

The Paved Trail Networks of South Puget Sound: Finding the Gaps and Connecting the Dots

With wildly fluctuating fuel prices, the onset of global warming, epidemic obesity, and the political problems accompanying dependence on foreign oil, many communities and regions are looking to bicycling as an important part of a comprehensive transportation solution. Local governments are investing in bicycling infrastructure. However, in the South Puget Sound region, these investments have lacked central coordination and a longer view of how the trails being built will fit into the larger bicycle transportation system. This has resulted in a piecemeal set of individual trail networks lacking interconnectivity. This lack of interconnectivity keeps the full potential of these trails as transportation infrastructure from being realized and, in some cases, renders them useful (for the most part) for recreation only.

Project Objectives

The aim of this project is to create and implement a GIS methodology that can be used by urban planners, bicycling advocacates, or any other interested party to identify "high value gaps" between the existing infrastructure assets of a region. Shortest distance gaps are found and then weighted to identify "high value gaps".

Methods

The methodology was the primary focus of this project. It is the author's hope that this method can be honed and made into a portable model for bicycle advocacy everywhere.

The input used for this project was three polyline shapefiles representing the paved trails in King, Pierce, and Thurston County in the State of Washington. These shape files were imported into a feature dataset to rectify projections and then merged into a single feature class containing regional trails. This feature class was then buffered using a 50 ft. buffer and dissolved resulting in a feature class of single distinct geometric features for each "network" of interconnected trails. The Generate Near Table tool was then run in ArcInfo 9.3 using this resulting feature class as both "input features" and "near features". This resulted in a large table containing information on the gaps between each trail network and every other trail network in the dissolved network layer. The resulting table contained XY start points, length and angle indicating the nearness of trail network A to trail network B.

In order to take the information contained in the resulting "gaps" table and generate a new feature class of "gap polylines", a new process was created using a python script. The script created a new polyline feature class. Two XY points were needed to create a line segment in this new feature class. The script cycled through the table locating matching pairs of entries - for example:

Input Object ID = 5, Near Object ID = 13 was matched to Input Object ID = 13, Near Object ID = 5

The XY point from each of these matched table rows were used as end-points to create a new polyline in the gap polylines feature class with the following attributes: Shape Area of the input feature, Shape Area of the near feature, Distance of gap. The script accounted for and skipped any entries with zero length.

A "select by location" procedure was then run with a buffer of -10 feet (removing tangent end points from consideration) to locate the gap polylines which intersected trail networks. The inverse of this selection was taken and exported as a new feature class. The gaps that remained were then narrowed further by removing all those that had lengths of greater than 25 miles. Two new fields were added to adjust the Shape Area fields to a number that more closely matched the total length of the trails represented. This was done using the following equation:

$$(\text{Shape Area} / 100) - 1000$$

This was intended to remove the 50 ft buffers initially applied to the trails. The 1000 subtracted at the end accounts for the square footage added by the 50 ft. buffers at the ends of the segments. Three new fields were added for valuation results. Three equations were then developed to provide valuation indexes for these new fields. The two main considerations for valuation were:

Which gaps, if bridged, result in the most total connected trail mileage after being adjusted for the distance required to fill the gap?

How can we keep our valuation from favoring the expansion of the largest trails without regard for the trails to which they are to be connected? That is, how do we keep the big trails from being "greedy"?

The equations tried were:

- 1) (Adjusted length of Trail Network A + Adjusted Length of Trail Network B) / Length of gap
- 2) (Adjusted length of Trail Network A / Length of Gap) * (Adjusted length of Trail Network B / Length of Gap)
- 3) Result of equation 1 * Result of equation 2

Equation 3 was favored as the most balanced solution. Gaps were sorted by the results of equation 3 in descending order and manually checked using aerial photography on map.google.com and mapquest.com, the author's personal experience with the areas in questions, and news stories related to the gap identified. Many "gaps" were proven not to be legitimate gaps, but rather the result of digitization or data accuracy problems. These were so marked. Others were found to have been adequately addressed through a combination of sidewalks and on-street marked bicycle lanes. Still others were short and ran along rural roads. However, a number of legitimate gaps were identified and marked. Details regarding some of these high value gaps can be found in the maps to the right.

Results and Conclusions

The methodology used to identify gaps in the regional trail system proved to be very effective. It is not (nor was it ever) intended to be used as a stand alone solution. Rather, it is intended to be used as one of many tools to help desicion makers and bicycling advocates make the most informed decisions possible as to where often limited funds will have the biggest impact. Some of the gaps identified by this tool are illustrated in the maps to the right. At least one is the site of a current trail construction project, which is very encouraging. These represent only a fraction of the high value gaps that were identified.

Future considerations and direction for this work will focus on creating a portable model that can produce similar spatial output in other regions of the country to encourage the development of additional infrastrcutre and the promotion of bicycling as a means of transportation.

It may also be desirable to hone the valuation equation used to make it even more effective.

Source Citations

Blair, S. (2009, June 1). Fix your favorite paths on national trails day. *Kitsap Sun*. Retrieved June 1, 2009, from <http://www.kitsapsun.com/news/2009/Jun/01/seabury-blair-jr-mr-outdoors-fix-your-favorite/>

Olympia, WA (2009). [map aerial photograph June 1, 2009]. Retrieved from <http://www.bing.com/maps/>

Map Data Sources: WAGDA, King County, Pierce County, Thurston County, Washington State Dept. of Ecology, Washington State Department of Transportation

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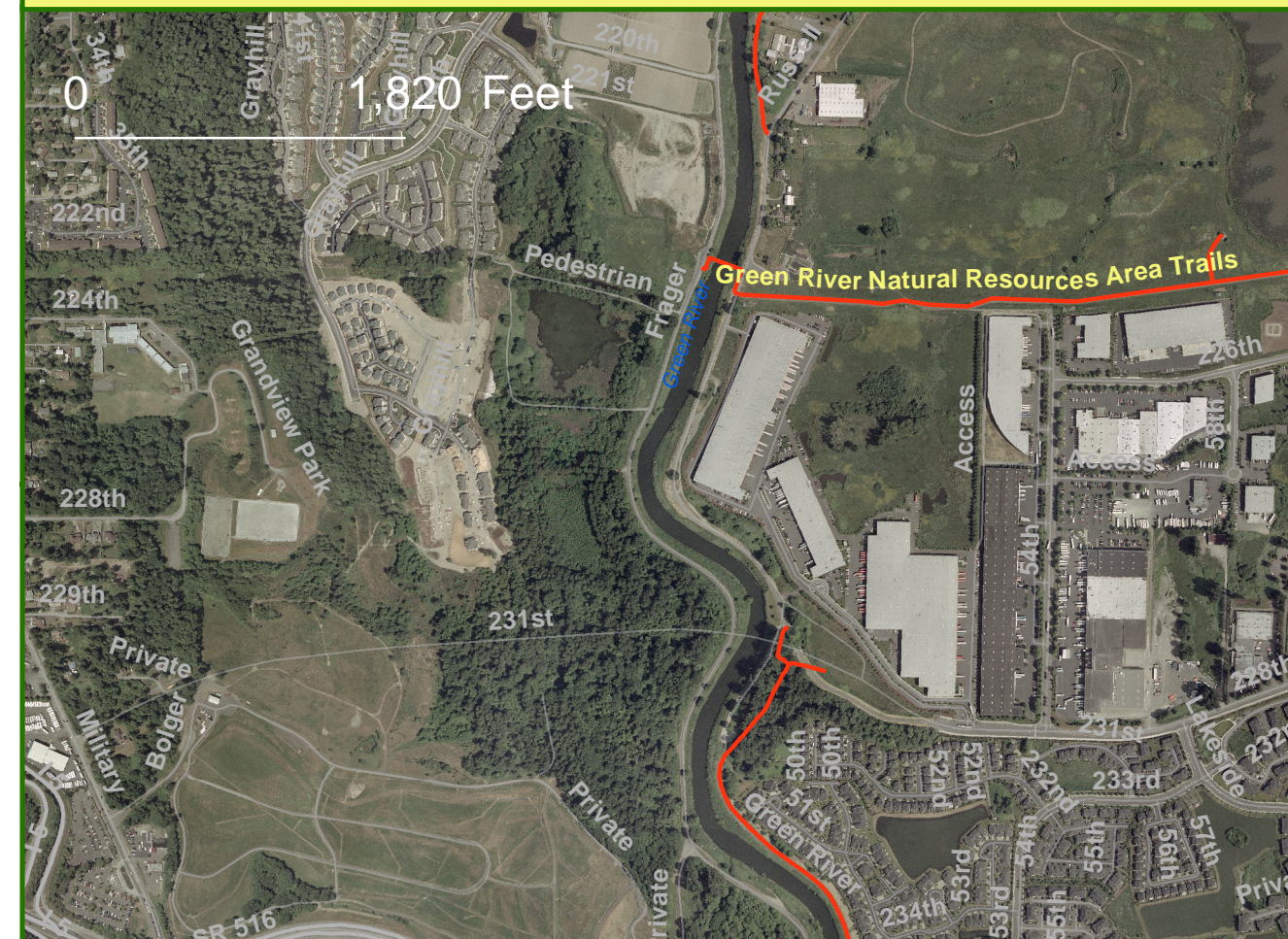
Trails of King, Pierce, and Thurston County: Seven High Value Gaps Identified

1) Points Trail - Hunts Point Gap



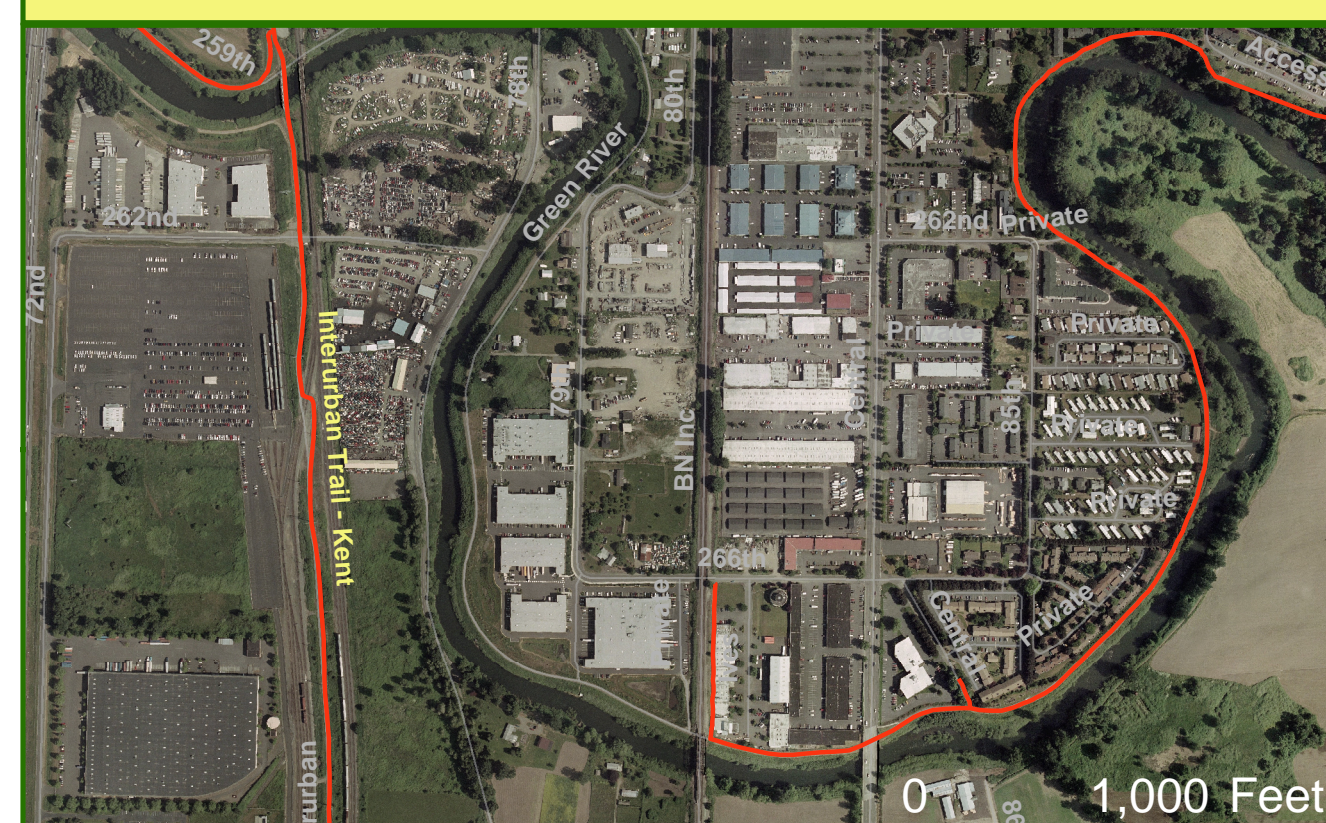
The gap identified here is seemingly innocuous. It is unlikely that it is considered to be an impediment to safe passage by cyclists. However, it may present a genuine danger, as it dumps the cyclist onto a roundabout which is fed directly by a highway on-ramp. No bicycle lane is provided.

2) Green River Trail - Russell Rd Gap



This gap forces Green River Trail riders onto Russel Road. While this is not a busy road, no accommodations appear to be provided on it for either cyclists nor pedestrians. An additional gap exists just to the north of this one which, while lower value, could be addressed at the same time joining three disconnected segemets.

3) Green River Trail/Interurban Trail Gap



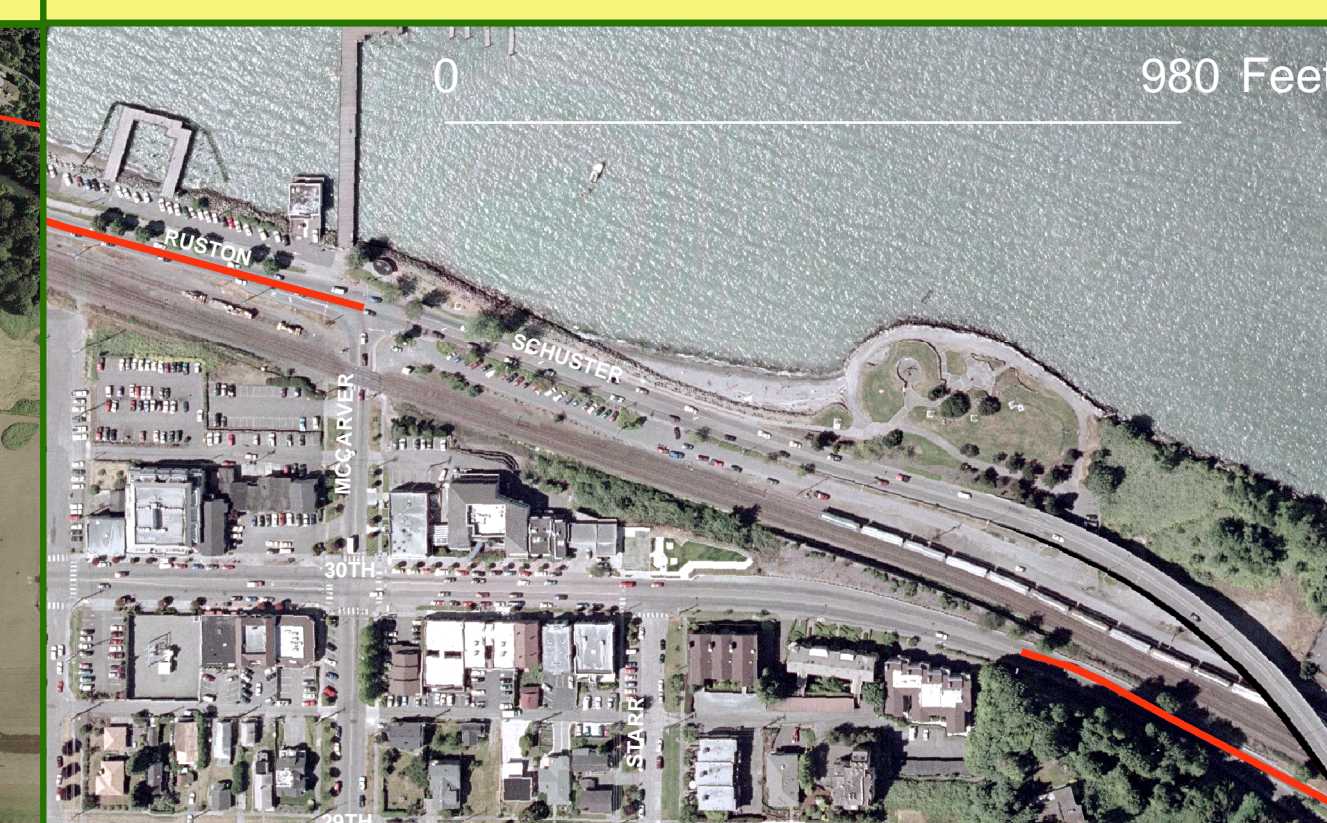
The primary barrier to bridging this gap is clearly the river. However, there are two bridges here - a road bridge and a railroad bridge - both at the end point of this segment of the Green River Trail. Once across the river, the Interurban Trail (one of the longest in the region) is just over a quarter of a mile away.

6) Chehalis-Western Trail - Martin Way Gap



This gap scored the highest of all gaps based up the valuation formula. Fortunately, Thurston County values it as well. According to the *Kitsap Sun* ground breaking on bike and pedestrain bridge over Martin Way is scheduled to begin on National Trail Day - June 6th - 2009 (Blair, S. June 1, 2009).

4) Tacoma/Ruston Waterfront Trail Gap



This gap forces riders pedalling toward downtown Tacoma on the Ruston Waterfront Trail to ascend a sharp grade on a road shared with car traffic to the busy traffic light at McCarver and 30th. A left left turn must then be made onto 30th in order to reach the trailhead for the continuation of the trail toward downtown. 30th has no dedicated bicycle lane nor does it have an ample shoulder.

7) Chehalis-Western Trail - Pacific Ave Gap



This gap across Pacific Ave forces trail users to cross multiple lanes of traffic and a dirt trail before rejoining the Chehalis-Western Trail. Upon completion of the Martin Way bridge, this will be the last remaining gap in the Chehalis-Western Trail.

5) Puyallup Riverwalk/Foothills Trail Gap



The map above highlights multiple gaps. Two are of particular interest. The main street bridge links the Riverwalk Trail and the nameless trail at the confluence of the Puyallup and White Rivers. This bridge lacks consideration for safe bicycle travel. The gap between the Foothills Trail and the Riverwalk Trail is highly prized and the focus of local advocacy groups. It is in the active planning and funding stages.

Acknowledgements

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"When I see an adult on a bicycle, I do not despair for the future of the human race." -H.G. Wells

