Bicycle Level of Service Application

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A bicycle suitability analysis was done in early 2002 on the most significant roads (urban arterials and collectors, plus paved rural roads) in the Kane County Council of Mayors planning area. The effort coincided with development of the Kane bike/ped plan. It was originally inspired by a recommendation of the Chicago Area Transportation Study's Bicycle and Pedestrian Task Force to try BLOS in Kane County before advocating its use region-wide.

This report includes descriptions of the Bicycle Level of Service (BLOS) measure, the method used in applying BLOS in Kane County, details and assumptions for specific terms, and general conclusions.

In addition to this report, the following products are being given to Kane County:

1. ArcView GIS layer (or other format) with fields for BLOS and its inputs. The fields are described at the end of this report.
2. Maps of BLOS (larger scale) and its individual inputs.
3. BLOS map and disclaimer for use in the Kane bicycle plan's public map.

Bicycle Level Of Service[1]

Bicycle Level Of Service (BLOS), together with the FHWA's Bicycle Compatibility Index (BCI) are emerging national standards for quantifying the "bike-friendliness" of a roadway. While other "level-of-service" indices relate to traffic capacity, these measures indicate bicyclist comfort level for specific roadway geometries and traffic conditions. Roadways with a better (lower) score are more attractive (and usually safer) for cyclists.

BLOS evaluation may be useful in several ways:

- A bicycle map can be produced for the public to assist them in route selection.
- The most appropriate routes for inclusion in the community bicycle network can be identified.
- "Weak links" in the network can be determined, and sites needing improvement can be prioritized.
- Alternate treatments for improving bike-friendliness of a roadway can be evaluated.
- Road project selection formulas can include a BLOS term to encourage implementation of bike planning goals.

Landis et al. developed the Bicycle Level of Service (1997) by measuring cyclist reaction to actual field courses. BLOS is similar to BCI in its sensitivity to curb lane width. Its traffic volume dependence is logarithmic, increasing the impact of changes at low and medium traffic levels. Additional paved shoulder or bike lane width has a major impact on the BLOS score, as do poor pavement condition and high volumes of heavy vehicles. The model was originally developed for use in metropolitan areas throughout the United States. The Bicycle Level of Service formula is illustrated and described on the following page.

$$BLOS = 0.507 \ln(Vol_{15}/L_n) + 0.199 SP_t(1+10.38HV)^2 + 7.066(1/PR_5)^2 - 0.005 W_e^2 + 0.760$$

where:

Vol_{15} = volume of directional traffic in 15 minutes = $(ADT * D * K_d) / (4 * PHF)$
- ADT = Average Daily Traffic on the segment
- D = Directional Factor
- K_d = Peak to Daily Factor
- PHF = Peak Hour Factor

L_n = number of directional through lanes
SP_t = effective speed limit = $1.1199 \ln(SP_p-20) + 0.8103$, where SP_p is the posted speed limit
HV = percentage of heavy vehicles (as defined in the 1994 Highway Capacity Manual)
PR_5 = FHWA's 5-point pavement surface condition rating (5=best)
W_e = average effective width of outside through lane:
- $W_e = W_v - (10' * OSPA)$ where $W_l = 0$
- $W_e = W_v + W_l (1 - 2 * OSPA)$ where $W_l > 0$ & $W_{ps} = 0$
- $W_e = W_v + W_l - 2 (10' * OSPA)$ where $W_l > 0$, $W_{ps} > 0$, and a bike lane exists.

W_t = total width of outside lane (and shoulder) pavement
OSPA = fraction of segment with occupied on-street parking
W_l = width of paving between outside lane stripe and edge of pavement
W_{ps} = width of pavement striped for on-street parking
W_v = effective width as a function of traffic volume
- $W_v = W_t$ if ADT>4000 veh/day
- $W_v = W_t (2 - (ADT/4000))$ if ADT<4000 and road is undivided and unstriped.

Bicycle Level of Service ranges associated with level of service (LOS) designations:

BLOS Score Range	≤ 1.50	1.51-2.50	2.51-3.50	3.51-4.50	4.51-5.50	> 5.50
LOS Level or Grade	A	B	C	D	E	F

[1] Landis, Bruce, "Real-Time Human Perceptions: Toward a Bicycle Level of Service," Transportation Research Record 1578 (Washington DC, Transportation Research Board, 1997).

Method Used in Applying BLOS in Kane County

These steps were taken to gather the required data:

1. Collect existing data.

The IDOT IRIS (Illinois Roadway Information System) database is available from CATS in ArcView GIS format, with almost all the required data fields for rural and significant urban roads in the six-county area. Some of the most recent version available is from year 2000. While IRIS is a very good starting point, there is lots of missing, inaccurate, and old data. The best data is from state roads, followed by county and then local roads. This IRIS data was supplemented with Kane DOT (KDOT) traffic volume maps (2000-01) plus some road width, paved shoulder, and speed limit information.

2. Send data to towns and townships.

Each agency (25 towns, 10 western and central townships) was sent a letter (attached) with an individualized map and a table of the best available data for the major roads in the area. They were requested to fill in missing data, correct wrong data, and give estimates if necessary – especially for traffic volumes which have been increasing countywide. Roads with significantly different segments had a data table record for each.

3. Collect data.

Many agencies sent in their replies promptly, however, some required in-person or phone meetings. Unfortunately, a few agencies never responded despite repeated requests. For those towns that failed to respond, informal fieldwork was performed to gather missing data. In addition, field work and phone calls were used for follow-up questions.

4. Calculate BLOS.

ArcView GIS data entry using the IRIS layer was the starting point for the calculations. New fields were added for the returned values of the necessary terms. ArcView maps of the input terms and BLOS calculations illustrate the findings.

Comments on Specific Terms

A particular road's characteristics can change frequently over its course. Some smoothing of the data was done to reduce the number of distinct segments. Road cross-sections were rated away from intersections, where characteristics frequently change. The only intersection effect considered was the narrowing of some specific shoulders at long turn lanes.

Most towns and townships accepted the supplied data without many corrections. While most of the data was fairly accurate, the **traffic volumes** may be suspect. Most towns did not have these numbers, some were reluctant to make estimates (even when no IRIS data was given), and many just accepted the IRIS volumes. This under-reporting was compensated by two effects: first, the 15-minute volume for rush hour was used, giving a worst-case score; and second, the BLOS sensitivity to traffic volume is not as high as one might think. A doubling of traffic changes the score by 0.35-0.40, less than half a grade. Assumptions taken include D=0.565, K_d = 1/11, and PHF =1.

Heavy vehicles were assumed to be 3% of the total traffic on all roads. Available data from IRIS and other sources was very limited, so a constant value was taken.

Most **lane widths** were either available from IRIS, KDOT, or from the agencies. A few rural road lanes were assumed to be 10', consistent with other roads of that type. Roads with parking but no parking stripes included the entire travel and parking space in the lane width. When parking was striped, the parking area was treated as a paved shoulder or bike lane.

A striped **paved shoulder** had a huge effect on BLOS score. In fact, almost any road with a 10' shoulder would score an "A" – even Randall Road. The BLOS formula was actually derived using 5' shoulders as the maximum, so extrapolating beyond that is suspect. Using the formula directly, each 2' increase above 5' improved the score by approximately another grade. This seemed excessive, so I halved any width increase over 4' (e.g., I used 7' for 10' shoulders). Also, I reduced shoulder width on segments with long turn lanes of narrowed or no shoulders – like northbound Randall in Batavia. These corrections were made after discussions with Sprinkle Consulting.

For the rare roads with on-street parking, field estimates of the **percentage of occupied parking** and whether a stripe separated parking from the travel lane were used.

Surface condition was a difficult parameter to use correctly. Generally, IRIS data was quite old and often inaccurate or non-existent, with no indication of resurfacing since the measurement date. To simplify and to account for degradation over time, I would typically truncate any value less than 5 (newly paved) to the nearest whole number, usually 3 or 4. Sometimes towns would make corrections. Surface condition had an appreciable effect: the BLOS decrease from 4 to 3 is 0.35, with more impact at lower values. Also, the IRIS "Surface Type" parameter is used in the IDOT bicycle maps to determine whether a road is paved or gravel. That parameter and the responses from townships were used to flag only paved rural roads for BLOS rating.

Finally, the BLOS formula has a correction term for low-volume rural roads without **center striping**. The effective widening of the road has a huge impact – up to 1½ grades – but the correction does not apply to quiet, striped roads. This seems debatable.

Conclusions

Clearly, no formula for perceived bicyclist comfort level can be perfect. In addition to anomalies with different terms, there is a very wide range of bicyclists. However, that Bicycle Level of Service is an excellent tool that could be applied region-wide.

An experienced traffic-tolerant cyclist compared the BLOS rating with personal experiences riding on many of the rated roads in central and southern Kane County and agreed with almost all of the ratings. Most experienced riders feel comfortable on roads of "C" or better and will ride on many "D" roads, if necessary. In comparison. more casual cyclists prefer to ride on only "B" or better roads. A good bicycle accommodation design policy should call for a minimum LOS of "C" for all roads and "B" for roads with high latent demand (near important destinations).

The method and amount of time (90-100 hours) for this project seemed appropriate. IDOT's IRIS database fit in perfectly as a starting point, providing data for rural roads and major roads (collectors and arterials) within towns. Asking agencies for corrections saves on data collection and provides a level of "buy-in"– but factors including traffic volumes and surface condition were not always accurate. Doing a BLOS analysis on a narrower level, such as a specific road project, would justify more effort to get full accuracy of the parameters.

The approach of rating rural roads and major urban roads was appropriate for an outer suburban county like Kane. Areas developed within the past two or three decades have much more reliance on arterials and collectors, so rating these roads make sense. However, inner suburbs built entirely on a grid pattern might require a different approach, since cyclists could frequently use side streets as alternative routes.

The inclusion of these BLOS ratings in the Kane "public" bicycle map will increase the transportation and recreational usefulness of the map. The effort by Kane County to try a countywide BLOS analysis will help regional acceptance of this valuable planning tool.

BLOS Explanation and Disclaimer

The following text is also included in the public bike map. This Bicycle Level of Service (BLOS) map uses proven methodology to rate key roads in the county. BLOS is a nationally recognized measure of the perceived "comfort level" of a range of experienced adult bicyclists sharing a roadway with traffic. Key factors include traffic speed, daily traffic volume, surface condition, lane width, and the presence of on-road bike lanes or paved shoulders. Scores range from "A" (most comfortable for cyclists) to "F" (least comfortable).

Most paved rural roads and significant urban roads (collectors and arterials) are rated on this map. Urban side streets and residential roads are excluded. They are assumed to have a good BLOS score.

In many places (like modern, non-grid style development), urban arterials and collectors are often the only way to get to specific destinations. In other places, side streets or nearby trails provide better alternatives. However, to be consistent, all "significant" urban roads are rated here, even those with alternatives.

The BLOS ratings on this map are in no way an endorsement or recommendation of a particular road or an indication that a road is intended for use by bicyclists. Rather, the ratings are only a quantified trip-planning tool for the individual adult bicyclist in the selection of roads meeting his or her experience, skill, and comfort levels.

Users of this map should be aware that potential hazards and obstructions may exist on the routes shown and that Kane County and the other relevant maintaining agencies in no way warrant the safety or fitness of the suggested routes. This map does not expand the liability of Kane County and the other maintaining agencies beyond existing law. The user of this map bears full responsibility for his or her safety.