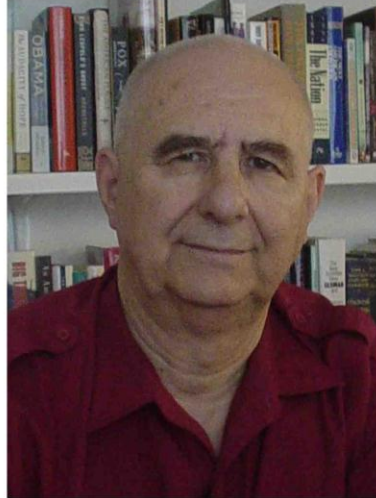


## GIS Use in Land Value Maps

H. William Batt,  
Ph.D., with  
Robert Breglio,  
M.R.P.  
Central Research  
Group, Inc., Albany



It's one thing to shift the property tax burden off structures, which are productive capital, and on to land values. It's another thing to assure that the assessed value for each component is accurate and up to date.

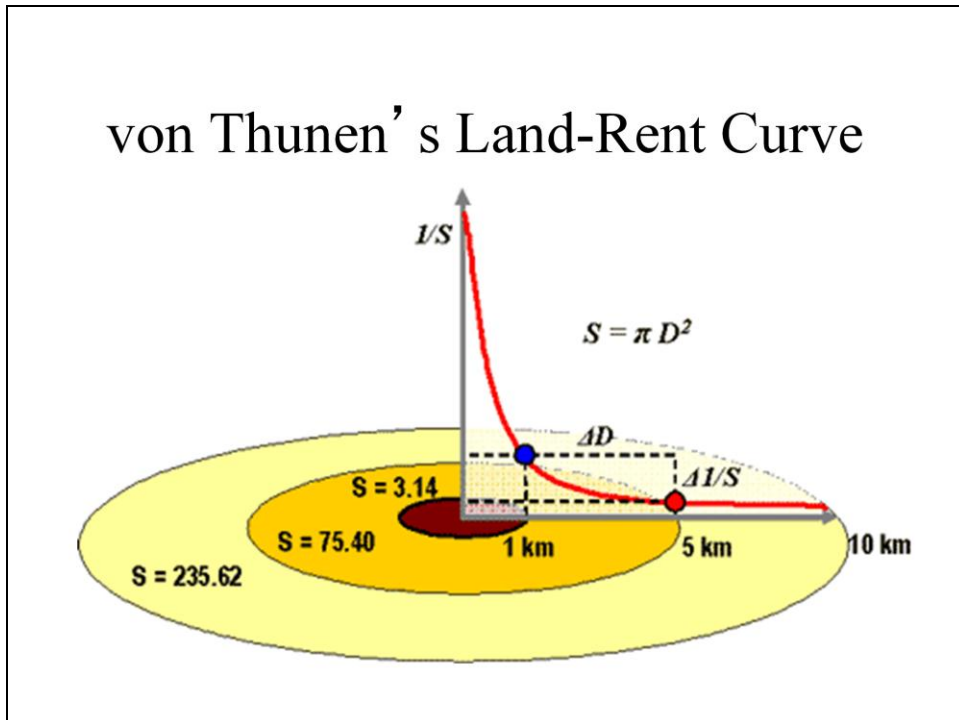
A recent Federal Reserve Board study has figured that building values typically decrease on average of about 1.5 percent yearly, whereas land values appreciate at rates far higher, in some instances as much as 20 percent in a year when a real estate bubble is in full flower. This means that if new homes reflected a building value of two-thirds of the total parcel cost as is often true (the balance being land value), the depreciation over the lifetime of a typical mortgage of thirty years would essentially reverse the proportions: two-thirds land value and one-third improvements. The increased market value of housing is likely increasingly to be the land component.

It has been difficult historically to ascertain the comparative accuracy of land values in local tax districts, even with the most intense scrutiny. This is now changed with the advent of GIS computer technology. GIS mapping allows the creation of accurate land value maps (also called landvaluescapes) that quickly reveal how well the land assessments have been performed and how up to date they are. What these maps generally show is that local assessments of land value, leaving aside the assessments of improvements, are clearly deficient.

The accuracy of assessments is important not just for any potential application of land value taxation but under conventional property tax administration as well. Assessors are generally in agreement that land sites are far easier to value than are improvements.

(<http://www.henrygeorge.org/ted.htm>) All this offers one more reason why land value taxation is a compelling solution to solving the challenges of administering tax justice.

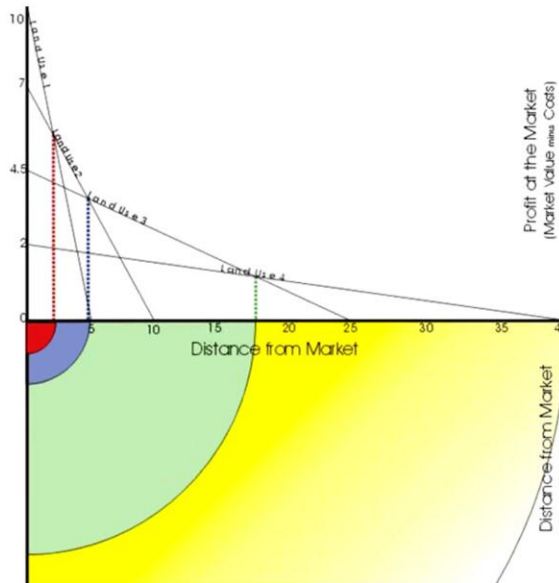
## von Thunen's Land-Rent Curve



Heinrich von Thunen was an early 19th century economist that some rank with the same stature as Marx. He is responsible for original calculations that show the relationship of land values and transportation costs, between the urban cores and peripheral productivity of sites. He calculated the optimal use of land for agricultural use as it related to its transport to markets in urban cores. The value of that land is measured in what is known as ground rent or economic rent. The differential value of rent is seldom appreciated except through land value maps. The total costs of access are essentially the sum of transportation and access together: the higher the price of location, the lower the cost of

transportation access.

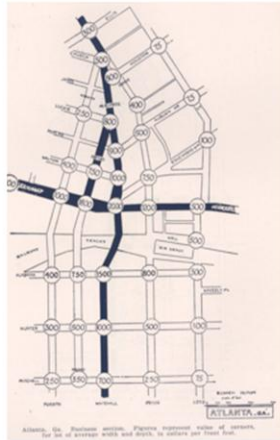
## von Thunen Land Rent Gradient



Land economists explain the market value of locations in terms of what is called economic rent, or ground rent. This term has largely dropped out of contemporary neoclassical economics, but it is critical to classical economists. As the study of land use configurations, transportation, and taxes converge, the concept of rent is of central importance. This is another depiction of the relationship between the amount of land rent and the distance from market exchanges.

## Atlanta 1900

Business Section



\$2000/ front foot at  
Marietta & Peachtree

Residential Section

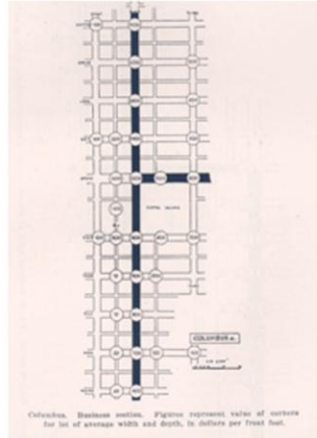


~\$20 / front ft half-mile out  
~\$10 / front ft one mile out

Strangely, land economists, transit administrators, and assessors understood these relationships more a century ago than they seem to at the present time. This graphic shows the value of sites in Atlanta, GA, in 1900. The center of the city had land values of \$2000/front foot, but they quickly dropped to \$20/front foot a half mile out, and to \$10/front foot one mile out.

## Columbus 1900

### Business Section



\$2500 front foot  
Broad & High Sts

### Residential Section

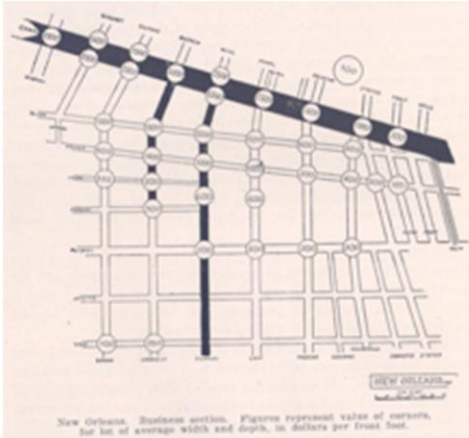


~\$75 /front ft 1/2 mile out  
~\$50 /front ft one mile out  
Double along E-W Broad St.

Columbus, OH, land values were \$2,500 / front foot at its downtown core, but dropped to about \$75/ front foot half a mile out, and to \$50/ front foot at one mile.

## New Orleans 1900

Business Section



Residential Section



\$3500/ front ft

~\$100 / front ft on Charles Ave.

Canal & Bourbon-Royal Sts. ~\$45 / front ft back two blocks

New Orleans frontage at the highest point was valued at \$3,500 / front foot, dropping quickly to about \$100 / front foot a few blocks further down Canal St, and to about \$45 / front foot a block back from Charles Ave.



New York 1900

Business Section Downtown

Residential Section Uptown



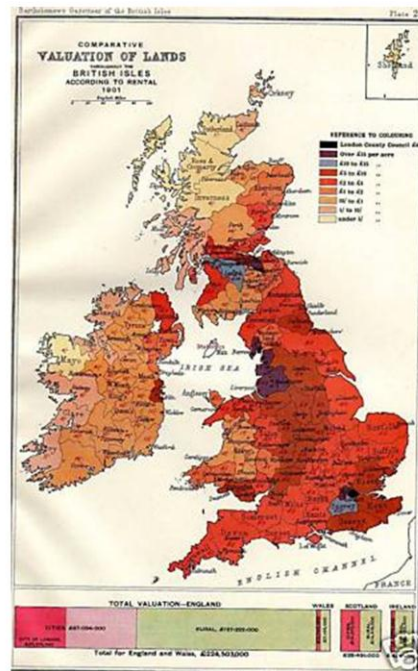
~\$400 /square ft  
Wall St & Broadway



~\$50 - \$90 / square ft  
along Broadway & Fifth Ave.

Front Footage was one way to assess site values, which took little account of the depth of the parcel. In Manhattan, in contrast, land sites were so valuable that it was measured per square foot. The highest site values in Manhattan about 1900 is put at about \$400 / square foot. As one traveled Uptown, the site values quickly dropped to between \$50 and \$90 per square foot.

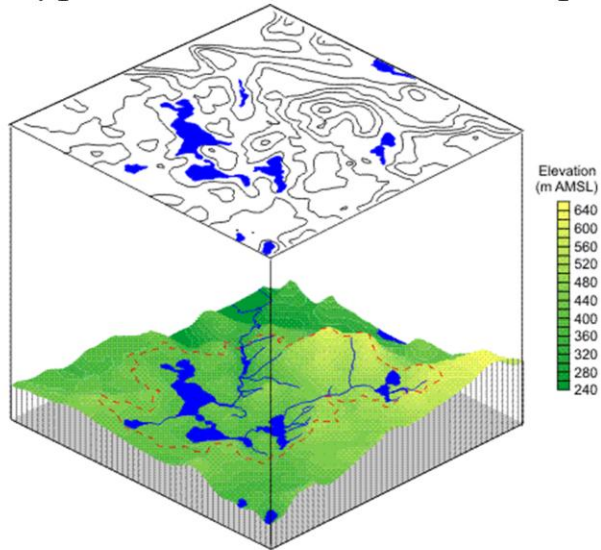
Land valuation was understood better a century ago than today. Here is a map of Britain done in 1904! David Lloyd George had succeeded in passing a law instituting land value taxation.



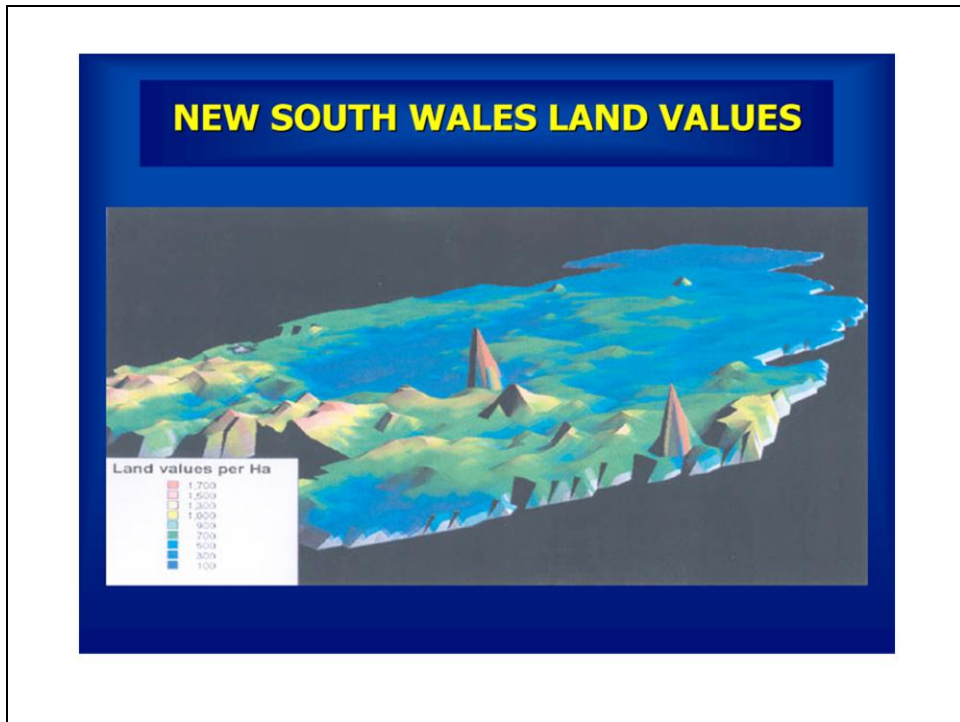
The economic theory behind taxing land values is impeccable, and has its roots in classical economics going as far back as the 17<sup>th</sup> century French Physiocrats. Adam Smith, Thomas Malthus, David Ricardo, John Stuart Mill, and most of all Henry George were all proponents of taxing the rental flow stemming from land sites. The practice has been applied in many nations, the US among them. Neoclassical economic theory denigrated the importance of land as a factor of production. Economic rent, also known as ground rent and Ricardian rent, was trivialized in contemporary textbooks. The obstacles also came from the political power of landed interests and the technical challenge of valuing land sites accurately and credibly. This pitfall constituted a formidable obstacle for a century, but computer power and available data now make it possible to demonstrate the merit and validity of land

value taxation. It is now finding a renewed interest worldwide.

## Typical 3-D Land Elevation Map



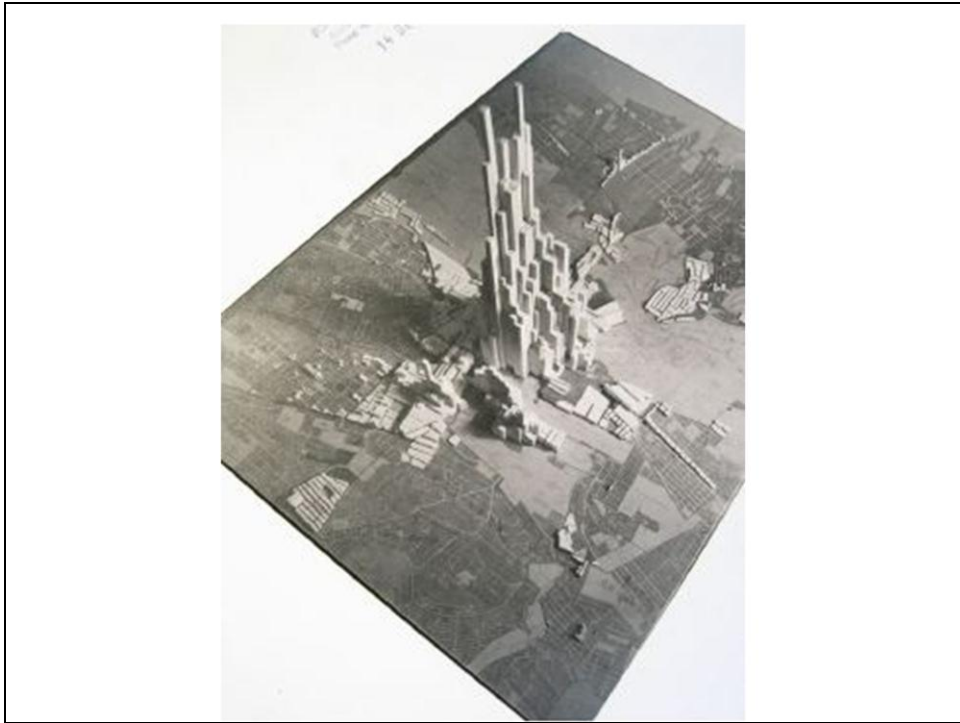
Computer graphics technology makes it very easy for us today to portray values in many ways. Land elevations are one of the graphics which geographers and GIS specialists are most familiar with.



Australia has a century old tradition of taxing land values, and the proficiency with which assessors value land is very good. Here in the province of New South Wales, it is easy to see where the land values are highest, those being the urban centers. Here, you can easily see Sydney and Canberra.

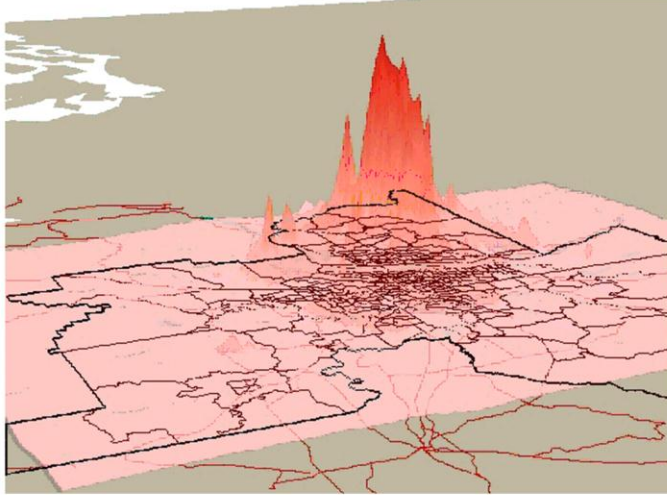


Here is a representation of site value using GIS technology. I'm told it is Johannesburg, South Africa. The sites with the greatest access, the ones where the most people tend to be, where the greatest volume or value of market exchanges is located, are the ones that will yield the highest land value. I will show you a graphic of Manhattan where sites are worth as much as \$500 million and \$1 billion per acre. Two decades ago, there were land prices in Tokyo of \$10,000 per square foot, or nearly half a trillion dollars an acre. Before the bubble burst, the land under the royal palace in Tokyo was worth more than all the real estate in California. Location, location, location. Real estate values are largely a function of the land value rather than the buildings. This should help you understand the current economic crisis.



Here is another view of Johannesburg. There is an acute awareness of land values in South Africa because land value taxation has been used there for a century.

## Portland Oregon LandValueScape



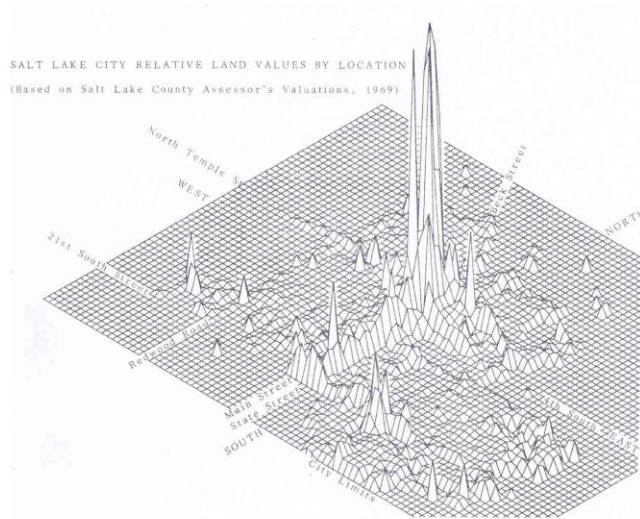
The City of Portland elected two decades ago to curb sprawl by imposing an urban growth boundary, beyond which development was prohibited. Putting such a girdle around the city created a huge differential between the value of land inside the UGB and those sites outside it. The wall was adjusted several times in the course of its history in response to political pressures. But ultimately, the pressure on the boundary became so strong that the wall burst – people elected to rescind the ordinance and allow development in what had heretofore been protected greenspace.

The people with land inside the boundary loved it, because the constrained development raised the value of their land sites. But those who could not afford to purchase sites within those limits felt that they were excluded from the



game.

## Salt Lake City Land Value Map, 1969



This land value scape of Salt Lake City antedates all the current technology, and it would be interesting to find out how it was done. What is most striking about it is the proportion of land value at the urban core as opposed to that at the periphery of the city. This graphic presentation appears to have been made with very accurate land assessments, unlike most municipalities that tend to undervalue the parcel sites in the urban core and overvalue sites elsewhere. Note how closely it follows the model of calculations that von Thunen would have us expect.

Look at almost any city skyline in the world, and it is easy to identify where the land values are highest. Typically the land constitutes about 40 percent of the aggregate value of all real property in an assessment district, although it is 55 percent in King County, Washington, 55 percent in Jackson, WY, and 71 percent in Greenwich, CT where economies are especially vibrant. One needs to understand in assessing real property that buildings depreciate in value, just like cars or refrigerators. It is land that appreciates. This is why land tends to get undervalued unless valuations are carried out frequently.

## St. Louis & Seattle Skylines



St. Louis, Missouri

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<http://www.panoramas.com>



Seattle, Washington

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<http://www.panoramas.com>

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# Boston & Charlotte Skylines



Boston, Massachusetts

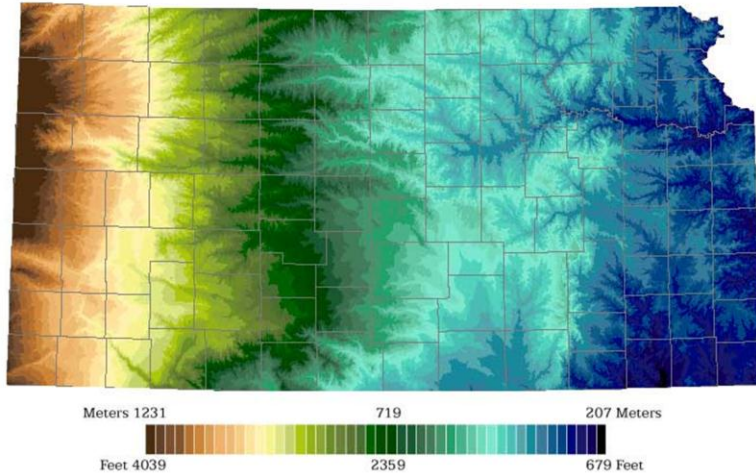


Charlotte, North Carolina

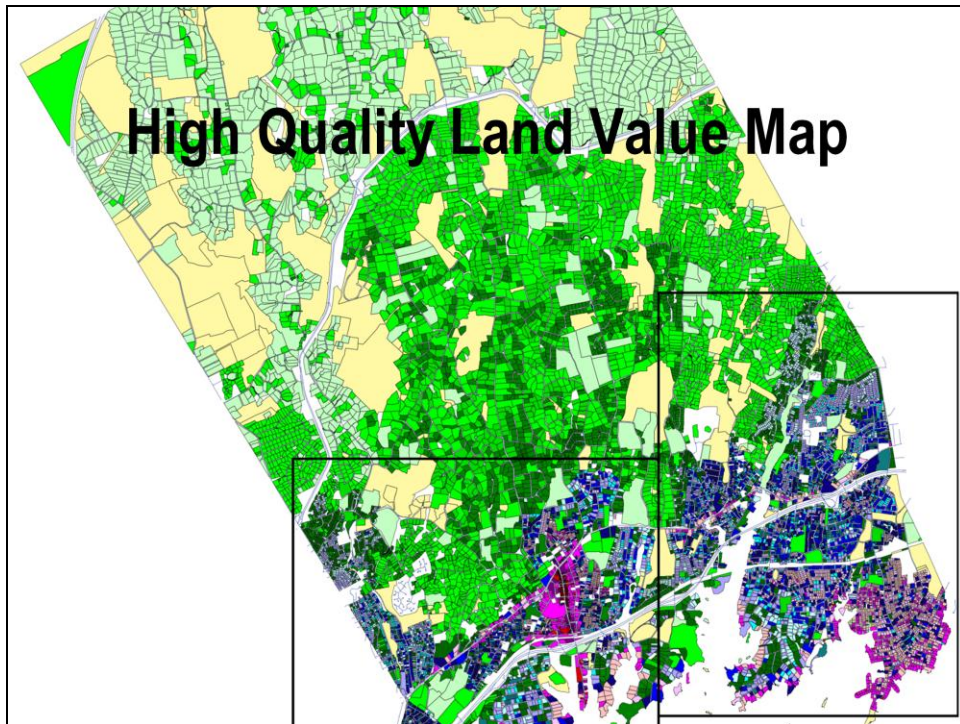
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Two More City Skylines.

## Kansas Color Elevation Map



Portraying land values might just as well be done by two dimensional color graphics for most purposes, just as one might do an elevation map. Here's Kansas, and you will see how closely it compares with some of our urban land value scapes to follow.



Greenwich, Connecticut, is one of the wealthiest cities in the country. It is where all the hedge fund managers live, along with movie stars and other celebs. So it can afford very good quality assessors. The local assessor is very aware of the value of sites, since the land values in the aggregate constitute 71% of total real estate value -- even with all the mansions and Fortune 500 business headquarters. The highest land value there (in cinnamon) is \$1,305 per square foot. But at the back end of the city, the area furthest away from the coast (in light green), the land value drops to about \$5 per square foot, all in a distance of about 5 miles.

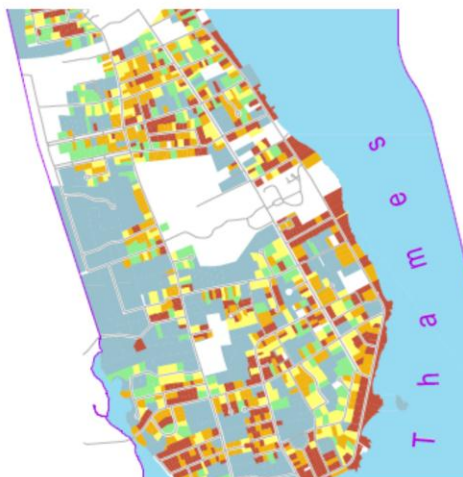


## New London, CT

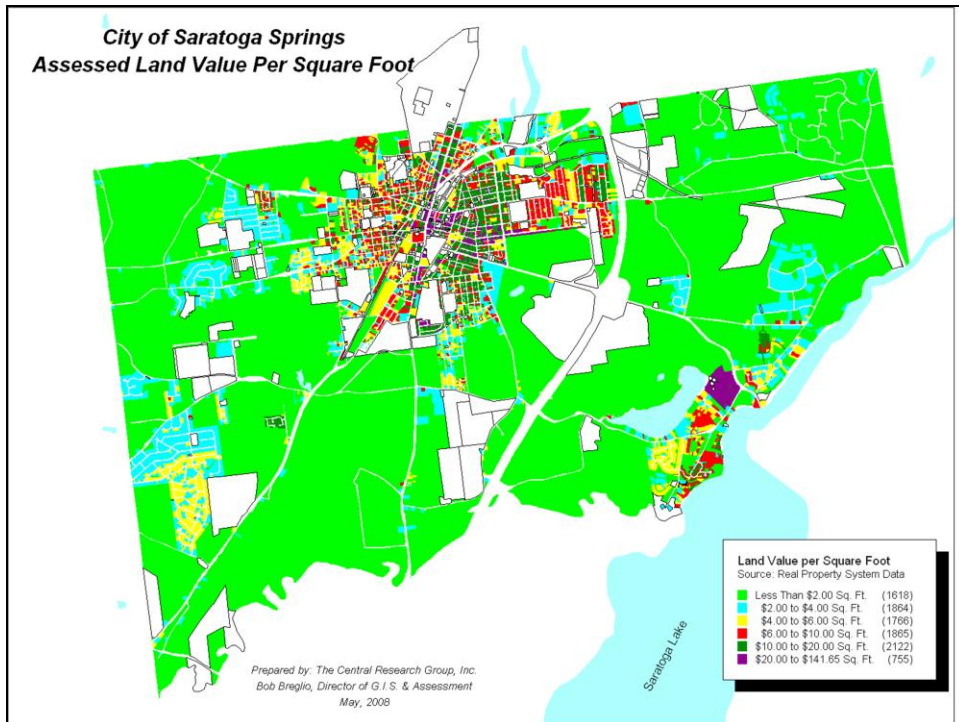
### Land Value per Acre

#### Low to High

0.00 - 291,696.42 (1173)
291,696.43 - 379,594.00 (1194)
379,594.01 - 467,506.22 (1193)
467,506.23 - 625,253.52 (1193)
625,253.53 - 8,679,609.27 (1193)

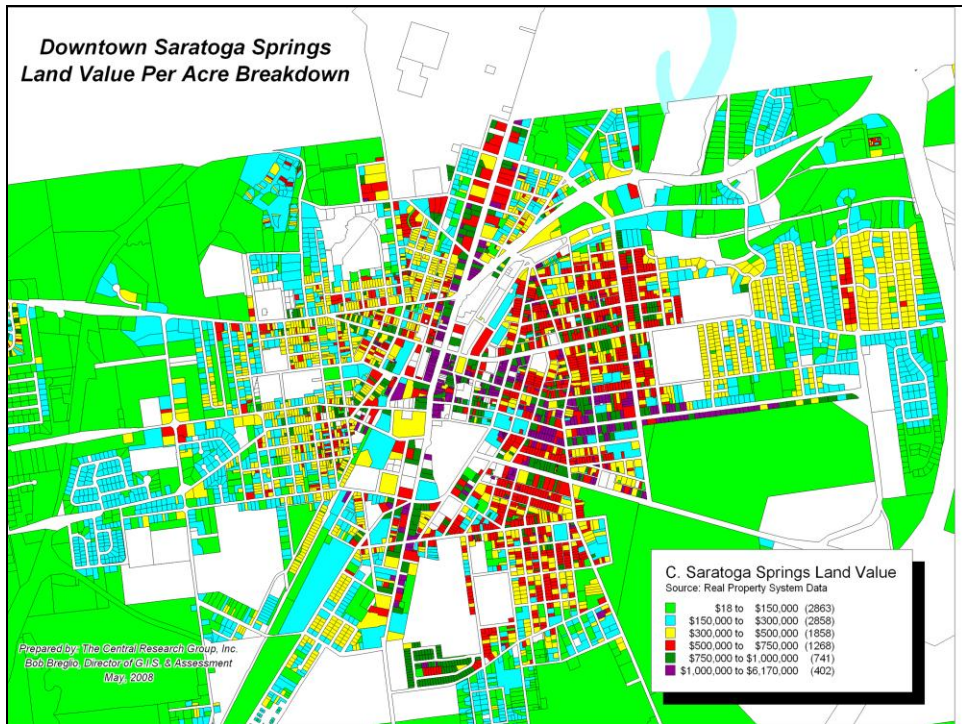


On the other hand, one can move further up the coast of Connecticut to look at a section of New London. Here the assessor has paid very little attention to the land value differences, even though he may well have gotten the total parcel value, building and land, right. This has just been completed because some citizens there are just now becoming appreciative of how the land and building need to be carefully looked at.



My colleague Bob Breglio has been working with me to look at how well the land values have been assessed in various New York localities. Here is Saratoga Springs, done using the most recent data. There is clear recognition that land at the periphery has much lower value than it does downtown. But when looking at downtown more closely, one sees much less care taken to show the building and land value split.

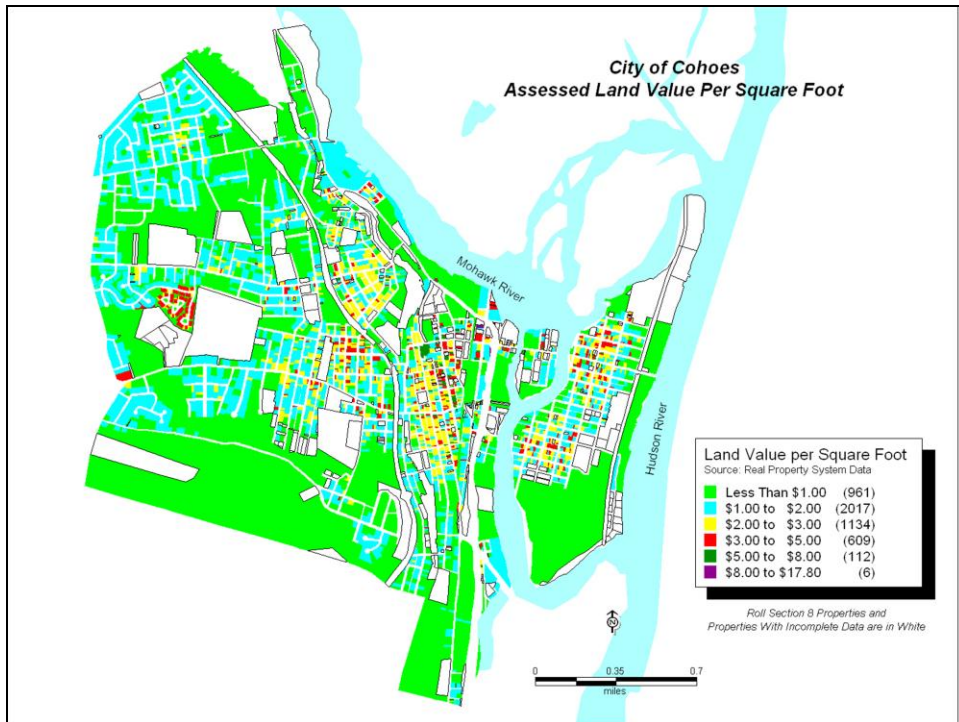




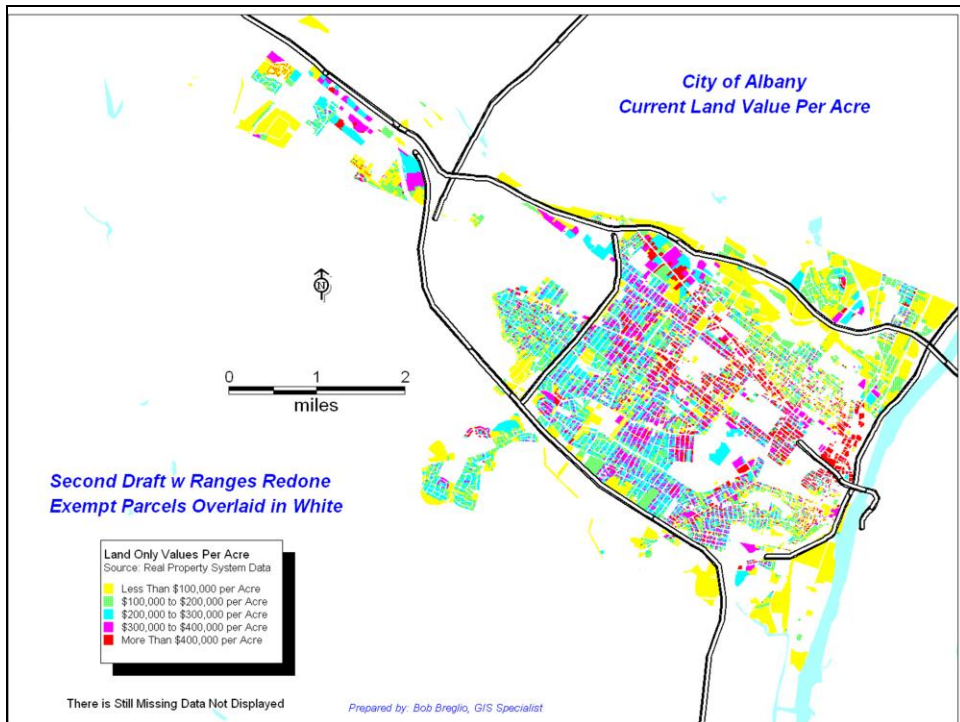
Here is downtown Saratoga Springs blown up from the prior map. If parcels are revalued every year, perhaps their assessments will maintain accuracy. But depreciation of buildings at 1.5% annually, and with land values rising at higher than the rate of inflation, titleholders are likely to be wary of the number put on their parcel values.



The City of Elmira also shows enormous disparities in the value of land sites right adjacent to one another. Using GIS as a check to the assignment of land values can assure greater confidence among both assessors and the public in the numbers put out.



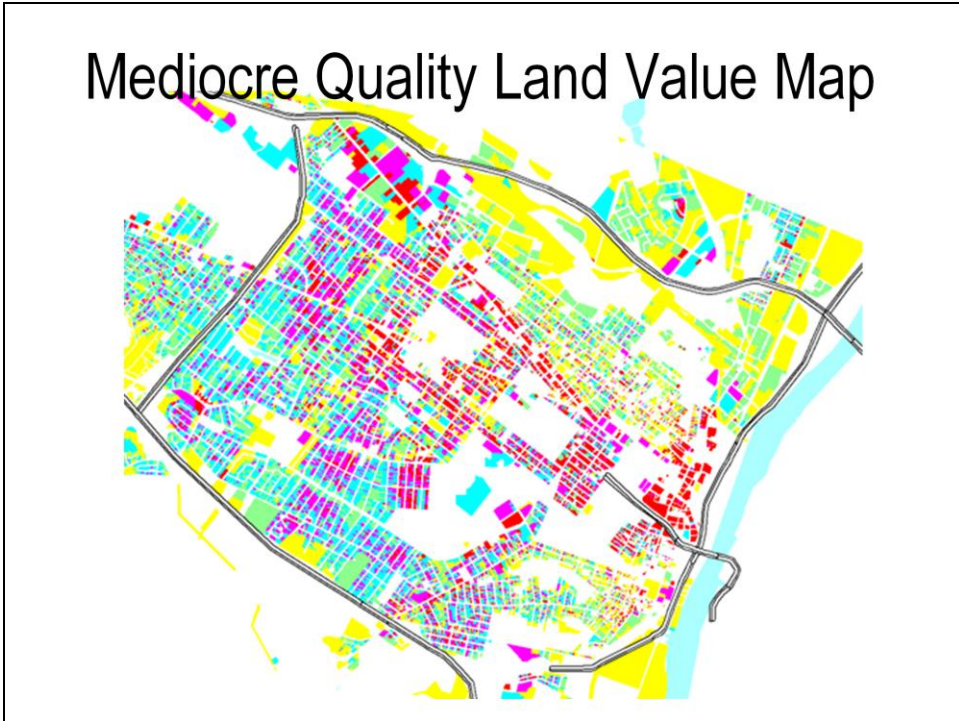
The City of Cohoes' assessment of land values also appears to be wanting. Although the outer areas are rightfully assigned lower values, the urban core seems to be much less accurately valued.



The City of Albany's assessments reveal enormous confusion as to the values of land and improvements. One wonders how it could be that some of the parcels so distant from the downtown center can have the same land value per acre.

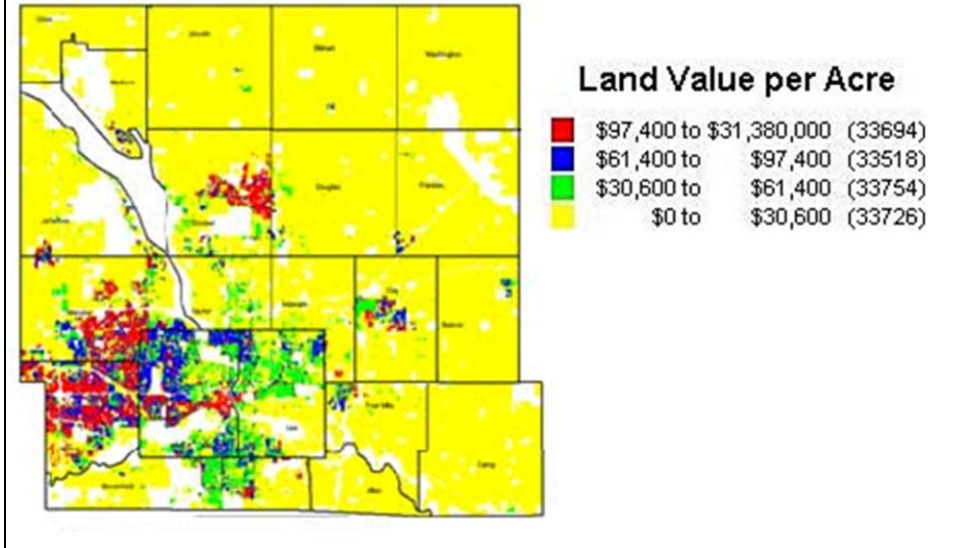


## Mediocre Quality Land Value Map



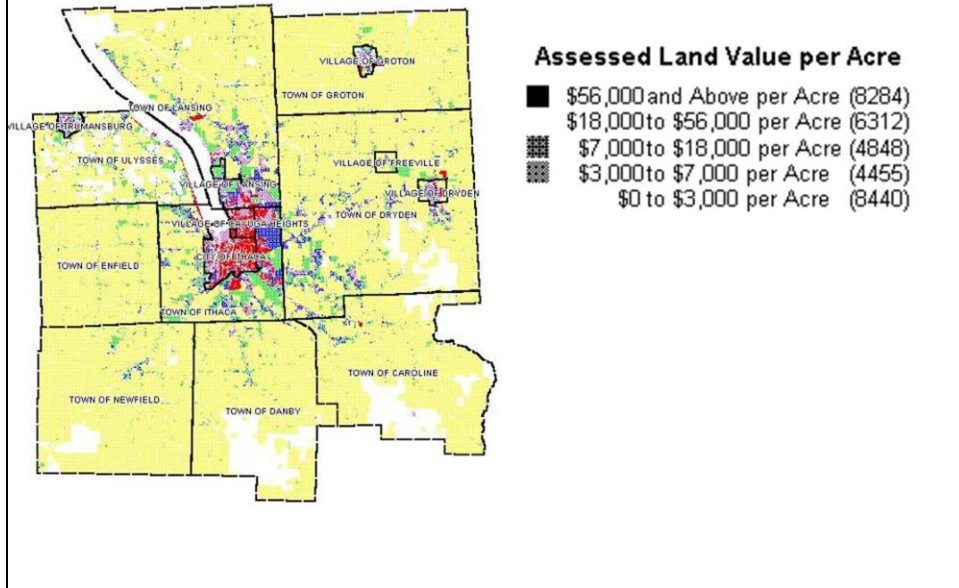
The assessments of downtown Albany and the immediate environs reflect little attention to the land values, even if the total assignments are correct. Remember, the sites shown in red are more than \$400,000 per acre, while the sites in yellow are less than \$100,000 per acre. In the areas of Arbor Hill and South Albany, where the structures should largely be depreciated to zero, the land should be assessed at far higher.

## Polk County, Iowa Land Value



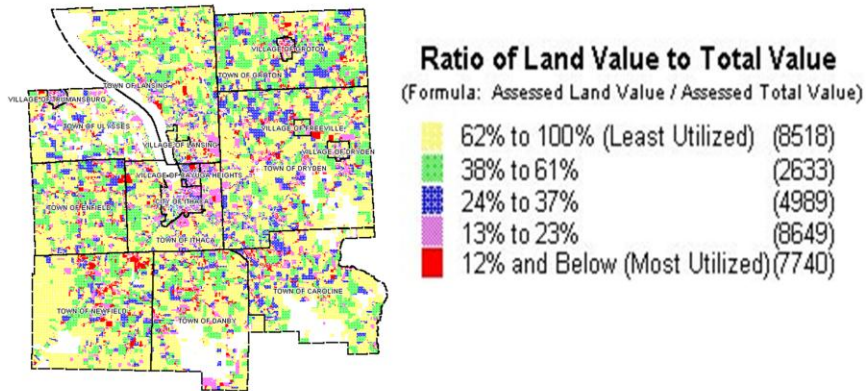
The highest land value in Polk County, Iowa is in the center of Des Moines. It is over \$31 million per acre. The quartile of parcels marked in red are all those over \$97,400 per acre up to the highest \$31 million. But if one travels to the county boundary, the yellow area of corn and wheat fields, the price per acre for this quartile is no more than \$30,600 per acre. This gradient of land value is a slope that people seldom appreciate.

# Tompkins County Land Value



Tompkins County, New York, which people better know as the site of Ithaca and Cornell University, is about thirty miles across, and even with a population of about 80,000 people and with half living in Ithaca proper, five percent of the land area (the red part, constitutes 95 percent of the land value, and the other 95 percent of the land comprise five percent of the land value. Even in this small town, the highest value quintile sites in 1995 when I did the study were over \$56,000 per acre. Walking ten minutes out of town the price per acre (in yellow) fell to less than \$3,000 per acre.

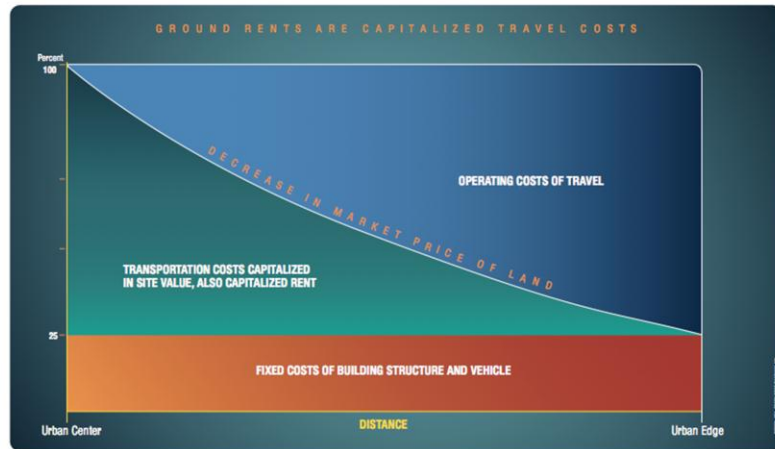
# Ratio of Land Value to Total Value: Sprawl Development



But if we do live in the suburbs of Tompkins County, you can see the inefficiencies of land use. Taking a ratio of land values to total values, or for that matter building to land or any other ratio, we can show how well the land is being used relative to its value. If we had high value sites holding high value improvements, and low value sites had little if any improvements, this ratio map would be all one color. This is a graphic representation of sprawl development.



## Ground Rents are Capitalized Travel Costs



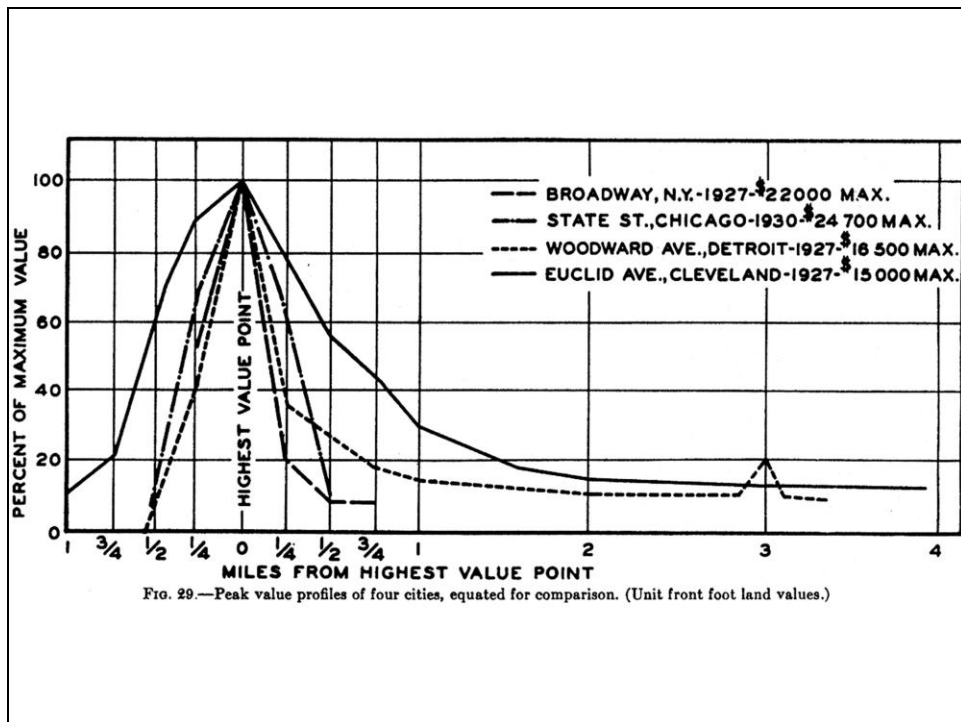
29

## Ground Rents are Capitalized Travel Costs

The market price of land sites shows pronounced differences according to their location, a factor easily understood and recognized by all people who take pains to explore this realm of study. Their range in value, measured per square foot, per acre, or by any other common unit, is a function essentially of where people most want to be, whatever sort of market exchanges they are engaged in. The first student of location to formalize ideas about how sites differ in value was German economic geographer, Heinrich von Thunen (1783-1850). He appreciated how the value of land in central markets and urban cores reflected the cost of farm goods and the cost of their transport. He was the first to articulate the thesis that what classical economists called land rent, or ground rent, was essentially capitalized transportation costs.

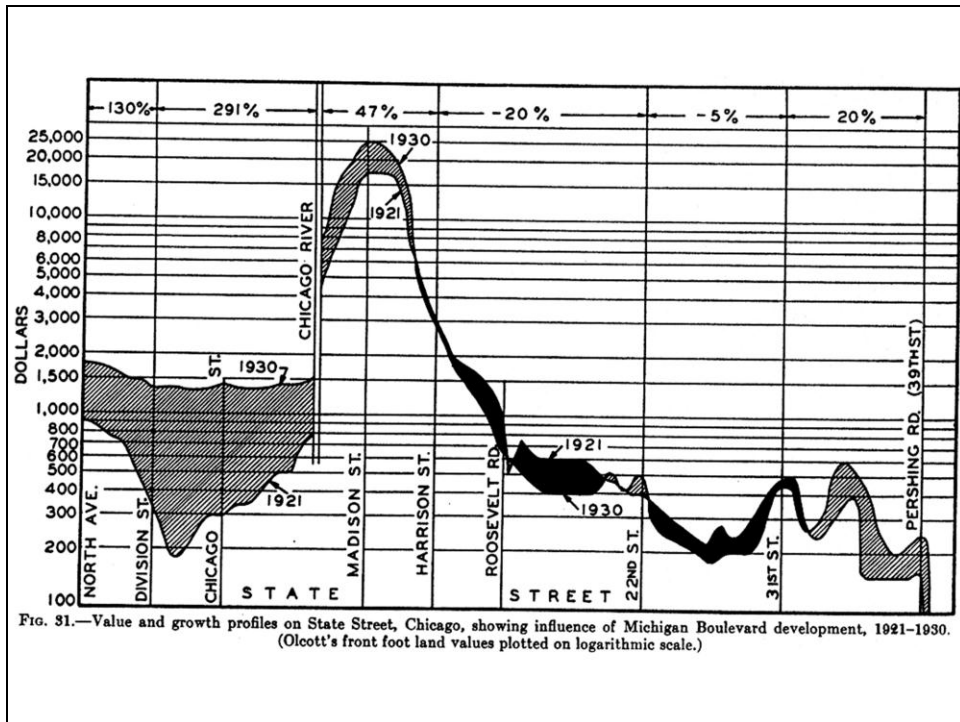
This fundamental tenet has wide applicability today, even though its truths are seldom applied in fostering efficient urban land use configurations. In any metropolitan area, it is easy to identify the land value gradients stretching from hinterlands to urban centers. The fixed costs involved either for buildings or for vehicles tend to balance out; it is the costs of travel and the costs of sites that tend to be reciprocal. This is often expressed in travel terms as the price of access and the price of mobility. Urban centers have high site rents but low access costs. Peripheral regions have low site rents but the costs of mobility are high. To be sure, for individual actors, the costs may not balance out because some may be borne collectively and others privately. But if travel costs are added together and site rents are similarly combined, one finds that they are typically

commensurate.



President Herbert Hoover established the President's Research Committee on Social Trends, with funding for the research granted by the Rockefeller Foundation. An expert staff was recruited from universities and scientific institutions nationwide, largely supervised by the Social Science Research Council. A series of studies was embarked upon in early 1930 and concluded in 1932. One volume, *The Metropolitan Community*, was by University of Michigan Professor of Sociology Roderick D. McKenzie. Like the slightly later *Encyclopedia of Social Sciences*, the President's Committee Report was valuable benchmark of the social sciences and trends of that period.

McKenzie's devoted entirely his entire Chapter XVII to land value mapping: "The Economic Topography of the City: Urban Land Values." He noted that "If [land] values were charted in topographical fashion, the chart would represent high peaks and low valleys."



McKenzie went so far as to note the differential value of land parcels relative to their traffic volume and general market activity. He was relying upon the experience of over thirty years of work by a number of assessors in several American cities. Unfortunately, the cost of performing such analysis was high, and the techniques never became more widely used given the demands of the times.

### Resulting Land Value Increases can pay for Infrastructure Investment

The nine-mile stretch of I-87 from Albany to the Mohawk River cost \$128 million in 1995 dollars. But the land value within two miles on either side of this corridor increased over 40 years by a total of \$3,734 million. This windfall gain to private owners of land sites could have paid for the capital costs of this highway construction many times over. The public investment in locational services became a lucky benefit to those close by.

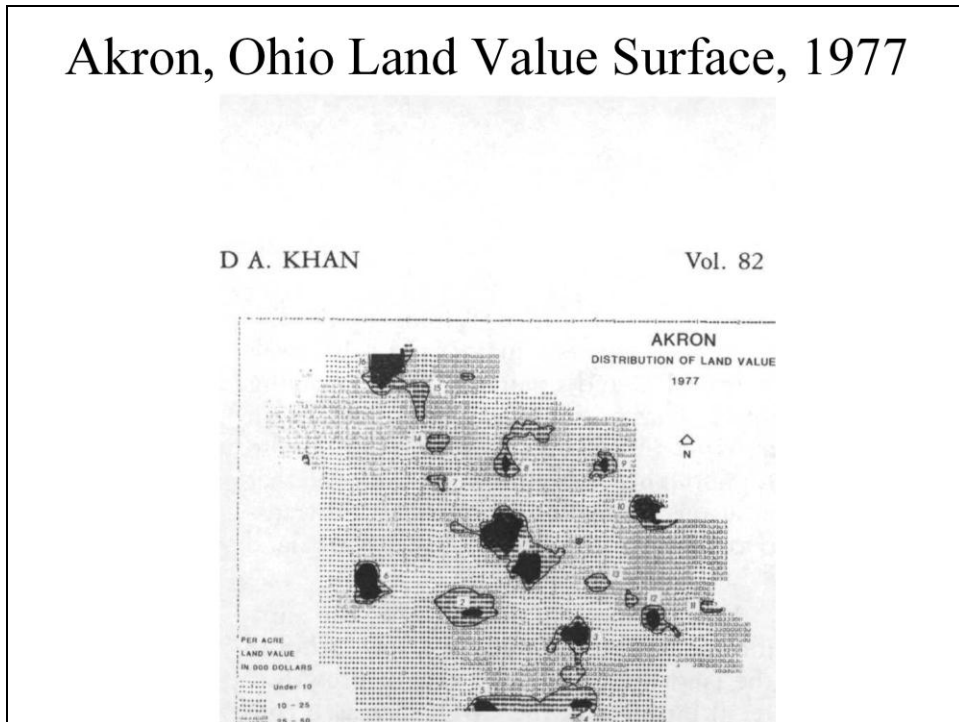


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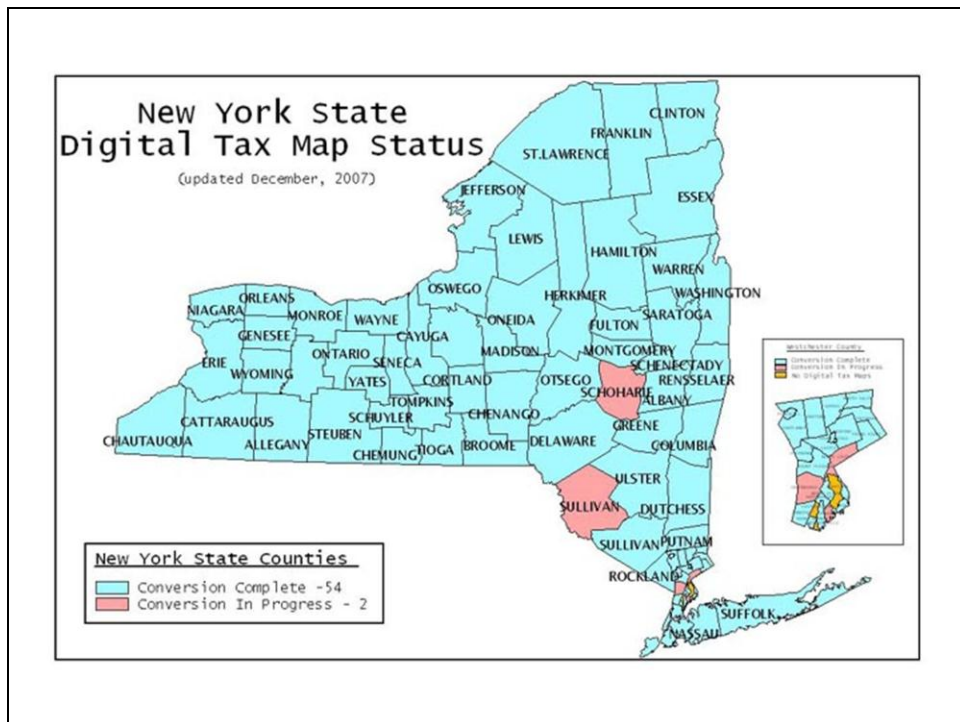
This study was published in *the American Journal of Economics and Sociology*, Vol. 60, No. 1, Special Issue: City and Country: An Interdisciplinary Collection (January, 2001), pp. 195-228.



## Akron, Ohio Land Value Surface, 1977



Prior to the motor vehicle transportation era, most cities were monocentric. Markets brought people together in urban cores, and further out were residential and agricultural land uses. The railroads were important in this process and creating centers of high market value. Automobiles have had just the opposite tendency, not just creating centrifugal forces of sprawl development. They also encourage multi-centered conurbations that have costly infrastructure to develop and maintain. Then getting around is expensive and time-consuming as well. From every standpoint – environmentally and socially, contemporary land use development is inefficient and less livable. Tax policy, the most effective tool we have to stem and to reverse such patterns, is not understood for the incentive effects that it has to correct such problems.

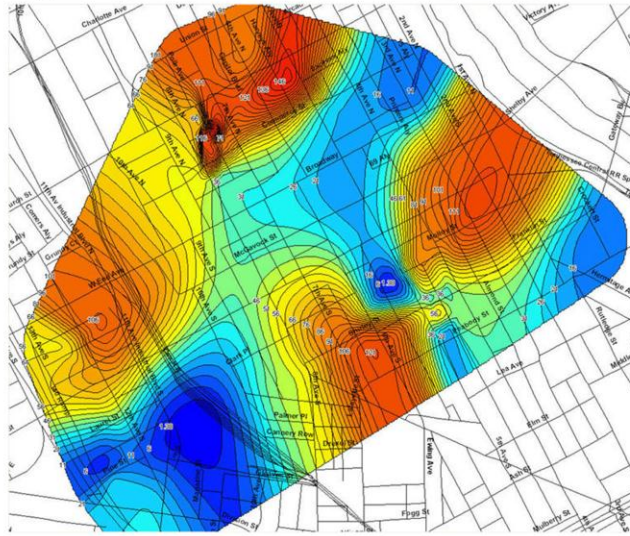


Just about all of New York State has now been digitized, so that making land value maps is possible everywhere. Doing so would not only be a good way to cross check the work of assessors; it would also help the public to understand the logic of their site values. A time will soon come, I believe, when we can enter the sales data real time into the cadastre, and then transfer it immediately to a land value map. It would be as easy to maintain as the real time weather maps.

ORPS Policy Director Jim Dunne told me that the cost assessment is \$65 per parcel upstate and \$100 per parcel downstate. Once the data is entered, GIS techs could do it for pennies. This is your challenge.



## GIS Land Value Assessment



GIS technology and available data are making it increasingly possible to assess the value of land sites largely by computer programs. Records of sale and incorporation of other factors into calculation formulas allow identification of where the site value are especially high and where they are low. This data can even be incorporated on a real-time basis, and for a fraction of the cost of the traditional “eyeball” approach. Since it makes little sense to tax improvements in any case, the adoption of this technology can clinch the case for land value taxation.

This particular map is of Nashville, and was made by Charles Williams of Integra, a commercial real estate appraisal firm, based in Kentucky-Southern Indiana. He has made similar maps for Louisville and Lexington. This approach extends the application of the work done by the Federal Reserve Bank of New York which was also based on records of arms length sales.