

HSM Applications to Multilane Urban Suburban Multilane Intersections

Exercise IV – Prediction of Crash Frequency
Performance for Urban/Suburban Multilane Street
and Intersection and Comparison to Substantive
Safety Performance

- **Session #12**



Exercise IV – IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

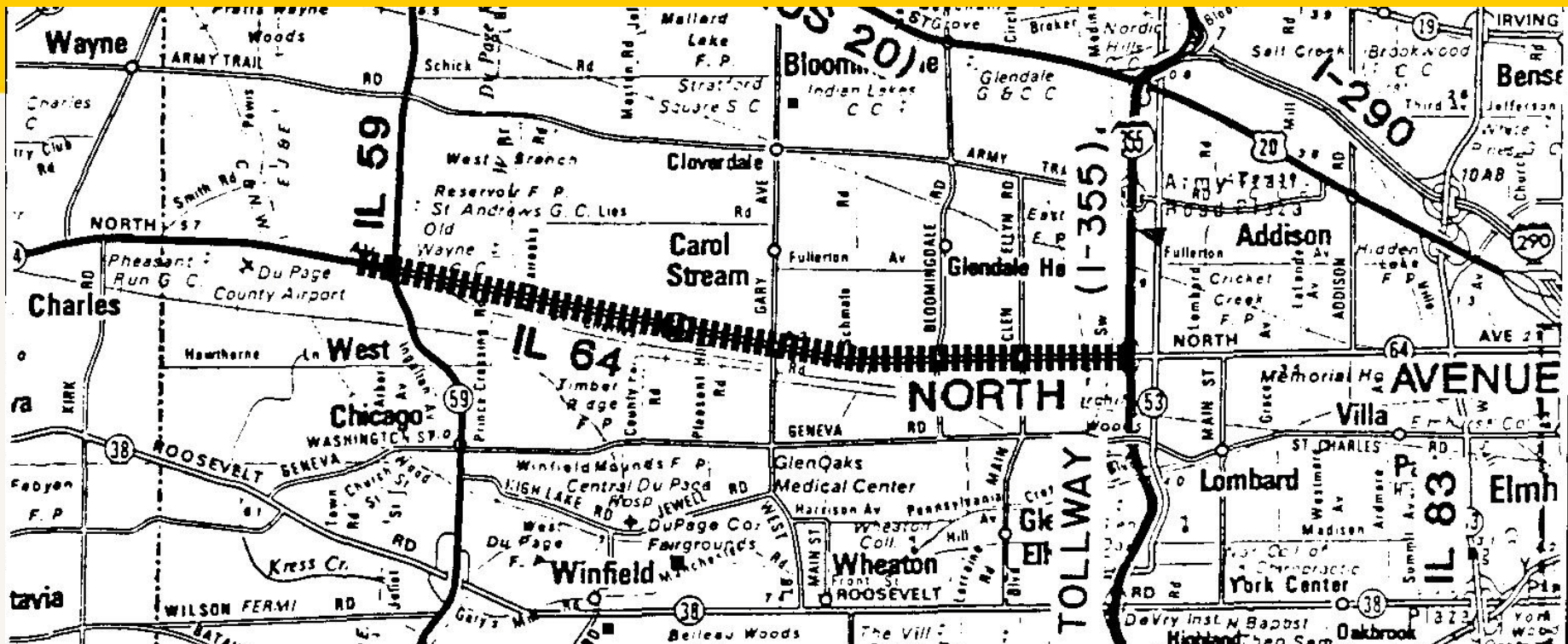
Learning Outcomes:

- ▶ Apply Urban/Suburban Multilane Crash Frequency Prediction model and CMFs
- ▶ Apply Urban/Suburban Multilane Intersection Crash Frequency Prediction model and CMFs
- ▶ Compare predicted Crash Frequency performance to actual safety performance

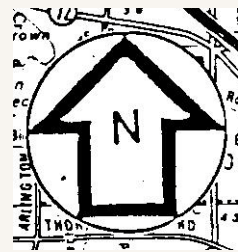
Exercise IV – IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

IL 64, DuPage County, Illinois:

IL Route 64, an east-west state highway initiates at Lake Michigan in the City of Chicago and terminates at the Mississippi River at the west border of Illinois. In DuPage County, 1987 population of 780,000, IL Route 64 is known as North Avenue traversing the cities of Elmhurst and Villa Park and through rural unincorporated areas west to St. Charles Illinois in Kane County. IL Route 64 was improved to 4 lanes in the 1960's throughout this length with intersection improvements at major crossroads such as other state routes and county routes consisting of left turn lanes and traffic signal control during the 1960's and 1970's.



ILLINOIS ROUTE 64 NORTH AVENUE
 ILLINOIS ROUTE 59 TO
 INTERSTATE ROUTE 355
LOCATION MAP
 EXHIBIT A-1



Exercise IV – IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

Study Section:

Length of Section = 0.97 miles

ADT = 37,000 AADT

No Horizontal Curves; 2.8% vertical curve west of Shopping
Center for 0.35 mi

Driveways:

Residential driveways (minor) 7

Minor commercial driveways (< 50 parking spaces) 7

Major commercial driveways (> 50 parking spaces) 11

Total # of Driveways **25**

Exercise IV – IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

Unsignalized T- Intersections w/o left turn lanes:

Mildred	700 AADT
Virginia	700 AADT
Bernice	700 AADT
Western	700 AADT
Pearl	1,500 AADT
Diane	700 AADT
Evergreen	700 AADT
Amy	700 AADT
Newton	700 AADT

Signalized 4-Approach Intersections with left turn lanes:

Bloomingdale Road	16,100 AADT
Shopping Center (north and south)	2,400 AADT
Main Street-Glen Ellyn	16,700 AADT

Crash data for 1986, 1987, 1988 – 3 years

Intersections:	Total	Injury	Day	Night
Mildred	9	2	6	3
Virginia	12	3	9	3
Bernice	16	3	11	5
Western	11	4	7	4
Pearl	22	6	16	6
Diane	16	5	11	5
Evergreen	11	4	7	4
Amy	7	4	4	3
Newton	12	5	8	4
Bloomingle Rd	170	68	122	48
Shopping Center	18	5	13	5
Main St-Glen Ellyn	146	45	100	46
Totals:	450	154	314	136

Exercise IV– IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

Study Section:

Crash data for 1986, 1987, 1988 – 3 years

	Total Crashes	Injury Crashes	Day	Night
Rdwy Segment	84	26	57	27
12 Intersections	450	154	314	136
Totals:	534	180	371	163

Exercise IV – IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

Proposed Design Cross-Section:

6 12-foot wide lanes with 42 foot wide curbed and landscaped median dividing the opposing directions of travel

12 foot wide paved shoulders

12 foot wide left turn lanes at all major intersections

+ 2 side street intersections

Total number of Unsignalized Intersections

with left turn lanes Pearl + Evergreen 2

Total number of Unsignalized Intersections

with no median opening nor turn lanes 7

Mildred Av

Diane Av

Virginia Av

Bernice Av

Amy Av

Western Ave

Newton Ave

Exercise IV – IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

Proposed Design Cross-Section:

Highway illumination on both sides at 200 foot spacing of 400watt HPS on 40 foot mounting height on breakaway poles; Utility poles relocated out of clear zone; Parking is prohibited

Signalized Intersections:

Bloomingdale Road (150 peds/day) 16,100 AADT

➤ 150 pedestrians per day

➤ three 12' lanes + 12' shoulder each direction/right turn lane + double left turn lanes = $1+3+2+3+1 = 10$ lanes

➤ 1 alcohol sales within 1,000 ft

➤ 1 bus stop within 1,000 ft

Shopping Center (north and south) 2,400 AADT

Main Street-Glen Ellyn 16,700 AADT

Exercise IV – IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

1. Predict the Crash Frequency and Apply CMFs for the segment using the Suburban Multilane Divided model (4D) for the following:
 - a. **Base Model Multiple Vehicle Non-Driveway**
 - b. **Base Model Single Vehicle Non-Driveway**
 - c. **Driveway Related Crashes**
 - d. **CMF's for Parking, Roadside Objects, and Lighting**
 - e. **Predicted Crashes with CMF's Applied**
 - f. **Pedestrian Crashes**
 - g. **Bicycle Crashes**
 - h. **Total Predicted Crashes for Segment**

Exercise IV – IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

1.i. From the analysis of Crash Frequency, answer the following question:



Is the actual Crash Frequency performance for the geometrics for IL 64 (Driveways, parking, and lighting) less than the Predicted Crash Frequency?

Substantive Safety Performance = ?

Predicted Crash Frequency = ?

Substantive Safety Performance less than Predicted Crash Frequency YES/NO

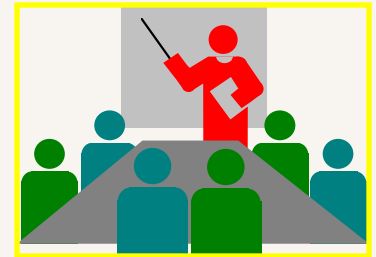
Exercise IV – IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

2. Predict the Crash Frequency for the Proposed Intersection Design for Bloomingdale Road at IL 64 using the Urban model (4SG):
 - a. **Base Model for Multiple Vehicle collisions**
 - b. **Base Model for Single Vehicle collisions**
 - c. **CMF's for left turn lanes + It tn phasing + right turn lanes + No Tn on Red + Lighting + spd enf**
 - d. **Predicted Crashes with CMF's Applied**
 - e. **Predicted Crashes for Peds and Bikes**
 - f. **Total Predicted Crashes for Intersection**
 - g. **Combined Roadway & Intersection Crashes**

Exercise IV – IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

From the Crash Prediction analysis,
perform the following:

- 2.1 Is the Predicted Crash Frequency performance for the intersection of Bloomingdale Road at IL 64 safer than the Substantive Safety Performance value?



Substantive Safety Performance = $170/3 = \underline{\quad} / \text{yr}$

Predicted Crash Frequency = $\underline{\quad}$ crashes/yr

**Substantive Safety less than
Predicted Crash Frequency** **YES/NO**

Exercise IV – IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

Learning Outcomes:

- ▶ Applied Urban/Suburban Multilane Crash Frequency Prediction model and CMFs
- ▶ Applied Urban/Suburban Multilane Intersection Crash Frequency Prediction model and CMFs
- ▶ Compared predicted safety performance to actual safety performance

IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn



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IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

“After” as a 6-Lane Divided Highway with 42 foot median and access restricted to right-in, right-out with only 2 unsignalized median openings



IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

“After” as a 6-Lane Divided Highway with 42 foot median and access restricted to right-in, right-out with only 2 unsignalized median openings



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IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

Study Section:

Crash data for 1986, 1987, 1988 – 3 years

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IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

BEFORE -Crash data for 1986, 1987, 1988– 3 years

AFTER -Crash data for 2003, 2004, 2005– 3 years

Traffic “before” = 37,000 ADT; “after” = 68,850 ADT

	<u>Total crashes</u>		<u>Injury crashes</u>		<u>Severity Ratio</u>	
Segment	84	98	26	14	0.31	0.14
9 side streets	116	36	36	10	0.34	0.28
Bloomingdale Rd	170	151	68	41	0.40	0.271
Shopping Center	18	28	5	6	0.278	0.21
Main Street-Glen Ellyn	146	142	45	26	0.308	0.18
Total	534		180			
Total	455		97			

IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

1. Predicted Crash Performance for the segment using the Suburban Multilane Divided model (4D) with 2005 traffic of 68,850 ADT

$$N_{br} = N_{\text{Multiple Vehicle (non-driveway)}} + N_{\text{Single Vehicle (non-driveway)}} + N_{brdwu}$$

$$= 19.8 \text{ crashes per year}$$

$$= 9.4 \text{ crashes per year after application}$$

of CMF's + Ped +bike

Substantive Safety Segment

$$\text{Crashes "after"} = 98/3 = 32.7 \text{ avg crashes per year}$$

- Check 1). HSM modeling or 2) crash patterns

IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

IL 64 North Ave – side road Intersections

1. Predicted Crash Performance for the intersections using the Suburban Multilane with 2005 traffic of 68,850 ADT:

$$N_t \text{ at } 900 \text{ adt} \times 8 = 8 \times 6.22 = 49.8$$

$$N_t \text{ at } 1,750 \text{ adt} \times 1 = 1 \times 8.19 = 8.19$$

$$N_{\text{side streets}} = 57.95 \text{ crashes per year}$$

Actual Int Crashes “after” = $36/3 = 12$ avg crashes per yr

- ▶ Check 1). HSM modeling or 2) crash patterns
- ▶ Modeling the 7 intersections as “intersections” with no median opening is *invalid*

IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

IL 64 North Ave – Side road Intersections

1. Predicted Crash Performance for the segment using the Suburban Multilane Divided model (4D) with 2005 traffic of 68,850 ADT – recalculate with only 2 side streets+7 driveways

$N_{\text{side streets}} = 14.4$ crashes per year

Side Street Crashes “after” = $36/3 = 12$ avg crashes per year

- “Close”

IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

IL 64 North Ave – Segment Crashes

1. Predicted Crash Performance for the segment using the Suburban Multilane Divided model (4D) with 2005 traffic of 68,850 ADT – recalculate with only 2 side streets+7 driveways

$N_{br} = 19.6$ crashes per year

Segment Crashes “after” = $98/3 = 32.3$ avg crashes per year

- ▶ **Check 1). HSM modeling or 2) crash patterns**

- Something is out of wack!!!!

IL 64 North Ave & Bloomingdale Rd Intersection

2. Predicted Crash Performance for the Intersection of Bloomingdale Road & IL 64 using the Urban SPF model (4SG) at 68,850 ADT:

$$\begin{aligned} N_{\text{bimv}} &= \exp(-10.99 + 1.07\ln(68,850)) + \\ &\quad 0.23\ln(23,475) \\ &= 25.64 \text{ crashes per year} \end{aligned}$$

$$\begin{aligned} N_{\text{bisv}} &= \exp(-10.21 + 0.68\ln(68,850)) + 0.27\ln(23,475) \\ &= 1.09 \text{ crashes per year} \end{aligned}$$

IL 64 North Ave & Bloomingdale Rd Intersection

2. Predicted Crash Performance for the Intersection of Bloomingdale Road & IL 64 using the Urban SPF model (4SG) at 68,850 ADT:

$$N_{bi} = 26.72 \times (0.66 \times 0.78 \times 0.85 \times 1.0 \times 0.9107 \times 1.0) = 10.66$$

$$N = N_{bi} + N_{pedi} + N_{biki} = 10.66 + 0.368 + .401 = 11.43$$

Total Crashes "after" = 46 crashes per year in 2005

Rear End Crashes = 31 or 67.4%

Which is significantly higher than 45 to 48% nationally

IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

IL 64 North Ave – Side road Intersections

1. Predicted Crash Performance for the segment using the Suburban Multilane Divided model (4D) with 2005 traffic of 68,850 ADT – recalculate with only 2 side streets+7 driveways

$N_{\text{segment}} = 20.0$ crashes per year

Segment Crashes “after” = $98/3 = 32.7$ avg crashes per year

- Something is out of wack!!!

IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

IL 64 North Ave & Bloomingdale Rd

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IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

IL 64 North Ave & Bloomingdale Rd

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IL 64 North Ave & Bloomingdale Rd Intersection



IL 64 North Avenue & Bloomingdale Road – Looking East

Rear End Crashes for IL 64 are $281/455 = 31$ or 61.7%
- 72/96 (75%) for 2005 are east-west



► **Signal Coordination**

CRF = 12 to 38% for reduction in total crashes

IL 64 North Avenue & Bloomingdale Road – Looking East



-Signal Coordination restored in April 2007 and awaiting 2008 crash info to confirm reduction in rear end crashes

Exercise IV – IL 64 North Avenue from Bloomingdale Road to Main Street-Glen Ellyn

Questions and Discussion

