DEPARTMENT OF TRANSPORTATION

Northwest Metro Mississippi River Crossing

Feasibility Analysis

Appendix D: Traffic Forecasting Technical Memorandum

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Date: June 10, 2021

Subject: Northwest Metro Mississippi River Crossing Feasibility Analysis: Forecasting Technical Memorandum

Introduction

This memorandum documents the assumptions for the validation of the travel demand model and the process of developing future year traffic forecasts for the Northwest Metro Mississippi River Crossing Feasibility Analysis. The regional Activity Based Model (ABM), which was developed and has been maintained by the Metropolitan Council, will be used to evaluate existing and future conditions. The existing year for the model has been updated to the year 2018 (from 2014) due to newly available socioeconomic data for the year 2018. Future year (2040) forecasts were developed to evaluate future congestion and potential improvements. This memorandum presents assumptions and methods used to develop the existing year model and year 2040 forecasts.

Travel demand models provide an estimation of traffic forecasts that include many future year assumptions. However, with uncertainty regarding future-year conditions, the model results should be considered estimates with some margin of error. As a general guideline, MnDOT considers long-range forecasts to have a precision of approximately ± 15 percent. Decision makers and designers should be aware of the uncertainty in long-range forecasts and whether that margin of error would affect outcomes or the recommended improvements.

The forecast development process documented in this memorandum follow traditional planning approaches used in the Twin Cities metropolitan area. These assumptions were established prior to the COVID-19 global pandemic. Specifically, daily activity patterns undertaken by travelers on the regional transportation system reflect data collected through the Metropolitan Council's Travel Behavior Inventory (TBI). Changes in travel behavior during the pandemic, such as increased telework and home delivery services, have insufficient data to be incorporated into modeling processes at this time. These trends should continue to be monitored to understand the extent to which travel demand will be impacted into the future.

Assumptions

Existing and year 2040 socioeconomic and roadway system assumptions are consistent with the regional development assumptions (Thrive MSP 2040) and regional transportation policy plan. These assumptions are incorporated into the model as described below.

Transportation Network

Existing Year Roadway Network

The baseline (2014) roadway system forecasts assume existing roadway system and was updated to reflect conditions as of the year 2018. Key roadway updates identified and incorporated include:

- CSAH 610 extension from CSAH 81 to I-94
- I-35E MnPASS from Little Canada Road to CR J
- I-694 3rd lane expansion in Shoreview
- I-494 3rd lane expansion in Plymouth
- TH 10/Main St area connection coding errors
- Interchange at TH 10 and Armstrong Blvd in Ramsey

Year 2040 Programmed Improvements

The 2040 No Build scenario includes the following planned and programmed improvements:

- I-94 lane additions from TH 610 to TH 101
- 109th Avenue reconstruction to four lanes (Jefferson Highway to CSAH 103)
- 101st Avenue – TH 169 interchange and reconstruction
- CSAH 81 reconstructed as a multi-lane roadway from north of 63rd Avenue North to CSAH 8 in Brooklyn Park.
- CSAH 103 (West Broadway Avenue) reconstructed as a four-lane divided roadway from CSAH 109 (85th Avenue N) to 93rd Avenue in Brooklyn Park.
- CSAH 103 (West Broadway Avenue) reconstructed as a four-lane divided roadway from 78th Ave to CSAH 109 (85th Avenue) in Brooklyn Park. This project includes the reconstruction of CSAH 109/CSAH 103 intersection.
- Highway 610 extension from I-94 to CSAH 30
- I-94 and Dayton Parkway Interchange
- Highway 10 grade separation at Ramsey Blvd and Sunfish Lake Blvd

Zonal Data and Socioeconomic Update

Development inputs to the model (i.e., population, households, and employment) are consistent with the Thrive MSP 2040 plan as of April 2020. Existing and future year municipal socioeconomic totals for key municipalities are shown in Table 1.

Table 1: Existing and Year 2040 Municipal Totals

	Population			Households			Total Employment		
	2018	2040	Delta	2018	2040	Delta	2018	2040	Delta
Andover	33,060	42,100	+9,040	10,651	15,200	+4,549	5,910	6,200	+290
Anoka	18,383	21,300	+2,917	7,482	8,700	+1,218	14,428	14,800	+372
Brooklyn Park	81,261	98,000	+16,739	27,701	34,500	+6,799	32,980	45,600	+12,620
Champlin	23,927	24,100	+173	8,606	9,700	+1,094	4,122	5,100	+978
Coon Rapids	63,747	72,100	+8,353	24,307	29,200	+4,893	25,373	32,900	+7,527
Dayton	6,158	10,500	+4,342	2,183	4,300	+2,117	1,306	3,700	+2,394
Elk River	24,891	27,000	+2,109	8,658	10,000	+1,342	11,860	15,800	+3,940
Maple Grove	66,523	89,700	+23,177	25,454	33,400	+7,946	35,488	52,700	+17,212
Osseo	2,729	3,200	+471	1,250	1,500	+250	2,139	2,500	+361
Otsego	17,308	17,800	+492	5,970	6,400	+430	3,477	5,000	+1,523
Ramsey	27,039	34,500	+7,461	9,204	12,900	+3,696	7,129	9,100	+1,971
Rogers	12,922	22,800	+9,878	4,223	8,600	+4,377	10,605	17,100	+6,495

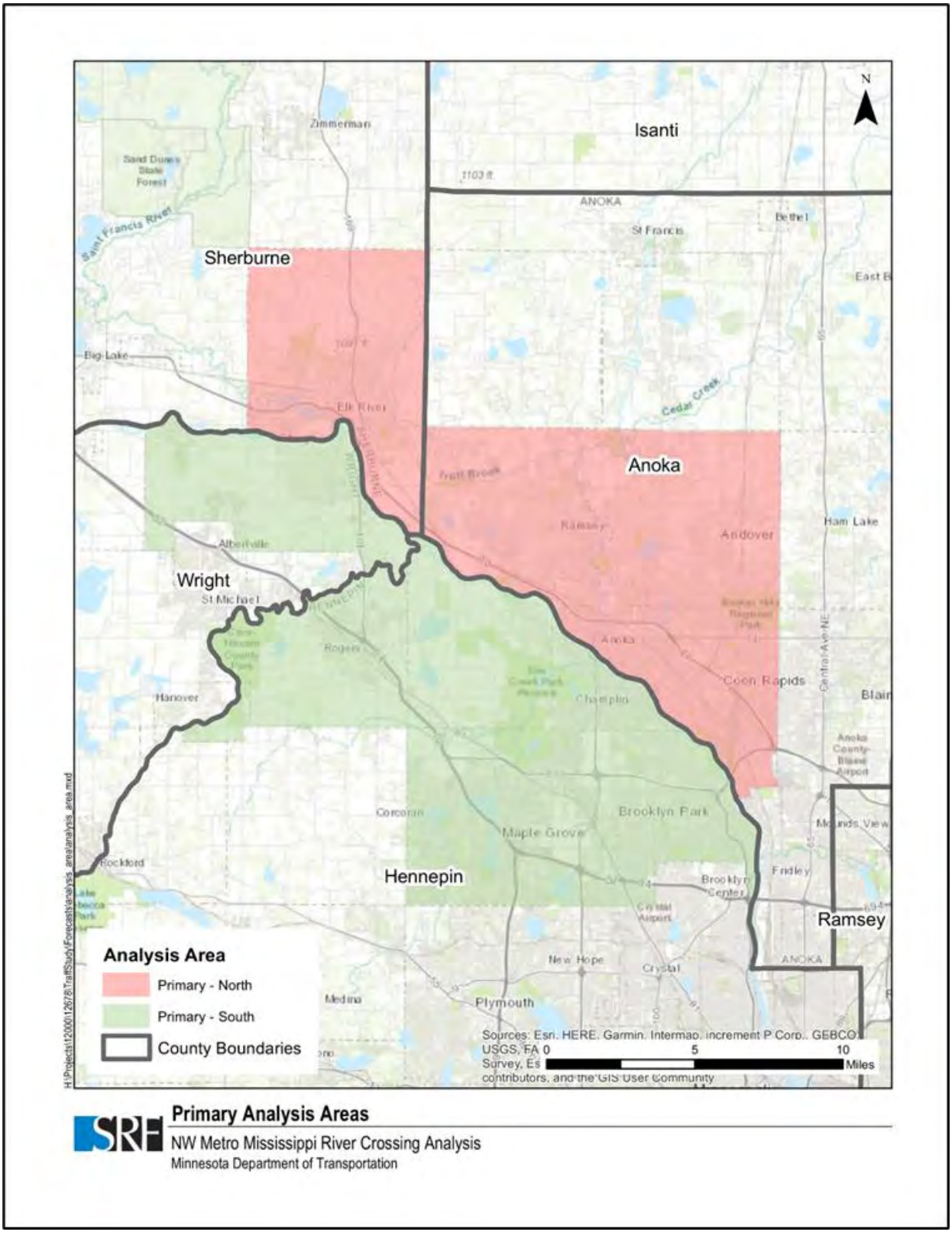
Model Validation

Forecasts were developed using the regional Activity Based Model (ABM). The existing network was reviewed for accuracy in functional class and number of lanes.

Validation of Existing Model

The model roadway network was updated with current MnDOT Average Annual Daily Traffic (AADT) data to facilitate the model validation process. Daily traffic volumes were validated based on the degree to which the model replicates known ground counts. The validation checks are based on the Federal Highway Administration's *Model Validation and Reasonableness Checking Manual*. Based on the Federal Highway Administration guidance, link percent Root Mean Squared Error (RMSE) gauges this degree of validation. The validation was compared to additional count locations collected in 2017 by Hennepin County to ensure more recent growth is being reflected in the projected 2040 values. The area where counts were updated is shown in Figure 1.

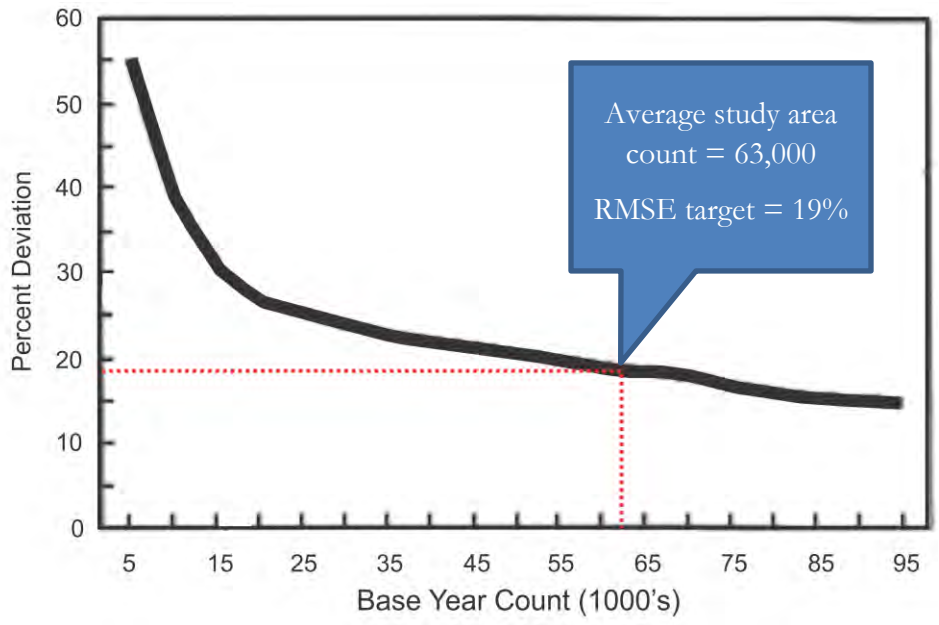
Figure 1: Analysis Area



Link Root Mean Squared Error (RMSE)

The average error of the model can be estimated in two ways. The first, the average arithmetic error, compares the average modeled volume with the average count volume. However, analysts frequently use a more restrictive measure called Root Mean Squared Error (RMSE) that does not allow a too-high volume to be averaged and offset against a too-low volume. Furthermore, error on higher volume facilities is weighted more heavily. It is often helpful to compare the error to the magnitude of an observed traffic count. To do so, the RMSE is normalized by dividing it by the mean count. This new variable is referred to as Normalized RMSE or Percent RMSE. For this project, an RMSE of 19 percent with an average count of 63,000 vehicles per day was obtained. As shown in Figure 2, this value is reasonable given the standard tolerates higher percentage errors with low numeric differences (a result of typical count deviations on low-volume roads and the low impact of those deviations on forecast lane requirements). Model performance for low volume roads is affected by the resources available to refine the geographic size of model zones, the roadway geometrics and traffic control parameters in the model.

Figure 2: Maximum Desirable Error for Link Volumes

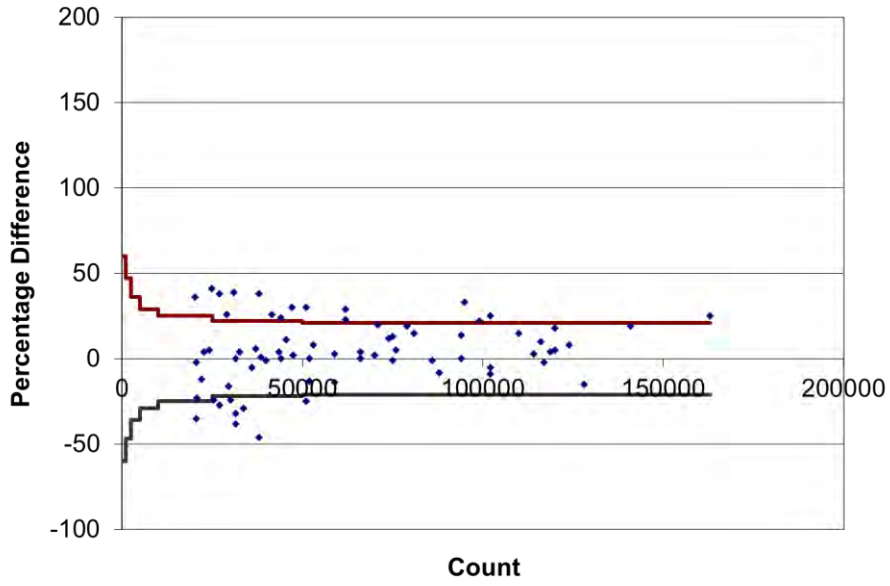


Source: Model Validation and Reasonableness Checking Manual (FHWA, 1997)

Link Deviation from Count

Differences between modeled volumes and ground counts are expected in a model. The significance of any difference depends on whether the difference affects roadway requirements, such as the number of lanes, and considers variance in traffic counts. For this analysis, the model attained a 19 percent RMSE, which necessitates applying an industry-standard post-model adjustment process. As shown in Figure 3, high volume roadways had the best fit; some roadways, particularly low volume roadways, exceeded the desirable deviation.

Figure 3: Model Performance for Segments with Counts



Model Traffic Volume Adjustment Process

The final step in model development was to establish a process for adjusting the future modeled volumes to account for the error in the base model. The National Cooperative Highway Research Program Special Report 255 suggests methods of adjusting models based on: a) the difference between model and count; b) the ratio of the model to county; and c) the magnitude of growth between existing and future. The calculations used in this process are provided below:

- Ratio Method: $AdjustedVolume = FutureModelVolume \times \frac{BaseCount}{BaseModelVolume}$
- Difference Method: $AdjustedVolume = FutureModelVolume + (BaseCount - BaseModelVolume)$
- Average Method: *Average of Ratio Method and Difference Method*

Table 2 shows the conditions under which each of these methods is applied for this project. In general, the ratio method provides potentially volatile and unstable adjustments where the travel demand model is extremely different than the counts, or where growth is proportionately high. Consequently, it is never used on its own. In most cases, the average method is used as the appropriate adjustment method.

Table 2: Model Adjustment Process

Condition	Implications of Condition	Method Used
$\frac{Future\ Volume}{Base\ Volume} > 3$	High model growth may cause the ratio method to result in unreasonably high adjusted volumes.	Difference Method (adjustment based on numeric count-model difference)
$\frac{Base\ Count}{Base\ Volume} > 1.5$	A large underestimation by the model in the base year may cause the ratio method to result in unreasonably high adjusted volumes.	Difference Method
$\frac{Base\ Volume}{Base\ Count} > 1.5$	A large overestimation by the model in the base year may cause the ratio method to result in unreasonably low adjusted volumes.	Difference Method
All Other Cases	The average method is used by default for link volume adjustments. The difference method is used only in cases where the model exhibits high levels of variation or growth.	Average Method (adjustment using average of difference and percent difference)

Source: NCHRP 255: Highway Traffic Data for Urbanized Area Project Planning and Design

Model Results

Year 2040 No Build

The year 2040 No Build daily forecasts are shown in Figure 1 in the appendix. The average percent volume growth on study area highways between 2018 and 2040 is 22 percent. Roadway segments with the highest growth are TH 252 between 73rd Avenue and Brookdale Drive, increasing from 53,000 to 123,300 and on TH 610 between TH 252 and TH 47, increasing from 102,000 to 124,600. The total volume crossing the Mississippi River on the three bridges in the study area (TH 101, US 169, and TH 610) is expected to increase from 205,000 to 246,500, representing 20% growth. The river crossing with the highest growth in TH 610, with an increase of 22,600 vehicles per day (vpd).

Year 2040 Concept Scenarios

Year 2040 Concept 1

Concept 1 incorporated the following improvements into the year 2040 highway network.

- TH 10 lane addition between Round Lake Blvd and Hanson Blvd
- TH 10 grade separation improvements between TH 101 and Armstrong Blvd
- Diverging diamond conversion of TH 101 / I-94 interchange

Daily traffic forecasts for Concept 1 are provided in Figure 4.1 in the appendix. These results show small increases in traffic are attracted to the corridors where improvements are located. Specifically, TH 10 has increases of 400 and 500 vpd associated with the improvements in Coon Rapids and Elk River, respectively. Similarly, an increase of 500 vpd is expected on TH 101 near the I-94 interchange. While these changes show minor increases in traffic are attracted to these facilities, these do not represent major shifts in regional travel patterns.

Year 2040 Concept 2

Concept 2 incorporated the following improvements into the year 2040 highway network.

- TH 10 lane addition between Round Lake Blvd and Hanson Blvd
- TH 10 at-grade improvements between TH 101 and Armstrong Blvd
- TH 101 southbound to eastbound I-94 flyover and interchange improvements
- TH 610 mobility improvement between US 169 and TH 252

Daily traffic forecasts for Concept 2 are provided in Figure 4.2 in the appendix. These results show small increases in traffic are attracted to the corridors where improvements are located. Specifically, TH 10 has increases of 400 and 500 vpd associated with the improvements in Coon Rapids and Elk River, respectively. Similarly, an increase of 700 vpd is expected on TH 101 near the I-94 interchange. A daily traffic increase of 12,700 vpd is expected on the improved section of TH 610, reflecting traffic that would be expected to shift to this highway from parallel local roads.

Year 2040 Concept 3

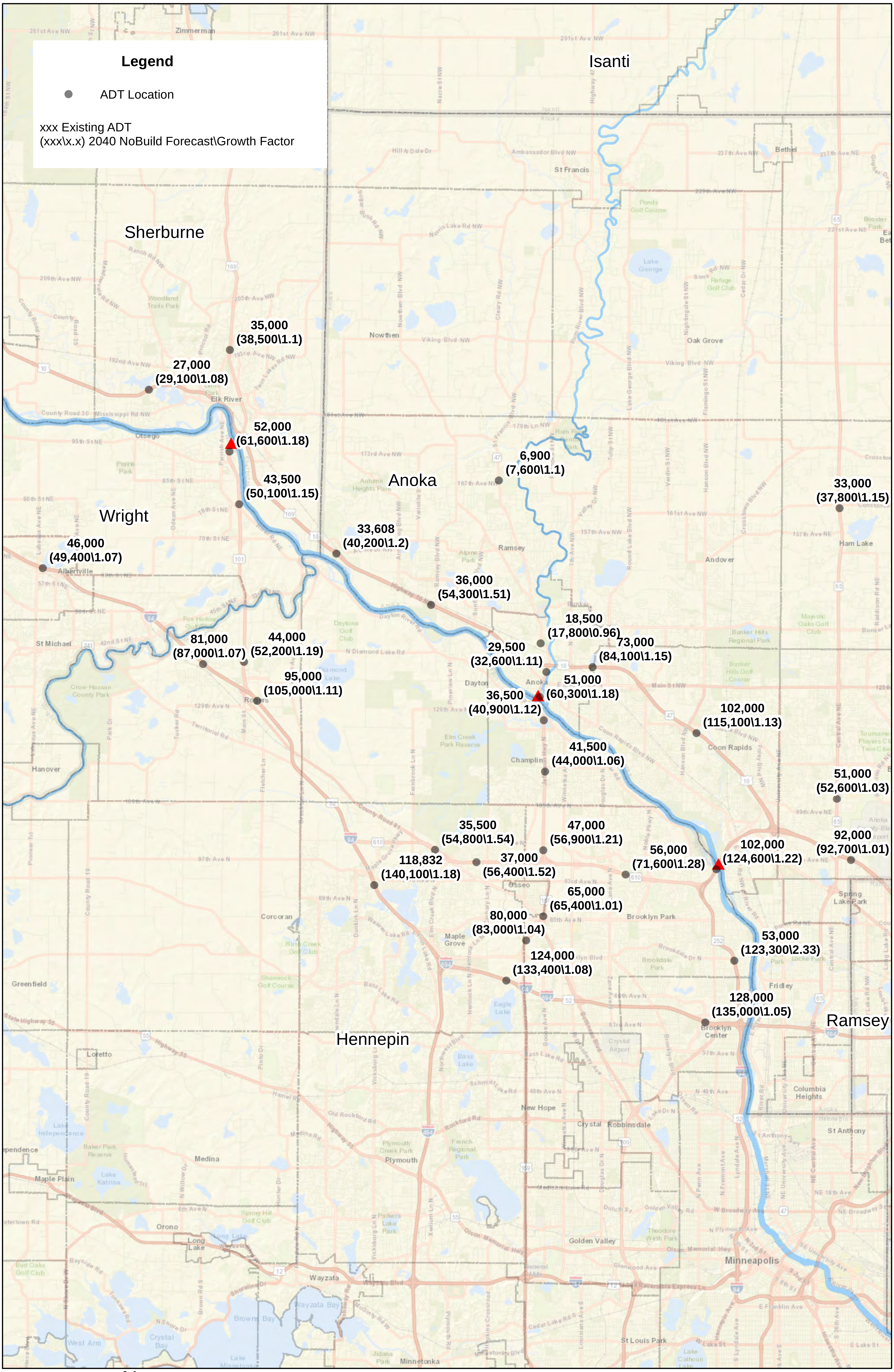
Concept 3 introduces a new Mississippi River crossing in between TH 101 and US 169. This new facility was assumed to connect to the south leg of the existing Armstrong Boulevard/TH 10 interchange north of the river and connect to the north leg of the Dayton Parkway/I-94 interchange south of the river. The new facility was assumed to be a four-lane divided arterial roadway with a speed limit of 45 miles per hour (mph).

The daily forecasts for Concept 3 are provided in Figure 4.3 in the appendix. The number of vehicles expected to use the new river bridge over the Mississippi River in 2040 is 24,200 vpd. This reflects shifts of 7,900 vpd off of the TH 101 bridge and 10,300 vpd off of the US 169 bridge. The shift of traffic from US 169 to the new river crossing approximately offsets the anticipated growth on this facility between 2018 and 2040 no build conditions, resulting in a 2040 forecast that is comparable to existing traffic volumes.

Year 2040 Concept 4

Concept 4 also include a new Mississippi River crossing in between TH 101 and US 169 similar to Concept 3. The alignment of the new river crossing connection was consistent with Concept 3, but the facility type was assumed to be a four-lane expressway with a speed limit of 55 miles per hour (mph) and a higher capacity.

The daily forecasts for Concept 4 are provided in Figure 4.4 in the appendix. The number of vehicles expected to use the new river bridge over the Mississippi River in 2040 is 27,600 vpd. This reflects shifts of 8,300 vpd off of the TH 101 bridge and 12,000 vpd off of the US 169 bridge. Since the expressway design in Concept 4 attracts more traffic compared to the arterial design in Concept 3, the traffic shifts from adjacent river crossings are slightly larger.



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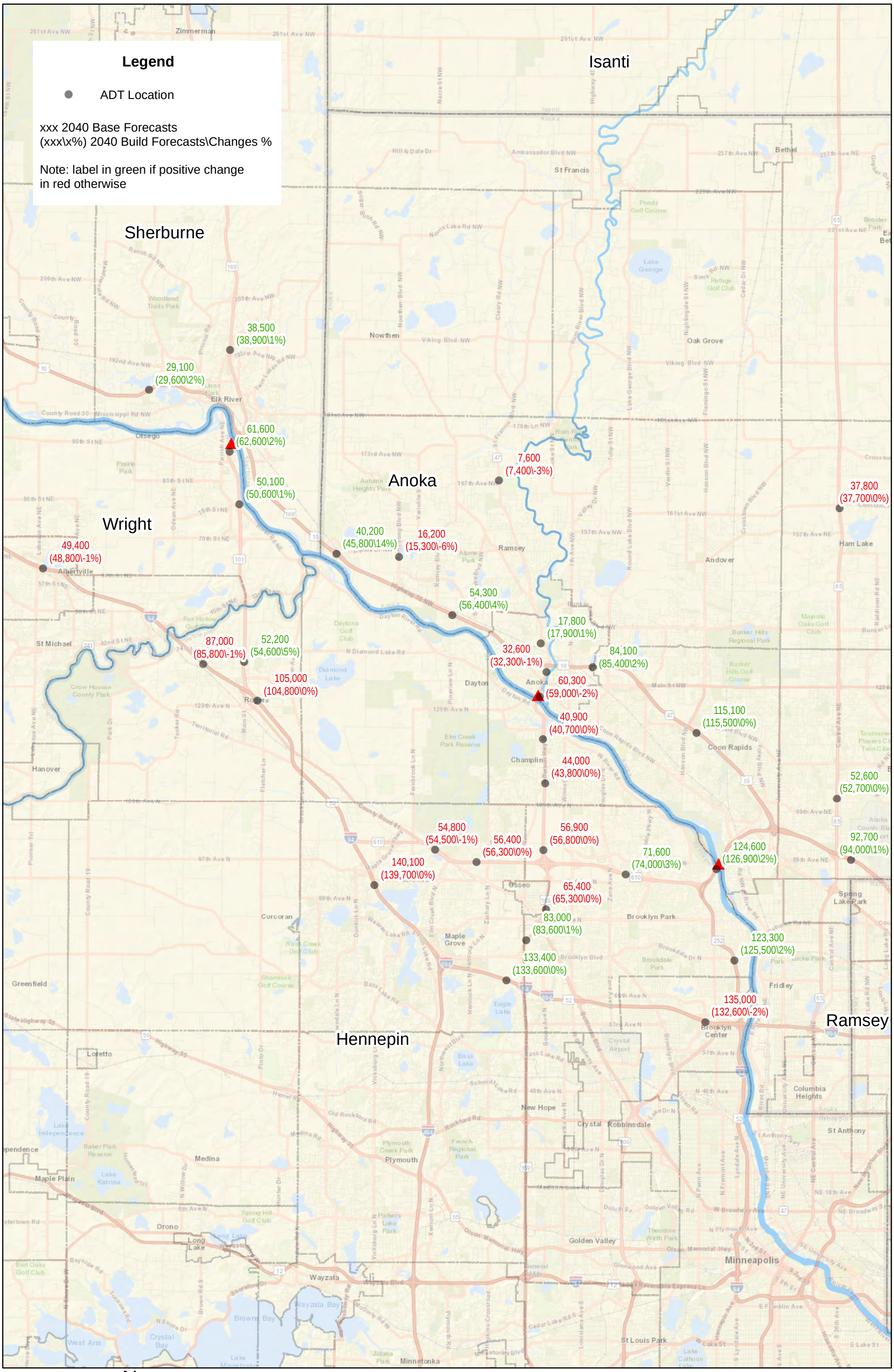
Author: HXiao

Date: 1/26/2021

Existing and 2040 Forecasted Daily Traffic Volumes

Figure 1

Northwest Metro Mississippi River Crossing Feasibility Analysis
MnDOT Metro, Minnesota



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Author: HXiao

Date: 3/9/2021

2040 NoBuild and Build Concept1 Forecasted Daily Traffic Volumes
(Concept 1: TH 101 & TH 10 Improvements)

Figure 4.1

Northwest Metro Mississippi River Crossing Feasibility Analysis
MnDOT Metro, Minnesota

Author: HXiao

Date: 3/9/2021

2040 NoBuild and Build Concept2 Forecasted Daily Traffic Volumes
(Concept 2: TH 101 & TH 10 & TH 610 Improvements)

Figure 4.2

Northwest Metro Mississippi River Crossing Feasibility Analysis
MnDOT Metro, Minnesota

N

Author: HXiao

Date: 6/9/2021

2040 NoBuild and Build Concept3 Forecasted Daily Traffic Volumes
(Concept 3: New 4-Lane Arterial River Crossing)

Figure 4.3

Northwest Metro Mississippi River Crossing Feasibility Analysis
MnDOT Metro, Minnesota

Legend

ADT Location

New Roadways

xxx 2040 Base Forecasts
(xxx\x%) 2040 Build Forecasts\Changes %

Note: label in green if positive change
in red otherwise

Isanti
Sherburne
Anoka
Wright
Hennepin
Ramsey

38,500
(38,500\0%)
29,100
(29,400\1%)
61,600
(53,300\-13%)
50,100
(42,700\-15%)
49,400
(49,900\1%)
40,200
(38,100\-5%)
16,200
(19,200\19%)
7,600
(7,900\4%)
37,800
(37,200\-2%)
0
(27,600\100%)
54,300
(58,200\7%)
17,800
(17,000\-4%)
87,000
(88,500\2%)
0
(15,100\100%)
84,100
(86,300\3%)
52,200
(49,600\-5%)
105,000
(102,400\-2%)
60,300
(48,300\-20%)
32,600
(29,500\-10%)
0
(16,600\100%)
40,900
(38,000\-7%)
115,100
(113,100\-2%)
44,000
(41,600\-5%)
52,600
(51,900\-1%)
54,800
(52,600\-4%)
56,900
(54,400\-4%)
92,700
(94,200\2%)
140,100
(144,000\3%)
56,400
(53,500\-5%)
71,600
(70,100\-2%)
124,600
(120,400\-3%)
65,400
(65,400\0%)
83,000
(81,200\-2%)
123,300
(122,500\-1%)
133,400
(133,300\0%)
135,000
(134,000\-1%)

N

Author: HXiao

Date: 3/9/2021

2040 NoBuild and Build Concept4 Forecasted Daily Traffic Volumes
(Concept 4: New 4-Lane Expressway River Crossing)

Figure 4.4

Northwest Metro Mississippi River Crossing Feasibility Analysis
MnDOT Metro, Minnesota

Legend

ADT Location

xxx Existing ADT
(xxx\xxx) 2040 NoBuild\TC_S0 Daily Forecast
TC_S0: Assuming 20% TeleCommute Trips

Isanti
Sherburne
Wright
Anoka
Hennepin
Ramsey

35,000
(38,500\35,100)

27,000
(29,100\27,900)

52,000
(61,600\56,000)

43,500
(50,100\46,400)

6,900
(7,600\7,600)

33,000
(37,800\37,300)

33,608
(40,200\37,500)

8,100
(16,200\13,000)

46,000
(49,400\46,400)

36,000
(54,300\49,800)

18,500
(17,800\16,600)

81,000
(87,000\81,100)

44,000
(52,200\49,700)

29,500
(32,600\32,000)

73,000
(84,100\82,100)

95,000
(105,000\100,900)

51,000
(60,300\55,800)

102,000
(115,100\113,600)

36,500
(40,900\39,300)

41,500
(44,000\43,300)

51,000
(52,600\52,300)

35,500
(54,800\50,000)

47,000
(56,900\55,100)

92,000
(92,700\93,600)

118,832
(140,100\137,400)

37,000
(56,400\51,800)

56,000
(71,600\68,600)

102,000
(124,600\119,200)

65,000
(65,400\64,800)

80,000
(83,000\81,800)

53,000
(123,300\118,400)

124,000
(133,400\129,000)

128,000
(135,000\130,800)

Author: HXiao

Date: 6/9/2021

Existing and 2040 Forecasted Daily Traffic Volumes
(With/Without 20% TeleCommute Trips)

Figure 5.0

Northwest Metro Mississippi River Crossing Feasibility Analysis
MnDOT Metro, Minnesota

Legend

ADT Location

xxx\xxx 2040 NoBuild\TC_S0 Daily Forecast
(xxx\xxx) 2040 Concept 1\TC_S1 Daily Forecast
TC_S0\TC_S1: Assuming 20% TeleCommute Trips

Sherburne

Wright

Hennepin

Ramsey

Isanti

Anoka

38,500\35,100
(38,900\35,200)

29,100\27,900
(29,600\28,900)

61,600\56,000
(62,600\57,000)

50,100\46,400
(50,600\47,100)

49,400\46,400
(48,800\45,700)

40,200\37,500
(45,800\42,100)

16,200\13,000
(15,300\13,300)

87,000\81,100
(85,800\79,800)

52,200\49,700
(54,600\51,700)

105,000\100,900
(104,800\100,800)

54,300\49,800
(56,400\51,800)

32,600\32,000
(32,300\31,700)

17,800\16,600
(17,900\16,600)

84,100\82,100
(85,400\83,200)

60,300\55,800
(59,000\54,700)

40,900\39,300
(40,700\38,800)

44,000\43,300
(43,800\43,000)

54,800\50,000
(54,500\50,200)

56,900\55,100
(56,800\54,800)

140,100\137,400
(139,700\136,600)

56,400\51,800
(56,300\52,200)

65,400\64,800
(65,300\64,700)

83,000\81,800
(83,600\82,300)

133,400\129,000
(133,600\127,900)

7,600\7,600
(7,400\7,600)

37,800\37,300
(37,700\37,300)

115,100\113,600
(115,500\114,100)

52,600\52,300
(52,700\51,500)

92,700\93,600
(94,000\94,100)

71,600\68,600
(74,000\71,400)

124,600\119,200
(126,900\120,600)

123,300\118,400
(125,500\120,400)

135,000\130,800
(132,600\127,600)

Author: HXiao

Date: 6/9/2021

2040 NoBuild and Concept 1 Forecasted Daily Traffic Volumes
(With/Without 20% TeleCommute Trips)

Figure 5.1

Northwest Metro Mississippi River Crossing Feasibility Analysis
MnDOT Metro, Minnesota

Legend

ADT Location

xxx\xxx 2040 NoBuild\TC_S0 Daily Forecast
(xxx\xxx) 2040 Concept 2\TC_S2 Daily Forecast
TC_S0\TC_S2: Assuming 20% TeleCommute Trips

Isanti
Sherburne
Wright
Anoka
Ramsey
Hennepin

38,500\35,100
(38,900\35,300)
29,100\27,900
(29,600\28,800)
61,600\56,000
(62,700\56,800)
50,100\46,400
(50,800\47,000)
49,400\46,400
(48,900\45,700)
40,200\37,500
(45,500\41,600)
16,200\13,000
(15,300\13,200)
87,000\81,100
(85,900\80,000)
52,200\49,700
(54,800\51,900)
105,000\100,900
(105,300\101,200)
54,300\49,800
(56,200\51,400)
7,600\7,600
(7,500\7,500)
17,800\16,600
(17,900\16,600)
32,600\32,000
(32,200\31,000)
84,100\82,100
(85,000\82,700)
60,300\55,800
(58,400\54,000)
40,900\39,300
(40,500\38,500)
44,000\43,300
(43,800\42,600)
115,100\113,600
(115,400\114,100)
37,800\37,300
(37,800\37,200)
52,600\52,300
(52,200\51,700)
54,800\50,000
(56,000\52,000)
56,900\55,100
(57,100\54,500)
140,100\137,400
(139,500\136,100)
56,400\51,800
(57,900\54,100)
71,600\68,600
(84,300\80,500)
92,700\93,600
(94,600\95,900)
124,600\119,200
(129,000\124,600)
65,400\64,800
(65,300\64,500)
83,000\81,800
(84,000\83,600)
123,300\118,400
(126,800\120,900)
133,400\129,000
(133,600\128,700)
135,000\130,800
(130,900\125,800)

N

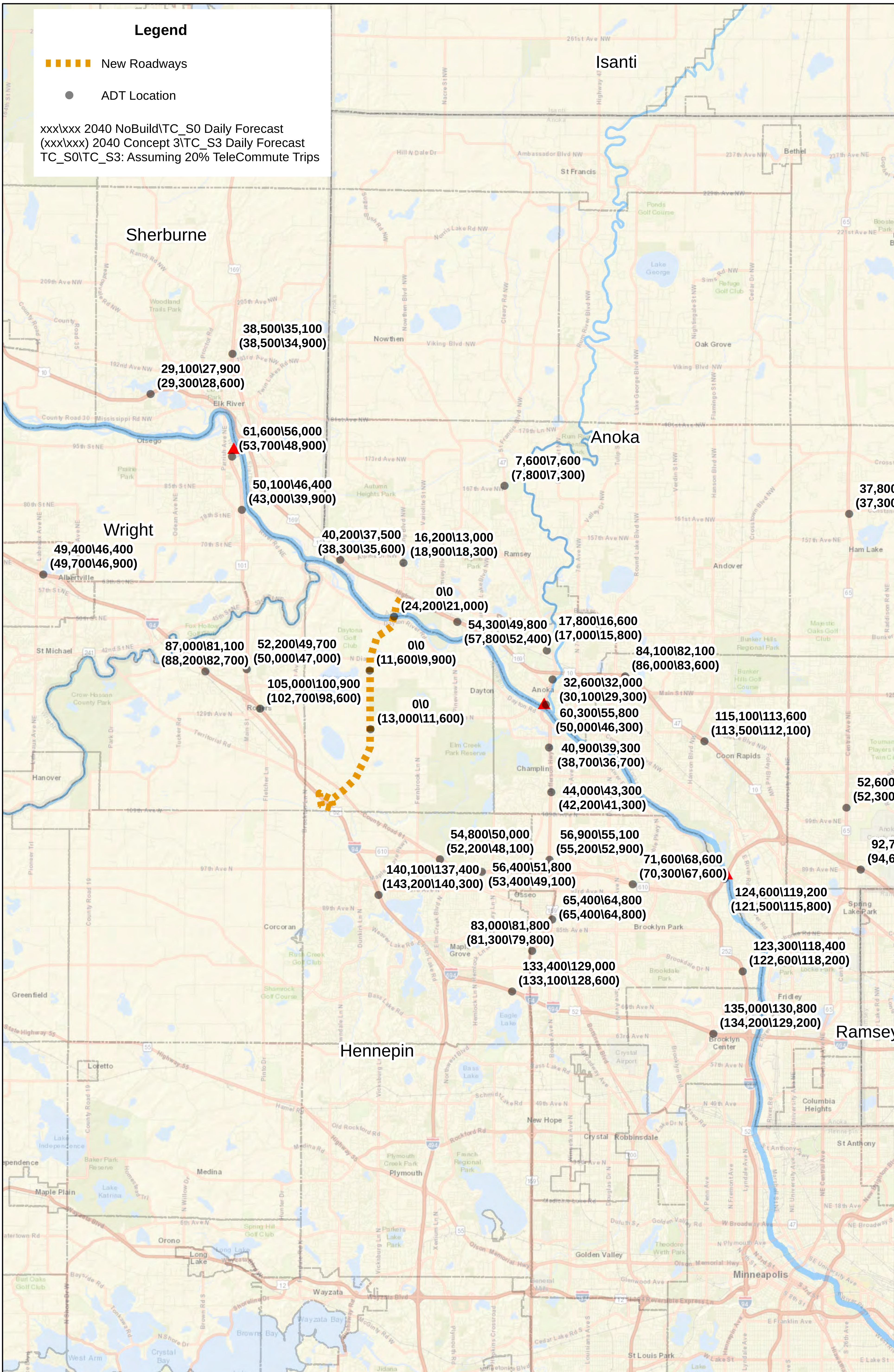
Author: HXiao

Date: 6/9/2021

2040 NoBuild and Concept 2 Forecasted Daily Traffic Volumes
(With/Without 20% TeleCommute Trips)

Figure 5.2

Northwest Metro Mississippi River Crossing Feasibility Analysis
MnDOT Metro, Minnesota


Legend
New Roadways
ADT Location
xxx\xxx 2040 NoBuild\TC_S0 Daily Forecast
(xxx\xxx) 2040 Concept 3\TC_S3 Daily Forecast
TC_S0\TC_S3: Assuming 20% TeleCommute Trips
Isanti
Sherburne
Anoka
Wright
Hennepin
Ramsey
38,500\35,100
(38,500\34,900)
29,100\27,900
(29,300\28,600)
61,600\56,000
(53,700\48,900)
50,100\46,400
(43,000\39,900)
7,600\7,600
(7,800\7,300)
37,800\
(37,300\
49,400\46,400
(49,700\46,900)
40,200\37,500
(38,300\35,600)
16,200\13,000
(18,900\18,300)
0\0
(24,200\21,000)
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(57,800\52,400)
17,800\16,600
(17,000\15,800)
87,000\81,100
(88,200\82,700)
52,200\49,700
(50,000\47,000)
0\0
(11,600\9,900)
84,100\82,100
(86,000\83,600)
105,000\100,900
(102,700\98,600)
32,600\32,000
(30,100\29,300)
0\0
(13,000\11,600)
60,300\55,800
(50,000\46,300)
115,100\113,600
(113,500\112,100)
40,900\39,300
(38,700\36,700)
44,000\43,300
(42,200\41,300)
52,600\
(52,300\
54,800\50,000
(52,200\48,100)
56,900\55,100
(55,200\52,900)
92,70
(94,60
71,600\68,600
(70,300\67,600)
140,100\137,400
(143,200\140,300)
56,400\51,800
(53,400\49,100)
124,600\119,200
(121,500\115,800)
65,400\64,800
(65,400\64,800)
83,000\81,800
(81,300\79,800)
123,300\118,400
(122,600\118,200)
133,400\129,000
(133,100\128,600)
135,000\130,800
(134,200\129,200)
Elk River
Otsego
St Francis
Bethel
Oak Grove
Nowthen
Ramsey
Andover
Ham Lake
Albertville
St Michael
Rogers
Dayton
Anoka
Champlin
Coon Rapids
Hanover
Corcoran
Maple Grove
Osseo
Brooklyn Park
Fridley
Brooklyn Center
Greenfield
Loretto
Medina
Maple Plain
Orono
Long Lake
Wayzata
Plymouth
New Hope
Crystal
Robbinsdale
Columbia Heights
St Anthony
Golden Valley
Minneapolis
St Louis Park
Minnetonka

N

Author: HXiao

Date: 6/9/2021

2040 NoBuild and Concept 3 Forecasted Daily Traffic Volumes
(With/Without 20% TeleCommute Trips)

Northwest Metro Mississippi River Crossing Feasibility Analysis
MnDOT Metro, Minnesota

Figure 5.3