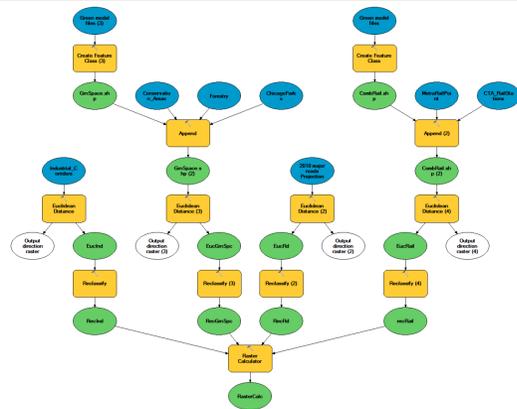


SUSTAINABILITY INDEX: A GIS TOOL FOR EVALUATING THE SUSTAINABILITY OF A MUNICIPALITY



DEMONSTRATED FOR
CHICAGO, IL



PRELIMINARY SUSTAINABILITY ANALYSIS MODEL

INTRODUCTION

Many cities and smaller municipalities have taken measures to become "sustainable". This has included everything from green building design to increasing public transportation or improved wastewater treatment. Several companies have measured and ranked the sustainability of cities in the U.S. and abroad. These projects only include major cities and do not have a way for other municipalities to rank themselves. Their results are also generally expressed in tables and spider charts. There is a need for a tool that can quantify the sustainability of any type of municipality independently of these large projects.

ArcGIS Model Builder can be programmed to perform a series of analysis that will give any municipality a total sustainability score, as well as a more nuanced look at their sustainability.

Visually mapping individual features affecting sustainability is also useful for identifying and addressing the areas of sustainability with which a municipality is struggling.

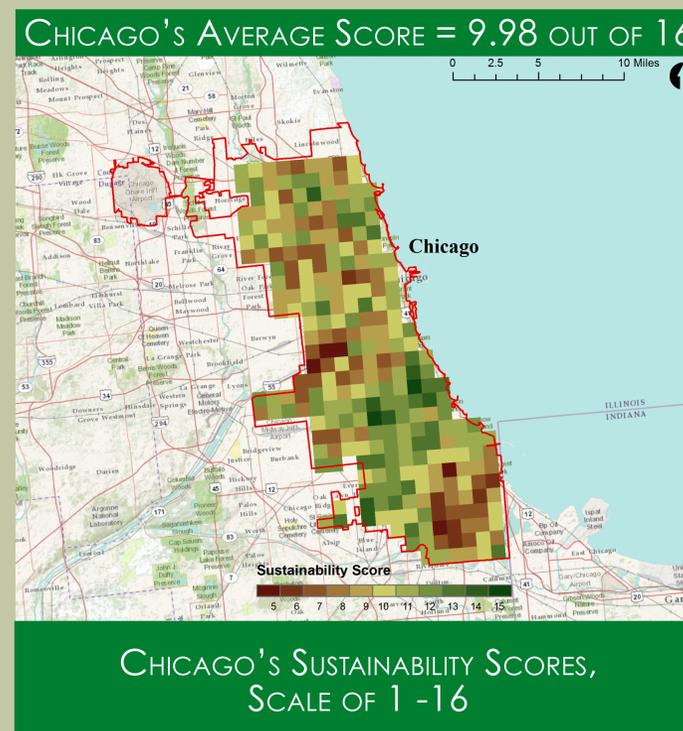
This project demonstrates how ArcGIS can be used as a tool for assessing the sustainability of a municipality. Chicago, IL was analyzed as an example of this tool. This model includes the distances from green space, industrial areas, major roads, and rail stations. Euclidian Distances from features were used to quantify access to these features in addition to their frequency within the city.

MODEL

A spatial analysis model was created with ArcGIS Model Builder that analysis the sustainability of a municipality. Before running the model, the geoprocessing environment was set to mask any spatial analysis through Chicago's city boundary.

Steps in Model:

- 1) First certain data sets need to be combined. In this example two types of rail stations, Metra and Chicago Transit Authority stations, were made into a new feature class called CombinedRail. At the same time all of the parks, forests, and conservation areas were also combined into a new feature class named GreenSpace.
- 2) Euclidian Distances were calculated for these two features, in addition to Major Roads and Industrial Areas. This type of analysis creates raster layers where each square receives a value for the distance category it is in. These distance categories from each feature were 0- 1/4 mi, 1/4 - 1/2 mi, 1/2 - 1 mi, and 1mi or more.
- 3) These layers could then be reclassified into the values 1 - 4, where 4 is the most desirable distance. For example, rasters less



Attribute Table. Field Calculator multiplied each value (1 -16) by the number of raster squares that received that value, for every sustainability score value. In the Chicago example only the values 5 - 15 were present. The score for the city is the sum of the values for Index divided by the total number of raster squares.

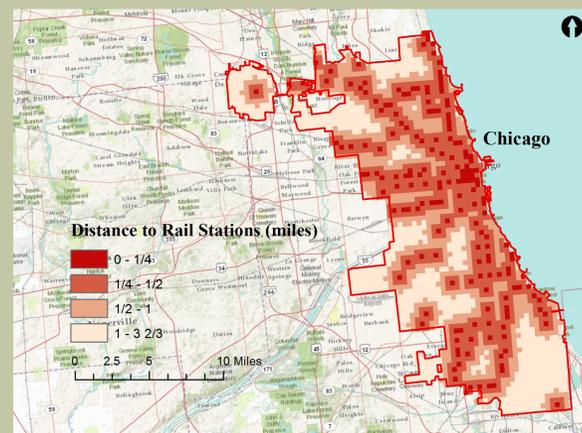
LIMITATIONS

This tool is mainly limited by the quality and extent of data available. Not all of the data layers cover the entire area of Chicago despite being taken from the City of Chicago's GIS database. Although, municipalities are investing in their GIS data systems, many may not be ready to use this tool for the next couple of years.

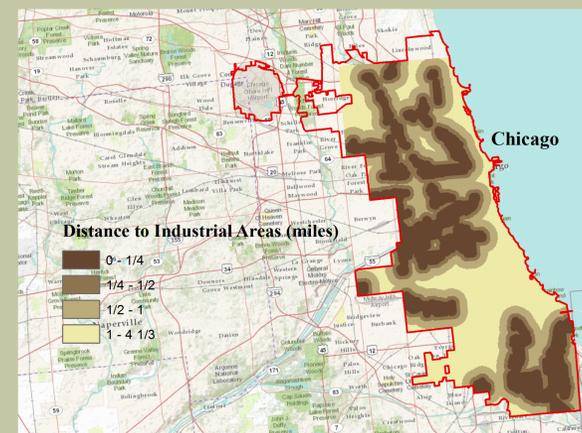
Another problem that came up was that there was a large discrepancy in the size of the data's raster. A raster of CO₂ emissions had to be removed from the model because its large rasters made the final sustainability score raster cover a much smaller portion of the City, and thus not equally represent the whole city.

FUTURE APPLICATIONS

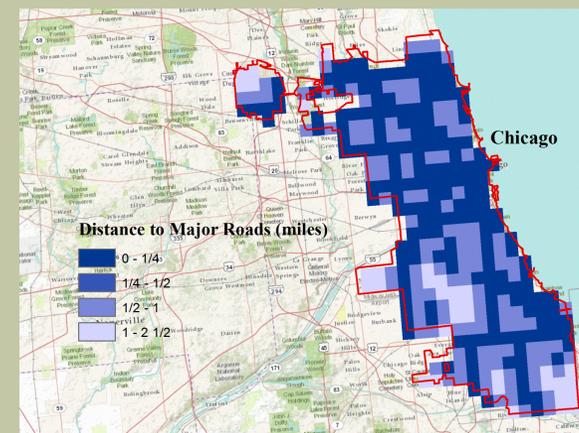
Future research should be aimed at determining the best data sets to use in this tool. Some useful data layers to be considered include: local environmental governance, air quality, waste management, water quality, transportation, buildings, land use, energy and level of CO₂ emissions. These will of course be limited by what types of data are available. The long-term application of this tool is to be able to use it to compare the sustainability of different municipalities.



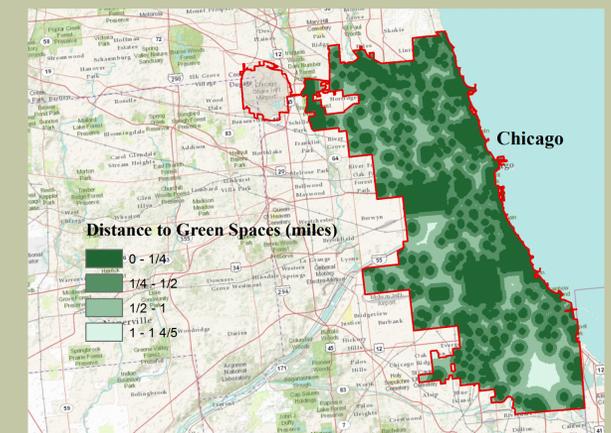
RASTER LAYER: DISTANCE TO RAIL STATIONS IN CHICAGO



RASTER LAYER: DISTANCE TO INDUSTRIAL AREAS IN CHICAGO



RASTER LAYER: DISTANCE TO MAJOR ROADS IN CHICAGO



RASTER LAYER: DISTANCE TO GREEN SPACE IN CHICAGO