

# **Analyzing Suitability of Land for Affordable Housing**

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## **Abstract:**

This paper explains the use of a geographic information system (GIS) to distinguish areas that might have potential to support affordable housing. The Delaware Rural Housing Consortium (DRHC), a collaboration of nonprofit rural housing developers, created a three-year plan to build affordable housing for 750 families in Delaware. To locate potential sites, we employed ArcGIS and Spatial Analyst. Features analyzed, among others, were current land use, water availability, and proximity to other development. From the census, we used socio-economic data, such as income, age of housing, housing payment and recent construction. Project output was twofold: presentation maps and virtual maps created using ArcPublisher / Arc Reader.

## **Background**

The Delaware Rural Housing Consortium (DRHC) consists of seven non-profit housing development organizations that operate throughout rural Delaware. The Consortium's mission is to provide affordable housing for lower income families in Delaware. In 2002, the consortium was completing its current three-year plan and was initiating work on its next plan for the years 2003-2005. MAK Associates, consultant to the DRHC, approached the Water Resources Agency (WRA), within the Institute for Public Administration (IPA) at the University of Delaware, to investigate the possibility of using a geographic information system in this planning activity.

The consultant's original plan was to develop a rural housing development data book for the more rural areas in Delaware (Map 1). The book would be a compendium of relevant data from the 2000 U. S. Census. It would be used as a resource guide to help the Consortium members establish their goals for the next three years. They also hoped to support this effort with a map, but were unsure of what kind of map would be most useful.

We suggested performing a suitability analysis to locate areas with potential for affordable housing. Once we explained the concept of geographic overlay analysis, they were very eager to proceed. They felt that the results of such an exercise would initially identify, or more closely pinpoint, areas that should receive additional evaluation. Because the results could be shown on a map and areas easily identified, it would negate the need to pore over pages of figures in attempt to locate such areas. The state's counties, from north to south, and in decreasing order of urbanization, are New Castle, Kent and Sussex. Kent and Sussex are the counties used in this model.



## **Methodology**

MAK Associates and the DRHC identified census data they felt needed inclusion in the study. The WRA suggested additional statewide data that could be beneficial in a GIS analysis. Among these were statewide orthophotography and land use data. The feeling was that affordable housing should be located near existing urbanized areas and not in areas predominantly rural. In a more rural area, the population is more dispersed and jobs are not nearby. The state also has an initiative called “Livable Delaware.” This program seeks to guide development and foster growth into preferred areas in order to mitigate urban sprawl. Thus, we also used data on land use, water availability, and proximity to current developed areas as inputs to the model. In conjunction with the DRHC, the consultant created a list of criteria they felt should be included in the model and determined what might constitute high values. See Table 1.

Table 1. Study variables.

<b>VARIABLE</b>	<b>HIGHER VALUES FOR</b>
Land Use	Open land (exclude park land)
Distance from Water Service	Close to water service
Proximity to town boundary	Infrastructure and “Livable Delaware”
Population Density	Higher density reflects higher demand
Income	< \$35,000
% of Income paid for Rent	> 30%
Median Age of Housing Stock	Declining condition, older housing
% of Housing is Rental	> 40%
Recent construction activity	> 20%

Three levels of suitability were decided upon: low, moderate and high. Each variable was ranked based on a subjective evaluation of its importance to locating suitable areas. Table 2 shows the values assigned to the variables. To be noted in this figure is that open land (agriculture, barren land) and forest were the only areas on which the final suitability analysis was performed. Excluded were any local, state, and federal parks or recreation areas. Thus, the land use variable could only have a value of 3 for forest or 5 for open land; any other land uses (urban, wetlands, water) were considered non-study areas.

Table 2. Values assigned to variables.

<b>VARIABLE</b>	<b>VALUES</b>		
	<b>1</b>	<b>2</b>	<b>3</b>
Land Use	Non-Study	Forest	Open Land
Distance from Water Service	> 0.5 mi.	< 0.5 mi.	In service area
Proximity to town boundary	> 3 miles	1 – 3 miles	< 1 mile
Population Density	Low 1/3	Middle 1/3	High 1/3
Income (% earning <\$35,000)	< 20%	20 – 40%	> 40%
% paying > 30% income for rent	< 20%	20 – 40%	> 40%
Median Age of Housing Stock	Post 1980	1960 - 1980	Before 1960
% of Housing is Rental	< 20%	20 – 40%	> 40%
Recent Construction	< 10%	10 – 20%	> 20%

Each of the variables was represented in a single polygon feature class. The U.s. Census Bureau block group TIGER (Topologically Integrated Geographic Encoding and Referencing) line files were used, and the relevant census data joined to these files. For each of these feature classes, a field was created in its attribute table to contain the value to be assigned. Once all the values were entered, Arc Spatial Analyst was used to create a raster file of cells thirty meters on a side. Next, using Spatial Analyst, the grids were summed to create a final grid showing the relative suitability of each thirty-meter cell based on our criteria. See Maps 2 and 3. The range of values for Kent County was 17 to 39; those for Sussex county ranged from 17 to 41.

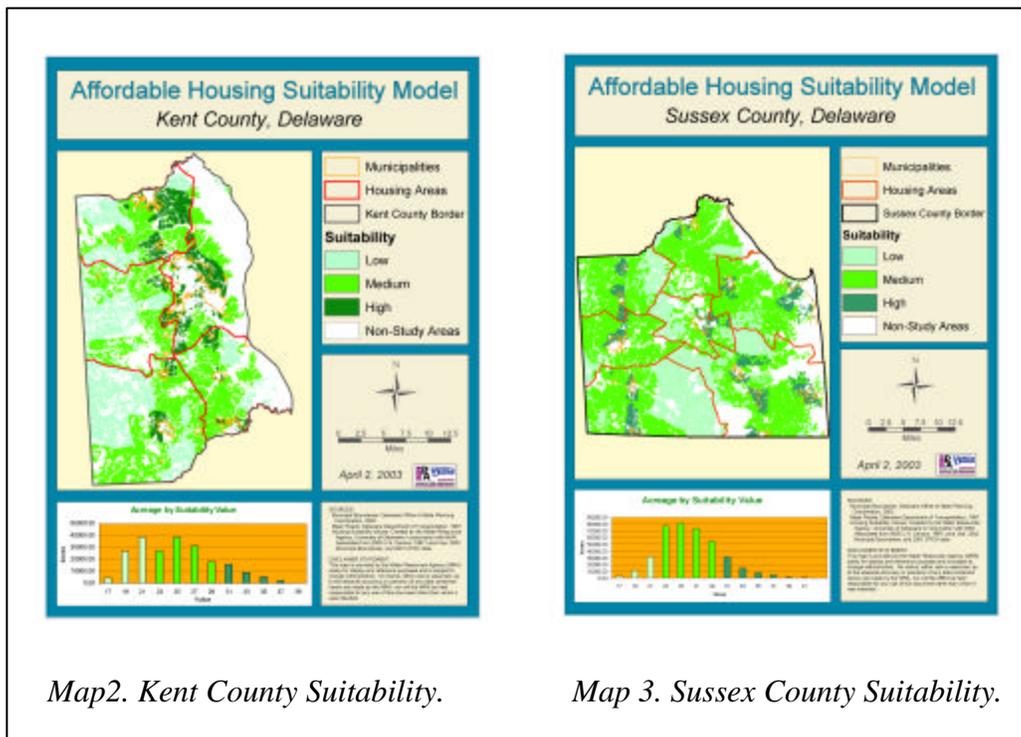
## Results

Map 2, Kent County, shows the areas excluded are along the eastern coast (Bombay Hook National Wildlife Refuge), areas inside cities, and areas in northwest and west central part of the county. The areas showing highest potential are located in the north, southeast of Smyrna and west of Cheswold, and in central Kent County, east of the state capital, Dover, and in the south surrounding the cities of Felton, Harrington, Milford, and Magnolia.

Map 3, Sussex County, indicates that the excluded areas lie in coastal areas along the Delaware Bay and Atlantic Ocean and in large wetlands in the south central part of the county. Areas showing most potential are those around towns in the western and central part of the county.

## Presentation and Investigation of Results

The maps were valuable to the consortium as guides to locations that should be evaluated further. However, more data are available that could be very useful in any further evaluation. This GIS-formatted data includes nearby roads or streams, proposed state growth areas, school district boundaries, size of parcels in the areas, etc. Adding it to these maps would make the maps so cluttered as to make them almost useless. What was needed was a method to quickly examine the data by zooming in to a larger scale. Being able to view this ancillary data would add greatly to the use of the analysis as a tool.



We decided to use ArcReader to address this issue. We showed the consultant the potential of this tool, and he immediately saw its value for presenting the work to the Consortium. ArcReader is a free GIS viewer available from Environmental Systems Research Institute of Redlands, California. With it, the user can turn layers on and off, zoom, pan, identify and perform a few other map interrogation tasks. It has both a data view and a layout view. The user can zoom in on the map in the layout view, and print a map of the layers shown in the new map extent.

To the ArcMap project file used to create the maps, we added the following shapefiles:

- Streams and roads
- State Preferred Growth areas
- School district boundaries
- Property Parcel boundaries of parcels greater than five acres.
- Land Use polygons

We also added the individual raster files for each of the variables used in the model. Once all the layers used for the analysis were added, we created a map layout into which these layers could be placed. We then used ArcPublisher to create the publisher file (pmf) readable by ArcReader. When brought up in ArcReader, the map is dynamic so that when you change the extent in either data or layout view, it also changes in the map. This capability allows one to zoom into an area, turn on the layers he wishes to view, and to print larger scale maps of any area shown on the smaller scale paper map.

The consultant presented the hardcopy map to the Consortium, but he also had ArcReader and an ArcPublisher file installed on his laptop. He was then able to respond to questions from the Consortium regarding specific areas by investigating any area in more depth. He could view the grid files to explain what variables contributed to that cell's total score. He could overlay the property parcel file on the suitability cells to determine the size of properties and the parcel numbers.

## **Conclusion**

Because of time constraints, this analysis had to be completed in only two months. Had more time been available, we would have attempted to add more data to the analyses. One obvious omission is that of sewer availability. Also, additional census data might be used to further refine the model. Nevertheless, the model proved useful in aiding the Consortium in identifying areas that show a high suitability for the development of affordable housing, and they indicated an interest in updating the analysis in the future.

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