HISTORICAL STREET AND HIGHWAY SPENDING

TABLE 11 HISTORICAL O & M AND TOTAL SPENDING

	2003 Dollars								2005 Dollars			
	2000		2001		2002		2003		Yearly Average		30 Year Spending	
	O & M	Total	O & M	Total	O & M	Total	O & M	Total	O & M	Total	O & M	Total
Municipality												
C. Janesville	$7,003,312	$10,806,090	$6,812,980	$10,545,587	$5,119,121	$9,092,127	$5,416,100	$9,677,400	$6,398,360	$10,541,846	$191,950,800	$316,255,385
C. Milton	355,876	977,778	373,209	796,677	593,967	1,707,975	429,500	1,108,800	460,483	1,206,346	13,814,492	36,190,373
T. LaPrairie (60%)	76,923	76,923	62,866	62,866	42,577	42,577	88,320	88,320	71,123	71,123	2,133,681	2,133,681
T. Milton (44%)	42,167	51,427	50,123	68,353	62,446	122,687	46,684	46,684	52,923	75,975	1,587,685	2,279,237
T. Harmony (38%)	63,821	63,821	82,708	82,708	42,468	42,468	35,416	35,416	58,965	58,965	1,768,936	1,768,936
T. Janesville (73%)	85,635	85,635	65,495	65,495	101,364	101,364	96,871	144,540	91,796	104,321	2,753,869	3,129,620
T. Rock (37%)	44,115	44,115	38,614	38,614	59,510	59,510	48,063	48,063	50,002	50,002	1,500,058	1,500,058
Rock County (20%)	1,226,969	1,930,878	591,485	755,556	469,243	645,297	770,420	1,001,120	803,520	1,138,456	24,105,610	34,153,692
Planning Area	**$8,898,817**	**$14,036,667**	**$8,077,480**	**$12,415,856**	**$6,490,696**	**$11,814,005**	**$6,931,374**	**$12,150,343**	**$7,987,171**	**$13,247,033**	**$239,615,131**	**$397,410,981**

Percentage of the Township's road miles within the MPO's jurisdiction

Operations and maintenance (O & M) costs were extrapolated from the *Revenues & Expenditures by Wisconsin Counties, Cities, Villages & Towns (2000 -2003),* referred to as the bulletin henceforth. The operations and maintenance column is based on the following lines from the bulletin: “Highway Maintenance & Administration,” and “Road Related Facilities.” The total column represents all transportation spending in the MPO; it is the operations and maintenance figure, plus the “Highway Construction” line from the bulletin. The definitions of the bulletin lines are as follows:

- Highway Maintenance and Administration: Operating expenditures and capital outlay for engineering, highway equipment and buildings, and maintenance. In counties, includes depreciation for equipment and buildings
- Road Related Facilities: Operating expenditures and capital outlays for limited purposed roads, street lighting, sidewalks, storm sewers, and parking facilities.
- Highway Construction: Operating expenditures and capital outlay for constructing highways

The operations and maintenance costs reported in the bulletin were not used in the analysis because they contain some capital costs and have the potential to over inflate the O & M spending.

The total highway spending was used to gauge if future spending estimates were reasonable.

The figures shown in Table 11 are the total amounts spent within each category, they include both federal and local funds. The percentage of total road miles within the MPO were used to calculate the Townships' and County's total spending within the MPO.

	Roadway Miles within MPO	Total Roadway Miles	% within MPO
Local Roads (non-CTH)			
City of Janesville	317	317	100%
City of Milton	27	27	100%
T. Harmony	46	122	38%
Milton	32	72	44%
Janesville	37	51	73%
Rock	19	52	37%
La Prairie	26	44	60%
Total Local Roadways	**505**	**685**	
STH	75	--	--
County	44	218	20%
MPO Total	**624**	**685**	

J:\Development\Planning\MPO\Long Range Plan\2004\Streets & Highways\[Commmited_&_Planned_Projects_2005.xls]Miles to Rehab

WisDOT supplied total miles within MPO and within each jurisdiction 1-Oct

The amount reported in each year was inflated to 2003 dollars using the appropriate inflation factor. The yearly average was calculated and inflated to 2005 dollars, as shown, and multiplied by 30 for the total spending over 30 years. Robert Sahr's inflation factors, *Conversion Factors in 2003 Dollars for 1800 to estimated 2015*, available through Oregon State University, were used. Available at, http://oregonstate.edu/Dept/pol_sci/fac/sahr/sahr.htm, accessed November 10, 2005.

TABLE 12 INFLATION FACTOR

Original Dollars	Final Dollar Years 2003	2005
2000	0.936	
2001	0.963	
2002	0.977	
2003		1.051

HIGHWAY IMPROVEMENT TYPE DEFINITIONS

HIGHWAY IMPROVEMENT TYPE DEFINITIONS

Improvement Type & Abbreviation	Definition	Examples	Design Standards
Resurfacing RESUR **Design Timeline:** **18 – 24 mos.**	Placing a new surface on an existing roadway to extend or renew the pavement life. Generally no improvement in capacity or geometrics is performed. No additional R/W is required; except minor acquisition for drainage and intersection improvements. Overlay must be placed directly on top of existing pavement (no intervening base course)	• Asphalt or PCC overlay without removal of existing pavement. • Mill/grind a portion of existing pavement & overlay. • Diamond grind pavement. • Repair or patch joints in existing pavement and place overlay. • Overlay existing driving lanes & pave shoulders. • May include spot replacement of curb and gutter in urban areas. • Widen existing driving lanes and either reduce shoulder width or steepen the shoulder inslope to match existing subgrade shoulder point. • Resurfacing may include some elimination or shielding of roadside obstacles, culvert replacements, signals, marking, signing and intersection improvements.	Interstate: • FDM 11-44-1 Expressway/Freeway: • FDM 11-10-5 • FDM 11-15-1 • FDM 11-40-2 All others: • FDM 11-40-1
Pavement Replacement PVRPL **Design Timeline:** **18 – 24 mos.**	Removing the total thickness of all paving layers, existing asphalt and concrete, from an existing roadway and providing a new paved surface without changing the subgrade. Generally no improvement in capacity or geometrics and no increase in roadbed width is performed. May include transfer of width between pavement and shoulders. Pavement replacement may include some of the same types of associated work as resurfacing. Additional R/W will typically not be required. Does not include storm sewer construction. (No change to subgrade means location of shoulder points is not changed.)	• Remove & reinstall pavement only. • Remove & reinstall pavement and add shoulder paving. • Mill & reprocess or relay existing asphalt pavement as base course, reinstall pavement. • Remove existing pavement, modify base course, reinstall pavement ⇒ Add to or delete from thickness of existing base course ⇒ Add OGBC with drain collection system • Remove and reinstall urban pavement and curb and gutter to same line and grade • Rubbilize existing concrete pavement and overlay with new pavement	Interstate: • FDM 11-44-1 Expressway/Freeway: • FDM 11-10-5 • FDM 11-15-1 • FDM 11-40-2 All others: • FDM 11-40-1
Reconditioning RECON **Design Timeline:** **24 –30 mos.**	Work in addition to resurfacing or pavement replacement. Reconditioning includes improvement of an isolated grade, curve, intersection or sight distance problem to improve safety, or changing the subgrade to widen shoulders or to correct a structural problem. Reconditioning projects may require additional R/W. Does not include increasing the number of driving lanes & does not include adding continuos lanes. May include reconstruction not to exceed 50% of the length of the project May include replacement of curb and gutter in urban areas with up to 50% of new curb and gutter on new horizontal or vertical alignment	• Resurfacing or pavement replacement plus any of the following: ⇒ Regrading of individual horizontal or vertical curves ⇒ Relocating parts of the project. ⇒ Continuously widening subgrade to allow pavement or shoulders to be widened along existing horizontal and vertical alignment ⇒ Adding non-continuous (turning, climbing or passing) lanes ⇒ Continuously or intermittently grading ditches and slopes to improve drainage or flatten vehicle recovery areas ⇒ Adding parking lanes in urban areas • Placing "gravel lift" (new base course) over existing pavement and a new pavement on top of that • May include replacing and/or expanding existing storm sewer systems. • May include continuos shoulder pavement or subgrade widening	Interstate: • FDM 11-44-1 Expressway/Freeway: • FDM 11-10-5 • FDM 11-15-1 • FDM 11-40-2 All others: • FDM 11-40-1
Reconstruction RECST **Design Timeline:** **42 - 48 mos.**	Total rebuilding of both the pavement and subgrade of an existing highway. Removing parking together with pavement replacement is in this category, because the traffic carrying capacity of the roadway is increased without act ually constructing new through travel lanes. It includes minor widening of urban streets to widen lanes or to add parking, bicycle accomodations or auxillary lanes. Normally, this type of reconstruction will require additional R/W. Work which either changes the location of the existing subgrade shoulder points or removes all of the existing pavement and base course for at least 50% of the length of the project.	• Improving horizontal or vertical alignment for more than 50% of the length of the project • Replacing pavement structure and widening subgrade to widen lanes and/or shoulders • Upgrading existing interchanges (i.e.: realigning or reprofiling ramps, lengthening ramp tapers, etc.) • Adding continuous parking or auxiliary lanes • Replacing existing urban pavement, curb and gutter and storm sewer • Converting a rural roadway to an urban roadway with the same number of driving lanes • May include elimination or shielding of roadside obstacles.	New Construction: • FDM 11-10-5 • FDM 11-15-1 • FDM 11-20-1
Expansion RECSTE **Design Timeline:** **42 – 48 mos.**	Same as reconstruction and also involves the construction of additional through travel lanes beyond the work associated with reconstruction. In some cases, expansion may include construction of an entirely new street or highway on new alignment. May or may not include rebuilding the existing roadway. Relocation means changing the horizontal alignment sufficiently so that old and new R/W are no longer contiguous. Substantial R/W may be necessary. Major projects are excluded from this definition.	• Relocating a roadway for more than 50% of the length of the project • Adding one or more travel lanes for more than 50% of the length of the project • Constructing a 2-lane or 4-lane community bypass • Converting a rural 2-lane roadway to an urban roadway with four driving lanes • Constructing new interchanges or adding lanes to existing interchange ramps	New Construction: • FDM 11-10-5 • FDM 11-15-1 • FDM 11-20-1

HIGHWAY IMPROVEMENT TYPE DEFINITIONS

Improvement Type & Abbreviation	Definition	Examples	Design Standards
Major MAJOR **Design Timeline:** **48 – 60 mos.**	Project with cost of more than $5 million and which involves any of the given examples. WisDOT may perform needs assessments, preliminary engineering and design work for possible major highway projects not enumerated. No major highway project may be constructed unless the project is enumerated. WisDOT may not within any 6-year period, construct a highway project consisting of separate contiguous projects which do not individually qualify as major highway projects but which in their entirety would constitute a major highway project without fist submitting the project to the Transportation Projects Commission for it's recommendations and report. Substantial R/W may occur with these types of projects.	• Constructing a new highway 2.5 miles or more in length • Reconstructing or reconditioning an existing highway by either relocating 2.5 miles or more of an existing highway or adding one or more lanes for at least 5 miles to an existing highway • Improving to freeway standards 10 miles or more of an existing divided highway having 2 or more lanes in either direction	New Construction: • FDM 11-10-5 • FDM 11-15-1 • FDM 11-20-1
Bridge Rehabilitation BRRHB **Design Timeline:** **12 – 18 mos.**	Repair, restoration or replacement of the components of the existing structure, including asphaltic surfacing or concrete overlays, as well as work to correct safety defects. Additional R/W will typically not be required, except minimal acquisitions may be necessary to accommodate subordinate improvements for drainage or for the construction of an abutment or pier.	• Initial or replacement concrete or asphalt/membrane deck overlay • Replace or repair any of the following: ⇒ parapets with or without widening the deck ⇒ deck, girders, joints, delaminated concrete ⇒ portions of abutments or piers ⇒ any superstructure component • Widen deck and substructure units and add girders • Strengthen structural steel by adding plates, rewelding or rebolting • Add fencing • Raise deck to improve vertical clearance below	Interstate: • FDM 11-35-1 • FDM 11-44-1 All others: • FDM 11-35-1 • FDM 11-40-1
Bridge Replacement BRIDG **Design Timeline:** **24 – 36 mos.**	Building of a new bridge at the location of the existing structure or at a new location usually contiguous to the existing structure. A bridge of any length or type may be replaced by any other. Minor acquisition of new R/W may be required.	• Remove and rebuild a 2-lane bridge • Remove and rebuild a 2-lane bridge with wider lanes and shoulders or additional lanes • Replace a 2-lane bridge with a 4-lane bridge • Replace a 4-lane bridge carrying counter directional traffic with a pair of bridges each carrying traffic in a single direction • Replace a small bridge with a triple-cell box culvert 20' (6.0m) long • Remove a railroad/highway grade separation and install an @grade crossing	Interstate: • FDM 11-35-1 • FDM 11-44-1 All others: • FDM 11-15-1 • FDM 11-35-1
Roadway Maintenance (SHRM) RDMTN **Design Timeline:** **6 – 12 mos.** "N/A" for local roads	Projects of this type span the gap between routine maintenance and improvement projects. Their primary focus is to preserve and maintain existing roadways and structures. They are not intended to improve or upgrade highway facilities. Structural and/or safety enhancements would not typically be expected; however, it is permissible to include them when it can be done easily and inexpensively. A single lift of asphaltic concrete (½" - 2") thick will usually suffice for projects of this type but total average thickness shall not exceed 2 ½". No change in roadway or pavement alignment is performed other than pavement elevation changes due to milling or asphaltic resurfacing operations. Typically, no new R/W is acquired. The project must qualify as a Programmatic Type III Environmental Report and total construction cost, including E&C, traffic control, etc.. must be less than $100,000/mile per 2-lane roadway	• Resurfacing (total average overlay thickness of 2 ½ " or less) • Shoulder paving • Milling • Rut Filling • Diamond grinding • Culvert pipe liners • PCC joint repairs • Culvert replacement • Beam guard • Shoulder widening	Maintenance Manual

See FDM 21-5-5 for guidance on selecting the appropriate type of environmental documentation required for each type of highway improvement project.

STATEWIDE AVERAGE HIGHWAY IMPROVEMENT COSTS

Prepared by Jim Wendels 4/22/2004 — Page 1

Statewide Average Highway Improvement Costs for 2004

Imrprovement Type	Cost/Mile ($2004)	
Resurface[1-8]		
Rural (2-Lane)	$215,000	
Rural (Multilane)	$420,000	
Urban (2-Lane)	$480,000	
Urban (Multilane)	$725,000	
Recondition - Minor[1-5]		
Rural (2-Lane)	$360,000	
Rural (Multilane)	$520,000	
Urban (2-Lane)	$690,000	
Urban (Multilane)	$1,420,000	
Recondition - Major[1-5]		
Rural (2-Lane)	$555,000	
Rural (Multilane)	$1,750,000	
Urban (2-Lane)	$975,000	
Urban (Multilane)	$3,250,000	
Pavement Replacement[1-8]		
Rural (2-Lane)	$295,000	
Rural (Multilane)	$875,000	
Urban (2-Lane)	$720,000	
Urban (Multilane)	$1,000,000	
Reconstruction[1-8]		
Rural (2-Lane)	$1,205,000	
Rural (Multilane)	$2,300,000	
Urban (2-Lane)	$2,100,000	
Urban (Multilane)	$4,000,000	
Bridge[1-3]	Project Costs	Structure Costs Only
Bridge Replacement < 1500 SF	$130/S.F.	$90/S.F.
Bridge Replacement > 1500 SF	$90/S.F.	$75/S.F.
Bridge Deck Replacement	$60/S.F.	$45/S.F.
Bridge Deck Overlay	$15/S.F.	$12/S.F.
Box Culverts	$1100/L.F./BARREL	$900/L.F./BARREL
Retaining Walls[1-3]		
Split Block	$25-30/S.F.	
Cast-in-Place	$70/S.F.	
MSE (Mech. Stab. Earth)	$30/S.F.	

General Notes
1. Costs DO NOT include design engineering, these costs are typically 15% to 20% of construction costs.
1a. In general, use 20% design engineeing for construction projects < $500,000, bridge replacements or complex projects
2. Costs DO NOT include State design review, these costs are typically 20% of design engineering, minimum $5,000.
2a. This covers plan review, bid advertisement & printing/mailing of plans to bidders.
3. Costs are AVERAGES and include construction engineering, real estate & utility relocations.
3a. Costs will vary depending on project complexity.
3b. Costs DO NOT include extraordinary items such as: traffic signals, HAZMAT mitigation, railroad crossings etc..
3c. Costs are expressed in 2003 (current year) dollars
3d. For budgeting purposes, project current year to future year dollars using 3% inflation per year
3e. Projects which contain: rock ecavation, challenging soils, complex traffic control/staging etc..cost/mile may be higher
4. Rural Roadway - presence of side dtichs, no curb & gutter, no storm sewer and costs based on standard lane width of 12 feet.
5. Urban Roadway - presence of curb & gutter and costs based on pavement width from curb face - curb face
6. Unit Price Costs are based on statewide averages from WisDOT lettings
7. Costs DO NOT include geometric improvements to the intersection, includes traffic signal hardware & installation
7a. Secure a qualified design consultant familair with traffic signal design
8. General cost to produce, haul, and place asphaltic concrete pavement, costs DO NOT include CABC or prep of foundaion

Signalization of Intersection[7]	$100,000 - $150,000 EACH
Overhead Lighting Pole Assembly (150' ave spacing)	$1,800 EACH
Overhead Lighting - Wire & Conduit	$3.50/L.F.
Mill/AC Overlay/CABC Shoulders	$75,000 - $100,000/MILE
AC Overlay - CRC w/County	$60,000-$70,000/MILE
AC Shoulders Only	$12,000/MILE
Asphaltic Concrete Pavement[8]	$60/TON
PCC Joint Repair (through one travel lane)	$850/joint
Retro-Fit Dowel Bars	$30 EACH
Milling - AC Pavement	$1.50 - $2.00/S.Y.
Diamond Grinding PCC Pavement	$2.00 - $2.50/S.Y.
Common Excavation	$2.50/C.Y.
Crushed Aggregate Base Course	$7.00/TON
PCC Pavement - 9"	$20.00/S.Y.
Storm Sewer Pipe - 18"	$32/L.F.
Inlets - Type 3 (250' ave spacing)	$600 EACH
Inlet Covers - Type H	$300 EACH
Manholes - Type 3 (@ all junctions)	$2,150 EACH
Manhole Covers - Type L	$245 EACH
Concrete Sidewalk - 4"	$2.25/S.F.
Concrete Sidewalk - 6"	$2.80/S.F.
Concrete Curb & Gutter	$8.00/L.F.
Concrete Driveway	$24.00/S.Y.
Beam Guard	$10.00/L.F.
Beam Guard Anchorages & Grading	$2,500/End Treatment
Culvert Pipe - 36"	$38/L.F.
Culvert Pipe Endwall - 36"	$350 EACH
Reinforced Concrete Culvert Pipe - 36"	$62/L.F.
Reinforced Concrete Culvert PipeEndwall - 36"	$725 EACH
Riprap	$45/C.Y.

W:\Planning\Scoping\Program Level Scoping Doc's\Cost_Per_Mile_2004.xls

2003 Origin-Destination Survey for the Rock County Transportation Study

(Excerpt)

Wisconsin Department of Transportation
Division of Transportation Investment Management
Bureau of State Highway Programs
Traffic Forecasting and Analysis Section
P.O. Box 7913
Madison, WI 53707-7913

KEY FINDINGS

1. An extensive origin-destination survey was conducted around the Rock County Area during the months of May and June 2003 to determine the vehicle travel patterns that currently exist.

2. Twenty interview stations recorded a factored total of 193,717 daily vehicle trips. The three largest daily volume station locations are IH 39/90 south at 51,089; IH 39/90 north at 47,093; and IH 43 east at 15,087. Station locations can be found on Figure 1 with detailed descriptions beginning on page 3.

3. The majority of trips surveyed were through trips with 59.7% (115,732 trips). Local trips (internal-external) accounted for the remaining 40.3% (77,985 trips). Graph #1 on the following page illustrates local and through trips by O-D station.

4. Of the 193,717 total trips recorded, 37,137 or 19.2% are considered medium and heavy-duty trucks. The majority (79%) passes through the study area (29,262 trips) while the remaining 21% (7,875 trips) is local in nature

5. Of the 115,732 through trips recorded, 96,660 or well over eighty percent (83.5%) passed through the three stations on IH 39/90 south, IH 39/90 north and IH 43 east of the Rock County area.

6. Wisconsin provided 45.7% of the through trip ends or trips with either an origin or destination by state. Illinois followed with 27.3% of the through trip ends.

7. The two primary internal attraction zones were zone # 225 with 3,035 trips or nearly 4% of the total local trips and zone # 38 with 1,960 trips or 2.5% of the total local trips. All other internal zones had less than 1900 vehicle trips.

8. Autos accounted for 48.7% of the total trips while light trucks (pick-ups, vans, etc.) accounted for 32.1%. The remaining 19.2% consisted of medium and heavy trucks (delivery, semi-trailers, etc.). Graph # 2 illustrates vehicle type by O-D station.

9. The largest destination trip purpose was the work trip with 33.0%. This was followed by the home trip with 32.9%. The time of the survey (10 AM - 6 PM) indicates an equivalent proportion of "home" & "work" trips. Graph # 3 illustrates trip purpose by O-D station.

Vehicle occupancy, the average number of people in each vehicle recorded throughout the entire survey, was tabulated at 1.52. Graph # 4 illustrates vehicle occupancy by O-D station.

ROCK COUNTY AREA 2003 ORIGIN-DESTINATION SURVEY STATIONS

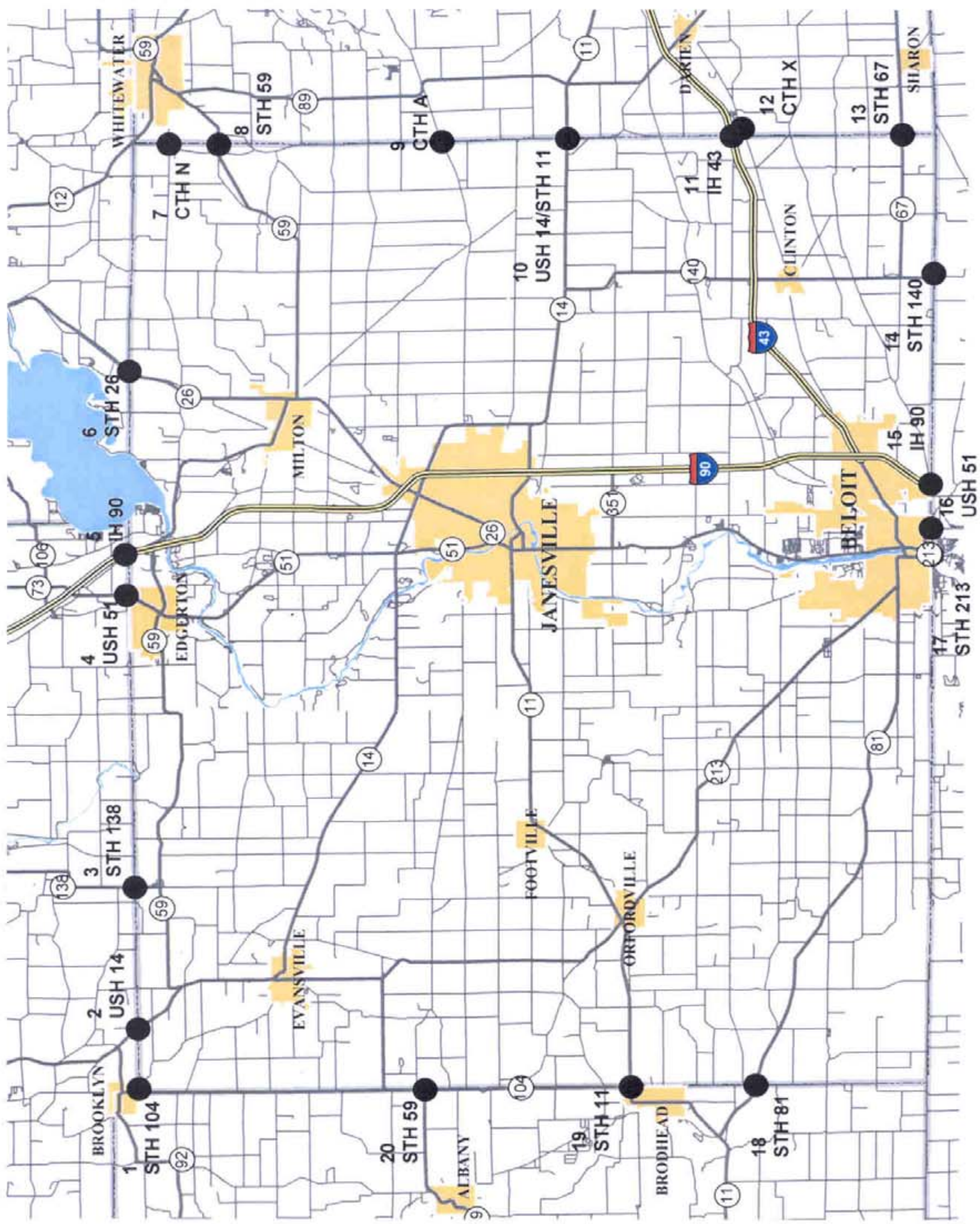


FIGURE 1

DEFICIENCY DEVELOPMENT

Deficiency Analysis

Date	To
5/12/05	David Cipra & Don Uelmen, WisDOT
	From
MEMORANDUM	Derek Hungness, Tim Flynn & Jerry Shadewald
	Subject
	Primary and Secondary Deficiency Analysis– MPO Models

The WisDOT TP+ travel demand models conduct deficiency analysis using a two-tiered approach. The primary analysis utilizes a numeric Level of Service (LOS) value and a Level of Service threshold as described in the Facilities Development Manual (FDM) Procedure 11-5-3 to determine roadway deficiency. This method incorporates an adjusted traffic forecast value, an operationally sensitive roadway capacity and a sliding deficiency determination based on the importance of the roadway within the overall transportation system. The secondary approach uses the ratio between the model volume and the model capacity on a link by link basis to determine the relative deficiency. The secondary approach is intended as a supplement to the primary approach and should only be used at locations where a primary deficiency is not available.

Primary Deficiency Analysis - LOS Deficiency

The LOS value is a measure of the amount of the link's available capacity used by the volume of traffic on the link segment and is calculated on a link-by-link basis within the TP+ model script. Table 1 correlates LOS with a numeric value and an approximate volume to capacity ratio.

Table 1, LOS Alpha/Numeric and Volume to Capacity Comparison

Level of Service (Alpha Value)	Level of Service (Numeric Value)	Volume to Capacity Ratio
A-(Not congested)	1.01 to 2.00	< 0.50
B-(Not congested)	2.01 to 3.00	
C-(Minimal congestion)	3.01 to 4.00	0.50 to 0.70
D-(Moderate congestion)	4.01 to 5.00	0.70 to 0.85
E-(Severe congestion)	5.01 to 6.00	0.85 to 1.00
F-(Extreme congestion)	6.01 to ~	> 1.00

Source: Wisconsin Department of Transportation Facilities Development Manual 11-5-3, Page 2, December 30, 2002 and HNTB Corporation

The capacity used in for traffic assignment in long-range planning models represents generalized values. Operationally, the amount of available capacity on a model link is influenced by many factors; therefore each link is assigned a 'LOS Lookup' value which is determined by the following factors:

- Facility Type
- Area Type
- Number of Lanes
- Posted Speed
- Signal Density
- Cross-Section Type

The TP+ script contains 48 different LOS Lookup values. The LOS Lookup value provides the TP+ script with a text file containing a link's lower and upper bounds of directional traffic within each LOS bin. The LOS value is then interpolated from these LOS bin values using the directional base year count or the directional future year traffic estimate using the following equation:

LOS Value = LOS Bin + [(Count-Lower Bound)/(Upper Bound – Lower Bound)]

For example, a four-lane undivided urban principal arterial designated as a Corridors 2020 Connector with a posted speed limit of 40 miles per hour and a signal density less than 1.5 signals per mile is given a LOS Lookup value of 17. The lower and upper bounds of LOS Bins for LOS Lookup 17 are shown in Table 2.

Table 2, Lower and Upper Bounds of LOS Bins for LOS Lookup 17

LOS Bin	Allowable Directional Volume	
	Lower Bound	Upper Bound
4.0 (or D)	15,800	17,700
5.0 (or E)	17,700	21,000
6.0 (or F)	21,000	

Source: HNTB Corporation

In this example, if the link's base year count was 17,250 in each direction (34,500 ADT), then the LOS value would be calculated as: 4.0 + [(17,250-15,800) / (17,700-15,800)] = 4.76

A level of service value by itself does not indicate definitively whether a link is deficient. A given level of congestion and corresponding LOS value may be acceptable on an urban corridor, while the same level of congestion may not be acceptable on a rural freeway segment. Therefore, an acceptable LOS threshold has been established for various roadway classes. The LOS threshold is determined by the link's overall importance to the transportation system as a whole and is based on the state truck highway sub-system attribute entered into the model network. These sub-system attributes reflect the Wisconsin TransLinks 21, Corridors 2020 Review and Update, June 1994. Table 3 defines the attributes entered into the TP+ model networks to indicate the STH sub-system.

Table 3, Link Attributes in TP+ network depicting STH Sub-Systems

STH Sub-System	Rural & Small Urban Areas (Population <50,000)	Urbanized Areas (Population >50,000)
C2020 Backbone Routes	BACKBONE	
C2020 Connector Routes	R_C2020	U_C2020
Other Principal Arterials	R_OPA	U_OPA
Minor Arterials	R_MA	U_MA
Collectors & Local Function Roads	R_OTHER	U_OTHER

Source: HNTB Corporation

The Facilities Development Manual provides the LOS threshold for each sub-system component as shown in Table 4. LOS values that exceed the LOS threshold trigger the need to consider improvements.

Table 4, Level of Service Thresholds

STH Sub-System	Rural & Small Urban Areas (Population <50,000)	Urbanized Areas (Population >50,000)
C2020 Backbone Routes	4.0	4.0
C2020 Connector Routes	4.0	4.5
Other Principal Arterials	5.0	5.5
Minor Arterials	5.0	5.5
Collectors & Local Function Roads	5.0	5.5

Source: Wisconsin Department of Transportation Facilities Development Manual 11-5-3, Page 2, December 30, 2002

Finally the TP+ script compares the LOS value to the LOS threshold to determine the deficiency status of the link. The TP+ output reports one of five possible values depending on the ratio between the LOS value and the LOS threshold. Table 5 shows the five levels of deficiency status reported by the TP+ script.

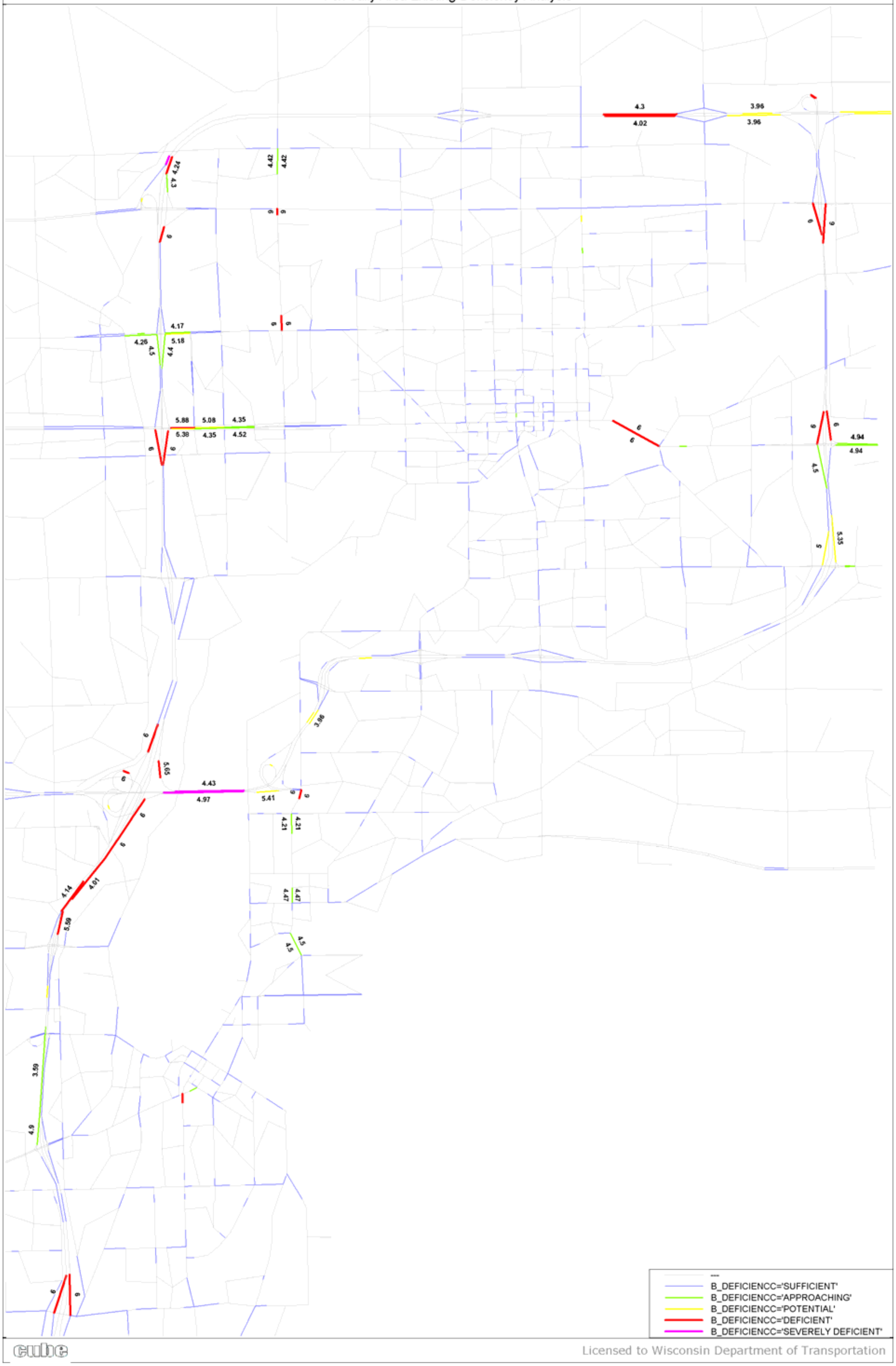
Table 5, Reporting of Primary Deficiency Status

Volume to Threshold Capacity Ratio	Reported Status
<0.75	Sufficient
0.75 to 0.89	Approaching
0.90 to 0.99	Potential
1.00 to 1.09	Deficient
>1.10	Severely Deficient

Source: HNTB Corporation

The primary deficiency value for the example link would be calculated as follows:
LOS Threshold for Urban C2020 Connector Route = 4.5 LOS Value = 4.76
4.76/4.5 = 1.06 , therefore the link would be assigned a deficiency value of 'Deficient'.
The following exhibit shows the results of the MPO model deficiency analysis as calculated using the Primary Analysis for the existing Fox Valley area transportation system.

Fox Vally Area Existing Deficiency Analysis



Secondary Analysis – Volume to Capacity Ratio

Similar to the Primary Analysis, the volume to capacity ratio is a measure of the amount of the link's available capacity used by the volume of traffic on the link segment and is calculated on a link-by-link basis within the TP+ model script. Unlike the Primary Analysis, the Secondary Analysis utilizes only the raw model assignment and the generalized roadway capacity used for traffic assignment. Table 1 is repeated below to correlate LOS with a numeric value and an approximate volume to capacity ratio.

Table 1(repeated), LOS Alpha/Numeric and Volume to Capacity Comparison

Level of Service (Alpha Value)	Level of Service (Numeric Value)	Volume to Capacity Ratio
A-(Not congested)	1.01 to 2.00	< 0.50
B-(Not congested)	2.01 to 3.00	
C-(Minimal congestion)	3.01 to 4.00	0.50 to 0.70
D-(Moderate congestion)	4.01 to 5.00	0.70 to 0.85
E-(Severe congestion)	5.01 to 6.00	0.85 to 1.00
F-(Extreme congestion)	6.01 to ~	> 1.00

Source: Wisconsin Department of Transportation Facilities Development Manual 11-5-3, Page 2, December 30, 2002 and HNTB Corporation

The capacities used for the Secondary Analysis are calculated using the TP+ capacity look-up tables. Each link is cross-classified by functional class and area type, and then an hourly capacity value per lane is assigned. This hourly capacity is multiplied by the number of lanes and a daily inflation factor to arrive at the daily capacity used for traffic assignment.

For the example link, an urban principal arterial would receive an hourly per lane capacity of 1200 vehicles per hour. This would equate to a daily directional capacity of 20,160 vehicles per day. A directional volume of 17,250 vehicles per day would result in a volume to capacity ratio of 0.856.

The Facilities Development Manual provides the LOS threshold for each sub-system component as shown above in Table 4. An approximate conversion between the LOS values in Table 4 and the volume to capacity ratio is to divide the LOS values by 6 (which assumes 6.0 is the E/F LOS threshold and 1.0 is the E/F volume to capacity threshold). Table 6 shows the approximate volume to capacity thresholds for each sub-system component.

Table 6, Volume to Capacity Thresholds

STH Sub-System	Rural & Small Urban Areas (Population <50,000)	Urbanized Areas (Population >50,000)
C2020 Backbone Routes	0.67	0.67
C2020 Connector Routes	0.67	0.75
Other Principal Arterials	0.83	0.92
Minor Arterials	0.83	0.92
Collectors & Local Function Roads	0.83	0.92

Source: HNTB Corporation

Finally the volume to capacity ratio is compared to the volume to threshold capacity ratio to determine the deficiency status of the link. The Secondary Analysis then outputs one of five possible values depending on the ratio between the volume to capacity ratio and the volume to threshold capacity ratio. Table 7 shows the five levels of deficiency status reported by the TP+ script.

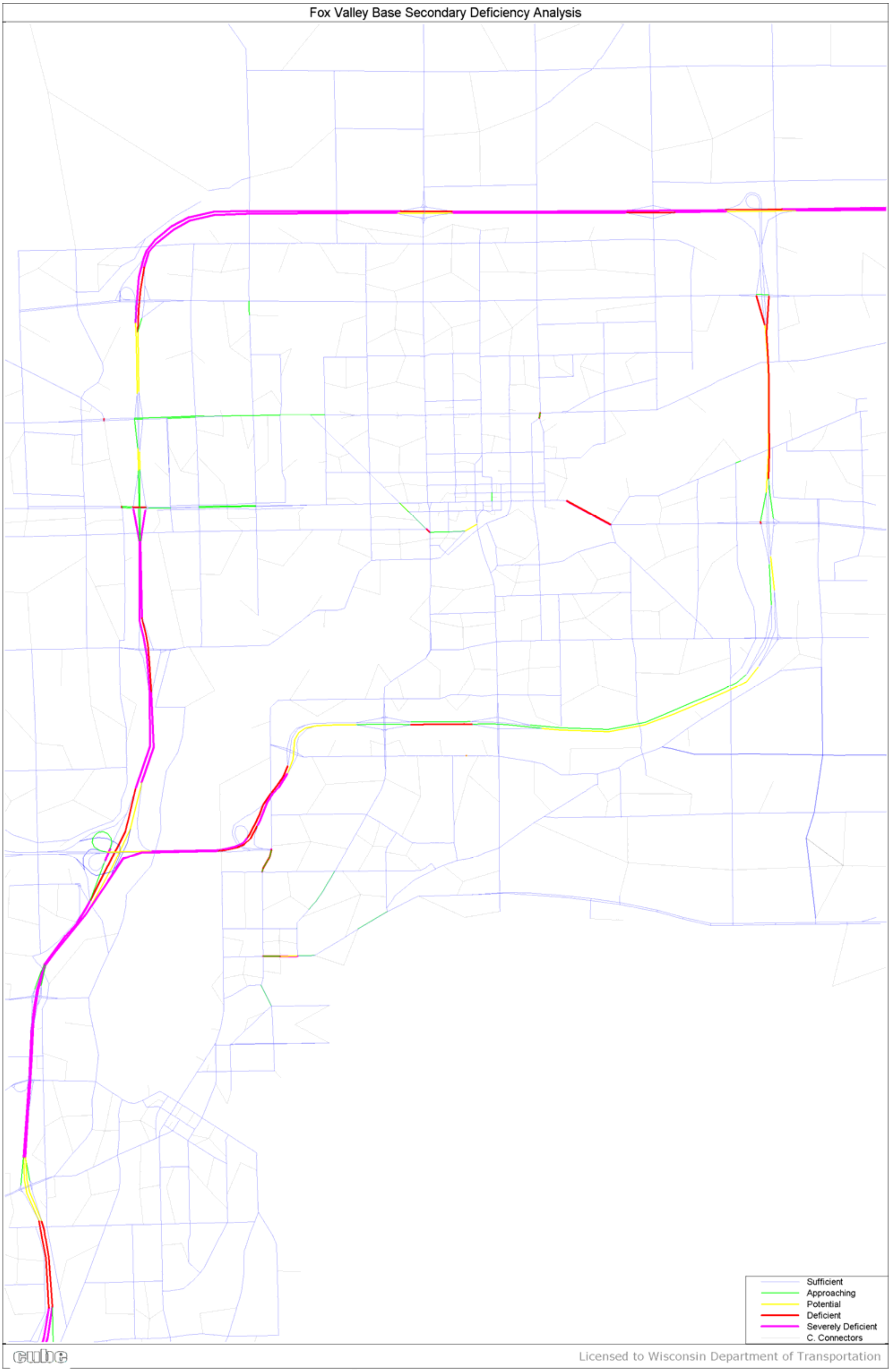
Table 7, Reporting of Secondary Deficiency Status

Volume to Threshold V/C Ratio	Reported Status
<0.75	Sufficient
0.75 to 0.89	Approaching
0.90 to 0.99	Potential
1.00 to 1.09	Deficient
>1.10	Severely Deficient

Source: HNTB Corporation

The secondary deficiency value for the example link would be calculated as follows:
V/C Threshold for Urban C2020 Connector Route = 0.75 V/C Value = 0.856
0.856/0.75 = 1.14 , therefore the link should be considered 'Severely Deficient'. Note that the Secondary Analysis result (1.14 and Severely Deficient) is slightly different than the Primary Analysis (1.06 and Deficient). Because the Secondary Analysis uses less exact methods, the Primary Analysis should be utilized.

The following exhibit shows the results of the MPO model deficiency analysis as calculated using the Secondary Analysis for the existing Fox Valley area transportation system.


Fox Valley Base Secondary Deficiency Analysis
Sufficient
Approaching
Potential
Deficient
Severely Deficient
C. Connectors
cube
Licensed to Wisconsin Department of Transportation

Usage of Primary and Secondary Analyses

The Primary Analysis is a more complex deficiency calculation incorporating adjusted traffic forecasts, operationally sensitive roadway capacity and a sliding deficiency determination based on the importance of the roadway within the overall transportation system. This approach is the preferred method of deficiency analysis and should be used whenever available. However, due to the need for an existing traffic count to calculate an adjusted traffic forecast, the Primary Analysis is conducted at limited locations. Professional judgment must be used to determine the appropriateness of applying a deficiency value to links in close proximity and of similar operating characteristics to links with a Primary Analysis rating.

The Secondary Analysis is a less complex deficiency calculation which utilizes only the raw model assignment and the generalized roadway capacity used for traffic assignment. This approach provides a deficiency estimate for every link in the model network. However, due to the less exact data used to determine the Secondary Analysis, it should only be used in locations where the Primary Analysis could not generate an actual or inferred deficiency calculation.

Example One: A series of four links bounded on either side by two links with a Primary Analysis rating of 'Deficient'. If the six links would be expected to all operate in a similar manner, the entire six link series should be considered 'Deficient'. In this case, the Secondary Analysis would not be utilized to supplement the Primary Analysis.

Example Two: A series of four links bounded on either side by two links with a Primary Analysis of 'Approaching' and 'Potential', east to west respectively. Two minor north-south corridors intersect the four link series between the two Primary Analysis links. The Secondary Analysis confirms the values at the Primary Analysis locations and also shows higher volume to capacity ratios between the two minor north-south corridors. The Secondary Analysis is indicating that the four links between the two Primary Analysis locations are at least as deficient as the two Primary Analysis locations, and depending on the severity of the volume to capacity ratio, could be considered to be 'Deficient'.

LOS

Facilities Development Manual

ORIGINATOR Director, Bureau of Highway Development	PROCEDURE 11-5-3
CHAPTER 11	Design
SECTION 5	General Design Considerations
SUBJECT 3	Highway Capacity

General

The analysis of existing and future operating characteristics of a facility are typically referred to as the Measures of Effectiveness (MOE) and the resulting Level of Service (LOS) provides an indication of the ability of the facility to satisfy both existing and future travel demand. Capacity analysis must be an integral part of a highway improvement project. Capacity and LOS of the mainline facility, including major intersections, must be determined on each project. Capacity and LOS determination may identify potential improvement needs.

When evaluating the MOE, LOS and capacity of a highway, follow the procedures in the 2000 Highway Capacity Manual, published by the Transportation Research Board. For further information on how to obtain this document, write or call:

Transportation Research Board

National Research Council

2101 Constitution Avenue, NW

Washington, D.C. 20418

(800) 424-9818 (202) 334-3214

This manual can be obtained from the TRB on-line bookstore. Go to

www.nationalacademies.org/trb/bookstore and use the search function to look for SR209E.

Another reference that is useful for understanding capacity related issues is "A Policy on Geometric Design of Highways and Streets," AASHTO 2001. For further information on how to obtain this document, see Procedure 1-1-1.

Design Hour Volume (DHV)

WisDOT policy is to use the 100th highest hour volume (K100) as the Design Hour Volume for the following types of projects.

- interstates,
- projects in smaller urban areas.
- majors,
- new construction,
- reconstruction,
- 3R

The 100th highest hour volume or higher may also be appropriate for traffic signal warrant analysis. Coordinate traffic signal issues with district traffic personnel. The 200th or greater hourly volume is often used in large (>50,000 population) metropolitan areas with heavy daily traffic.

Level Of Service

The State Highway Plan provides a level of service (LOS) matrix that is used to evaluate long-term highway needs. Table 1 shows the relationship between the traditional alpha value for LOS and the recent concept of the numeric value for level of service at WisDOT. The LOS is converted from the alpha-character scale to a numeric scale in order to facilitate a more detailed comparison between segments and to compare segment values with threshold values. For example, LOS D is represented by a numeric LOS range of 4.01 to 5.00; if the computation falls midway within the LOS D range the numeric value for that LOS is 4.5.

See district traffic staff for more guidance on calculating a numeric value for level of service. Table 1, LOS Alpha/Numeric Value Comparison

LEVEL OF SERVICE (Alp ha Value)	LEVEL OF SERVICE (Numeric Value)
A (Not congested)	1.01 to 2.00
B (Not congested)	2.01 to 3.00
C (Minimal congestion)	3.01 to 4.00
D (Moderate congestion)	4.01 to 5.00
E (Severe congestion)	5.01 to 6.00
F (Extreme congestion)	6.01 to ~

Congestion Triggers

The LOS thresholds shown in Table 2 may act as triggers for mobility improvements on highway segments whose operating conditions exceed these thresholds in the predominant traffic flow direction in the design hour. These LOS thresholds allow higher levels of congestion on some routes than under previous WisDOT policy. To arrive at these thresholds WisDOT had to balance the social, environmental, and dollar costs that would be incurred by using the traditional performance threshold of LOS 4.0 (moderate congestion) against the costs of accepting more congestion on some portions of the State Trunk Highway System.

Table 2, Level of Service Thresholds

STH Sub-System	Rural & Small Urban Areas (Population < 50,000)	Urbanized Areas (Population > 50,000)
C2020 Backbone Routes	4.0	4.0
C2020 Connector Routes	4.0	4.5
Other Principal Arterials	5.0	5.5
Minor Arterials	5.0	5.5
Collectors & Local Function Roads	5.0	5.5

The highest LOS thresholds are applied to the Corridors 2020 system in recognition of its importance from a mobility and economic development perspective. On Corridors 2020 routes, only “minimal” congestion is allowed, except on connectors within urbanized areas, where slightly higher congestion levels are permitted. On other rural non-Corridors 2020 routes, “moderate” levels of congestion are allowed before improvements are identified. Even some “severe” congestion is allowed on non-Corridors 2020 routes in urbanized areas before a deficiency triggers an improvement. It should be noted that, in certain situations, expansion of facilities may be needed for reasons other than relieving congestion (e.g. safety, economic development or system continuity).

Design Year Target

The designer should become familiar with the LOS thresholds provided in Table 2 above. Once an improvement project is identified, designers should strive to provide a design year minimum LOS that is one LOS higher than the trigger provided in Table 2.

For rural and small urban areas, on C2020 Backbone and Collector routes, designers should strive for LOS C (3.0). On other principal and minor arterials as well as collectors and local routes the designer should strive for LOS D (4.0).

For urbanized areas designers should strive for; LOS C (3.0) on C2020 Backbone; mid LOS C (3.5) on C2020 Connector routes; and mid LOS D (4.5) on other principal and minor arterials, collectors and local roads.

Incremental Improvements

One of the most cost effective and safe ways to make highway improvements is through advanced planning and providing incremental improvements to the system. Additional lanes are considered as a last resort. The most efficient intersection, in terms of minimal delay, is a two-way stop control, the next most efficient is usually the four-way stop control or actuated signal.

In urbanized areas consider:

• Access control and review traffic • Mass transit and High Occupancy operations at intersections. Vehicle (HOV) lanes.

• Adding left or right turn bays or extending the length of existing turn In rural areas consider: bays • Auxiliary passing lanes and turn lanes.

• Review island locations. • Truck climbing lanes.

• Upgrade the signal timing and phasing. • Intersection sight distance impacts and

• Upgrade signal equipment. geometric improvements.

• Signal coordination and actuated • Vertical and horizontal alignment signal control. improvements, shoulder

• Conversion to a one-way street, from improvements. two-way street

Traffic Capacity Analysis
In order to evaluate the need for incremental improvements, or if additional lanes are needed, a traffic analysis may need to be completed. The design criteria tables in Procedures 11-15-1 and11-20-1 contain planning level ADT thresholds that indicate whether incremental improvements or lane additions are needed on a project. If a project is at or above these ADT thresholds, analyze the project for capacity improvements. The analyses needed to evaluate capacity improvements differ on rural and urban projects.

- Number and widths of travel lanes,
- Shoulder widths,
- Amount of no-passing zones,
- Type of terrain,
- Volume of traffic and
- Amount of heavy vehicle traffic. The ADT thresholds in the Arterial Design Criteria Tables in Procedure 11-15-1 are based on Highway Capacity Manual analyses using conservative data for typical 2-lane and multi-lane roadway configurations. All the design criteria tables in FDM 11-15-1 for ADTs above 3500 require lane and shoulder width values that maximize the computed capacity of 2-lane and multi-lane roads. This means that these capacity thresholds provide a fairly accurate indication, on most rural highways, of when capacity improvements maybe needed. These threshold values, along with guidance in Procedures 11-15-10 and 11-25-1, 5, 10 & 35, provide sufficient information in most cases, to assess when capacity or other operational improvements should be considered. Project-specific capacity and LOS analyses may need to be considered on projects when traffic volumes become very large, when interchanges and traffic signals are present or when a more sensitive determination of the number of future lanes on a project is needed.

Urban Capacity Analysis
Capacity and LOS on urban highways are affected by more factors than are rural highways. Some of these factors include:

- Type of intersection control (stop signs, traffic signals, etc.),
- Traffic signal timing and level of coordination between adjacent traffic signals or within a system of traffic signals,
- Presence of exclusive turn lanes,
- Number and lengths of exclusive turn lanes,
- Presence of medians,
- Level of access control,
- Presence of parking and bus stalls and frequency of maneuvers within those stalls,
- Number and widths of travel lanes. The dynamics of all these factors makes the capacity and LOS of individual urban roadways unique. The threshold values in the urban design criteria tables in Procedure 11-20-1 provide a general indication of when capacity improvements may be needed. In order to analyze the actual capacity and LOS on an individual project and to assess appropriate improvements, an individual traffic analysis needs to be completed. These traffic analyses can be completed by WisDOT, a consultant or local government design or traffic engineering staffs trained in the use of the Highway Capacity Analysis methodology. In general, begin a traffic analyses by evaluating the existing operation of the project using existing data collected in the field such as traffic volumes, roadway geometrics, traffic control operations (i.e., signal timing plans) and other features (i.e. parking stalls and maneuvers, driveway operations, etc.).

Once the existing traffic analyses are calibrated and the results are validated, the existing traffic analyses can be modified to model future traffic volumes, operations and geometric improvements to meet an agreed to level of service. Tables 3 and 4 in this procedure include guidance on the types of software available to complete traffic analyses on WisDOT projects and the appropriate applications of these programs.

Traffic Projections

Refer to Procedure 3-10-10 for guidance on how to obtain project level traffic forecasts and example forms to use for requesting traffic forecasts.

Traffic Signals

Refer to Procedure 11-50-5 for guidance on the evaluation of need for special intersection treatment and/or traffic signals. Another reference for evaluating the need for traffic signals is the Wisconsin Department of Transportation, "Traffic Signal Design Manual" (TSDM). The TSDM manual is typically used by the district traffic personnel.

Capacity Software Programs

Generally the most current version of the following highway capacity software programs shall be used for final analysis of WisDOT planning, design and traffic projects, subject to WisDOT District concurrence. Table 3 lists the software programs that are to be used for specific applications. Table 4 provides more detail on each program in terms of function, usage, applications and limitations.

TABLE 3, Software Programs for Various Applications.

Isolated, Signalized Intersection		**Arterial**	**Arterial Networks**
HCS		HCS	Transyt-7F
		Transyt-7F	CORSIM
	Passer II-90		
SIGNAL	CORSIM		
CORSIM			

Diamond Interchange	**Freeways**	**Other Applications Are: Unsignalized Inter., Two-Lane Hwys., Multi-Lane Hwys**
Passer III-90	HCS	HCS
Transyt-7F	CORSIM	
	Freq11	

Other software programs may be used to assist in analyzing data or to simulate traffic, but shall NOT be used as a final product. Examples of other software programs may include but are not limited to NOSTOP and PASSER IV. For additional recommendations on other appropriate software programs, contact district traffic personnel. Projects with capacity analysis that require submission to FHWA for review in Washington D.C., such as major freeway and freeway interchange modifications, shall be checked with the Highway Capacity Manual (HCM) criteria/Highway Capacity Software (HCS).

TABLE 4. HIGHWAY CAPACITY SOFTWARE DESCRIPTION LIST.

PROGRAM	FUNCTION	USAGE	APPLICATIONS	LIMITATIONS
HCS 2000 Release 4.1- Freeways	Calculates level of service and capacities for freeway segments, ramps (no ramp metering) and weaving sections based on the Highway Capacity Manual (HCM) (2000 Update).	Freeway segment analysis, ramp merge/diverge operation and weaving sections.	Provides accurate results in unsaturated conditions for freeway segments and ramps. User friendly menu system.	Poor weaving analysis model.
HCS 2000 Release 4.1 Signalized Intersection	Calculates level of service for signalized intersections based on the Highway Capacity Manual (HCM) (2000 Update). All functions within the software are for analysis only, none of them perform optimization.	Isolated signalized intersections.	Provides accurate results in unsaturated conditions. Is the most well known and accepted software. User friendly menu system.	Performs analysis only, no optimization. It is recommended to use software that optimizes for signalized intersections.
HCS 2000 Release 4.1 Unsignalized Intersection	Calculates level of service for unsignalized intersections based on the Highway Capacity Manual (HCM) (2000 Update).	Unsignalized intersections. CAUTION: Previous version of the unsignalized intersection module has been known to give inaccurate results, (a gap study is typically done to confirm the results).	Greatly improved over previous version. Now equates level of service with a delay value. Provides accurate results in unsaturated conditions. User friendly menu system.	Still needs gap study backup for LOS D or worse. Not reliable for intersections affected by upstream signals, need assumptions for divided roadway conditions.
SIGNAL 2000 TEAPAC Version 1 (Capacity & Optimization)	Calculates level of service, capacities and maximum queue lengths for all lane movements at a signalized isolated intersection based on the procedures outlined in the HCM (2000 Update). SIGNAL2000 also optimizes to find the most efficient cycle length, phasing sequence and timing. The optimization process minimizes delay of critical movements. SIGNAL2000 can be used to design for any level of service. SIGNAL2000 is the base program of the TEAPAC software family and each SIGNAL2000 file can be loaded into other TEAPAC programs such as PREPASSER, PRETRANSYT and RENETSIM.	Used for all isolated and coordinated signalized intersections to determine level of service, maximum queues, optimum cycle length, phasing sequence, and timing. Used as an input into other TEAPAC programs such as PREPASSER, PRETRANSYT and PRENETSIM to form a coordinated signal system.	Optimizes to minimize the delay for the critical movements on all approaches. Provides accurate maximum queues. Has ability to export data directly to an HCS file. Users can store many files under one file name through the use of line numbers. Excellent software support through TEAPAC.	Unconventional menu system and out dated graphics. Has a tendency to select a two phase signal and a small cycle length, even if the volumes support a left turn phase. Difficult to model a five leg intersection.
PASSER II Version 2 PASSER II	PASSER II-90 is a model for optimizing arterial progression. PASSER II-90 calculates level of service, queues, bandwidths, efficiency, attainability, fuel consumption, number of stops, speed of progression, a time-space diagram and ff t PASSER II 90	PASSER II-90 is used for arterials only, where the intersections are not closely spaced. It is used primarily as a bandwidth optimization program. It is recommended to not th PASSER II 90	Excellent model for bandwidth optimization for arterial progression. Above average menu system.	Cannot model signal networks. Poor cycle and split optimization model. Does a fair job of dealing with queue clearances. Confusing phasing and movement di (b d

PROGRAM	FUNCTION	USAGE	APPLICATIONS	LIMITATIONS
(cont'd)	offsets. PASSER II-90 can optimize cycle lengths, splits and offsets. PASSER II-90 can be used to simulate or optimize.	use the PASSER II-90 cycle or split optimization because it tends to give insufficient green time to the side streets and left turn phases (LOS E or F). If intersections are closely spaced, it is recommended to use TRANSYT-7F, which does a better job of keeping the queues in the interior of the intersections minimal.		diagrams (based on the NEMA scheme).
PASSER III Version 1.0	PASSER III-90 analyzes and optimizes fixed sequence signalized diamond interchanges. It also calculates signal timing plans for interconnecting a series of interchanges along continuous frontage roads.	PASSER III-90 is used for signalized diamond interchanges only. The cycle lengths are determined through SIGNAL2000 and PASSER III-90 is used for splits and offset optimization.	Good model for optimizing diamond interchanges. Above average menu system.	Confusing phasing and movement diagrams (based on the NEMA scheme). PREPASSER or AAPEX cannot be used with this program.
TRANSYT7F Release 8.2	TRANSYT-7F is a traffic signal timing optimization program which can both evaluate existing timings and optimize new plans to minimize stops, delay, fuel consumption and costs. Output includes delays, average queues, stops, fuel consumption, time-space diagrams, flow profile diagrams and platoon progression diagrams. The primary function of TRANSYT-7F is not to provide bandwidths but to minimize stops, delay and fuel consumption, which may or may not provide arterial progression. However, a recent addition to the model (PROS) can be used to give a combination of wide bandwidths along an arterial while still trying to minimize the stops, delays and fuel consumption.	TRANSYT-7F is used for traffic signal networks and arterials (where the intersections are closely spaced where queuing could be a problem). If wide progression bands are desired along an arterial in a network, PASSERII-90 is used to determine the offsets for the arterial and those offsets are input into TRANSYT-7F to obtain a coordinated network with a wide progression bandwidth along the primary arterial. SIGNAL2000 is used to determine cycle lengths, phasing and splits. TRANSYT-7F is typically only used to determine offsets.	Excellent model for minimizing stops and delays in a signal network. Excellent model for optimizing offsets along an arterial with closely spaced intersections. User friendly interface for running TRANSYT-7F, but not for data input.	Undesirable model for arterial progression if the prime goal is wide bandwidths along the arterial. The program is based on cards, which makes the data input out dated. A preprocessor such as PRETRANSYT or AAPEX may be a good investment. Queues which are given as an output are more an average queue and not a maximum. Undesirable model for split optimization as it tends not to give enough green time to the side street (LOS E/F).

PROGRAM	FUNCTION	USAGE	APPLICATIONS	LIMITATIONS
CORSIM* Version 4.32 (TRAF- NETSIM portion)	TRAF-NETSIM is an extensive simulation model that can model fully actuated or pretimed signalized intersections, unsignalized intersections and bus stops in an isolated or coordinated system. The best feature of the model is the animation. The user can view the entire system or part of the system in real time. The user can view the effects of progression, queues, delays, loop detector placement and timing, signal timing, bus stops, lane designation and gaps. TRAF-NETSIM is the only model that can effectively model a fully actuated signalized intersection.	TRAF-NETSIM is used for situations where TRANSYT-7F and PASSERIV-90 cannot do an adequate job, such as corridors where there are many major unsignalized intersections, a high volume of busses and bus stops, and actuated signals which are not part of a coordinated system. TRAF-NETSIM animation is used for public meetings to illustrate traffic operations with or without traffic signals, additional lanes or other roadway improvements .	TRAF-NETSIM has excellent animation graphics, does a good job of modeling actuated signals and provides adequate output for unsignalized intersections. TRAFNETSIM is an excellent tool for "what-if" roadway improvement scenarios such as converting a one-way street to two way.	TRAF-NETSIM is a simulation model and cannot optimize any criteria. It is quite time consuming to build and debug a network. A preprocessor such as PRENETSIM may be a good investment. Based on past experience, plan on spending one hour debugging the input data for every hour spent entering the data.
CORSIM* Version 4.32 (FRESIM portion)	FRESIM is an enhancement to the INTRAS model. It is from the same family of programs as TRAF-NETSIM and uses the same interface. FRESIM is a microscopic freeway analysis tool. FRESIM can simulate freeway geometric conditions such as 1-5 thru lanes, 1-3 lane ramps, grades, curves, superelevation, lane additions, lane drops, incidents, work zones and auxiliary lanes. The operational features include lane-changing, ramp metering, surveillance system; different vehicle types, different driver habits and warning signs for lane drops, incidents and off ramps.	FRESIM is used to model freeway corridors to determine impacts of adding additional lanes, ramps and weaving sections. FRESIM is first used to model and replicate existing conditions. Then modifications to the model are made such as geometric improvements and future volumes. FRESIM is used to model design year volumes on the existing and improved freeway system.	Excellent freeway microscopic simulation tool. Provides detailed output. Does a much better job than HCS in modeling weaving areas.	FRESIM is based on cards which makes it awkward to input data and prone to input errors. Poor ramp metering model. It is quite time consuming to complete a FRESIM run. FRESIM will not directly model HOV's or reduced lane widths. FRESIM does not give a level of service for ramps or weaving sections. No graphics are available.
FREQ11 Version 3.0	FREQ is a macroscopic freeway analysis tool. FREQ11PE is used for ramp metering analyses. FREQ11PL is used for HOV lane analyses.	FREQ11PE is used for designing ramp metering systems and FREQ11PL is used for HOV lanes.	Excellent tool for modeling ramp meters and HOV lanes and impacts to the freeway system.	Time consuming to build a model. No graphics are available.

- CORSIM is a software program that combines NETSIM and FRESIM ★.

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