

Bicycle and Pedestrian Level of Service Measures

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Ed Barsotti
League of Illinois Bicyclists
630-978-0583
ed@bikelib.org
www.bikelib.org



Outline



- Why consider bike/peds in road designs?
Why are measures needed?
- Bicycle Level of Service / Pedestrian Level of Service overviews, uses
- Policy possibilities
- Resources - including easy-to-use on-line calculator

Why should road designs accommodate bikes & peds?



■ It's what people want:

- 53% want more fed \$ on bike facilities, even if it means less gas tax for roads
- 50% support requiring roads to have bike lanes or paths, even if it means less space for cars and trucks
- Most bicycling takes place on roads, not separate trails.
- 52% bike trips for recreation, 43% to get to destinations.

■ Context-sensitive design

Why should road designs accommodate bikes & peds?

- Arterials and collectors provide the only access, especially in newer, non-grid areas



Why should road designs accommodate bikes & peds?




- Encourage diversion of short trips, for health, environment, less congestion
- Provide for the many who don't drive for economic, age, other reasons

Why should road designs accommodate bikes & peds?

- Bikes/peds will be there to some extent anyway, so better to design for them



Bike/ped performance measures - why?



- “Accommodating bike/ped” a common goal, but very subjective
- Bicyclists’ needs especially tough to know for those lacking experience, training
- Other transportation goals (air quality, congestion) have performance measures
- Mainstream bike/ped planning

Bicycle Level of Service

Pedestrian Level of Service



- Both models developed by Sprinkle Consulting Inc., used throughout USA
- Research based on perception of comfort, safety for range of adults
- Both based on roadway corridor cross-sections and traffic conditions
- Numeric result, grade ranges "A" (best) to "F" (worst)

Bicycle Level of Service



- Measures on-road bicycling conditions, NOT separate trails!
- For mid-block cross-sections, not for intersections
- Applicable for teen and adult cyclists

BLOS input variables



- Motorized traffic: Volume, Speed, % Trucks, % Occupied Parking
- Roadway: # of Lanes, pavement condition, width of outside lane and extra pavement (shoulder/parking/bike lanes)

BLOS model

$$\text{Bicycle LOS} = 0.507 \ln(\text{Vol}_{15}/L) + 0.199 \text{SP}_t (1+10.38\text{HV})^2 + 7.066(1/\text{PR}_5)^2 - 0.005 W_e^2 + 0.760$$

Vol_{15} = volume of directional traffic in 15 minute time period

L = total number of through lanes

SP_t = effective speed limit = $1.1199 \ln(\text{SP}_p - 20) + 0.8103$, SP_p is posted speed

HV = percentage of heavy vehicles

PR_5 = FHWA's 5-point surface condition rating (5=best)

W_e = average effective width of outside through lane = $W_t + W_1 - \Sigma W_r$

W_t = total width of outside lane and shoulder/parking pavement

W_1 = width of paving from outside lane stripe to pavement edge

ΣW_r = width reduction due to encroachments in outside lane

BLOS Levels



Level-of-Service

BLOS Score

A

≤ 1.5

B

> 1.5 and ≤ 2.5

C

> 2.5 and ≤ 3.5

D

> 3.5 and ≤ 4.5

E

> 4.5 and ≤ 5.5

F

> 5.5

Sample street



- ADT = 12,000 vehicles/day
- Two 12' lanes
- No paved shoulders, bike lanes, parking
- 40 mph speed limit
- $PR_5 = 4$ (good pavement)

- BLOS Score = 4.1 (D)

Lane Width and Striping

Outside lane width	With striping		
10	4.36 (D)		
12	4.14 (D)		
14	3.88 (D)	12 - 2	3.58 (D)
16	3.58 (D)	12 - 4	2.86 (C)
18	3.24 (C)	12 - 6	1.98 (B)

- Extra space benefits cyclists
- Striping particularly helpful



Lane Width and Striping



Pedestrian Level of Service



- Walkers' perception of comfort and safety
- Mid-block cross-sections, including any sidewalks and buffers

PLOS input variables



- Motorized traffic: Volume; Speed; % Occupied Parking
- Roadway: # of Lanes; width of outside lane; width of extra pavement (shoulder/parking/bike lanes)
- Sidewalk: Width; buffer width and type (e.g., tree spacing)

PLOS model

$$\text{Pedestrian LOS} = -1.227 \ln(W_{ol} + W_1 + f_p \times \%OSP + f_b \times W_b + f_{sw} \times W_s) + 0.009 (\text{Vol}_{15}/L) + 0.0004 \text{SPD}^2 + 6.046$$

W_{ol} = width of outside lane

W_1 = width from outside lane stripe to pavement edge (shoulder, parking, bike lanes)

f_p = on-street parking effect coefficient

$\%OSP$ = percent of segment with on-street parking

f_b = buffer area barrier coefficient

W_b = buffer width (between edge of pavement and sidewalk)

f_{sw} = sidewalk presence coefficient

W_s = width of sidewalk

Vol_{15} = volume of directional traffic in 15 minute time period

L = total number of through lanes

SPD = average running speed of traffic

PLOS Levels



Level-of-Service

PLOS Score

A

≤ 1.5

B

> 1.5 and ≤ 2.5

C

> 2.5 and ≤ 3.5

D

> 3.5 and ≤ 4.5

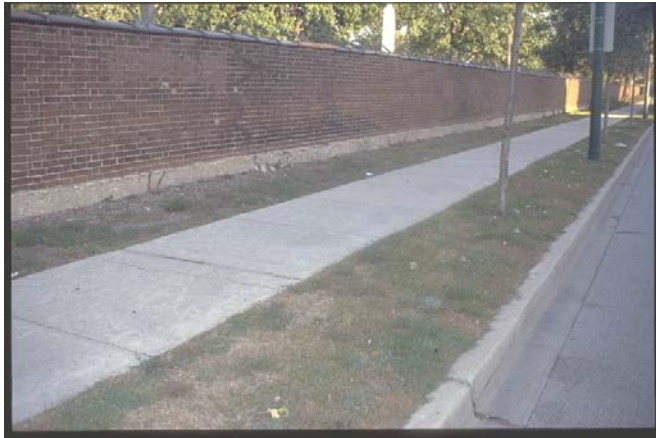
E

> 4.5 and ≤ 5.5

F

> 5.5

Sample cases

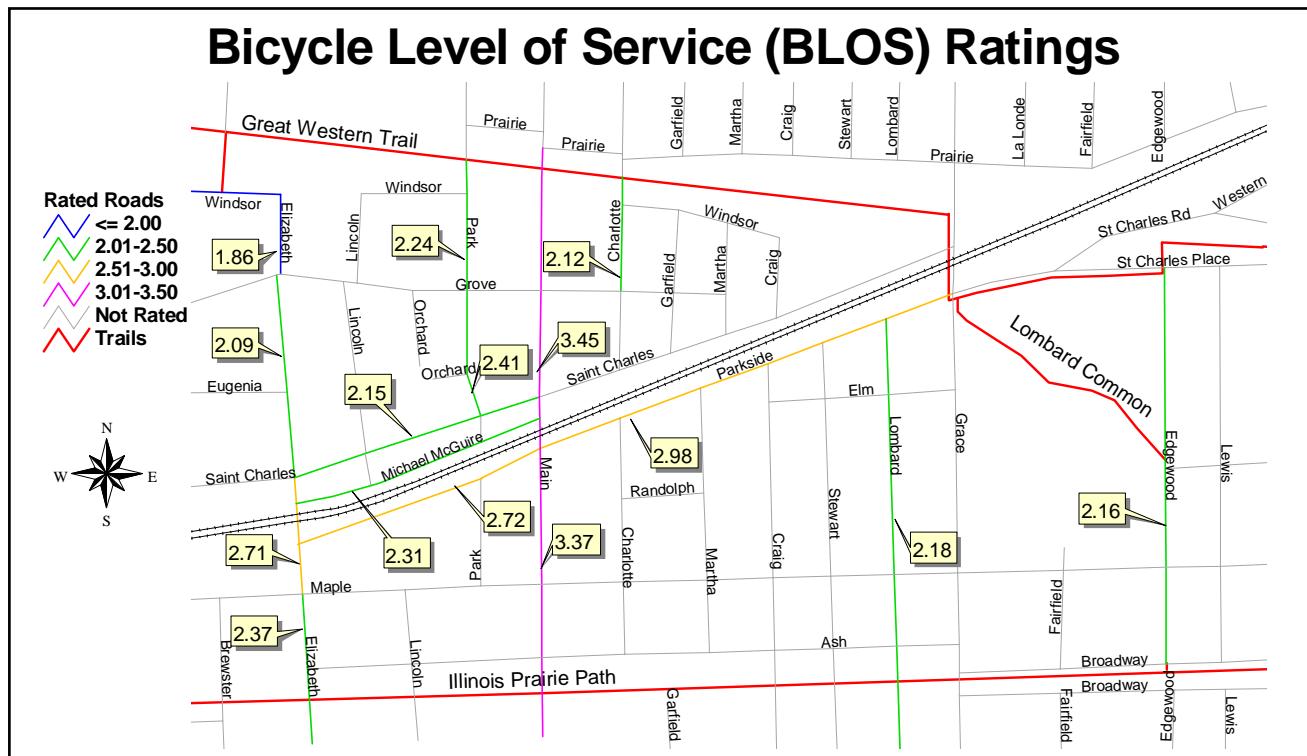


Sample cases

- ADT = 12,000 vehicles/day; Speed = 40 mph
- Two 12' lanes; No paved shoulders, bike lanes, parking
- No sidewalk: **PLOS = 5.03 (E)**
- 5' sidewalk, 6' buffer, no trees: **PLOS = 3.53 (D+)**
- 5' sidewalk, 20' buffer, no trees: **PLOS = 3.17 (C)**
- 5' sidewalk, 6' buffer, trees every 40': **PLOS = 3.16 (C)**

BLOS, PLOS Applications

- Pick routes for community bike network
- Identify “weak links” in bike or ped network



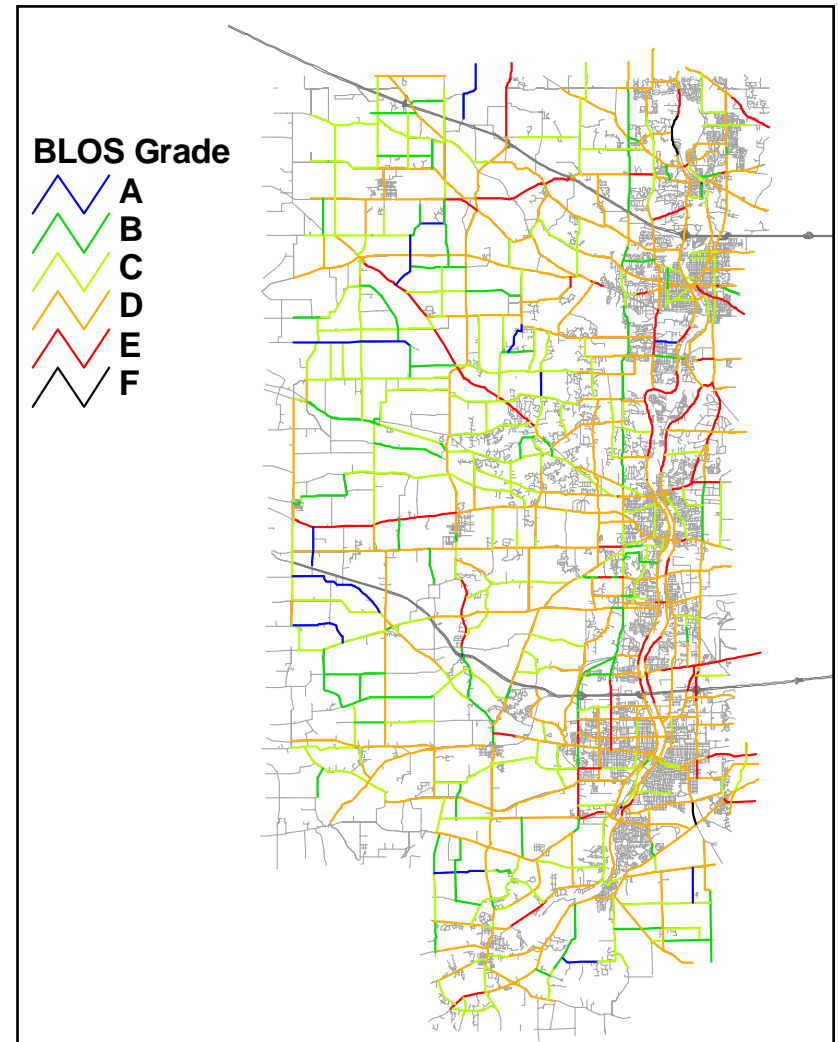
BLOS, PLOS Applications



- Prioritize sites needing improvement
- Evaluate alternate treatments during design - providing flexibility to engineers

BLOS, PLOS Applications

- Develop a suitability map to help with route selection



BLOS, PLOS as policy tools



- Performance measures can be tied to goals and policies for all road projects
- Policies can range from simply reporting bike/ped impact up to target LOS levels

3 levels of increasing policy commitment



- 1) Raise awareness: calculate and report before-and-after BLOS and PLOS
- 2) Provide incentive: include measures in road project selection
- 3) Policy requirement: meet a certain BLOS/PLOS level

Calculate and report before-and-after scores

- Each project proposal includes BLOS and PLOS - report scores in TIP?
- Use simple on-line calculator form
- Raises awareness of project impact, easy to do

BLOS and PLOS for the following road segment			
Lanes per direction:	1		
Outside lane width:	12 ft		
Paved shoulder/bikelane width:	4 ft		
Bidirectional ADT traffic volume:	12000 (veh/day)		
Posted speed limit:	40 mph		
Heavy vehicle percentage:	3%		
FHWA's pavement condition rating:	4		
% of segment with occupied parking:	0%		
% of segment with sidewalks:	100%		
Sidewalk width:	5 ft		
Sidewalk buffer/parkway width:	10 ft		
Buffer/parkway avg tree spacing:	80 ft		

	Score	Level-of-service	Compatibility Level
BLOS:	3.18	C (2.51-3.50)	Moderately High
PLOS:	3.06	C (2.51-3.50)	Moderately High

Use as incentive during road project selection



- In selection criteria or formulas, include BLOS and PLOS terms
- Credit (or discredit) for post-project scores, and/or before-to-after change
- Terms could be weighted by simple demand-side criteria or other analysis

Policy requirement examples



- New roads & roads requiring ROW acq: BLOS of "C" or better, "B" or better in areas of higher demand. PLOS similar.
- All projects: maintain or improve scores - Do NOT worsen conditions!

On-line BLOS/PLOS calculator

■ www.bikelib.org/roads/blos/losform.html

First, enter data into form

The screenshot shows a web browser window titled "BLOS/PLOS Form - Microsoft Internet Explorer". The address bar displays "http://www.bikelib.org/roads/blos/losform.html". The main content area is titled "BLOS/PLOS Calculator Form" and contains the following text: "To calculate Bicycle Level of Service (BLOS) and Pedestrian Level of Service (PLOS) of a particular roadway section, fill out the following. The references are given [here](#)."

The form consists of several input fields with their respective labels and default values:

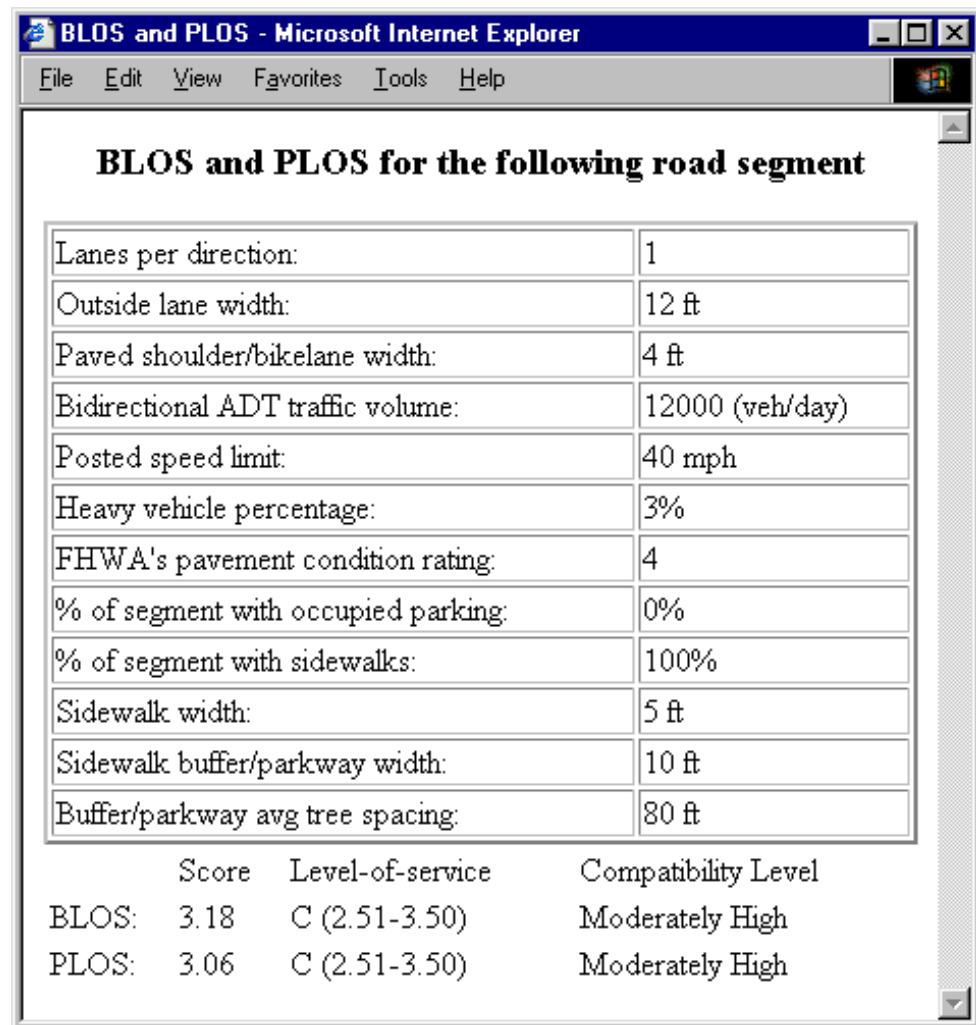
- Through lanes per direction: (Default = 1) [1]
- Width of outside lane, to outside stripe, in ft: (Default = 12) [12]
- Paved shoulder or bikelane, outside lane stripe to pavement edge, in ft: (Def=0) [4]
- Bi-directional Traffic Volume, in ADT: (Default = 12000) [12000]
- Posted speed limit in mph: (Default = 40) [40]
- Percentage of heavy vehicles: (Default = 3) [3]
- FHWA's pavement condition rating: (5 = Best, 1 = Worst; Default = 4) [4]
- Percentage of road segment with occupied on-street parking: (Default = 0) [0]
- Percentage of segment with sidewalks: (0 - 100, default = 100) [100]
- Sidewalk width, in ft: (Default = 5) [5]
- Sidewalk buffer/parkway width, in ft: (Default = 10) [10]
- Buffer/parkway average tree spacing, in ft: (Default = 80, 0 for no trees) [80]

At the bottom of the form, there are two buttons: "Calculate" and "Reset".

On-line BLOS/PLOS calculator

■ www.bikelib.org/roads/blos/losform.html

Then, result window pops up with scores



The screenshot shows a web browser window titled "BLOS and PLOS - Microsoft Internet Explorer". The page content is titled "BLOS and PLOS for the following road segment" and displays a table of input parameters and their values. Below the table, the calculated scores for BLOS and PLOS are shown, along with their corresponding Level-of-service and Compatibility Level.

Parameter	Value
Lanes per direction:	1
Outside lane width:	12 ft
Paved shoulder/bikelane width:	4 ft
Bidirectional ADT traffic volume:	12000 (veh/day)
Posted speed limit:	40 mph
Heavy vehicle percentage:	3%
FHWA's pavement condition rating:	4
% of segment with occupied parking:	0%
% of segment with sidewalks:	100%
Sidewalk width:	5 ft
Sidewalk buffer/parkway width:	10 ft
Buffer/parkway avg tree spacing:	80 ft

	Score	Level-of-service	Compatibility Level
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Other Resources



- Bicycle LOS: Landis et al., TRB 1578
Pedestrian LOS: Landis et al, TRB 1773
Sprinkle Consulting - 813-949-7449
- AASHTO's Guide for the Selection of Bicycle Facilities (1999) - Ped version soon
- www.bicyclinginfo.org and www.walkinginfo.org (Pedestrian and Bicycle Information Center)