A New Alignment for the Amtrak’s Northeast Corridor North of New York City

A Raster Analysis

Introduction

Presently the Northeast Corridor, or NEC, is the only rail line in the United States with sections classified as high speed rail. Unfortunately these sections allowing travel up to 150 miles per hour are coupled with sections with limits under 50 miles per hour. Many of the slowest sections are found in Connecticut since trains use a 19th century alignment running close to the shore with low design speeds due to a low curve radius and grade crossings. Furthermore, there is significant congestion on the line, specifically after New Haven, making a new alignment an even more pressing need, especially as highways are projected to grow more congested. High speed rail lines require significant investment and have very specific parameters to enable safe travel above 180 miles per hour. The fastest current journey between Boston and New York City is around 3 and a half hours, this project aims to reduce the journey time to 2 hours. The area of analysis is limited to Connecticut, Rhode Island and Massachusetts; the fastest current journey time to the Connecticut border is at Port Chester and is slightly less than 45 minutes, meaning the line analyzed in this project should enable travel from Boston to the Connecticut border between Greenwich and Port Chester in roughly 1 hour and 20 minutes. Although this project does not aim to take curve radius into account, the next steps would involve designing for a minimum between 4000 and 5400 meters. The straight line distance is roughly 16.5 miles, meaning the infrastructure built should enable an average journey speed of 125 miles per hour. Most new high speed rail lines are built with a 4000 meter curve radius which is the minimum radius for roughly 180 mile per hour travel. Including invalid speed restrictions in parts of the track and station stops, this design speed should enable travel time well below 2 hours from Boston to New York and potentially increase inland residents’ access to both cities.

Methodology

This project aims to determine new alignments mainly through raster analysis. A variety of variables were combined and least cost paths were created. Different cell sizes from 30 to 360 were utilized to see if paths change, and some variables were fuzzified to generate more accurate values for the cost raster. Many of the layers were originally vectors and needed to be rasterized. Afterwards each layer was classified in order of cost and the layers were combined to create a cost raster over the entire area of analysis. The layers selected for fuzzification were those which had continuous values like slope, neighborhood population, and distance. The starting point (Boston’s South Station) was added and a cost distance raster was created. The end point was added, and the raster least cost path was created between the two. This process was repeated for each cell size and the final path rasters were converted to polylines.

Conclusion

There are other algorithms that exist which can have more specific parameters like curve radius. Utilizing these algorithms could potentially create new alignments previously unconsidered. Many of the alignments found in this study could likely have much higher costs when radius is taken into account making it incomplete. This analysis also assumes that the last roughly 30 miles to New York City are fixed, if the area of analysis was expanded to include the New York area, new alignments further north could be possible. However, this project proves that an inland routing could be a practical solution to the low speeds in Connecticut while increasing access to high speed rail to significantly more people in Southern New England. Further analysis could also include more areas to avoid such as schools and hospitals which are not included in the current analysis. It is also interesting how changing the cell size can have dramatically different effects on the final least cost path. It seems one of the major trade-offs was whether serving Worcester was worthwhile and whether following I-84 between Massachusetts and Connecticut was better than a completely new alignment.

Sources

US Census, MassGIS, RI GIS, CTECO, USGS, ESRI