Tori Hesedahl

Geoffrey Morgan

CEE 424

Final Project Report

Seattle Bike Lane Slope Paths For Use In Severe Weather

Objectives: The objective of this project was to discern which bike paths in the Seattle area were hazardous to bikers during periods of severe weather, such as snow and ice. By identifying these areas of concern (high slope) and making maps available, bikers will be able to avoid hazardous areas and stay on safer (low slope) routes.

Data: To complete this project we had to locate several layers of data. The first sets of data we located on the Kind County GIS Data collection website. There we downloaded the bike lane shape file, and the roads shape file. For elevation data we went to Puget Sound LIDAR to download 6-ft DEM files of the Seattle area. Metadata for all the layers is in the appendix which includes information about scales, abbreviations, projections, and more.

Analysis: To conduct our analysis we used two different methods in search of a more accurate map. Our first method started by making a mosaic with the LIDAR data so that all the elevation data was in one layer. Next we used the spatial analyst slope function to create a slope layer. Our next step was to use the raster calculator to create new raster files of slopes with varying degrees (0-2, 2-3, 3-4, etc). To make sure we got only the values returned from our query we reclassified each new file using the reclassify tool in spatial analyst. Next we converted each new raster to a polygon using the conversion tool from raster to polygon. Once the new polygons were created we intersected each with the bike route vectors (which has been cut down so there was only data in Seattle by using the edit tool) using the analyst intersect tool. Each intersection was then given a color to rate danger level based on slope severity. Next the roads layer was added so the map displayed a more accurate representation of the bike route location complete with labels. For our second method we started with a mosaic DEM covering all of Seattle, made in the same manner with data from the same source as in the previous method. The bicycle facilities features were then used as a mask to calculate slope only for raster cells that are on bicycle facilities. Next, we reclassified the raster so that to better control break points between colors representing different ranges in grade. different grades would appear different colors to show slope severity.

Results and Conclusions: Upon completion of our first map we noticed that some of the slope data was inaccurate since parts of the Burke-Gilman Trail had a slope of greater than 12%, which is not true. We determined the reason for this was that the slope information used was cross-slope data, i.e. if the Burke cut through a hillside the hillside was included in calculating the slope making the slope appear much greater than it actually is. To try and rectify this we decided to try the second method for creating the map by using the mask tool. Slope was calculated essentially in the same manner as before, however, areas of the trail that cut through steep cross slopes still show maximum slope about the cell, not actual slope of path. Upon closer inspection it appeared that the GIS data for the bike lanes were not exactly where they should have been and thus not the actual slope of the lanes. The cross-slope error appears to occur much more frequently on bike trails than on shared roadways because of the greater width of the road and the accuracy of the data. We thought of manually correcting all of the poor slope information but decided that due to time constraints it would be sufficient for this project simply to mention the poor data and if we had started earlier could have made the proper corrections. A potential future possibility for increasing the usefulness of our map for the Seattle bike riding populace would be to create a user interface to find the fastest route with the lowest amount of slope between two points by using the Network Analyst Tool.

Appendix:

* Metadata for Bike Lane Layer (Bike\_facilities)

Keywords

Theme: transportation, street, transit, bike, bicycle, non-motorized

Place: King County, WA, Pacific NW, Washington state, Seattle, Bellevue, Renton

Description

Abstract

Bike Routes identified in unincorporated King County and by participating cities within King County.

Purpose

Used to aid bicyclists in choosing routes between locations.  Six class codes are identified, soft surface regional trails, paved regional trails, on street bike lane, signed bike route, shared roadway and caution areas.

Supplementary Information

None

Links to graphics describing the data

JPG File of layer overlain on base of WA counties or local cities (JPG): <http://www5.kingcounty.gov/sdc/DataImages/bike_facilities.jpg>

Status of the data

Complete
*Data update frequency:* Quarterly

Time period for which the data is relevant

*Date and time:* 20100526

Publication Information

*Who created the data:* King County

*Date and time:* 20100526

*Publisher and place:* King County, King County, WA

Data storage and access information

*File name:* bike\_facilities
*Type of data:* vector digital data

*Location of the data:*

 \\ATLAS\C$\GISProject\bike\_facilities\bike\_facilities.shp

*Data processing environment:* Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 3; ESRI ArcCatalog 9.3.0.1770

Accessing the data

*Data format:* ESRI Shapefile
*Size of the data:* 2.753 MB
*Data transfer size:* 2.753 MB

Network location:

 \\gisdw\kclib\plibrary2\transportation\shapes\arc\bike\_facilities.shp

*Available media:* Yes

Constraints on accessing and using the data

*Access constraints:* This data is not in any way warranty or guarantee as to the stability of roadway conditions or the fitness of listed routes for bicycling. Many of the routes identified in this data cross or run along public roads which are exposed to wear and tear and degradation due to weather, traffic, and other environmental concerns. Riders should remain alert as routes may contain pavement rutting, cracks, bumps, expansion joints, natural or other debris on pavement surfaces, and vegetation which may encroach on routes or portions thereof. Riders should also remain alert for areas of visual impairment and other irregularities that may impact rider and motorist ability to see each other or potential road hazards. The chance that one may come into an area of visual impairment or a route irregularity warrants special care on the part of route users.

*Use constraints:*

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Details about this document

Contents last updated: 20101206 at time 17523500

Who completed this document

Tamara Davis
King County Dept. of Transportation, Road Services Division
*Mailing and physical address:*

201 S Jackson St

Seattle, WA 98104

USA
206-684-2118 (voice)
firstname.lastname@kingcounty.gov

Standards used to create this document

*Standard name:* FGDC Content Standards for Digital Geospatial Metadata
*Standard version:* FGDC-STD-001-1998
*Time convention used in this document:* local time
Metadata profiles defining additonal information

 ESRI Metadata Profile: <http://www.esri.com/metadata/esriprof80.html>

Horizontal coordinate system

*Projected coordinate system name:* NAD\_1983\_HARN\_StatePlane\_Washington\_North\_FIPS\_4601\_Feet

*Geographic coordinate system name:* GCS\_North\_American\_1983\_HARN

Details

Map Projection Name: Lambert Conformal Conic

*Standard Parallel:* 47.500000
*Standard Parallel:* 48.733333
*Longitude of Central Meridian:* -120.833333
*Latitude of Projection Origin:* 47.000000
*False Easting:* 1640416.666667
*False Northing:* 0.000000

Planar Coordinate Information

*Planar Distance Units:* survey feet

*Coordinate Encoding Method:* coordinate pair

Coordinate Representation

*Abscissa Resolution:* 0.000000

*Ordinate Resolution:* 0.000000

Geodetic Model

*Horizontal Datum Name:* D\_North\_American\_1983\_HARN

*Ellipsoid Name:* Geodetic Reference System 80

*Semi-major Axis:* 6378137.000000

*Denominator of Flattening Ratio:* 298.257222

Altitude System Definition

*Resolution:* 1.000000

*Encoding Method:* Explicit elevation coordinate included with horizontal coordinates

Bounding coordinates

Horizontal

In decimal degrees

*West:* -122.524601

*East:* -121.592049

*North:* 47.862340

*South:* 47.144074

In projected or local coordinates

*Left:* 1225211.250000

*Right:* 1451628.251000

*Top:* 315498.308000

*Bottom:* 57056.070000

Spatial data description

Vector data information

ESRI description

bike\_facilities

*ESRI feature type:* Simple
*Geometry type:* Polyline
*Topology:* FALSE
*Feature count:* 21013
*Spatial Index:* FALSE
*Linear referencing:* FALSE

SDTS description

Feature class: SDTS feature type, feature count

bike\_facilities: String, 21013

Details for bike\_facilities

*Type of object:* Feature Class

*Number of records:* 21013

Attributes

FID ESRI

OBJECTID*Alias:* OBJECTID
*Data type:* Number
*Width:* 10
*Definition:* ESRI

TLINK\_ID

*Alias:* TLINK\_ID
*Data type:* String
*Width:* 38

CLASS\_CODE

*Alias:* CLASS\_CODE
*Data type:* Number
*Width:* 10

SHAPE

*Alias:* Shape
*Data type:* Geometry
*Width:* 0
*Precision:* 0
*Scale:* 0
*Definition:*

- Metadata for LIDAR Mosaic

Horizontal coordinate system

*Projected coordinate system name:* NAD\_1983\_StatePlane\_Washington\_North\_FIPS\_4601\_Feet

*Geographic coordinate system name:* GCS\_North\_American\_1983

Map Projection Name: Lambert Conformal Conic

*Standard Parallel:* 47.500000
*Standard Parallel:* 48.733333
*Longitude of Central Meridian:* -120.833333
*Latitude of Projection Origin:* 47.000000
*False Easting:* 1640416.666667
*False Northing:* 0.000000

Planar Coordinate Information

*Planar Distance Units:* survey feet

*Coordinate Encoding Method:* row and column

Coordinate Representation

*Abscissa Resolution:* 6.000000

*Ordinate Resolution:* 6.000000

Geodetic Model

*Horizontal Datum Name:* North American Datum of 1983

*Ellipsoid Name:* Geodetic Reference System 80

*Semi-major Axis:* 6378137.000000

*Denominator of Flattening Ratio:* 298.257222

Bounding coordinates

Horizontal

In decimal degrees

*West:* -122.441478

*East:* -122.246594

*North:* 47.752038

*South:* 47.622510

In projected or local coordinates

*Left:* 1244830.440000

*Right:* 1291930.440000

*Top:* 277527.860000

*Bottom:* 231195.860000

Lineage

ESRI geoprocessing history

1. Process

*Date and time:* 20101204 at time 152144
*Tool location:* C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Data Management Tools.tbx\Mosaic

Command issued

Mosaic C:\GISProject\test\data1;C:\GISProject\test\data2;C:\GISProject\test\data3;C:\GISProject\test\data4;C:\GISProject\test\data5;C:\GISProject\test\data6 C:\GISProject\test\data1 LAST FIRST # # NONE 0 C:\GISProject\test\data1 NONE

Spatial data description

Raster dataset information

*Raster format:* GRID

*SDTS raster type:* Grid Cell

*Number of raster bands:* 1

Raster properties

*Origin location:* Upper Left

*Has pyramids:* TRUE

*Has colormap:* FALSE

*Data compression type:* Default

*Display type:* matrix values

Cell information

*Number of cells on x-axis:* 7850

*Number of cells on y-axis:* 7722

*Number of cells on z-axis:* 1

*Number of bits per cell:* 32

Cell Size

*X distance:* 6.000000

*Y distance:* 6.000000

*-* Metadata for Car Lanes

Keywords

Theme: transportation

Place: King County, Washington

Description

Abstract

Spatial View: Transportation mode class for CAR created from TRANSPORTATION NETWORK featureclass and TRANS\_TLINK\_TMODE table

Purpose

Spatial View: Transportation mode class for CAR created from TRANSPORTATION NETWORK featureclass and TRANS\_TLINK\_TMODE table

Supplementary Information

<http://www5.kingcounty.gov/sdc/addl\_doc/SpatialTabularViewDetail.htm#TRANS\_NETWORK\_CAR\_LINE\_VIEW>

Data storage and access information

*File name:* trans\_network\_car\_line\_view
*Type of data:* vector digital data

*Location of the data:*

 \\ATLAS\C$\GISProject\trans\_network\_car\_line\_view\trans\_network\_car\_line\_view.shp

*Data processing environment:* Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 3; ESRI ArcCatalog 9.3.0.1770

Accessing the data

*Data format:* SDE Spatial View
*Size of the data:* 1.860 MB
*Data transfer size:* 1.860 MB
*Available media:* Yes

Constraints on accessing and using the data

*Access constraints:* None

*Use constraints:*

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Details about this document

Contents last updated: 20101206 at time 18011100

Horizontal coordinate system

*Projected coordinate system name:* NAD\_1983\_HARN\_StatePlane\_Washington\_North\_FIPS\_4601\_Feet

*Geographic coordinate system name:* GCS\_North\_American\_1983\_HARN

Details

Map Projection Name: Lambert Conformal Conic

*Standard Parallel:* 47.500000
*Standard Parallel:* 48.733333
*Longitude of Central Meridian:* -120.833333
*Latitude of Projection Origin:* 47.000000
*False Easting:* 1640416.666667
*False Northing:* 0.000000

Planar Coordinate Information

*Planar Distance Units:* survey feet

*Coordinate Encoding Method:* coordinate pair

Coordinate Representation

*Abscissa Resolution:* 0.000000

*Ordinate Resolution:* 0.000000

Geodetic Model

*Horizontal Datum Name:* D\_North\_American\_1983\_HARN

*Ellipsoid Name:* Geodetic Reference System 80

*Semi-major Axis:* 6378137.000000

*Denominator of Flattening Ratio:* 298.257222

Bounding coordinates

Horizontal

In decimal degrees

*West:* -122.436606

*East:* -122.245978

*North:* 47.753671

*South:* 47.622703

In projected or local coordinates

*Left:* 1246041.625000

*Right:* 1292083.101000

*Top:* 278120.969000

*Bottom:* 231241.046000*Process description:* Dataset copied.
*Source used:* \\gisimage\images\FTPData\AllShapeFiles\transportation\trans\_network\_car\_line\_view
*Process date:* 20101129 at time 15051800

ESRI description

trans\_network\_car\_line\_view

*ESRI feature type:* Simple
*Geometry type:* Polyline
*Topology:* FALSE
*Feature count:* 18821
*Spatial Index:* TRUE
*Linear referencing:* FALSE

SDTS description

Feature class: SDTS feature type, feature count

trans\_network\_car\_line\_view: REQUIRED: Enter G-polygon if polygon features, String is line features, or Entity point if point features, REQUIRED: Enter an integer representing the approximate numbe of features

Details for trans\_network\_car\_line\_view

*Type of object:* Feature Class

*Number of records:* 18821

Attributes

FID ESRI

Shape ESRI

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*Alias:* TLINK\_ID
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EFFEC\_DATE

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DB\_MD\_DATE

*Alias:* DB\_MD\_DATE
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END\_DATE

*Alias:* END\_DATE
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KC\_FCC\_ID

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GRADE

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SPEED\_LIM

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JURIS\_R

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ZIP\_R

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*Number of decimals:* 3

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*Width:* 50

CITY\_R

*Alias:* CITY\_R
*Data type:* String
*Width:* 50

CAR\_FLOW

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*Data type:* Number
*Width:* 5

Shape\_len

*Alias:* Shape\_len
*Data type:* Float
*Width:* 19
*Number of decimals:* 11

Overview

This is a SQL view built on underlying tables documented separately. Refer to the Supplemental Information section for a link to the documentation for those tables that contribute to the view.