



MEMORANDUM

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DATE: October 27, 2000

SUBJECT: I-494 RECONSTRUCTION FINAL EIS TRAFFIC FORECASTS METHODOLOGY AND RESULTS

This memorandum describes the travel forecasting process used for the Final Environmental Impact Statement (FEIS) for I-494 and the resulting forecast volumes. Level of service analyses for freeway operations and intersections for this project are included under separate memoranda.

This memorandum includes the following:

1. A description of the regional travel forecast modeling process
2. Corridor-specific assumptions and changes to the modeling process
3. Results of model validation for the I-494 corridor
4. Travel forecasting results to be used in the Final EIS

The boundaries of the I-494 Final EIS are from I-394 to the Minnesota River. However, model refinements were also made in the Plymouth and Maple Grove areas to provide a better model validation and forecast for I-494 in the I-94 to I-394 segment.

TRAVEL FORECASTING PROCESS

The travel forecasts were prepared using the Twin Cities regional travel forecasting model, modified to improve responsiveness to issues relating to the specific study. The model includes a series of computerized procedures for systematically predicting travel demand changes in response to development and transportation facility changes.

The model, used primarily for major project planning efforts, is calibrated and validated at a level of accuracy sufficient for planning regional facilities such as freeways and major arterials. This provides sufficient accuracy for most regional and corridor-level planning. The Metropolitan Council and Mn/DOT completed the current model in 1994 using data from an extensive regional Travel Behavior Inventory (TBI) conducted in 1990.

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The eight main components of the travel forecasting process are shown in Figure 1 and described below. Detailed discussion of assumptions specific to the I-494 EIS are described in a subsequent section.

Highway Network Representation

All of the freeways, expressways, and major arterial roadways in the Twin Cities area are compiled into a computer representation of the region's highway system. In addition, most minor arterials and many collector roads and other local streets are included. The attributes of the roadways are described in terms of area type, facility type, distance, free-flow speed, number of lanes and capacity.

Additional roadways in and near I-494 area were added to the regional model to better estimate the effects of different roadway design considerations. Specific future-year highway improvements assumed for forecasting purposes are discussed in a subsequent section of this report.

Transit Network Representation

All regional transit routes are included in a computer representation of the transit system. The transit network looks at the transit system in terms of links (which represent the highway system) and lines (which define a transit route's frequency and path). Data in the transit network include link speed, link distance, route frequency and route type.

These forecasts assume completion of the Hiawatha Corridor light rail transit line from downtown Minneapolis to the Mall of America.

Zonal Socio-Economic and Demographic Data

The regional travel forecast models divide the seven county Twin Cities Metropolitan area into 1,165 geographic transportation analysis zones (or TAZ). Various demographic and socio-economic data are allocated into these zones for the purposes of the forecast models. The zones also serve as the beginning and end locations of travel in the region. In addition to the 1,165 zones, the 35 most important points of entry into the region are identified and included as "external" zones. The zonal system was determined primarily on the basis of physical boundaries and major roadways.

For the purpose of this study, TAZs near I-494 were split into an additional 200 TAZs so that more refined trip estimation and traffic impact analysis could be conducted. Figure 2 shows the location of the TAZ boundaries in the study area. Refinements were based on the Hennepin County travel forecasting model with additional detail in the Mall of America and Minneapolis-St. Paul (MSP) International airport area.

Figure 1 8 1/2 x 11
Travel Forecasting Process

The Metropolitan Council's demographic database dated May 2000 was used as the source of zonal-level information. This database includes socio-economic data provided by cities in the I-494 corridor, reflecting their planned development through year 2020. The base assumes implementation of the 1996 *Regional Blueprint* of the Metropolitan Council. Communities are in the process of refining their comprehensive plans based on the policy direction of the *Blueprint*.

The distribution of activity to the more refined zone level was accomplished mainly using the distributions assumed in the Hennepin County travel forecast model. Zone-level growth from 2020 to the design year of 2022 was done on a pro-rating of growth from current levels. Demographic assumptions are summarized in a subsequent section of this memorandum and detailed in the Appendix.

Trip Generation

Trip generation is the process by which the number of trips attributed to a zone are estimated based on the amount and type of activity in that zone. Trips are either "produced" by or "attracted" to a zone, depending on the type of trips. The end result of trip generation estimation is a total number of trips produced by and attracted to each zone. The trips at this point are called "person-trips," and do not have any association with a given mode of travel.

The determinants of household trip production are household size, the number of automobiles owned and location. Several factors contribute to trip attractions, depending on the trip purpose. The main variables are retail employment, non-retail employment, amount of activity within a given proximity and area type.

The trip generation phase of the forecasting process uses trip rates (i.e., number of trips per person, household or employee) based on the 1990 regional TBI applied to each zone to calculate the number of trips taken, by purpose. This study uses the regional trip generation model. The regional model was augmented with site-specific trip generation information from environmental studies currently underway including the Mall of America expansion EIS (5.6 million additional square feet at the Mall of America plus additional development in the Airport South area), the Norman Pointe EAW and the Best Buy campus EIS during the traffic operations analysis process.

Trip Distribution

The trip distribution process converts the person-trips estimated in the generation step to movements between pairs of zones based on the amount of travel activity in a zone and the generalized travel time proximity of the producing zone to other zones. The resulting trip tables provide the number of trips between zones.

Figure 2 **11 x 17**

Most standard models consider only highway time in the distribution function. The non-work models in the Twin Cities are based on this method. However, the work trip distribution models in the Twin Cities region employ a composite impedance function, which treats distribution based on overall time and cost, including that of alternate modes. Trips beginning or ending outside of the Twin Cities area are modeled using a growth-rate model based on TBI trip distribution patterns.

This analysis did not use any changes to the regional modeling process for trip distribution.

Mode Choice

The mode choice phase of forecasting uses mode choice models to identify the number of person-trips between each pair of zones and determine whether the trips are made by single-occupant vehicles, carpools, or transit riders. The models are further used to determine whether the trip is a candidate for a high occupancy vehicle (HOV) lane.

This study did not make any changes to the regional modeling process for mode choice. However, the HOV component of the mode choice model served as a basis for estimating the number of new HOV users.

Time of Day Estimation (Temporal Distribution)

Time-of-day, or “temporal distribution” models, take the estimated trips and distribute them across periods of time for the purposes of more accurately reflecting peaking conditions on roadway and transit systems. The basis for the temporal distribution is the 1990 regional TBI. The time periods considered are:

1. A.M. peak hour
2. A.M. peak shoulders
3. First P.M. peak hour
4. Second P.M. peak hour [generally used for operations analysis]
5. P.M. peak shoulders
6. Off peak time periods

Differentiation among peak hours enables better estimates of congested conditions on an hourly basis.

This analysis did not make any changes to the regional modeling process for mode choice. However, refinements were made to the forecast peak hour traffic volumes on specific roadway segments if warranted by traffic counts.

Highway and Transit Assignment

The trip assignment models choose the route between zones for any given trip. The highway assignment process chooses routes based on travel times that reflect the appropriate traffic volume, roadway capacity and speed relationship. It is an equilibrium model, which uses multiple iterations to balance demand with capacity. The regional model uses the TRANPLAN travel forecasting software. This study used the TP-PLUS software package, which is an updated version of TRANPLAN but uses the same mathematical model of assignment. Tests indicate that the models produce nearly identical results with an average difference of 0.2 per link (calculated using the root mean square error method) and a correlation coefficient of 0.985.

The assignment model will permit a demand in excess of the model-designated capacity. The regional model in the Twin Cities area is generally defined at Level of Service D, therefore assignment of additional demand indicates Level of Service E or F. The default congestion functions in the model are link-based, meaning the effect of intersection and ramp-meter queues are not fully accounted for in the base modeling process. In addition, these types of models cannot show the queuing effects of traffic bottlenecks on freeways.

The regional modeling process was modified in two areas: capacity estimates and ramp meter modeling. The differences are shown in Table 1. The basic regional model assumes a per-lane capacity of 1950 vehicles on a metered freeway, but allows traffic assignments in excess of capacity. MnDOT Traffic Management Center data indicates capacity varies widely depending on the number and type of lanes on a facility. For the purpose of this analysis, it was assumed that through lanes have average capacities of 2200 vehicles per through lane. In addition, auxiliary lanes are used primarily for merge-diverge movements to or from freeway interchanges and do not realistically support full-lane capacities. For the purposes of this analysis the capacity of auxiliary lanes less than one mile long was assumed at 1400 vehicles per hour. These values are comparable to the assumptions used in the freeway operations modeling (exact replication could not be accomplished without compromising the validation of the regional forecast model). The volume-delay functions used in the model were modified to reflect the additional capacity without significantly changing the amount of calculated delay by creating a new assignment class for the freeways coded with the alternate capacities.

Ramp metering is an important characteristic of the regional freeway system in the Twin Cities. Unfortunately, the capabilities do not exist within the current regional forecast model to fully reflect ramp metering. Monte Carlo simulations of varying ramp meter rates and traffic volumes were used to develop a simplified method of incorporating some ramp metering delay. A resulting linear relationship of $(T_i = \max(0, 0.497 * (V_i / \text{rate}_j) - 31.1))$ permits calculation of a ramp time (T_i) for a given model iteration (i) based on a modeled volume (V_i) and metering rate (rate_j) for a given ramp (j). While this simplifies the true nature of ramp metering, it provided a reasonable introduction of ramp metering into the modeling process, which is important for calculating the benefits of HOV bypasses and lanes as well as increased metering rates due to additional capacity. The analysis assumed that the ramp metering rate would be increased under the Build alternatives in proportion to the increase in capacity.

Transit assignment was not conducted for this study. However, HOV lane traffic assignment is performed as part of the highway assignment process for the purpose of comparing the general benefits and costs of general purpose versus HOV lane designation.

**TABLE 1
 MODIFICATIONS TO REGIONAL MODELING HIGHWAY ASSIGNMENT**

Facility Type	Hourly Capacity		Speed	
	Regional Model	I-494 Forecasts	Regional Model	I-494 Forecasts
Metered Freeway Capacity	1950 vehicles per lane	2200 vehicles per lane (through) 1400 vehicles (auxiliary)	53-55 MPH	60 MPH
Metered Ramp Capacity	625 vehicles per hour	Based on metering rate (build alternative metering rates assumed to increase in proportion to new mainline capacity.	25 MPH, congestion based on BPR curve	2-10 minutes delay, based on linear function (T= max(0,0.497*(V/rate)-31.1))

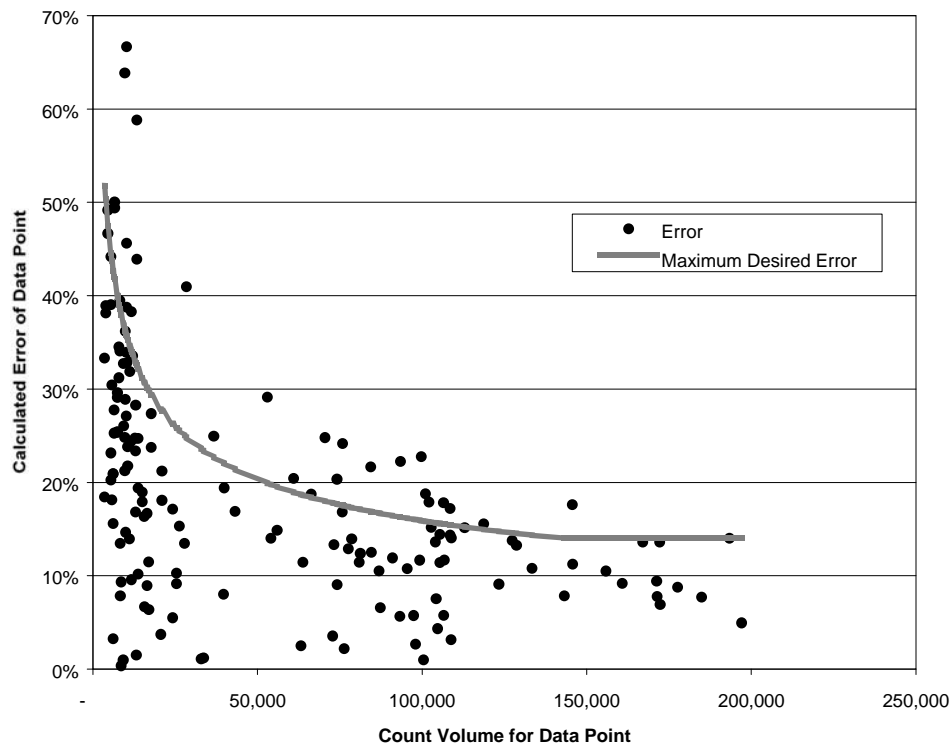
Model Validation

An important measure of the usefulness of the regional modeling process is how well it replicates existing conditions. Existing traffic counts in the I-494 study area were compared to model output. Daily traffic counts were from a variety of sources, including data from the 1998 Mn/DOT traffic flow maps (the most recent available), the April, 2000 MnDOT Loop Detector Report (October 1999 ramp and freeway volumes), the 1999 Hennepin County traffic flow map, and traffic counts collected for the purpose of this study.

Figure 3 shows the results of the calibration.. Eighty percent of the 160 data points (roadway segments) had an error less than the maximum desirable error for a given ADT volume. This exceeds the recommended 75 percent threshold (*Model Validation and Reasonableness Checking Manual*, Federal Highway Administration, 1997) and therefore shows reasonable validation. The average error for a freeway link was 13.4 percent and the average error for arterial and collector roadways was 27.7 percent, calculated using the RMSE (root mean square error) method.

The forecast model results, plus information regarding the fit of the model for any datapoint, was used to determine the link-specific forecast volumes.

Figure 3
I-494 Model Validation



ALTERNATIVES CONSIDERED

I-494 Design Alternatives

Forecasts were prepared for three I-494 alternatives:

- No Build
- Build – Managed HOV (Final EIS Preferred Alternative)
- Build – HOV

The number of lanes and interchange locations assumed along I-494 are shown in Figure 4. The **No Build** alternative represents the existing condition on I-494 in terms of the number of lanes and the location of freeway access. For the purposes of this study, this alternative assumes only two through lanes (existing) on I-494 from TH 100 to TH 212 even though additional lanes are included in the current State Transportation Improvement Program for the year 2002.

The **Managed HOV** can be generally described as an additional through lane from I-394 to 34th Avenue South, the addition of one or more auxiliary lanes in selected locations, and the addition of HOV ramp-meter bypasses where none currently exist. Transit enhancements would be included along the corridor including bus use of shoulders. Under this alternative interchange access would be changed in the following locations:

- 12th Avenue South: close interchange
- Portland Avenue South; add east ramps (EB, WB)
- Nicollet Avenue: close interchange
- Nicollet Avenue: west ramp movements moved to I-35W CD road system
- Penn Avenue: east ramp movements moved to CD road system
- East Bush Lake Road: add EB exit ramp and WB

Directional interchange movements would be added at I-35W (NB to WB and SB to EB), TH 77 (SB to EB) and TH 100 (NB to WB and SB to EB).

The **HOV** alternative is identical to the Managed HOV alternative except that one mixed-use lane (assumed as the inside lane) would be replaced by an HOV lane. The lane is assumed to be open to carpools of two or more persons, and would operate during both a.m. and p.m. peak periods in both directions.

Figure 4 shows the conceptual existing and future lane and interchange configuration on I-494.

Other Assumed Regional System Improvements

The forecasts for all alternatives assumes the improvements currently being considered for the draft MnDOT Metro Transportation Systems Plan and Metropolitan Council *Transportation Development Guide/Policy Plan*. These plans are expected to be adopted later in the year 2000. The assumptions most critical to the I-494 corridor are listed in Table 2.

**TABLE 2
 MAJOR REGIONAL ROADWAY IMPROVEMENTS ASSUMED IN I-494 FEIS**

Roadway	Description
TH 610	Constructed from I-94 to TH 169 as a four-lane freeway (under construction from TH 169 to TH 252)
I-94	Additional through lane in each direction from Weaver Lake Road to CSAH 152 plus auxiliary lanes from TH 169 to Weaver Lake Road; includes modification of I-494/I-94 interchange.
I-35W	Extension of HOV from I-494 to 46 th Avenue South and reconstruction of TH 62 interchange (under construction).
Various Freeways	Installation of ramp meters on all remaining freeways in the region
TH 212	Construction of new TH 212 from TH 5 to Chaska (under construction from I-494 to CSAH 4)
I-494	Construction of new Mississippi River crossing and TH 61 interchange area

The forecasts do not assume the upgrade of TH 169 to a freeway from the Minnesota River to I-494, since it is not currently included in the regional plans for implementation by the year 2025.

Assumed Local Roadway System Improvements

In general, the regional travel forecast model includes all principal and minor arterials, and many collector roadways, but only some local roadways. It was therefore necessary to review the regional forecast model network to ensure that existing and planned critical non-arterial roadway segments were included in the I-494 Corridor forecast model. The transportation elements of local comprehensive plans were reviewed for the communities of Plymouth, Minnetonka, Eden Prairie, Bloomington, Edina and Richfield. Changes were made in both the existing and future year networks (all alternatives) as necessary.

Figure 4
Lane Configurations

The major improvements assumed for the local roadway system are listed in Table 3.

**TABLE 3
 SUMMARY OF LOCAL ROADWAY IMPROVEMENTS TO BE INCLUDED IN
 TRAFFIC FORECASTING AND OPERATIONAL ANALYSIS**

Roadway Improvement	Scheduled To Be Completed By:	Lead Agency
Longfellow Avenue	Reconstruct 2002	MAC
McCauley Trail/West	TH 169/Valley View Road 2002	Edina
78th Street frontage road connection	interchange to TH 169/I-494 interchange	
66th Street	Reconstruct Interchange 2003	MAC
77th Street	Complete to 24th 2003	Richfield
79th/80th Street	Reconstruct bridge at I-35W 2003	Bloomington
Lyndale Avenue	Reconstruct interchange 2003	Richfield
34th Avenue	Four-lane divided roadway plus LRT 2004	Mn/DOT
77th Street	Add north ramps on TH 77, close 2005 Diagonal Boulevard interchange on TH 77	Richfield
24th Avenue ITS Information Signs	I-494 to 86th Street 2006	Hennepin County/ Bloomington/ Mn/DOT
24th Avenue Operational Upgrade	I-494 to Lindau Lane (geometrics) 2006	Hennepin County/ Bloomington/Mn/DOT
24th Avenue/Lindau Lane	Modify Lindau Lane/TH 77 to 24th Avenue 2006	Bloomington
East 79th Street (TH 77 to 24th Avenue)	Reconstruct/realignment/ geometric improvements 2006	Bloomington
East Old Shakopee Road/28th Avenue	Signalize intersection, improve geometrics 2006	Bloomington
I-494/34th Avenue north side off-ramps	Provide up to five lanes at ramp, as needed (dual left-turn, two through, one right-turn lane) 2006	MAC/Mn/DOT
I-494/34th Avenue south-side off-ramps	Provide up to minimum of four lanes at ramp, as needed (dual left-turn, left/through shared lane, right-turn lane) 2006	Mn/DOT/Bloomington
Penn Avenue	Reconstruct interchange 2002	Richfield

DEVELOPMENT ASSUMPTIONS

The Metropolitan Council's 2020 regional forecast model data base was used as the basis for the travel forecasts. This database is maintained by the Metropolitan Council and reflects growth expectations of the Metropolitan Council as reflected by local comprehensive plans. The Council's data were revised to reflect proposed developments for which environmental review is underway:

- *Airport South* (Bloomington, south of I-494 and east of TH 77) which includes the 5.6 million square feet expansion of the Mall of America plus additional new development in that area. The assumed development reflected "Alternative 1 of the environmental impact statement for the Mall of America expansion.
- *Norman Pointe* (Bloomington, south of I-494 and west of Normandale Boulevard). The proposed development of this site is assumed at 1.3 million square feet of office space and 95,000 square feet of hotel, with an estimated 4,000 employees.
- *Best Buy Campus* (Richfield, north of I-494 and east of Penn Avenue). This redevelopment site would include 1.9 million square feet of office space plus 9,500 employees.
- *MSP International Airport Expansion* Implementation of the MSP master plan is assumed, including relocation. Growth in airport-related traffic in the forecast model is a function of passenger originations, which are estimated to increase by 65 percent from 2000 to 2022 based on the Metropolitan Airports Commission's "high-end" commercial operations forecast. In addition, year 2022 vehicle traffic to/from the MSP airport campus was reallocated based on the planned improvements to gate and parking facilities at the Lindbergh and Humphrey terminals. It is estimated that the current distribution of passenger-related traffic (parking plus curbside) is 75 percent Lindbergh Terminal and 25 percent HHH Terminal. The expansion of the HHH plus additional parking facilities near the HHH terminal (assumed at 10,000 spaces) is expected to change that split to 65 percent/35 percent. It has also been assumed that 20 percent of the traffic from the air cargo area would relocate to new facilities on the west side of the airport (near 66th Street and TH 77).

Table 4 shows the assumed population, household and employment levels of the communities in the corridor. Most of the residential land in the communities is already developed. Overall, the number of households is expected to increase from approximately 152,000 to 184,000 – an increase of 21 percent over 22 years. Excluding Plymouth and Maple Grove, which are north of I-394, an 11 percent increase in households is expected.

Commercial development in the corridor is expected to increase at a higher rate. The expected number of jobs (retail and non-retail) is expected to increase from approximately 320,000 to 413,000 – an increase of 30 percent. Excluding Plymouth and Maple Grove the increase is expected to be 24 percent.

**TABLE 4
 DEMOGRAPHIC ASSUMPTIONS FOR COMMUNITIES ALONG THE I-494 CORRIDOR**

	1999				2022			
	Population	Household	Retail Emp	Non-Retail Employment	Population	Household	Retail Emp	Nonret Emp
Maple Grove	47,974	16,103	3,041	12,134	74,850	29,700	5,054	26,347
Plymouth	61,339	22,986	5,769	42,141	64,942	29,227	9,465	54,019
Minnetonka	51,637	21,129	9,720	35,234	50,680	22,830	10,952	46,049
Eden Prairie	52,081	19,895	4,441	42,369	60,100	26,550	5,600	51,750
Edina	47,357	20,886	9,967	44,886	49,150	21,550	10,550	49,850
Richfield	35,566	15,505	4,616	6,189	37,704	17,370	4,818	7,963
Bloomington	88,464	35,759	20,411	78,910	91,670	37,110	25,719	105,271
Total	384,417	152,263	57,965	261,862	429,096	184,337	72,157	341,247

Source: Metropolitan Council, SRF Consulting Group, Inc./regional travel forecast model

ANALYSIS AND RESULTS

Trip Characteristics

The I-494 corridor study area (see Figure 5) lies within the urbanized portion of the Twin Cities area, and encompasses a substantial amount of both residential and commercial uses. Trips generated by land uses in the corridor are expected to increase from approximately 1.9 million trips per day in 1999 to 2.5 million trips by 2022, an increase of 28 percent. This is slightly higher than the expected regional growth as a whole of 26 percent. Approximately 43 percent of the trips (839,000 out of 1,941,000 trips) currently stay within the corridor, a percentage that is not expected to change by 2022. The corridor currently accounts for 1.9 million of the regional total of 7.4 million trips, or 26 percent; this percentage is expected to increase slightly by 2022.

TABLE 5
SUMMARY OF TRIP CHARACTERISTICS

	1999	2022	Growth
Trips generated within the corridor ⁽¹⁾	839,000	1,073,000	28%
<u>Trips from/to the corridor</u>	<u>1,102,000</u>	<u>1,414,000</u>	<u>28%</u>
Total corridor-related trips	1,941,000	2,487,000	28%
Trips outside the corridor	5,531,000	6,941,000	25%
Total Trips in Metro Area	7,472,000	9,428,000	26%

Source: SRF Consulting Group, Inc./regional travel forecast model

⁽¹⁾see Figure 4.

Congestion on I-494

Interstate-494 is currently one of the most congested corridors in the Twin Cities region. The congestion is expected to increase over the next 20 years as local and regional development continues. One measure of a congested facility is the duration of congestion. The travel forecast model, which estimates daily traffic as the sum of six discrete time periods, was used to assess the number of time periods over which congestion occurs currently and is expected to occur. While this method provides a reasonable overview of congestion levels, it must be remembered that the forecast congestion does not reflect additional congestion due to mainline queues that develop as a result of traffic bottlenecks. Separate technical memoranda have been prepared detailing traffic and freeway operations.

Figure 5 8 1/2 x 11
Forecast Model Corridor Definition

Table 6 shows that 74 percent of I-494 currently operates under congested conditions (i.e. level of service D or worse) for at least one hour of the day, with 43 percent operating at level of service E or F (slow-and-go/stop-and-go). Currently, 24 percent is operating at level of service D or worse for four or more hours of the day. Under the No Build alternative, 83 percent of the freeway will operate at level of service D or worse for at least one hour, but the duration of congestion and magnitude of the congestion would increase substantially compared to current conditions—52 percent of the freeway would be congested four or more hours per day and 65 percent would experience at least one hour of level of service E/F conditions. Fourteen percent of the roadway would operate at level of service D or worse for at least six hours per day.

Under the Managed HOV alternative, most of I-494 would still experience some congestion, with 78 percent expected to operate at level of service D for at least one hour. However, it can be seen in Table 6 that the duration of congestion falls substantially under the Managed HOV alternative, with only four percent of the roadway experiencing level of service D or worse for four hours of the day. None of the facility would operate at level of service E/F outside of a single peak hour.

**TABLE 6
PERCENT OF I-494 WITH CONGESTION⁽¹⁾**

	2022		
	Existing	No Build	Managed HOV
<u>Level of Service “D” or Worse</u>			
At least one hour per day	74%	83%	78%
At least two hours per day	73%	80%	38%
At least three hours per day	52%	74%	6%
At least four hours per day	24%	52%	4%
At least five hour per day	14%	32%	0%
At least six hours per day	5%	14%	0%
<u>Level of Service “E” or Worse</u>			
At least one hour per day	43%	65%	33%
At least two hours per day	39%	59%	0%
At least three hours per day	15%	40%	0%
At least four hours per day	5%	19%	0%
At least five hour per day	4%	7%	0%
At least six hours per day	0%	4%	0%

Source: SRF Consulting Group, Inc./regional travel forecast model

⁽¹⁾ Based on 36 directional miles of roadway, I-394 to Minnesota River

The current model-estimated peak hour average speeds are 40-42 miles per hour in the a.m. peak hour, and 36-38 miles per hour (mph) in the p.m. peak hour (Table 7). By 2022 these speeds will drop to 31 to 35 mph in the a.m. and 26-30 mph (p.m.). The Managed HOV Alternative will improve these speeds to approximately current levels. However, as noted above, the duration of

congestion will drop substantially, and the forecast model under-represents traffic queuing due to bottlenecks.

**TABLE 7
SPEED AND TRAVEL TIME COMPARISONS**

	1999 ⁽¹⁾	2022 2022 No build	2022 Managed HOV	% Difference (Managed-No Build)
<u>AM Peak average trip time along I-494 (minutes)</u>				
Eastbound: I-394 - Minnesota River	29	35	28	-22.2%
Westbound: Minnesota River – I-394	27	31	25	-19.7%
<u>AM Peak average trip speed along I-494 (mph)</u>				
Eastbound: I-394 - Minnesota River	40	32	41	28.5%
Westbound: Minnesota River – I-394	42	36	45	24.5%
<u>PM Peak average trip time along I-494 (minutes)</u>				
Eastbound: I-394 - Minnesota River	30	38	28	-25.0%
Westbound: Minnesota River – I-394	32	43	31	-27.3%
<u>PM Peak average trip speed along I-494 (mph)</u>				
Eastbound: I-394 - Minnesota River	38	30	40	33.4%
Westbound: Minnesota River – I-394	36	26	36	37.6%

⁽¹⁾Model-estimated trip time and trip speed

Source: SRF Consulting Group, Inc./regional travel forecast model

Figures 6 through 8 depict the relative level of congestion on freeways in the in the I-494 corridor area. In general, freeways in the area are currently operating at or above capacity, resulting in congestion. Performance levels will continue to worsen by the year 2022. Under the Managed HOV alternative congestion would still exist; however the number of hours where the facility would operate at level of service D or worse would decrease. Furthermore, some reduction of congestion on TH 62 would result from traffic diverting from TH 62 to the new capacity on I-494.

FIGURE 6 8 1/2-11
No Build LOS

FIGURE 7 8 1/2-11
Build LOS

FIGURE 8 8 1/2-11

Comparison of No Build and Managed HOV Corridor

The Build alternatives and the No Build alternative in the I-494 need to be compared at three different levels:

- (1) The differences between alternatives at a **regional** level
- (2) The differences between alternatives on the I-494 **facility** itself
- (3) The differences between alternatives in the I-494 **corridor**

The differences between alternatives can be considered in the context of changes in travel time (vehicle hours of travel) and travel distance (vehicle miles of travel). These two measures best reflect the time and cost benefits and disbenefits of alternatives.

The first level of analysis (regional), is included to ensure that all travel changes in the region are taken into account, including those diverting from other corridors into the I-494 corridor. Decreased congestion on I-494 provides sufficient benefit to long-distance trips that it affects travel patterns outside of the corridor. I-494 is part of the “beltway” of the Twin Cities area. The second level of analysis (corridor) is commonly used to assess the amount of traffic that would divert to or from a facility under different alternatives. For example, increases in freeway capacity may reduce the amount of medium-to-long distance traffic on parallel minor arterials or freeways. The final level of comparison (facility) is necessary for the purposes of facility design and localized impacts such as air quality and noise. On a currently congested roadway such as I-494 it can be expected that traffic levels will increase from a No-Build to a Build alternative as additional capacity is added.

Table 8 summarizes the changes in regional travel as measured by vehicle miles of travel (VMT) and vehicle hours of travel (VHT) between the Managed HOV and No Build alternatives. On a regional level, VMT does not change substantially between alternatives but VHT decreases by approximately 21,000 hours per day (a 1.1 percent reduction). This is an indicator that some travelers are replacing their trips with similar-length but less-congested alternatives (and/or that the traffic remaining on routes where traffic is diverted from experiences less congestion). Other travelers may take longer distance trips if it results in a travel time savings. Increased trip distances that result in time saved are reflected in higher VMT. On a facility level they appear to indicate induced traffic, since they give the appearance of more traffic; however, they only represent a change in the length of a trip, not the number of trips taken.

Under the Managed HOV alternative the I-494 corridor becomes more attractive due to its additional capacity and reduced congestion. Travel in the corridor *increases* by 200,000 VMT per day (1.9 percent) with 6,400 *fewer* hours of vehicle travel (a 2.2 percent reduction).

Traffic on I-494 itself is expected to increase by 14.1 percent (VMT) between the No Build and Managed HOV alternatives, with a 4.4 percent increase in vehicle hours of travel.

**TABLE 8
SUMMARY OF REGIONAL, CORRIDOR AND FREEWAY TRAVEL CHARACTERISTICS:
2022 NO BUILD AND MANAGED HOV ALTERNATIVES**

	2022			% Difference (Managed- No Build)
	1999	No Build	Managed HOV	
<u>Regional Travel</u>				
Daily Vehicle Hours Traveled (hours)	1,427,000	2,002,000	1,981,000	-1.1%
Daily Vehicle Miles Traveled (miles)	56,940,000	76,188,000	76,151,000	0.0%
<u>Travel in the I-494 corridor</u>				
Daily Vehicle Hours Traveled (hours)	215,400	276,400	270,200	-2.2%
Daily Vehicle Miles Traveled (miles)	8,736,800	10,706,300	10,906,200	1.9%
<u>Travel on I-494</u>				
Daily Vehicle Hours Traveled on I-494 (hours)	41,900	55,300	57,800	4.4%
Daily Vehicle Miles Traveled on I-494 (miles)	2,148,100	2,618,000	2,987,000	14.1%

Source: SRF Consulting Group, Inc./regional travel forecast model

Analysis of the users of I-494 reflect both the regional importance of I-494 as well as its role as a “beltway” in the regional highway system. As shown in Table 9, an estimated 608,000 vehicle trips per day would use a portion of I-494 in the year 2022 under the Managed HOV alternative, or 7 percent of all trips made in the region. Of those trips, 80 percent are trips that would be greater than three miles in length (total trip length). In the peak hour, 88 percent of trips on I-494 would be greater than three miles in length, a reflection of the ability of the ramp metering system to discourage local trips on the regional highway system.

A total of 2,987,000 VMT are forecast to occur on I-494 over the course of its 18 miles. This translates to an average trip of 4.9 miles on I-494 for each user. I-494 is a beltway roadway, and the 18-mile segment has interchanges with other principal arterials every three miles on average—it is therefore logical to expect that a substantial amount of trips would have a short duration on I-494. However, the average total trip length of I-494 users is 17.2 miles, which is over twice the forecast regional trip length of 8.1 miles. Approximately 28 percent of the trip of a vehicle that uses I-494 would occur on the I-494 facility itself.

**TABLE 9
FORECAST TRIP CHARACTERISTICS OF I-494 USERS ⁽¹⁾**

Total Regional Vehicle Trips	9,425,000
Vehicle Trips Using I-494	608,500
<i>Percent of trips that use I-494</i>	<i>7%</i>
I-494 trips greater than 3 miles in length	484,930
<i>Percent</i>	<i>80%</i>
Total Daily Regional VMT	76,042,000
Daily VMT on 494	2,987,000
<i>Percent of VMT that is on I-494</i>	<i>14%</i>
<i>Average Trip Length on I-494 (miles)</i>	<i>4.90</i>
Total-Trip VMT of I-494 Users	10,488,300
<i>Average trip length (miles)</i>	<i>17.2</i>
<i>Percent of trip that is on I-494</i>	<i>28%</i>

Source: SRF Consulting Group, Inc./regional travel forecast model

⁽¹⁾ Based on Year 2022 Managed HOV alternative

Comparison of Managed HOV Corridor and HOV Corridor

Forecasts of the impacts of an HOV lane alternative were generated by assuming the inside lane of the Managed HOV alternative would be replaced with an HOV-only lane during the peak periods. The assumption was made to provide the HOV lane in both directions during both peak periods.

Table 10 shows the effect of the HOV lane alternative on choice of modes: time savings provided by the HOV lane generates 325 additional carpools (relative to the No Build alternative) compared to 100 new carpools for the No Build alternative. This represents a small reduction relative to the estimated 160,000 work-trip vehicle-trips that use I-494. The primary reasons for the low level of carpool formation are:

- As noted above, the average trip on I-494 is for only 4.9 miles, which is not long enough to generate substantial travel time savings considering the need to weave to and from the HOV lane.
- The primary market for I-494 work trips is suburb-to-suburb travel, which does not have high levels of either the residential or employment density.
- The suburban work-trip market is not subject to parking costs that provide further incentives for carpool formation.

TABLE 10

I-494 USER HOME-BASED WORK TRIP CARPOOL FORMATION

Alternative	Single-Occupant Vehicles	Multi-Occupant Vehicles	Total Vehicles	Total Persons	Average Vehicle Occupancy	Percent Vehicles that are Multi-Occupant
No Build	146,925	13,075	160,000	175,925	1.099	8.17%
Managed HOV	146,725	13,175	159,900	175,950	1.100	8.24%
<i>Difference from No Build</i>	<i>-200</i>	<i>100</i>	<i>-100</i>	<i>25</i>	<i>0.001</i>	
<i>Percent Difference</i>	<i>-0.1%</i>	<i>0.8%</i>	<i>-0.1%</i>	<i>0.0%</i>	<i>0.1%</i>	
HOV Lane	146,275	13,400	159,675	175,975	1.102	8.39%
<i>Difference from No Build</i>	<i>-650</i>	<i>325</i>	<i>-325</i>	<i>50</i>	<i>0.003</i>	
<i>Percent Difference</i>	<i>-0.4%</i>	<i>2.5%</i>	<i>-0.2%</i>	<i>0.0%</i>	<i>0.2%</i>	

Source: SRF Consulting Group, Inc./regional travel forecast model

Table 11 summarizes the changes in regional travel as measured by VMT and VHT between the managed HOV and No Build alternatives. On a regional level the HOV alternative has slightly higher VHT than the Managed HOV alternative, an indicator of a slight loss of efficiency. Within the corridor itself, VHT increases by 0.7 percent while VMT is reduced; this reflects fewer trips diverting into the corridor, with a slight increase in congestion. Finally, on I-494 itself a 3.3 percent decrease in VMT is accompanied by a 2.3 percent reduction in VHT.

**TABLE 11
SUMMARY OF REGIONAL, CORRIDOR AND FREEWAY TRAVEL
CHARACTERISTICS: 2022 MANAGED HOV AND HOV LANE ALTERNATIVES**

	2022		% Difference (Managed- Exclusive)
	Exclusive HOV	Managed HOV	
<u>Regional Travel</u>			
Daily Vehicle Hours Traveled (hours)	1,980,900	1,989,700	0.4%
Daily Vehicle Miles Traveled (miles)	76,150,800	76,169,400	0.0%
<u>Travel in the I-494 Corridor</u>			
Daily Vehicle Hours Traveled (hours)	270,200	272,100	0.7%
Daily Vehicle Miles Traveled (miles)	10,906,200	10,849,500	-0.5%
<u>Travel on I-494</u>			
Daily Vehicle Hours Traveled (hours)	246,900	241,300	-2.3%
Daily Vehicle Miles Traveled (miles)	10,578,300	10,228,200	-3.3%

Source: SRF Consulting Group, Inc./regional travel forecast model

The reductions in VMT and VHT are reflections of the lower overall carrying capacity of I-494 under the HOV alternative. The replacement of a mixed-use lane with an HOV-only lane increases the amount of congestion in the remaining mixed-use lane relative to the Managed HOV alternative. The additional congestion is not offset by benefits to HOV users or by the creation of new HOVs. Table 12 shows the forecast increase in the number of congested hours on I-494 with the HOV alternative—the number of miles of I-494 experiencing a second or third hour of peak congestion increases substantially under the HOV alternative.

**TABLE 12
PERCENT OF I-494 WITH CONGESTION⁽¹⁾**

	2022	
	Managed HOV	HOV
<u>Level of Service “D” or Worse</u>		
Congested at least one hour per day	78%	82%
Congested at least two hours per day	38%	75%
Congested at least three hours per day	6%	31%
Congested at least four hours per day	4%	6%
Congested at least five hour per day	0%	1%
Congested at least six hours per day	0%	0%
<u>Level of Service “E” or Worse</u>		
Congested at least one hour per day	33%	31%
Congested at least two hours per day	0%	26%
Congested at least three hours per day	0%	1%
Congested at least four hours per day	0%	0%
Congested at least five hour per day	0%	0%
Congested at least six hours per day	0%	0%

Source: SRF Consulting Group, Inc./regional travel forecast model

⁽¹⁾Based on 36 directional miles of roadway, I-394 to Minnesota River

Traffic Volumes

The existing and forecast daily traffic volumes are shown in Figures 9 through 17. These volumes were used as input to the traffic operations analysis discussed under a separate memorandum. Although the forecast volumes represent a substantial increase over current levels, they will be constrained by the capacity available on I-494, even under the Managed HOV alternative.

Table 13 shows the existing and forecast daily traffic volumes on selected segments of I-494 under the various alternatives. Included in the table is an “unconstrained forecast” that represents the true demand for travel on I-494 by assuming no congestion-related delay. In general, the managed HOV alternative will accommodate all but approximately 10,000 to 20,000 of the possible demand, or 90 to 95 percent. The area where the biggest deficit is expected to exist is in the vicinity of TH 169 and Bush Lake Road where an additional 23,000 vehicle per day demand would exist.

Figure 9 8 1/2 x 11

Figure 10 8 1/2 x 11

Figure 11 8 1/2 x 11

Figure 12 8 1/2 x 11

Figure 13 8 1/2 x 11

Figure 14 8 1/2 x 11

Figure 15 8 1/2 x 11

Figure 16 8 1/2 x 11

Figure 17 8 1/2 x 11

TABLE 13
DAILY TRAFFIC FORECAST ON SELECTED TWO-WAY SEGEMENTS OF I-494

Segment	2022						
	1999 Existing	No Build	Mixed Use	HOV Lane		Managed HOV	Unconstrained
				HOV	Total		
CR 10 and I-94	83,000	105,000	104,100	6,100	110,000	117,000	128,000
<i>Change over existing</i>		27%			33%	41%	54%
<i>Change over No Build</i>					5%	11%	22%
CR 6 and TH 55	110,000	130,000	129,000	7,000	136,000	145,000	160,000
<i>Change over existing</i>		18%			24%	32%	45%
<i>Change over No Build</i>					5%	12%	23%
Minnetonka Blvd and I-394	110,000	135,000	133,000	7,200	140,000	148,000	166,000
<i>Change over existing</i>		23%			27%	35%	51%
<i>Change over No Build</i>					4%	10%	23%
Valley View Rd and TH 62	77,000	101,000	99,000	5,000	104,000	110,000	120,000
<i>Change over existing</i>		31%			35%	43%	56%
<i>Change over No Build</i>					3%	9%	19%
TH 169 and East Bush Lake Rd	123,000	132,000	150,000	6,000	156,000	164,000	187,000
<i>Change over existing</i>		7%			27%	33%	52%
<i>Change over No Build</i>					18%	24%	42%
Penn Ave and France Ave	187,000	218,000	238,000	7,900	246,000	255,000	272,000
<i>Change over existing</i>		17%			32%	36%	45%
<i>Change over No Build</i>					13%	17%	25%
Portland Ave and Nicollet Ave	175,000	212,000	224,000	7,400	231,000	236,000	244,000
<i>Change over existing</i>		21%			32%	35%	39%
<i>Change over No Build</i>					9%	11%	15%
34th Street and 24th Street	178,000	214,000	224,000	-	224,000	225,000	228,000
<i>Change over existing</i>		20%			26%	26%	28%
<i>Change over No Build</i>					5%	5%	7%
TH 212 and TH 169	100,000	125,000	130,000	6,000	136,000	146,000	157,000
<i>Change over existing</i>		25%				46%	57%
<i>Change over No Build</i>					9%	15%	26%