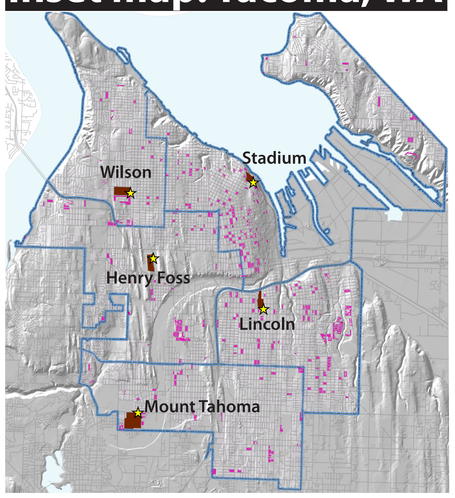
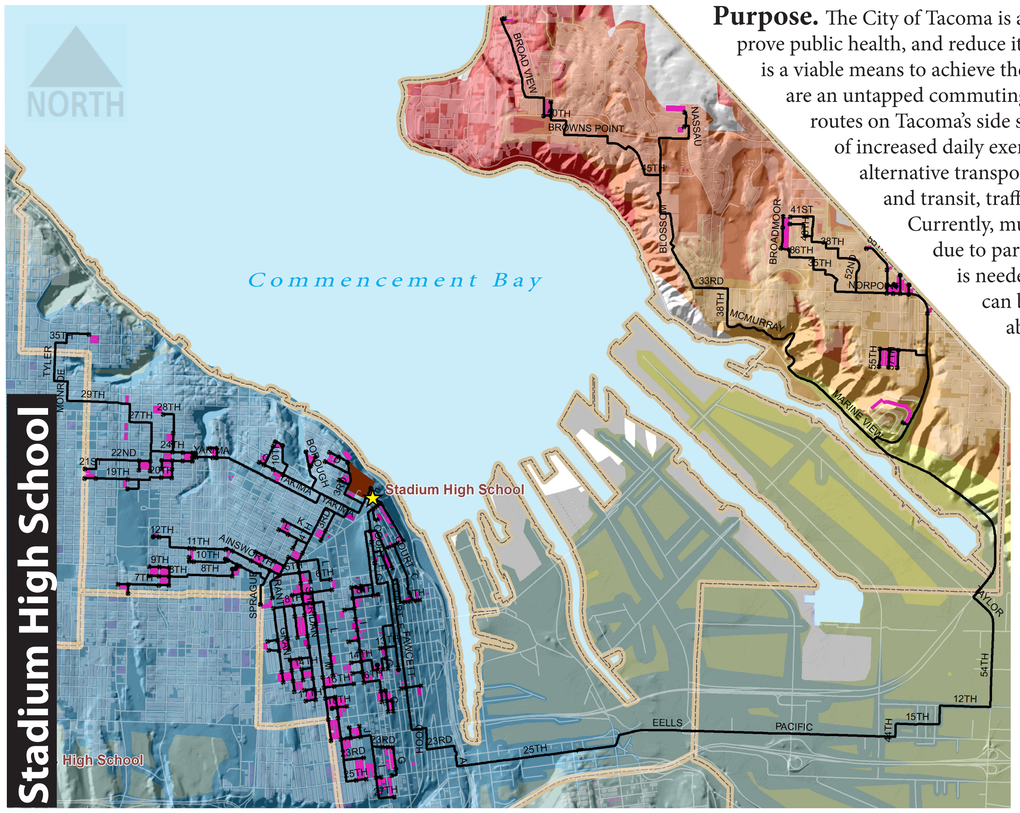
Predicting optimal bike routes to Tacoma public high schools

Inset map: Tacoma, WA



Study area. This project covers the Tacoma Public Schools district boundary in Tacoma, Washington. The boundary loosely follows the Tacoma city limits and includes limited portions of Ruston, University Place, Fife, Lakewood, and unincorporated Pierce County. The district boundary is divided into five geographically bounded high schools: Henry Foss, Lincoln, Mount Tahoma, Stadium, and Wilson. Magnet schools without a traditional boundary are excluded from this work.



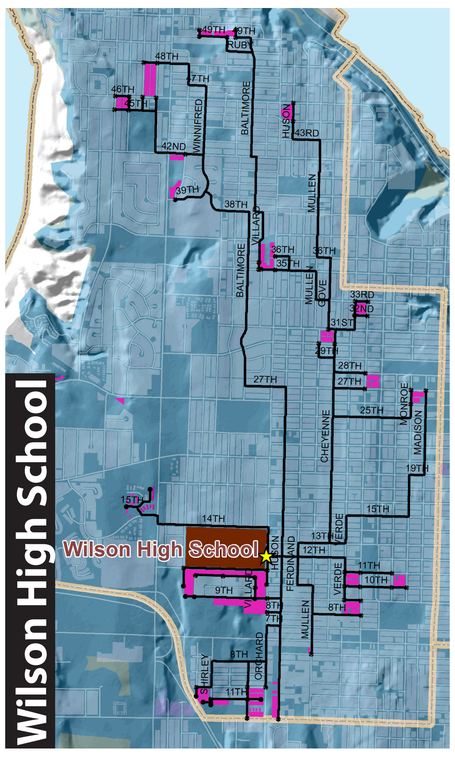
Purpose. The City of Tacoma is actively working to enhance livability, improve public health, and reduce its carbon footprint. Bicycle commuting is a viable means to achieve these common goals. High school students are an untapped commuting audience who could easily ride short routes on Tacoma's side streets while enjoying the health benefits of increased daily exercise. As more students commute using alternative transportation modes such as cycling, walking, and transit, traffic hazards around schools may decline. Currently, much of the peak traffic around schools is due to parents driving their kids to school. Change is needed. Objective bicycle routing information can be a first step toward creating a sustainable culture of active transportation.

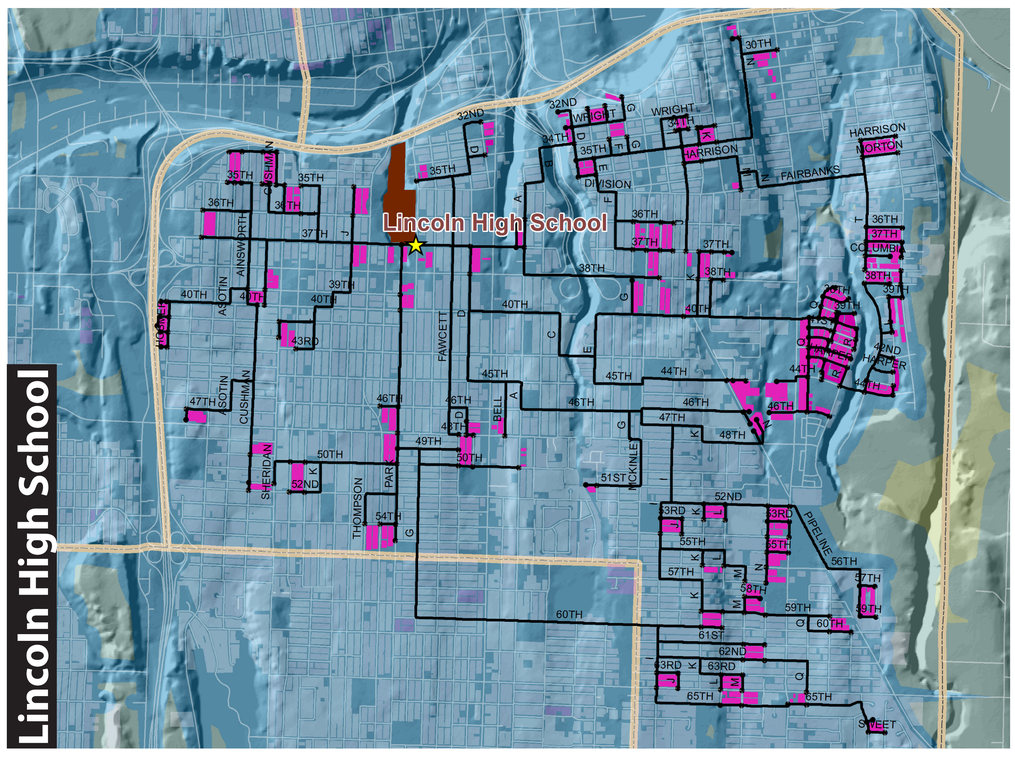
Objective. This project seeks to predict optimal bicycle commuting routes from densely populated neighborhoods to the Tacoma School District's five geographically bounded high schools. Because parental beliefs are among the largest influences on a student's choice to cycle to school, it is important to change perceptions about the hazards or difficulty of bicycling. By highlighting routes along the city's flatter, low-traffic roads, this project seeks to inform parents and encourage students who may be interested in active commuting as an alternative to driving.

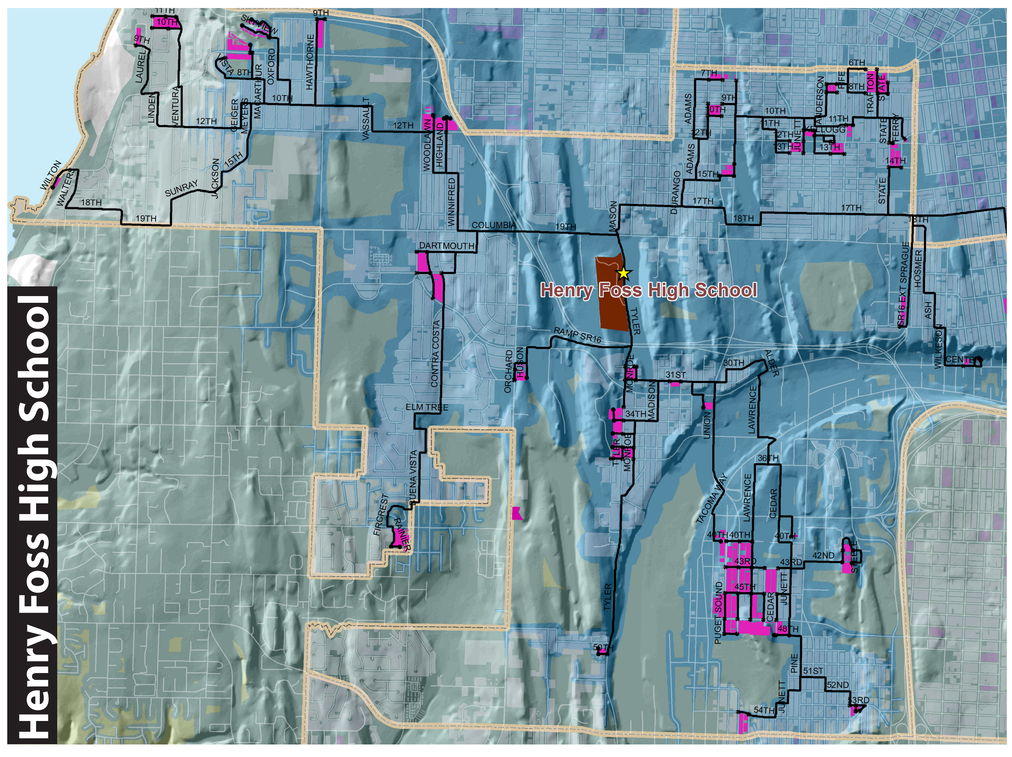
Methods. This project began with manual digitization of high school service area boundaries because GIS data did not exist. Boundaries were verified using TPS legal descriptions, Pierce County Public GIS, and adjacent district maps. All lines were snapped to roads, shorelines, and parcels where appropriate. As a courtesy, digitized school district and high school boundary data was provided to Tacoma Public Schools and the City of Tacoma GIS staff. Geocoded school addresses served as route destination points.

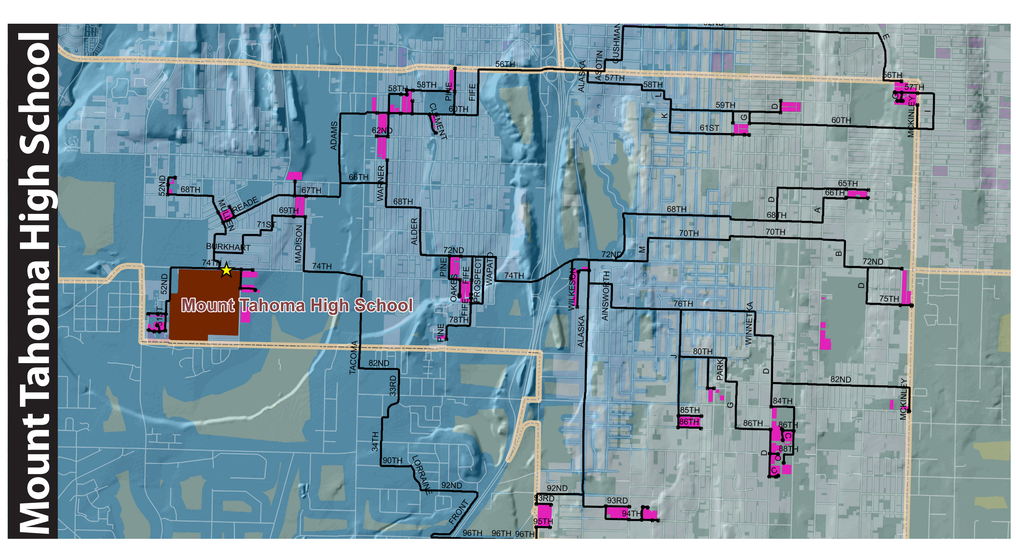
Population density was derived using 2010 census block populations of high-school aged children (14-18 years of age) normalized by residential land area. Residential tax parcels in each block were dissolved for hot spot symbolization. The hot spots were also used to select route start points on the road network. Hot spots more than 60 feet from a road intersection were excluded from the analysis.

Routes were generated using a cost path analysis. The raster algebra formula aggregated weighted costs based on road type (50%), slope (30%), and distance (20%). Distance cost in half-mile increments was generated from a Pierce County road network service area analysis to properly account for road travel around shorelines and other obstructions (rather than Cartesian distance analysis). Slope cost was attained from a U.S.G.S. 10-ft DEM of the Tacoma urban area classified by degrees. Road type classification was used to generate incremental road costs such that residential roads were the most desirable choice and highways were removed from consideration. After determining cost distance, cost path analysis produced rasters of routes that were converted to polylines. Coincident road names were selected from the road layer and labeled with the route polylines. Consistently symbolized defined interval cost path classifications were used to show relative costs of cycling across all schools. Created using ESRI ArcMap 10.









Results. Students from each school might look at similar route maps to find their neighborhood and a suggested route for biking to school. As indicated by the bluish shading, many students can ride to school quite easily within 5-30 minutes. A service area analysis showed that most students live within a 4-mile drive of their school—and many within 1 or 2 miles. Traveling by bike over these distance is faster than walking and nearly as efficient as driving (in congested urban areas).

Residents of Northeast Tacoma are the true outliers, living 8.5-12 miles from Stadium High School. This is more than double the longest distance at the other schools. Because they must traverse the Port of Tacoma on high-traffic roads on sometimes steep slopes, students who live in Northeast Tacoma incur the greatest challenge and risk (indicated on the map by orange and red shading).

Any effort to increase cycling among the Northeast Tacoma population should include safety equipment and education. Infrastructure improvements, such as a separated cycle track along SR-509, are also critical to minimizing risks associated with riding on the shoulder beside highway traffic.

Disclaimer. These maps may contain dangerous or misleading information! This is a conceptual study of bicycle suitability using geographic information systems. These routes were not physically inspected and may contain serious hazards. Routes may include unsafe or illegal segments. This analysis was done using available data under time constraints. Known weaknesses include routing on highway ramps and omission of existing bicycle facilities such as bike lanes and shared use trails. Before riding any route, perform your own research and testing. Always wear a helmet and use lights at night. ***Ride safely!***

About. Designed and prepared by Kris Symer. This poster and accompanying paper are delivered as the final research project for the GIS Certificate Program at the University of Washington Tacoma. See paper for bibliography. Completed June 2012.

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