Collecting Bikeways Data in Minnesota

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Introduction: Why Collect Bikeways Data, Anyway?

So you've been asked to help in your area's bikeways data collection effort, so what now? First, a little background information on what the *Bikeways Project* is and what it hopes to accomplish:

The Bikeways Project is an ongoing joint effort of several state agencies – including MnDOT, Met Council, and LMIC – citizen groups, advocates, and concerned individuals who have worked in the Twin Cities for many years, with the goal of advancing the cause of alternative transportation, in general, and bicycle safety and accessibility, more specifically, throughout the state of Minnesota. To this end, the Project's organizers hope to develop (are in the process of developing, more accurately) a comprehensive database of all of the bike routes, bike lanes, and bike paths – collectively known as bikeways – in the state, beginning with those in the Twin Cities metropolitan area. It will be based in Geographic Information Systems (GIS), allowing for the electronic collection, analysis, and updating not only of the bikeways' locations, but also of a wide variety of qualitative characteristics of the bikeways.

So now you're wondering, where do I fit in? I'm no GIS technician. Well that's the great thing about this project and about this manual; it has been designed to be as accessible as possible to those willing to help (i.e. you!), even if they are unfamiliar with GIS. By following the instructions in this manual, you will be able to collect and record an abundance of useful data for the Bikeways Project. By recording the data you collect in the Excel Spreadsheet Supplement (Appendix C) – which you may want to print off and fill in manually when you have to go out 'into the field' – and then transmitting it to your local coordinator to be added to the growing database, you will be helping to complete a major step in the Bikeways Project process. With your help, we will soon be on our way to a greener, healthier, safer Minnesota.

Thank you and Good Luck!

Bikeway Segment Location and Name

Before any qualitative data is gathered about a bikeway, it is necessary to know something about its location. Therefore, your first task will be to collect locational data about each bikeway – or, more accurately, each **bikeway segment** – including its **name**, if one exists (so the GIS technician receiving your data will know where to begin!). We propose a simple process by which to collect this data, explained below.

Bikeway Segments

One important aspect of gathering bikeway data is where to begin and end a bikeway segment. A new segment starts where an attribute changes significantly. If that is at an intersection, the new segment will begin at that intersection. If it is between intersections, decide which intersection is closest to the significant change and begin the new segment there (note: intersections include where trailheads meet streets).

To collect segment data, simply record (in the Excel Spreadsheet Supplement, Appendix C) the names of the cross-streets, or -paths, at the intersection at the beginning of each segment (known as the 'From Node') and those at the intersection at the end of each segment ('To Node'). The rest of the data collected, then, will correspond to the bikeway segment falling between these two nodes; the data will be collected *for* this segment (see Appendix C).

Important – from this point on, the more general term 'bikeway' will be used in reference to what has just been defined as a 'bikeway segment.' Also, 'ESS' will be used to abbreviate 'the Excel Spreadsheet Supplement, Appendix C.'

Bikeway Name

The next piece of information to gather is the name of the bikeway. This, too, should be fairly straightforward. In general, bikeways will already have at least one name associated with them. If a road or trail has a second name (e.g. Snelling Avenue is also MN 51) choose the name that is most prominent and make a note of the other name in the notes section at the end of the ESS.

If the bikeway is part of a road, the bikeway name will be the same as that of the road. For example, the bikeway going down Summit Avenue in St. Paul will be named 'Summit Ave'.

For trails, there are two ways of getting the correct name. Many trails will have their names posted at the trailhead. Otherwise, whoever maintains the trail has probably given it a name. If it is a local trail, your best bet would be to contact your local Parks and Recreation Department. If it's on the premises of a building, e.g. the paths on a high school campus, name the bikeway after that building. Examples: 'Kennedy High School Paths' or 'MLK Community Center Paths.'

Bikeway Type

Definition

The **bikeway type** field in this database helps to define the specific characteristics of the bikeways in your community. Is the bikeway a road or a trail? Is it designated for bikes? Is it one-way or two? If it's a road, how high is the traffic volume? This section includes definitions for the different types of bikeways, information on how to collect type data, and a decision chart to help you effectively categorize different bikeways. In addition, you will be asked to note whether or not the bikeway is **active** (see below).

For the purposes of this project, the bikeway types are predefined in the following table; every bikeway should fit into one of these twelve categories.

Paved Trail	These bikeways consist of paved trails *off of streets* ('off-street') which are 8 feet or more in width.
Non-paved Trail	These bikeways are unpaved trails (consisting of packed gravel or crushed limestone instead of pavement), are off-street, and are 8 feet or more in width.
Bike Lane	These bikeways are on-street, are 4 feet or more in width, and are designated with a striped lane, painted bike symbols, and signs noting that the lane is for bikes only.
Paved Shoulder >= 5 Feet	These bikeways are paved and have a width of 5 to 8 feet (not including the gutter width) with parking *prohibited*. Alternately, they can have a width of greater than 8 feet (again not including gutter width) with parking *allowed*.
Low Volume Road with Shoulder < 5 Feet	These bikeways include only *County roads* with a traffic volume of 1,000 AADT or less. These roads may have a paved shoulder of less than 5 feet or no shoulder at all.
US/State Road with Paved Shoulder >= 5 Feet	These bikeways include only *MN/DOT roads* with a traffic volume of 10,000 AADT or less. This category includes paved roads that either have a width of 5 to 8 feet (not including the gutter width) with parking *prohibited* OR have a width of greater than 8 feet (again not including gutter width) with parking *allowed*.
Paved Trail, One-Way Direction	These bikeways must be one-way, paved, off-street, and 8 feet or more in width.
Non-paved Trail, One-Way Direction	These bikeways are one-way, unpaved trails (consisting of packed gravel or crushed limestone), are off-street, and are 8 feet or more in width.
Bike Lane, One-Way Direction	These bikeways are one-way, on-street, 4 feet or more in width, and are designated with a

	striped lane, painted bike symbols, and signs noting that the lane is for bikes only.
Paved Shoulder >= 5 Feet, One-Way Direction	These bikeways are one-way, paved, and either have a width of 5 to 8 feet (not including the gutter width) with parking *prohibited* OR have a width of greater than 8 feet (again not including gutter width) with parking *allowed*.
Gap Filler	These bikeways consist of relatively short segments used to connect official bikeways. They do not fit within any of the above categories (of official bikeways) but are used simply as to connectors in the larger bikeways system.
Other	Bikeways that do not fit into any of the above categories should fall into this category and should be briefly described.

Data Location

Certain municipal and county government bodies may have databases with information regarding bikeways and bikeway type. If yours does, this would be an excellent place to begin (i.e. by comparing their bikeway type definitions to those listed above). Most likely, however, the gathering of bikeway type data will require personal observation and measurements 'in the field.' The data literally consist of all the bikeways in your area, and you have the ability to categorize all of them under one of the twelve listed types.

Collection Process

Collecting bikeways type data in the field should be a fairly straightforward process. To help in defining each bikeway as accurately as possible, a decision chart has been included (below). The decision chart asks a series of yes-or-no questions to get more specific information until the bikeway fits into one of the twelve type categories. Simply answering the questions posed in the chart, in order and using the above definitions of bikeway types (as you observe each bikeway), should result in an accurate decision as to the bikeway type. Record the bikeway type for each bikeway in the ESS.

Active? (Y/N)

In addition to collecting data regarding bikeway type, we would appreciate your collection of data regarding whether or not a bikeway is **active**, by which we mean ‘in existence’ or ‘in use,’ as opposed to ‘proposed.’ This variable is primarily administrative; hence, most bikeway data that you will be able to collect in the field will be listed as ‘Y’ (active) under this attribute (in the ESS). Inactive bikeways will most often be *proposed* bikeways belonging to various longer-term regional planning initiatives and will thus be added by administrative planners interested in such initiatives. Therefore, ‘N’s will occur relatively infrequently as you collect bikeways data in your community. Regardless, collection of data for this subfield is both helpful and appreciated.

Hints

As previously mentioned, bikeway type data will largely be collected ‘in the field.’ Whether driving, biking, or walking, follow along each of the potential bikeways in your community. As you travel, categorize each road (using the decision chart as a guide) and make notes in the ESS. Carry a tape measure for distance measurements and keep an eye out for marked bicycle route signs. You may need to seek out county or state data on traffic volumes for final type categorizations.

Surface Quality

Definition

The **surface quality** attribute is actually a composite of several sub-attributes. The following table lists these and gives definitions for each.

Surface Type (for all bikeway types)	What material was used for the bikeway surface? – Dirt / Concrete / Asphalt / Gravel / Crushed Rock / (Mountain Bike Trail)
Shoulder Rumble Strip (for all non-trail bikeway types)	Is there a rumble strip within the shoulder (or bike lane)? – Yes / No
Shoulder Usage (for all non-trail bikeway types)	Is the shoulder (bike lane) also used for on-street parking? – Yes / No Is the shoulder (bike lane) also designated for bus use? – Yes / No Is the shoulder (bike lane) plowed during the winter? – Yes / No
Shoulder Drainage (for all non-trail bikeway types)	Is there a drain gutter in the shoulder (bike lane)? A drain gutter is defined as a portion of the surface angled sharply to divert water to the sides of the shoulder (bike lane). – Yes / No
Creation Date (for all bikeway types)	When was the bikeway created? (This may also mean, when was the road put into place/most recently resurfaced?) – DD/MM/YY
Pavement Condition Rating (for paved bikeway types only)	If this data is not available through your DOT, please make a judgment call using the Federal Highway Administration's *Present Serviceability Rating (PSR)* system (Appendix A).

Data Location and Collection Process

Like bikeway type, surface quality will most likely be assessed by visual inspection. In order to effectively collect and record these attributes, you may the checklist and contact information provided below, if you so desire. Otherwise, simply record the surface quality data in the ESS.

Surface Type	Dirt ___	Concrete ___	Asphalt ___	Gravel ___
	Crushed Rock ___	(Mountain Bike Trail) ___		
Shoulder Rumble Stripping	Yes ___	No ___		
Shoulder Usage	*On-street Parking*	Yes ___	No ___	
	Bus Use	Yes ___	No ___	
	Plowed	Yes ___	No ___	
Shoulder Drainage	Yes ___	No ___		
Creation Date (and/or Resurfacing Date)*	____________ Creation Date	____________ Resurfacing Date		
Pavement Condition Rating	1 ___ 2___ 3___ 4___ 5___			

*Creation and Resurfacing Dates may be found by contacting your DOT.

Suitability

Definition and Data Locations

Like surface quality, **suitability** is a composite of several sub-attributes which combine to give an impression of how safe a particular bikeway is for bicyclists (its 'bikeability'). For the purposes of this project, suitability will be assessed using a modified version of the Bicycle Level of Service (BLOS) model. The BLOS model is a statistically reliable way of evaluating the suitability of shared roadways for bicyclists, based on a study of bicyclists traveling in actual urban traffic and roadway conditions. The model, published in *Transportation Research Record 1578* by the Transportation Research Board of the National Academy of Sciences, quantifies a cyclist's perceived safety on a particular roadway as a function of several factors, and translates these factors to a 'letter grade' rating from A to F; the factors that were found to affect bicycling suitability are defined below. The study revealed that pavement surface conditions and striping of bicycle lanes are key factors in the compatibility of roadways for bicyclists. The striping of bike lanes was substantially more meaningful than a wider outside lane alone.

Many different kinds of data must be collected in order to compute the suitability rating for a bikeway; some may be collected by contacting local agencies, others may have to be collected manually (visually). The following table lists the types of data needed, gives a definition for each, and describes how each might be collected (where the data might be found).

Posted Speed Limit (Lane_Numb)	Speed limit of roadway in mph.
Pavement Condition Rating (Pave_Cond)	Use the same value as was determined for the Pavement Condition Rating attribute under '*Surface Quality*.'
Number of Lanes in Both Directions (Lane_Numb)	Do not include turn lanes.
Width of Outside Travel Lane to Pavement Edge (Lane_Shld_Width)	Make sure this value is in feet. Include width of right-most travel lane and striped paved shoulders, bike lanes, or marked parking spots. The standard lane width is 12 feet. If it is a wide outside lane, it could be 14 feet or 16 feet. This depends on the right of way available when the road was built, and may be available from your state DOT.
Width of Striped Shoulder (Shld_Width)	Make sure this value is in feet. Besides a striped bike lane, this width may also be, or include, marked parking spots. This value should be the value determined for the

	preceding attribute, minus the width of the outside lane.
Width of Pavement Striped for On-Street Parking (Shld_Park_Width)	Make sure this value is in feet. Standard width is 7-8 feet.
Bi-Directional Traffic Volume (Road_AADT)	Measured in annual average daily traffic (AADT). This data is available for most roads through your state DOT. If it is not collected for the specific roadway, look at a roadway with comparable volume for which there is data available and use that.
Percentage of Heavy Commercial Annual Average Daily Traffic (HCAADT) (Road_Heavy)	Percentage of AADT which is heavy commercial traffic. Heavy AADT is usually available from the DOT along with the AADT.
Percentage of Road Segment with Occupied On-Street Parking (Shld_Park)	This value will necessarily be an estimate obtained by field work or satellite photos. It can be collected on any given day or averaged over a week. Collect data for both sides of the road segment.

Analysis Process

The BLOS rating is determined from an equation which is a function of all of the above attributes. For a detailed look at the equation, refer to Transportation Research Record 1578, referenced in Appendix A. The equation has been created for you and is located in Appendix D (an Attached Excel Spreadsheet) such that simply inputting collected data will result in a numeric value, which you can then use to determine the 'letter grade' and suitability level (see table below). Record both of these in the ESS along with the values for the above sub-attributes.

Range	≤ 1.50	1.51-2.50	2.51-3.50	3.51-4.50	4.51-5.50	> 5.50
Grade	**A**	**B**	**C**	**D**	**E**	**F**
Suitability Level	Extremely High	Very High	Moderately High	Moderately Low	Very Low	Extremely Low

Hints

Important – The BLOS model was developed using roads with the following parameter ranges. The model is not meant to be used on roads outside these ranges:

- Lanes per direction (excluding turn lanes): 1 to 3

- Width of outside travel lane: 10 to 16 feet
- Paved shoulder or bike lane, outside lane stripe to pavement edge: 0 to 6 feet (no rumble strips)
- Bi-directional traffic volume: 550 to 36,000 ADT
- Posted speed limit: 25 to 50 mph
- Percentage of heavy vehicles: 0 to 2%
- FHWA's pavement condition rating: 5 (very good) to 2 (poor)
- A wide range of development types and parking conditions

Grade

Definition

Grade (gradient, slope in ArcMap) is the measurement of the change in vertical and horizontal distances (rise and run) between points. Generally, the higher the grade, the more difficult the ride will be along the given bikeway. Knowledge of grade, therefore, is very important for potential bikers. Unfortunately, gradient is also one of the more time-consuming attributes to collect. Grade can be calculated in degrees (°) or percent (%), where 45° translates into a 100% slope; given this relationship, as you approach 90° the grade approaches infinity.

Grade: Model Attribute Field

Value in table (GRIDCODE)	Description
1	0 – 3.0 % Gradient
2	3.1 – 5.0% Gradient
3	5.1 – 10.0 % Gradient
4	10.1 – 20.0 % Gradient
5	20.1 – 50.0 % Gradient
6	50.1 – Maximum Gradient

Data Collection

Please record the data for Grade in the corresponding field in the ESS. We recommend the following methodology for collecting grade data:

The first step is to find contour data for your area. These data can be found at any of the following locations:

GIS Data	Non-GIS Resources
State Department of Natural Resources (www.datadeli.com)	State Department of Natural Resources
Municipal / County / State Department of Transportation	Municipal / County / State Department of Transportation
Municipal / County / State Public Works Department	Municipal / County / State Public Works Department
MetroGIS (www.datafinder.org)	TopoZone (www.topozone.com/)
Minnesota Geographic Data Clearinghouse (www.lmic.state.mn.us/chouse/)	United States Geological Survey (www.usgs.gov)
GIS Data Depot (http://data.geocomm.com/)	Topographic Maps can be found at local outdoor recreation stores
US Census Tiger Files (http://arcdata.esri.com/data/tiger2000/tiger_download.cfm)	GlobeXplorer (www.globexplorer.com)

The data from these sources include 1, 3, or 5 meter / foot *contour lines*. For GIS, *LIDAR* (Light Detection and Ranging Technique) can also be used. LIDAR data, however, are rarely available for public use, and are unnecessary for the purposes of this project. 3 or 5 meter / foot contour lines are sufficient; more precise data are unnecessary and will only increase the number of calculations with little effect on accuracy.

Methodology

A) Calculate Gradient without GIS

While the use of Geographic Information Systems allows a team to obtain and represent detailed information on the gradient of bikeways, there are many methods to determine this information without use of GIS. These techniques lack the precision that can be obtained through use of a GIS; this is not necessarily detrimental, however, depending on the goal of the given project, as well as experience of the team involved in building the database. Two accurate and highly expandable methods of calculating the gradient of given bikeways include: Trigonometric Leveling and Interpolation from Topographical Maps.

i) Trigonometric Leveling:

This process involves the use of a Global Positioning System (GPS) to determine elevation at specific locations on the earth's surface. Knowing the elevations of these points and the distance between them, we are able to determine the vertical angle that separates the two locations, and solve for the change in elevation.

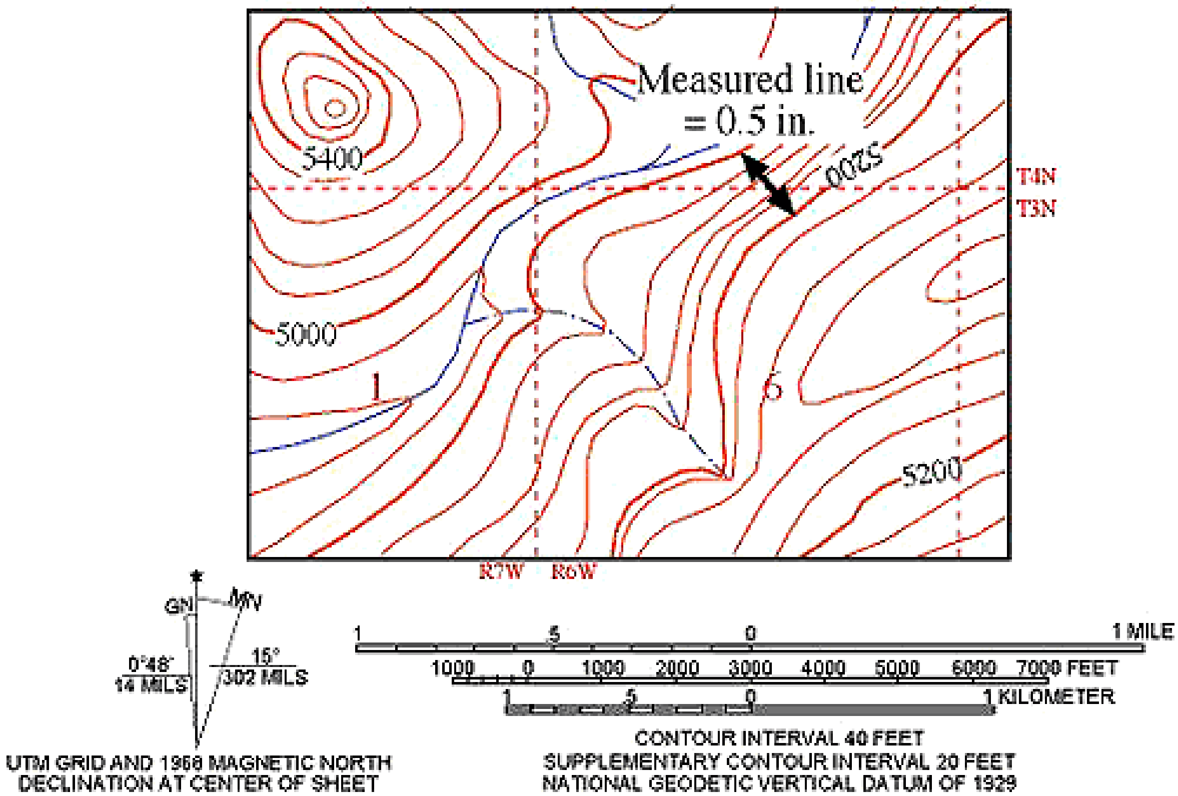
- Firstly, determine the respective elevations at Points A & B. This is done using the elevation field on the GPS unit. (Note: You must have at least 4 satellites to report elevation.)
- Next, determine the *horizontal distance* between Points A & B. This can be done using the waypoints of both A & B, and solving for the distance between points (in feet, meters, miles, etc).
- Thirdly, subtract the elevation of Point B from the Elevation of Point A. This will give the difference in elevation between the two points (*vertical distance*).

- Finally, calculate Percent Slope: $\frac{\text{Vertical Distance}}{\text{Horizontal Distance}} \times 100$
- *Main Challenges*:
  1) The accuracy of the data will be affected by the accuracy of the given GPS unit's measurement of elevation. Most importantly, you need a minimum of 4 satellites to measure elevation at any given point. Different GPS models have different accuracy when it comes to taking both way-points and elevation. For every calculation, therefore, you must take into account the % error of your device. This will also help you determine whether or not this methodology applies to your situation. If the percentage error remains constant, however, you can still calculate useful information regarding slope.
  2) Human Error: Although GIS is often very complicated and takes a significant amount of experience / knowledge / time to utilize, one of the many benefits gained by using this system is that it performs the necessary calculations for you. While completing the calculations by hand does not require advanced math skills, the amount of data involved may lead to calculation errors.

3) The distance between two points along a bikeway is not necessarily minimized. That is, when calculating the distance separating two points taken from a GPS, you are calculating the straight-line distance between those two locations. The bikeway may not run directly between those two points. The impact of this on your measurements can be reduced by significantly minimizing the distance between points used in the calculations. As the number of calculations increases, however, so does the likelihood of measurement error.

ii) Interpolation from Topographical Maps:
This process involves the use of contour lines from topographical maps to determine gradient. Similar to the process outlined above, knowing the elevations of two points and the intermediary distance can be used to easily calculate grade. In this case, however, the calculations are based on topographic maps that can have incredibly precise measures of elevation.

- Firstly, determine the elevation of Points A & B using the contour lines on the map. The Vertical Distance between the two points is determined by subtracting the elevation of Point A from that of Point B.
- Next, measure the horizontal distance between the two points in a straight line running from A to B. This is accomplished using a ruler, and interpolating distance based on the map scale.
- Finally, compute the percentage slope using the same formula as above. (**See Figure 1, next page**)
- *Main Challenges*:
  When determining slope from a topographical map, accurate measurements must be made along a straight line running perpendicular to the two given contour lines. Not surprisingly, bikeways do not necessarily run in straight lines, especially in relation to contour lines. The percent gradient, calculated, therefore, will not necessarily represent the change in slope along the bikeway, but simply the generalized gradient between two points that the bikeway intersects.



Determining hillslope from a topographic map

Length of measured line = 0.5 in, 0.5 in x $\frac{2000\text{ ft}}{1\text{ in}}$ = 1000 ft (.19 mi)= horizontal distance

Elevation change = 200 ft. (read off of contour lines)

Percent slope = $\frac{200\text{ ft.}}{1000\text{ ft.}}$ x 100 = 20% slope

Slope angle = arctan $\left(\frac{200\text{ ft.}}{1000\text{ ft.}}\right)$ = 11.3° slope

Figure 1. Calculate percent grade from topographic maps.
source: http://geology.isu.edu/geostac/Field_Exercise/topomaps/images/slp1.gif

B) Calculate Gradient using Geographic Information Systems (GIS)

1) TIN Creation

Once you have obtained the necessary contour data, you are ready to begin constructing a *Triangular Irregular Network* (TIN). A TIN gives a series of contiguous but non-overlapping triangles based on the x, y and z values of the data set. This provides the ability to compare changes in elevation between areas. The specific topography of the given area will influence the necessary interval of the gradient data (i.e. calculate percent rise per mile, block, etc.). Make sure that when creating your TIN, the elevation source selected is the highest possible of the given fields. Contour line data often contain numerous elevation fields that provide the highest, second highest, third highest, etc. points along a given line. When making our TIN, we are only interested in the highest point along each line.

In Arc Map:
Select *3D Analyst* → *Create/Modify TIN* → *Create TIN from Features*. Select your elevation data as your input layer. Set triangulation as 'hard line,' and 'height source' as the maximum elevation field. You may need to look at the given metadata to determine the name of this attribute field. (**See Figure 2**)

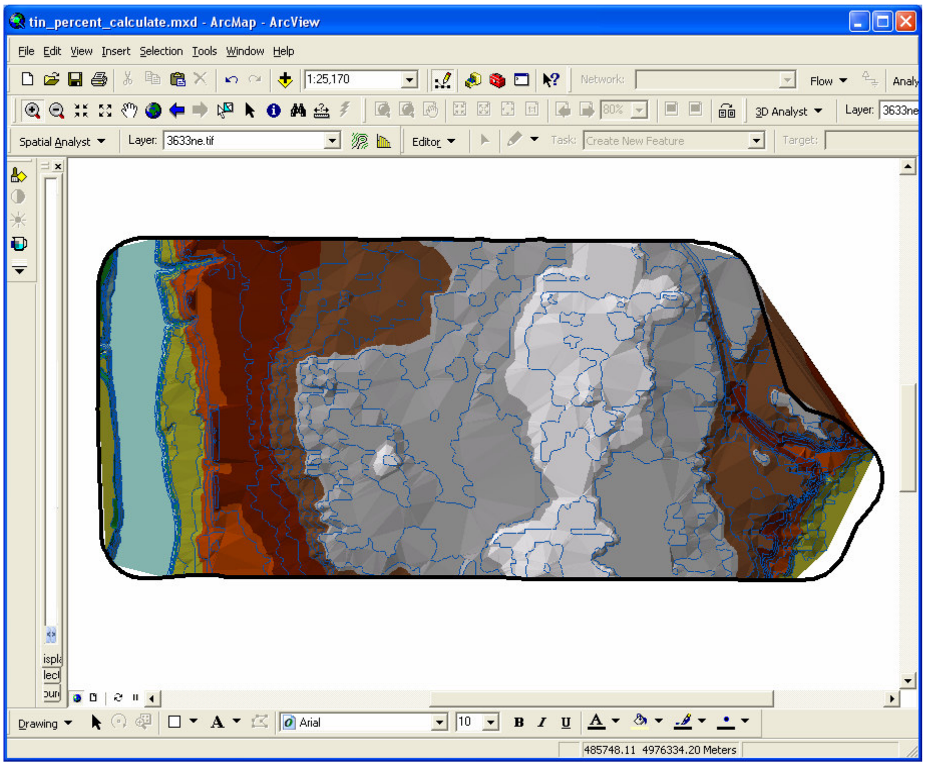


Figure 2. Screen Shot of a TIN

2) Calculate Slope of the TIN

Once the TIN has been created, various analytical tools can be applied to give percent change or degrees of slope. This step provides you with a raster layer that depicts the percent or degree of slope at regular intervals.

Select *Spatial Analyst* → *Surface Analysis* → *Slope*. From the dialog box that appears, set the 'input surface' as your newly created TIN layer, and 'output measurement' to Percent. The *Z factor* is used to convert the TIN's z units to x and y units. Leave the Default value as 1. 'Output cell size' determines the size of pixels that will be used in the newly created raster. This value will change depending on the scale of analysis and available hardware. The smaller the output cell size, the smaller the pixels used in the raster. For our data, we used an output cell size of 10 (size of each pixel = 10 meters). In ArcMap, slope is calculated based on the given pixel as well as 8 surroundings cells (**See**

Figure 3). As we increase the size of pixelation, therefore, the area from which slope is calculated increases dramatically. If working in an area with many changes in topography, this could lead to large, misleading generalizations in the data.

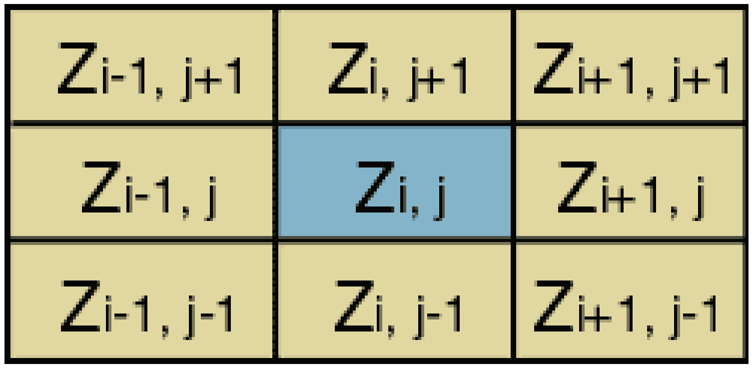


Figure 3. Grid for calculating slope in ArcMap
source: www.sli.unimelb.edu.au/gisweb/DEMModule/images/table1.gif

3) Map Reclassification

After creating a surface of slope (percent or degree), we must re-classify the given values into categories that are useful to the user. In a map depicting slope, for example, the user may wish to re-classify the entire range of values into defined categories of slope that are easily understood by bikers. This is accomplished using 'Reclassify' under the Spatial Analyst toolbar. For our example, we reclassified the full range of values into 6 categories. All of the data were used so that the entire coverage area remained.

Select *Spatial Analyst* → *Reclassify*. Select your slope grid as the 'input raster' and leave the default value in the 'Reclass Field.' Next, reclassify the data according to a series of mutually exclusive categories. These will be translated into a gridcode, and eventually your attribute table. Depending on the range of data and the desired number of categories, group the old values into desired ranges. Each old value should be associated with a unique value in the 'new values' column that corresponds to the number of categories chosen. For Mac-Groveland, we chose to divide the data into 6 categories. We deleted the remaining entries, and left the NoData row in both colums. Do not delete the NoData Rows. (**see Figure 4**)

The outcome of the reclassification process divides the area into the categories defined in the 'old values' column. In the ouput, each range is associated with the corresponding 'new value' integer. (i.e. a percent slope of 0 – 3.0 shows up as all areas with a value of 1).

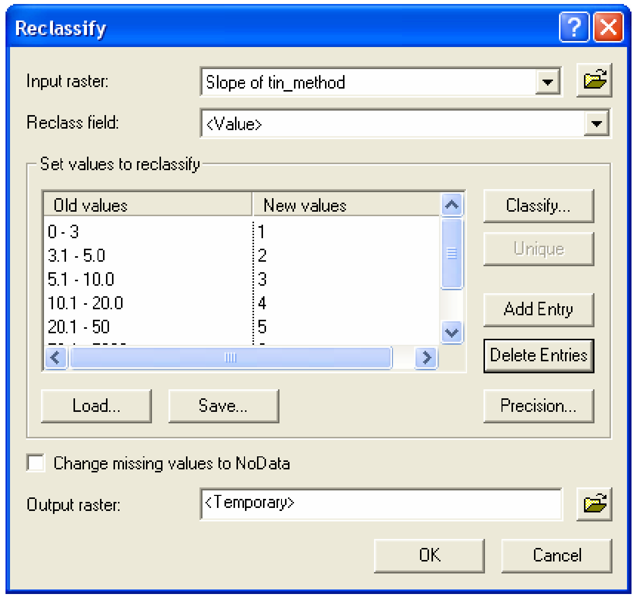


Figure 4. Reclassify Slope given attribute ranges

4) Convert Raster to Feature

Having reclassified the raster surface into a series of categories that define different ranges of slope, the next step involves converting the raster surface to polygons. This step will create polygons based on the different slope categories, and allow us to intersect this data with the given bikeways.

Select *Spatial Analyst* → *Convert* → *Raster to Features*. Set the 'input raster' field as your newly reclassified slope layer, and leave the other fields as their default values. After creating the new polygon layer, change the symbology to show differences in slope. Select *Properties* from the menu of the newly created feature layer → select *Symbology* → *Quantities* → *Graduated Colours* → In the 'Value' Field, select *GRIDCODE.* This will display the polygons of the newly created layer according to their associated GRIDCODE. Remember the GRIDCODE refers to the slope categories determined during the reclassification step. A whole number is to represent the given ranges, which cannot be converted to unique, vector features.

5) Intersect newly created polygons with Bikeways layer

After converting the layer from raster to features, we are now able to intersect the layer containing information on slope with the bikeways data. This is a necessary step of adding our grade data (specifically the calculated gridcodes) to the bikeways attribute data. Intersect combines two spatial data layers and determines the areas common to both (points, lines and polygons) while discarding all others. The tables of the two layers are combined into one. By intersecting the bikeways polylines with the newly created polygons showing slope, we are able to add info about slope into the bikeways attribute table. (**See Figure 5**)

Select *Analysis Tools* from the ArcToolbox → *Overlay* → *Intersect*. The input features are the two layers you want to overlay, in this case, the bikeways layer and newly created layer. Leave the default values for all other fields. Once the new layer has been created, you can change the symbology to show the different values of slope all along the bikeways layer. Select *Properties* → *Symbology* → *Quantities* → *Graduated Colours*, and in the 'Value' Field, select GRIDCODE. This will display the different gridcodes that exist along the bikeways of the area.

Attributes of reclass_6_insct_bike1

FID	Shape*	FID_grovel	OBJECTID	GRIDCODE	SOURCE	SIDE
0	Polyline	0	6042	5	St. Paul	NA
1	Polyline	0	6042	4	St. Paul	NA
2	Polyline	0	6042	1	St. Paul	NA
3	Polyline	0	6042	1	St. Paul	NA
4	Polyline	0	6042	4	St. Paul	NA
5	Polyline	0	6042	1	St. Paul	NA
6	Polyline	0	6042	3	St. Paul	NA
7	Polyline	0	6042	1	St. Paul	NA
8	Polyline	0	6042	4	St. Paul	NA
9	Polyline	0	6042	1	St. Paul	NA
10	Polyline	0	6042	4	St. Paul	NA
11	Polyline	0	6042	3	St. Paul	NA
12	Polyline	0	6042	4	St. Paul	NA
13	Polyline	0	6042	1	St. Paul	NA
14	Polyline	0	6042	2	St. Paul	NA
15	Polyline	0	6042	1	St. Paul	NA
16	Polyline	0	6042	3	St. Paul	NA
17	Polyline	0	6042	5	St. Paul	NA

Record: 0 Show: All Selected Records (0 out of 431 Selected.) 0

Figure 4. Attribute Table for Mac-Groveland Bikeways. Highlighted Gridcodes

6) Generalizing Data Based on Distance

Depending on the project at hand, you may wish to calculate the slope over a given distance interval. The methodology described above calculates the percentage change in slope based on the size of the pixels defined. For example, if the size of pixels selected is 10, and the projection is UTM, then each square pixel represents an area 10 meters by 10 meters. The percentage slope values calculated, therefore, will vary greatly on the size of pixels from which the data are calculated. Specific projects may require gradient data to be standardized over a given distance or area. (i.e. % change in slope per mile, or between intersections). This can be done by building and cleaning the data, a process where the topology of the line file is edited by removing specific nodes (requires ArcInfo license). While removing nodes to present change in grade over a set distance may be useful in numerous circumstances, there are also many drawbacks to altering these data. Most importantly, removing nodes will limit the ability to create a route finder, which requires nodes at every possible intersection along a roadway / bikeway.

Main Challenges:
In ArcMap, slope is calculated from the steepest downhill plane of the given TIN (ESRI), and is based on the area within 1 pixel, and its 8 neighboring cells. (figure 3 above). These factors raise three problems.

i) First, the plane from which slope is calculated does not necessarily run parallel to the given bike or roadway. The grade depicted along a bikeway therefore, may relate to a grade that runs sideways rather than lengthways across the path. While important to acknowledge, this problem is less of an issue given that engineers construct roads to run up and down, not along gradients.

ii) Secondly, the precision of the slope values for a given area is directly tied to the size of pixel output selected when creating the TIN and GRIDCODES. Although ArcMap calculates gradient based on the given and surrounding cells, the bikeway does not necessarily cover the entire area of calculation. The slopecode, therefore, may be highly skewed by a number of the cells (i.e. if a bike path runs along the edge of a cliff).

iii) Thirdly, if you choose to clip contour lines to a smaller study area (i.e. Mac-Groveland), this can cause highly inaccurate calculations of slope at the edges of the surface. When a contour line runs beyond the extent of a given area (i.e. Mac-Groveland), the lines are clipped based on the point at which they intersect the layer used to clip. Seeing as TINs are constructed from lines the x,y and z data from contour lines, clipping topographical data, therefore, results in numerous small triangles the coincide around the edge of the map. When slope is calculated from these triangles, the value are often impossible / unrealistic (i.e a slope of 7000% within a 10m by 10m area).

Amenities on Recreational Bikeways

Definition

The **recreational amenities** (or simply, **amenities**) data is somewhat different from the others, in that the information collected is going to be used to create a new data layer of amenities and *their* attributes. Thus, the explanation will be a little more involved.

Amenities

This part of the data collection is more specific and complex. This layer concerns locating amenities along recreational bikeways. Recreational bikeways are defined simply as trails separated from roadways. These 'paths' are meant to be used generally for recreational purposes. Listed below are the amenities for which you will be collecting data, complete with definitions.

Amenity	Definition
Motor Vehicle Parking	Secure short-term and long-term parking in proximity to bike path, at trail beginning, terminus or in between
Information Centers	Centers in proximity to recreational bikeways which provide cyclists with information such as a tourist bureau or park center
Signage	Any sign/posted map which gives the recreational user important or educational information (Map, Rules, Route Marker, Entry, Environmental Info, Warning, History or Other)
Restrooms (Toilets)	Any public facility in proximity to a recreational bike path
Lighting	Separated paths and bike parking areas require appropriate-scale lighting where evening walking and cycling is expected
Bike Racks	A device designed to hold and secure a bicycle within proximity to bike path
Drinking Fountains	Any potable water source which allows cyclists to fill up water bottles or drink directly from the source within proximity of a bike path
Benches	Any public facility which allows bikers to sit in order to rest in proximity to a recreational bike path
Picnic Areas	Any area with public picnic facilities (outdoors or sheltered) in proximity to a

	recreational bike path
Picnic Tables	Any picnic table in proximity to a recreational bike path
Scenic Overlook	A scenic spot in proximity to a recreational bike path
Telephones	Any public telephones in proximity to a recreational bike path which could be for general use or, more importantly utilized in the event of an emergency

Attributes

Each amenity has a different set of attributes associated with it. Thus, when collecting data about each amenity, it will be necessary to collect specific information relating to that amenity. This information will allow the recreational bikeways user to make informed decisions about where to bike, based on certain amenities. The following is a list of the amenities and the corresponding attributes and attribute definitions for each.

Motor Vehicle Parking

Location	Where is the parking lot located?
Pay	Does it cost money to park? (Yes or No)
Cost	How much does it cost to park? (In dollars/hour).
Spaces	How many spaces are in the lot?
Overnight	Can you park overnight in the lot? (Yes/No)
Handicapped Accessible	Are these parking locations handicapped accessible? (according to ADA standards)
Notes	Any other relevant and important information

Information Centers

Location	Where is the information center located?
Type	What type of information center is it? (For example, tourist bureau, park office etc.)
Hours	What are the hours of the information center?
Notes	Any other relevant and important information

Signage

Location	Where is the sign located?
Lit	Is the sign lit?
Type	What type of sign is it? (Map, Rules, Route

	Marker, Entry, Environmental Info, Warning, History or Other)
Content	What is the content of the sign
Notes	Any other relevant and important information

Restrooms

Location	Where is the restroom located
Type	What type of restroom is it? (Port-a- potty, building or other)
Male Facilities	Are there male facilities? (Yes or No)
Female Facilities	Are there female facilities? (Yes or No)
Baby Changing Facilities	Are there baby changing facilities? (Yes or No)
Handicapped Accessible	Is the restroom handicapped accessible? (according to ADA standards)
Notes	Any other relevant and important information

Bike Racks

Location	Where is the bike rack located?
Rack Spaces	Number of spaces that will hold bikes in rack
Permanent	Is this a permanent bike rack? (i.e. is it bolted to the ground?) (Yes or No)
Rack Type	What type of rack is this? (Single Post, Rack or Other)
Notes	Any other relevant and important information

Drinking Fountains

Location	Where is the water fountain located?
Notes	Any other relevant and important information

Benches

Location	Where is the bench located?
Length	How long is the bench (in feet)?
Notes	Any other relevant and important information

Picnic Areas

Location	Where is the picnic area located?
Type	What type of picnic table is it? (Sheltered

	or Outdoor)
Name	What is the name of picnic area (if applicable)?
Capacity	How many people will picnic area hold?
Electricity	Is there electricity available? (Yes or No)
Notes	Any other relevant and important information

Picnic Tables

Location	Where is the picnic table located?
Capacity	How many people will picnic table fit?
Length	How long is the picnic table (in feet)?
Handicapped Accessible	Is this picnic table usable under ADA guidelines?
Notes	Any other relevant and important information

Scenic Overlooks

Location	Where is the picnic table located?
Notes	Any other relevant and important information

Telephones

Location	Where is the telephone located?
Payphone	Does the phone cost money to use? (Yes or No)
Cost	What is the cost of using the phone? (in dollars/minute)
Notes	Any other relevant and important information

Data Locations and Collection Processes

Here are two recommended ways to go about collecting location data for amenities:

1) Check Local Sources

The first place to look for data on amenities is through your local governmental organizations, which may have already collected all or at least a large amount of this data. In highly populated areas, there will, most likely, be specialized groups that keep track of recreational areas. Frequently, the Division of Parks and Recreation will be the group which manages recreational bikeways and the amenities associated with them. In smaller areas, this may not be a highly specialized division of the government, but rather a smaller committee or even a single person.

Usually, these local sources will have information on the location of each amenity. It is possible that the other attributes will have also been previously collected. However, if this is not the case, this information must be collected by the data collector.

2) Create New Data

If amenities data has not yet been compiled or it is incomplete, it may be necessary to collect this data yourself by examining recreational bikeways and the surrounding areas. For the majority of the amenities, answering all of the attribute questions should be a fairly simple task once in the field.

For the location attribute of each amenity, however, the process is more involved. There are two ways to go about data collection of the location attribute for the amenities data on your own.

1. *With a GPS Unit* – If you, any organization or your local government organization has a GPS unit (a basic Garmin unit will be effective though Trimble units are more precise), you can collect the coordinates of these points with that. Using the GPS unit will allow you to accurately mark the *location* of each amenity (the most important attribute for each amenity). When collecting this data with a GPS unit, you will want to use a standard setting to aid the entry of data into the GIS system. For the state of Minnesota, using the UTM Zone 15 Geographic Coordinate System is optimal.
2. *Without a GPS Unit* – If you do not have access to a GPS unit, it is still possible to effectively collect your data manually.

   Use a paper map (the larger the scale of the map, the better) of the recreational area in which your recreational bikeway lies. Survey scale maps can usually be obtained through local government offices. By surveying the area yourself, you can use the map to mark the location of each amenity. This method is not nearly as precise, however, and is only recommended as a last result if there is absolutely no access to a GPS unit.

Data Management

In order to facilitate data collection, a data log should be created. Each amenity has different important attributes which must be collected (as described above). See Appendix A for a sample data log. Please record the collected data in the ESS.

Glossary

(Alphabetical by Section)

Introduction

Bikeway: Refers to the features that the Bikeways Project is interested in collecting data on (and that this manual provides information about how to collect information on); any surface deemed appropriate for biking that will be recognized in this project and will fit into one of the 12 'Bikeway Type' categories

Database: A collection of data organized for easy retrieval and analysis

Geographic Information Systems (GIS): A system for management, analysis, and display of geographic knowledge, which is represented using a series of information sets such as maps and globes, geographic data sets, processing and work flow models, data models, and metadata (ESRI)

GIS Technician: A trained professional who uses GIS technology on a daily basis

'Into the Field': See 'In the Field' under *Bikeway Type*

LMIC: Land Management Information Center

Met Council: Metropolitan Council

MnDOT: Minnesota Department of Transportation

Qualitative (characteristics): Also referred to as 'Attributes' (see 'Attribute' under *Bikeway Location and Name* section)

Bikeway Location and Name

Attribute: A quality or characteristic inherent in or ascribed to someone or something, in this case, to a particular bikeway; all of the qualitative data you collect are considered attributes of the bikeways

Bikeway Segment: A section of a bikeway; the basic unit used to organize bikeways data for this project. Sections are considered distinct from those that they link up with when there exists a disparity among at least one of the bikeway segment's attributes

'From Node': The 'beginning' intersection, marking the beginning of the bikeway segment

Intersection: Here referring to the place where two or more roads bisect one another

Node: A GIS term meaning point, in this context signifying where a bikeway segment begins or ends

Premises: Here refers to the building 'grounds'

Segment: See 'Bikeway Segment'

'To Node': The 'end' intersection, marking the end of the bikeway segment

Trailhead: The beginning of a trail, often where it meets up with a non-trail area

Bikeway Type

AADT: Annual Average Daily Traffic. This is the total volume of traffic on road segment divided by the total number of days in the year. AADT includes all types of vehicles.

Field: See 'In the Field'

Gutter: As opposed a road's shoulder. A gutter is the part of the road designed to drain surface water off the road. These are generally not suitable for biking on as they are often uneven and are generally punctuated with metal grates.

'In the Field': Refers to going out into your local environment to assess bikeway qualities via visual inspection

Official Bikeway: Bikeways conforming to any of the (first) ten descriptive categories (excluding Gap Filler and Other)

Off-street: This term refers to the specific location of bikeways in reference to automobile traffic. "Off-street" means that the relevant bikeways are physically separated from automobile traffic with the bikeway located away from the streets or roads. "Off-street" usually refers to bicycle trails in parks.

On-street: This term indicates a shared roadway with automobile traffic. Separation from traffic may take the form of a painted bicycle lane or shoulder divisions. The bikeway is directly adjacent to and located on, without physical barrier from, the street or road.

Shoulder: A reserved area alongside a roadway, often kept clear of all traffic though often used by bicyclists

Striped Lane: Refers here to special markings (a pained line, usually) designating a section of pavement for exclusive use by bicyclists

Sub-attribute: An attribute which fits into a larger attribute category

Surface Quality

Drain Gutter: See 'Gutter' under *Bikeway Type*

Mountain Bike Trail: A distinct class of bikeway surface notable for its off-road feel and separate regulations

Pavement Condition Rating: A numerical assessment of the condition of a road surface, available through the Department of Transportation or by using the PSR system (Appendix A)

Resurfaced: Paved over to make 'as new'

Rumble Strip: Strips of ridged or grooved road surface designed to alert drivers of when they are veering off of the road

Shoulder: See 'Shoulder' under *Bikeway Type*

Sub-attribute: See 'Sub-attribute' under *Bikeway Type*

Visual Inspection: Looking, yourself, 'with your own eyes'

Suitability

Annual Average Daily Traffic (AADT): See 'AADT' under *Bikeway Type*

Bicyclists: Those biking on a bikeway

'Bikeability': A term measure of the compatibility of a roadway to bicycling

BLOS model: Bicycle Level of Service model

Heavy Commercial –

> **Traffic:** Traffic composed of heavy commercial vehicles
> **Vehicle:** A vehicle having dual tires on one or more axels, or buses with a seating capacity of over 10.
> **Annual Average Daily Traffic (HCAADT):** The total volume of truck and bus traffic on a segment of road in one year, divided by 365.

Outside Travel Lane: The right-most travel lane on a directional road segment

Pavement Edge: The intersection of roadway pavement and gutter

Striped Shoulder: A paved and striped extension to the outside travel lane, designated for biking or parking.

Striping: Markings used to separate travel lanes, bike lanes, and designated parking areas on a roadway.

Grade

Clip: The process of extracting features from one coverage that lies completely within a defined boundary. Attribute information is not changed during a clip.

Contour Line: A line on an isoline map (i.e. topographic map) that connects points of equal elevation

Grade (gradient): The measurement of the change in vertical and horizontal distances (rise and run) between points

Horizontal Distance: The difference between two points along a horizontal plane.

Intersect: An overlay tool, where two or more (depending on license) spatial data layers are combined based on areas common to both. Those fields that are not common to both (or all) are discarded.

LIDAR: Stands for 'light detection and ranging,' and is a remote sensing technique. Similar to RADAR and the use of sound-waves, LIDAR transmits light onto a target area (using lasers); light reflects off the given surface back to the measurement device. Measuring the time it takes the light to return to the instrument enables you to calculate relative distances accurately.

Pixel: An abbreviation for 'picture element,' pixels are the smallest units used in an image or raster data model. Each pixel represents on cell used in the construction of the matrix of rows and columns. The size of the pixilation (size of pixels used to represent the data) has a significant effect on image clarity and raster based calculation.

Raster: A spatial data model used to represent continuous data, based on a matrix of equally sized and spaced cells

Triangulated Irregular Network (TIN): Vector data structure that divides the given area into a series of contiguous but non-overlapping triangles based on x, y and z values

Vector: A spatial data model where geographic features that are represented using either points, lines or polygons

Vertical Distance: The difference between two points along a vertical plane

Z Factor: A conversion factor that determines the number of vertical units (z-units) in each horizontal unit (ESRI). Changing this can be used to exaggerate the appearance of elevation for each triangle, and can be used to modify the equation, when units of elevation (z) are different from the x,y data (ArcHelp).

Amenities on Recreational Bikeways

ADT standards: The American Disabilities Act design standards; found at http://www.usdoj.gov/crt/ada/stdspdf.htm

Data Layer: A collection of related data

Garmin Unit: A common type of GPS unit

Global Positioning System (GPS): A radio navigation system that allows users to determine their exact location

GPS Unit: A portable unit for tapping into the Global Positioning System (GPS)

Potable: Water that is suitable for drinking

Proximity (in proximity to): 'in proximity to' is herein determined to be no more than *100 meters* away from a bikeway

Recreational Amenities: Something that conduces to comfort, convenience, or enjoyment that serves cyclists biking on recreational bike paths.

Recreational Bicycle Paths: "Bicycle paths are specially designed for cyclists and are generally located away from all automobile traffic. They may be reserved for cyclists only or they may be open to other road users, such as pedestrians or rollerbladers. Signs similar to those used on road are always posted on cycling paths and, when possible, markings are also used."
(as defined by http://www.mtq.gouv.qc.ca/en/reseau/velo/index.asp#types)

Survey scale maps: Very detailed, large-scale maps

Trimble Unit: A very precise type of GPS unit

Appendix A

(By Section)

Suitability

***Present Serviceability Rating (PSR) system description*:**
(http://www.fhwa.dot.gov/policy/2002cpr/ch3b.htm)

4.0- 5.0 Only new (or nearly new) superior pavements are likely to be smooth enough and distress free (sufficiently free of cracks and patches) to qualify for this category. Most pavements constructed or resurfaced during the data year would normally be rated in this category.

3.0 - 4.0 Pavements in this category, although not quite as smooth as those described above, give a first-class ride and exhibit few, if any, visible signs of surface deterioration. Flexible pavements may be beginning to show evidence of rutting and fine random cracks. Rigid pavements may be beginning to show evidence of slight surface deterioration, such as minor cracking and spalls.

2.0 - 3.0 The riding qualities of pavements in this category are noticeably inferior to those of the new pavements and may be barely tolerable for high-speed traffic. Surface defects of flexible pavements may include rutting, map cracking, and extensive patching. Rigid pavements may have a few joint fractures, faulting and/or cracking and some pumping.

1.0 - 2.0 Pavements have deteriorated to such an extent that they affect the speed of free-flow traffic. Flexible pavement may have large potholes and deep cracks. Distress includes raveling, cracking, and rutting and occurs over 50 percent or more of the surface. Rigid pavement distress includes joint spalling, faulting, patching, cracking, and scaling and may include pumping and faulting.

0.0 - 1.0 Pavements are in extremely deteriorated conditions. The facility is passable only at reduced speed and considerable ride discomfort. Large potholes and deep cracks exist. Distress occurs over 75 percent or more of the surface.

References

Transportation Research Record 1578

Landis, Bruce. “Real-Time Human Perceptions: Toward a Bicycle Level of Service,” *Transportation Research Record 1578*, Transportation Research Board Washington DC, 1997

Barsotti, Ed and Kilgore, Gin. "The Road Network is the Bicycle Network: Bicycle Suitability Measures for Roadways and Side paths."

Maryland Statewide Bicycle and Pedestrian Plan, Project Documents www.fhiplan.com/md%5Fbike%5Fped%5Fplan/pdfdocs/bicyclelos.PDF

Amenities on Recreational Bikeways

Sample data log:

Motor Vehicle Parking

Location	
Pay	
Cost	
Spaces	
Overnight	
Handicapped Accessible	
Notes	

Information Centers

Location	
Type	
Hours	
Notes	

Signage

Location	
Type	
Notes	

Restrooms

Location	
Type	
Male Facilities	
Female Facilities	
Baby Changing Facilities	
Handicapped Accessible	
Notes	

Bike Racks

Location	
Rack Spaces	
Permanent	
Rack Type	

Notes	

Drinking Fountains

Location	
Notes	

Benches

Location	
Notes	

Picnic Areas

Location	
Type	
Capacity	
Electricity	
Notes	

Picnic Tables

Location	
Capacity	
Notes	

Telephones

Location	
Payphone	
Cost	
Notes	

Appendix B: Useful Contacts

(Placeholder, for now)

APPENDIX C
Data Collection Sheet

Qualitative Data Section	Subsection	Attribute	EXAMPLE	Segment No. 1	Segment No. 2	Segment No. 3	Segment No. 4
Bikeway Segment Location and Name	Bikeway Segment	Segment Street (Street common to both to and from intersections)	Summit Ave				
		From Node Cross-Street	Snelling Ave				
		To Node, Cross-Street No. 1	Fairview Ave				
	Bikeway Name	Bikeway Name	Summit Ave				
Bikeway Type	Bikeway Type	Bikeway Type	Bike Lane, One-Way Direction				
	Active?	Active?	Y				
Surface Quality	Surface Type	Surface Type	Asphalt				
	Shoulder Rumble Strip?	Shoulder Rumble Strip?	N				
	Shoulder Usage	On-street Parking?	N				
		Bus Use?	Y				
		Plowed?	Y				
	Shoulder Drainage?	Shoulder Drainage?	N				
	Creation Date	Creation Date	n/a				
		Resurfacing Date	3/2/2001				
	Pavement Condition Rating	Pavement Condition Rating	3.9				
Suitability	Posted Speed Limit	Posted Speed Limit (mph)	30				
	Pavement Condition Rating	Pavement Condition Rating	3.9				
	Number of Lanes in Both Directions	Number of Lanes in Both Directions	2				
	Width of Outside Travel Lane to Pavement Edge	Width of Outside Travel Lane to Pavement Edge (feet)	xx				
	Width of Striped Shoulder	Width of Striped Shoulder (feet)	xx				
	Width of Pavement Striped for On-Street Parking	Width of Pavement Striped for On-Street Parking (feet)	xx				
	Bi-Directional Traffic Volume	Bi-Directional Traffic Volume	xx				
	Percentage of Heavy Commercial Annual Average Daily Traffic	Percentage of Heavy Commercial Annual Average Daily Traffic	xx%				
	Percentage of Road Segment with Occupied On-Street Parking	Percentage of Road Segment with Occupied On-Street Parking	xx%				
	BLOS Rating	Letter Grade	B				
		Suitability Level	Very High				
Grade	GRIDCODE (Value in Table)	GRIDCODE (Value in Table)	1				
Amenities on Recreational Bikeways	Motor Vehicle Parking	Location	n/a				
(For Recreational Bikeways Only)		Pay	n/a				
		Cost	n/a				
		Spaces	n/a				
		Overnight	n/a				
		Handicapped Accessible	n/a				
		Notes	n/a				
	Information Centers	Location	n/a				
		Type	n/a				
		Hours	n/a				
		Notes	n/a				

APPENDIX C
Data Collection Sheet

Qualitative Data Section	Subsection	Attribute	EXAMPLE	Segment No. 1	Segment No. 2	Segment No. 3	Segment No. 4
	Signage	Location	n/a				
		Type	n/a				
		Notes	n/a				
	Restrooms	Location	n/a				
		Type	n/a				
		Male Facilities	n/a				
		Female Facilities	n/a				
		Baby Changing Facilities	n/a				
		Handicapped Accessible	n/a				
		Notes	n/a				
	Bike Racks	Location	n/a				
		Rack Spaces	n/a				
		Permanent	n/a				
		Rack Type	n/a				
		Notes	n/a				
	Drinking Fountains	Location	n/a				
		Notes	n/a				
	Benches	Location	n/a				
		Notes	n/a				
	Picnic Areas	Location	n/a				
		Type	n/a				
		Capacity	n/a				
		Electricity	n/a				
		Notes	n/a				
	Picnic Tables	Location	n/a				
		Capacity	n/a				
		Notes	n/a				
	Telephones	Location	n/a				
		Payphone	n/a				
		Cost	n/a				
		Notes	n/a				
General Notes	General Notes	General Notes No. 1	"Name" is also "MN 51"				
		General Notes No. 2					
		General Notes No. 3					

Road Name	From	To	Lanes	Traffic Data		Speed limit	Width Of Pavement			% Occupied On-street Parking		Pavement condition	Existing Bicycle LOS	
				Volume	Heavy									
			Lane_Numb	Road_AADT	Road_Heavy	Road_Speed	Lane_Shld_Width	Shld_Width	Shld_Park_Width	Shld_Park		Pave_Cond	Score	Grade
			#	AADT	%	mph	ft	ft	ft	N/E %	S/W %	1 (worst) through 5 (best)		A..F
													#DIV/0!	######
													#DIV/0!	######
													#DIV/0!	######
													#DIV/0!	######