

Site Suitability Analysis for Biomass Energy Plants Using GIS

Cartographer: Zhaohuan Li
 Department: Civil & Environmental Engineering
 Date: December 13, 2013



Introduction

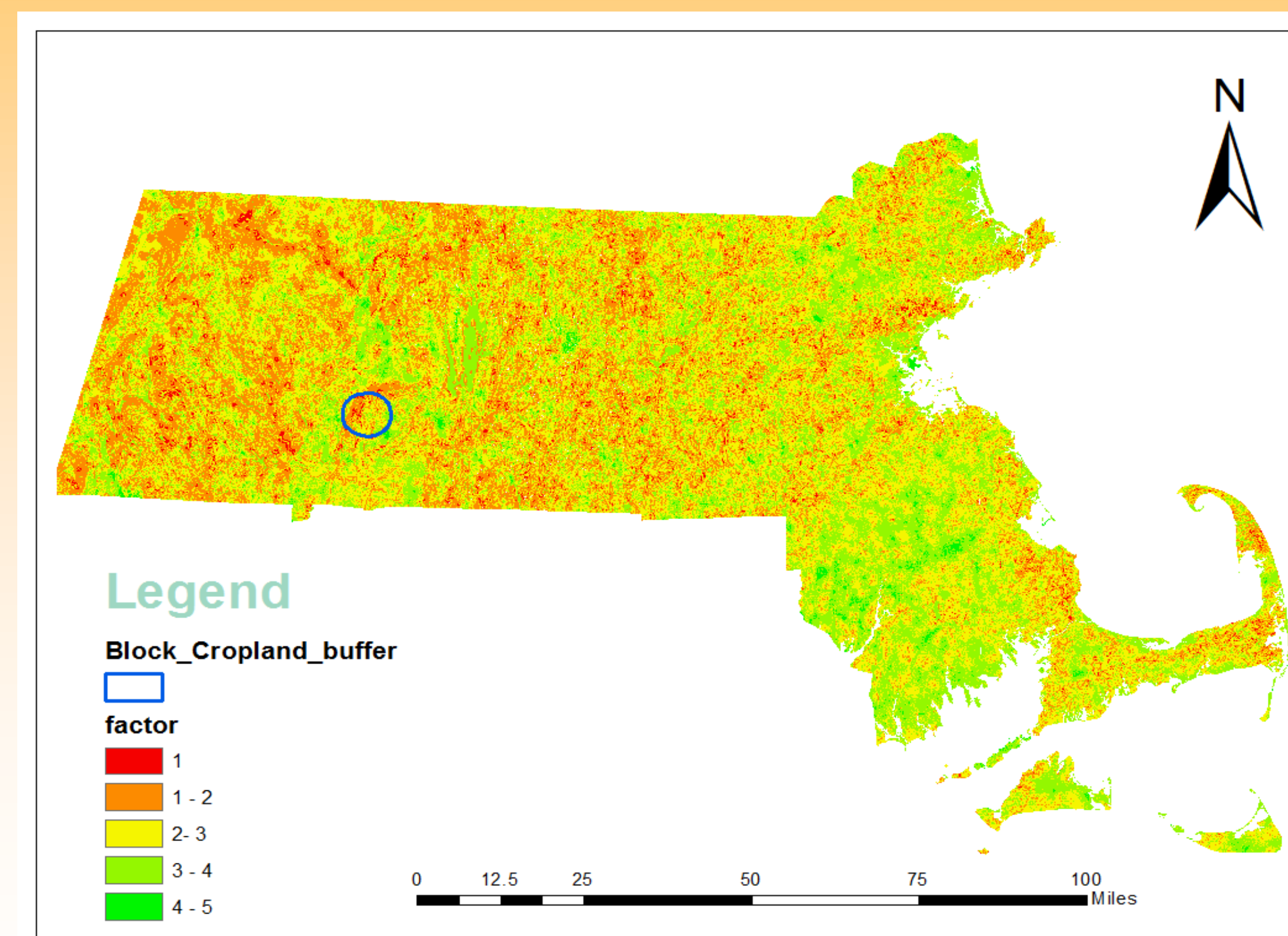
More and more environmentalists and naturalists are beginning to understand that the potential disastrous impacts of global climate change from greenhouse gases released during the combustion of fossil fuels to provide energy will be far worse than the impact caused by erecting large biomass energy plants throughout the state that are intended to produce clean power. As energy needs by developing and industrialized countries is become larger and larger, find a renewable energy with high potential is important. About 16% of global final energy consumption comes from renewable resources, with 10% of all energy from traditional biomass. New renewables (small hydro, modern biomass, wind, solar, geothermal, and biofuels) accounted for another 3% and are growing very rapidly. These energy resources all have great energy potential. However, the meaning of potential is not just defined by energy transfer, but defined by economic, environmental friendly and transport easily as well. This analysis will seek to identify the most suitable locations for a renewable energy plant.

Methodology

To determine a suitable land for a new plant, I developed three major steps (1) Choosing cropland (2) Ranking and (3) Choosing suitable land.

In the first step, croplands were selected from my analysis based on multiple criteria. First, they must near the major roads as they can easily accessible. Second, they must near the transmission line. A

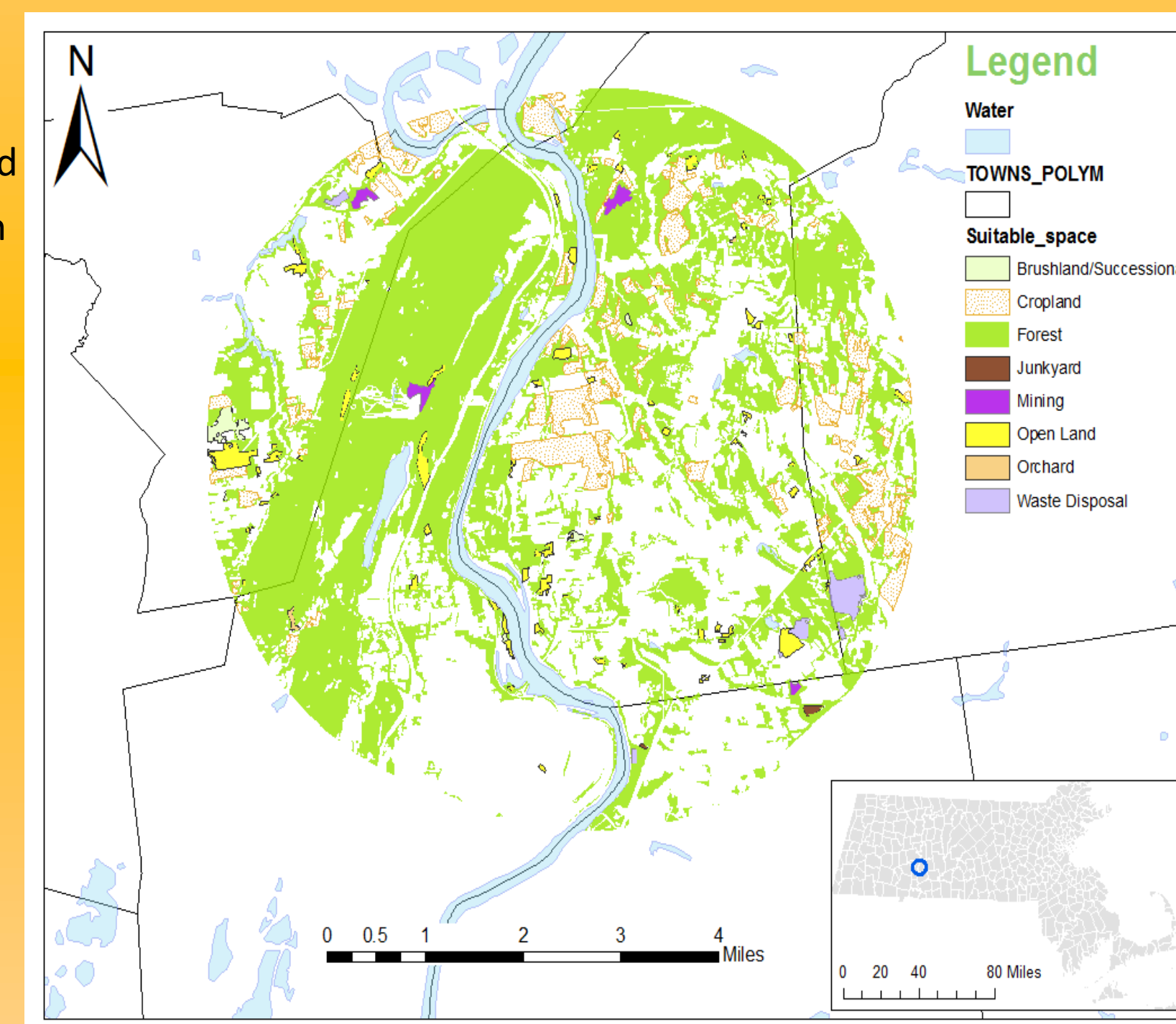
Map 1. Factor class



short distance to transmission lines is important for getting electric power to the grid. Moreover, the croplands must be big enough in order to supply plenty of crop residues. The last thing is that there must have large population in some distance from the croplands, so the power can be used efficiency.

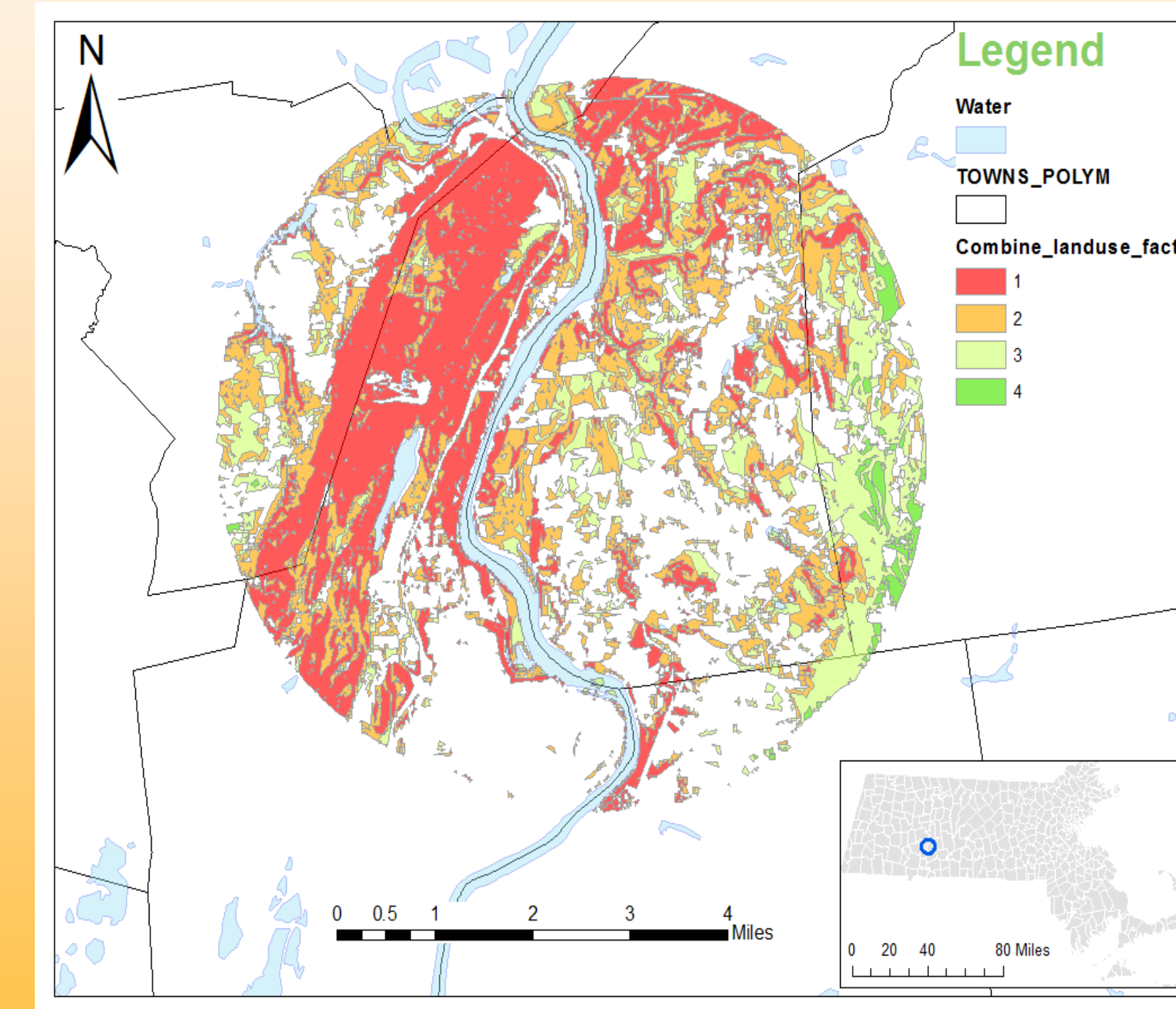
As far as there is one cropland remaining in my first analysis, I forward to step two. This step ranked the cropland's suitability based on distance away from the conservation land and water and slopes of the land near the cropland. Away from the conservation land and water is important to protect the environment. A higher slope will increase the difficulty of construction, so lower slope area is more suitable for the new plant. Attributes were ranked on a scale of 1 to 4 with 4 being the most suitable for development (shows in Map 1). Then I selected the available land from landuse data (shows in map 2) and combined it with ranking. Map 3 is the ranking of available land.

Map 2. Available land



Then in step 3, I selected the available land which ranked over 3 and have to be big enough for construct a plant and near the selected cropland. The final result is in Map 4.

Map 3. Combined landuse with factor



Conclusion and Further Improvement

In the end I thought my final approach worked out well. I am glad for the experience working with ArcGIS and proud of my final product. However, looking back there are some changes that I would make if I were to do it all over again. First of all I will add the canopy layer in ArcGIS. Though this will increase workload, it will be very important for economic purpose, as there will not be always enough crop residues in real life. Second is accessible, as I mention it above, it cannot simply use select by location tool to determine. The improvement method is to use Network Analyst to determine the travel time. However, the only problem is that it will take lot of time if there are too much data. The last thing is the break value I set for slope. As I set the break value very small and slope weight a lot in raster calculation, most of the land is out of consideration, which in reality is not true. However, the result is still good for me.

Reference

Data Sources:
 MassGIS, 2010 U.S Census (American Fact Finder), USGS

Projection:
 NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 (Meter)

Literature:
 D. Voivontas, D. Assimacopoulos, E.G. Koukios (2001). Assessment of biomass potential for power production: a GIS based method. *Biomass and Bioenergy* 20, 101 – 112.
 Nazli Yonca Aydin, Elcin Kentel, Sebnem Duzgun (2001). GIS-based environmental assessment of wind energy systems for spatial planning: A case study from Western Turkey. *Renewable and Sustainable Energy Reviews* 14, 364–373
 Arnette, A. N., & Zobel, C. W. (2011). Spatial analysis of renewable energy potential in the greater southern Appalachian mountains. *Renewable Energy*, 36, 2785-2798.
 Tegou, Leda-Ioanna, Heracles Polatidis, and Dias A. Haralambopoulos. (2010). "Environmental management framework for wind farm siting: Methodology and case study." *Journal of Environmental Management*, 91(11): 2134-2147.



Limitation

As there is no data shows which croplands are belong to the same host, I have to choose the croplands as big as possible. However, 200000 SQ.MT is not that big. So if there any improvement, the first thing is to find the information of the croplands and combine the croplands which belong to the same host to one polygon.

The second one is that though I find a suitable land followed by the steps above, there is still a problem. As I open the land use layer, there are some very low density residential nearby (less than 100m). Building a new plant here will definitely affect their lives.

Map 4. Selected cropland and Selected land

