Site Suitability Analysis for Agricultural Operations in Vermont:
A demonstration of the "weighted overlay" raster analysis technique

Vermont Agriculture
An Overview

A site suitability analysis like this one would support efforts to promote new, small-scale, sustainable farms in the state of Vermont. Across the U.S., agriculture has become industrialized, with fewer operators producing our food on larger and more specialized farms. One reason for this trend is that farmers are receiving a smaller and smaller portion of the consumer's dollar as wholesalers and retailers have taken over the distribution and marketing of our food.

There has been a backlash against this industrialization over the last few decades as Americans take back control over *how*, *where*, and *by whom* their food is produced. Small-scale farmers are often better land stewards and tend to be focused on quality rather than quantity of production. Small-scale operations can be profitable with a direct-to-consumer marketing system—selling produce at one or more of the farmers' markets or cooperatives across the state. This way, farmers capture 100% of the consumer's dollar, and consumers can connect with the people growing their food.

In 2005 Vermont had:
6,300 farms
1.25 million acres of land in farms
(21% of total land area)
62 active farmers markets
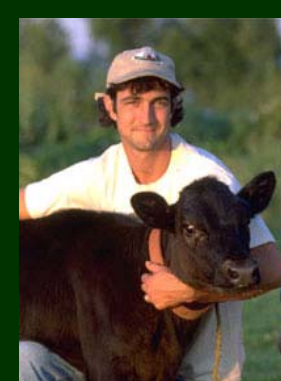
In 2002:
Average age of principal operator was 54
1,163 farms were selling direct to consumers
179 farms sold certified organic commodities
261 farms had land in orchards
1,723 farms had tapped maple trees
413 farms sold vegetables & melons

Vermont's top products:
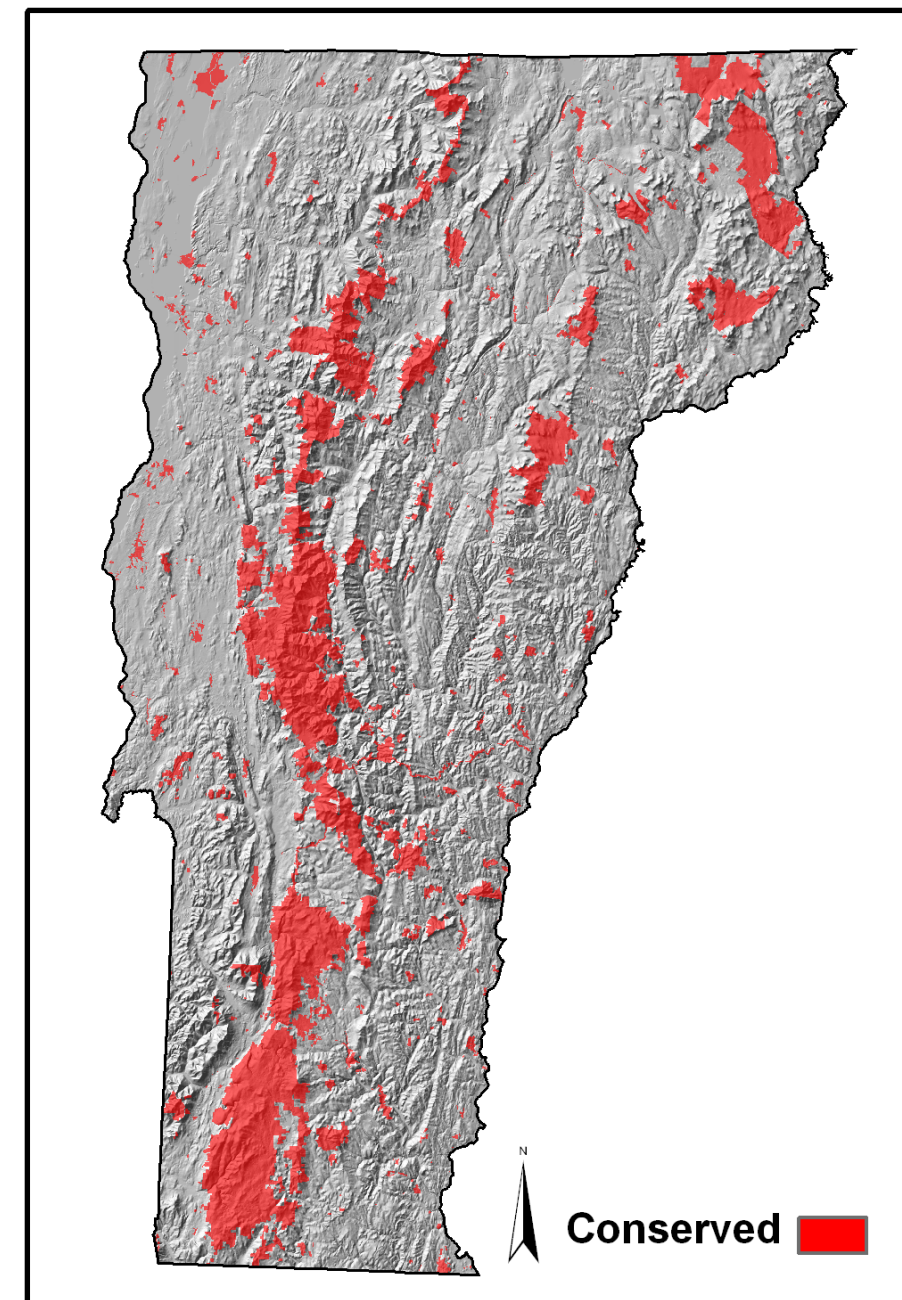Dairy, maple syrup, Christmas trees, apples

Sources:
USDA National Agricultural Statistics Service
http://www.nass.usda.gov/Statistics_by_State/

Input Maps

Public Conservation Land

Conserved ■

Population Density

Burlington
South Burlington
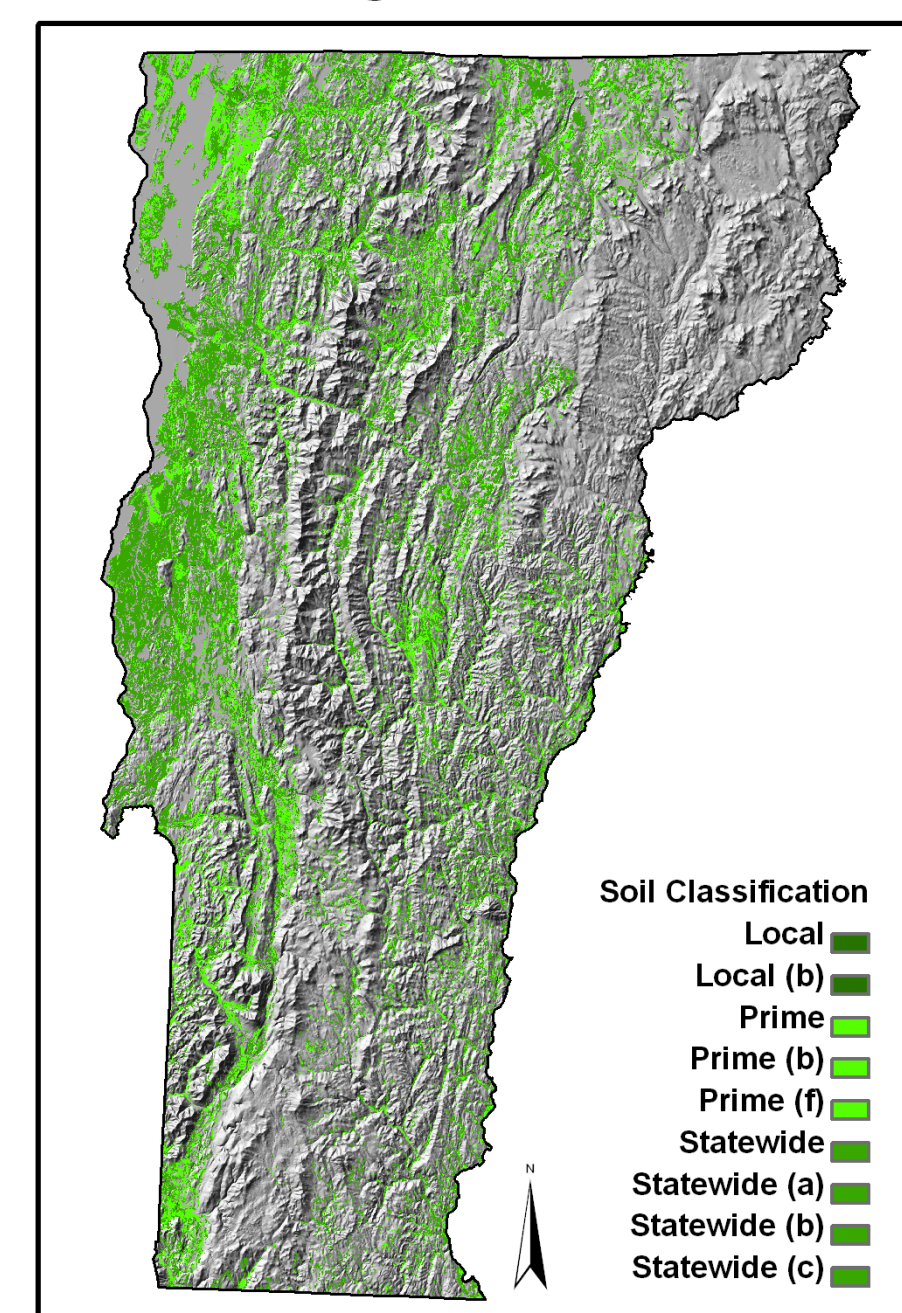Montpelier
Rutland

Yr 2000 Census Blocks
People/Square Mile
0
0 - 50
50 - 200
200 - 1,400
1,400 - 730,000
• Major cities

Prime Agricultural Soils

Soil Classification
Local
Local (b)
Prime
Prime (b)
Prime (f)
Statewide
Statewide (a)
Statewide (b)
Statewide (c)

Burlington Area Land Cover

Water or Wetland
Barren
Residential
Commercial/Industrial
Orchard
Crops or Other Ag
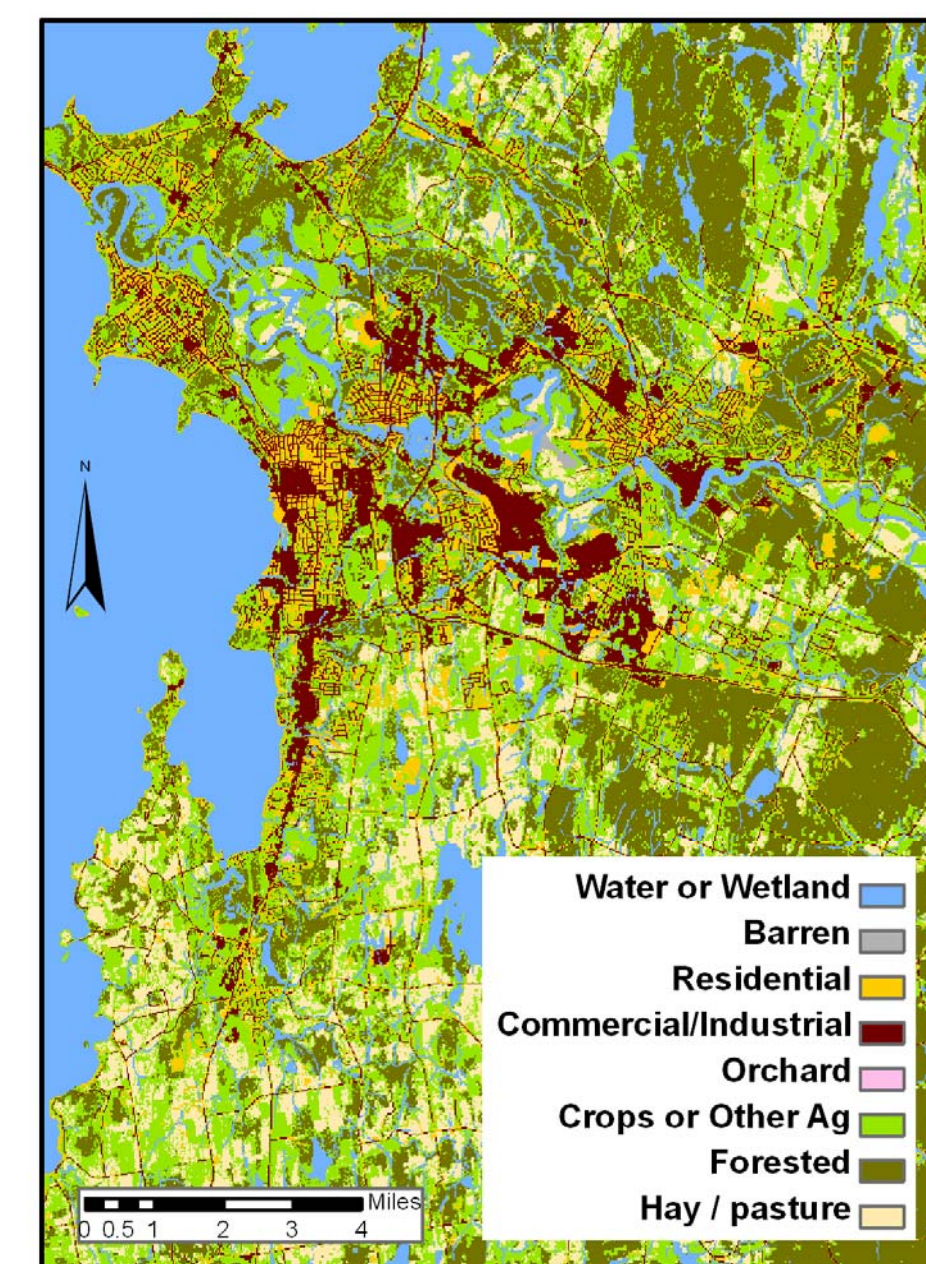Forested
Hay / pasture

Major Roads

Major Roads

Methodology

1) Collected data layers – raster if available
2) Merged soil classification data tiles (which were by county) into a single layer file
3) Converted all vector format files to raster format
4) Resampled all 30m cell-size raster files to 90m cell-size so that file size was manageable
5) Used spatial analysis to create a kernel density map from census block population data
6) Used spatial analysis to create a distance from major roads map
7) Reclassed all input layers into integer values on a scale of 1-9
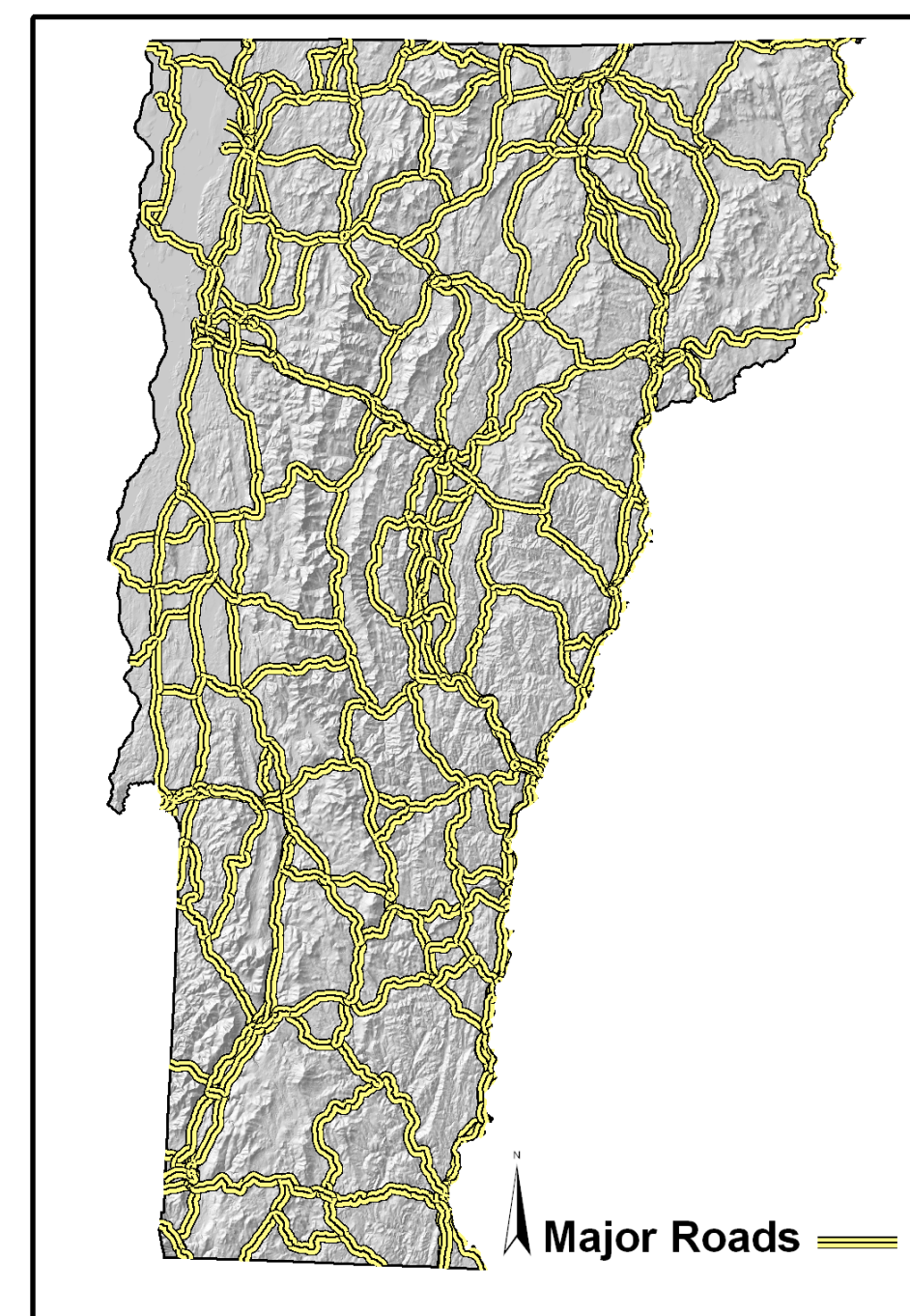8) Performed a weighted overlay raster analysis, with the following weighting:

50% soil classification
20% land cover/land use

20% distance to population centers
10% distance to major roads
0% public conservation land (binary variable)

Input Rationale

Soils Classification: The NRCS has identified and mapped "prime" agricultural soils, soils of "statewide" importance, and soils of "local" importance. The NRCS considered soil composition and texture, moisture level, slope, aspect, and temperature. The footnotes a, b, c, and f mean the following: a)slope limitation b) wetness limitation c) bedrock limitation f) flooding limitation. Because this classification is so comprehensive, I did not need to derive slope from DEM or include a hydrological analysis.

Public Conservation Land: I excluded publicly-owned conservation land from potential sites. Privately-owned conservation land, including land bearing easements, is included in potential sites and may be a particularly good resource for new farms.

Access to Major Roads: I consider proximity to major roadways to be a desirable factor in site suitability. This assumes that the producer would aim to sell directly to consumers at farmers' markets or cooperatives in city and town centers.
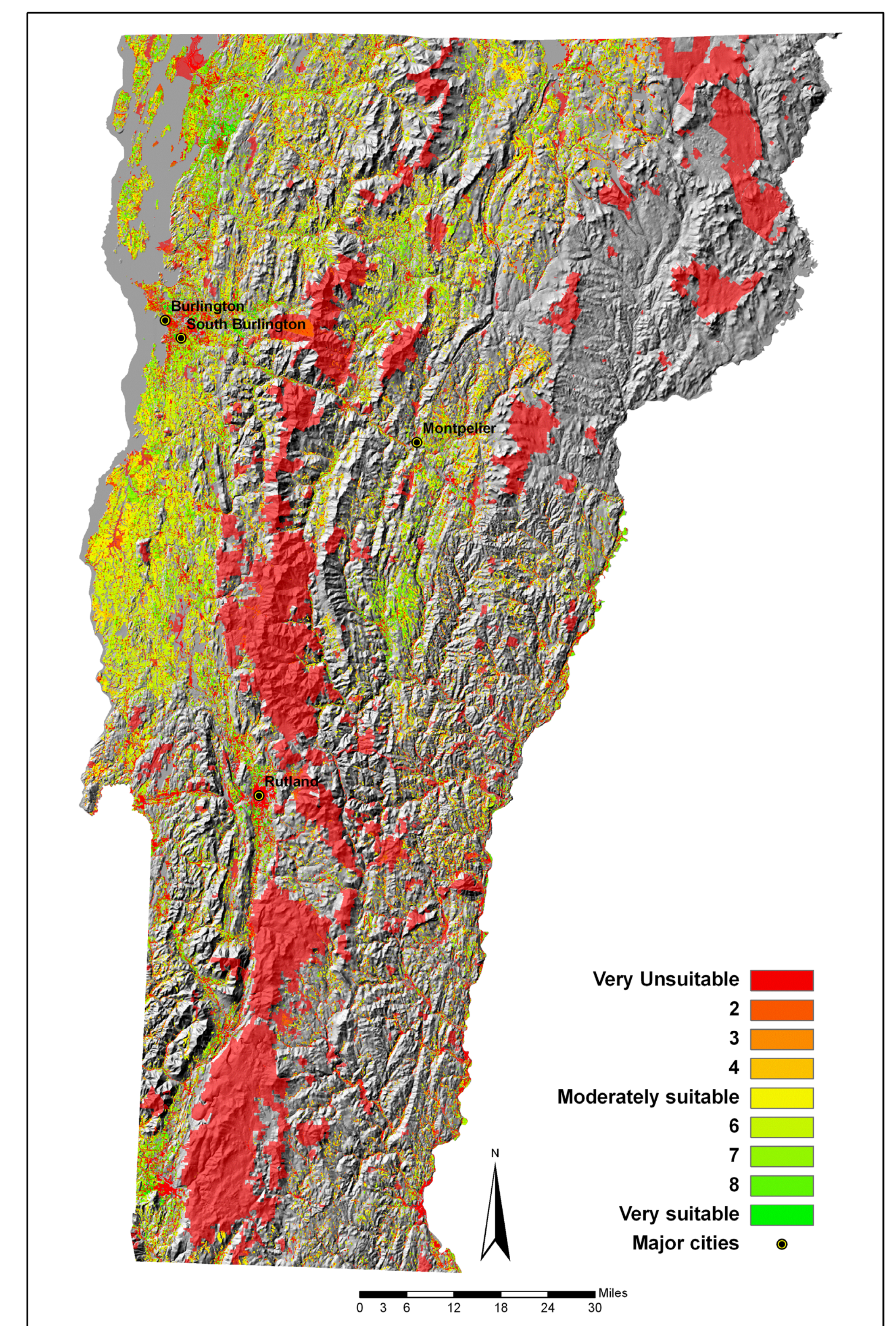
Population Density: Because I couldn't map Vermont's existing farmers' markets, I included a population density input from 2000 Census blocks, assuming that where there are dense populations, there are robust markets for agricultural products.

Land Cover/Land Use: Any land that has been classified as wet, barren, or developed was excluded from potential sites. Land currently classified as "open" or agricultural received the highest ranking and forested land received a lower ranking due to the cost of clearing brush or trees prior to cultivation.

Intermediary Maps

Kernal Density: Population

Population/Square Mile
0
0 - 12
12 - 25
25 - 50
50 - 100
100 - 200
200 - 400
400 - 800
800 - 1600

Distance to Major Roads

Meters
0 - 400
400 - 800
800 - 1,200
1,200 - 1,600
1,600 - 2,400
2,400 - 4,000
4,000 - 5,600
5,600 - 7,200
7,200 - 8,800
8,800 - 10,400

Challenges

I wanted to include a land value variable, to give preference to more affordable land, but had difficulty finding anything meaningful. The USDA has data on the average value per acre of current agricultural land and buildings, but this is only at the county level. The U.S. Census has median home value by town, but this doesn't take undeveloped land into account. I was also hoping to geocode farmers' market locations across the state, because proximity to a direct-to-consumer market would be very desirable for a small-scale farm. But the Vermont Agency of Agriculture, Food & Markets doesn't provide true addresses for the existing 62 markets. Finally, a professional investigation of site suitability for new farms would use a complete network analysis if proximity to major roads was a factor. I strictly used Euclidian distance.

New Farm Site Suitability

Burlington
South Burlington
Montpelier
Rutland

Very Unsuitable
2
3
4
Moderately suitable
6
7
8
Very suitable
• Major cities

Miles
0 3 6 12 18 24 30