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Virginia Association for Mapping and Land Information Systems (VAMLIS)

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"It is difficult to make predictions, especially about the future" Niels Bohr

Contents

1. Objectives of Study

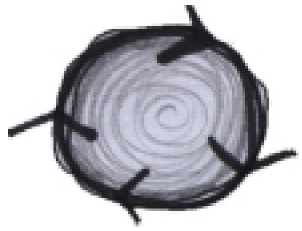
This study was initiated as a break from abstract theorizing. Part of the objective was to familiarize self with neighborhood. Part was to constantly update understanding of the varied factors effecting urban growth.

The study was designed to better estimate trends in growth and reasons thereof, and refine the present to face this estimation. It was a response to answer some basic planning questions- how does one refine planning methodologies to best achieve social good?

…identification *appreciation*

planning *response*

refinement *identification…*



Admits all these questions grew a desire to equip the planner with tangible skills and tools. The limited potential of such skills in planning was never ignored. However, an attempt has been made.

The approach was to use geographic and demographic information about a city and its neighborhood, and make a growth projection for that region.

In brief, the analysis can be broken down into the following main steps:

- Evaluating Potential Effect and Assigning Weights
- Calculating Growth Potential
- Distributing Projected Population
- Detailing Distributed Population into Neighborhood Elements

2. Data collection and Explanation

The Thomas Jefferson Planning District Commission (TJPDC) was the main source of GIS compatible data. The Geo-Spatial Data Center at Alderman library, UVA also proved helpful. Data gathered was then processed into Arcview GIS 3.2 for spatial analysis and growth projection.

Note that data used for this study is of 1990 and later origins. Attached maps are for study purpose only.

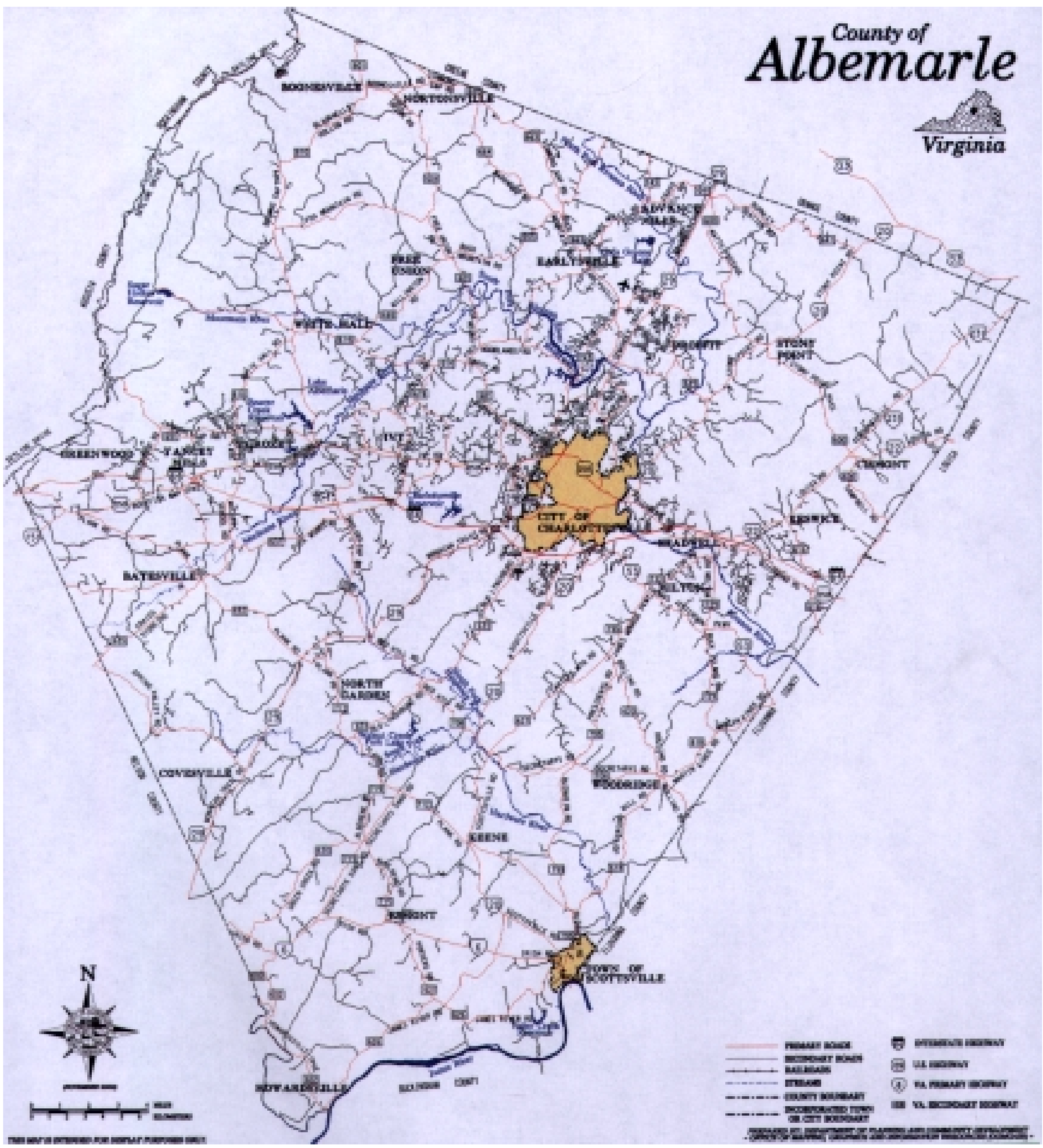
Other main sources used were:

- Weldon Cooper Center for Public Service, University of Virginia
- Virginia Employment Commission
- U.S. Department of Census website (www.census.gov/)
- U.S. Geological Survey website (www.usgs.org/)
- U.S. National Wetlands Inventory website (www.nwi.fws.gov)

- 1990: US Census Data, C90STF3A, Charlottesville, VA, SMSA.

(please refer to citations for web data-sources)

<u>3. About the Study-area</u>



The city of Charlottesville along with the surrounding region in Albemarle County formed the periphery of the study-area. Charlottesville with significant tourism and cultural potential, houses the University of Virginia. Albemarle County has the Shenandoah mountain range in the northwest, and the Ruckersville commercial and residential development area to the north. It has the South-West Mountains Rural Historic District to its northeast.

To be able to calculate the future growth potential, the study-area was broken down into following attributes. This list is in no way complete, but sufficient nevertheless to arrive at a general picture.

1. Major Employers
2. Water Bodies
3. Rail Transportation
4. Cultural Centers
5. Surface Transportation
6. Natural Landmarks
7. Air Transportation
8. Municipal Points
9. Small Natural Points
10. Land Uses
11. Elevation and Ground Slope
12. Floodplain and Wetland
13. Historic Districts
14. Tree Cover

<u>1. Major Employers</u>

The study-area shows a concentrated spread of major employers in and around Charlottesville. Some of these are distributed along the northern segment of Route 29.

NAME	EMPLOYER TYPE	SIZE CODE*
University of Virginia Hospital Division	hospital and college	6
University of Virginia college	college	5
Martha Jefferson Hospital	hospital	5
Albemarle County	government	5
Blue Ridge Sanatorium	hospital	5
GE Fanuc	industry	5

* size code: (5) = 1000→4,999 employees; (6)= 5,000→10,000 employees

2. Water Bodies

The region is well endowed with natural water bodies. Annual active life of such bodies was not considered as a factor affecting future growth.

List of major water-resources in study region (proposed and existing)

- Buck Island Creek Reservoir
- Chesapeake
- Chris Green Lake
- Fluvanna Ruritan Lake
- Hardware River
- Lake Anna
- Mechums River
- North Fork Rivanna River Reservoir
- Preddy Creek Reservoir
- South Fork Rivanna River Reservoir
- James River

3. Rail Transportation

Rail routes considered were the CSX Railroad and the Norfolk Southern Railway.

4. Cultural Centers

They include civic buildings (ex. Rotunda).

5. Surface Transportation (ex. Streets and Roads)

6. Natural Landmarks

(Ex. Blue Ridge Mountains)

7. Air Transportation

(Ex. Charlottesville-Albemarle airstrip)

8. Municipal Points

(Ex. Amphitheaters)

9. Small Natural Points

(Ex. Madison bowl, ridges)

The five ridges included are:

NAME
Southwest Mountains
Goat Ridge
Pea Ridge
Pond Ridge
Sawlog Ridge

10. Land Uses

This attribute was further divided into sub-types based on population density. I considered open spaces (defined by a density of 1 H.U. per 50 to 100 acres), to urban landuse (defined by a density of 12 or more H.U. per acre). Categories included Commercial/Industrial, Sub-urban, Neighborhood, Large Lots, Rural, and Open Space, Federal Parks, Lakes, Ponds.

* H. U. = Housing Unit

11. Elevation and Ground Slope

A slope database was created classifying terrain into Flat (<5%), Tilted (6-20%), Sloping (21-30%), Steep (31→maximum available on site), and No Data.

12. Floodplain and Wetland

For the study-region, total land area covered by floodplains is approximately 5% of the overall area.

13. Historic Districts

14. Tree Cover

Region shows a healthy green cover.

State of study-area in terms of demographic attributes considered

Demographic attributes seemingly have more temporary impact on deciding future growth as they continuously fluctuate with population shift. These small changes are difficult to evaluate precisely. The demographic attributes nevertheless did prove useful in arriving at a general growth projection. Note that density distributions of these characteristics were measured per block group.

The demographic attributes considered were

- Urban Population Density Distribution
- Density Distribution of Persons Aged 16-64 in Workforce
- Poverty and Labor Attributes

    Density of Persons Below Poverty

Density Distribution for Unemployed Persons Aged 16 and Above

Urban Population Density Distribution-

The study-area shows urban population mostly in and around Charlottesville. Approximately 70 % (70,246) of the entire population encompassed within the political boundaries of Albemarle County (study-area) (1,08,381) is categorized as urban in Census 1990.

Density Distribution of Persons Aged 16-64 in Workforce-

This attribute measured the spread of workforce aged 16-64. Relatively high densities are seen near Scottsville (Tract 0113.98 BG6, Area Key 510030113986) and the Zion intersection (Tract 0104 BG4, Area Key 510030104004). The highest work force density is 5.21% according to Census 1990.

Density of Persons Below Poverty-

At tract level, the study-area is fairly consistent in the distribution of this attribute. However, Tract 0111 BG3 (Area Key 510030111003), situated at approximately 12 kilometers to the west from Charlottesville, shows a high 26.12% people below poverty in 1990 Census.

Density Distribution for Unemployed Persons Aged 16 and Above-

Ratio of unemployed persons aged 16 and above is higher in the southern-most block group in Albemarle County (Tract 0114 BG3, Area Key 510030114003). Highest unemployment rate in the study-area is 6%. Charlottesville city and Albemarle County contributed 895 and 905 unemployed persons aged 16 or higher in 1990.

4. Analysis and Projection

For analysis, it was assumed that future growth would occur at the current rate without any major changes (say a heightened environmental awareness, or an acute energy crisis). It was believed that ‘Healthy Growth’ would occur in the study time frame of 30 years in the study-area.

This 'Healthy Growth' scenario is referred to as Scenario 1 or *'default circumstance'.*

Evaluating Future Potential

The collected information about geographic and demographic attributes was broken down, and each such attribute was then inquired into. These attributes were categorized as impacting future growth either positively or adversely or staying neutral or both.

Ex. Cultural Points would have a positive impact on growth possibilities in their surroundings. Some attributes were treated as having both positive and negative impacts. Ex. Natural landmarks (like the Shenandoah National Park) would discourage growth (negative impact) on itself and in abutting areas because of zoning ordinances to protect the park. However it would attract growth, housing or commercial, (positive impact) to its neighborhood because of, say its scenic factor and natural settings.

The influence of each geographic and demographic attribute for the study-area was calibrated in terms of *proximity to the attribute*. The supposition here was that such an attribute, say a positive attribute like an airport or a highway, would cause more growth in areas closer to it than otherwise. Attributes thus developed bands of distance-ranges to depict their influence on growth.

For gradation, categories of distance-bands were invented:

(Buffer Zone), Abutting, Direct Effect, Neighborhood Effect, Regional Effect, Little Effect and No Data.

Note that here, effect of an attribute is being simplified to fit distance-bands for calculation convenience. Attributes thus had varied distance-ranges, i.e. different band sizes, depending upon their character.

Ex. The University Baptist Church located in Charlottesville was awarded band sizes as follows:

- 0-500 meters→ Direct Effect
- 501-1000 meters→ Neighborhood Effect
- 1001-6000 meters→ Regional Effect
- 6001-26,656.379→ meters (edge) Little Effect

- Rest→ No Data

This meant that, for study purposes, it is assumed that the physical location of such a church in the study habitat would have a direct impact on growth stimulation in an area defined by a radius of 500 meters. Then a lesser impact would affect an area between 500 and 1000 meters. And so on.

Whereas the University of Virginia Hospital employing 5,000-10,000 people was assigned following band sizes:

- 0-3000 meters→ Direct Effect
- 3001-15,000 meters→ Neighborhood Effect
- 15001-24000 meters→ Regional Effect
- 24001-46126.188 meters→ (edge) Little Effect
- Rest→ No Data

This meant that, given the above-mentioned assumptions, the University of Virginia Hospital would have a strong direct impact on future growth in an area defined by a radius of 3 kilometers. A lesser impact would fall in the area after that until 15 kilometers. And so on.

For analysis, the entire study-area and some surrounding parts (so as to form a rectangle) were divided into 57,456 grid cells. Since spatial analysis is on county-level, the grid size for analysis in GIS was set at a relatively high value (250 meters by 250 meters = 15.444 acres = 0.024 sq.miles). It was further assumed that a cell, 250 meters by 250 meters, could form a growth unit, and that within such growth modules, growth and geographic and demographic attribute effect would be fairly consistent.

Each band range was then assigned an integer value (either positive, or negative or neutral) on a scale of –6 to 0 to 6. Then all grid cells falling in a particular band got assigned the same value, a positive value indicating good potential for future growth and a negative value indicating a grim scenario for future growth (please refer to the table below).

Ex. In the above-mentioned case of the University of Virginia Hospital employing 5,000-10,000 people, integer values assigned were:

Band size from edge/center of attribute	Band category invented	Integer value assigned (range = -6-0-+6)	Future growth assumption

0-3000 meters	Direct Effect	+4	Strong impact
3001-15,000 meters	Neighborhood Effect	+3	Good impact
15,001-24,000 meters	Regional Effect	+2	Little impact
24,001-46126.188 meters	Little Effect	+1	Weak effect
Rest	No Data	0	Neutral effect

Note that here the entire range from –6 to +6 has not been used.

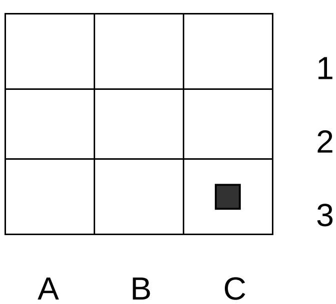
The integer value indicates the proportionate share of, or influence on future growth, in corresponding band type due to this attribute.

Finally, all the different attribute layers generated overlapping grids, one for each attribute, with an integer value between –6 to 6 for each of their 57,456 cells. These layers were then added to form the final graded map for the study-area.

I thus got an indication under scenario 1 (‘default circumstance’ or ‘healthy growth’) of growth potential for the study-area.

Ex. Let us consider a 3 cell by 3 cell table. Let us also consider two attributes, City Hospital (Large Employer, positive) and Wetland (negative).

Let the City Hospital be located in cell C-3 (column C, bottom). Here, all distance-bands are equal in area, or equal to 1 cell dimension.



Given our assumptions, we assign integer values for the level of effect on future growth to arrive at the following table:

A	B	C	
1	1	1	1
1	2	2	2
1	2	3 ■	3

Here, 3 indicates highest potential for urban growth, while 1 indicates low potential for urban growth, due to the presence of the City Hospital.

Let the Wetland be located in cell B-1 (column B, top). We assume that the adverse effect of a wetland would be twice as much as the positive impact of a city hospital. Also, that it would have the most impact on area closest to it, and so on, and assigning integer values for the level of effect on future growth, we arrive at the following table:

A	B	C	
-4	-6 ■	-4	1
-4	-4	-4	2
-2	-2	-2	3

Here, -6 indicates the most adverse impact due to this wetland on urban growth potential, while –2 indicates a less adverse wetland impact. Please bear in mind that in cases where there is a substantial change in impact within a single attribute, I have divided the attribute into sub-categories (Ex. Large Employer attribute has been divided into 4 categories to account for the varying number of people employed). Each sub-type (Small Employer, Large Employer, etc.) is treated as a separate attribute.

Now, we would simply add each cell of the above two tables.

We make no further adjustment to attribute effect (Ex.- instead of making adjustments to cell value for wetland in value-assignment stage, we could also make these adjustments in the final adding-up stage, i.e. we could add:
[(assumed effect due to a hospital) to (twice the assumed effect of a wetland)].

The added table:

	A	B	C
1	-3	-5	-3
2	-3	-2	-2
3	-1	0	1

From our calculations, we conclude that land area occupied by the lower-most cells is most likely to attract future growth and therefore future population. Cell B-1 is least likely to grow. Infact, since we had assumed that the adverse effect from a wetland would be twice as much as the positive effect of a hospital, most of the cells are losing population.

In this case, Cell B-1 would not even be considered for future population since it is occupied by wetland.

5. Population Forecast and Distribution

On extending trajectory of population figures provided by the Virginia Employment Commission (VEC), the main body for population projections in the region, and Census 1990, a 1% decline in Charlottesville's population over the next 30 years is seen*. This decline in city's population may be a result of decreasing household size.

*** VEC source: Virginia Population Projections. 1993. (method used- cohort survival)**

Population Forecast-

The Virginia Employment Commission projected study-area population until 2010. Since the study-area population is to be projected until 2030 (30 years being the time span considered), some extrapolation was required. This was done by simply extending the trajectory of the current growth rate to arrive at figures for 2030.

Virginia Employment Commission data-

Albemarle County:

1980	1990	2000	2010	2020	2030

55,783	68,172	79,081	90,148	1,02,769	1,17,157
Approximate annual growth rate:					
(80-90) 2.0	(90-00) 1.5	(00-10) 1.3	(10-30) 1.3*	(10-20) 1.3*	

Charlottesville city:

1980	1990	2000	2010	2020	2030
39,916	40,475	40,817	41,225	41,637	42,053
Approximate annual growth rate:					
(80-90) 0.1	(90-00) 0.1	(00-10) 0.1	(10-20) 0.1*	(20-30) 0.1*	

Hence, population figures for 2030:

- Albemarle county: 1,17,157 (an increase of 38,076 over 2000 population)
- Charlottesville: 42,053 (an increase of 1,236 over 2000 population)

Therefore, an overall population increase of 38,076+1,236 = 39,312 or approximately 40,000 in the next 30 years in the study-area.

Population Distribution-

All grid cells in the study-area that were occupied by a no-growth feature, like a wetland or a steep mountain slope or a river, were discarded for future population distribution. Then the additional population figure was shared by the remaining cells in proportion to the band sizes they were a part of. Population thus added, resulted in different density distribution scenarios.

Method 1-

Ex. Please refer to a randomly-generated 3 by 3 table:

	A	B	C
1	3	5	3
2	3	2	2
3	1	0	1

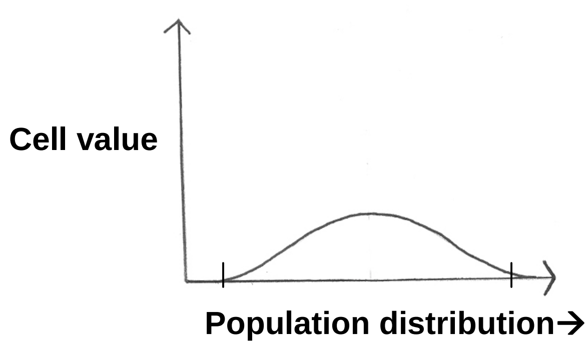
Here, assume that each cell value indicates growth potential for the region occupied by that cell. Now suppose that the land denoted by this matrix started with a population of 100 people, which was projected through an increase of 20% to 120 in model time frame.

Here, [a sum of all cell values] = [+3+5+3]+[+3+2+2]+[+1+0+1] = +20. Corresponding the two values, we get population for each cell as shown below:

	A	B	C
1	3	5	3
2	3	2	2
3	1	0	1

Cell C-2 thus has a future population density of 2 persons per cell area……..(1)

In this case, it is assumed that additional population would spread over the entire 3 by 3 matrix. Such a sprayed population distribution would result in an unrealistic smooth spread of population.



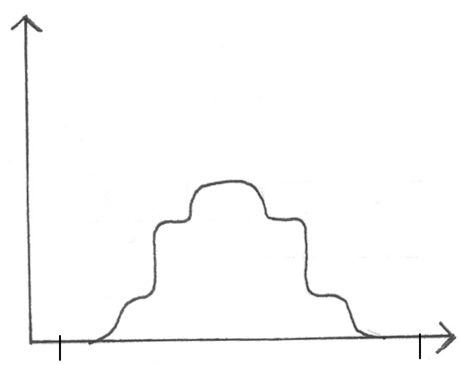
Method 2-

Alternatively, one can prefix different population densities depending upon land use type, ex. urban, residential, suburban, large lots and rural.
Here, distributing surplus population would start with the highest density onwards. One would first completely fill up all cells with the highest growth potential with the surplus population in its highest density. If there is still some surplus population left, then we would shift to cells showing the second highest growth potential, and distribute surplus population with the second highest density.

Likewise, we would completely distribute the increase in population. Here, the entire land area (as indicated by the two dashes on either side of the uneven curve) may not necessarily get filled up with extra population, unlike method 1. However, since growing population does tend to stick together, a more credible scenario may emerge with method 2.

In this approach, the spread of population is uneven.

Prefixed population density level



Population distribution→

Taking the above example for demonstrating method 2, we decide that surplus population for the earlier 3*3 matrix be now distributed in two densities, viz. 8 persons per cell area and 4 persons per cell area.

Since the surplus population in this example is 120 -100 = 20, we first distribute this 20 in the cell with the highest growth potential (+5 in this case), viz. B-1. This is done using the highest of the prefixed densities, i.e. 8 persons per cell. So, B-1 receives 8 of the 20 surplus population.

Remaining surplus population is then distributed in the cells (A-1, A-2, C-1) with the second highest growth potential (+3) using the second highest prefixed density (4 persons per cell area). And so on, until we completely distribute the surplus population. We thus fill 4 people in cells A-1, A-2 and C-1.

A	B	C	
4	8	4	1
4	0	0	2
0	0	0	3

Here, cell C-2 gets no additional population……………[please refer to (1)]

Since this gave a more realistic distribution, for this study, I used Method 2.

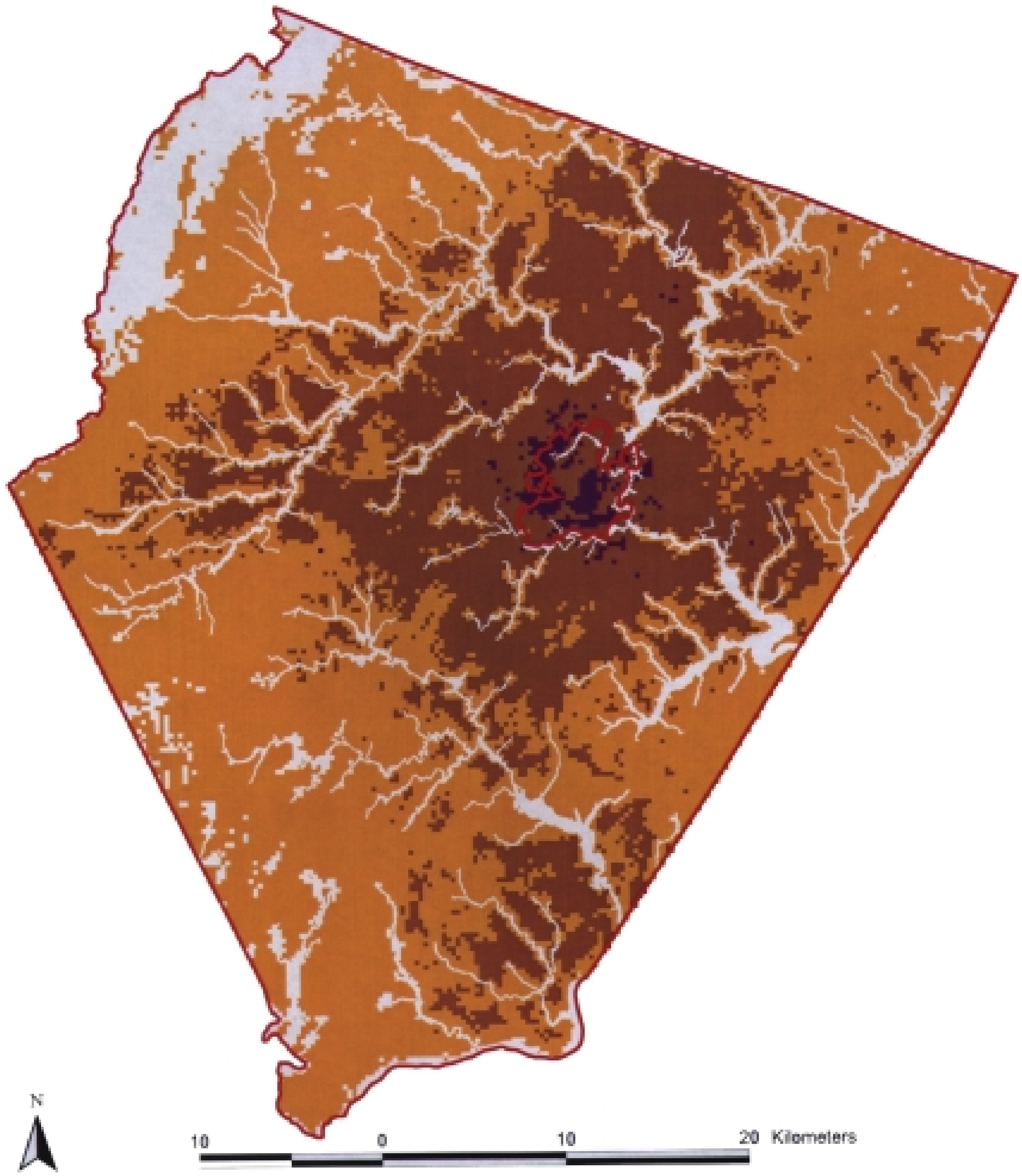
6. Preliminary Conclusions from Map Analysis

(please refer to final map attached below)

We observe that cells with the highest growth potential (+3) cover an area of 18.06 square kilometers. Some or whole of the estimated surplus population for the next 30 years (39,312) would get absorbed within this area according to method (2) of population distribution (please refer to appendix 1.). Thus, interestingly, this study does indicate that some population growth would be accommodated in Charlottesville. Note that this contradicts preliminary population forecasts by the VEC (reference: Virginia Population Projections, 1993).

As can be seen from the final map, the southern part of Albemarle County shows a region for high-growth. That part of the county around Scottsville *is* currently showing rapid residential development leading to traffic congestion.

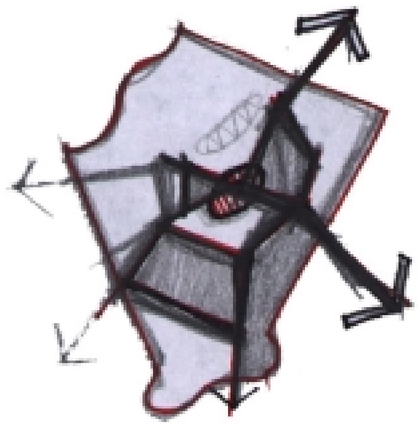
Overall, the study region holds 'medium' growth potential in the given time frame.



Low Growth Potential
Moderate Growth Potential
High Growth Potential
County Boundary
Floodplains, Natural Landmarks

REGIONAL GROWTH POTENTIAL
FOR STUDY-AREA

How could these changes impact the region? The Southwest Mountains Rural Historic District (SWMRHD), situated to the northeast of the county, may, as a result, get compromised to accommodate future population in the region.



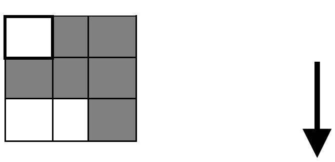
The possibility also exists for a transport connection cutting through SWMRHD and joining the city airport to Zion crossroads. This would then serve as an 'outer-ring connection' and pull some traffic away from the Charlottesville. Some effective growth boundary (rigid or porous) for the county is also suggested. As done successfully in many other places, the government could acquire potential development land to better regulate and direct this urban growth.

<u>7. Character of Neighborhood Elements within Study-Area</u>

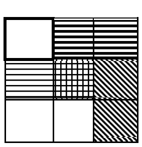
Knowing how this region could develop was the next step. The basic "settlement definitions" were arrived at during meetings for the Thomas Jefferson Planning District Commission's (TJPDC) Eastern Planning Initiative, and studies done by the TJPDC to define existing community elements in the region.

I simplified the projected area into neighborhood elements based on *supporting population density required as a precondition*, and infrastructure type.

Schematic Potential Growth Areas



Further Definitions for these Growth Areas in Step (8)



Some questions arose- since such neighborhood elements, when part of one urban fabric, share a blurred interdependency, can we list them in order of their influence on each other? Do they share some hierarchical structure? And are there any other pre-conditions for their presence? Is there some dimensional relationship?

The need was felt for some relation to help spatially locate such neighborhood elements (please refer to drawings).

The neighborhood elements in our study-area were then ranked as follows:

INDEX FOR (SUPPORTING POPULATION DENSITY REQUIRED AS PRECONDITION)	**CHARACTER OF NEIGHBORHOOD ELEMENTS NEAR CHARLOTTESVILLE**
3	Suburban Retail
2	Urban Mixed Use;
1	Urban Residential/Recreation; Suburban Mixed Use/Office;
0	Suburban Residential/Recreation/Conservation; Rural Town Center/Mixed Use;
-1	Suburban Industrial; Rural Residential/Recreation/Conservation;
-2	Rural Industrial/Agricultural;
*	Urban University/Institutional;
**	Sustainable Neighborhood Elements;

<u>General Definitions</u>

- Index 3-

Suburban Retail

An edge community, suburban neighborhood or community, or suburban power center where the predominant land use is retail. (Example: Route 29 Corridor).

- Index 2-

Urban Mixed Use

A densely developed, or densely populated, area or community within a metropolitan context, which contains more than one of the following land uses: residential, retail, office, civic, institutional, or industrial. (Example: West Main Street or the Downtown Mall, Charlottesville).

- Index 1-

Urban Residential

A densely developed, or densely populated, area or community within a metropolitan context, in which the predominant land use is residential. (Examples: Belmont, Fifeville, and North Downtown areas in Charlottesville).

Urban Recreation

A location within a densely developed or densely populated area or community within a metropolitan context, where the predominant landuse is parkland/recreation. (Example: McIntire Park).

Suburban Mixed Use

An edge community, suburban neighborhood or community, or suburban power center that contains one or more of the following land uses: residential, retail, office, industrial, or institutional. (Example: Forest Lakes development in Charlottesville).

Suburban Office

An edge community, suburban neighborhood or community, or suburban power center where the predominant landuse is office space. (Example: UVA Research Park).

- Index 0-

Suburban Residential

An edge community, or suburban neighborhood or community, where the predominant landuse is residential. (Examples: Greenbriar and Locust Grove neighborhoods outside Charlottesville).

Suburban Recreation

A location within an edge community or suburban area/community where the predominant landuse is parkland/recreation. (Example: Jack Jouett Middle School Trail).

Suburban Conservation

A location within an edge community or suburban area/community where the predominant landuse is conservation. (Example: Ivy Creek Conservation Area north of Charlottesville).

Rural Town Center

A well-defined center of rural activity that is surrounded by sparsely developed, or sparsely populated, rural or agricultural land. The area contains at least several of the following land uses: residential, retail, office, civic, institutional, industrial, and park/recreation. (Examples: Scottsville, Palmyra, Earlysville).

Rural Mixed Use

A sparsely developed, or sparsely populated, area or community that contains more than one of the following land uses; residential, retail, office, industrial, institutional, and agricultural/forest. (Example: Zion Crossroads, Ruckersville).

- Index (–1)-

Suburban Industrial

An edge community, or suburban area or community, where the predominant landuse is industrial. (Ex. UPS warehouse facility outside Charlottesville).

Rural Residential

A sparsely developed, or sparsely populated, area or community where the predominant landuse is residential. (Example: Residential farm clusters in Fluvanna and Louisa Counties).

Rural Recreation

A sparsely developed, or sparsely populated, area or community where the predominant landuse is recreation. (Example: Walnut Creek park).

Rural Conservation

A sparsely developed, or sparsely populated, area or community where the predominant landuse is conservation. (Example: Green Springs Rural Historic District).

- Index (-2)-

Rural Industrial

A sparsely developed, or sparsely populated, area or community where the predominant landuse is industrial. (Example: Luck Stone quarries in Greene and Fluvanna County).

Rural Agricultural

A sparsely developed, or sparsely populated, area or community where the predominant landuses are agriculture, horse farms, forested land, or large areas of natural open space. (Example: Agricultural areas in Fluvanna and Louisa Counties).

- Index (**)-

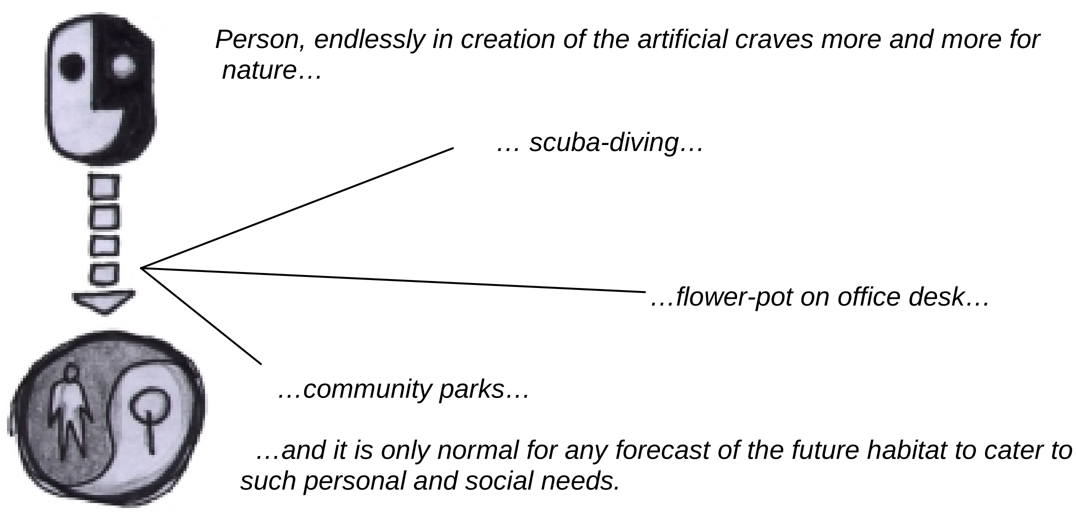
* *Urban University/Institutional*

A densely developed, or densely populated, area or community within a metropolitan context, in which the predominant land use is university education/institutional. (Examples: UVA grounds, Hospital and surrounding facilities).

- Index (*)-

** *Sustainable Neighborhood Elements*

The integration of sustainable neighborhood elements within the future urban pattern of the region, is an important part of this study. Appreciation of the desire for a communion with the natural resulted in introduction of these elements.

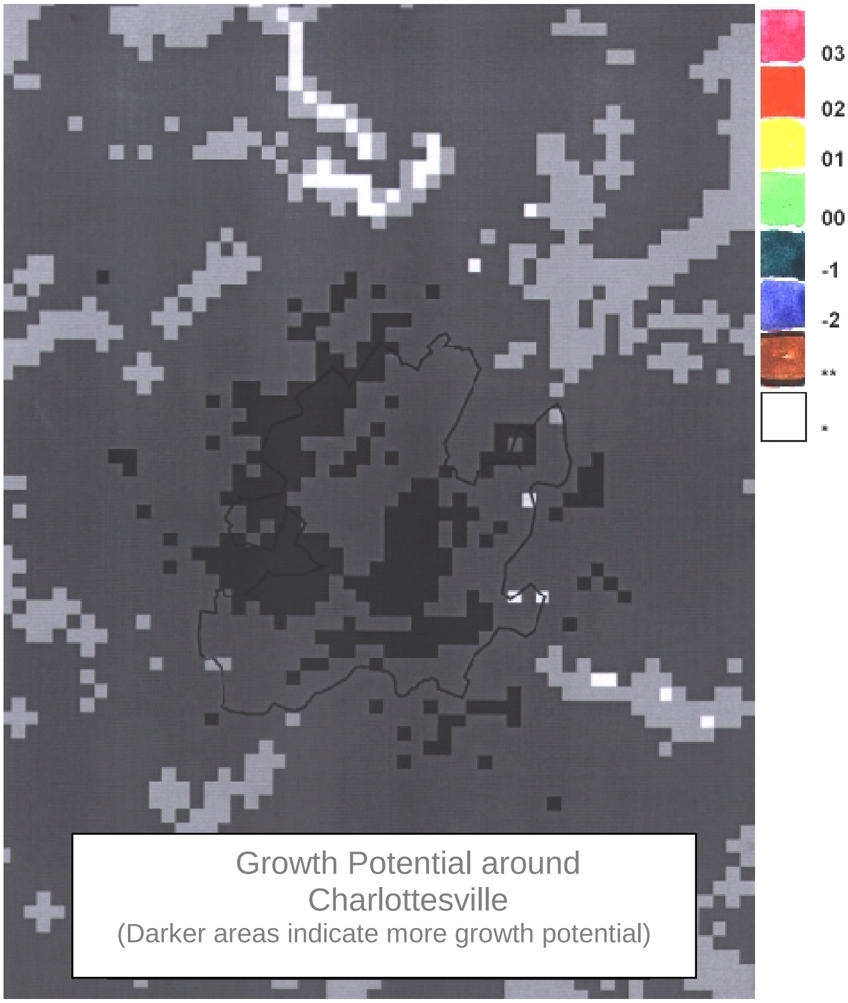


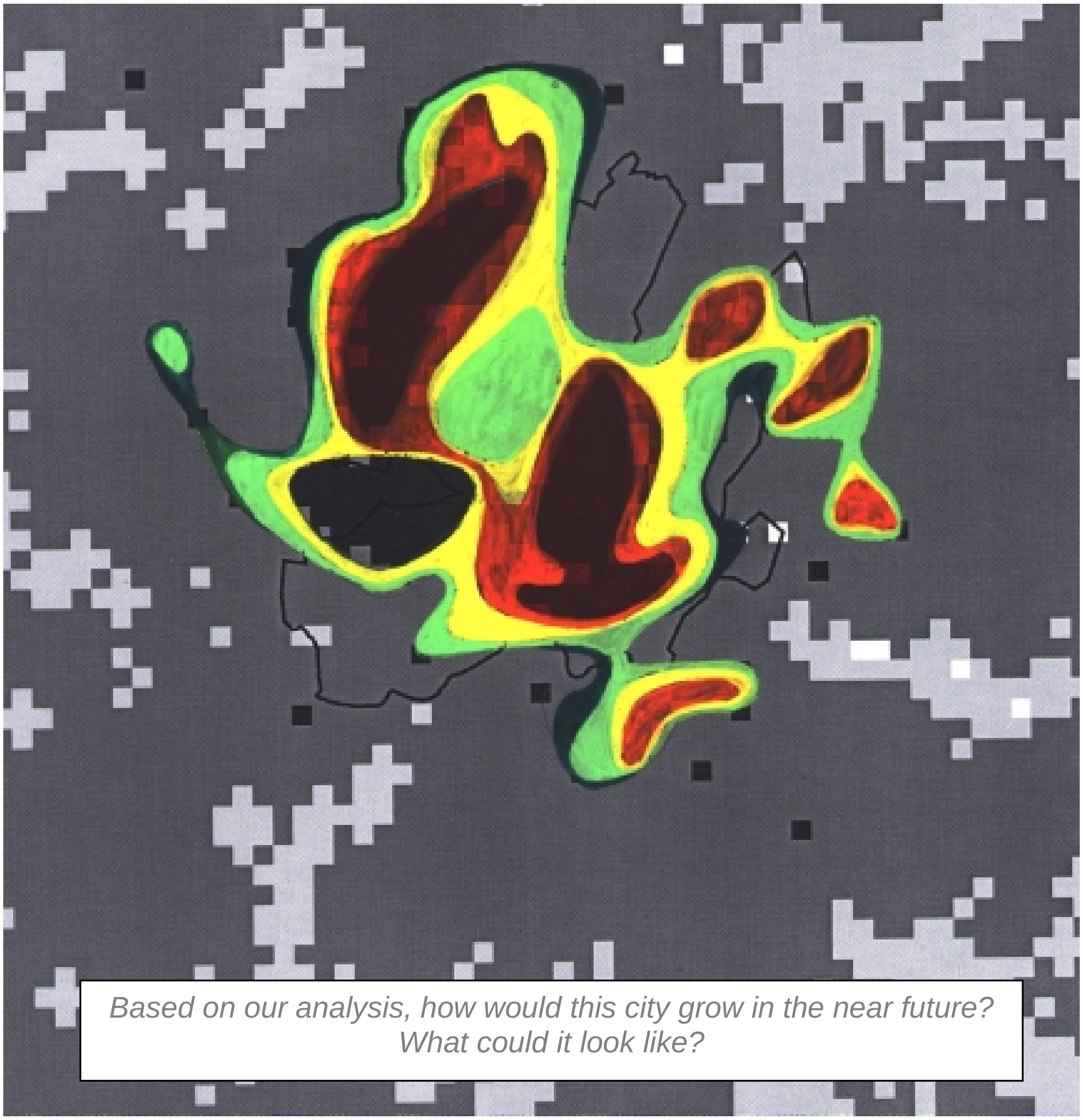
Defining characteristics of these elements was the next step. Although each locality should fashion this neighborhood according to its own energy-concerns and cultural-taste, some schematic suggestions are offered:

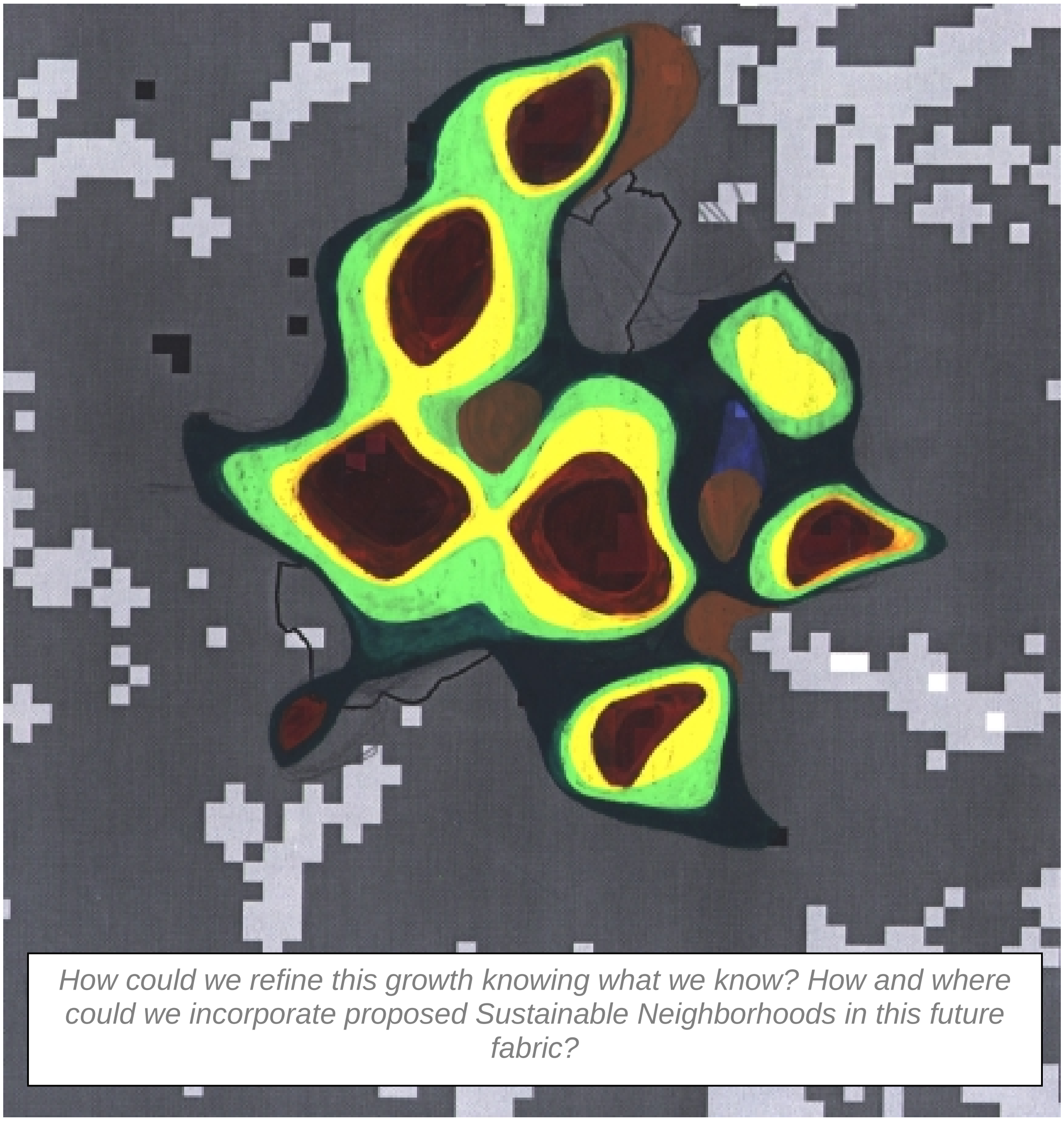
Such an element would be a sufficiently dense, energy-conscious ‘green’ neighborhood. The neighborhood would have a dense core- more radical in its pursuit of energy-consciousness than other parts. This would be surrounded by a ‘green’ buffer; and a less dense, largely residential, doughnut-like outer-core. The whole neighborhood form would enable easy “plug-ins” to accommodate future population. Public buildings, utilities, and high-use office spaces would be centrally located in the core to minimize *overall traffic time, but also sized appropriately to avoid excessive congestion due to a radial pattern. This core would serve as a testing ground for sustainability ideas in urban design and planning.*

Corbusier's design suggestion where he talked about an urban form on stilts- free on the first floor (or ground floor), and with 'gardens on terraces', resonates strongly with the visual of this neighborhood. However such a radical change may be restricted to the center only. Important here would be the neighborhood's power generation, distribution and usage. Here, some energy use-limit per block, unit or user, could also be made 'enforceable'.

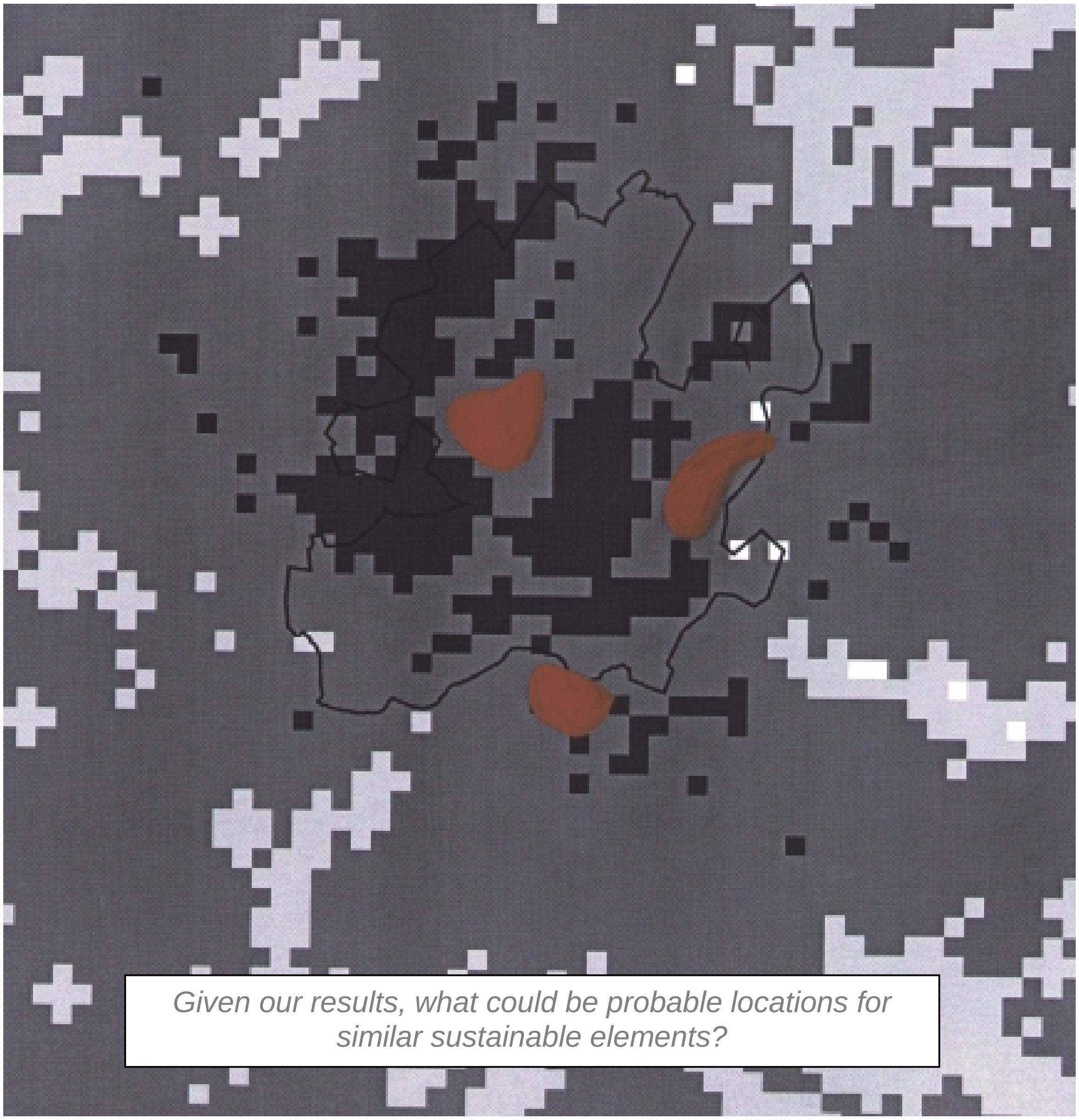
INDEX
(please refer to the table above)




Based on our analysis, how would this city grow in the near future?
What could it look like?



How could we refine this growth knowing what we know? How and where could we incorporate proposed Sustainable Neighborhoods in this future fabric?



Given our results, what could be probable locations for similar sustainable elements?

A Caveat

Such a planning methodology of data collection and projection does have some intrinsic faults: it relies heavily on knowledge-based skills. It assumes that 'correct solutions' to social problems can be obtained from a scientific analysis of various data. It must be noted that a solution-driven approach and heavy reliance on physical sciences as opposed to social sciences, is inherently inaccurate since the 'best planning answer' is a non-existent variable, changing with time, society, culture, resource availability etc. And there is always a danger of being consumed by this technique, and confusing the result for a solution.

The nature of this study involved making some basic assumptions about the way our study-area could evolve in the not-so-distant future. There have been doubts raised about the correctness of such a clinical technique wherein an urban settlement is 'stripped' of its various attributes, and these attributes then individually graded. Appreciation of the intricate complexity of human society, where each individual is a separate factor, is absent. Lack of importance to these inter-relationships is a flaw of such an analysis.

For Ex. In the current study, if we were to discover one other attribute, say a desert, how would it affect the final map? We would, using this approach, simply grade each cell one more time. Then we would add this new map to our list of maps, and calculate the new final map. However, we would fail to evaluate how the addition of a desert affects each of the other attributes individually.

But this flaw may not be as aggravated as it seems. Each cell gains its final value from all attributes. If in a hypothetical case, one could gather a 'complete list of attributes' that would impact future growth, and assign them 'correct values' (without even breaking them into distance-bands which are only for convenience), finally adding them in the 'right equation', one would come up with a case-specific fairly accurate growth forecast (however, even then, any sudden future changes would still get missed).

There have also been some other approximations:

- The integer weights assigned to attributes.

- Or, areas outside the study-area that exert significant impact on urban growth, but got ignored because of study limitations.

- Also, on examining the Cultural Points table, it is found that Cemetery was included as a row category. Cultural Points have been considered as having positive influence on future growth. But a cemetery would not have an entirely positive influence on urban growth. Furthermore, parts of UVA were used as cultural points. The university was also used as a major employer. Thus, there has been some overlapping. This resulted in disproportionate values for some cells.

But this study is an illustration more of a proactive planning approach, than an accurate projection of urban growth for an area. And even though limited in its effectiveness, any attempt to administer planning remedies would have to include some such non-arbitrary problem-solving technique.

8. Credits

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- Hanna Twadell, TJPDC
- Jason Overstreet, TJPDC
- Staff, Geostat Laboratory, Alderman Library, UVA
- Weldon Cooper Center for Public Service, UVA

9. Citations

1. Chou, Yue-Hong, Exploring Spatial Analysis in Geographic Information Systems, 1997.
2. Corbusier, Le. The City of Tomorrow. 1924.
3. ESRI (Environmental Systems Research Institute). Getting to know Arcview GIS. 1999.

4. Hamburg, Morris. Statistical Analysis for Decision-Making. 1991.

5. Krueckeberg, Donald A. Urban Planning Analysis- methods and models. 1974.

6. Landis, John. CUF Model Simulation Results- alternative futures for the greater Bay area. Year unknown.

7. Schumacher, E. F. Small is Beautiful- economics as if people mattered. 1989.

8. Toffler, Alvin. Future Shock. 1971.

Web sources for digital data-

- http://ngmdb.usgs.gov/ngmdb/ngm_catalog.ora.html
- http://edcwww.cr.usgs.gov/doc/edchome/ndcdb/ndcdb.html (EROS Data Center)
- http://epic.er.doe.gov
- http://www.dot.gov
- http://www.ccps.virginia.edu/publications/SPOT9.pdf [for publications on VaStat (population trends)]
- http://mapping.usgs.gov/www/gnis [The Geographic Names Information System (GNIS)]

10. Metadata

These files are for academic, non-commercial use ONLY.

File directory (ELEVATE) contains an Arc/INFO GRID raster coverage of elevation in the Thomas Jefferson Planning District. The cells are 33 1/3 meters per side, and the coverage is projected as follows:
PROJECTION UTM
ZONE 17
UNITS METERS
DATUM NAD27

SPHEREOID CLARKE1866

Projection Data

Tiger/Line Data, Rideshare Data

projection	geographic
units	decimal degrees
datum	nad27

Elevation, Floodplains, Soils, and Wetlands,SHIPS

projection	utm
zone	17
units	meters
datum	nad27

Both floodplains and wetlands are projected in UTM Zone 17 NAD 27. The source of the wetlands data is the National Wetlands Inventory (http://www.nwi.fws.gov/). The wetlands coverage have been modified from the original by joining the quadrangles and by the removal of the uplands (non-wetlands) polygons. The zipped file wetcodes.exe contains a small DOS program which gives much greater detail as to the meaning of the codes. The floodplains were digitized from paper FEMA floodplain maps by TJPDC staff; more information about them is contained in the accompanying document floodnote.doc.

11. Notes on discrepancies and inaccuracies in the digitized maps

The floodplain maps, except for Greene County, were digitized in July-September 1994, by Rochelle Garwood of the Thomas Jefferson Planning District Commission using PC-VirGIS software. FEMA paper maps were aligned with USGS 1:24,000 topographic maps on a light table, and the floodplain outlines carefully traced onto the quad sheets. Floodplains were then digitized from the quad sheets. In some cases, the FEMA maps had to be photo-reduced; these cases have been noted. Greene County floodplains were digitized in July 1994 by John R. Meador of the TJPDC using Micro-station.

Albemarle

General

Albemarle floodplain maps are based on the quad sheets (right down to the place-name labels) for the area, and therefore show generally good agreement with the quad sheets. They are occasionally slightly distorted; distortion is somewhat worse with the five quad sheets (Free Union, Crozet, Charlottesville West, Charlottesville East, and Alberene) that are divided in fourths and blown up to 1:12,000. Some distortion likely occurred in the 50% photo-reduction that was used in order to match the scale of the quad sheets.

Despite this, agreement between topo maps and floodplain maps in Albemarle is better than in any other area listed here.

Specific

The floodplain of the Rivanna River is more than twice as wide on the north edge of the panel corresponding to the Simeon quad (panel 375) than it is on the south edge of the panel covering the southeast corner of the Charlottesville East quad (panel 245).

Charlottesville

General

Charlottesville floodplain maps have poor agreement with streets and streams (and in some areas, county lines) as shown on the topographic maps and are clearly not based on the topographic maps. However, once the features are lined up as well as possible, coincidence of floodplains with contour lines seems no worse than average.

A great deal of detail was lost in the transfer of the Charlottesville maps because the scale of the topographic maps was just 30% of that of the floodplain maps; the latter had to be photo-reduced accordingly.

Specific

An area along Moore's Creek near Nassau Street is in Zone A on Charlottesville map (panel 2), Zone B on Albemarle map (panel 240), creating an unlikely Zone B island in the middle of Zone A.

Correspondence of county lines between Charlottesville panel 2 and the Charlottesville East topography map is exceptionally poor in the area near Nassau Street and I-64; floodplain accuracy is particularly suspect in this area.

The floodplain of a tributary of Moore's Creek is narrower on the city (panel 3) than the county (panel 240) side. The same tributary as represented on the topographic map (Charlottesville East) lies outside of the floodplain for approximately 500 ft. of its length south of Rock Creek Rd.

Although a floodplain for Schenk's Branch (a tributary of Meadow Creek) is shown on the county floodplain map (panel 240), the floodplain is not continued on Charlottesville panel 2.

12. Appendix

1. Population Distribution Calculation

Method 2-

Uneven Distribution

Assuming a high 12 H.U. per acre density for urban areas for the future, I started distributing population in the cells with the highest growth potential.

12 H.U. per acre = 12 H.U. per 4047 square meters…………………….(1)

Note *,
Total population in Albemarle county in 1990 = 68,172 people (VEC)
Total H.U.s in Albemarle county in 1990 = 25,958 H.U. (1990 Census)
Average H.U. size = 2.626 people per H.U

Also,
Total population in Charlottesville city in 1990 = 40,475 people (VEC)
Total H.U.s in Charlottesville city in 1990 = 25,958 H.U. (1990 Census)
Average H.U. size = 1.559 people per H.U.

Taking the mean for both the areas,
➔ [2.626+1.559] / 2 = 2.093 people per H.U.

Therefore, in equation (1) above,
12 H.U. per 4047 square meters = (12*2.093) = 25 people per 4047 square meters.
Or, 1 person per 162 square meters………………………………………(2)

On inquiring in ArcVIEW, I observed that cells with the highest growth potential (+3) cover an area of 18.06 square kilometers.
Therefore, I first distributed the surplus population (39,312) in this 18.06 square kilometers using 1 person per 162 square meters as distribution density (please refer to (2)).

I thus found that nearly all of the estimated surplus population for the next 30 years would get absorbed in these 18.06 square kilometers located in and around Charlottesville, which show high growth potential.

2. Cell Valuation Weight Tables for geographic and demographic attributes considered

Note that Band Sizes, Integer Values Assigned, and Effect on growth, are not validated.

Geographic attributes-

1. Major Employers

50-249 employees

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-500 meters	Direct effect	+4	Strong impact
501-2500 meters	Neighborhood effect	+3	Good impact
2501-4,000 meters	Regional effect	+2	Little impact
4,001-edge	Little effect	+1	Weak effect
Rest	No data	0	Neutral effect

250-999 employees

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-1000 meters	Direct effect	+4	Strong impact
1001-5,000 meters	Neighborhood effect	+3	Good impact
5,001-8,000 meters	Regional effect	+2	Little impact
8,001-edge	Little effect	+1	Weak effect
Rest	No data	0	Neutral effect

1000-4.999 employees

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-2000 meters	Direct effect	+4	Strong impact
2001-10,000 meters	Neighborhood effect	+3	Good impact
10,001-16,000 meters	Regional effect	+2	Little impact
16,001-edge	Little effect	+1	Weak effect
Rest	No data	0	Neutral effect

2. Water Bodies

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption

0-250 meters	Abutting	-1	
251-3000 meters	Direct effect	+3	Strong impact
3001-6,000 meters	Neighborhood effect	+2	Good impact
6,001-edge	Regional effect	+1	Little impact

3. Rail Transportation

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-500	Abutting	-1	
501-1000 meters	Direct effect	+1	Strong impact
1,001-6000 meters	Neighborhood effect	+3	Good impact
6,001-15,000 meters	Regional effect	+2	Little impact
15,001-edge	Little effect	+1	Weak effect
Rest	No data	0	Neutral effect

4. Cultural Centers

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-500 meters	Direct effect	+4	Strong impact
501-1000 meters	Neighborhood effect	+3	Good impact
1001-6,000 meters	Regional effect	+2	Little impact
6,001-edge	Little effect	+1	Weak effect
Rest	No data	0	Neutral effect

5. Surface Transportation

US Highways, County Level

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-250 meters	Abutting	+4	Strong impact
251-3,000 meters	Direct effect	+3	Good impact
3,001-6,000 meters	Neighborhood effect	+2	Little impact
6,001-edge	Little effect	+1	Weak effect
Rest	No data	0	Neutral effect

Streets, County Level

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-250 meters	Abutting	+3	Strong impact
251-3,000 meters	Direct effect	+2	Good impact
3,001-edge	Neighborhood effect	+1	Weak effect
Rest	Little effect	0	Neutral effect

US Highways (29 or 250 Bypass), Charlottesville

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-50 meters	Abutting	+4	Strong impact
51-500 meters	Direct effect	+3	Good impact
501-1,000 meters	Neighborhood effect	+2	Little impact
1,001-edge	Little effect	+1	Weak effect
Rest	No data	0	Neutral effect

Streets, Charlottesville

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-50 meters	Abutting	+3	Strong impact
51-500 meters	Direct effect	+2	Good impact
501-edge	Neighborhood effect	+1	Weak effect
Rest	Little effect	0	Neutral effect

6. Natural Landmarks

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-500 meters	Direct effect	-2	Strong impact
501-1000 meters	Neighborhood effect	-1	Good impact
1001-3,000 meters	Regional effect	+2	Strong impact
3,001-edge	Little effect	+1	Good impact
Rest	No data	0	Neutral effect

7. Air Transportation

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-500 meters	Buffer	-2	Strong(-ve) impact
501-1,000 meters	Abutting	-1	Good (-ve) impact
1,001-2,000 meters	Direct effect	0	Little impact
2,001-5000 meters	Neighborhood effect	+3	Strong impact
5,001-10,000 meters	Regional effect	+2	Good impact
Rest	No data	+1	Little impact

8. Municipal Points

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-250 meters	Direct effect	+3	Strong impact
251-5,00 meters	Neighborhood effect	+2	Good impact
5,01-1,000 meters	Regional effect	+1	Little impact
Rest	No data	0	Neutral effect

9. Small Natural Points

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-25 meters	Direct effect	0	Neutral effect
26-250 meters	Neighborhood effect	+2	Good impact
251-500 meters	Regional effect	+1	Little impact
Rest	No data	0	Neutral effect

10. Landuses

<u>Commercial/Industrial</u>

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption

0-3000 meters	Direct effect	+4	Strong impact
3001-15,000 meters	Neighborhood effect	+3	Good impact
15,001-24,000 meters	Regional effect	+2	Little impact
24,001-edge	Little effect	+1	Weak effect
Rest	No data	0	Neutral effect

<u>Suburban 1</u>

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-2000 meters	Direct effect	+4	Strong impact
2001-10,000 meters	Neighborhood effect	+3	Good impact
10,001-20,000 meters	Regional effect	+2	Little impact
20,001-edge	Little effect	+1	Weak effect
Rest	No data	0	Neutral effect

<u>Neighborhood</u>

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-1500 meters	Direct effect	+4	Strong impact
1501-8,000 meters	Neighborhood effect	+3	Good impact
8,001-15,000 meters	Regional effect	+2	Little impact
15,001-edge	Little effect	+1	Weak effect
Rest	No data	0	Neutral effect

<u>Sub-Urban 2</u>

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-1000 meters	Direct effect	+4	Strong impact
1001-5,000 meters	Neighborhood effect	+3	Good impact
5,001-10,000 meters	Regional effect	+2	Little impact

10,001-edge	Little effect	+1	Weak effect
Rest	No data	0	Neutral effect

<u>Large Lots</u>

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-800 meters	Direct effect	+4	Strong impact
801-3,000 meters	Neighborhood effect	+3	Good impact
3,001-6,000 meters	Regional effect	+2	Little impact
6,001-edge	Little effect	+1	Weak effect
Rest	No data	0	Neutral effect

<u>Rural</u>

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-500 meters	Direct effect	+3	Strong impact
501-2,000 meters	Neighborhood effect	+2	Good impact
2,001-4,000 meters	Little effect	+1	Little impact
Rest	No data	0	Neutral effect

<u>Open Space, Federal Parks, Lakes, Ponds</u>

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-250 meters	Direct effect	+3	Strong impact
251-500 meters	Neighborhood effect	+2	Good impact
501-1,000 meters	Little effect	+1	Little impact
Rest	No data	0	Neutral effect

11. Elevation and Ground Slope

Slope in degrees	Band category invented	Integer value assigned	Future growth assumption
0.041-5	Flat ground	+1	Strong impact
6-20	Tilted ground	0	Neutral effect
21-30	Sloping ground	-1	Little impact

31-60.646	Steep slope	-6	Strong impact

12. Floodplain and Wetland

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-250 meters	Buffer	-6	Strong impact
251-1250 meters	Abutting	+2	Little impact
1251-2,000 meters	Direct effect	+3	Good impact
2001-6,000 meters	Neighborhood effect	+2	Little impact
6,001-10,000 meters	Regional effect	+1	Very Little impact
Rest	No effect	0	Neutral effect

13. Historic Districts

Band size from edge/center of attribute	Band category invented	Integer value assigned	Future growth assumption
0-200 meters	Self-occupied	-2	Strong impact
201-1000 meters	Neighborhood effect	-1	Good impact
Rest	No effect	0	Neutral effect

14. Tree cover (density as defined in source data)

Distance from coniferous or deciduous cover	Band category invented	Integer value assigned	Future growth assumption
0-25 meters	Buffer	-2	Strong impact
26-250 meters	Abutting	0	Neutral effect
251-500 meters	Direct effect	+1	Little impact
Rest	Open space	+2	Good impact

Demographic attributes-

1. Urban Population Density Distribution

Density in block group	Integer value assigned	Future growth assumption
Low	-1	Strong impact

Moderate	0	Neutral effect
High	+1	Strong impact

2. Density Distribution of Persons Aged 16-64 in Workforce

Density in block group	Integer value assigned	Future growth assumption
Low	0	Neutral effect
Moderate	+1	Little impact
High	+2	Good impact

3. Poverty and Labor

<u>Density of persons below poverty</u>

Density in block group	Integer value assigned	Future growth assumption
Low	0	Neutral effect
Moderate	-1	Little impact

<u>Density distribution for unemployed persons aged 16 and above</u>

Density in block group	Integer value assigned	Future growth assumption
Low	0	Neutral effect
Moderate	-1	Little impact

3. Miscellaneous

a).

During this study, I came across software applications designed to accomplish similar tasks:

- WhatIf- The Collaborative Planning Support System (by R. E. Klosterman, Department of Geography and Planning, University of Akron, Akron, Ohio 44325-5005. Klosterman@Uakron.edu)
- Smart Places- A Tool for Design and Evaluation of Land Use Scenarios (by Sapient Technology, http://www.smartplaces.com)

b). A Vision??

Transportation and work: 'demise of geography'?

- Work-by-wire urban working class. Collapse of the 9-to-5 day. The cost of infrastructure to tele-connect is far less for non-intensive desktop service jobs.
- Automated rapid transit vehicles connect buildings in high-rise dense neighborhoods at multiple levels.
- Areas of improvement: renewable fuels, alternative fuel vehicles, tougher vehicle emission and industrial standards.
- Out-sourcing work: Reverse migration of labor force.

The Building Industry and The City

- Wide-scale use of biodegradable, recyclable and local materials in construction.
- Photovoltaic cells widely incorporated within building standards.
- Refinements seen in the outer shell of buildings.
- Reusing building parts.
- Higher percentage of sub-terrainian buildings.
- Increase in land ownership.
- Water, a more valuable resource.