139,563	$1,560,977	$2,745,356	$873,679	$813,168	$291,866
Subtotal	**$28,298,190**	**$12,466,086**	**$21,139,129**	**$6,000,502**	**$5,584,903**	**$2,004,562**
2039	$5,216,656	$1,473,859	$2,695,322	$886,784	$825,365	$296,244
2040	$5,294,906	$1,381,012	$2,640,890	$900,086	$837,746	$300,688
2041	$5,374,329	$1,282,174	$2,581,847	$913,587	$850,312	$305,198
2042	$5,454,944	$1,177,072	$2,517,971	$927,291	$863,066	$309,776
2043	$5,536,769	$1,065,420	$2,449,034	$941,201	$876,012	$314,423
2044	$5,619,820	$946,920	$2,374,794	$955,319	$889,153	$319,139
2045	$5,704,117	$821,264	$2,295,002	$969,648	$902,490	$323,926
Subtotal	**$30,144,852**	**$8,147,721**	**$17,554,860**	**$6,493,916**	**$6,044,144**	**$2,169,395**
Total	**$88,410,549**	**$23,044,013**	**$65,053,539**	**$18,749,015**	**$17,450,447**	**$6,263,404**

Summary of Expenses between P&M and Expansion

Based on the financial analysis the following distribution of funds are the result of the fiscal constraint methods established for Arrive 2045.

Table 8.6: Distribution of Funds Between P&M and Expansion

	Urban	Regional	Interstate
Expansion	82.0%	20.9%	47.4%
O&M	18.0%	79.1%	52.6%

Methods and assumptions used for Arrive 2045 are based on an analysis of past trends. Changes in Federal funding programs and funding levels in the future could impact these assumptions. However, these assumptions are based on the best available data regarding reasonably expected revenues and revenue splits. The distribution of funds between P&M and expansion is shown in Table 8.6.

Chapter 9
Fiscally Constrained Plan

ARRIVE 2045
Bismarck-Mandan MPO
Metropolitan Transportation Plan

FISCALLY CONSTRAINED PLAN

The following chapter brings together all earlier elements of Arrive 2045, with the realities of the limited transportation funding presented in Chapter 8, to develop the Arrive 2045 MTP Fiscally Constrained Plan.

Although this fiscally constrained plan is constrained to available revenue and year of expenditure costs, it has flexibility in that projects are prioritized and grouped by short-, mid-, and long-term horizon years. Projects can be reprioritized within the time period.

This chapter begins with a summary of the process, a prioritization of roadway projects, the allocation of available funds, and then a summary of what projects are included in the Fiscally Constrained Plan.

The process for developing the fiscal constraint begins with identifying total projected revenues as presented in Chapter 8. Before any of these revenues can be used for new projects, Operations and Maintenance (O&M) costs, Preservation and Maintenance (P&M) costs, and previously committed projects as defined by the BMMPO Transportation Improvement Plan (TIP) must be subtracted from the forecast revenues.

Prioritization of Projects

To determine which projects would be selected given limited funds and in what time period the project would be proposed, all projects were prioritized. This process took three steps including project evaluation, public input, and agency/Steering Committee review.

Project Evaluation

Each of the proposed projects presented in the among the Universe of Alternatives were evaluated based on the Arrive 2045 project goals and evaluation criteria presented in Chapter 2. Each criterion was transparent and based on measurable comparisons, such as level of service, cost effectiveness, delay saved, environmental impacts, etc. A composite score was calculated for each project based on the goal score times the goal weight which was developed as part of the public involvement process.

The full prioritized list of projects, each projects performance score for the goals, and the project's cumulative total based on the weighting of each goal is included in Appendix C.

Public Involvement

The second step of the process was seeking public input through the second round of public meetings. At these meetings, the technical information was presented in a Round Table format (see Chapter 3). Participants were asked if they agreed with the high, medium, and low prioritization for each project. In general, there was strong support for the overall prioritization of projects; however, there were some projects that were suggested to move up in the process and conversely some down.

Steering Committee

A series of Steering Committee meetings were held to discuss potential projects and prioritization. These meetings provided the opportunity for each jurisdiction to provide input regarding the technical analysis and the public input. Through this agency review, some projects moved up and others down. There were several different reasons in support of the prioritization changes. In some cases, they were technical reasons, such as Project A must precede Project B. In other cases, both Project A and B are needed to serve future demand.

Because there are limited Federal Surface Transportation Program Urban funds, BMMPO used existing and historic Capital Improvement Program (CIP) revenue to project local funds based on local sales tax, state aid to cities/counties, local assessments, and bonding to allow for a larger constrained list of purely locally funded transportation projects.

Fiscal Constrained Roadway Plan Assumptions and Principals

The development of the Fiscally Constrained Plan included various assumptions, principles, and input from various agencies. These are presented as follows to provide additional understanding of the proposed Fiscally Constrained Plan.

Principles for Fiscally Constrained Plan

The BMMPO worked closely with local and State partners on the development of the fiscal constraint element of the Arrive 2045. The Arrive 2045 fiscal constraint element was built upon cooperative revenue estimates developed through the planning process. Further, the fiscal constraint element assumes that all O&M and P&M needs are covered first. Secondly, the fiscal constraint element also assumes a robust program of major rehabilitation and preservation projects throughout the Bismarck-Mandan metropolitan area.

Considerations for Local Investments in Arrive 2045

The fiscal constraint element for Arrive 2045 constrains agreed to revenue streams for the Surface Transportation Program (STP) for the urban and regional roadway system and Interstate Maintenance (IM and NHPP) funds for Interstate related improvements. Further, the fiscal constraint element of Arrive 2045 constrains local investments (Sales Tax, Assessments, Bonds, etc.) from existing municipal and county Capital Improvement Programs (CIPs) over the life the plan. All locally funded improvements shown in the fiscal constraint element of Arrive 2045 are constrained by reasonably anticipated local revenues. There is a long-standing trend locally in funding major transportation investment with purely local funds. Arrive 2045 uses this assumption to constrain several major roadway investments beyond the availability of Federal revenues.

Fiscally Constrained Project List

The final phase of the Arrive 2045 MTP development is the constrained element. This element of the MTP is largely driven through integration of previous steps, including both technical scoring, both macro and micro level modeling analysis and public input. Based on this list of projects, the fiscal constraints was developed following assumptions for available local, state, and federal funds. Arrive 2045 depended on the findings of the alternative evaluation phase to assist with smoothing some of the recommendations regarding larger project needs. Figure 9.1 shows the proposed overall recommended project phasing for Arrive 2045.

Project Phasing

The following sections discuss the project lists for short, mid, and long range time periods for Arrive 2045, which are defined as:

- Short-Range: 2024 to 2031
- Mid-Range: 2032 to 2038
- Long-Range: 2039 to 2045

Projects are assigned a time period based on their relative need. So, even if a project could be funded in a later phase, it is kept in the phase at which it is needed and would be listed as "illustrative" which allows for a better representation of unmet funding needs.

Short-Range Projects

The most significant time period and project list is the short-range list, which reflects projects from which to choose for developing the next five TIPs until Arrive 2045 is updated in 2025. Table 9.4 shows the short-range project list. Projects with a yellow fill are recommended for inclusion in the constrained plan and would reflect the MPO's prioritized list.

Short-Range Financial Analysis

Based on the identification of short range projects, Table 9.1 reflects the financial analysis for the years 2024 to 2031 of Arrive 2045, with a summary of the revenue programs below.

- Urban Program
  - Requires $16M to $19M in Bismarck sales tax to balance program.
  - All Bismarck projects are sales tax eligible; sales tax benefit to the urban system is not fully shown in MTP financial analysis.
- Regional Program
  - Program is balanced; however, P&M revenues needed to support low cost improvements on State Street.
  - Assumes constraint of low cost improvements on State Street while high cost improvements on State Street remain illustrative.
- Interstate Program
  - Generally balanced, includes reconstruction of Exit 161.

Table 9.1: Short-Range Financial Analysis

Revenue			
Program	**Capacity**	**P&M**	**Total**
Urban	$35,961,008	$6,262,725	$42,223,733
Regional	$2,916,247	$28,231,016	$31,147,263
Interstate	$28,995,505	$21,355,245	$50,350,749
Safety	$14,491,196	$0	$14,491,196
Total	**$82,363,956**	**$55,848,986**	**$138,212,941**
Expenses			
Program	**Capacity**	**P&M**	**Total**
Urban	$54,702,586	$2,924,646	$57,627,233
Regional	$22,396,942	$3,217,111	$25,614,053
Interstate	$29,246,464	$0	$29,246,464
Safety	$9,106,179	$0	$9,106,179
Total	**$115,452,171**	**$6,141,757**	**$121,593,929**
Program Balances			
Program	**Capacity**	**P&M**	**Total**
Urban	-$18,741,578	$3,338,079	-$15,403,500
Regional	-$19,480,695	$25,013,905	$5,533,210
Interstate	-$250,959	$21,355,245	$21,104,285
Safety	$5,385,017	$0	$5,385,017
Total	**-$33,088,216**	**$49,707,228**	**$16,619,013**

Mid Range Projects

Table 9.5 shows the mid-range projects. Projects with a yellow fill are recommended for inclusion in the constrained plan. Unlike the short-range project lists, there is no Urban Program priority. These projects can be prioritized as necessary.

Mid-Range Financial Analysis

Based on the identification of mid-range range projects, Table 9.2 reflects the financial analysis for the years 2032 to 2038 of Arrive 2045, with a summary of the revenue programs below.

- Urban Program
  - Program slightly out of balance, likely balanced with use of Bismarck Sales Tax.
- Regional Program
  - Program is balanced; however, requires use of P&M revenue to support program.
  - Assumes constraint of low cost improvements on State Street but high cost improvements on State Street remain illustrative.
- Interstate Program
  - Requires more capacity investment to support reconstruction of Exit 159; program still balanced.

Long-Range Projects

Table 9.6 shows the long-range projects. Projects with a yellow fill are recommended for inclusion in the constrained plan and can be prioritized as necessary.

Long-Range Financial Analysis

Based on the identification of long-range range projects, Table 9.3 reflects the financial analysis for the years 2039 to 2045 of Arrive 2045, with a summary of the revenue programs below.

- Urban Program
  - Program balanced.
- Regional Program
  - Program is balanced; however, requires use of P&M revenue to support program.
  - Assumes constraint of low cost improvements on State Street while high cost improvements on State Street remain illustrative.
- Interstate Program
  - No capacity programmed in long range (e.g. 66th Street Interchange not included in constrained MTP).

Table 9.2: Mid-Range Financial Analysis

Revenue			
Program	**Capacity**	**P&M**	**Total**
Urban	$33,957,828	$7,346,907	$41,304,735
Regional	$14,959,303	$33,118,272	$48,077,575
Interstate	$23,253,042	$25,052,191	$48,305,233
Safety	$13,902,486	$0	$13,902,486
Total	**$86,072,658**	**$65,517,370**	**$151,590,028**
Expenses			
Program	**Capacity**	**P&M**	**Total**
Urban	$45,949,625	$0	$45,949,625
Regional	$18,171,716	$5,941,431	$24,113,146
Interstate	$43,227,870	$0	$43,227,870
Safety	$6,826,001	$0	$6,826,001
Total	**$114,175,211**	**$5,941,431**	**$120,116,642**
Program Balances			
Program	**Capacity**	**P&M**	**Total**
Urban	-$11,991,796	$7,346,907	-$4,644,890
Regional	-$3,212,413	$27,176,841	$23,964,429
Interstate	-$19,974,828	$25,052,191	$5,077,363
Safety	$7,076,485	$0	$7,076,485
Total	**-$28,102,553**	**$59,575,939**	**$31,473,387**

Table 9.3: Long-Range Financial Analysis

Revenue			
Program	**Capacity**	**P&M**	**Total**
Urban	$36,173,822	$9,668,028	$45,841,850
Regional	$9,777,265	$43,581,387	$53,358,652
Interstate	$19,310,346	$32,966,974	$52,277,321
Safety	$15,045,672	$0	$15,045,672
Total	**$80,307,106**	**$86,216,389**	**$166,523,495**
Expenses			
Program	**Capacity**	**P&M**	**Total**
Urban	$32,392,806	$0	$32,392,806
Regional	$25,018,834	$0	$25,018,834
Interstate	$0	$0	$0
Safety	$15,193,624	$0	$15,193,624
Total	**$72,605,264**	**$0**	**$72,605,264**
Program Balances			
Program	**Capacity**	**P&M**	**Total**
Urban	$3,781,016	$9,668,028	$13,449,044
Regional	-$15,241,569	$43,581,387	$28,339,818
Interstate	$19,310,346	$32,966,974	$52,277,321
Safety	-$147,951	$0	-$147,951
Total	**$7,701,842**	**$86,216,389**	**$93,918,231**

Figure 9.1: Project Phasing

Project Phasing

- Short Range Projects
- Mid Range Projects
- Long Range Projects
- Short Range Projects for Constrained Plan
- Mid Range Projects for Constrained Plan
- Long Range Projects for Constrained Plan
- Bismarck Sales Tax Eligible Corridors

0 0.6 1.2 1.8 Miles

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Metropolitan Transportation Plan

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Table 9.4: Short-Range Project List

ID	Location	Termini	Termini	Description	Phase	Cost	Year of Expenditure [YOE]	Program	Urban Program Priority
6	Old Red Trail	56th Avenue	40th Avenue NW	Reconstruct as 3-lane urban section.	Short	$8,400,000	$9,826,812	Urban	2
18	Old Red Trail	Sunset Drive	ND1806 / Collins Avenue	Restripe for 3-lane urban section.	Short	$39,500	$46,209	Safety	
21	Division Street	Sunset Drive	ND 1806 / Collins Avenue	Reconstruction.	Short	$2,500,000	$2,924,646	Urban	5
22	3rd Avenue NE	Main Street	5th Street	Reconstruction.	Short	$2,500,000	$2,924,646	Urban (P&M)	7
23	Division Street	8th Avenue E	Mandan Avenue	Construct as 2-lane urban section.	Short	$2,880,000	$3,369,193	Urban	
27	Highway 1806	19th Street	Heart River Bridge	Add turn lanes and signals at 8th Avenue and 19th Street.	Short	$1,750,000	$2,047,252	Regional (P&M)	
30	McKenzie Road	Highway 1806	39th Avenue E	Construct as 2-lane rural section. Include new bridge across Heart River. Add signals at McKenzie Drive/ Bismarck Expressway ramps and at McKenzie Drive/40th Avenue.	Short	$15,650,000	$18,308,286	Urban	
31	McKenzie Road	46th Avenue SE		Intersection capacity improvement.	Short	$2,500,000	$2,924,646	Urban	
32	Washington Street	Burleigh Avenue	Drainage Channel	Reconstruct as 3-lane urban arterial.	Short	$8,720,000	$10,201,167	Urban	3
33	Washington Street	Drainage Channel	Denver Avenue	Turn lane improvements including restripe south of Reno Avenue as 3-lane section.	Short	$39,000	$45,624	Safety	
34	Bismarck Expressway	Washington Street	12th Street	Safety improvements.	Short	$5,000,000	$5,849,293	Safety	
45	Main Avenue	Bismarck Expressway	66th Street	Widen from 2-lane to 3-lane section (including intersection improvement at 52nd Street).	Short	$10,020,000	$11,721,983	Urban	6
49	Bismarck Expressway / Centennial Road	Divide Avenue	Century Avenue	Widen from 5-lane to 6-lane section.	Short	$3,960,000	$4,632,640	Mix	
50	Bismarck Expressway / Centennial Road	I-94		Interchange reconstruction.	Short	$25,000,000	$29,246,464	Interstate	
52	Divide Avenue	Turnpike Avenue	26th Street	Restripe as 3-lane urban section.	Short	$143,500	$167,875	Safety	
54	Rosser Avenue	Main Avenue	10th Street	Restripe as 3-lane urban section.	Short	$62,000	$72,531	Safety	
59	Century Avenue	Tyler Parkway		Intersection capacity improvement.	Short	$2,500,000	$2,924,646	Urban	
62	Tyler Parkway	Valley Drive	43rd Avenue	Construct as 2-lane urban section.	Short	$4,260,000	$4,983,597	Urban	
64	Tyler Parkway	43rd Avenue	57th Avenue	Overlay existing roadway to 2-lane rural section.	Short	$500,000	$584,929	Urban	8
65	Ash Coulee Drive	Tyler Parkway	Washington Street	Widen from 2-lane to 3-lane urban section.	Short	$5,240,000	$6,130,059	Urban	4
78	State Street	Calgary Avenue	43rd Avenue	At grade improvements: Calgary Avenue and 43rd Avenue; widening to 6-lane urban section from Calgary Avenue through 43rd Ave intersection.	Short	$15,185,000	$17,764,302	Regional	
78i	State Street	43rd Avenue		Grade separation.	Short	$30,000,000	$35,095,757	Regional	
81	43rd Avenue	State Street	26th Street	Construct 3-lane or 5-lane urban section.	Short	$10,000,000	$11,698,586	Urban	1
82	19th Street	North Valley Loop/Yucca Avenue	43rd Avenue	Reconstruct as 3-lane urban section.	Short	$1,380,000	$1,614,405	Urban	1
87	71st Avenue	Centennial Road		Intersection capacity improvement.	Short	$2,500,000	$2,924,646	Safety	
TBD	State Street	Calgary Avenue	43rd Avenue	Shared use path.	Short	$1,000,000	$1,169,859	Regional	

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Table 9.5: Mid-Range Project List

ID	Location	Termini	Termini	Description	Phase	Cost	Year of Expenditure [YOE]	Program
8	Boundary Road	32nd Avenue	Sunset Drive	Construct as 3-lane urban section.	Mid	$12,640,000	$20,237,047	Urban
9	32nd Avenue	I-94		Grade separation.	Mid	$15,000,000	$24,015,483	Urban
12	38th Street NW	Old Red Trail	Collins Avenue / ND 1806	Construct as 2-lane urban section.	Mid	$8,700,000	$13,928,980	Urban
13	Sunset Drive	Middle School	38th Street	Construct as 2-lane urban section.	Mid	$4,500,000	$7,204,645	Urban
14	8th Avenue NW	27th Street	38th Street	Construct as 2-lane urban section.	Mid	$6,000,000	$9,606,193	Urban
16	ND 1806	Old Red Trail	37th Street	Intersection capacity improvement, add turn lanes at key intersections. (Assume minor intersection improvements to match new 37th St section)	Mid	$2,711,000	$4,340,398	Regional (P&M)
17	27th Street N / Sunset Drive Intersection	Sunset Drive		Intersection capacity improvement.	Mid	$2,500,000	$4,002,581	Safety
20	Boundary Road	Sunset Drive		Signalize and stripe turn lanes on all approaches.	Mid	$350,000	$560,361	Safety
25	3rd Street	6th Avenue / ND1806	Memorial Highway	Restripe to include turn lanes or restripe to 3-lane section with center turn lane and no parking.	Mid	$57,000	$91,259	Safety
26	I-94	I-194		Additional westbound lane from I-94/I-194 to Main St/Exit 155.	Mid	$6,000,000	$9,606,193	Interstate
28	19th Street SE	ND 6	ND1806	Reconstruct as 3-lane urban section.	Mid	$14,400,000	$23,054,864	Urban
35	Bismarck Expressway	12th Street	Yegen Road	Implement 3/4 access control at 5 intersections and add right turn at Airport Road.	Mid	$500,000	$800,516	Regional (P&M)
39	66th Street	Lincoln Road	Northgate Drive	Widen from 2-lane to 3-section.	Mid	$5,480,000	$8,773,657	Urban
43	Apple Creek Road	Yegen Road	66th Street	Intersection capacity improvements at all intersections.	Mid	$5,000,000	$8,005,161	Urban
44	66th Street	Apple Creek	Highway 10/ Old Main Avenue	Widen from 2-lane to 3-section.	Mid	$4,040,000	$6,468,170	Urban
46	Main Avenue	Hay Creek Crossing		Structural replacement.	Mid	$500,000	$800,516	Regional (P&M)
53	4th Street	Boulevard Avenue	Divide Avenue	4th Street signal timing Improvements, stripe turn lanes at key intersections, potential new signal at Turnpike.	Mid	$278,500	$445,887	Safety
55	4th Street	Divide Avenue	Century Avenue	4th Street signal timing Improvements, stripe turn lanes at key intersections, potential new signal at Turnpike.	Mid	$303,000	$485,113	Safety
56	4th Street	Century Avenue	Montreal Street	4th Street signal timing Improvements, stripe turn lanes at key intersections, potential new signal at Turnpike.	Mid	$275,000	$440,284	Safety
60	Interstate Avenue	Country West Road	Country West Road	Construct as 2-lane urban section.	Mid	$1,140,000	$1,825,177	Urban
71	57th Avenue	Tyler Parkway	Crested Butte Road	Construct as 3-lane rural section.	Mid	$3,150,000	$5,043,251	Urban
72	57th Avenue	Crested Butte Road	Washington Street	Construct as 3-lane rural section.	Mid	$3,710,000	$5,939,830	Urban
73	57th Avenue	Washington Street	State Street	Construct as 3-lane rural section.	Mid	$7,000,000	$11,207,226	Urban
77	State Street	43rd Avenue	57th Avenue	Widen to 6-lanes from N of 43rd through 57th; intersection improvement at 57th.	Mid	$11,350,000	$18,171,716	Regional
79i	State Street	Interstate Boulevard		Grade separation.	Mid	$23,000,000	$36,823,741	Regional
80	State Street	I-94		Interchange reconstruction.	Mid	$21,000,000	$33,621,677	Interstate
84	19th Street	Skyline Boulevard	71st Avenue	Construct as 3-lane urban section.	Mid	$15,040,000	$24,079,525	Urban
85	26th Street	43rd Avenue	71st Avenue	Construct as 3-lane rural section.	Mid	$16,000,000	$25,616,515	Urban
89	Centennial Road	Jericho Road	43rd Avenue	Widen from 3-lane to 5-lane urban section.	Mid	$2,800,000	$4,482,890	Urban
91	52nd Street	Century Avenue	43rd Avenue	Reconstruct as 3-lane rural section.	Mid	$7,440,000	$11,911,680	Urban
92	Century Avenue	52nd Street	66th Street	Construct 3-lane urban section.	Mid	$9,040,000	$14,473,331	Urban
94	66th Street	Century Avenue	43rd Avenue	Reconstruct as 3-lane urban section.	Mid	$4,190,000	$6,708,325	Urban
95	43rd Avenue	52nd Street	66th Street	Widen from 2-lane to 3-lane or 5-lane urban section.	Mid	$8,000,000	$12,808,258	Urban

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Table 9.6: Long-Range Project List

ID	Location	Termini	Termini	Description	Phase	Cost	Year of Expenditure [YOE]	Program
1	37th Street NW	ND 25	56th Avenue	Construct 2-lane urban section.	Long	$12,060,000	$24,431,347	
2	37th Street NW	56th Avenue	ND 1806	Construct 3-lane urban section.	Long	$27,920,000	$56,560,797	
3	56th Avenue	Old Red Trail	37th Street	Reconstruct as 3-lane urban section .	Long	$8,000,000	$16,206,532	Urban
4	56th Avenue NW	I-94		New interchange.	Long	$25,000,000	$50,645,413	Interstate
5	56th Avenue NW	I-94 Business Loop (Main Street)	Old Red Trail	Construct as 3-lane urban section.	Long	$19,280,000	$39,057,742	Urban
7	Boundary Road	56th Avenue / I-94 Interchange	32nd Avenue	Construct as 3-lane urban section.	Long	$13,200,000	$26,740,778	Urban
10	32nd Avenue W	I-94 Business Loop (Main Street)	Boundary Road (Future)	Construct as 2-lane urban section.	Long	$12,660,000	$25,646,837	Urban
11	31st Street	Lohstreter Road	Boundary Road (Future)	Construct as 2-lane urban section.	Long	$5,940,000	$12,033,350	Urban
15	Northern Bridge Corridor	38th Street (Mandan)	River Road	Construct as 2-lane rural section. Include new bridge across Heart River. Add signals at McKenzie Drive / Bismarck Expressway ramps and at McKenzie Drive / 40th Avenue.	Long	$62,450,000	$126,512,241	
19	Sunset Drive	I-94		Interchange reconstruction.	Long	$25,000,000	$50,645,413	Interstate
24	Mandan Avenue	I-94		Interchange reconstruction.	Long	$25,000,000	$50,645,413	Interstate
29	McKenzie Road	ND 6	ND 1806	Construct as 2-lane rural section.	Long	$12,550,000	$25,423,997	Urban
36	12th Street	Burleigh Avenue	Santa Fe Avenue	Add turn lanes at Santa Fe Avenue and Burleigh Avenue.	Long	$1,000,000	$2,025,817	Safety
37	48th Avenue S	University Drive	66th Street	Construct 2-lane rural section and structure improvements at Apple Creek crossing.	Long	$19,800,000	$40,111,167	Urban
38	66th Street	48th Avenue S	Lincoln Road	Reconstruct as 2-lane urban section.	Long	$5,880,000	$11,911,801	Urban
40	Lincoln Road	Yegen Road / Airway Avenue		Intersection capacity improvement.	Long	$2,500,000	$5,064,541	Safety
41	Yegen Road	Lincoln Road	Morrison Avenue	Add 6 new turn lanes in key locations.	Long	$1,500,000	$3,038,725	Safety
42	Apple Creek Road	Yegen Road		Intersection capacity improvement.	Long	$2,500,000	$5,064,541	Safety
47	66th Street	Highway 10 / Old Main Avenue	Century Avenue	Construct as 3-lane urban section (tied with project for interchange with I-94 at 66th Street).	Long	$19,920,000	$40,354,265	Urban
48	Divide Avenue	Bismarck Expressway	66th Street	Reconstruct as 3-lane urban section.	Long	$15,200,000	$30,792,411	Urban
51	Hamilton Street / Channel	Divide Avenue	Century Avenue	Construct as 2-lane urban section with grade separation.	Long	$20,940,000	$42,420,598	Urban
57	Tyler Parkway	Schafer Road	Burnt Board Drive	Intersection capacity improvement. Add turn lanes and include safety improvements.	Long	$750,000	$1,519,362	Urban
61	Burnt Boat Drive	River Road		Intersection capacity improvement.	Long	$2,500,000	$5,064,541	Urban
66	57th Avenue	River Road	Tyler Parkway	Construct as 3-lane rural section.	Long	$10,220,000	$20,703,845	Urban
67	Burnt Creek Loop South (57th Avenue)	River Road		Intersection capacity improvement.	Long	$2,500,000	$5,064,541	Urban
68	Burnt Creek Loop North / River Road	ND 1804		Intersection capacity improvement.	Long	$2,500,000	$5,064,541	Regional
69	71st Avenue/ ND 1804	15th Street/Tyler Parkway	State Street	Widen from 2-lane to 4-lane section.	Long	$10,150,000	$20,562,038	Regional
70	Tyler Parkway	57th Avenue	ND 1804 / 71st Avenue	Construct as 3-lane urban section.	Long	$7,920,000	$16,044,467	Urban
74	71st Street	State Street		Intersection capacity improvement.	Long	$2,200,000	$4,456,796	Regional
74i	71st Street	State Street		Grade separation.	Long	$25,000,000	$50,645,413	Regional
75	State Street	57th Avenue	71st Avenue	Widen to 6-lanes from 57th Avenue to ND 1804/ 71st Avenue.	Long	$12,600,000	$25,525,288	Regional
76	57th Avenue	State Street	26th Street	Construct 3-lane urban section.	Long	$7,680,000	$15,558,271	Urban
83	Calgary Avenue	DMVW Railroad	Haycreek Road	Construct 2-lane urban section across DMVW RR with grade separation.	Long	$36,980,000	$74,914,695	Urban
86	71st Avenue	State Street	Centennial Road	Widen from 2-lane to 3-lane rural section.	Long	$7,280,000	$14,747,944	Urban
88	Centennial Road	43rd Avenue	71st Avenue	Widen from 2-lane to 3-lane rural section.	Long	$7,960,000	$16,125,499	Urban
90	Century Avenue	Centennial Road	52nd Street	Reconstruct as 5-lane urban section.	Long	$10,875,000	$22,030,755	Urban
93	I-94	66th Street		New interchange.	Long	$25,000,000	$50,645,413	Interstate
96	43rd Avenue	Roosevelt Drive	52nd Street	Widen from 2-lane to 3-lane urban section.	Long	$1,960,000	$3,970,600	Urban
97	66th Street	43rd Avenue	71st Avenue	Reconstruct/New Construct as a 3-lane urban section.	Long	$15,600,000	$31,602,738	Urban
98	71st Avenue	Centennial Road	66th Street	Reconstruct as a 3-lane urban section.	Long	$16,160,000	$32,737,195	Urban

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Total Plan Financial Analysis

Table 9.7summarizes the overall financial analysis for the constrained short-, mid- and long-range elements of Arrive 2045.

- Urban Program
  - Program generally balanced.
  - Deficit likely filled with Bismarck Sales Tax.
- Regional
  - Program is balanced; however, requires use of P&M revenue to support program.
- Interstate Program
  - Program balanced; doesn't allow for any new capacity beyond Exit 161 (short range) and Exit 159 (mid-range).

Table 9.7: Arrive 2045 Financial Analysis

Revenue			
Program	**Capacity**	**P&M**	**Total**
Urban	$105,879,844	$23,277,660	$129,157,504
Regional	$27,652,816	$104,930,675	$132,583,490
Interstate	$71,558,893	$79,374,410	$150,933,303
Safety	$43,439,354	-	$43,439,354
Total	**$248,530,906**	**$207,582,745**	**$456,113,651**
Expenses			
Program	**Capacity**	**P&M**	**Total**
Urban	$133,045,017	$2,924,646	$135,969,663
Regional	$65,587,492	$9,158,542	$74,746,033
Interstate	$72,474,334	$0	$72,474,334
Safety	$31,125,804	$0	$31,125,804
Total	**$302,232,646**	**$12,083,188**	**$314,315,834**
Program Balances			
Program	**Capacity**	**P&M**	**Total**
Urban	-$27,165,173	$20,353,014	-$6,812,159
Regional	-$37,934,676	$95,772,133	$57,837,457
Interstate	-$915,441	$79,374,410	$78,458,969
Safety	$12,313,550	$0	$12,313,550
Total	**-$53,701,740**	**$195,499,557**	**$141,797,816**

Arrive 2045 Investment by Major Program

The allocation of resources to preservation and maintenance (P&M) and capacity for each of the three major funding programs are shown in Table 9.8. The splits generally follow the historic trend lines evaluated earlier in the MTP for the years 2011 to 2023 for both the Urban and Interstate programs. However, the Regional Program tilts more towards capacity, primarily to ensure the lower cost capacity improvements along State Street are included in the constrained project list.

Table 9.8: Investment by Major Program

	Urban	Regional	Interstate
Capacity	85.2%	49.5%	47.7%
P&M	14.8%	50.5%	52.3%