GIS in Research

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Introduction

The use of Geographic Information Systems (GIS) for energy and educational outreach projects at The Nature Conservancy's (TNC) Bridgestone Reserve at Chestnut Mountain shows the value of this technology for a range of programs.

Starting with the educational outreach project, GIS was useful for TNC in locating and evaluating eligible private forest landowners for potential TNC-led courses.

- GIS was used to set criteria to determine the appropriate audience to receive informational pamphlets.
- 35,987 total parcels were narrowed down to 449 applicable landowners with the use of landowner databases and National Landcover Databases.

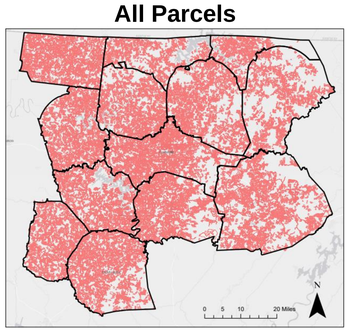
Regarding the carbon neutrality project, the use of GIS allowed for a cost effective and timely survey of Chestnut Mountain that will also mitigate issues in the future with poor wind turbine or solar panel placement.

- The usage of Digital Elevation Models to calculate for hill slope and direction in addition to wind speed and capacity, solar exposure, and a few other components allowed for remote calculations.

Outreach Evaluation

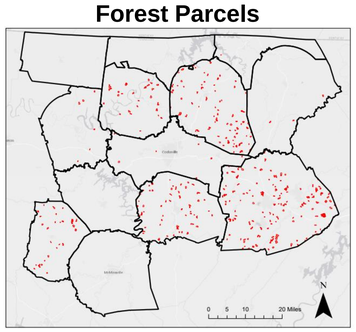
- GIS was used to separate forest parcels from all parcels, using the land use type of each parcel.
- This allowed addresses of each forest parcel owner to be gathered easily and efficiently.
- The two maps below show these parcels before and after GIS was implemented.
- Without GIS, each individual parcel would have been manually separated based on land use type. Given that we started with over 35,000 parcels, this would have been very time-consuming.

All Parcels



County Borders
All Parcels

Forest Parcels



County Borders
Forest Parcels

Program Awareness

- Using the information collected from the parcels, a letter was written inviting landowners to classes.
- The program information ranges from acquiring conservation easements to general forestry care.
- These outreach programs are designed to benefit the landowners and the future of their land.

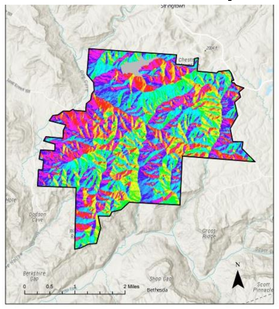
GIS in Choosing an Alternative Energy Source

- GIS allowed us to use a variety of tools to evaluate alternative energy sources at Chestnut Mountain. These include area solar radiation, slope, and inverse distance weighted calculations.
- GIS also allowed us to give an accurate determination of alternative energy system placement.
- Without GIS, physical maps and mathematical models would have been needed, potentially making the results less accurate and more time consuming.

Solar Energy Evaluation and GIS

- GIS allowed us to calculate the slope direction of the land at Chestnut Mountain, which tells which cardinal direction the land points toward.
- Because solar panels are best placed on land with southern exposure, we were able to determine the best place for solar panels.
- GIS also allowed us to calculate solar radiation exposure on the rooftops of the three structures. This allowed evaluation of the effectiveness of placing solar panels on the rooftops.

Hill Direction Map



Hill Direction
Flat
North
Northeast
East
Southeast
South
Southwest
West
Northwest

Property Boundary

Solar Exposure on Structure Rooftops

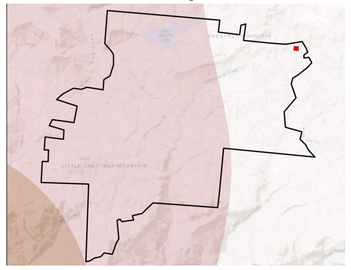
Solar Radiation (Kilowatts)
1450.0
1350.0

Wind Energy Evaluation and GIS

- GIS allowed the calculation of average wind speed on TNC property, which was used to determine the best location to place a wind turbine.
- GIS also allowed average wind capacity to be calculated on TNC property, which gives the areas that would produce the most wind energy if a wind turbine were placed there.
- GIS allows wind speed and capacity to be evaluated geographically. This can be compared to TNC property boundaries and points of interest to determine the best places for a wind turbine.
- GIS allowed us to use Digital Elevation Models to calculate the slope of Chestnut Mountain and calculate the best ranges for a potential wind turbine (where slope is less than 16.5 degrees).
- Comparing the slope calculations to the points of interest given to us by The Nature Conservancy, we were able to evaluate that all preferred locations have a good slope potential.

Wind Energy Evaluation and GIS

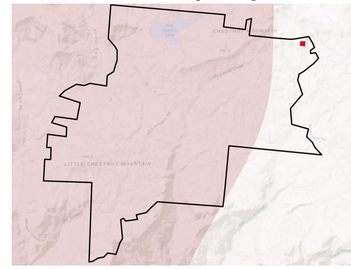
Wind Speed



Nature Conservancy Buildings
Nature Conservancy Property Boundary

Windspeed at 120m (m/s)
≤ 2.2
≤ 2.4
≤ 2.6

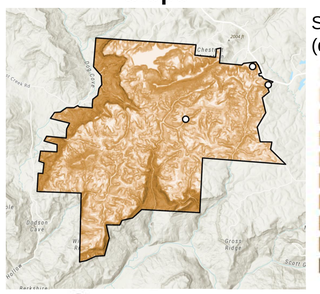
Wind Capacity



Nature Conservancy Buildings
Nature Conservancy Property Boundary

Capacity Potential (mW)
≤ 150
≤ 175
≤ 200

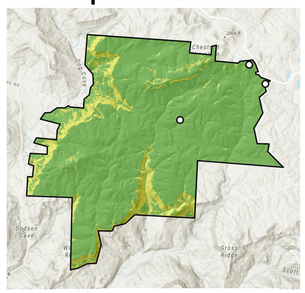
Slope



Slope (degrees)
≤ 2.0
≤ 4.0
≤ 6.0
≤ 8.0
≤ 10.0
≤ 15.0
≤ 20.0
≤ 30.0
≤ 45.0
≤ 90.0

Points of Interest
Property Boundary

Slope Calculation



Points of Interest
Property Boundary
Too Steep
Ideal Slope

Acknowledgements

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References Cited

"Digital Elevation Models (DEMs)." *TNGIS*, www.tngis.org/elevation.htm.

National Land Cover Database, www.usgs.gov/centers/eros/science/national-land-cover-database?qt-science_center_objects=0#qt-science_center_objects.

TN Property Viewer, tnmap.tn.gov/assessment/.

"Wind Resource Data, Tools, and Maps." *NREL.gov*, www.nrel.gov/gis/wind.html.