Siting a Composting Facility Using ArcGIS Model Builder

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Abstract

Many cities across the United States are beginning to seek out regional solutions for food and yard waste, which are major sources of greenhouse gas emissions in the urban environment. According to the U.S. EPA, in 2012 alone, more than 36 million tons of food waste were generated and only five percent of the waste was diverted from landfills through composting and incineration. A viable solution to the issue of waste and its resultant emissions is the production of compost, which is made from decomposed food and yard waste that can be used as a soil amendment. Cities such as San Francisco and Seattle are closing their waste loops by pioneering programs for food and green waste composting. The objective of the project is to perform a suitability analysis for a composting facility in a part of the country where such a program does not currently exist. There are many environmental factors involved in site selection, which vary regionally and include: proximity to rivers, bodies of water and wells; soil type; slope; size of available parcel; and surrounding land use zoning. Managing waste at a regional scale requires logistics to take variables such as road network and volume demand in relation to distance from facility into consideration. This complex task is best accomplished through geospatial modeling, which for this project, was performed using Esri's ArcGIS Model Builder interface. Through analysis, several parcels were identified within the county's current land holdings that would be suitable for a siting a composting facility, should such a program be implemented in the near future.

Figure 1: Jepson-Prairie Composting Facility services San Francisco County (Life Magazine)

Problem

1. How can Model Builder generate a surface that illustrates suitable site selection, given criteria established by North Carolina Law, Section 1400, which establishes criteria for compost facilities (Figure 2)?

1. What service areas will Network Analyst generate for public facilities that are producing significant quantities of food waste (Figure 4)?

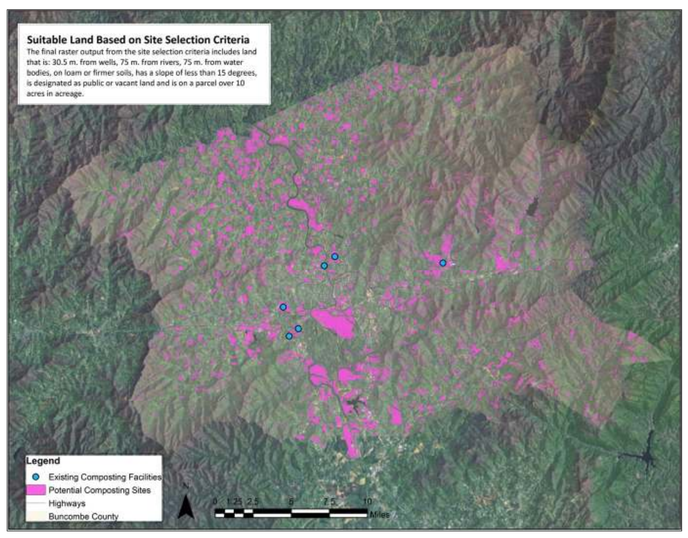


Figure 2: Suitable Land Based on Site Selection

Methods

The following GIS model displays appropriate sites for a composting facility based on several key variables. The following data were input into Model Builder: *wells, rivers, water bodies, soils, property boundaries, property classifications and DEM* of Buncombe County. After the suitable land was generated, this polygon was overlaid with the two existing facilities that accept food waste to generate two service areas that met existing North Carolina Compost Facility codes. Euclidean distance was run against rivers, wells and water bodies, then reclassified parcels into two categories: those within the distance threshold and those outside of it. Parcels that did not meet the slope requirements were excluded from the analysis through the model. Zoning was also taken into consideration, as residential lots were excluded and vacant government-owned lots were given higher preference. The final raster layer generated from this model could inform policymakers' and planners' decision making in siting a source separated organics composting facility.

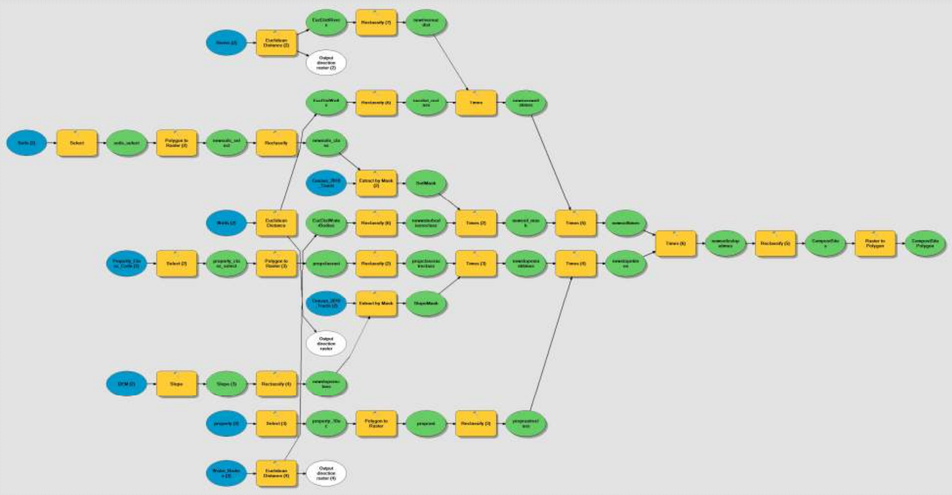


Figure 3

Findings

The final raster aligned with the existing composting facilities, validating the site selection criteria. The model was accurate, in that, it identified parcels upon which there were already waste collection facilities with similar site specifications. The final raster was converted to a polygon, which was utilized in a Network Analysis (Figure 4) of the county to determine the service shed. The goal of performing this analysis was to determine service areas for two existing composting facilities in the county currently accepting food waste. Siting the facility from a logistics perspective was not as challenging, given that most of Buncombe County is within a 20-25 minute drive time of both existing food composting facilities. Future studies should examine local public schools as pilot projects, since most are within a 20 minute drive of existing facilities.

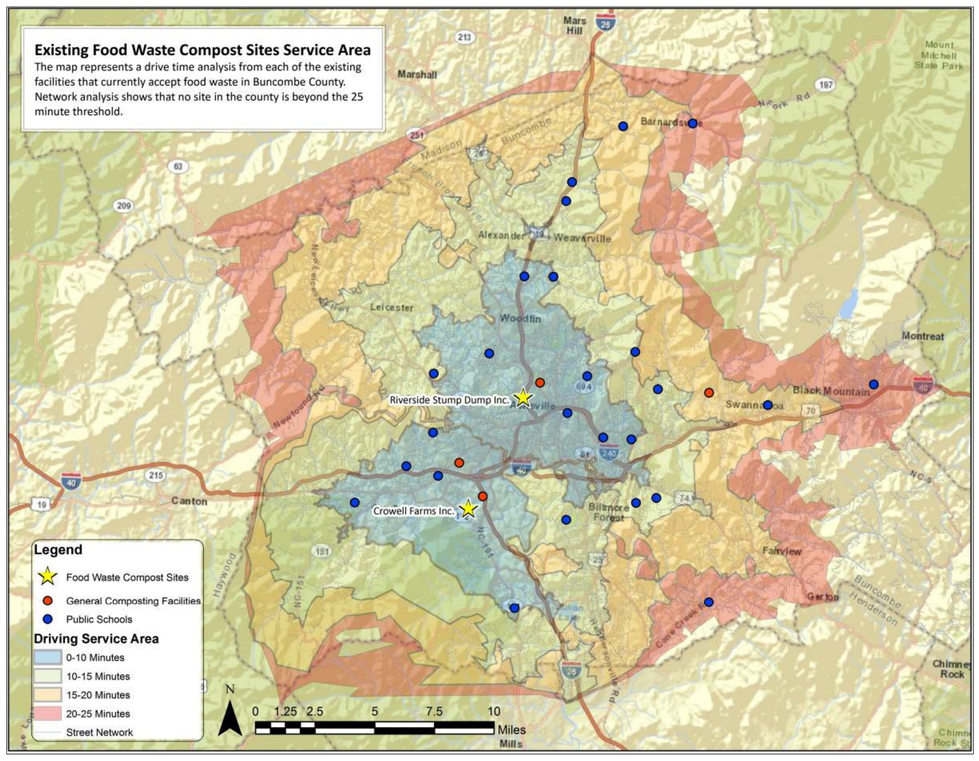
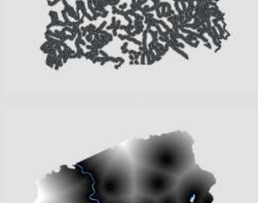


Figure 4: Existing Food Waste Compost Site Service Area

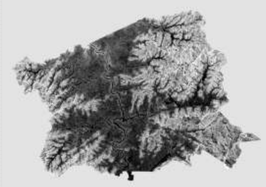
Results

The selection criteria were informed by NC Section .1400 – Compost Facilities. According to North Carolina Law as of May 2013, compost facility sites require:

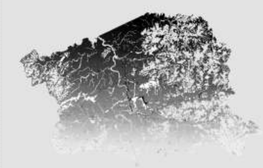


< 10 Acre Parcels
Size of the parcel is an important factor in siting the facility for logistical reasons. A minimum requirement is enforced.

Property Class
Vacant and publically held properties were favored as the acquisition of these parcels would be less involved.



Slope
Based on known contour information, properties that contained areas with over 5 degree slopes were excluded.



Soils
Loamy or loose soils are problematic for contamination reasons. Clay or impenetrable rocky soils are preferable.

Rivers
A minimum distance from an existing river or stream is an environmental consideration. Local codes necessitate this.

Water Bodies
Proximity to bodies of water is an important factor, as this influences local hydrology and determines soil permeability.

Wells
Areas near wells are vulnerable to contamination, especially of drinking water. A 100 foot buffer from wells was established.

References

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