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Predicting the Spatial Pressures of Development in San Luis Obispo County: Is the Transferable Development Credits Program Controlling Urban Sprawl?

A Group Project submitted in partial satisfaction of the requirements for the degree
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by

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The mission of the Donald Bren School of Environmental Science & Management is to produce professionals with unrivaled training in environmental science and management who will devote their unique skills to the diagnosis, assessment, mitigation, prevention, and remedy of the environmental problems of today and the future. A guiding principal of the School is that the analysis of environmental problems requires quantitative training in more than one discipline and an awareness of the physical, biological, social, political, and economic consequences that arise from scientific or technological decisions. The Group Project is required of all students in the Master's of Environmental Science and Management (MESM) Program. It is a three-quarter activity in which small groups of students conduct focused, interdisciplinary research on the scientific, management, and policy dimensions of a specific environmental issue. This Final Group Project Report is authored by MESM students and has been reviewed and approved by:

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Table of Contents

List of Figures

List of Tables

List of Regressions

List of Maps

Executive Summary

In recent years the debate surrounding the environmental consequences of urban sprawl has attracted substantial media attention, becoming one of the most important policy issues on the U.S. urban/environmental agenda. Proponents of sprawl point to a long and prosperous history of urban expansion: this process is a natural evolution of a healthy city. Critics of sprawl argue that excessive urban expansion leads to a loss of amenity benefits from open space, traffic congestion and increased air and water pollution.[1] In turn, environmental groups advocate that bad planning policies, including excessive investment in highways, mortgage interest deductions from income taxes and fragmented government bodies further exacerbate the natural attraction of individuals to low density residential lifestyles.[2]

San Luis Obispo County is slated to grow by 32% over the next decade.[3] This increasing pressure on a primarily rural county has forced the local government to consider alternatives to channel new growth and meet the demands of an additional 325,000 new residents. Specific land characteristics should affect development decisions. Therefore a meaningful approach to land use planning can account for development pressures associated with these features. This analysis uses a hedonic model that incorporates a variety of predictive variables, associated with both environmental and socio-economic characteristics, to portray the probability of land use conversion throughout the county. While previous policies have relied on general criteria and *Planning Area Standards*, a more quantitative method for land use determinations may be necessary. This project has developed an analytical tool that can be used to guide these determinations.

The results show specific trends for development occurring on the fringes of current urban uses and nearby road networks. While urban centers and roads are generally accepted as good predictors of development, this model also shows that lesser known variables, such as scenic amenities, hospitals, schools and other infrastructure can exert strong influences on choices for land conversion. Additionally, the inclusion of these other variables also predicts a pattern of rural fragmentation not associated with urban amenities. This pattern of fragmentation, a primary concern in San Luis Obispo County, poses an even greater threat to ecologically sensitive areas and open space lands by virtue of its potential to disrupt existing natural corridors and viable habitats.

Typical planning mechanisms for controlling sprawl have traditionally been command-and-control in nature, therefore dictated by local planning departments. These regulations allow little flexibility in meeting planning objectives and are often met with public dismay due to excessive government intrusion. While there may be

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[1] Brookings Review, Vol. 16, No. 4, Fall 1998 issue.

[2] Mieszkowski, P. and E.S. Mills. "The Causes of Metropolitan Suburbanization." Journal of Economic Perspectives, V7(N3): 135-147, 1993.

[3] http://www.ucsb-efp.com/publs.htm

a place for some of these directive policies, such as Urban Growth Boundaries and Building Moratoriums, market mechanisms have been gaining support as an alternative approach to the determination of optimal land use.[4] One such mechanism looks to reallocate growth through the transfer of development rights, severing development rights from a particular lot of land without threatening other "rights" (such as water, coverage, etc.) and private property ownership. In general, development rights will be transferred from an area intended for preservation (sending site) to an area of targeted growth (receiving site). Once these rights are transferred, the sending site lot will be protected via application of a conservation easement, in perpetuity.

San Luis Obispo County uses a series of general and specific criteria, as applied by a Transferable Development Credits (TDC) Review Committee, to approve sending and receiving sites for designation. A total of 6 sending sites and 4 receiving sites have been approved for designation to date. Using the model output and mapped pressures of development, we are able to analyze the location of these sites for the appropriate control of sprawl. While some of these sending sites are located in areas of high development pressure, their preservation may actually be protecting areas best suited for residential development. Additionally, although rural fragmentation concerns may be paramount, there is currently no provision in the ordinance for directed preservation of rural areas, as opposed to those on the fringe of urban uses. The inclusion of predicted development pressure as a criterion could increase the effectiveness of the ordinance in meeting the County planning objectives.

The San Luis Obispo County TDC program is facing review through a series of public meetings and Grand Jury proceedings. It is possible that the use of this tool in designating future sites could increase the chances of the success of the program. Additionally, it may be appropriate to limit the scope of the TDC program to target low-density development in rural areas, in combination with other growth control mechanisms. However, regardless of the future of the TDC program, this tool can and should be considered for future land use decisions and policy making.

[4] Although "alternative" policies may exist, these mechanisms still rely on a firm planning base of zoning and General Plan designations.

Introduction

The Problem

Like all growing communities in the United States, cities and counties throughout California are having a vigorous debate on the choice of alternative policies to control for the environmental externalities[5] associated with urban sprawl. A major trend in regulation has seen municipalities moving away from command-and-control policies (such as zoning) and moving toward market-based mechanisms (such as Transferable Development Rights or Credits). In general, economists point towards these market-based mechanisms as a more efficient means of accomplishing policy objectives; individual firms may choose the most appropriate level of compliance, given their individual demand and supply functions. However, the interplay of various internal and external variables, related to land-use conversion, may result in the failure of these mechanisms, and the market in which they are based.

San Luis Obispo County represents a local example of a community struggling with the planning implications of urban sprawl. On the one hand, residents wish to preserve open space and protect the rural character of the County. On the other, they resent and protest increased density within city borders. It therefore becomes important for County Planners to create and employ a General Plan that targets the most acceptable, and community-backed locations for preservation and, alternatively, future development.

We therefore ask the questions, "What are the predicted spatial pressures of development in San Luis Obispo County using a hedonic framework in coordination with a Geographical Information System," and "Is the TDC program controlling urban sprawl?" There are therefore two phases to this Group Project. Part I will take the form of a program evaluation, based only on known community characteristics, ordinance intricacies, and a comparison with other market-based growth control programs throughout the country. Part II introduces the Geographical Information System in order to analyze the ordinance within a spatial framework. The final product of Part II is an analytical tool that provides a basis for future planning decisions, as it draws on specific and objective spatial data to determine relative pressures for development.

[5] An externality is said to exist when the welfare of one agent (firm or consumer) depends directly on the actions of another agent. An environmental externality would be a change in environmental welfare as a result of said actions.

Part I: Program Evaluation:

Is the San Luis Obispo County Transferable Development Credit Program Controlling Sprawl?

Project Objectives

The San Luis Obispo County Board of Supervisors is currently reviewing the County Transferable Development Credit (TDC) Ordinance. The ordinance, which is intended to facilitate market-aided relocation of development from areas considered valuable in open space use to areas within the urban core, was recently the subject of a Grand Jury Hearing. Local objections and a sluggish market may affect the future of the ordinance. However, a similar program in the Cambria region of the county has been a huge success.

This analysis looks at the differences in these two programs, as well as others throughout the country. By comparing and contrasting the main components of successful programs, we are able to provide recommendations regarding local planning decisions and the implementation of a TDC program.

Background

Urban Sprawl

Urban sprawl is a development pattern that only became prominent in the U.S. after World War II and, until recently, has largely been absent in the rest of world. For most of the industrial age, development in the U.S. was focused around a central business district. These business districts needed to be easily accessible to employees without automobiles and thus included various forms of public transportation and a mix of residential types that made public transit and walking feasible.

However, once automobiles became widely affordable, many land developers and other businesses began marketing the "American Dream" as owning a large single-family house on a large lot in the suburbs. This marketing appeal resonated with many consumers, who saw the suburbs as an opportunity to escape the noise, crowds, and social problems of the city and to raise children in a safe, clean environment. Now, virtually all American cities face the same expansion pressures: growth at the edge, decline at the core.

Urban sprawl involves the spreading out of a city and its suburbs at the periphery of an urban area. This entails the reduction of open space due to the increase of the total size of a city's land area and its suburbs over a particular period of time. Though this definition of sprawl is certainly not the only one, it is the most widely used quantitative measure of rural urbanization in cities of all regions of the

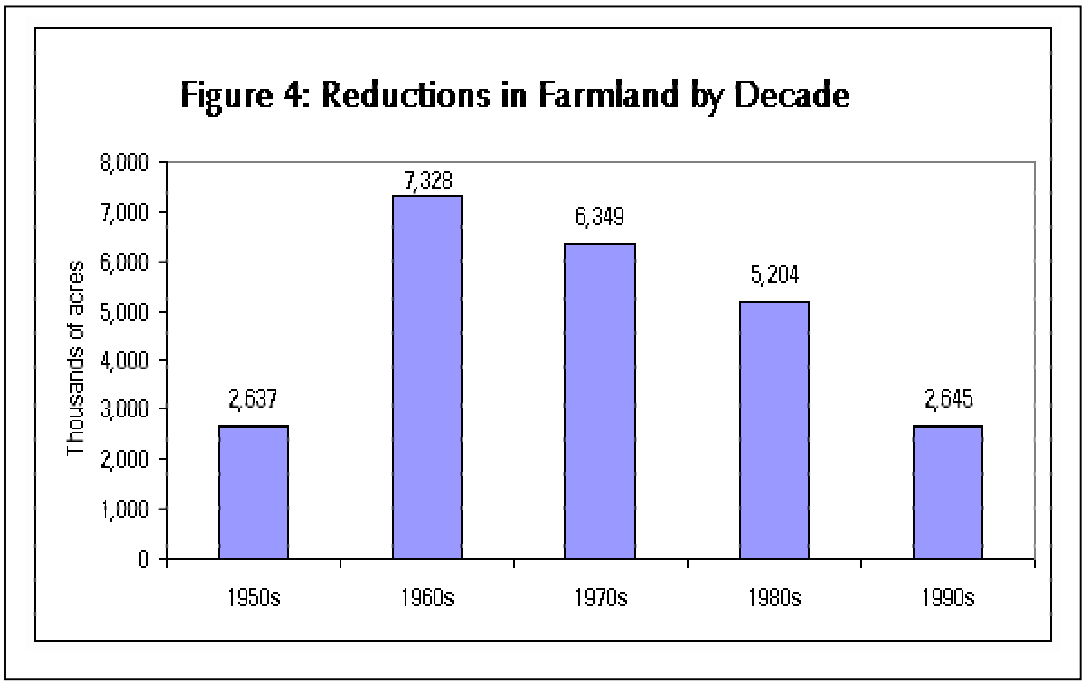
country, and is used by the U.S. Bureau of Census to measure urbanized areas. This measurement of the amount of land consumed closely resembles the most common American understanding of sprawl. Whether or not this type of growth has a negative connotation associated with it is debatable. Some claim that growth and development is a natural and progressive process of vital cities.

Benefits of Sprawl

While sprawl has become an issue of concern only relatively recently, some would claim that the majority of effects from this pattern of growth have already been felt. As can be seen in Figure 1, reductions in farmland have actually decreased through time, with the majority of land conversions occurring between 1960 and 1980. Additionally, the entire cache of "urban land" is less than 5% of the United States. Of this 5%, three-quarters of the population is focused on 3.5% of the land (therefore only 1.5% of the land is populated at "sprawling" densities).[6] While it may be argued that agricultural land is slowly being converted to residential use, sprawl proponents would argue that rural parks and wildlife areas have been growing in number as a consequence. Additionally, the means by which sprawl achieves reduced density development may be positive for city revitalization. Sprawl can be subdivided into three major types of development: leapfrog development, strip development, and low-density, single dimensional development.[7]

Figure 1: Conversion from Farmland to Urban and Residential Use – By Decade[8]

[6] Staley, Samuel R. "The Sprawling of America: In Defense of the Dynamic City." Reason Public Policy Institute, Policy Study 251, 1999.
[7] *Ibid.*
[8] *Ibid.*



- Leapfrog Development
  This term describes development that occurs when developers avoid building on land directly adjacent to an existing urban area, and instead choose to develop land at some distance from the city. This land is generally cheaper, resulting in the development of more affordable housing. Although this housing is a greater distance from employment centers, some individuals will find the tradeoff between a longer commute time and more affordable housing worthwhile. While leapfrog development definitely results in a dilution of density from the city center, it may nurture future commercial development in the empty parcels. These "leapfrogged" parcels actually represent an ideal location for retail stores, office buildings, and businesses,[9] situated conveniently between residential and employment areas. While this type of growth pattern is often unpredictable, it almost always results in a connected community (newly urbanized areas in the suburbs are eventually connected to the older urban center via commercial infill development).
- Strip or Ribbon Development
  A second type of development typical of sprawling metropolitan areas is strip or ribbon development, and involves the linear growth of commercial entities along both sides of major roads and highways leading into the city center. Such "strip malls" are generally viewed as public nuisances (they are unsightly and cause traffic congestion), however, strip development does have some benefits. While it may increase traffic flow in its direct vicinity, overall automobile traffic may be reduced as disparate goods and services are

[9] Holcombe, Randall G. "In Defense of Sprawl." PERC Reports. 17 (1): 3-5, 1999.

brought together (thereby reducing the need to travel long distances from store to store).[10]

- Low Density, Single-Dimensional Development
  Single-family dwelling units on large lots are typical of subdivisions located outside of most busy metropolitan areas. Such subdivisions have been criticized for their lack of locational planning, requiring that their inhabitants drive to get anywhere. However, people like having a backyard and a neighborhood where it is safe enough for their children to play outside in the evening. This is the materialization of the "American Dream."

Consequences of Sprawl

Although there may be some benefits associated with sprawl, it is difficult to deny that it is actually happening. While some analysts insist that this trend is slowing down, there is evidence to the contrary. Between the years of 1970 and 1990, the density of the United States urban population decreased by 23 percent. During this same time period, over 30,000 square miles of rural lands were converted to urban use.[11]

The consequences of sprawl affect six general groups:[12]

- Taxpayers
  It has been argued that sprawl actually benefits individual taxpayers as houses in rural communities may be less expensive than those in the urban core. However, these lower purchase prices often fail to account for a number of "hidden costs" that may manifest themselves at a later date. New highways will have to be built and maintained so that residents in sprawling communities can drive to and from work, school, and commercial interests. A complementary problem is the associated air pollution resulting from an increased number of miles driven. Because of a shift out of the urban core, older neighborhoods may become hotbeds of social problems associated with neglect. Finally, implementing solutions to the environmental problems created by development of sensitive natural areas may be very costly.
- Job-Housing Balance
  Businesses tend to locate within local centers of commerce. Therefore, as customers move to the suburbs, commercial entities will follow. However, not all businesses have the luxury of easy relocation. When businesses cannot relocate, employees are forced to commute greater distances, which can translate into increased labor costs and decreased productivity. Additionally, because of the negative impacts of sprawl on individuals,

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[10] *Ibid.*

[11] Associated Press. "Census: Cities Takeover US." Statesman Journal. December 18, 1981

[12] Greenbelt Alliance. "Beyond Sprawl: New Patterns of Growth to Fit the New California." 1995. http://www.greenbelt.org/pubs_merchandise/beyond_sprawl_txt.html

businesses may choose not to relocate within state/county boundaries, opting instead for areas devoid of sprawling characteristics. Not only do sprawling areas have negative environmental and social externalities associated with them, but costs of conducting business are often increased as municipalities endeavor to provide infrastructure to these growing communities. When businesses leave an area, these older communities must struggle to stay competitive and often face economic crisis.

- Residents of New Suburbs
  While residents of these new communities are often considered the primary beneficiaries of suburban sprawl, affordability of home ownership and safe communities may be coming at a high price. Because jobs are often not located in the direct vicinity of new developments, commuting distance (and time) increases. Because commuters desire reliable transportation, income spent on automobiles (purchase and maintenance) is increasing, resulting in a decreasing amount of time and income available for other activities. Finally, the cost of providing new infrastructure, required to support these new communities, often translates into increased taxes for these individuals (contrary to the belief that these new areas are low-tax neighborhoods).[13]
- Residents of Central Cities and Old Suburbs
  These individuals may be the biggest losers in the age of sprawl. While location in these areas (urban centers and nearby suburbs) was at one time preferable (as these areas were central to work, shopping and entertainment), many of these communities are now experiencing a rapid transition. Jobs that were once nearby are moving to the outskirts as city centers become plagued by social ills. Individuals who could previously walk or take public transportation to work are now forced to find new ways to commute, or new jobs. In some cases, the latter is not possible and increased numbers of laborers join the ranks of the unemployed. To compound this problem, upper and middle class individuals often choose to relocate to the new suburbs, leaving behind the poorest members of society, and eroding the economic and social integrity of these city centers. Consistent with these shifts of residency are changes in the locus of political power, and thus government spending. As money is shifted to new and thriving areas, it becomes increasingly difficult to revitalize city centers. Investments within the urban core, if not completely abandoned, may become stagnant as consumers and tenants follow this outward trend.
- Farmers
  Not only must the farming community adapt to a long-term loss of land in agricultural use, but the land preserved may not be as productive. Sprawl-induced pollution degrades the quality of soils and thereby increases the incentive for farmers to sell their land to developers.[14]
- Environment

[13] *Ibid.*
[14] *Ibid.*

> Residents of sprawling communities drive three to four times as much as those living in compact, well-planned areas.[15] Sprawl increases the amount of vehicle miles traveled by citizens who either live in the urbanized area and supply services to the outermost areas of the city, or who live in the suburbs and commute to the city center for work or other services. Unsuccessfully, cities have tried to abate the negative transportation effects associated with growth by building new roads or extra freeway lanes; however this only exacerbates the problem by alleviating the externality to the commuter and allowing sprawl to continue. Additionally, the trend of increased automobile usage that results in increased distances traveled and increased congestion will also result in an increase in automobile-related air pollution.[16] There are many ecological consequences of increased road density and traffic volume.[17]
>
> Sprawl necessarily cuts down on the reserve of open space, as agricultural plots are converted to residential developments. A consequence of the consumption of open space is the inability of developers to supply adequate infrastructure and services to the citizens of the distant suburbs.

Fledgling cities are often born on the fringe of sprawling urbanized areas because individuals in these newly developed areas desire the same services that urban core inhabitants are receiving. After they form a "new city" they are able to have services such as police, fire, and public infrastructure provided more readily via a community tax base. However, the formation of these new cities only leads to the introduction of the sprawl scenario yet again.

Some have argued that the tax revenue generated by increased growth and population will offset negative effects by utilizing the monetary gain for abatement. However increases in tax revenues are eaten up by the costs to the community of delivering new services, including water and sewer lines, schools, police and fire protection, and roads for people who live far from existing infrastructure. For example, in the city of Fresno, California, population has doubled since 1980, producing a total of $56 million in yearly revenues. Yet the costs of services have risen to $123 million, not including costs for roads and sewers.[18] Another economic/social equity concern associated with a sprawling city includes the separation of unemployed people living in cheap city housing from low-wage jobs in developing suburbs. An additional lack of public transportation alternatives decreases the ability of these individuals to travel to distant job markets, causing blight to spread from growing pockets of major metropolitan areas into outlying suburbs.

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[15] Sierra Club. "Sprawl Factsheet." http://www.sierraclub.org/sprawl/factsheet.asp

[16] United States Environmental Protection Agency. "Antidotes to Sprawl: Air and Water Pollution." 1999. http://www.epa.gov/region5/sprawl/airpollution.htm

[17] Forman RTT, Alexander. "Roads and their major ecological effects." Le Annual Review of Ecology and Systematics. 29:207+, 1998.

[18] Rysavy, Tracy. "Adding Up the Costs of Sprawl." Yes! A Journal of Positive Futures, Summer, Positive Futures Network, 1999. http://www.futurenet.org/10citiesofexuberance/rysavy_sprawl.htm

When tax revenues do not compensate for growth, and sprawl looks inevitable there are tools that communities can use to combat this turn of events. Communities throughout the nation have begun focusing on "Smart Growth" plans and methods. These instruments range from regulatory tools such as zoning and urban growth boundaries, to market-based mechanisms like Transferable Development Rights (TDRs), and redevelopment incentives.

Smart Growth

Smart growth is an effort to design an approach to growth that identifies a common ground where developers, environmentalists, public officials, citizens, and financiers can find ways to accommodate growth that is acceptable to each entity. Smart growth begins from the assumption that there will be growth. Smart growth development approaches have clear environmental benefits, including improved air and water quality, increased wetland preservation, more brownfield sites cleaned and reused, and increased preservation of open spaces. There are also clear economic benefits, including employment and business opportunities, expansion of the local tax base, provision of neighborhood services and amenities, and the creation of economically competitive communities.

Smart growth is local and regional in nature; a discussion built up from the grassroots level that rejects top-down, command-and-control policy implementation. Smart growth is about being fiscally responsible with tax dollars, investing in existing infrastructure, and eliminating obstacles to infill and the prohibitive costs of redevelopment.[19]
Communities across the nation are struggling with the question of how to grow while maintaining their quality of life and sense of community. For many, the answer lies in taking a step back and developing a strategy to accommodate growth while still preserving important community characteristics. For others, the answer lies in working hand in hand with neighboring communities to address common challenges (crime and transportation are two examples) that often cannot be effectively met alone. While these emerging partnerships form to address different challenges, from land use and transportation to economic and social policy problems, these communities often find opportunities for cost sharing, cost reduction, or improved service quality by jointly addressing these issues. By working together, communities can devise effective strategies that help them grow according to their values.

Though smart growth is a term that is used commonly throughout communities nationwide, there is not a set package of tools associated with smart growth. For example, one metropolitan area might use a combination of impact fees, urban growth boundary, and minimum lot zoning while a neighboring community will

[19] Anderson, Geoff. *Why Smart Growth: A Primer.* International City/County Management Association, Washington, DC, 1998.

useTDRs and open space acquisitions. While both communities are using different tools to deal with sprawl, they are both undertaking smart growth planning measures.

Alternative Policies

Zoning

An authority exists under the "police power" (see "Legal Issues – TDRs," page 17) of the government to control land uses that are either physically harmful or offensive to commonly accepted community values. Such controls have been called "nuisance laws." Zoning is a land use control that was introduced in the U.S. as a reform of a nuisance law that had been made necessary by the rapidly increasing complexity of modern urban life. While European cities in the late 19th century developed the controls that would later evolve into what is known today as zoning, New York City developed the first zoning ordinance in 1916. New York's 1916 Zoning Resolution established height and setback controls on buildings and separated incompatible uses to stop the encroachment of industry into Manhattan's office and department store district.

Before zoning regulations, commercial areas were crowded with private dwellings, industries were located throughout residential areas, and tall buildings in some larger cities were packed in next to each other without consideration for what was happening below, where the streets were dark and never had sun. City officials had no effective mechanism for controlling such development. Without zoning, growth was haphazard and this lack of control or direction led to the abandonment of many adequate buildings each year, as they were surrounded by inappropriate land uses. Acting as a land use law, zoning divides both the land use control and the property rights between the personal owner and the local government. This effectively creates collective property rights that are held by the local government.

Zoning is typically found within a local government's municipal code, where it lists (normally accompanied by a map) specific zones or areas in the city and uses allowed in those areas. Zones and their conforming uses vary between different governments in addition to the mode of enforcement. Typically governments employ a zoning and enforcement division that monitors changing land uses and issues permits and fines as a form of regulation.

Zoning, with its legal basis in police power, placed substantial new restrictions on the use of personal property without offering public compensation. In his famous brief to the Supreme Court defending zoning, Alfred Bettman argued: "The need of

zoning has arisen to a considerable degree from the inadequacy of the technical law of nuisance to cope with the problems of contemporary municipal growth."[20]

The validity of zoning was established in a landmark Supreme Court decision in 1926, Euclid v. Ambler Realty Co.,[21] in which it was determined that the exclusionary nature of zoning was appropriate and in the public interest as a means to reduce nuisances, and as such, overrides the interests of individual property owners. This case guaranteed the validity of zoning as a rightful use of the state's police power, and led to its importance as the most significant tool of land use and planning yet devised.

Urban Growth Boundary

One of the most popular smart growth tools, especially at the local government level, is the Urban Growth Boundary (UGB). A UGB is a politically designated line around a city, beyond which development is either highly encouraged or highly discouraged.[22] UGBs are set for significant periods of time, typically 20 years or more, to discourage speculation at the urban or suburban fringe.[23] California, in particular, has turned to the UGB to solve its land management problems. This policy can be used to support both No Growth and Pro-Growth agendas, depending on how and where the line is drawn. Like other growth control mechanisms, there are many potential benefits that a municipality may derive from such a boundary:

- UGBs are often an attempt by a city or other municipality to reduce the rate of population increase over time. Generally this principle manifests itself in limiting the number of new living units and associated facilities and services built within the boundary. However, in order for a UGB to discourage growth within its boundaries, policies and regulations must be associated with the boundary (e.g. within the boundary and not outside of the boundary). Without these associated regulations, the boundary serves only to delineate between the developable land (within the boundary) and open space (outside the boundary). In other words, development within the boundary could continue at present or increased rates without the implementation of specific command and control regulations.
- UGBs can encourage higher-density new growth within the community (inside the boundary), leaving the fringes as open space. This concept is particularly popular in communities where a great deal of open (developable)

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[20] Bettman, Alfred. *City and Regional Planning Papers*, Harvard City Planning Studies, Vol. XIII, Cambridge, Massachusetts, 1946

[21] Charles M. Haar and Jerold S. Kayden. "Foreword: Zoning at Sixty--A Time for Anniversary Reckonings." from Haar and Kayden. *Zoning and the American Dream*. Chicago: Planners Press. pp. ix-xi, 1989.

[22] Staley, Samuel R. and Gerard C.S. Mildner. "Urban Growth Boundaries and Housing Affordability: Lessons from Portland." Reason Public Policy Institute. Policy Brief No. 11 (October), 1999.

[23] Greenbelt Alliance. "Urban Growth Boundaries." San Francisco, CA, http://www.greenbelt.org/pdf_files/ugbinfo.pdf

land exists on the fringe (on the outskirts of town). The boundary is thus intended to create a compact community surrounded by undeveloped open space.

- Local (or city-level) UGBs are often preferable (to citizens) to regional UGBs, which are difficult to modify after adoption by the governing body. Local boundaries can be adjusted as the needs of local residents change.
- The UGB increases the property values for individuals owning land within the boundary and decreases the value of land outside of the boundary because it is no longer "available" for development.[24]

Conversely, there are also some shortcomings associated with the implementation of UGBs:

- For reasons mentioned above, UGBs tend to be implemented on a local level and there is no assurance that when all UGBs are compiled for the region that the result will be a consistent and effective land management plan. This lack of coordination increases the possibility that the policies within one community can offset or negatively impact those in nearby or surrounding communities. This is particularly the case when one community imposes a UGB but neighboring communities do not. The result is often that growth is simply deflected from the implementing community onto the neighboring community, therefore still creating unwanted growth or sprawl.
- Costs of development may be greatly increased for developers who own land or options in communities where UGBs have been imposed. This effect is necessarily dependent on the location of the involved land in relation to the boundary. Individuals who own land outside the boundary will be forced to endure losses due to an unanticipated decrease in property value associated with land that can no longer support development.
- Finally, even with the implementation of an UGB, there is no assurance that development will take place in the most optimal locations within the boundary. Available sites within the boundary may be suboptimal as opposed to some outside the boundary, reflecting inefficiency in the land development market.[25]

Legal Issues - UGBs

The controversy that surrounds UGBs usually surfaces during the designation of developable and undevelopable lands. During the boundary designation agencies attempt to include enough land within the limits to provide for future urban

[24] Associated decreases in values have led to legal proceedings regarding takings claims (discussed further in legal issues, below).

[25] National Association of Industrial and Office Properties (NAIOP). "Local Urban Growth," 2002. http://www.naiop.org/membercenter/government/growth/ugb.shtml

expansion for approximately 10-20 years on average. After setting the UGB, agencies can designate certain areas around the limit line as "urban reserves."

Since urban reserves are usually the next area for expansion after the UGB is reevaluated, a controversy is created between the agencies and communities affected by the designation. The Oregon State Land Use Board of Appeals (LUBA) issued a landmark opinion overturning the Portland Metropolitan Planning Agencies March 6, 1997, decision designating 18,759 acres of land outside of the existing Metropolitan Urban Growth Boundary as "urban reserves."[26] Communities that are designated to be within an "urban reserve" or UGB often plead the case that they are being unfairly dealt with and usually attempt to be removed from the boundary. Unfortunately due to the authority granted to planning departments by law, the communities' exclusion/inclusion from UGBs are often not litigated, as these cases are nearly always lost.

Another topic that is highly controversial is the relation of UGBs to the "takings" issue. An area within an UGB will most likely have a higher "developable" land value than areas outside this boundary. Some landowners that are excluded from UGBs claim that their property has been "downzoned" or devalued and argue that the governing agencies are "taking" value away from them. In another case in Oregon, a State at the forefront of UGB issues, property owners affected by an UGB pushed for legislation protecting their property values. On November 7, 2000 the voters of Oregon passed Ballot Measure 7 by a margin of 53 percent. The measure amended the Oregon Constitution and requires state and local governments to pay full compensation to a property owner, if a law or regulation reduces any of the property's value.[27]

Ballot Initiatives

A few communities in California have made changes to zoning regulations via referenda. A popular example of such a proposal is the Save Open Space and Agricultural Resources (SOAR) initiative.[28] When passed, these ordinances require a popular vote to rezone land from agricultural or open space use to more intensive (residential, commercial or industrial) use. Generally, a "City Urban Restriction Boundary" (CURB)[29] is established around the city (or county) implementing such a program. Land outside the boundary cannot be developed without voter approval (whereas land within the boundary may be). Communities that subject zoning changes to a vote generally exhibit negative growth, relating the desire of these

[26] Court of Appeals of Oregon. *D.S. Parklane Development, Inc. et al. v. Metro et al.*, 994 P.2d 1205, 1999-2000.

[27] Oregon Department of Land Conservation and Development. "Perspectives, Measure 7." 2001. http://www.lcd.state.or.us/perspectives/measure7.html

[28] SOAR initiatives have passed in Ventura and Napa counties, and one was proposed for San Luis Obispo County. However, this initiative failed soundly at the polls.

[29] Ventura County Resource Management Agency, Planning Division. "SOAR: Questions and Answers," 1998. http://www.ventura.org/vcrma/planning/pdf/soar.pdf

citizens to circumvent sprawl.[30] Like UGBs, SOAR initiatives have been subject to landowner discontent. Individuals outside the CURB may experience losses in property value, due to an inability to develop (whereas landowners within the CURB may experience an increase in value, as their land becomes subject to even greater development pressure). Additionally, while ballot initiatives may work in some communities, they do require an active citizenry. Developers and landowners may stunt such initiatives without an involved public at the grassroots level.

A local example of a SOAR initiative was passed in Ventura County in 1998. Not only has the County itself passed this initiative, so have several cities within county boundaries (Ventura, Camarillo, Moorpark, Oxnard, Simi Valley, and Thousand Oaks). The majority of these ordinances will remain in effect until 2020, with Ventura (2025) and Thousand Oaks (2030) lasting a bit longer.

Infill Development

Infill development focuses new growth on unused or underutilized land within the existing urban core. This mode of development keeps resources in the city center, where population density is already focused, and allows for rebuilding and revitalizing of communities. Although suburban growth may still occur, infill development accommodates a diversity of affordable housing options for individuals who need to live closer to services and employment. In addition to creating mixed-use environments, infill development can reduce traffic congestion by locating residential areas near commercial centers, thereby encouraging alternative means of transportation.[31] A great example of infill "success" is taking place in San Francisco and surrounding areas. The Greenbelt Alliance, a local non-profit has been endorsing affordable housing and infill development. Projects that qualify are given an environmentally friendly rating, in the hopes of influencing area developers to build green.[32]

One specific type of infill that has been receiving a lot of attention is brownfield redevelopment. Brownfield sites have been contaminated by industrial waste and are no longer suitable for farming or other open space uses. However, these sites may present the perfect opportunity for directed density within urban boundaries. While many of these sites were previously avoided by developers because of real or perceived barriers to development, recent initiatives[33] by the U.S. Environmental Protection Agency (EPA) and other organizations have created an incentive for redevelopment. These sites are often in prime industrial or commercial locations and, following mitigation, may once again constitute ideal parcels for targeted

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[30] Staley, Samuel R. "Ballot-box zoning, transaction costs and land development." Reason Public Policy Institute. Urban Features Working Paper No. 98-2, 1998.

[31] Greenbelt Alliance. "Infill Development: Rebuilding Our Cities for a Sustainable Future." 2000. http://www.greenbelt.org/about_us/program_infill.html

[32] *Ibid.*

[33] http://www.epa.gov/region5/sprawl/infill.htm

growth. Additionally, tax incentives and federal loan programs may generate the necessary push to encourage developers to focus growth within city boundaries.

Conservation Easements/Banks

A conservation easement is the permanent retiring of the development potential of a piece of land by the owner. Generally a non-profit organization, such as a land trust, will assume responsibility for these retired rights. Because the landowner gives up the rights to develop their land, they are often eligible for income tax deductions (as long as the easement is permanent and donated). Conservation easements may also result in a reduction of the amount of the taxable estate, such that families may be able to reasonably pass property on to future generations by reducing property and inheritance taxes. Conservation easements are generally sought in agricultural areas that might face conversion to urban uses under new ownership. Therefore, while there are certainly tax incentives to legal development of a conservation easement, many families look to this option as a means of permanently protecting the land that they have come to love.[34]

Alternatives to the legal creation of a conservation easement may not be feasible for all landowners, but include the donation of land or the sale of land to a land trust at less than market value. These options are usually popular with landowners who have no family to inherit the property, or who wish to avoid costly inheritance and property taxes associated with such a legacy. Both of these options may result in considerable income and estate tax credits.

Another conservation tool that has become popular with land planners is "mitigation banks." Mitigation banks are large tracts of land on which creation, restoration, enhancement, and/or preservation efforts are undertaken to create a fully functioning ecosystem. Mitigation banks are created in order to provide compensation for impacts on sensitive habitats. Acreage within these banks is measured in "credits." Mitigation banks are authorized to sell "credits" to landowners, developers, or governmental agencies to offset impacts on sensitive habitats. Purchasing credits from a mitigation bank may have benefits such as: providing an alternative to landowners and developers by relieving them of the responsibility to maintain habitat to agency standards, providing a market where threatened habitat can still be preserved, and allowing the possibility of improved quality to habitat and surrounding areas.[35]

Market Mechanisms

Market-based instruments are regulations that encourage behavior through market signals rather than through explicit directives regarding command and control

[34] Land Conservancy of San Luis Obispo County. "Conservation Easements: Permanent Land Conservation / Potential Tax Benefits." 2001. http://www.special-places.org/whatis.htm

[35] Conservation Resources. "Mitigation Banks." 1999. http://www.conservation-resources.com/mitigation.html

levels or methods. When properly designed and implemented, market-based instruments should allow any desired level of environmental quality to be realized at the lowest overall cost to society, via incentives for reductions in degradation. These instruments fall into four major categories: environmental charges, market barrier reductions, government subsidy reductions, and tradable permits.[36]

- Market barrier reductions can make substantial gains in environmental protection by removing existing barriers to market activity. Three types of market barrier reductions stand out: market creation, as with measures that facilitate the voluntary exchange of water rights and thus promote more efficient allocation and use of scarce water supplies; liability rules that encourage firms to consider the potential environmental damages of their decisions; and information programs, such as energy-efficiency product labeling requirements.
- Government subsidy reductions are the mirror image of taxes and can provide incentives to address environmental problems. However, in practice, a variety of subsidies are believed to promote economically inefficient and environmentally unsound practices.
- Environmental charge systems assess a fee or tax on the amount of pollution or environmental effect that a firm or source generates. These applications can be classified as: effluent charges, deposit-refund systems, user charges, insurance premiums, sales taxes, administrative charges, and tax differentiation. These systems may also include an impact fee, which is charged to developers and used for the provision of new services (roads, parks, public facilities, police, fire, library, schools, water, sewer, etc.) demanded by additional growth.[37]
- Tradable permits can achieve the same cost-minimizing allocation of the control burden as a charge system, while avoiding the problem of uncertain responses by firms. There are two basic types of the tradable permits: credit programs and cap-and-trade systems. Credit programs can enable the same or another firm to meet its control target optimizing levels of pollution given the individual firm's characteristics including costs. Cap-and-trade systems can be freely exchanged among sources thereby resulting in an overall reduction in pollution.

Transferable Development Rights

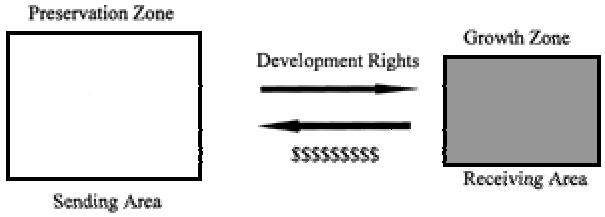
The concept of TDRs evolved about 25 years ago in response to difficulties faced by cities wishing to buy land for conservation. Under a TDR system, density in certain parcels of land is limited, allowing for the creation of zoning variance permits that

[36] Robert N. Stavins, "Experience With Market-based Environmental Policy Instruments." From *The Handbook of Environmental Economics*, Daniel W. Bromley, editor. Blackwell, Cambridge, Massachusetts, 1995.

[37] Snyder, Ken and Lori Byrd. "Paying the Costs of Sprawl: Using Fair-Share Costing to Control Sprawl." Center of Excellence for Sustainable Development, U.S. Department of Energy, 1998. http://www.sustainable.doe.gov/articles/sprawl.shtml

can be sold, and the revenue used to preserve land in other regions.[38] TDR programs create a market for development rights by separating a development right from the bundle of property rights associated with each parcel of land.[39] Optimally, developers who wish to build at increased density within the portion of the community designated as the receiving area may only do so by purchasing a development right from a sending site in an area meeting the criteria for the preservation (please see Figure 2 for a visual representation of this program).[40] TDR programs vary, but some of the more successful programs such as Malibu, CA and King County, WA designate sending and receiving areas prior to the implementation of the program.[41] However, because participation in the program is usually voluntary, the takings[42] issue can be avoided. A variation that can be made on the TDR concept is the marketable development rights (MDRs) idea, in which a certain proportion of all land is set aside for preservation, and the rights for the remaining percentage are traded between developers and landowners.[43] In addition, zoning restrictions could be used to further refine the possible uses of a land for development.

Figure 2: Transfer of Development Rights[44]



Benefits associated with TDRs include:

- Planners use TDRs in cases where zoning regulations are viewed to be too inefficient and costly for useful land development to emerge. The market in permits created by TDRs offers some efficiency that would not be present in a purely command-and-control regime.

[38] Small, Leslie E. and Donn A. Derr. "Transfer of Development Rights: A Market Analysis" American Journal of Agricultural Economics. February 1980: 130-135.
[39] Barrows, Richard L. and Bruce A. Prenguber. "Transfer of Development Rights: An Analysis of a New Land Use Policy Tool." American Journal of Agricultural Economics. November 1975: 549-556.
[40] Some programs including SLO County do allow for other methods for increased density, thereby threatening the effectiveness of the program by limiting incentives to purchase rights.
[41] The San Luis Obispo County TDC program is rather unique in the fact that it only sets criteria for designation, but does not predesignate areas as either sending or receiving sites.
[42] Costonis, John J. "Development Rights Transfer: An Exploratory Essay." The Yale Law Journal. 83(1): 75-128, 1973.
[43] Thorsnes, Paul and Gerald P.W. Simons. "Letting the market preserve land: The case for a market-driven transfer of development rights program." Contemporary Economic Policy, 17(2): 256-266, 1999.
[44] Platt, Rutherford H. *Land Use and Society: Geography, Law, and Public Policy*. Island Press: Washington D.C., 1996.

- The net benefit of a TDR program should be the creation of more densely populated areas, which should reduce infrastructure costs for sparsely-developed areas that in theory would normally emerge. In addition, the program provides some benefit for land that would otherwise be worthless under a simple zoning designation of "open space."
- TDRs may result in the preservation of ecologically sensitive, historically significant, or naturally beautiful areas significant to the local community.[45]
- TDRs also allow planners (or other 3rd party representatives) to be intermediaries in transactions involving landowners and developers, and this may help to further reduce costs in addition to infrastructure reductions.
- TDRs are politically feasible, particularly because of added benefits for landowners who would prefer to keep their open (particularly agricultural) land rather than selling it to developers.
- A TDR program should provide some flexibility to developers in how to develop a parcel of land. With the ability to buy density from other parcels, developers are able to build as they wish within the area of land specified for development.
- The creation of a credit bank or clearinghouse run by a non-governmental organization can help to create the program by facilitating transactions and providing information about real values for rights and land in the community.[46]

There are, however, limits to the usefulness of TDR policies:

- TDRs should not work if the development costs for outlying unincorporated regions are much less than that inside the city itself (i.e. leapfrogging). This would provide a perverse incentive to build outside municipal boundaries, where presumably zoning regulations would be less strict.
- Compensation for the sale of development rights to the sending site participant by the receiving site participant must be reasonably related to the market for development (e.g. how much the sending site would be worth following development less current land value). Without a fair market for compensation, the program will certainly fail.[47]
- The voluntary nature of some TDR programs may result in a "patchwork quilt"[48] of development with preserved and developed land as close

[45] Schiffman, Irving. "Transfer of Development Rights (TDR)." In: *Alternative Techniques for Managing Growth*. Institute of Governmental Studies, University of California at Berkeley, pp. 130-133. Berkeley, California, 1989.
[46] Lane, Robert. "Transfer of Development Rights for Balanced Development." Land Lines. March, 1998. http://www.lincolninst.edu/landline/1998/march/march4.html
[47] *Ibid;* Small, Leslie E. and Donn A. Derr. "Transfer of Development Rights: A Market Analysis." American Journal of Agricultural Economics, Feb. 1980: 130-135.
[48] Schiffman, Irving. "Transfer of Development Rights (TDR)." In: *Alternative Techniques for Managing Growth*. Institute of Governmental Studies, University of California at Berkeley, pp. 130-133. Berkeley, California, 1989.

neighbors and no distinct area of preservation or infill development. Additionally, preserved areas may not be those of the most significance ecologically, historically or culturally.

- Increased density, allocated to receiving sites, may be utilized for strip development (rather than infill development) resulting in localized sprawl within the urban center.[49]
- The preservation of open space in the form of sending sites may benefit all residents of the community, however the costs of increased density within the urban area may affect only the neighbors of the new development,[50] resulting in claims of environmental injustice.
- The administrative costs associated with implementing a TDR program are not insignificant, and may overwhelm potential benefits from added market efficiency. In particular, if the TDR program does not reduce unwanted growth more than other policies, there may be no incentive to change to such a program.

Legal Issues – TDRs

The Fifth Amendment to the United States Constitution established significant rights for individuals, intended to protect the citizenry from exploitation by the government. In particular, the "taking" of private property without compensation was expressly forbidden; however, as long as compensation was just, government had a right to take property for public use, a power known as eminent domain. In addition, other court rulings have allowed for land to be taken partially without compensation if using police power, the ability to regulate a community's health, safety, or general welfare.

Background on the takings issue

Litigation surrounding TDR programs almost always focuses on the issue of takings. The idea of takings has evolved from the Fifth Amendment protections of private property from unnecessary government intrusion. If a landowner is fully deprived of the economic uses of her property, she must be compensated for her loss by the government. However, private property rights can be infringed upon if it serves the public welfare and interest in doing so (the "police power" given to local governments). Local governments are allowed to limit a landowner's economic uses of her property, without compensation, in the name of public welfare, as long as those uses are not fully restricted.

The origins of the takings issue lie in the colonial days of the United States, when the British government often expropriated private property for public uses, such as the stationing of British soldiers in private homes. This intrusion by the colonial

[49] Lane, Robert. "Transfer of Development Rights for Balanced Development." Land Lines, March 1998. http://www.lincolninst.edu/landline/1998/march/march4.html

[50] Raymond, George M. "Structuring the Implementation of Transferable Development Rights." Urban Land. July/August 1981: 19-25.

government became one of the main bases for the American Revolution.[51] In order to prevent further abuses of personal and property rights, checks on the power of government to interfere with private citizens were incorporated as the Fifth Amendment.

> The Fifth Amendment to the United States Constitution states:
>
> "No person shall be held to answer for a capital, or otherwise infamous crime, unless on a presentment or indictment of a grand jury, except in cases arising in the land or naval forces, or in the militia, when in actual service in time of war or public danger; nor shall any person be subject for the same offense to be twice put in jeopardy of life or limb; nor shall be compelled in any criminal case to be a witness against himself, nor be deprived of life, liberty, or property, without due process of law*; nor shall private property be taken for public use, without just compensation* (emphasis added)."

This last clause in the Fifth Amendment has come to be known as the "takings" clause. In essence, governments taking action that deprives owners of use of their land must pay the owner proper compensation for this taking. The main requirement for a lawsuit alleging uncompensated taking of land is "ripeness," that is, a specific and conclusive action by a government agency that prevents economic use of the land in question. A secondary requirement involves the ability of a person to partake of compensation options offered by the governmental agency. In addition, the Supreme Court has allowed some leniency in interpretation of the takings clause, because it has concluded that the government must be able to perform some actions that might affect economic values or use of private land without compensation. These actions include police power, granted to individual communities under zoning laws consistent with the "public health, safety, morals or general welfare" of the community, a standard set under the landmark case, *Village of Euclid v. Ambler Realty Co.*[52] It has also been found by the Supreme Court that the takings clause in the Fifth Amendment does apply to the states through the Fourteenth Amendment, specifically, "nor shall any state deprive any person of life, liberty, or property, without due process of law."

While the Supreme Court has not specifically ruled on the validity of TDRs to circumvent the "takings" requirement of compensation, a review of current cases involving TDRs suggests that TDR programs do provide a method of possible compensation for a change in status of land holdings under the Fifth Amendment.

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[51] Musselman, James L. and Bruce W. Burton. "The Emerging Regulatory Taking Laws: Prospective Internal Revenue Consequences." Suffolk University Law Review. Winter, 1995.
[52] U.S. Supreme Court, 272 U.S. 365, 1926.

The benchmark case used to oversee both the takings issue in general and TDRs specifically is *Penn Central Transportation Co. et al. v. New York City et al.*[53] This case involved the designation of Grand Central Station in New York City as a historical landmark under a landmark preservation statute that also included the possibility of a transfer of development rights. The statute prevented construction in the airspace above Grand Central Station unless the Landmark Preservation Commission approved it, but also allowed airspace development rights to be transferred to other places instead. The Supreme Court ruled that the designation of the landmark did not constitute a taking, since the use of the land for Grand Central Station was not impeded; nor was development over the station prohibited, just restricted. In addition, the possibility of TDRs offered another method by which Penn Central could "use" the airspace over Grand Central Station without impeding Grand Central Station's historical value. While this decision does not conclusively state that TDRs circumvent the takings issue, TDRs offer an option for compensation that would have to be considered before a taking could be ruled as uncompensated.

The takings issue, particularly concerning the balancing of legitimate government needs against innate property rights, continues to remain a contentious and highly debated issue in the courts, as well as in the state and national legislatures. Any single analysis of takings law currently thus remains difficult.

Current status of the takings issue

The most visible recent case involving the takings issue was *Palazzolo v. Rhode Island, et al.*,[54] suggesting that a takings claim is not nullified if the ownership of land changes after government intervention has caused an illegal taking of land rights. The case revolves around a landowner who sued the state of Rhode Island for compensation for takings because he was deprived of a significant use of his land due to wetlands regulation. While the landowner was not the original landowner when the wetlands regulations were enacted, the Supreme Court found that this did not prevent his claim of an illegal taking. This case encompassed several contentious issues involving the takings issue, including the timing and foreknowledge needed of regulation issues when purchasing land, as well as how much deprivation of use of land constituted a taking. In this particular case, Palazzolo had available a portion of his land for development, so the Supreme Court found that economic use had not been limited to a "token use," which would constitute a taking, and remanded the case with the understanding that the claim was ripe, but that an uncompensated taking had not been established.

Other significant legal cases

The boundaries of what constitutes a taking were further refined in *MacDonald, Sommer & Frates v. County of Yolo et al.*,[55] in which a California property owner believed that an open space regulation effectively prohibited economic uses of his

[53] U.S. Supreme Court, 438 U.S. 104, 1978; generally referred to as Penn Central.

[54] U.S. Supreme Court, 533 U.S. 606, 2001.

[55] U.S. Supreme Court, 477 U.S. 340, 1986.

land, thus constituting a taking under takings law. However, it was later found that other economic uses were available for the land, although they were potentially restricted; thus it was found by the Supreme Court that since the possibility of gaining a permit to use the land was not impossible, it was not considered a taking. This case helped to reaffirm the idea that the community (or in this case, the county) has the right to limit uses of the land, as long as there is some possible use of the land left under the regulations passed. It also specifically suggested that the definition of a taking was not a set line or factor, but instead was a matter of degree of control by the government over the use of the land.

First English Evangelical Lutheran Church of Glendale v. County Of Los Angeles, California[56] established the concept that a taking does not have to be permanent in nature. In this case, after a flood, a temporary flood control ordinance was enacted to reduce the possibility of further flood damage in the area affected. However, at the time it prevented the church in question from proper use of its land, even though it was for a temporary period of time until better flood controls could be enacted. The Supreme Court noted that such a policy, valid for the public safety, still constituted a taking even though it was for a limited period of time.

Several controversies arose concerning the development of a TDR program for the Lake Tahoe basin. Among these cases was *Suitum v. Tahoe Regional Planning Agency* (TRPA), [57] in which a landowner in the Tahoe basin sued the planning agency for an uncompensated taking of private land due to restrictions imposed in an attempt to preserve the clarity of Lake Tahoe itself, among other reasons. Much of this case hinged on what constituted a "final action" by the TRPA, but parts of it involved how TDRs would be valued when a taking is decided. The case suggested that the value of Suitum's property rights as TDRs needed to be ascertained in order to determine whether an illegal taking had occurred; in addition, the ability of Suitum to exercise or sell the TDRs needed to be further evaluated.

Both *Suitum* and *Palazzolo* suggest that the value of TDRs in an enacted program offer some amount of compensation for the economic taking of the land, and so as long as TDRs can be bought and sold freely for prices that do not constitute a token value for the land rights in question, the institution of a TDR program would not constitute an uncompensated taking. These cases also suggest that local governments can impose some level of economic harm on individual landowners, such as a change in property values, if they can establish that public welfare would be improved as a result.

Based on the current state of takings cases in the United States, it is most likely that the implementation of a TDR program would not constitute a takings issue unless:

- The TDR program is a mandatory program instituted by a local government or agency; or

[56] U.S. Supreme Court, 482 U.S. 304, 1987.
[57] U.S. Supreme Court, 520 U.S. 725, 1997.

- People affected by the TDR program (either TDR owners or their neighbors) are unable to exercise their rights to receive some proper amount (larger than a "token amount") of value from their land.

Other Legal Issues, San Luis Obispo County

The Subdivision Map Act

The California Legislature created the Subdivision Map Act in 1974 to determine appropriate methods of subdividing land parcels for potential future development, subject to local and state laws. It has been revised numerous times since 1974, including recently, in 2001.

One potential loophole in this act had concerned previous parcel-based maps created before this act was passed. It was established in the Subdivision Map Act that parcels created prior to the implementation of the act could be preserved, given they met certain requirements for lot size and residence upon the land. This ambiguity has increased the use of so-called "certificates of compliance," land deed transactions dating back to the 19th century.[58] Until recently, under the Subdivision Map Act, these certificates could be used to prove the existence of previous parcels on land that would otherwise be designated as contiguous.

Most specifically, developers have used the threat of development under this loophole to boost potential land values near the coast. In San Luis Obispo County, the Hearst Ranch has used this ambiguity to suggest that it had the right to subdivide its land into 279 parcels and then develop them, using old maps suggesting previous hopes for development in this fashion. This loophole, however, was recently repealed by SB 497, which was signed into law in 2001 by Governor Gray Davis.[59]

The Williamson Act

The Land Conservation Act enables local governments to enter into contracts with private landowners for the purpose of restricting specific parcels of land to agricultural or related open space use. Private land within locally designated agricultural preserve areas is eligible for enrollment under contract. The minimum term for Land Conservation Act contracts is ten years, however, since the term automatically renews on each anniversary date of the contract, the actual term is essentially indefinite.[60]

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[58] Also see: Office of the Attorney General of the State of California, Opinion No. 91-105 (74 Op. Atty Gen. Cal. 149), August 13, 1991, which discusses a situation like this in Stanislaus County and suggests that the parcels legally created before the Subdivision Map Act be grandfathered.

[59] Bustillo, Miguel and John Johnson. "Governor Gets Busy With His Green Pen," Los Angeles Times, California Section, Part 1, Page 1, October 14, 2001.

[60] California Department of Conservation, Division of Land Resource Protection. "LCA/OSSP – Information." 1998, last updated March 2002. http://www.consrv.ca.gov/dlrp/LCA/info.htm. Also see Note 59.

Landowners receive substantially reduced property tax assessments in return for enrollment under Land Conservation Act contracts. Property tax assessments of land enrolled under Land Conservation Act contracts are based upon generated income as opposed to potential market value of the property. This translates into decreased taxes for property owners. Local governments receive compensation for forgone property tax revenues from the state via the Open Space Subvention Act of 1971.

Contracts may be exited at the option of the landowner or local government by initiating the process of term non-renewal. Under this process, the remaining contract term (nine years in the case of an original term of ten years) is allowed to lapse, with the contract null and void at the end of the term. Property tax rates gradually increase during the non-renewal period, until they reach normal (i.e., non-restricted) levels upon termination of the contract. Under a set of specifically defined circumstances, a contract may be cancelled without completing the process of term non-renewal. Contract cancellation, however, involves a comprehensive review and approval process, and the payment of fees by the landowner equal to 12.5 percent of the full market value of the property in question.[61] Local activities such as eminent domain or, in some rare cases, city annexation, also result in the termination of Land Conservation Act contracts.

[61] California Department of Conservation, Division of Land Resource Protection. "Land Conservation Act / Open Space Subvention Program." Last updated March 2002. http://www.consrv.ca.gov/dlrp/LCA/

San Luis Obispo County Case Study

San Luis Obispo Land Use History

California state law requires each city and county to adopt a general plan "for the physical development of the county or city, and any land outside its boundaries which…bears relation to its planning."[62] The general plan expresses the community's development goals and embodies public policy relative to the distribution of future land uses, both public and private. The plan also provides citizens with opportunities to participate in the planning and decision making processes of their community.

Pursuant to state law,[63] subdivisions, capital improvements, development agreements, and many other land use actions must be consistent with the adopted general plan. In counties and general law cities, zoning and specific plans are also required to conform to the general plan. These plans outline all guidelines and applicable laws and ordinances surrounding land conversion. There are seven required elements in every plan: land use, conservation, circulation, open space, housing, noise, and safety. In addition to these required elements, San Luis Obispo county has adopted optional elements: recreation, historic, aesthetic, and offshore energy.

Of primary interest to this project are the land use, [64] conservation, and open space[65] elements of the general plan. These elements prescribe the policies that the county intends to implement in its land use planning process.

- Land Use Element
  The land use element includes designations for the types of uses (residential, commercial, industrial, open space, etc.) as well as absolute densities in a particular use. While most municipalities throughout the country generally have a second ordinance devoted entirely to zoning, San Luis Obispo County is unique in that these "designations" are included in the County General Plan.
- Open Space Element
  This section of the general plan identifies areas throughout the county, which have been deemed appropriate for preservation in open space use. This element has recently been combined with the Agricultural Element, such that the "Agriculture and Open Space Element" will also contain

[62] Rivasplata, Antonio and Gregg McKenzie. "General Plan Guidelines." (California) Governor's Office of Planning and Research. November 1998.
[63] The first state law requiring the preparation and adoption of such a plan was passed in 1927.
[64] County of San Luis Obispo. "Land Use Ordinance." Title 22 of the San Luis Obispo County Code. 1980.
[65] San Luis Obispo County Department of Planning & Building. "Open Space Plan." San Luis Obispo County General Plan. 1972.

provisions for the protection of agricultural land. Not only does this document identify potential open space and agricultural areas that should be preserved, it also identifies mechanisms to protect these resources.

- Conservation Element
  This section is contained in the County Environment Plan,[66] and serves to address concerns regarding use, development, and conservation of natural resources (such as water, forests, soils, rivers, and minerals).[67]

Additionally, the Land Use Ordinance includes a list of "standards" and permit procedures for land development. [68] Finally, the Growth Management Ordinance considers resources available within the county when setting an annual growth rate.

According to State law, the general plan (and therefore all the aforementioned elements) may be amended up to four times per year to incorporate changes, as initiated by the Planning Department or individual citizens. Finally, a set of general Planning Area Standards relate planning goals and objectives not covered directly in the general plan.

The TDC program was established in the summer of 1989 when the Board of Supervisors appointed a Blue Ribbon Committee to study growth in the county. The Committee provided recommendations that ranged from ways of encouraging low income housing projects to ways of enhancing environmental protection.[69] One of the decisions made by the committee involved a need to have a better understanding about the management of land use trends in the rural lands of the county. This recommendation spurred the county to develop the "Rural Settlement Pattern Strategy." The Strategy consisted of three phases:

- Phase I- an inventory and documentation of the development trends (completed 1990);
- Phase II- a series of recommendations based on information from Phase I (completed 1991); and
- Phase III- the development of the TDC program as a mechanism to control land use.

There are two Transfer of Development Credits programs in San Luis Obispo County at this time: a community-based program developed for the community of Cambria in the 1980s and a countywide program adopted in 1996.

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[66] San Luis Obispo County. "Environment Plan." 1974.

[67] San Luis Obispo County Department of Planning & Building. "General Plan Information." 1997. http://www.slonet.org/vv/ipcoplng/genplan.html

[68] This list of standards includes minimum parcel size, setback requirements, building height limitations, etc.

[69] Belknap, Ray. "TDC Feasibility." The Land Conservancy of San Luis Obispo County, November 1999.

The Cambria TDC Program

Cambria is located in the northern part of San Luis Obispo County at the foot of the scenic Highway One and the Big Sur Coast, halfway between Los Angeles and San Francisco. The population is approximately 5,000 inhabitants and is known as an artistic seaside community, frequented by vacationers. One of the many scenic attributes in Cambria's coastal hills is the Monterey Pine and Cambria Pine. Much of the pine's habitat surrounding Cambria is located on "antiquated subdivisions." These 9,000 subdivided lots were created in the late 19th century and are located on steep and highly erodible slopes that are substandard for development.[70]

Needing a system to address these antiquated subdivisions, the Cambria TDC program was developed in 1984. The program was created out of a partnership between San Luis Obispo County, the Land Conservancy, the California Coastal Conservancy, and the CCC. These organizations were interested in protecting the open space in the County, and more specifically, the Cambria Pine habitat, which would be threatened if the buildout of the subdivisions occurs. The Cambria Pine population is also on the decline due to a disease called the Pitch Canker.

Prior to the County's own LCP, the Commission required that developers retire one substandard lot in the steep-sloped region called the Lodge Hill area in exchange for building approval on a separate lot. This was an attempt to achieve a "no-net" increase in development. The County first took responsibility for Coastal Development Permits in 1984 after development of the County's LCP. The County's LCP codified permit conditions that had been routinely imposed by the CCC. The LCP stated that TDCs must be purchased from a non-profit organization that is approved by the County Director of Planning and Building. The Coastal Conservancy gave The Land Conservancy of San Luis Obispo County a revolving $275,000 grant. The Land Conservancy proposed a conservation plan for the intended conservation areas in Cambria,[71] and has since been the only non-profit agency to be approved for Cambria TDC transactions. The Conservancy participates in the program by purchasing the lots intended for preservation (pre-determined), applying for TDCs from the County, and then marketing the TDCs to applicants searching to develop in designated receiving sites. The owners of property in these receiving areas can increase the size of their homes by buying development credits from the Land Conservancy to build additional floor area on their lots beyond current zoning regulation standards. After the transaction takes place, the Land Conservancy records a conservation easement on the sending site lots restricting future development. The proceeds from these sales are returned to the revolving fund and used to buy more sending sites.

To allow additional floor area on the receiving lot a minor use permit must be obtained. Certain criteria must be met to approve the permit: that the easements on

[70] Pruetz, R. *Saved by Development: preserving environmental areas, farmland and historic landmarks with transfer of development rights*, Arje Press, Burbank, California, 1997.

[71] Belknap, Ray. "TDC Feasibility." The Land Conservancy of San Luis Obispo County, November 1999.

the sending site permanently preserve that site as open space; that the proposed receiving site can accommodate the additional floor area without the need for variances; and that the proposed transfer implements the purpose of the program. A minor use permit is granted administratively, but the staff decision can be appealed to the County Planning Commission.[72]

The Cambria program requires a one-to-one transfer ratio.[73] The floor area purchased by the receiving site owner represents the same amount of floor area that will not be built in a sending area because it has been purchased and deed-restricted by the Land Conservancy. Restrictions on the floor area transfer include: the maximum footprint cannot exceed 45 percent of the receiving lot area and the total floor area cannot exceed 90 percent of the receiving lot area.[74]

Incentives included in the Cambria TDC program involve the transfer of water and/or sewer credits from the sending to receiving sites. Additionally, water and sewer connection rights can be transferred to other properties within the Cambria Community Services District that are not served with sewer or water. Furthermore, two potential receiving site owners can jointly finance the retirement of a sending lot with the owner of a Lodge Hill receiving site getting the transferred floor area and the owner of a lot outside of Lodge Hill, but within the Community Services District, receiving the water and sewer connection rights.[75] Figure 3[76] portrays the current status of the successful Cambria TDC program.

Figure 3: Cambria TDC Program as of April 2000

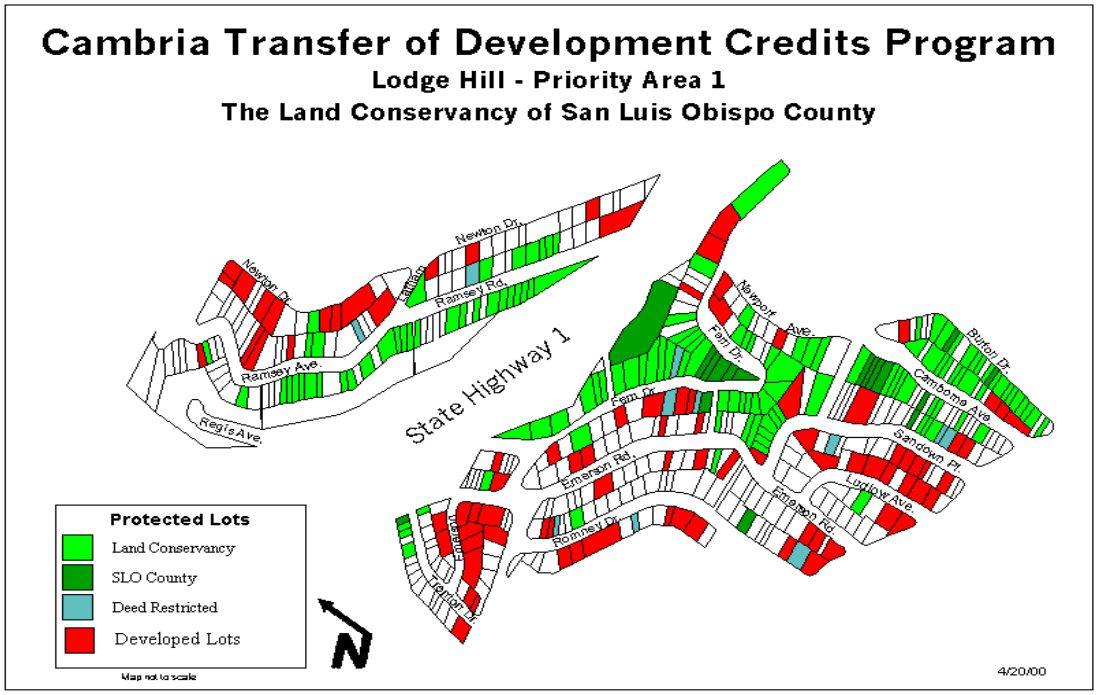
[72] San Luis Obispo County. "Minor Use Permit Criteria-Cambria TDC." 1984.

[73] One "credit" of development at a sending site must be retired for every "credit" of development increase on a receiving site.

[74] In actuality, most receiving site applicants do not need the maximum allowed footprint or floor area. For lots receiving TDCs from 1987 through 1990, building footprints averaged 31 percent of the lot area and floor area averaged 55 percent of the lot area.

[75] Pruetz, R. "Selected Case Studies," from *Saved by Development: preserving environmental areas, farmland and historic landmarks with transfer of development rights*, Arje Press, Burbank, California, 1997.

[76] http://www.slonet.org/vv/land_con/lhillmap.gif



Program Status

Since inception the Land Conservancy has purchased 85,000 square feet of floor area credits resulting in approximately 230 set for protection. These prices for these lots ranged from $4,500 to $6,000 per lot. Since 60,000 square feet of credits have been sold, the program bank contains 25,000 square feet of credits as of April 1997. At the average rate of 5,000 credits sold per year, the program probably has enough credits to last for five more years without having to buy any more lots.

Ray Belknap of the San Luis Obispo Land Conservancy attributes the success of the Cambria program to five other factors.[77]

- The receiving sites were scattered throughout the community; consequently no single neighborhood had to bear the entire burden of the additional density.
- The sending sites were prominent parcels, so the community clearly related to the objective.
- The people of Cambria are committed to the preservation of the Cambria Pine.
- The value of the transferred density stays within the community.
- The program was tailored to the unique needs of the Cambria community.

[77] Belknap, Ray. "TDC Feasibility." The Land Conservancy of San Luis Obispo County, November 1999.

Though Belknap notes that there are areas for improvement in the Cambria TDC design, the program has been successful overall in preserving the sensitive pine areas threatened by development.

San Luis Obispo County TDC Program

Due to increasing concern over potential development pressure in the largely rural county, a Growth Management Advisory Committee was appointed in 1989 to devise potential policy instruments for controlling growth. As previously mentioned, the committee requested the preparation of a series of studies into growth in the region, known as the Rural Settlement Pattern Strategy.[78] Based on the findings from Phases I[79] and II,[80] Phase III, representing the culmination of this committee's work, was the development of a second, countywide TDC program, adopted in October of 1996.

Phase III outlined a series of steps in the development of the new ordinance, including the formation of the TDC Technical Advisory Committee, which would be responsible for identifying areas with TDC potential. Additionally, this committee was charged with demonstrating how TDCs could work in cases specific to the county (while the ordinance is countywide in scope, the County also allows individual planning areas to establish community-based programs[81]). The ordinance[82] relies on criteria for the determination of program eligibility. The committee is therefore also responsible for determining whether sending sites applying for designation will meet one of the three primary goals of the ordinance: preservation of land in agricultural use, protection of natural resources and ecologically sensitive areas, and the retirement of lots in antiquated subdivisions. This decision to rely on criteria rather than preselected mapped sites for the

[78] The Land Conservancy of San Luis Obispo County. "Rural Development Pattern Strategy Reports." Undated. http://www.special-places.org/rural.htm

[79] Phase I identified a total of 23,000 undeveloped lots in the unincorporated portions of San Luis Obispo County. Of this 23,000, there are12,000 lots are located in rural areas, and 2,000 are within antiquated subdivisions. Additional provisions within the County's general plan could result in the creation of 8,000 new lots in rural areas. The general conclusion of Phase I was that trends in county land use were moving towards development of land on the fringe of urban areas, resulting in potentially serious consequences for agriculture, the environment, and the provision of infrastructure and public services. (Pruetz, R. "Selected Case Studies," from *Saved by Development: preserving environmental areas, farmland and historic landmarks with transfer of development rights*, Arje Press, Burbank, California, 1997.)

[80] Phase II of the Rural Settlement Pattern Strategy report included the recommendation of four major policies: 1) Focus development in urban areas; 2) Concentrate new within or in close proximity to existing urban areas; 3) Avoid fragmented patterns of development on the fringe and outside of urban reserve lines; 4) Protect agricultural and rural character by retaining existing uses and lot sizes in outlying areas (The Land Conservancy of San Luis Obispo County. "Rural Development Pattern Strategy Reports." Undated. http://www.special-places.org/rural.htm)

[81] The original program in Cambria is considered a community-based program and a recently approved program in Nipomo could replace the TDC program in the South coast planning region, pending continuation of the county program in April of 2002.

[82] San Luis Obispo County. "Voluntary Transfer of Development Credit Program." County Ordinance No. 22.04.500, 1996. Available online at http://www.special-places.org/tdcordinance.pdf .

designation of eligible sending and receiving areas was primarily due to the extensive information required[83] to accurately determine qualifications for each separate parcel. Additionally, using criteria instead of maps relieves the county from potential litigation regarding the takings issue. The program remains essentially voluntary in nature, without establishing any sort of "green cloud" around mapped sending sites that could result in increases in property values.[84]

Sending Site Determination Criteria

The TDC ordinance was designed to retire the development sites of parcels currently in agricultural use, within antiquated subdivisions, or having significant natural resources. For each of these goals, specific and general criteria were established. Upon meeting either the general or specific criteria, a base or minimum number of credits are assigned to the property. In addition to the base credits, the owner may also apply for bonus credits to increase the number of credits assigned. Previously restricted sites are not eligible for sending site designation. The ordinance outlines both specific and general criteria for each category. If land meets any one of the specific criteria it should be approved for designation under the ordinance, unless it fails to meet the more general criteria, as determined by the Review Board. However, if a parcel fails to meet specific criteria, if the overall character of the site is consistent with the general criteria, it may still be approved for designation.

Agricultural Criteria

San Luis Obispo County has a characteristically rural feel. A majority of land in the county is still in "open space use," and one of the primary goals of the ordinance is to preserve the pastoral atmosphere of the county. This includes the preservation of land use for agricultural parcels. To qualify for designation, a site must meet either the specific or the general agricultural criteria.

Specific Criteria

1. Land Capability
   To meet the land capability criteria, a site must be at least 40 acres[85] and 50 percent of soils must fall into either Class I or Class II[86] types.

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[83] San Luis Obispo County lacks adequate staff to undertake such a time-intensive task.

[84] Pruetz, R. "Selected Case Studies," from *Saved by Development: preserving environmental areas, farmland and historic landmarks with transfer of development rights*, Arje Press, Burbank, California, 1997.

[85] These 40 acres may be spread across multiple lots under common ownership or neighboring lots under different ownership.

[86] Soil types as classified by the Natural Resources Conservation Service.

2. Grazing
   Land in pasture use for a minimum of 10 years and at least 320 acres in extent may fall under this criterion. At least 100 acres of this site must also be at least moderately suited for rangeland.[87]

General Criteria

One of the purposes of the TDC program was to enable family farms that might otherwise be sold to remain in productive use. The general agricultural criteria therefore allow for these sites, which also exhibit productive soils, to apply for designation as long as one of the following requirements is met:

1. The land remains in its current productive capacity.
2. The designation preserves an area with a particular micro-climate that supports specific crop types.
3. The site under designation relies on localized groundwater resources (therefore limiting the tapping of these reserves).
4. The retirement of credits on a site will reduce erosion and promote soil and resource conservation.

Natural Resource Criteria

A second major objective of the TDC ordinance is the protection of significant natural resources within the county. This objective tends to be met with the greatest public support as evidenced by the success of the Cambria program, which aimed to save the Cambria pine. However, success does rely on the availability of a local, significant and generally visible natural resource worth saving.

Specific Criteria

1. Natural Area
   If a site falls under the Natural Areas Plan[88] as a Natural Area or a Significant Biological, Geographical or Riparian Habitat, it is eligible for designation under this criterion. This criterion exists for the preservation of very specific natural resources and their locales. However, it makes no provision for the management of these resources following preservation.
2. Open Space
   Property adjacent to land in existing[89] open space use that would therefore facilitate a corridor between lands in open space use may be designated as a sending site. This goal is consistent with current ecological theories that support connectivity in the preservation of species diversity.

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[87] As classified by the Natural Resources Conservation Service, and again either operated under single ownership or contiguous lots of different ownership.

[88] The Natural Areas Plan is part of the Open Space Element of the County General Plan, and is available online through CERES: http://elib.cs.berkeley.edu/cgi-bin/doc_home?elib_id=812 .

[89] Existing open space may be under either public or private ownership.

3. Viewsheds
   Retirement of development potential on these sites preserves rural views from highways such as HWY 1, 41, 46, 58, 101 and 166. Preservation of open spaces along major highways reinforces the importance of maintaining the rural feel of the county as one of the primary goals of the ordinance.

General Criteria

If a site does not meet specific natural resources criteria, but still contains scenic, cultural or natural resources, it may qualify for designation under the general criteria. Property that reduces erosion potential or helps to protect area watersheds, promotes land use projects and policies of local municipalities, or protects and makes available natural resources or special features for public enjoyment may receive TDC sending site designation. This is the only criterion within the ordinance that makes any allowance for public use of preserved land. Public use may be controlled and/or regulated by the landowner.[90]

Antiquated Subdivision Criteria

Antiquated Subdivisions are areas in primarily rural parts of the county that were zoned at some time in the generally distant past for residential use. Zoning in these areas cannot be changed without making drastic changes to the General Plan. An alternative to rezoning is simply to retire these lots from residential use (transfer development credits elsewhere) by recording a conservation easement on these parcels.

Specific Criteria

1. To qualify as an antiquated subdivision under the ordinance, a site must be located at least 10 miles from an urban or village reserve line.[91] Additionally, the lot may not be more than 20 acres in size.
2. Sites smaller than 10 acres in size need only be 5-10 miles from an urban reserve line to qualify.
3. The Department of Planning and Building also maintains a map of antiquated subdivisions. Sites on this map automatically qualify for designation under this specific criterion.

General Criteria

Lots not meeting the specific criteria but located within antiquated subdivision and distant from urban and village centers may still qualify for designation if they meet one of the following criteria:

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[90] The county makes no claims toward management of private lands, but grants authority to the landowner to manage public use on their property.

[91] An Urban Reserve Line (URL) is a boundary separating urban/suburban land uses and rural land uses; the amount of land included in a community URL by the Land Use Element is based on: 1. Community Population Projections, 2. Land absorption rate, 3. Existing and planned local infrastructure/services, and 4. Community preferences regarding the amount and timing of growth.

1. The site exists within an antiquated subdivision containing substandard improvements.
2. Retirement of development would result in decreased costs to county for services and infrastructure provided, while also resulting in improved air quality (due to decreased vehicle miles traveled).

Number of Credits

Following approval of designation, the next step towards the transfer of development rights is a determination of the number of base credits that will be assigned to a particular site. Originally there were two methods of determining this base number of credits:

1. Existing Lots
   The number of credits assigned is equal to the maximum number of primary single family residences allowed on the underlying legal lots. This number is on record with the county.
2. Development Value
   The number of credits assigned is equal to the development value[92] divided by $10,000

However, in order to create a more consistent basis for determining credit assignment, the Existing Lots method of designation was abandoned.[93]

Bonus Credits

Sites qualifying for sending site designation may also apply for bonus credits on top of the base number of credits determined from development value of the property. These bonus credits must be based on: existing documentation criteria, special study criteria, or transfer of property by landowner in fee to a public agency or non-profit organization.[94] A ten percent bonus is granted for each criteria satisfied, at a maximum of a fifty percent bonus (over base credits).

Existing Documentation Criteria

Bonus credits are assigned based on information already on file with the county, or obvious natural features of the site in question. Criteria for bonus credits under this category include:

1. Combining Designation

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[92] Appraised value of development potential using the Uniform Standards of the Professional Appraisal Practices as published by the Uniform Standards Board of the Appraisal Foundation; the difference in the value of the property with and without credits is equal to the development value, this value is then divided by 10,000 to determine the number of credits.

[93] If a site meets designation requirements but fails to qualify for one full credit using the above criteria, the owner may request that one credit be assigned to the site. However, only sites receiving designation under the Specific Natural Resource Criteria are eligible. Additionally, such sites may not apply for nor receive bonus credits.

[94] San Luis Obispo County. "Voluntary Transfer of Development Credit Program." County Ordinance No. 22.04.530 – Bonus Credits, 1996. Available online at http://www.special-places.org/tdcordinance.pdf .

Property falls within one of the following land type designations as defined by the Land Use Element:[95] Sensitive Resource Area, Flood Hazard, Geologic Study Area, Earthquake Fault Zone, Historic, or Very High Fire Hazard Area.

2. Riparian Habitat
   Property adjacent to a river or stream[96] with established riparian vegetation may qualify for bonus credits.
3. Natural Resource of State or National Significance
   Some resources have been identified by state and/or federal governments as significant in achieving state or national resource protection goals. A site containing such a resource may apply for additional credits.
4. Acreage
   Sites containing over 1,000 acres[97] may qualify for bonus credits.

Special Study Criteria
Landowners applying for bonus credits under this category must submit technical information to back their claims. If the owner can prove that any of the following conditions are met through retirement of development, they may receive bonus credits for the site:

1. Rare or Endangered Species
   Property is home to or contains habitat for rare and/or endangered species, as listed by the Endangered Species Act.
2. Habitat Protection
   A large natural area of with the potential for serving as habitat for any number of plant and/or animal species.
3. Woodlands
   Oak woodlands, of such a size that future oak woodland regeneration can be expected, are contained on site.
4. Wetlands
   A wetland is contained on site.
5. Groundwater
   Property falls within an important groundwater recharge area.

Following the receipt of an application for sending site designation, the Review Committee has six months to make a decision, during which time a public hearing (subject to appeal) must be conducted, thereby allowing area residents to voice their opinions. Once an application is approved by the committee, the site owner is issued a Notice of Eligibility, thereby qualifying that site owner for the program and delineating the number of credits assigned to that property. At this point, the site owner takes over the responsibility of locating a buyer (receiving site) for the credits and engages in negotiations for the sale.

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[95] San Luis Obispo County. "Land Use Element (inland)." San Luis Obispo County General Plan, originally created in September 1980; available through CERES: http://elib.cs.berkeley.edu/cgi-bin/doc_home?elib_id=799 .
[96] As defined by the USGS.
[97] Multiple lots under common ownership or neighboring lots under different ownership.

However, before the TDCs can be sold to a willing buyer, an easement must be recorded on the property, prohibiting the residential development of the site. If the site has applied for and received bonus credits, additional limitations will be recorded in the easement, often prohibiting the destruction of specific natural resources (for which bonus credits were assigned).

The County TDC Administrator[98] is responsible for a maintaining various records regarding the program status: the number of TDCs assigned to a property, who TDCs are transferred to, where TDCs are ultimately used, and how many TDCs are available for transfer. The TDC Administrator is also responsible for the issuing the Certificates of Sending Credits, which accompany the Notice of Eligibility and proof of a recorded easement, following site approval. Additionally, after new easements are recorded, the County must also amend the General Plan to give these sending sites TDC-Sending Site Combining Designation.[99]

Receiving Site Designation

There are seven criteria that a site must meet in order to qualify as a receiving site:[100]

- As required under the California Environmental Quality Act (CEQA), the proposed project must undergo a thorough environmental review resulting in either a negative declaration or a final Environmental Impact Report (EIR) that indicates that the increased density will not impose "significant, unavoidable adverse environmental impacts."[101]
- The property does not fall within an Agricultural Preserve.
- The site is either inside or within ten miles of an urban reserve line.
- The site area for the proposed project, including building pad and access roads, has a slope of less than 30 percent.
- The development footprint is outside the Sensitive Resource Area, Flood Hazard, Geologic Study Area, Earthquake Fault Zone or Very High Fire Hazard Area as defined by the County Land Use Element.
- The development footprint is outside of a Natural Area or Significant Biological, Geographical or Riparian Habitat Area as shown in the County's general plan.
- The development will comply with all development standards.[102]

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[98] The current administrator for the Transfer of Development Credits Ordinance is Kami Griffin, with the County Department of Planning and Building.

[99] Pruetz, R. "Selected Case Studies," from *Saved by Development: preserving environmental areas, farmland and historic landmarks with transfer of development rights*, Arje Press, Burbank, California, 1997.

[100] San Luis Obispo County. "Voluntary Transfer of Development Credit Program." County Ordinance No. 22.04.530 – Bonus Credits, 1996. Available online at http://www.special-places.org/tdcordinance.pdf .

[101] *Ibid.*

[102] Development standards include water, sewage disposal and access standards, in addition to any further requirements contained in Titles 19, 21, 22, and 23 of the county code.

Receiving sites can apply for increased density depending on location and other site attributes and, in most cases, increased density must also be approved by affected cities and/or villages.

Sites falling outside of the city limit line but within an urban of village reserve:

- Up to a 75 percent bonus if the site is within an urban reserve line and served by community water and sewer.
- Up to a 50 percent bonus if the proposed site is within a village reserve line.

Sites outside urban and village reserve lines:

- Up to 50 percent density bonus is available for a receiving site located 0 to 5 miles from an urban reserve line.
- Up to 35 percent bonus is achievable for receiving sites that are located 0 to 5 miles from a village reserve line or 5 to 10 miles from an urban reserve line.

The following additional density bonuses are also available, given that the total increased density on the site does not exceed 100 percent:

- An extra 25 percent bonus can be granted if the TDCs come from a sending site determined to be a significant natural resource by the TDC Review Committee.
- An extra 25 percent bonus can be granted to receiving site projects which incorporate special amenities such as trails, coastal access and parkland.

Because the County wishes for those neighborhoods receiving excess density to be compensated for this impact, sending sites should be located within a three mile radius of the receiving location. While this is the preferable situation, when no sending sites are located within this radius, credits may be purchased from sending sites outside the three-mile radius in order to ensure the success of the program, as long as these credits come from within the same planning region.

If a property owner wishes to determine whether their site might be eligible for designation within the program, but does not wish to initiate the process without some guarantee, they may choose to apply for a Preliminary Determination. While this determination may allow an owner to ascertain relative probability of designation, this determination will in no way allocate the appropriate number of credits or bonus density the site would be eligible for under the ordinance.

Although the countywide TDC program was developed to be voluntary, incentive-based and market driven, it has still met with a great deal of resistance from local residents. In fact, immediately following the adoption of the countywide TDC program in 1996, the County was sued by a concerned citizens group, claiming they were being negatively impacted by increased density at receiving sites without being justly compensated. In response, a Grand Jury convened and issued a report

in March of 2001 that addressed several concerns regarding the current state of the program.[103]

Grand Jury Report and Response

On March 2, 2001, the Grand Jury of San Luis Obispo County[104] issued a report on the countywide TDC Program. The Grand Jury undertook a review of the County TDC program in response to a complaint received from the community. In April of 2001 the San Luis Obispo County Department of Planning and Building (SLOCDPB) responded to the Grand Jury's Report. This response was tailored to "answer to" particular problems outlined by the Grand Jury as well as to respond to recommendations made in the Report. The Board of Supervisors, which was required to respond to the Grand Jury Report, adopted the County Planning and Building Response for this purpose. Responses can be grouped into the following categories:

Response to the Body of the Report

- Voluntary Program
  The voluntary nature of the San Luis Obispo County TDC program was disputed by the Grand Jury, due to the fact that the community that is home to receiving sites often feels the impacts of increased density involuntarily. However, the SLOCDPB maintains that because the program is *voluntary, incentive-based and market-driven*, it is, in fact, a voluntary program. Additionally, the SLOCDPB makes the point that *any* project (not just a receiving site project) could be "imposed" on a community if that community did not support the project and it was approved. Finally, the ordinance does allow for public comment on proposed sending and receiving sites prior to their approval (the same sort of process allowed for any potential project, not just those falling under the ordinance).
- Community-based
  The Grand Jury expressed doubts about the community-based nature of the ordinance, citing the example of the Nipomo region. Concerns surrounded the apparent abandonment of a community-based TDC program. Additionally, the Grand Jury quotes the ordinance, noting, "The literature on TDC programs says the best programs, the ones that work, are based on local needs."[105]
  The SLOCDPB response indicates that the Nipomo plan was passed in March and is awaiting approval from the Board of Supervisors (if approved, this

[103] Pruetz, R. "Selected Case Studies," from *Saved by Development: preserving environmental areas, farmland and historic landmarks with transfer of development rights*, Arje Press, Burbank, California, 1997.
[104] http://www.slocourts.net/slo_county_grand_jury.htm
[105] San Luis Obispo County. "Voluntary Transfer of Development Credit Program." County Ordinance No. 22.04.500, 1996. Available online at http://www.special-places.org/tdcordinance.pdf .

community-based plan would replace the county-wide program in the South County Planning Area). The TDC ordinance encourages the development of community specific plans to address individual needs. A prime example, as cited in both the Grand Jury Report and the Ordinance itself is the successful Cambria program, which was specifically tailored to the needs of the local community.

- A Complex Program
  The complexity and supposed lack of clarity of the ordinance was discussed by the Grand Jury, which found that participants may require legal counsel or other expert help in order to participate. The SLOCDPB staff maintains that the complexity of the ordinance is required to meet legal needs and that the use of experts in land use approval issues is common practice not limited to the TDC ordinance.
- Tax Implications
  The Grand Jury report outlined a number of concerns with regard to the tax implications of the ordinance. These included the fact that the Assessor's office lacked a role in the approval of sending or receiving sites, and because of this, the ordinance failed to require any sort of calculation of the fiscal impact[106] of reassessment of particular parcels. Additionally, sites qualifying for sending site status would enjoy a significant tax reduction (due to decreased property value), and these consequences were not considered during the development of the program. Finally, the Grand Jury expressed concern that the Assessor's office had not adequately participated in the development of the program and that their participation would now be limited to determination of conservation easements. The SLOCDPB responded to all these concerns, noting first that a representative of the Assessor's office had been invited and present at all development meetings. The fact that the office had no role in the approval process is consistent with a lack of involvement by the assessor in any land use decision. Tax reductions were addressed during the development of the program, when the Assessor's office did raise concerns about these implications.[107] The program was therefore designed to carefully track individual participation in the program, including the establishment of well-recognized conservation easements, over which the Board of Supervisors would have no control or authority.
- California Environmental Quality Act
  At this point in the program's history, all sending sites that have applied for and been approved for designation have received either a General Rule Exemption or a Categorical Exemption under CEQA by the Environmental Coordinator in the SLOCDPB.[108] Additionally all receiving sites (to date) have been approved via a

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[106] Final Report: Transfer of Development Credit Program – San Luis Obispo County (This Final Report was originally issued by the 2000-2001 Grand Jury on March 2, 2001. It is also included in the Final Grand Jury Report of the County for the same period 2000-2001.)

[107] Tax implications were specifically addressed in a report entitled, "Lessons, Issues and Recommendations for a TDC Program in San Luis Obispo County – December, 1995."

[108] Final Report: Transfer of Development Credit Program – San Luis Obispo County. (This Final Report was originally issued by the 2000-2001 Grand Jury on March 2, 2001. It is also included in the Final Grand Jury Report of the County for the same period 2000-2001.)

negative declaration. Because the sending and receiving sites are often reviewed separately despite the fact that they are connected through transferred density led the Grand Jury to find that the ordinance involved a very cursory CEQA review. The department argues that the review is not cursory, and in fact involves a very thorough analysis of each proposed site for potential impacts. Additionally, the SLOCDPB cites CEQA requirements that compel the agency only consider foreseeable impacts, and that the cumulative impacts under question may in fact be unforeseeable and therefore exempt from the review process.

- General Plan
  It is the position of the Grand Jury that the County General Plan outlines very specific long-range goals and protections. The public perception, as gathered from complaints logged with the Grand Jury, is that the TDC program imposes an element of uncertainty to land use regulation and therefore weakens the credibility of the General Plan. The SLOCDPB takes issue with the statement that the TDC ordinance weakens the General Plan and offers the fact that all projects, including those not falling under the ordinance, are subject to the same review process, which compares goals and consequences of projects to the long-range goals of the General Plan. Additionally, while the General Plan contains many very general goals, many local areas[109] may include very specific goals in their local area plans. These specific goals may call for the use of a TDC program in some situations.
- Sending Sites
  To date, all sending site applications received by the TDC Review Committee have been approved. The Grand Jury states that these approvals used CEQA exemptions. Additionally, the agricultural criteria outlined in the ordinance, used for decisions on the acceptability of sending sites, appears to be rather weak, and could include all soil types and agricultural parcels in the county. Finally, the ability of sites to apply for and qualify for bonus credits results in questionable addition of density to receiving sites that do not have to apply for the bonus. The SLOCDPB clarifies that approvals follow the Land Use Ordinance of the General Plan, not CEQA exemptions. The criteria, under which a parcel of land can qualify for sending status, are divided into three types: agricultural, environmental, and antiquated subdivisions. All types involve both general and specific criteria. If a site meets these criteria, then it is eligible for designation. Bonus credits are assigned only to sending sites and do not transfer to receiving sites. These additional credits were designed to compensate a landowner for additional value associated with retired development rights when land supports significant natural, historical or cultural features.
- Receiving Sites
  The Grand Jury's main problem with receiving site designation followed from a claim that all receiving sites have qualified under CEQA negative declarations,

[109] The South County Area Plan is cited as a specific example by the Department of Planning and Building.

and that the review process has looked at sites individually, rather than considering the cumulative impacts of increased density (from many small project proposals). The SLOCDPB corrected the Grand Jury's finding that all sites have been approved under the ordinance, as one project was approved without the use of TDCs. Additionally, receiving sites are not approved through negative declarations (although they are subject to CEQA regulation) but instead go through the tentative map process, which includes the preparation of an environmental determination.[110]

Department of Planning & Building Response to Grand Jury Recommendations

1. TDC ordinance should be amended to provide for community-based programs only, tailored to local needs.
   Communities have the option of developing programs to address specific local needs. Programs, such as the Nipomo community-based program recently approved by the Nipomo Community Advisory Council,[111] may take the place of the countywide program (in the South County Planning Area) pending approval by the Board of Supervisors. The countywide program would apply until a plan is developed and approved for a particular local area.
2. TDC ordinance should be amended to modify the membership of the TDC Review Committee as previously recommended by the planning Commission.
   The Board of Supervisors has the authority to implement or disregard this recommendation pending the discussion of the potentiality at a public meeting.
3. The Board of Supervisors should stay implementation of the TDC ordinance until recommendations are implemented.
   A review of this issue was scheduled for May 15, 2001, and the SLOCDPB had recommended that the Board proceed with this review as scheduled. However, this review has since been rescheduled until April of 2002. The SLOCDPB recommended the avoidance of a stay on the ordinance.
4. A Public Hearing should be scheduled by the Board of Supervisors to discuss the response.
   The SLOCDPB recommended that the scheduled review serve as the public meeting and that the Board of Supervisors advise on amendments to the ordinance following this review, now scheduled for April 16, 2002.

Matters of concern over this ordinance and its fate are still uncertain. The review process will decide the fate of the ordinance and land use policy in the county. The SLOCDPB largely responded to these concerns, during several meetings of the Board of Supervisors.

[110] San Luis Obispo County Department of Planning and Building. Response to Grand Jury Report on the Countywide Transfer of Development Credit (TDC) Program. April 17, 2001.
[111] As of March 9, 2001.

TDC Ordinance and the Board of Supervisors

The subject of the TDC Ordinance has been brought to the attention of the Board of Supervisors several times over the past year. On January 9, 2001, the SLOCDPB recommended that the Board authorize the modification of the membership of the TDC Review Committee (and therefore alter Title 22 of the County Code). This resolution was approved by the Board.

During the next meeting of the Board of Supervisors, a public hearing was planned to consider an ordinance to amend Title 22 of the County Code. However, due to the action of the Board at their January 9, 2001 meeting, no hearing was necessary.

The Ordinance was next discussed during the May 15, 2001 meeting of the Board of Supervisors, at which time the SLOCDPB presented a response to the Grand Jury report of March 2, 2001. Issues discussed by planning and building included: 1) the number of credits assigned to a sending site; 2) receiving site density bonuses; 3) community based programs; 4) exclusion of areas; 5) credit banking; 6) the TDC Review Committee membership; and, 7) program abandonment.[112]

The Board responded to this discussion with a review of several issues considered of primary importance, including: the number of easements created; the relocation of development; the creation of density rather than the transfer of density; the number of hours staff has spent on the TDC program; no balance between sending and receiving sites; membership of the TDC Review Committee; and the TDC program as a tool.[113] The Board then gave the department the assurance that the TDC program is working and will not be destroyed. Instead, Board and community members offered options for implementing changes to the existing ordinance that could result in increased success.

One to One Ratio

Under the current ordinance, there is a not a direct one to one relationship between the number of development credits granted to a sending site and the number of credits required by receiving sites to increase new development density. Sending sites qualify for credits not only based on the property value of the land in question, but also with regard to natural, historical and cultural resources that add value to that land if preserved in agricultural or open space use. These bonus credits increase the attractiveness of this program to land owners who should therefore be compensated for the true value of avoiding development.[114]

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[112] San Luis Obispo County Board of Supervisors, Minutes, 5/15/01, item F-1, Kami Griffin.

[113] San Luis Obispo County Board of Supervisors, Minutes, 5/15/01, item F-1, Board Members' response.

[114] It should be noted that properties obtaining bonus credits will be subject to increased development constraints as written in to the recorded easement (not only will uses of the land be regulated, but property owners may also be subject to rules regarding preservation of the resources for which these bonus credits were obtained).

These credits are then available for purchase by developers who wish to increase zoned density on receiving sites. Sending site owners must now negotiate with owners of receiving sites on the price of the TDC. However, because the value of increased density may not actually equal the value of land preserved, it is often the case that credits from one sending site will go towards the increased density at two or more receiving sites.

Because the original intent of the program was to retire development rights from as many parcels in antiquated subdivisions, agricultural use, and with environmental significance as possible, it has been argued that a strict one to one ratio of sending to receiving sites should be imposed.

South County TDC Program

A TDC program was recently developed and approved for the Nipomo region of the county, and is awaiting approval by the board of supervisors. If approved, this plan could replace the countywide program for the South County region.

Addition of Members to the TDC Committee

The approval of sending and receiving site designation is the responsibility of a TDC Committee, rather than elected officials (the County Board of Supervisors). Membership on the committee can strongly influence the direction of decisions. It has therefore been argued that the committee should be composed of one member from each district of the county, the County Planning Director, and the Agricultural Commissioner. Because it can be tempting to approve sending sites within ones own district and receiving sites without, such a varied membership should result in the designation of sites that truly meet the criteria, rather than sites (or site ownership) known to a particular district.

Grandfathered Units

The TDC program has been active since its inception in 1999. However, at the time of this study, only one transaction had taken place along with only a handful of designations. However, those transactions and designations already recorded have been subject to different rules than would hold under the future version of the ordinance. Therefore, the fate of these prerecorded parcels would be uncertain under a revised TDC program.

Community-based Program

Several studies on TDRs and TDCs have indicated that such program will only be successful with the involvement and support of the local community. More specifically, studies by the San Luis Obispo Land Conservancy have indicated that residents of various towns within the county will not support a program that plans

to retire development on parcels they have never seen in exchange for increased density within their city boundaries.

The successful Cambria program aimed to preserve endangered pine trees and pristine slopes of the area. Preservation of these species and their environments was a tangible amenity that local residents could enjoy and value. At the same time, these residents valued the option to increase density on lots that previously would have supported only very small homes (not consistent with the land value in this highly desirable area). Therefore, a program that worked to develop individual TDC plans for each community/district, therefore appealing to and receiving support of local residents could prove much more successful than the current countywide endeavor.

Credit Banking

Sending sites and receiving sites do not always appear at the same time. In order for a truly voluntary, market-based program to exist, individual land owners should have the choice to retire development at the time when it is the most financially advantageous for them to do so. Currently, credits may only be sold once a legitimate buyer (receiving site) has approached the sending site owner to purchase these rights. An easement is then recorded and the transaction can take place. However, instead of relying on landowners to locate each other, the establishment of a bank for credits could facilitate the ease of transfer of credits. Sending site owners could sell development credits to the bank, preferably run by a nonpartisan third party (such as the Land Conservancy), even if no buyer exists at the time of sale. This type of banking scheme requires a fairly active market (such that this third party banker is assured of eventual sale of credits to receiving sites). Because a total of 12,000 lots currently exist in rural areas, a significant market appears to exist within the county.

Sending, Receiving, and Neutral Zones

The county program relies on the use of general and specific criteria for sending and receiving site designation. These criteria relate to three separate goals to retire lots: in antiquated subdivisions, on land currently in agricultural or open space use, or on land considered a significant natural area. Therefore, sites throughout the county and not necessarily located with any consistency can apply for and become sending and/or receiving sites.

Some TDC programs (e.g. Malibu) have pre-designated parcels in sending, receiving, and neutral zones, such that only those parcels within these respective zones can apply for designation. While this type of policy certainly results in a more organized pattern of development, it can fly in the face of personal property rights by increasing land values of those within either sending or receiving zones and decreasing that value in neutral zones. Such a program therefore requires full support of the local community.

Upzoning

Upzoning refers to any increase in density on a per-lot basis and can be used to target areas for development as opposed to those deemed worthy of preservation in current state of use. Because such changes in zoning are incorporated into the General Plan, there is less of a risk of running into property rights law-suits.

Agriculture Cluster Ordinance

Instead of attempting to retire development rights on agricultural land on a lot by lot basis, an ag cluster ordinance sets aside a larger tract (or tracts) of land deemed to be the most worthy of preservation in its current agricultural state. This type of policy is similar to pre-designation of sending, receiving, and neutral zones in that such clusters may result in differently property values depending on location of land within or without the cluster.

Following the discussion of alternatives, the Board authorized the staff of the SLOCDPB to:

1) Develop a one on one sending for sending unit.
   A single site could receive increased density for every one site retiring its development rights.
2) Look into sending and receiving sites approved as a single united process.
   Designation would only be approved if both a sending and receiving site apply together.
3) Look into changing the TDC Review Committee to be made up of one appointed member from each district, the Planning Director and the Agricultural Commissioner.
4) Review and bring back input regarding onsite transfer and planning development programs.
5) Look at integrating community based program in with the TDC program.
6) Finally, a five-year extension was granted to the development of this program.

The following month, during a June 19, 2001 meeting, the Board set a time for the consideration of the TDC program amendment timelines. The SLOCDPB presented their plan for the development of amendments, indicating that the six items (outlined in the previous meeting of the board) on the timeline would take the department approximately one year to accomplish. The Board of Supervisors expressed some concern over the status of the program in the interim, as they have already been issued complaints regarding a "slow down"[115] in the processing of TDC applications. Additionally, because the SLOCDPB plans to process interim applications under the current ordinance, the Board feels that there may be a rush of applications in order to avoid more stringent guidelines in the future.

[115] San Luis Obispo County Board of Supervisors Meeting Minutes. June 16, 2001.

Following a great deal of discussion regarding the suspension of the program pending the development of the new ordinance and the duration of the program, the Board approved a motion requiring the county to come back with an amendment to the current ordinance which would require the suspension of the TDC program until such time as the new ordinance is implemented and requiring the sunset (retirement) of designated sending sites in five years time.

Additionally, in April of 2001, the Land Conservancy of San Luis Obispo developed a draft report outlining potential problems with the current TDC program that could be addressed for future success:

- Because potential sending and receiving sites are not predesignated by the ordinance, approval of sites is left up to the TDC review committee and therefore may be somewhat arbitrary depending on: who is sitting on the committee, economic status of the county (and country), availability of other sites in the same geographical area, and community support. Therefore sites that are designated as sending may not be those with the greatest conservation value. Similarly, areas designated as receiving sites may not be those with the greatest community support for increased density.
- There are currently two methods being used to assign the number of credits to a sending site; the Appraisal Method and the Number of Existing Lots method. Occasionally these methods may result in a different number of designated credits, resulting in increased controversy. Additionally, due to the desire to create a fair market for credits (and thereby assign credits using the same standard for all sending sites) it will take more than one new lot (credit) to retire one old lot (more lots are created than retired).
- There appears to be a lack of backing by the local community due to the fact that preservation (in the form of sending sites) is often not related to the increased development on receiving sites. Unlike the Cambria program, where a specific resource was targeted and preservation supported by the local community, no target of preservation exists for the county program. Unless people can see the benefit of increased density in terms of preservation, they will be unlikely to support the program.
- Creation of a TDC bank might encourage public support as the community would be involved in decisions to purchase development rights presumably through addendums to the General Plan.
- Allowing mixed use as an alternative to new lot receiving sites could also increase public support for potential receiving sites.
- Community-based programs are destined to be more successful than countywide programs.

Boulder City and Boulder County, Colorado

For more than 40 years Boulder County and the City of Boulder, Colorado have been home to some of the most innovative open space programs in the nation. Boulder City has imposed limitations on urban expansion since the 1950s; locally funded open space acquisition programs since the 1960s; and a TDR program since the 1980s. Boulder County started a TDR-like program in 1978 and is now developing a countywide TDR program. All these programs have worked together and interacted in significant ways to shape both open space protection and urban development in the Boulder area.

Historic, Geographic, and Political Context

Located in the north-central part of Colorado, the county sits 15 miles northwest of Denver. Boulder County is one of 64 counties in the State of Colorado, counting the recently incorporated County of Broomfield carved from the Southeast corner of Boulder County and three other adjacent counties. The County is composed of 13 municipalities as well as several unincorporated areas. Broomfield City and County is worth noting as an example of recent rapid growth that was 'approaching' from the Denver area.

Bordered by the mountainous Continental Divide to the west and expansive rolling plains to the east, the county contains diverse land uses: lush farmland, destination ski-resorts, and large urbanized areas. The county encompasses 753 square miles and is situated on the eastern slope of the Rocky Mountains. Elevations within the boundaries of the county vary from the 5,000 foot level of the plains to the 14,000 foot peak of the Continental divide.

As a part of the Louisiana Purchase, eastern Colorado became a part of the United States in 1803. The first record of modern settlement in Boulder County dates from March 1859, when reference is made in a letter to the laying out of the City of Boulder. In 1861, the Colorado Territory was created with Boulder County being one of the 17 counties represented in the first Territorial Assembly.

During the late 19th Century, competition among Boulder County settlements for new residents and businesses was intense. Residents encouraged the establishment of railroad service, hospital and school buildings, and stable town governments. The

town of Boulder was incorporated in 1871. Open space protection began in 1898 when Chautauqua Park, at the foot of Flagstaff Mountain, was purchased through a bond issue that initiated the Boulder Mountain Parks System. In 1910, famous landscape architect Fredrick L. Olmstead came to the City of Boulder and suggested a program for preserving scenic Parks and Open Space lands.

The University of Colorado at Boulder was founded in 1876, the first campus in the University of Colorado's four campus system. The faculty and students at this liberal arts university played a major role over the decades in establishing a high value on open space and nature.

With the mining economy faltering in the early 1900s, the Boulder area relied on tourism until World War II. During the decade of the 1950s, the City of Boulder more than doubled in population, growing from 20,000 to 37,700 persons. Citizens concerned with growth in their community formed a group known as PLAN-Boulder County, established in 1959. In that same year PLAN-Boulder County helped push an innovative policy called the "blue line." This amendment to the City Charter established a limit above which City water would not be supplied. In post-war era United States where development and prosperity were common, these ideas of growth controls and restrictions were rare and ground-breaking.

Between 1960 and 1970 the population in the City of Boulder nearly doubled again, from 37,700 to almost 70,000. With pressure mounting between development and slow growth advocates, City of Boulder citizens approved a 0.4% increase in the city sales tax. Sixty percent of the funds created by the increase were devoted to transportation and 40% were devoted to open space programs. Four years later, city voters amended the City Charter to allow the city to issue bonds against this revenue stream in order to purchase open space resulting in several large parks and open space purchases. Meanwhile, Boulder County's Parks and Open Space Advisory Board was formed in 1968 to begin directing land acquisitions in the unincorporated areas.

In 1970, acknowledging the desire for joint regional open space and land use efforts, the City of Boulder and Boulder County began developing the Boulder Valley Comprehensive Plan, which defined the extent of urbanization. In 1978 the Boulder County Comprehensive Plan (BCCP) was adopted. The plan included goals and policies for preserving open space, protecting environmental resources (including both natural and cultural resources) and developing a county-wide trail system. More importantly, the BCCP designated urban-service lines that acted as a greenbelt and/or urban growth boundary.

Areas that citizens thought were most important to be preserved as open space for future generations were shown on a map, which together with the goals and policies formed the open space plan. But Boulder's approach to protecting this open space did not consist exclusively of zoning or other land-use restrictions. The designation of "proposed open space" on that map (and subsequent maps) was not a zoning category, and development of any designated area was still determined by the

applicable zoning. The implementation of the County Open Space Plan was based on both private cooperation and the county's financial ability to either acquire or place easements on selected parcels.

During the late 1970s the rural land parcels of Boulder County were zoned one unit per 35 acres of land. Beginning in the early 1980s, several mid- and north-county parcels were developed with large sprawling homes and, combined with development activity approaching from the Denver area, prompted the County to take more action to preserve open space. Boulder City was buying open space in the southern portions of the county. The County did not have funds to purchase open space at their previous rate and a 1978 ballot initiative to implement a sales tax for Open Space had failed, prompting the County to search for alternative ways to control growth. The first effort was the Non-Urban Planned Unit Development.

In 1981, Boulder County introduced a TDR program named "Non-Urban Planned Unit Development" (NUPUD). NUPUD applied principally to the rural and agricultural parcels with the county's 1 unit per 35 acres zoning. NUPUD did not transfer development rights between parcels but instead encouraged developers and owners to cluster their homes in one corner and continue to farm or graze at least 75 percent of the land. The County created the NUPUD process because Colorado state law did not explicitly authorize the use of TDRs, the County had only small amounts of general funding for open space and/or easement acquisition, and the pace of development of the rural areas was picking up.

Recognizing that the NUPUD process was not creating the desired effect of completely protecting open space in rural areas, the County expanded its program in 1989. The new process was known as non-contiguous non-urban planned unit development (NCNUPUD) and it allowed development rights to be transferred to a non-contiguous parcel, keeping the sending site "whole" and free from development. This program, in practice, was not as popular as NUPUD and has recently been overshadowed by a county-city TDR program implemented by means of Intergovernmental Agreements (IGA) allowing for cross-jurisdictional transfers.

Program Descriptions

Non-Urban Planned Unit Development[116]

The NUPUD must contain 320 acres, of which at least 75 percent must be designated by the BCCP as agricultural land of state or national significance, designated open space, critical wildlife habitats and/or corridors, rare plants sites and associations, natural landmarks, wetlands, and archeological sites. NUPUD also allows for a minimum of 35 acres for pre-1994 parcels and if the proposed units are less than 2,500 square feet above grade or is less than one mile from an exiting

[116] Section 6-400 of the Boulder County Zoning Code sets up the NUPUD, section 6-800, Conservations Easements.

municipality. NUPUDs may only be proposed on Agricultural, Rural Residential, Suburban Residential, and/or Multifamily zoning districts.

NUPUD doubles the allowed residential density in most cases from 1 to 2 units per 35 acres. Development is subject to site plan review and must occur on the least productive agricultural land with minimal impact on open space. Lots must be efficiently clustered and attempt to maintain a rural character. The remaining undeveloped land is then platted as an outlot and a conservation plan may be required. The conservation easement is then granted to Boulder County and the outlot is usually leased for active farming or grazing and/or purchased by the County or another governmental entity.

NUPUD has been used about 250 times as of 2001 resulting in over 10,000 acres set aside with a conservation easement, about 14 percent of the 73,000 acres in easements owned by the City or County of Boulder. Much of the NUPUD land is in active farming or grazing as part of the 60,000 acres cultivated overall in the County. The County and City may initially manage the outlots but also sell them to area farmers while retaining the easement. The County grosses about $350,000 a year from leases.[117] NUPUD is still active although there is less eligible land due to the program's own success.

An example is provided using data from the Dodd Ranch NUPUD. If a ranch was 210 acres, Rural Residential zoning would allow six 35-acre subdivisions that would be developed and marketed for $600,000 to $1,000,000 each. Assume the total market value was $5,000,000. The NUPUD program allows 12 units on 25 percent of the land that would each still bring a high value, say $500,000 each, for a total market value of $6,000,000. After the NUPUD process, the value of the 157.5 acre agricultural outlot (75% of 210 acres) would be about $6,000 per acre, totaling $945,000.

The County could then buy the outlot with open space bond money (a 0.25% open space sales tax that was adopted by voters in 1993 generating about $6 million per year) or from its annual $4 million general fund open space account for about 20 percent of its pre-NUPUD value. The trade-off is a 12-unit development in one corner of the former ranch that would generate substantial net local tax revenues (and presumably be well-designed at a density of 4.4 units per acre to still 'fit' the rural landscape) and increasing traffic on rural roads. Overall value of both the developed land and agricultural outlot would be nearly $7,000,000 compared to $5,000,000 under regular zoning. NUPUD appears to be a win-win program except that the rural area was still being developed, albeit in clusters.

[117] Conversations with County staff at various times during 2000 and 2001 and Pruetz, R. "Exhibit B: 33 TDC Program Case Studies: Butte County TDC Feasibility Study," from *Saved by Development: preserving environmental areas, farmland and historic landmarks with transfer of development rights*, Arje Press, Burbank, California, 1997.

Non-Contiguous Non-Urban Planned Unit Development[118]

In 1989 the County expanded the NUPUD into the NCNUPUD to encourage the complete preservation of sending sites by moving the development rights into an existing city or designated or negotiated receiving. The NCNUPUD program is a 'real' TDR program in that rights transfer to a different site rather just to the corner of the parcel as in NUPUD. NCNUPUD is explicitly a modification of the NUPUD program and incorporates most NUPUD criteria. NCNUPUD is intended to produce less overall negative impact and greater benefit compared to a series of NUPUDs on the same land. To entice developers and owners, NCNUPUD gives an additional 300 percent density bonus at the receiving parcel: up to 6 units per 35 acres compared to 2 for NUPUD and 1 under regular zoning. Unused density may be banked and used in a subsequent project. NCNUPUD also included a measure for the County to gain title and retire privately held lots in the national forests in the western half of the county by creating a sending site ratio of 1 unit per 175 acres of contiguous forest land.

With NCNUPUD, our 210 acre ranch owner would be paid for its NUPUD-based 12 development rights at about $60,000 per right, for a total of $720,000 and the entire 210 acre ranch would then sell to the County for $1,260,000 (210 X $6,000) for a total buyout package of just under $2,000,000. The County would be able to leverage $1,260,000 into $5,000,000 worth of open space acquisition at pre-NCNUPUD values, about 20 cents on the dollar. The downside is that a relatively high-density project residential project is developed somewhere else, probably in or near an unincorporated suburban area.

Unlike NUPUD, NCNUPUD requires a public notice and hearing process and significant County review of both sending and receiving site characteristics and proposals. This perceived uncertainty coupled with some public opposition to proposed development at the receiving sites has discouraged developers, resulting in only five NCNUPUD projects. But NCNUPUD introduces several additional TDR tools: designated sending and receiving sites, transfer bonus, public notice and review, and banking.

County-Wide TDR with Inter-Governmental Agreements[119]

The City and County of Boulder both adopted the Boulder Valley TDR Program in 1995, the first in a series of IGA's between the County and its incorporated cities that are intended to transfer development rights from rural and other sensitive unincorporated areas of the County (sending sites) to incorporated cities (receiving sites) and several developed unincorporated areas of the County. Each IGA differs in some details and several have sunset[120] dates and transfer caps. The Boulder IGA, for example, accepts up to 250 transferred units, has a five-year sunset clause, and

[118] Section 6-500 of the Boulder County Zoning Code sets up the NCNUPUD.

[119] Section 6-700 of the Boulder County Zoning Code.

[120] Sunset dates refer to the point in time when the program is slated to end, having retired adequate development rights, given the amount of potential sending and receiving sites.

requires both city and county approvals for projects or program changes in the county portion of the IGA area. The IGAs are modeled after the County TDR Program and generally act to receive development rights according to each city's criteria. The key components of the Boulder County TDR program are:

- The County TDR Program promotes countywide preservation of agriculture, rural open space and character, scenic vistas, natural features, and environmental resources including the perpetuation of large areas of generally contiguous parcels for agriculture.
- Sending sites are designated by the County. County sending sites are zoned Agriculture, Rural Residential, Environmental Resources, and Suburban Residential. These zones allow development of one unit per 35 acres, two per 35 when transferred, and three per 35 acres if the sending site has deliverable water rights that are granted to the County. Owners may both develop at the sending site (at the rate of one per 35) and still transfer rights from the remaining portion, if applicable.
- Many, but not all, receiving sites are explicitly designated (both Sending and Receiving Sites are denoted as 'Potential' on maps). Receiving site owners must apply for designation and meet suitability requirements. Receiving sites are generally located in or adjacent to municipalities where they can benefit from urban services. There are several appropriate locations in the unincorporated plains and some areas around the City of Longmont, the Town of Niwot, and the City of Boulder.
- A TDR is initiated by the sending site owner who applies for a conservation easement in tandem with a Development Rights Certificate for each proposed transfer unit, subject to County staff review (and respective city staff, depending on the IGA). The Certificates are then used by the receiving site developer to augment the receiving site's underlying zoning. Certificates sell for between $20,000 and $50,000 each.
- Ideally, receiving sites will be located in or adjacent to municipalities where they can benefit from urban services. A conceptual plan and/or site plan, subdivision and/or Planned Unit Development (PUD) application, and Planning Commission and Board of County Commissioners approvals are all required. There may be several public hearings.
- The County's Land Use Department (i.e. planning and zoning) maintains a list of interested TDR sellers and buyers, as do several local real estate agents. There is no TDR bank although it remains a possibility.
- Residential development rights may be converted to other uses provided the net effect is no worse than the residential uses. The conversions are negotiated as part of the approval process.

Many exceptions are imbedded in the Code, suggesting both the detailed knowledge gained over the 20 year history of conservation and open space planning and program management by Boulder County and City and the need to negotiate details and tailor programs for multiple jurisdictions and circumstances.

No transfers occurred into the City of Boulder in the first five years of the County/City IGA due largely to community opposition to the increased density at the city receiving sites. Each TDR "deal" is unique as no two sets of sending and receiving sites and receiving communities are alike.

Discussion

The NUPUD, NCNUPUD, and IGA programs may be thought of as the evolution of a TDR program over 20 years, first in unincorporated areas and now county-wide. All three programs are secondary to purchase of open space, which has been Boulder City's primary focus for over 30 years. The County's NUPUD program kept approximately 10,000 acres in active ranching or agriculture, about 15 percent of the County's total ranching or agriculture land. NUPUD allowed Boulder County and sometimes Boulder City to strategically buy the outlots at agricultural values rather than upscale development values. The result is the gradual implementation of the Open Space Plan that keeps permanent greenbelts between the cities and focuses development to areas with existing services and away from environmentally sensitive and/or desirable scenic and/or recreation areas.

The City and County are active players in the local real estate market backed by sales tax revenues, bond proceeds, and annual general fund allocations. Their financial resources would not be possible without the sustained backing of local voters and their elected officials. Continued Denver area growth has led to development past Boulder and an increase in cross-county commuting. Boulder City itself is net jobs-rich with expensive housing. Still, public support for the IGA remains as that program begins to find its feet.

Boulder's transfer programs are relatively simple compared to the TRPA transfer programs with the exception of the variations among the IGA's. Boulder programs deal with development rights whereas TRPA programs also cover impervious surface, motel/hotel rooms, and commercial floor area. Both programs are implementing regional plans although the TRPA spans two states, four counties, and two cities. The Boulder plans are voluntary and offer at least a 100 percent density bonus incentive. TRPA's programs are mandatory and have few incentives. Boulder programs have sustained local political and financial support whereas TRPA is more of a top-down regulatory environment.

Boulder's programs may be characterized as fulfilling the lifestyle desires of a generally upscale population that has, in turn, made the Boulder area even more desirable. More open space raises values and amenities, which attract additional high-income households who continue to support the TDR and open space programs. This program prefers to acquire open space and retire development rights and use the TDR program more as an adjunct. The Boulder programs all allow development based on underlying zoning. It is not surprising, then, that the Boulder programs are generally well-accepted.

Malibu Coastal Zone Transfer of Development Credit Program

Between 1978 and 1991 the TDC program in the Malibu Coastal Zone was one of the most active and successful TDR programs in the nation. The TDC program is still in effect but activity has declined substantially since the incorporation of the City of Malibu in 1991. The California Coastal Commission (CCC) used the TDC program and public acquisition to prevent development in rugged, unsafe, and environmentally sensitive hillsides where over 5,000 small "vacation cabin" lots remained from 1920s and 1930s subdivisions. By 1999, 544 transfers retired 924 lots covering about 800 acres.

Historic, Geographic, and Political Context

The Malibu Coastal Zone is a fragile ecosystem with diverse plant and animal species. With the Santa Monica Mountains rising upward directly out of the sea, steep slopes mark much of the landscape and increase the likelihood of erosion. Seasonal wind and fire danger potential are high. In the past decade, the City of Malibu suffered four major natural disasters, including a 1993 brush fire that destroyed 270 homes. The Malibu area, on average, has been subject to a large fire (one thousand acres plus) every two and a half years, and the entire surface of the Santa Monica Mountains has burned three times in the last 100 years. Emergency access is limited and sometimes closed due to slides, floods, and fire. Yet, Malibu's beaches, ocean views, movie star residents, and access to Los Angeles create high demand and an average 2001 property value of about $850,000.

Towards the end of the 18th Century, Spanish expeditions set foot on the California coast in an attempt to solidify and secure Spanish interests from possible English and Russian encroachment. "Rancho Malibu" became a well-established cattle ranch and the home for Jose Bartolome Tapia, the first owner of the rancho. After California changed from Spanish to Mexican to American hands in the first half of the 19th Century, the ranch remained relatively intact until the 1920s. As Southern California grew, the once pristine beachfront/cattle-ranch became a desirable spot for many people. Those who flocked to the area were primarily those working in the film industry that came for the beauty and relatively cheap land. Several vacation "villages" were laid out on hillsides and along creeks with lots between 4,000 and 7,000 square feet, usually without adequate water or road access and no sewer system. Most of these lots remained undeveloped but retained entitlement to one unit under county zoning.

In 1972, California voters approved Proposition 20, known as the California Coastal Zone Conservation Act, which became permanent in 1976 with passage of the California Coastal Act (CCA). This legislation is intended to protect the coastal environment, conserve resources, maximize public access, and encourage local initiatives and planning in coastal areas. As a result of the CCA, the CCC has ultimate authority over private land in the area. The Act requires all cities and

counties to develop a Local Coastal Plan (LCP) outlining management of their coastlines. Once the CCC approves an LCP, the local government regains day-to-day power to issue land-use permits. However, the CCC has never approved an LCP for Malibu, meaning the commission itself has retained land-use permitting power. The City of Malibu is currently preparing an LCP for the CCC.

In 1978, the U.S. Congress sought to further protect the ecology in the area by designating the Santa Monica Mountains National Recreation Area (SMMNRA) in 1978. The Santa Monica Mountains Conservancy was created by the state shortly thereafter. Approximately 150,000 acres is owned by state and federal agencies for conservation purposes in the SMMNRA.

Much of the land in the Malibu Coastal Zone is now owned by government agencies, including the National Park Service (which operates the SMMNRA), the California Department of Parks & Recreation, and the Santa Monica Mountains Conservancy, a California state agency. The Malibu Coastal Zone is divided among the County of Los Angeles, County of Ventura, and City of Malibu with the CCC having significant regulatory oversight on many land use issues.

The 1976 Coastal Act prohibits additional subdivisions if over 50 percent of existing lots are undeveloped. In 1978, 8,600 lots (about 64 percent of a total of 13,475 lots) in the Malibu Coastal Zone were undeveloped, many of these being small hillside lots without adequate services. Two 1978 planning studies recommended that development potential be transferred from substandard entitled lots to new subdivisions that met current standards.[121] The CCC needed to develop a policy that could either slow or move development from the small-lot subdivisions in the hillside, and decrease the net development within the Malibu Coastal Zone. Consequently, the Commission developed their own TDC program to not only move development closer to "existing development," but to also mitigate the impacts of the new land divisions in the Santa Monica Mountains/Malibu Coastal Zone that would occur as a result of the policy. The CCC began in 1978 to facilitate transfers on a project review basis as a pilot program, eventually leading to the 1979 adoption of guidelines (with several later modifications) and establishment of the formal TDC program.[122] The County of Los Angeles would not include a TDC program in the Malibu/Santa Monica Mountains Land Use Plan even though the plan supported the underlying goals. As long as there was no certified LCP, the CCC was required to be the permitting authority in the Malibu Coastal Zone for subdivisions. The CCC's 1981 Interpretive Guidelines acts as a "TDC zoning code" and the ability to require mitigation for "cumulative impact" as a condition of approval for discretionary permits is the legal mechanism for the TDC program.

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[121] California Coastal Commission, "Review of the Malibu/Santa Monica Mountains Transfer of Development Credit Program," April 25, 1996. Memorandum, pp. 1.

[122] Pruetz, R. "Exhibit B: 33 TDC Program Case Studies" from *Saved by Development: preserving environmental areas, farmland and historic landmarks with transfer of development rights*, Arje Press, Burbank, California, 1997.

Program Description

The TDC program applies only to subdivisions and is technically voluntary as landowners may seek development approval based on the underlying zoning without subdividing their property. The TDC program is considered a discretionary mitigation included in the conditions of a project or subdivision approval. New subdivisions and projects must also meet other conditions for approval so the TDC is not a right to develop by itself. Because of high land values and strong demand, Malibu landowners have considerable economic incentive to subdivide and therefore must participate in the TDC program. The CCC requires a one-for-one mitigation trade of new subdivided lots for qualifying old undeveloped substandard lots, which is then usually permanently prevented from future development with a scenic easement. As the TDC program evolved, exceptions and rules were added as needed. The following bullets summarize the main elements:

- The goal of the TDC program is to retire existing development rights in substandard subdivisions by transferring them to new current standard subdivisions resulting in no net increase in lots in the Malibu Coastal Zone.
- Sending Sites were chosen by the CCC and consisted of small lot subdivisions followed in 1981 with the addition of larger and un-subdivided lots in Significant Ecological Areas (SEA). The State Coastal Conservancy (a division of the State Resources Agency) later proactively focused on four project areas for restoration: El Nino, Malibu Lake, Cold Creek, and Las Flores Heights. The subdivision sending sites were inland between Point Dume and Malibu Point and inland along Topanga Creek. The SEA areas were generally all undeveloped inland highland areas and several canyons.
- One TDC is generated for any combination of small lots which total one acre or more regardless of their ability to be developed. Or, one TDC is generated for one or more lots with access to a road within 300 feet, not located in a landslide or earthquake area, and capable of supporting 1,500 square feet of floor areas according to the Gross Structural Area (GSA) slope-intensity formula.[123] Or, one TDC is generated for three existing lots of at least 4,000 square feet each, buildable or not. Or, one TDC shall be generated for each parcel located within a Significant Watershed except where the parcel exceeds 20 acres in size; one TDC is for each 20 acres. Fractions are not allowed.
- TDCs are approved for transfer from the sending site owner after the CCC accepts permanent scenic easements, which may or may not preclude public access, and possibly a Declaration of Restrictions in lieu of the reverting contiguous lots to common ownership for recordation.
- Receiving sites are chosen by the CCC for subdivision or multi-family projects, generally along the coastal terrace and a few inland pockets. When

[123] *GSA = (A/5) x ((50-S)/35) + 500* where A = building site are in square feet and S = slope.

the applicant submits a permit for a subdivision or a multi-family project, the CCC then must find that the parcels created by this action contain building sites that can be developed in accordance with CCA policies. As a condition of approval, the applicants must mitigate the cumulative impacts of their project by providing TDCs on a one lot to one lot basis. For multi-family projects, the CCC requires one TDC for each unit over 2,500 gross structural area[8], minus the number of existing parcels within the project site. Lots that otherwise qualify for subdivision would need to present TDCs for each additional new lot being created. CCC staff and local realtors initially match up TDC sellers to buyers.

With the 1981 interpretive guidelines setting the stage, the TDC market began to progress. The CCC staff found the transaction process to be extremely time consuming. Complaints were piling up about how the permits were too expensive, in short supply, and it was difficult for the applicants to search for applicable donor sites. Since the TDC program was a "market-based" mechanism by nature, the approval of the market "players" was vital to keeping the program afloat. The Coastal Conservancy (and later the Mountains Restoration Trust created by the Conservancy specifically to buy and sell TDCs) began to bank TDCs as the initial supply of TDCs was too low and the TDCs were selling for $25,000 to $40,000 each, a fee considered too high by developers. The Conservancy used $2.6 million to stake a revolving TDC "bank" fund. The Conservancy's and the Trust's involvement proved to be a positive addition to the TDC program. TDC projects used the banked credits and substandard lots were retired as planned. Unfortunately, the TDC activity was nearly emptying the bank and the Conservancy was looking for a solution to increase donor TDC supply. The Conservancy decided to sell groups of 10 TDCs through an auction, either monthly or bi-monthly, limiting the highest bidders to a maximum of 5 TDCs each. In the winter of 1981 the first TDC auction was held. As a form of quality control, the bidders were prescreened, limited on the number of TDCs that could be purchased, and required to reveal their approved coastal permit. Additionally, the credits were site-specific and could not be transferred to another project. Because the demand to subdivide land within the coastal zone was high, the auction was a success. However, the auction nearly emptied the TDC bank.

In other efforts to increase TDC supply and lower their cost, the Coastal Conservancy began allowing developers to pay mitigation fees in lieu of TDCs, using the funds to later purchase TDCs. While the in-lieu fees have made progress in retiring over 100 lots, there was often a delay in completing the transactions and many retirements were never completed. For this reason, the in-lieu fee system has been placed on hold.

The CCC also reduced the formula for generating TDCs in watershed areas to one TDC for two contiguous lots or five non-contiguous lots. TDCs were also accepted as charitable tax deductions by owners who held several contiguous lots but only

planned to build on one. Additionally, the CCC credited public agency resource purchases with 53 TDCs.

Meanwhile, the CCC had other policies to deal with the impacts of buildout in the region, such as disallowing road and water permits in undeveloped areas, strict analysis often requiring reductions in the amount of grading (and other processes that impact the watershed and surrounding resources), and recommending that the Los Angeles and Ventura County portions of the Malibu Coastal zone have a reduction in density as stated in their Land Use Plans (LUPs). The City of Malibu Draft LCP calls for a continuation of the TDC program, but there is doubt that the city will approve increasing densities.

The CCC also developed requirements related to development of small lots using the GSA formula. Owners wishing to build more than allowed by the GSA for their lot could gain a bonus by retiring development rights of an adjacent or nearby lot. The GSA "bonus" and TDC programs are parallel and related and often confused.[124]

Occurring nearly simultaneously with the development of the TDC and GSA programs was the creation of the Santa Monica Mountains Comprehensive Planning Commission in 1977 by the State. The planning commission prepared a comprehensive plan for the conservation and appropriate development of the Santa Monica Mountains. It was a precursor to the state's Santa Monica Mountains Conservancy which works closely with the National Park Service. Often, the Conservancy acquires the parkland through purchase and then transfers it to the National Park Service. To date, the National Park Service's open space acquisitions have totaled over 21,000 acres, the Conservancy has purchased over 23,000 acres, and the Mountains Recreation and Conservation Authority (a closely related state authority) has acquired an additional 7,000 acres.[125]

Around 1990 development began to cool down as the recession set in and the Malibu City incorporation effort gathered steam, introducing considerable uncertainty for developers. Elizabeth Wiechec, former Executive Director of the Mountains Restoration Trust (1982-1992), authored "Transfer of Development in the Malibu Coastal Zone" in 1995 and proposed the creation of a permanent TDC bank and promotion of private TDC brokers, as well as better tracking of trades through the use of Geographical Information Systems (GIS). CCC staff completed a comprehensive review and prepared a generally positive report in April 1996 without specific recommendations. This was followed by the Santa Monica Mountains/Malibu Regional Cumulative Assessment Project (ReCAP) that recommended in its 1999 final report that the TDC program "significantly reduced cumulative impacts" and proposed several changes including revising donor site criteria to include parcels in wildlife corridors and parcels adjacent to parkland and

[124] California Coastal Commission, "Review of the Malibu/Santa Monica Mountains Transfer of Development Credit Program," April 25, 1996. Memorandum, pp. 11.
[125] *Ibid.*

encouraging the City of Malibu to participate in TDC program. The January 2002 Draft Malibu LUP retains the TDC program for both the city and the unincorporated areas.

Discussion

The Malibu TDC program retired approximately 924 substandard lots and the mitigation fee program retired another 39 lots for a total of 963 lots, roughly 20 percent of the 5,000 "vacation" lots that were the original target and rationale for the program. The combination of the TDC GSA programs have essentially enabled development of over 1,100 units that theoretically could have been built in inland areas had costly service and serious safety issues been satisfied. As state law would not allow new coastal development as long as the inland lots remained undeveloped, the TDC program "killed two birds with one stone" by enabling coastal development while removing the potential high cost of servicing entitled inland lots. The TDC program was gradually expanded to serve other environmental planning objectives of parkland acquisition, watershed protection, and habitat enhancement.

In an attempt to keep the project active and to create stability in the TDC market, the CCC had to involve the State Coastal Conservancy (who later created the Mountains Restoration Trust to better create financing deals not allowed to state agencies). Though it is not typical for a state agency to be involved in a TDR program, it was clear that both agencies could stabilize the market by serving as bankers.

King County Transferable Development Credits Program

King County, Washington, the county that contains the City of Seattle, has a history of innovative land use policy. In the 1970s, the county was one of the first in the nation to use public funds to purchase development rights from farmers as a way of preserving agricultural land. The county participated in regional growth management planning before the passage of the state's 1990 Growth Management Act. The King County TDC Program began as a pilot project in October 1998 and was permanently adopted September 2001.[126] The County's award-winning TDC Program is modeled after others including Boulder City and County, Montgomery County, and the New Jersey Pinelands and represents 'state-of-the-art' ideas and procedures for a large-scale TDC program, including a well-designed public-friendly Internet information site that refers to the program as a TDR.

Historic, Geographic, and Political Context

King County covers nearly 2,130 square miles of northwestern Washington ranging from Puget Sound on the western side to rugged mountains on the east and includes scenic coastline, river floodplains, plateaus, lakes and salmon streams. Prospering in the last 150 years from the large timber industry and its valuable Port of Seattle, King County today is the largest county in Washington and the 13th largest in the nation, with a Census 2000 population of 1,737,000. Of this, 350,000 live outside the county's 39 cities. The population grew by 11% between 1990 and 2000, which is relatively moderate compared to surrounding counties. Housing units increased faster than population, growing by 15.2% (230,000) during the same period. The King County economy, which includes Boeing, Microsoft, and international trade, grew much faster, by 24% in the 1990s.

All of these changes have put a great deal of pressure on King County's urban infrastructure, agriculture, government, and natural resources. The county is generally divided into: north (Seattle), east (Lake Washington, Bellevue, and Lake Sammamish suburbs), south (southern suburbs to Pierce County), and rural/resource areas (Vashion Island and the eastern half of the county). The three largest environmental issues are salmon, forests, and agriculture/open space.

Many salmon stocks in Washington are listed as either threatened or endangered under the Federal Endangered Species Act due to past commercial fisheries and habitat loss. Salmon conservation can be achieved only by involving large portions of the landscape that are currently (or in the past) managed primarily for natural resource extraction or intensive development. Agriculture and timber management have been the two most dominant uses of these areas. Added to that mix are the pressures for additional urban development spreading eastward from the Seattle suburbs and, to a lesser extent, growth in the small cities in the east county.

[126] Ordinance No. 14190 and codified in King County Code Chapter 21A.37.

King County began responding to urban growth pressure in 1979, when voters passed the Farmland Preservation Program that authorized planning officials to preserve rapidly diminishing farmland by purchasing the development rights. To date, the County has spent $50 million in bond proceeds to purchase development rights on 12,800 acres of farmland. When farmers sell their development rights, they agree to a wide variety of future restrictions, including limiting the number of permitted residences on the property, allowing only agricultural or open space uses, maintaining 95% of the property as open for cultivation, maintaining a minimum lot size if property is subdivided, and restricting activities that impair agricultural uses.

The County also developed the Forestry Program, which serves as the policy basis for the TDC program. The Forestry Program provides education, technical assistance, and economic incentives aimed toward retaining the forest resources. Staff foresters meet with property owners to discuss a "Forest Stewardship" plan which will provide direction on how to manage their land to keep it productive, healthy, and economically beneficial.

Similarly, the County also developed the Public Benefit Rating System (PBRS) and the Timber Land programs to provide incentives to private landowners to voluntarily conserve and protect land resources, open space and timber. In return for preserving their resources, the County assesses the land at a value consistent with its "current use" rather than the "highest and best use," meaning it is not assessed at its speculative value for urban development. More than 550 properties and 7,000 acres are presently participating in the program. The PBRS program provides an economic incentive to protect the land without requiring the landowner to permanently deed restrict the land.

The State Growth Management Act (GMA) was passed by the Washington State Legislature in 1990. The GMA requires the state's most populous and fastest growing counties and their cities to prepare and adopt comprehensive LUPs that direct growth into designated urban areas and away from rural areas and open space. UGBs are designated. Additionally, the plans must include potential critical environmental areas as well as commercially significant forestry area designations. In metropolitan Seattle, the GMA led to the creation of an UGB and fostered incorporations and annexations so that a larger percentage of the region's population now lives inside cities compared to 20 years ago.

King County planning policies discouraged development in or near salmon habitat and/or watersheds. In regulating land use, King County acknowledged that alternative programs must be seriously considered in order have an effect on development patterns. In October 1998, King County adopted a three year TDC Pilot Program. The purpose of the pilot program was to supplement current land use regulations, resource protection efforts, and open space acquisition programs. The program was also intended to encourage increased residential development density where it can be best accommodated with the least impacts on the natural environment and public services. A $1.5 million appropriation was made available by the Metropolitan King County Council for establishment of a TDC bank, along

with $500,000 set aside for neighborhood improvements that might be adversely affected by additional density. On February 22, 2000, the King County Council adopted the TDC bank provisions outlining the selection criteria and rules of spending, and was permanently adopted September 2001.

Program Description

The King County TDC program is authorized by ordinance and administered by the Natural Resources and Parks Department, Water and Land Resources Division. The program has the strong support of the King County Executive and nearly all members of the county council who voted 10-1 for its adoption. The TDC program is administered as part of the entitlement process along with zoning and other discretionary permits. There are also several Interlocal Agreements between the county and several cities so that the cities may be receiving sites.

The minimum zoning applies to R-4 through R-48 (residential: 4 units per acre to 48 per acre) as ranges between 65 to 85 percent of base zoning. The minimum zoning ensures consistency with the GMA which governs service and utility extensions and improvements. Maximum zoning is the amount of extra density available from two programs, TDC and Residential Density Incentives (RDI), a program designed to increase affordable housing. Maximum density may be up to 200 percent of base density if all applicable criteria are met. The TDC program is voluntary and relies on the market incentive of reaching the maximum density at the receiving site to trigger a transfer.

The basics of the TDC are:

- The goals of the TDC are to implement the Comprehensive Plan policies to protect rural resource lands and preserve rural character, implement the GMA by redirecting residential growth from resource lands to serviced urban and rural areas, develop an innovative market tool rather as an alternative to public purchases or additional regulations, and preserve agricultural, forest, and salmon habitat lands. In the county there are three zoning density levels: base, minimum, and maximum.
- The sending site application is included with a proposed development and/ore subdivision application at the receiving site. Sending sites must be certified by the office of Regional Policy and Planning. To qualify as a sending site, the property must demonstrate a possible public benefit if density should be removed. Potential sending and receiving sites are shown on maps provided by the Department of Development and Environmental Services (DDES). They are designated agricultural, forest, forest focus areas, regional trails, open space, future parks, species habitat, R-1 urban separators, and historic landmarks. A Forest Stewardship Plan is also required in Rural Forest Districts.
- Receiving sites are parcels where existing infrastructure can accommodate additional growth zoned R-4 to R-48, incorporated cities (if there is an Interlocal Agreement), and some rural areas zoned Neighborhood,

Community Business, Regional Business, or Office. Certain rural areas zoned RA-2.5 and RA-5 may only receive TDCs from a Rural Forest Focus Area sending site. Developers may combine TDCs from several sending sites and with RDI credits up to the Maximum zoning, subject to public hearings and discretionary review and conditions.

- After TDCs are transferred off of the sending site, a permanent conservation easement is placed on the property. The property remains in private ownership, so that it will be retained in forestry, farming, and other conforming uses. In essence, the TDC program is similar to the purchase of development rights program, except that the landowners in the areas to be protected (the sending areas) are compensated by landowners in the receiving areas rather than by the county government.
- County staff assist in matching sending and receiving site sellers and buyers. The County staked a $1.5 million TDC bank that is currently full. The bank may only purchase from sites in the rural, agricultural, or forest production districts based on providing the greatest public benefit.

The TDC program is still relatively new and the TDC bank has generated the majority of purchases. The TDC bank purchased 56 credits ($1.4 million, or $25,000 for each TDC, R-5 zoning) on a 285-acre tree farm that is Sugarloaf Mountain. The residual value was $1.2 million and the owners donated the land for forestry and recreation. The transfer allowed the developer to exceed usual height limits and some fear the loss of views. The Denny Triangle TDC Interlocal Agreement was approved in April 2000 that matches rural land owners in three river basin to the Denny Triangle neighborhood in Seattle, an area near downtown planned for mid- and high-rise development. King County will match up to $500,000 from developers to design and construct streetscape and other public amenities as development proceeds.

King County received recognition in 2001 at the Vision 2020 awards in Seattle, for using the TDR program to transfer 62 rights from a threatened 313-acre McCormick Forest in rural east King County into Issaquah's urban area. The program has met some opposition from residents in the receiving areas. Some cities and towns in King County are accepting of the program, while others are wary of the idea of rights transfer due to possible adverse effects of density. As of January 2001, the TDC bank had acquired $10 million worth of land (700 acres, or $14,285 an acre) for a total of $1.7 million, a "savings" of $8.3 million.

Discussion

The King County TDC program is still "getting its feet wet" and finding that not all residents in receiving areas are receptive to additional density enabled by the TDC program. King County's program is relatively simple as it identifies and trades only residential development rights based on existing zoning in the sending site on a one for one basis. The TDC program in King County is just one of the preservation tools available and is augmented by the Farmland Purchase of Development Rights (PDR)

program, land stewardship programs, and tax incentive options. King County preservation efforts have wide public and political support so far. Maintaining and enhancing watersheds and forests are shared goals by other programs across the country, although King County is focused on Salmon habitat. King County has one agency, actually one person, monitoring all trades. The county also encourages TDC transfers between developers and rural landowners.

TDC Ordinance Characteristics & Recommendations

Comparing some of the most prevalent TDR or TDC programs in the United States to the San Luis Obispo County program is helpful in determining some of the optimal community characteristics for the implementation of a successful TDC program. While some facets of a program may ensure its success in any area, others are specific to certain regions and community situations. Table 1 below is a matrix of defining characteristics of some of the most well known TDR/TDC programs throughout the country, including the Cambria and San Luis Obispo County programs. Some of the more particularly unique or defining characteristics of each program are then compared to those of the San Luis Obispo County program in order to define potential improvements that could be made to the existing ordinance.

Table 1: TDC Program Characteristics

LOCATION	TARGET	AGENCY	Special Characteristics	STATUS
Montgomery County, MD	Farmland preservation	Single planning area	- Public education & outreach - Additional incentives - TDRs only way to increase density in receiving areas - Fewer credits available than opportunities to use - Simple process	- 318,000 total acres - Over 6,000 TDRs purchased to date
Calvert County, MD	Farmland Preservation	Single planning area	- Public involvement early - TDRs only way to increase density in receiving areas - Additional incentives	- $2,500/acre
New Jersey Pinelands	Natural Resource Protection	Multi-jurisdictional	- TDRs only way to increase density in receiving areas - Fewer available credits that opportunities to use (market creation) - TDR bank	- 1 million total acres eligible - 25,000 acres preserved to date - Current price of TDRs: $8,000
Tahoe	Water quality (and clarity) protection	TRPA (involves multiple states and planning areas)	- No link between sending and receiving sites - Property rights litigation - Multiple regulations: building allocations, TDRs and Coverage	- Still active/transferring - Legal hassles regarding compensation; criteria not

			rights (up to 30% allowable lot coverage) - TDR bank - Tourist units could be used to increase commercial floor space - Transfers should take place from areas of more sensitivity to less sensitivity (Bailey Study)	consistent with goals
Malibu, CA	Retirement of Substandard lots in Antiquated Subdivisions	CCC (multiple counties (LA, Ventura); multi-jurisdictional: National, State and Local	- Pre-designation of target areas for sending/receiving and neutral zones; used market mechanism, compensatory mechanism to enforce - In lieu fees led to problems with TDR banking - One to one exchange ratio - Property values issue - Disputes over administration of TDR bank	- Overall success of the program; saved a lot of land
Boulder, CO	Open Space Preservation	Multiple planning areas (city and county)	- Don't want downtown density - Reliance on tourism - Active citizen groups - Down Zoning - No agriculture preservation goals - Use of lottery funds to purchase open space - Sales tax allocated towards preservation of open space - Cluster development - New Urbanism	- TDR program currently "second best alternative" to strict open space preservation using lottery and sales tax revenues for public purchase
King County, WA	Conservation of Land, Resources and Timber	Single planning area	- Opposition from residents near receiving sites - Voluntary program - Potential sites mapped prior - Presence of strong political leader to push program through - Growth moderate in the county - Farmland Preservation Program: outright purchase of rights - Inclusion of temporary restriction of development program (PBRS)	- Still active - TDC bank includes 1.5 million of appropriated money for outright purchase of rights, including $500,000 for local improvements in areas receiving increased density - 724 acres preserved to date - The 1998 ordinance created a 3 year TDC

			- TDC bank - Pre-designation of sites, in combination with criteria - Tax incentives for retaining land in current use - Promotion of program by networking with developers	program
Cambria	Retirement of Substandard Lots in Antiquated Subdivisions, preservation of Cambria Pine	Single planning area	- TDC bank, administered by San Luis Obispo Land Conservancy - Early public involvement - Down zoning	- Very successful program
San Luis Obispo County	Land and Resource Preservation	Multiple planning areas within the county	- Development allowed in sending areas - Public opposition to increased density in receiving areas (NIMBY) - More than one way to increase density (other than TDCs) - Potential for development of "new towns"	- Ordinance under review by Board of Supervisors, scheduled for public hearing, April 16, 2002 - Legal hassles regarding compensation mechanisms - 6 sites approved to date for sending status, 4 for receiving

- Voluntary vs. Mandatory
  One of the first distinctions among TDR programs is voluntary or mandatory nature. Voluntary programs only downzone (or reduce/retire the development potential of) a piece of land following the agreement of the landowner to participate in the TDC program. Mandatory programs limit the development in sending areas prior to designation or owner participation in an attempt to "force" participation or direct growth. Voluntary programs are often deemed superior to mandatory programs because they meet with less public resistance, face fewer litigation hassles and assist in the creation of markets for the transfer of development rights, or credits. The County program is voluntary in nature and has therefore escaped some litigation hassles.
- Preservation Target
  The specificity of the preservation target may help to ensure the success of the program. One of the major problems with the County program is a lack of relationship between receiving sites and sending sites. Although sending sites should be located within a 3-mile radius of proposed receiving sites, this constraint is not actively enforced. Therefore, because residents feel no connection to the land being preserved, they will not feel an incentive to accept increased density in surrounding areas. In areas where TDR programs

were relatively successful, the preservation target was fairly specific. For example, the Cambria program targeted preservation of the Cambria pine, a natural resource that area residents could easily relate to. However, while protection of Lake Tahoe water quality (and clarity) was very important to local residents, the specificity of this target did not ensure the success of the TDR program.

- Designation
  TDC programs may require pre-designation or zoning of potential sending, receiving, and/or neutral zones. When zones are designated prior to the implementation of the ordinance, the administering agency has the opportunity to target specific areas for growth and preservation, avoiding haphazard patterns of development and preservation.[127] However, such pre-designation may impinge on the success of the market mechanism, especially when areas do not contain enough potential participants to drive the market. In these cases, it may be more appropriate to establish criteria, which, when met, allow for landowners to receive designation. The San Luis Obispo County program reliance on specific and general criteria for the determination of sending and/or receiving site designation has elicited some criticism from residents. Complaints often surround the fact that responsibility for the determination of designation falls to the TDC Review Committee. Even when additional members are added to this committee,[128] designation decisions will still be made based on a subjective determination of the attainment of criteria. For this reason, it may be most appropriate for the county to consider the pre-designation of sending, receiving and neutral zones.
- Administrative Agency/Jurisdictional Issues
  In many cases, as with the San Luis Obispo County TDC program, multiple agencies are involved in land use decisions. The presence of multiple planning areas (the county is divided into five planning areas), in addition to city and county level interactions often results in increased difficulty in reaching agreements regarding land use. For this reason, areas with complicated jurisdictional issues should consider the use of pre-designation for sending and receiving sites.
- Public Involvement
  A program that solicits public input early in the development process will meet with greater success than one that fails to involve the citizenry, or neglects to invite public comment until late in the process. The Cambria TDC program solicited public input in the form of a questionnaire polling public support and potential participation in the program. Both Calvert & Montgomery Counties in Maryland involved the public in the planning stages of their TDR programs, and the Montgomery County program

[127] Owners with land falling within sending zones may apply for designation to retire development credits (while owners within receiving zones may apply for increased density).

[128] The current review of the TDC Ordinance by the Board of Supervisors is considering the addition of members to the TDC Review Board to increase the objectivity of the Board in making designation decisions.

continues to involve the public through educational outreach efforts. Similarly, the King County, Washington program solicits public involvement by actively recruiting and educating developers in the area. The San Luis Obispo county-wide program has met with a great deal of public dissent, presumably because the county failed to involve the community in the development of the ordinance. Instead of the support enjoyed by the neighboring Cambria program, the county program has met with a fairly intense Not-In-My-Backyard (NIMBY) reaction. The development of a questionnaire to gauge public interest in the program, priorities for preservation, and willingness to pay for the preservation of open space could provide a solution for lack of early public involvement.

- Coordination with Existing Zoning Regulations
  A unique feature of the countywide TDC program is its failure to incorporate the ordinance into existing zoning regulations. Although the ordinance is consistent with the county General Plan, no zoning changes have been made to ensure that TDCs are the only means of increasing density in receiving areas or that sending areas are excluded from density increases prior to TDC transfers. Other programs, including Montgomery & Calvert counties in Maryland exclude all increases in density that don't involve the use of TDRs. The San Luis Obispo County program has not invoked the coordination of zoning regulations due to the voluntary nature of the program.
- Calculation of credits
  There are several ways to calculate the number of credits to be assigned to a particular piece of land. The countywide program relies on an assessed value method to determine the total potential value of a parcel of land in developed use (less the value in current use). This value is divided by a predetermined $20,000/credit value to determine the number of credits assigned to each parcel. These credits can then be sold at the market price. Other programs assign credits on a per acre basis, or depending on the development pressures on particular types or parcels of land. The hedonic model offers the potential calculation of credits using this final method. Utilization of the severity of pressures map[129] to determine the number of credits a parcel should be assigned meets the requirement of preservation of pressured land. Additionally, because the hedonic not only accounts for the locational, but also environmental amenities associated with particular pieces of land, natural resource values may also be considered in this type of credit allocation.
- Credit Banking
  Many TDC programs rely on third party bankers to facilitate exchanges between buyers and sellers. The Land Conservancy of San Luis Obispo County facilitates exchanges for the Cambria program. A bank, possibly

[129] Please see Maps M-2-B-3 (Severity of Pressures) for a visual look at the pressure gradient influencing development on individual parcel pages within the county.

facilitated by the Land Conservancy, is currently under consideration by the Board of Supervisors for the countywide program. There are many benefits of banks, including increased accuracy in record-keeping and instilling public confidence in the TDC programs. Additionally, banks not only serve as a matchmaker between buyers and sellers, but may also serve as buyers of last resort: when sending sites have available credits, but no buyers exist, banks may purchase credits and therefore preserve land from development, even without increases of development elsewhere. On the other hand, banks that facilitate the sale of in lieu credits (the sale of development credits to receiving sites when no sending site credits are available for purchase, in the hope that new sending sites will surface in the future to sell development credits back to the bank) may get into trouble, as evidenced in both the Tahoe and Malibu TDC programs.

To ensure a successful TDC program, adequate incentives must be in place for the program to remain viable. The incentives for the SLO County TDC program lie primarily within the development credit assessment. The issue of the development credit ratios assigned to sending sites for potential transfer is currently being debated. Under the existing structure, the sending site credits are determined by finding the difference in the value of the property with and without the credits (determined by an appraisal). The remaining value is then divided by 10,000 to determine the number of credits. This formula was based on research that shows developers are only willing to pay $10,000 per TDC. The formula does not determine the price of the TDC, which is determined in negotiations between buyers and sellers.

Despite providing adequate incentives for sending site owners, the developers on the receiving end find the current transfer ratio to be uninviting. This downfall can be attributed to the relatively high land value of designated sending sites. Due to growing populations, areas once rural are now very much on the urban fringe, while maintaining a pastoral feel not common in the city center. For this reason, many of these sending sites actually face more development pressure than cites within the urban core. A possible alternative is the location of sending sites farther out in the rural areas, where not only is the land of less developable value (making the transfer ratio more desirable for the developers to partake), but also of equal environmental significance.

The location of lower priced sending sites farther away from urban centers in an effort to even the transfer ratio meets with difficulty in terms of receiving community benefits: Why should a TDC be transferred from an extremely distant rural area to a receiving site within a community where the subsequent density will not result in off-setting benefits? This argument is valid and reveals the inherent problem with the current program. It might be in the best interest for the County to consider the coordination of the TDC program with the "new town" concept. More specifically, the TDC program should begin involving multiple community-

based goals aimed at focusing growth in rural areas that are beginning to experience haphazard growth patterns. In this respect the "proximity" issue would be solved by providing a connection between sending and receiving sites within a given community. Additionally, the prices of sending sites will become more desirable for developers looking to increase density in the receiving areas.

There is also an argument that questions whether or not a truly "voluntary" program like the one in San Luis Obispo will ever be able to provide enough incentive for participants. The Cambria program, which is also considered voluntary, carries with it a mandatory weight. Modified zoning regulations in Cambria forced developers to buy TDCs if they wanted to increase lot sizes due to "maximum lot size" requirements. The SLO program is completely voluntary allowing developers to build in conformance with existing requirements. Successful voluntary programs such as Malibu, CA and King County, WA are different than San Luis Obispo County in that the credit prices are more desirable for developers to increase density.

The existing format for designating prospective sending sites also poses possible problems. Currently, the TDC review committee processes individual sending and receiving sites applications and decides if the criteria are met. This method keeps the public in the dark in the decision-making process and further distances the public from buying in and supporting the program. Further, the ordinance lacks a system of checks and balances, therefore failing to ensure equal application evaluation.

Part II:
Predicting Spatial Pressures of Development Using Geographic Information Systems

Project Objectives

San Luis Obispo County remains primarily in open space use. However, increasing development pressures, augmented by an expected population boom over the next decade[130] will result in increased land conversion potential. Carefully planned growth could avoid the negative externalities associated with urban sprawl.

Planning decisions, within the County, rely on adherence to the General Plan designations and associated land use ordinances. While the goals of these tools are still solid, Geographical Information Systems (GIS) are emerging as the primary tool for land use decision-making. The inclusion of GIS could eliminate some of the subjectivity in the planning process that has, in the past, led to public dissent and litigation. We therefore incorporated this technology, and asked the following questions:

- Where are the greatest pressures for future development?
  One of the primary goals of this analysis is the identification of sites under the most pressure for future development. This analysis is based on the hedonic model, described in some detail below, which determines the value of a parcel of land in residential use, based not only on current land value, but also on community characteristics which have a bearing on the perceived value of a piece of property. For example, we would expect a piece of land within a superior school district and within a reasonable distance to shopping, public services (such as water and sewer) and open space to have a higher value in residential use than a piece of land that borders public nuisances such as prisons or landfills. The hedonic framework therefore assumes that land with the greatest approximated "hedonic" value (in residential use, and considering costs of development) will face the most development pressure. Therefore we can create a map showing the relative development pressure exerted on each land unit within the study. If we can determine areas that will experience the greatest levels of development pressure, these areas can then be compared to development goals within the county, in order to target areas of concern. Additionally, because we have also determined probable values in agricultural use, it is possible to determine which units are the most valuable in agricultural use. These areas

[130] Williamson, Christopher. "Land Use, Growth, and Trends: Tough Choices." San Luis Obispo County 2002 Economic Forecast Seminar Proceedings, 2002.

will face the least pressure for development and can therefore receive little attention (unless of course these areas lie within areas targeted for development). The development pressures map can therefore be used to analyze areas where incentives might be needed to encourage development, whether in the form of a TDC program, or other incentive programs.

- How should sites be chosen for designation in the future given the criteria and available data on land characteristics and zoning?
  Sites applying for designation under the San Luis Obispo County TDC ordinance must meet specific (or in some cases general) criteria in order to qualify. However, because decisions are made by a committee with rotating membership, approvals necessarily involve some level of subjectivity, not associated with TDR programs that predesignate sending, receiving and neutral zones. We were therefore interested in determining whether decisions, processed by the TDC review committee, were consistent with the criteria outlined in the ordinance. Land within the county was therefore analyzed within a GIS framework to determine its suitability for preservation under the ordinance. For example, one of the specific criteria under the natural resources preservation category calls for the designation of a site if it protects the habitat of a federally listed species. Therefore, sites meeting these criteria could be identified within the GIS framework, and compared with sites applying for designation under the same criterion. An alternative to the current method of sending site designation might include the use of a development pressure criterion, at least with regard to future decisions concerning the protection of open space. This criterion can be estimated from the development pressures map
- What policy recommendations can we make given available data?
  This goal hinges on the results of the analysis. However, it is our hope that by analyzing current patterns of development and future development pressures, we will be able to recommend areas of concern, where future planning efforts could be focused. Additionally, based on the observed patterns, we hope to be able to recommend additions or deletions from the current ordinance, relying on a comprehensive review of successful programs throughout the nation.

GIS Pre-Analysis

Current land use

(Map M-1-A)

The current land use pattern within San Luis Obispo County stemmed from post World War II development programs allowing growth to occur near highways and water supply projects (primarily in the western half of the County). Historical land uses other than urban residential and tourist serving uses have been primarily rural ranch lands and over fifty vineyard operations.

Experiencing slow to moderate growth in the past few decades the County has been able to reasonably accommodate the balance between jobs and housing. Recent forecasts have predicted, however, a possible 32% growth in population within the county boundaries in the next decade (approximately 325,000 new residents).[131] Recognizing the potential pressure for increased housing and industry we assessed the current land use within the County.

Our GIS study began by looking at the current land uses for San Luis Obispo County. By using the land use component provided by the County's Building and Planning Department we were able to calculate the percentage of each use compared to the county's total area.

Undeveloped uses: agriculture lands compose over 65% of the County's land, rural lands make up over 14% and open space lands cover approximately 10% of the County's total land area. Many of the rural ranch lands are possessed by only a few different landowners (i.e. George Hearst and Wells Fargo Bank).

Developed uses: public facilities, residential, commercial, and industrial uses compose approximately 4 % of the land use, while areas set aside for urban expansion amount to just under 5 %. The county's remaining 5% of land is made up of recreation, reservoirs, and right of way uses (See Map M-2-B-2).

Current land value

(Map M-1-B)

In order to assess how the land use market is structured in the County, we obtained land values from the U.S. Census 2000, involving redistricted blocks.[132] For the purpose of our model these values are used as the actual purchase value of the

[131] http://www.ucsb-efp.com/publs.htm
[132] http://swdb.berkeley.edu/

individual properties. The values have been displayed visually in Map M-1-B (located in the Appendix), showing spatial land value gradients.

Environmental map

(Map M-1-C)

Environmental factors are presumed to have an effect on land development. San Luis Obispo County has focused many planning efforts to deal with the environmental and conservation goals for the region. Agricultural and open space uses have been recognized as areas for possible future preservation and therefore the County has created general criteria outlining these areas of concern.

In addition to environmental preservation, another area of concern is water availability. Water in the County is a major economic and political concern for many citizens and developers due to its tendency to induce or restrict growth.

Included in the environmental map were locations of: urban centers, railroads, major roads, water bodies, coastal zones, significant resource areas, and slope. We attempted to include factors that are considered both environmental amenities and disamenities.

Neighborhood Amenities

(Map M-1-D)

Location decisions for individuals pertaining to residential uses can be affected by a variety of variables. Many studies have been conducted using transportation factors as an independent variable.[133]

Our study looks at multiple neighborhood variables that could possibly have an effect on optimal residential locations. Neighborhood amenities were mapped to see the location of uses such as: public infrastructure, fire and police, hospitals, schools and central business districts or job centers throughout the county.

Population map

(Map M-1-E)

The population of the county was mapped to see how the residents of San Luis Obispo County were dispersed throughout the area. Population numbers were extracted from 2000 U.S. Census information. The information received from the census was available on the block level. This information was reformatted to accommodate the study's planning units (assessor parcel pages).

[133] Weisbrod, Glen, Ben-Akiva, Moshe, and Steven Lerman. "Tradeoffs in residential location decisions: Transportation versus other factors." Transportation Policy and Decision Making, 1(1), 1980

The population was unevenly distributed throughout the county, primarily located on the western half of the county closer to the coastal areas and state highway 101.

Methods

Hedonic Models

The hedonic model is used to estimate economic values for ecosystem or environmental services that directly affect market value. It is most commonly applied to variations in housing and land prices that reflect the value of local environmental attributes. The basic premise of the hedonic model is that the price of a marketed good is related to its characteristics, or the services it provides. For example, the price of a parcel of land reflects the characteristics of that land — slope, land use type, topology, distance to desirable location, etc. Therefore, we can value the individual characteristics of a piece of land by looking at the price that people are willing to pay for it, and how that price changes when the characteristics change. For instance, there are two plots of land offered for sale in the market. The characteristics of these plots are the same with the exception of slope. The difference of their land prices is 5,000 dollars. We can therefore assume that the contribution of the slope to land value is 5,000 dollars because the buyer is willing to pay 5,000 dollars more (or less) for land depending on the slope characteristic.

The most relevant studies of land value generally apply the hedonic approach to estimate willingness to pay (WTP) for specific land characteristics such as environmental contributions. The hedonic model can be used to estimate the willingness to pay for certain non-marketed characteristics in net benefit and total benefit and to analyze the effects of such characteristics on the price of a good or factor from many exchanges. In the hedonic model, property records are typically very reliable. Data on property sales and characteristics are readily available through many sources. The model therefore adapts to consider several possible interactions between market goods and environmental quality.

Hedonic property value models are often used to derive point estimates for identifying the relationship between environmental quality and property prices by analyzing the effects of locational, structural, and neighborhood variables on the price. The measurement of the environmental quality variable is often selected based on convenience, but variables reflecting different perceptions about environmental quality may result in implicit prices that vary substantially.[134] Hedonic models constructed for this purpose include binary (dummy) variables denoting the presence or proximity of some desirable or undesirable effects. Alternatively, continuous variables measuring the extent of some effects may be included. Such

[134] Michael, H. J., K. J. Boyle, and R. Bouchard. "Does the measurement of environmental quality affect implicit prices estimated from hedonic models?" *Land Economics*, 76 (2): 283-298, 2000.

variables might include distance from a park or the quantity of the pollution reaching a specific lot of land.

The data are analyzed using regression analysis,[135] which relates the price of the property to its characteristics and the environmental characteristics of interest. Therefore, the effects of different characteristics on price can be estimated. The regression results indicate how much property values will change for a small change in each characteristic, holding all other characteristics constant. The analysis may be complicated by a number of factors. For example, the relationship between price and characteristics of the property may not be linear – prices may increase at an increasing or decreasing rate when characteristics change. In addition, many of the variables are likely to be correlated, so that their values change in similar ways. This can lead to understating the significance of some variables in the analysis. Thus, different functional forms and model specifications for the analysis must be considered. [136]

The hedonic method can be used to identify land values for environmental services based on their direct impact on the prices of market goods. This method is most commonly applied to variations in land prices that reflect the value of environmental quality and amenities: by estimating the elasticities of land, the valuation of a property is sensitive to changes for developed use. Hedonic land price indices are created from regression of land value on lot size and locational characteristics. The estimated coefficients are used to calculate a price for land. The rationale for this method is that the characteristics that contribute to value can be applied directly. These indices can be created to measure the movement of land value over time and compare quality-controlled prices among locations. When price equals marginal cost for all products, then both the marginal value of characteristics and fixed-weight price index can be estimated from a hedonic regression.

A Historical Look at Hedonics

Among the different modeling approaches for estimating preferences for housing attributes, the ones that have received considerable theoretical and empirical attention are Rosen's (1974)[137] two-step standard hedonic model, Ellickson's (1981)[138] random bidding model, and McFadden's (1974)[139] random utility model

[135] Regression analysis is a statistical process for fitting a line through a set of data points. It gives the intercept and slope(s) of the "best fitting" line. Thus it tells how much one variable (the dependent variable) will change when other variables (the independent, or explanatory, variables) change.

[136] Function forms include linear, semi-log, double log, etc.

[137] Rosen, S. "Hedonic prices and implicit markets: product differentiation in perfect competition." Journal of Political Economy, 82: 34–55, 1974.

[138] Ellickson, B. "An alternative test of the hedonic theory of housing markets." Journal of Urban Economics, 9: 56–79, 1981.

[139] McFadden, D. "Conditional logit analysis of qualitative choice behavior." In: Zerembka, P. (Ed.), *Frontiers of Econometrics*, Academic Press, New York, pp. 105–140, 1974.

(RUM). Each of these models can be used to generate benefit estimates for changes in environmental amenities. Rosen's model uses evidence of market equilibrium between buyers and sellers of bundled goods to estimate a marginal price for the non-market attributes of the good. The model is based on an equilibrium attained when consumers (buyers) maximize the utility of choosing a bundle of attributes while producers (sellers) maximize utility of profits from producing the commodity bundle. Ellickson's model develops a logit model of the property auction process using the bid rent function rather than the utility function. This approach focused on the landowner's problem of selling to the highest bidder, which is the consumer making the highest bid. McFadden's random utility model is a conditional logit model that treats quality as an index that can be estimated by examining a discrete choice of alternative sites facing a consumer.

In a recent study, Chattopadhyay (1998)[140] finds that the willingness-to-pay (WTP) estimates obtained using the standard hedonic and the random bidding approaches are quite close, implying that either approach can be successfully adopted for benefit estimation. Mason and Quigley (1990),[141] carry out an extensive comparison of benefit measures derived from the conditional logit and hedonic models, using Monte Carlo simulation. They find that, under different assumptions for market and error conditions, the hedonic technique yields benefit estimates of marginal changes that are as good as those obtained using the conditional logit model. The conditional logit model is suitable when the response variable is a set of alternative choices measured on a nominal scale. It is typically employed in the case where variables are the characteristics of the choices, often called attributes of the choices. Cropper et al. (1993),[142] in a simulation exercise, find that the conditional logit technique yields better benefit estimates of non-marginal changes than those obtained using the hedonic technique. This paper also provides similar evidence regarding the performance of the nested logit model relative to the hedonic model.

Some papers have indicated that environmental contributions may have both positive and negative effects. Mieszkowski and Saper (1978),[143] Damm et al (1980)[144] and Uyeno et al (1993)[145] analyzed the effects of airport noise on housing prices and

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[140] Chattopadhyay, S. "An empirical investigation into the performance of Ellickson's random bidding model, with an application to air quality valuation." Journal of Urban Economics, 43: 292–314, 1998.

[141] Mason, C., Quigley, J.M. "Comparing the performance of discrete choice and hedonic models." In: Fisher, M.M., Nijkamp, P., Papageorgiou, Y.Y. (eds.), *Spatial Choices and Processes*, Elsevier-North Holland, Amsterdam, pp. 219–246, 1990.

[142] Cropper, M.L., Deck, L.B., Kishor, N., McConnell, K.E. "Valuing product attributes using single market data: a comparison of hedonic and discrete choice approaches." Review of Economics and Statistics, 75: 225–232, 1993.

[143] Mieszkowski, P. and Saper, A.M. "An Estimate of the Effects of Airport Noise on Property Values." Journal of Urban Economics, 5(4): 425-440, 1978.

[144] Damm, D., Lerman, S.R., Lerner-Lam, E. and Young, J. "The response of urban real estate values in anticipation of the Washington Metro." Journal of Transport Economics and Policy, 14(3), 1980.

[145] Uyeno, D., Hamilton, S.W. and Biggs, A.J.G. "The density of residential land use and the impact of airport noise." Journal of Transport Economics and Policy, 27(1), 1993.

found that housing located in areas of high airport noise are associated with considerable sales price discounts. A similar analysis, followed by Ridker and Henning (1968),[146] Brookshire et al (1982)[147] and by Graves et al (1988),[148] has been carried out to examine the influence of levels of air pollution on house prices. Jimenez (1982)[149] found low WTP for in-house water and toilet facilities for a slum in Manila, Philippines.

Basis for GIS-based Land Use Modeling

GIS models were originally utilized within a planning framework in an effort to increase the objectivity of land use decisions. Our model was originally based on a discussion and analysis of land-use development patterns with respect to water quality issues by Bockstael and Bell.[150] This discussion focused on the pattern of land use change as a result of natural features and local land-use policies in Anne Arundel, Prince George's, Charles, and Calvert Counties in south-central Maryland, and their subsequent potential effect on water quality in the Chesapeake Bay area using a GIS-based model.

The values of land in agricultural and residential uses will determine the likelihood of land conversion from one type of use to the other. For the most part, economists are concerned with the conversion of agricultural land to residential land, as this is the most likely outcome with increased population growth. The potential values of this land for agriculture (referred to in the Bockstael paper as W_U) and residential (W_D) use can be determined based on a series of variables that we can infer relate to potential values. Bockstael and Bell determined estimates of W_U with a separate model mainly as a function of soil type; we estimate W_U with a hedonic model as a factor of distance to market, slope values, and proximity to other current agriculture, among other factors. W_D is determined using a hedonic model measuring distance to urban centers,[151] distance to coastline, and proximity to a myriad of other potential desirable and undesirable uses. The models can follow the linear form,

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[146] Ridker, R. and Henning, J. "The determinants of residential property values with special reference to air pollution." Review of Economics and Statistics, 46: 246-257, 1967.

[147] Brookshire, D.S., Thayer, M.A., Schulze, W.D., and D'Arge, R.C. "Valuing public goods - A comparison of survey and hedonic approaches." American Economic Review, 72(1): 165-177, 1982.

[148] Graves, P., Murdoch, J.C., Thayer, M.A., and Waldman, D. "The robustness of hedonic price estimation - Urban air quality." Land Economics, 64(3): 220-233, 1988.

[149] Jimenez, E. "The value of squatter dwellings in developing countries." Economic Development and Cultural Change, 30: 739-752, 1982.

[150] Bockstael, N. and K. Bell. 1997. "Land use patterns and water quality: the effect of differential land management controls." In: Richard Just and Sinaia Netanyahu, (eds.*), International Water and Resource Economics Consortium, Conflict and Cooperation on Trans-Boundary Water Resources*. Kluwer Publishing, 1997.

[151] Bockstael and Bell use the cities of Washington, D.C. and Baltimore; for our purposes urban centers are the clusters in and near San Luis Obispo County with a population greater than 15000.

$$W_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \beta_3 X_{i3} \ldots + \varepsilon_i ,$$

where W_i represents the potential value of a particular area of land; X represents a potential amenity or disamenity; β represents the slope values (relative impacts, or distance elasticities) from the various amenities/disamenities, and ε represents the potential error in calculation of value for the parcel page (or other land unit).

Probability of land conversion can then be determined by comparing the values of W_U and W_D. Ideally, we would assume that we only observe a portion of variables (V) that affect the net worth of land and include a random portion (η) that we cannot predict. From this, we can assume that the probability of land conversion for parcel *i* follows as the discrete choice model:

$$\Pr(development)_i = \Pr(V_{iD} + \eta_{iD} > V_{iU} + \eta_{iU}) .$$

When it is likely that land is more valuable in residential use (after considering the development costs for building on the land), we can predict that the land will probably (but not always) be converted to residential use. This also means that the ideal price for preserving land for agricultural use (or for alternate uses, such as open space) would be enough to make the land more valuable for the owner in its current uses rather than for development. In place of this sort of discrete choice model, we have made some assumptions about the potential development pressure on a parcel of land by measuring its potential value for residential use, and comparing that to value for agricultural use.

Several potential problems arise when developing a model of this sort. Most significant are the use of a linear model for potentially nonlinear variables, as well as spatial autocorrelation, a common problem when dealing with spatial GIS data of this sort. Bockstael and Bell attempted to compensate for spatial autocorrelation by computing the regression using an alternate method, the generalized method of moments (GMM), and comparing the results to the original ordinary least squares (OLS) regression. Bockstael and Bell concluded that the differences in the results between the two regressions was negligible, and in fact it was possible that the compensation for spatial correlation actually blurred some of the spatial distinctions of the variables, particularly open space. Because of potential missing variables in the estimation, as well as possible problems with autocorrelation, these hedonic models only capture some of the potential valuations, as measured by the R-squared value. Bockstael and Bell's model had an R-squared value of 0.5316, capturing about 53% of the possible valuation data by using their hedonic model.

Bockstael and Bell continue their discussion by comparing the potential change in development probabilities as the result of different zoning regulations across the several counties they studied. They suggest that varying policies across counties can have an impact on comparative development between them.

Other GIS-based spatial models

GIS models have also been used to attempt to assess ecological viability as well as economic viability. Lathrop and Bognar[152] used a GIS model in negotiations concerning development inside the Sterling Forest in southern New York, which has some ecologically sensitive areas, contains a portion of the Appalachian Trail, but yet is still close to New York City. This model used variables expressing development suitability (due to soil or slope issues), distance from water or wetlands, distance from development, visibility from major hiking trails, and known sensitive habitat areas to express overall ecological sensitivity and public value of the Sterling Forest area. While the negotiations did not preserve all of the lands considered as sensitive by this model, it was used to help construct a conservation buyout that would protect much of the Sterling Forest.

Geoghegan, Wagner, and Bockstael[153] approached the Maryland area studied by Bockstael and Bell from a more ecological perspective, using the same data to calculate potential descriptors for the ecological value of the landscape using formulae indicating potential fragmentation, landscape diversity, fractal dimension,[154] and so forth. Irwin and Bockstael[155] revisited the Maryland results from Bockstael and Bell and Geoghegan *et al.* and attempted to compensate for spatial autocorrelation in a more methodical fashion. Open space was broken into private and public holdings, similar to our model, although percentage of proximate open space was used for the analysis. A particular focus of the model was placed upon the characteristics of the individual houses being developed and the neighborhoods. Further comparison of our results with these models is given below.

Potential benefits from open space

One issue that continues to be debated and examined in the literature is the proper value that should be assigned to open space. Bockstael and Bell concluded that residential value increased with proximity to open space – but also increased with proximity to developed use, perhaps because of the correlation between that and the urban centers nearby. It is uniformly suggested that open space must have some proper value for economic analysis, if open space is to be preserved at all. If nothing

[152] Lathrop, Richard G. and John A. Bognar. "Applying GIS and landscape ecological principles to evaluate land conservation alternatives." Landscape and Urban Planning, 41: 27-41, 1998.
[153] Geoghegan, Jacqueline, Wagner, Lisa A., and Nancy Bockstael. "Spatial Landscape indices in a hedonic framework: an ecological economics analysis using GIS," Ecological Economics, 23: 251-264, 1997.
[154] Fractal dimension is a method of exploring the variability of boundary lines between different regions. The idea is based on the fact that a straight line is one-dimensional, a square is two-dimensional, and a cube is three-dimensional; thus, a curved line could be said to have a dimension more than 1 but less than 2, and so forth.
[155] Irwin, Elena G. and Nancy Bockstael. "The Problem of Identifying Land-Use Spillovers: Measuring the Effect of Open Space on Residential Property Values." American Journal of Agricultural Economics, 83(3): 698-704, 2001.

else, the perceived benefits of being near open space should have some economic value assigned to them.

Potential benefits include:

- Scenic Value. Perhaps the most obvious, tangible benefit to preserving open space is the ability to gaze upon lands that remain green and relatively untouched. People are more likely to live near scenic areas if possible – if other factors don't intervene. In addition, scenic value may allow for the influx of money from tourism, as in the parks throughout San Luis Obispo County and the United States.
- Soil Preservation. Natural environments, preferably undisturbed by agricultural cultivation, are better able to retain topsoil and reduce erosion from other areas.
- Ecosystem Preservation. Available open space can act as a nature reserve for plants and animals of all sorts, endangered or not. This could also encourage the development of game to be hunted or fished.

The Model

In our model, we use a double-log functional form to predict the relationship between land value and environmental characteristics. Chattopadhyay (1999) used a flexible functional-form approach and found that the double-log hedonic price function performed the best and was the simplest form to use in estimating the marginal and the non-marginal WTP measures.[156] This model regresses the log of parcel page prices on a log combination of environmental and socio-economic characteristics. The log functional form is therefore given by:

$$\log P = \beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2 + \ldots\ldots\ldots + \beta_n \log X_n + \varepsilon$$

Where P is the land value; β_0 is the intercept of linear regression; β_i is the coefficient of the variables; X_i are the variables; and ε is the error.

Variables

In one version of the hedonic model, land value variations are measured by the coefficients of a series of location-specific variables. Variable selection can significantly affect these estimates. Moreover, the relative importance of variable selection varies by variable type (land specific, neighborhood specific, community specific and environmental specific). In order to estimate the environmental contribution of the land value, we used data from the same county and assume that characteristics of social conditions are fixed. Table 2, located in the Appendix, describes the variables used in the model, and the expected impact of each variable

[156] Chattopadhyay, S., "Estimating the demand for air quality: new evidence based on the Chicago housing market." Land Economics 75: 22–38, 1999.

on the regression. Variables were chosen based on potential influence on land value and availability of data.

The majority of independent variables rely on spatial data. They are transferred to a distance measure[157] when estimating the hedonic price function because differentiation of the estimated function with respect to the distance provides an estimate of the WTP to live further away from the desirable or undesirable locations. Therefore we used a distance model[158] that assumes a continuous relationship between distance and land value. The distance model assumes a continuous gradient in land value as distance from the locational variable increases. The advantage of this assumption is that the hedonic price function is easy to interpret. The disadvantage is that it is likely to be correct only to the extent that the perceived risk declines continuously with distance from the location. If effects are localized then the simple distance model may misspecify the true relationship and cause biased inferences about the role of individual variables in the determination of hedonic land value.

Data Collection

Most data collected for analysis was obtained through the San Luis Obispo County Department of Planning and Building (SLOCDPB),[159] which currently maintains GIS data for the county. This data was projected in State Plane – California Region V, North American Datum (NAD) of 1983, and length was specified in feet. The projection for California Region V has been defined as:

- Projection: Lambert Conformal Conic
- 1st Standard Parallel: 34°02'00"
- 2nd Standard Parallel: 35°28'00"
- Central Meridian: -118°00'00"
- Origin (Latitude): 33°30'00"
- False Easting (meters): 2000000
- False Northing (meters): 500000

State Plane was developed by the United States Geological Survey (USGS) in 1937 to facilitate land use mapping on local (countywide) scales. Many county maps before the advent of GIS used the State Plane system, and it is still often used for county-level planning decisions. Because this projection was used for the majority of the data gathered in this analysis, and in order to facilitate further correspondence with the Department of Planning and Building, this projection was chosen for the data analysis below.

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[157] Distance measures and variable values for each parcel page are calculated by ArcView and transferred to an Excel document.

[158] Dale, L., *et al.* "Do property values rebound from environmental stigmas? Evidence from Dallas," *Land Economics*, 75 (2): 311-326, 1999.

[159] http://www.slonet.org/vv/ipcoplng/

Supplementary data was received from The California Spatial Information Library (CaSIL),[160] namely for location information of state and regional facilities, as well as the California GAP database,[161] namely for environmental information and land ownership information. Data from both of these sources was converted from the Albers projection chiefly used by the State of California into State Plane – California V using the ArcView 3 Projection Utility Wizard.

Digital Elevation Map (DEM) data used in this analysis were received individually in 7.5-degree USGS quads from the GIS Data Depot[162] and combined manually. The process involved conversion from SDTS format to standard DEM format, and combination of the grids using the join feature in ArcInfo. Additional processing was needed for certain quads of data to convert eastern portions of the county from Universal Transverse Mercator (UTM) 11 to UTM 10, and to convert the height of certain quads in the northeastern parts of the county from feet to meters to match the rest of the quads. When joined, the grid file was then converted from UTM 10/meters to State Plane – California V/feet using ArcInfo's conversion utility. Small but negligible errors may have been introduced into the elevation file because of these conversions, but could not be avoided given the nature of the data involved. ArcView 3 was also used to develop some supplemental data for use in calculations. Files that were specifically created for use in this project are listed separately from the other files in Table 3, located in the Appendix.

All data used in this analysis, unless otherwise restricted, will be given to the SLOCDPB for further use in evaluating the county's land use and policies. California Polytechnic State University also has planned to make the Department of Planning and Building data available to the public through the Internet.[163] Table 3 includes a list of all data files obtained and utilized throughout the course of the project, as well as our reasons for believing them useful for our calculations.

Selection of Appropriate Unit of Land Measurement

Of particular concern in all land use studies is the unit of analysis. Although the most appropriate unit of analysis might be the level at which transactions take place, data is not currently available for the entirety of San Luis Obispo County at the individual parcel level. Additionally, parcels may not always be the legal unit for land transactions, but may be designated only for tax purposes. Finally, it is much safer politically to avoid pinpointing particular parcels in an analysis. A unit that encompasses land in varied ownership is much more readily accepted than one that targets specific legal lots. Therefore, four alternatives were considered:

[160] http://www.gis.ca.gov/
[161] http://www.biogeog.ucsb.edu/
[162] http://www.gisdatadepot.com/catalog/US/61069/1993/
[163] http://discover.lib.calpoly.edu/gis/

1. Planning Watersheds: Watersheds are commonly used in ecological planning activities, as they tend to take a whole system approach to an area. The borders of these planning units mimic, to the greatest degree possible, actual ecological borders. Use of this unit would stress ecological goals above economic and/or development pressure considerations. Data is not currently available for all variables in this format. Additionally, the size of this unit is considerably larger than that of other alternatives being considered for this analysis.
2. Census Block Groups: This unit of measurement is used in United States Census calculations. Therefore population, employment, land value and other data regularly reported in the Census is currently available in this format. Census Block Groups have no uniformity in size or shape, and are instead smaller in area in locations with greater population density. Additionally, this unit of measurement is not commonly used in ecological planning, due to its variability and failure to contain various important ecological features with any consistency or continuity.
3. Assessor's Parcel Pages: The assessor's office breaks the county into a grid system. Each parcel page contains a number of individual parcels. However, because some parcels are larger than others, parcel pages, although of uniform shape are not of uniform size. This grid system is, however, readily available from the Land Conservancy of San Luis Obispo County.[164] Additionally, this system, because it is parcel-based, is the most closely related to the unit currently used in land transactions, without invoking concerns over ownership. Because of this relationship, a permit tracking system may be linked up to the parcel page map, which facilitates further analysis, should it become necessary. However, like the census block groups, the assessor's parcel pages are not the most appropriate unit for ecological management goals.
4. Uniform Grid: It is possible to develop a uniform grid in ArcView, which would partition the county into rectangles of equal size and shape. The benefits of this approach revolve around equal treatment of area throughout the county, regardless of current zoning and/or population density.

Each of these units of assessment has particular pros and cons associated with the project. Therefore, in order to determine the most appropriate unit, an Analytic Hierarchy Process (AHP) was implemented. This process involves several steps, which are outlined below.

Brainstorming of relevant criteria

The first step in the decision-making process is the determination of criteria upon which to base the final choice of planning unit. A brainstorming process resulted in a list of 10 criteria chosen to determine the most appropriate unit. The alternative

[164] Parcel pages are not available in digitized form from the County Assessor's office, however the Land Conservancy had previously digitized this data for their own analyses.

best able to meet the majority of criteria, and weighted according to criterion importance is therefore the unit of choice. Criteria considered included:

1. Units used in land-use decision-making and/or transactions: Based on a need to use this tool for future land use planning, implementability of results (and therefore ease of transaction) becomes paramount. It is our hope that the data complied in this analysis may be used in future land use planning decisions.
2. Data available on consistent basis for all units: In some cases, as in the case of parcel level data, some data is available (for some areas in the county, but not for others) but not for the entire study area.
3. Data available in usable form (digitized): In some cases, data was available but had not been digitized or was otherwise not usable for the type of analysis being conducted.
4. Units large enough to manage for ecological goals: Because one of the goals of the ordinance is the preservation of significant natural areas, we must consider whether the chosen unit can account for things like connectivity of habitat and adjacency issues.
5. Not too many units: A reasonable number of units will facilitate avoidance of computational hassles.
6. Planning units compatible with data available: Data came from a number of different sources (please see Data Collection) for use in this analysis. It is therefore important that data, if not currently available for the chosen unit, can be transformed into the chosen unit of measurement.
7. Uniform size and shape (of units): Important because heterogeneity among units is being compared, additionally, uniformity leads to better utilization of results by interested agencies. This criterion also related to the ease of data manipulation in the GIS.
8. Context of planning unit (as related to ecological management): This is an important consideration, because in the case of the TDC ordinance, even after development rights have been transferred, the landowner retains management obligation over resources for which credits have been issued.
9. Ecological continuity with regard to boundaries: Relates to the consistency with which planning boundaries mimic ecological borders.
10. Small enough to capture local gradients in values (small enough to capture heterogeneity in landscape): One of the primary aims of the hedonic model used was to measure changes in value from unit to unit, therefore this goal is of extreme importance in determining the validity of the analysis. If the unit fails to capture value differences, the results of the model become insignificant.

Combine variables into several categories

The next step in the AHP process involves grouping criteria into several categories. Preferences can then be assigned to a general category rather than an individual criterion. This step is most useful when a project involves a large number of relevant criteria. Because this analysis only involved 10 criteria, preferences were determined

at both the category and individual level. Groupings are therefore organized as follows:

Data Availability

2. Data available on consistent basis for all units
3. Data available in usable form (digitized)

Size

4. Units large enough to manage for ecological goals
5. Not too many units (computational limitations)
10. Small enough to capture local gradients in values

Data Compatibility

1. Units used in land-use decision-making and/or transactions
6. Planning units compatible with data available

Definitional Variables

7. Uniform size and shape (of units)
8. Context of planning unit (as related to ecological management)
9. Ecological continuity with regard to boundaries

Weighting of criteria

Criteria and/or criteria groups are then assigned a numerical weight based on a binary comparison, where each criterion (or category) is weighted with regard to all others. Through this pair-wise comparison we determine whether an individual criterion is: absolutely better, critically better, very strongly better, strongly better, definitely better, moderately better, weakly better, barely better, or equal. These qualitative preference rankings correspond with number values on a scale of 1- 9 (1 being equal and 9 being absolutely better). For example, because criterion 10 (Small enough to capture local gradients in values) is essential to the performance of the model, we consider it *definitely better* (5) than criterion 5 (not too many units), which only relates to our preference for ease in computation. A complete table of weighted preferences is located in Table 4, in the Appendix.

Scoring of Alternative Systems

Once the individual criteria had been preferentially scored, we rated the four alternatives with respect to how closely they met the above criteria, again using a pair-wise comparison. For example, the Planning Watershed Alternative most

completely meets criterion 9 (Ecological continuity with regard to boundaries), therefore when compared to the Census Block Alternative, for this criterion, the Planning Watershed performs *absolutely better* (9). A complete table of these pair-wise rankings is located in Table 5, in the Appendix.

Results of AHP Analysis

A software package, Criterion DecisionPlus, was utilized to complete the AHP process. Based on the series of criteria weightings and alternative rankings, the unit that most completely meets the criterion deemed most important for the purposes of this analysis (small enough to capture gradients, units used in land use decisions/transactions and availability of data) is chosen. While the other alternatives certainly meet several of the criteria (ecological continuity and context of planning unit, for example) better that the chosen alternative, these criterion were not considered the most essential. Figure 4 shows the relative influence that each criterion had in determining the appropriateness of each alternative. The end result of this process is an alternative that best fits the criteria as weighted. Figure 5, below, shows the relative weighting of each alternative given the assigned weights. Clearly, for the purposes of this project, the most appropriate planning unit is therefore the assessor's parcel page.

Figure 4: Contributions by Criterion to Best Planning Unit

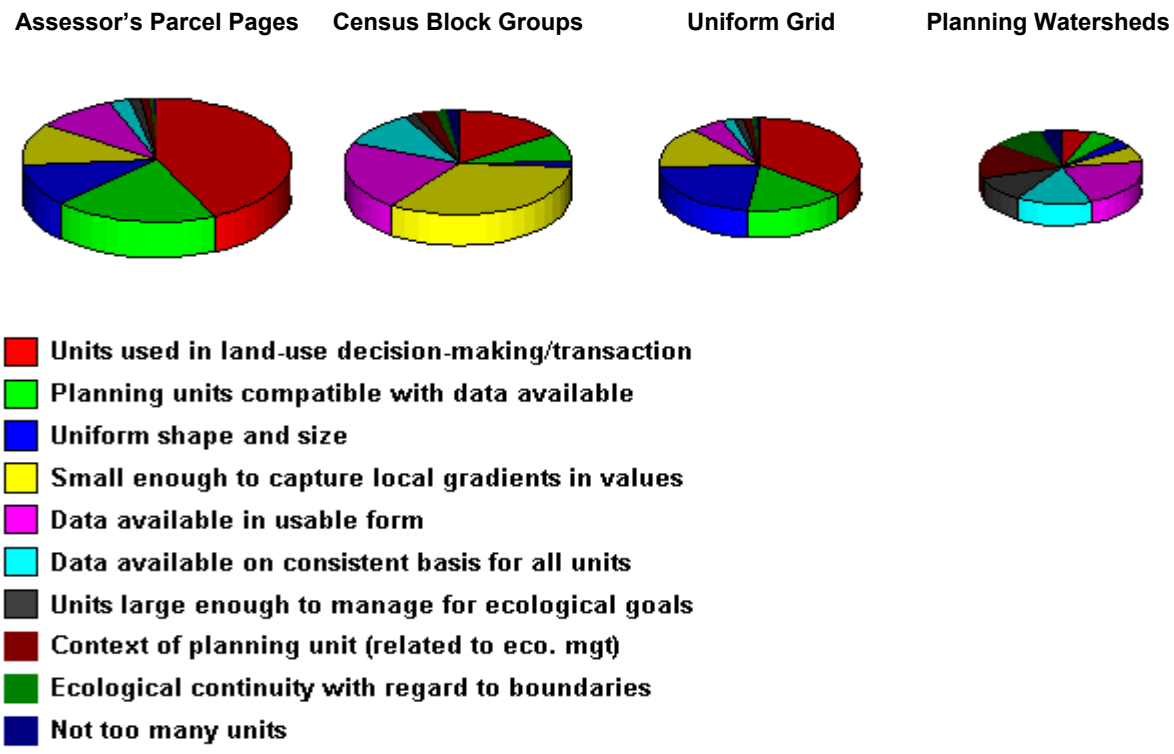
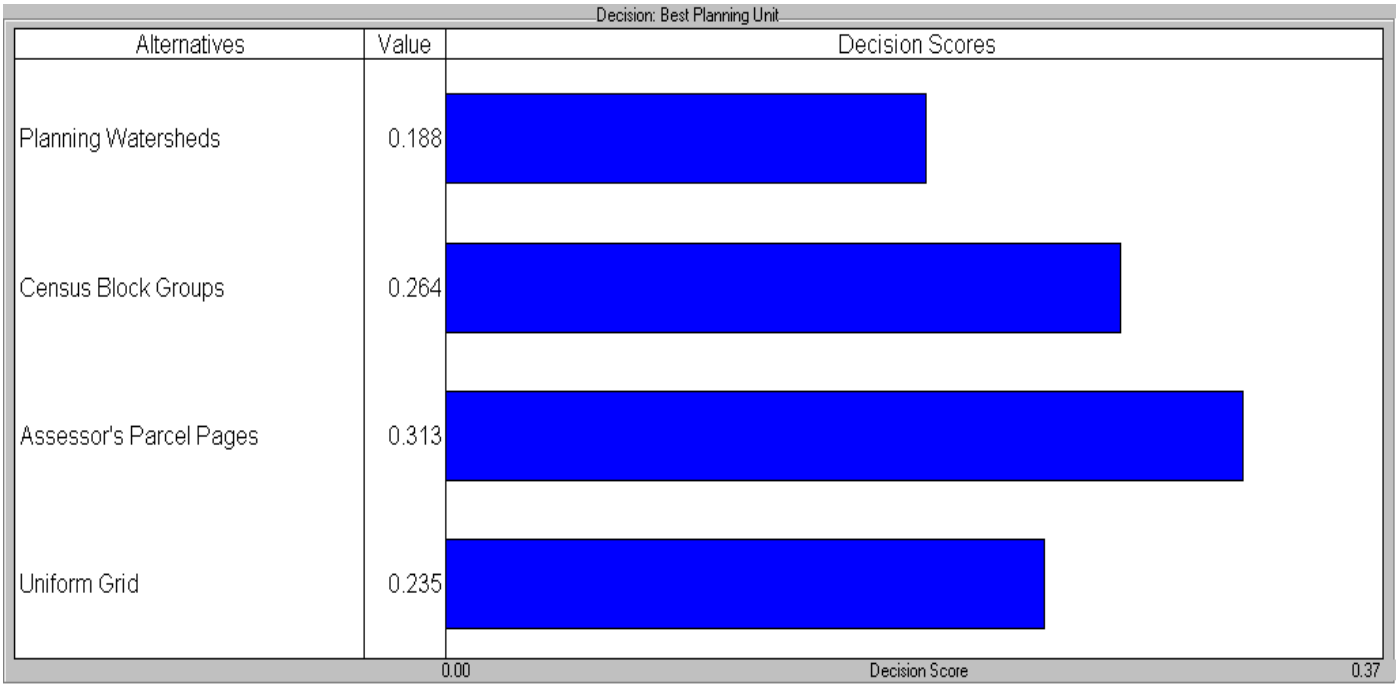


Figure 5: AHP Decision Scores



The Regressions

The majority of the variables used in this analysis represent amenities or types of use that can be measured as located some distance from parcel page. These distances are then calculated for each parcel page for each variable. A regression is then run to determine the relative influence of each of these variables on land value. Land value, available from census data in terms of transactions for land sales, and alternately from the county assessor's office, for land in agricultural, rangeland, or vineyard use, is the dependent variable. The resulting values for beta are the coefficients that are then used to calculate land value in alternative use (residential or agricultural). Regressions were then analyzed to determine whether variables are significantly impacting land values. We were looking for values of at least 0.35 for R^2.

The Residential Hedonic

Four scenarios were chosen for final regression analysis and input into the GIS. These scenarios varied by the inclusion (or exclusion) of the Taft cluster as an urban center and the population density variable. For the purposes of simplicity, we have labeled them in the following manner:

Run 1: Includes Taft cluster in the calculation of distance to urban center and excludes the population density variable (Please see Appendix R-1 for full regression report)

Run 2: Includes Taft cluster and the population density variable (Please see Appendix R-2)

Run 3: Excludes both the Taft cluster and the population density variable (Appendix R-3)

Run 4: Includes only the population density variable and excludes the Taft cluster in the calculation of distance to urban center (Appendix R-4).

The Taft Cluster

Urban centers were defined as areas with a population in excess of 15,000. The Taft cluster, on the southeastern edge of San Luis Obispo County, actually has a population of 14,921.[165] It was therefore excluded from preliminary analyses. However, because we wished to determine whether any changes in development pressure might result from the inclusion of a city center on the eastern side of the county, we did include it in 2 scenarios, one with and one without the population density variable (runs 1& 2).

Population Density Variable

An initial concern over the inclusion of the population density variable was excessive influence on predicted land values. In several separate runs, the inclusion of this variable was found to add as much as .06 to the R-squared variable, and the significance coefficient showed that density was accounting for as much as 50% of the final value (therefore affecting our model too much). Therefore, we ran two scenarios (Runs 1 & 3) where population density was excluded as a predictor.

In considering which scenario is the most appropriate, it is important to consider the theoretical basis for urban sprawl. People want to live near centers of commerce, but they hate living in high-density areas, particularly in a rural region like SLO where there's plenty of land for the taking. Therefore, population density actually should factor into the model, and a great deal of influence is actually the expected result. Therefore, the models that included the density variable were considered foremost in our conclusions, and those without the density variable were analyzed to determine the general non-population-based pressures in San Luis Obispo County.

Model Fit

We looked at several models with different forms (double log, semi-log and linear) and found that the double log relationship resulted in the greatest value for R^2, indicating that this model is the most appropriate for the data being analyzed (has

[165] http://www.taft-chamber.org/statistics.html

the best fit). R^2 values for the linear model ranged from 0.465-0.488,[166] depending on the exclusion of certain variables, while the semi-log model produced R^2 values ranging from 0.488-0.509. The double log model resulted in R^2 values ranging from 0.604-0.668. The double-log regressions with lower R^2 values omitted selected variables, including school, hospitals, law enforcement and fire stations. In addition to the support from the data, previous studies have analyzed the fit of various models to the hedonic framework. Chattopadhyay clearly showed in his paper that the double log model is the most appropriate for this type of analysis.[167] Comparing the four model scenarios as mentioned above, Runs 2 & 4 show the best fit, as the independent variables explain almost 67% of the variation of the dependent variable. In contrast, the independent variables in Runs 1 & 3 explain 60.4 % of the variation of the dependent variable.

Significance

Table 6, located in the Appendix, reports the regression results of our hedonic residential model. We were looking for a significance value of 0.05 or smaller, indicating that we can be 95% certain that values for b are significantly different from zero. The results suggested that nine variables are not significant in the analyses of all four scenarios. They are Airports, Coastal Zone, Fire Stations, Slope, DEM, Industry, Flood, Government Owned Land and Urban Centers parameters.

- The *airport* potentially exerts both positive and negative influence on the land value for convenient access and noise pollution concerns.
- The *costal zone* is subject to a variety of restrictions on use. Although coastal property often sells for a premium, developable coastal land is at a minimum in the county.
- *Fire stations* may have a strong correlation to proximity to urban centers. Besides, many rural areas do have fire stations within a reasonable proximity, often run by volunteers.
- Regarding the *slope* and *DEM* (elevation) parameters, the terrain in San Luis Obispo County is quite varied, and there is therefore no consistent relationship between slope and land value. In addition, although land may be located at a relatively high elevation, it may be of a more appropriate grade for development than land at lower elevations (or vice versa).
- The government owned land, one kind of the open space, is insignificant in this analysis. It may be due to its vary distribution in the county.
- The insignificant results of distance to *urban centers* is unexpected. The majority of land available for conversion is some distance from the urban or city centers, and instead is in closer proximity to small town cores. Amenities commonly associated with proximity to city center (such as employment, shopping, health care and education) are actually available with greater regularity, and therefore close proximity to the city center may

[166] Regression results for linear and semi-log model relationships available upon request

[167] Chattopadhyay, S. "Estimating the demand for air quality: new evidence based on the Chicago housing market." Land Economics, 75: 22–38, 1999.

actually be an impediment to active daily life (traffic, congestion, open space, etc). Additionally, this variable would have high correlation with other variables, therefore reducing the significance of urban center variable.

As expected, schools, roads, faults, rural (rangeland), vineyard, agricultural are fairly significant, implying that they are the most important factors for predicting pressures for land development.

- Parents generally consider the distance their children will have to travel to *school* when preparing to purchase land for residential development.
- *Roads* offer convenience and accessibility to individuals located nearby.
- The further a piece of land is from a *fault*, the more valuable it becomes.
- Land bordering rural *vineyard* and *agricultural lands* will have a higher value than land further away from these land use types. This is consistent with the American Dream of owning land on a large lot where children can play and dogs can run and consistent with the pattern of sprawl that has been proliferating in the county.

The results suggested some unexpected relationship between development pressures and some predictive variables.

- Generally we would expect to see a positive relationship between the *Water Bodies* variable and land value. However, because the majority of these "water bodies" are actually small streams, there is no real amenity associated with "stream front property" as might be expected were the water body a lake or river. Additionally, many of these "water bodies" are located within government-owned land where land is considered virtually "undevelopable". This additional constraint on conversion may be influencing the affect of this variable in the model.
- Unlike roads, which simply offer convenient arteries to and from major population centers, *highways* also constitute a noise pollution nuisance. The positive relationship between distance from roads and land value indicates that this nuisance has more effect on land value than the convenience offered via ease of travel. Additionally, the main highways in the county are generally used to travel through the county, rather than within it, and therefore would not be expected to be as attractive to potential residents as roadways.
- We would generally expect that land located nearby *parkland* would have a higher value, due to its proximity to open space. However, there is a positive relationship between distance from parks and land value. The map shows that the parks are located far away urban uses where the majority of high land values are clustered. We can therefore assume a convenience value: people who live near parks, because they exist at a great distance from urban centers, would be faced with decreased levels of convenience.

The *population density* variable was included in Runs 2 & 4 of the model. The reports show that this variable has very high t value in both regression results. In addition, it has a very high beta value of standardized coefficients, which indicates that the population density variable has the greatest affect on land value. The

parcels with high population density, like urban areas, show the highest values in residential use. Adding this parameter would affect some variables. *Golf* and *Presumed Rangeland* variables are no longer significant when the population density variable was included in the model. This is due to high correlation between these two variables and population density variable. Further, the *railroad* and *landslides* became significant after adding the population density variable. Because there is only one railroad track and a relative infrequency of landslides throughout the county, these variables do not cause a significant disruption to the majority of land, and are found in higher density regions of the county. Therefore the inclusion of the density variable reveals the true significance of these predictors.

Agricultural Hedonic Model

In our Agricultural Hedonic Model, we considered two regression relationships, in one case combining agricultural and vineyard open space use,[168] and in the second separating these variables. Unlike Residential Hedonic Model, the urban center variable and population density variable are not included in the Agricultural Hedonic Model. Therefore, Run 1 of the Agricultural Hedonic (See Regression R-5) remains constant in all four scenarios.

Significance

The result showed that all variables are significant except water sources parameter. It may be due to the fact that irrigation is subsidized and therefore relatively inexpensive for farmers in this state. Therefore, proximity to water sources does not greatly increase the value of land in agricultural use. The result suggested that proximity to roads increases the value of land in agricultural use due to the fact that farmers must have the capacity to transport crop output at the end of the growing season. Easy access to roadways therefore offers a convenience to agricultural land use. Further, lots situated on gently sloping land are better suited to agricultural use than land on steeply sloping hillsides. In addition, proximity Vineyards and agriculture does tend to increase land value. This is fairly consistent with the pattern of sprawl that has been proliferating in the county.

Land may continue to be used for "urban" purposes some distance from the urban center (this area is generally constrained by the urban reserve line). We would expect land to increase in value (for use in agricultural cultivation) as it moves away from land in urban use. However, we see an inverse relationship (-1.26×10^{-2}) between distance and urban use, perhaps due to the fact that when farmland is located further from city centers, crop output must be transported for greater

[168] Please see Regressions R-5 & R-6 for full reports for Runs 1 & 2 of the Agricultural Model.

distances, resulting in inconvenience and increased cost to farmers.

GMM Model Output

Similar to Bockstael and Bell, we have used a Generalized Method of Moments (GMM) estimation to check the values of our model in the presence of persistent spatial autocorrelation and variable autocorrelation, consistent problems in dealing with GIS-based distance models. In order to determine the proper weighting matrix for the data, we used an iterative *n*-step process with a Newey-West spectral density matrix using a GMM analysis package developed for Matlab[169]. This process recalculated the weighing matrix until the difference in sensitivity was 10^{-7}. Several starting points were input for the original weighing matrix, to assure that the matrix values converged on the same point no matter what the original start was. A sample result (Table 8, located in the Appendix), shows the results similar to OLS for Run 4, considering population density and excluding the city of Taft.

The GMM model results indicate the relative statistical importance of scenic variables (elevation, parks, distance to open space) over amenities (hospitals, schools). However, of the significant variables noted by the model, only some of them have values that we consider explainable. For example, strong positive slope values for golf courses, fire stations, and water bodies suggest that people do not want to live near these locations, which is unexpected as these services are generally considered positive amenities. These results do not correspond with the relatively small and statistically significant slope values using our linear model.

However, some interesting trends do emerge from this model. Specifically, we see that people do not like living near areas of high population density, but want to be near urban centers, which could potentially create a condition of low-density sprawl away from urban centers. The fault values suggest a heavy dislike of living near fault lines, potentially due to development costs, which is to be expected; the elevation value, which we believed might suggest potential scenic views, suggests that this might in fact be the case. People like to live near roads but not near highways, similar to our other results.

Many of the GMM results are similar to our OLS Run 4, the model run similar in treatment of the test variables. This model shows more significance for open space variables, such as pastures; the OLS model shows more significance for agriculture and vineyards. The OLS model's slope values are more consistent with what we might expect to see from a residential value model, with fewer large beta values, like golf courses in the GMM model[170].

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[169] The package was developed by Mike Cliff at Purdue University and is available freely on the web, http://www.mgmt.purdue.edu/faculty/mcliff/progs.html. We thank him for developing the model, which is relatively easy and quick to use for determining linear models.

[170] The exact reason for the golf value being high in the GMM model is curious, and might be because the relationship is more quadratic than linear: presumably it increases housing values somewhat

Comparison With Previous Models

Our model encompassed approximately 26 variables related mostly to amenities on the land: proximity to business, school, and open space, as well as safety variables and potential scenic values from slope or ocean proximity. To some extent, this model was also a test of the relative significances of the variables in determining land values. While the model performed quite ably in creating an impression of development pressures around San Luis Obispo County, it did not come without flaws and potential hindrances. Unfortunately, because of several problems with creating a valuation model like this, it may be difficult to determine how significantly the flaws hinder our model calculations.

Relevant Characteristics for Property Value:

Amenities, Zoning, and Design

Based on a literature review, our method for determining value based on relative proximity to amenities or disamenities remains relatively unique. Other models have focused on different methodologies as to how housing or land prices (and thus possible land conversion) are formed. Direct comparisons to previous models are unfortunately somewhat difficult as a result, although basic known characteristics (for example, distance to business centers and access to roads) can be compared and used as potential benchmarks for determining a "true value" for these characteristics across all analyses. A table including common variables between our model runs and other studied models is given as Table 9, located in the Appendix.

Bockstael and Bell constructed their model on an assumption of zoning characteristics and county location, the latter presumably being a measure of legal structures and other qualities that differed between the counties studied. They studied both distance to local towns and distance to large cities in the area (Washington, D.C. in this model), and found both to be significant, although the distance to Washington, D.C. played a smaller role in land values than distance to more local towns. The nearest metropolis to San Luis Obispo County is Los Angeles, some 4 hours away by car, and we did not feel it was appropriate to consider Los Angeles in our model, as we assume that Los Angeles exerts little development pressure on this county (in contrast, Ventura County, which contains several suburbs of Los Angeles, has seen significant development pressure). Bockstael also included calculations for shopping centers, something we could not accomplish with the data available. Her open space variables center on locations for cropland, pasture, and forest, and do not distinguish between private and publicly held lands. Most importantly, Bockstael and Bell note that the use of GMM removes the

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nearby, but not directly nearby. It could also be that golf courses are acting as a proxy for population density or current development, as all 3 of them are located in developed or urban areas, near Paso Robles, Morro Bay, and Nipomo.

positive effect of open space – though their results suggest that it only reduced their model significance, and did not change the beta values much. The beta values for open space in Bockstael and Bell are relatively small, something that subsequent models confirm, although whether the values are positive or negative is still being debated and is discussed below.

Geoghegan *et al.*'s model focused more on configuration of lands surrounding the housing unit as open space or development, as well as specific demographic variables that would vary over space, such as racial characteristics and income. They observed that open space values, such as land diversity, fragmentation, and proximate amount of open space to the household, had some statistical significance and impact on land values, though these significances varied based on the location's relative rural and urban characteristics. Demographic values were found to always be statistically significant, as well as lot size for the household and specific location for the household by county as well as by distance to Washington, D.C. Again, beta values for open space values (0.0036 for a 0.1km buffer; -0.034 for a 1.0km buffer), as well as fragmentation and diversity, remain relatively small. Geoghegan *et al.* included specific calculations of land configuration, potentially useful for calculating overall ecological health of the land, which we could not include due to inexact data on current development of the San Luis Obispo County area. More analysis of remote sensing data, such as comparing the California GAP database with aerial photography, would allow a better comparison with Geoghegan *et al.*'s results. Currently, we cannot confirm the potential amenity of open space availability (we focus on distance to open space instead of amount nearby), fragmentation, or diversity. Geoghegan et al. also included a quadratic model including the interactions between some of their variables, which does show some evidence that these interactions are quite significant in and of themselves. This holds potential for future analyses.

Irwin and Bockstael build on one conclusion of the Geoghegan *et al.* model, that individual characteristics of houses and neighborhoods are significant in determining housing values. Irwin and Bockstael's model assesses specific housing characteristics, such as number of bedrooms, number of bathrooms, lot size, and date of sale, in determining the potential value of houses. While this will explain specific housing prices in developed areas and helps to explain the potential increase of land value based on what is built on it, it may not capture general landscape-level trends or property values as well as our model. In addition, their model treats all variables as likely amenities without necessarily considering disamenities like water quality. Irwin and Bockstael also use a system of instrumental variables to attempt to compensate for spatial autocorrelation, as well as to assess conversion probability[171]. Irwin and Bockstael treat the amenities that we use to calculate land prices as spatially-autocorrelated errors in their model. An ideal model calculating housing and land values, and thus development pressures,

[171] This system of instrumental variables supposedly takes into account some of the properties potentially examined by our model, including slope value and soil quality. However, it is unclear in the paper exactly what variables were used to accomplish this model calculation.

likely needs to incorporate both the individual characteristics of the Irwin and Bockstael models with the amenity variables that we discuss in this paper.

Our model focuses more on amenities that are related to location – proximity to useful services or values, focused more on a landscape level similar to Geoghegan *et al.*'s model. Please note that we did not use dummy variables in our analysis, instead focusing on distance as a proxy for access to the variable. This also plays a role in our results: a negative beta value is considered to be an amenity, as those locations closest to the variable receive the most value from it. Models using dummy variables, or, alternately, look at percent configuration of space around the individual points, are likely to end up with positive beta values, as it considers the presence of the variable as an addition to value. This does not mean, of course, that one or the other approach is right or wrong for modeling the variable (indeed, constructing dummy variables may gain our model more clarification); however, it again complicates comparisons between models. In addition, like Bockstael and Bell's paper, we try to use land values for residential and agricultural use to create a matrix of development pressure, though we do not use a random discrete-choice model, instead settling on simply comparing the two sets of values to show potential development pressure, which can and will change over time due to inclusion of new roads, schools, urban centers, and so forth.

A model that tries to account for development pressures similar to ours comes from Pfaff *et al*[172]. Their model tries to account for where to put biological reserves in the face of uncertainty, focusing on Costa Rican tropical forests. Pfaff et al. create development pressures for conversion of forest land to agricultural use based on "lifezones," which can be considered a combination of soil, moisture, and temperature types similar to an agricultural hedonic. They combined these values with socioeconomic data and agricultural prices to create an OLS model able to better analyze Costa Rica' s targeted reserves. Although the conversion studied is deforestation for agriculture rather than open space conversion for residential use, the application is similar in methodology, and suggests that the GIS-based tool we have developed may potentially be adapted for a large scale of conversion issues beyond its current use for residential development.

Comparison of Basic Common Variables

Our models' slope values differed greatly on the value of distance to towns, although our value in Run 4 (-0.163) and the GMM model (-0.249) are both statistically significant and similar to Bockstael's value (-0.290), although all values of our models were less than Bockstael's, potentially due to the addition of amenity variables missing from the Bockstael model. This value also holds for Geoghegan *et al.*'s distance to Washington, D.C. (-0.172), although distance to smaller towns was

[172] Pfaff, Alexander, Sanchez, Arturo, and Suzi Kerr. "Deforestation Pressure & Biological Reserve Planning: An Illustrative Application for Costa Rica." Working Paper, 2001. http://www.bren.ucsb.edu/fac_staff/fac/kolstad/events/workshop_5-01/papers/pfaff.pdf

not considered in that model. Irwin and Bockstael also used distance from Baltimore (0.058) and Washington, D.C. (-0.063) but not smaller towns in the area, and these urban values seem closer to Bockstael's original estimates for distance to the major metropolitan areas and are similar to our results for Runs 2 (-.07), and 3 (-.098). The difference between the lower and higher model values is interesting, and may deserve future study.

What Role Does Open Space Play?

Bockstael, through her papers with Bell, Geoghegan *et al.*, and Irwin, consistently argues that open space must have some part to play in determining residential values, adding value to a specific parcel based on the amount of open space near the parcel. We would argue that does not necessarily have to be the case.

Bockstael and Bell used cropland, pasture, and forest as potential proxy values for open space. In each, the beta values were low, with pasture and forest representing increases in residential value as well as higher density areas, a factor that they associate with spatial autocorrelation between the density values and the city values. Their GMM model changed the beta values associated with the open space values slightly, but more specifically reduced their overall t-statistics and thus statistical significance in the model. They argued that this loss of significance was due to the blurring of spatial patterns by the use of the GMM model. This contrasts greatly with our GMM model, which in general made our open space variables (parks, rangeland/pasture, government-owned land, and rural lands) more statistically significant, not less.

The Geoghegan *et al.* model uses a quadratic model to attempt to explain variable interactions between variables. As stated earlier, this approach ideally might explain the spatial interactions between variables more clearly than a pure linear model. Most specifically, the introduction of interaction between diversity and fragmentation with distance from Washington, D.C. made their values statistically significant when in a purely linear model they were not. The problem with Geoghegan et al.'s quadratic model lies in two places: first, if interactions between variables are included, the number of potential interactions to observe becomes effectively (number of variables)^2, which could be quite cumbersome. Secondly, the quadratic model does not significantly improve predictive value, as noted by the R-squared value (0.4744 for the linear model; 0.493 for the quadratic model).

The Irwin and Bockstael linear model initially comes up with a negative value for private open space, suggesting that it detracts from housing values. In the belief that this is an underestimation of private open space values, instrumental variables are applied to the linear model based on other potential factors, and the open space values increase (from -0.007 to 0.06) and become statistically significant. Their other beta values for publicly-owned space (0.03) and privately-owned conservation areas (0.21) remain similar before and after the application of the instrumental variables and statistically significant, although the sharp increase in

value for land near private easements is particularly interesting. (Perhaps value increases as a belief that land near private easements will also be bought?) However, because of differences in how these variables are structured, it is difficult to compare their values to our model values, although the two are notably different.

A difficulty in the Geoghegan *et al.* and Irwin and Bockstael models is their use of buffer zones to calculate amount of proximate local space. Geoghegan *et al.* use buffer zones of 0.1 km and 1.0 km from the data points (and sometimes get drastically different results between the two); Irwin and Bockstael use a 0.4km buffer area. No reason is given in either of these papers as to why these values were chosen for buffers, and it is not clear that a particular value for a buffer zone is the "best" for determining value of open space.

No matter what, the role that open space plays is generally relatively small in all models[173], particularly compared with more development-oriented variables like roads and city access. This relatively small value suggests the potential for the open space value to change depending on which variables are included or excluded from the model, as with the differences in our four runs. It may be that unaccountable variables play a factor in whether open space is found to be beneficial, and no model (none of the models studied nor our own) can necessarily account for all these "missing variables."

Spatial and Variable Autocorrelation: How Significant?

All the reviewed papers attempted to account for correlation between their variables in some fashion, because spatial and variable correlation both have effects that may blur which variables are truly significant to the model and which are extraneous. None of these models specifically list their autocorrelation factors, and such would not be expected in research papers.

For the research papers studied, the alternate-model approach often created similar results, which allowed for the linear model to gain some amount of trust in how it determines statistical significance and model values. Bockstael and Bell dismissed their GMM model for blurring values that, in effect, depended on spatial correlation, and removing significance from open space values as a result. Geoghegan et al.'s quadratic model made some space configuration values more significant, but did not necessarily account for autocorrelation other than by examining the interaction of distance with open space variables, with some success. Irwin and Bockstael's results from the use of instrumental variables did not change their results significantly outside of open space values, and it is unclear what variables were used for their calculation. However, not much attention in any of these models is given to inter-variable autocorrelation (bedrooms in a house are

[173] Geoghegan et al.'s quadratic model sees a beta value of 0.207 for diversity and 0.337 for residential use, but neither of these specifies open space as such. Percent open space (1 km buffer) in the quadratic model is −0.109, which was statistically significant but detracts from residential value.

related to its size, population density is related to city location, and so forth), which could bias results further.

Our model, unlike these other models, has some differences between the attempted secondary (GMM) model and the primary (OLS) model. Our variables are significantly correlated both to each other and across spatial boundaries, meaning that any results could be potentially significantly biased. Our GMM model removed the significance for infrastructure like schools and hospitals, although this could potentially be due to a misrepresentation of quality of care from a distance model. The GMM model also added significance to most of our open space variables and significantly elevation, which we thought might significantly affect housing values due to development costs and scenic amenities. However, the beta values for our GMM model can vary significantly from the OLS model (water bodies, golf courses, elevation, fault zones) or sometimes vary little to not at all (population density, road access, open space). Further examination of the reasons behind this difference are necessary, including potentially a redefinition of the infrastructure variables to emphasize density or quality of use.

Potential Model Flaws

Our model relied on proximity measurements to determine the effect of services and other amenities on land values. However, a more appropriate measure might have been quality of service or density of coverage. This type of analysis would have required a calculation of, for example, the number of teachers per student in a particular school district. Additionally, air quality, which we believe does have an impact on land values[174], was not measured as a model variable due to the fact that data was only available on a point source basis. Soil quality was also not examined, due to incomplete data on the county level in the national SSURGO database.

Other housing valuation models and conversion models, particularly within the United States, have used the parcel as the unit of analysis, particularly because most land transactions are accomplished at the parcel level. Our model could not use parcels, as GIS-based parcel data for San Luis Obispo County was unavailable for much of the county. While parcel-based analysis might have offered a more detailed level of description, it may, in fact, only have reduced the scale. Because parcel lines are not fixed in time, a more "general" analysis may actually be more useful. Instead, as discussed previously, we tried to use a level of analysis similar to parcels, and opted on parcel page data, for which we did have countywide availability.

We cannot escape the problems of serial spatial and variable autocorrelation in our model, which alters the potential significance levels of individual variables and perhaps creates difficulty in determining which variables are truly significant. This

[174] See, for example, Harrison, David, Jr. and Daniel L. Rubenfeld. "The Distribution of Benefits from Improvements in Urban Air Quality." Journal of Environmental Economics and Management, 5(4): 313-332, 1978.

is something that can be controlled only to a certain extent before one might make assumptions about the data that might not necessarily be true. More research needs to be done on how to better account for correlation problems; however, in spite of autocorrelation, our model does give results that can be used for policy decisions.

We also lack the more detailed house and subdivision data available to Irwin and Bockstael, who rightly suggest that housing quality plays just as much a role in relative prices as other values. We also lack demographic data, although that can be obtained from the 2000 Census and added to our model fairly easily.

Model Output

Results from the regressions of the final four scenarios[175] include beta values, which are used to determine the relative influence of each variable in the calculation of land value, either in residential or agricultural (open space) use. Values for beta[176] and parcel page values for each variable are then input into both the residential and agricultural hedonic model to determine new land values in both uses.

Comparison of current land value and hedonic agriculture land value

Compared with the current land value,[177] the values estimated from the hedonic agriculture model increase when parcel pages border particular open space areas such as presumed rangelands, rural lands, government owned lands. However, the land value seems to decrease when parcel pages are in close proximity to other open space uses, including agriculture, vineyard and parks areas. Additionally, areas near urban uses, with high population density, result in lower land values, as estimated by the agricultural hedonic model. Moreover, proximity to transportation services such as railroad and highway exerts a negative influence on land value. These results show that farmland located further from city centers is valued less because crop yield must be transported over greater distances; therefore creating increased costs to farmers and other inconveniences.

Comparison of current land value and hedonic residential land value

We compared four hedonic model runs to predict land value in residential use throughout the County. The results show that the hedonic residential land value increases in areas of high slope and elevation. The same trend is evident in the eastern half of the County, which is mostly rangeland. Many of these eastern

[175] Again, the final four scenarios chosen for analysis included: Run 1: includes Taft cluster; Run 2: includes Taft cluster and population density variable; Run 3: Excludes both the Taft cluster and the population density variable; and Run 4: Includes the population density variable.
[176] Regression results for the final four scenarios are located in Appendices R.1-4.
[177] Current land value is taken fromthe 2000 U.S. Census.

regions are held within government ownership, and are areas of particular ecological sensitivity. We might therefore expect that they would exhibit lower residential land values. Land near schools, law enforcement and urban uses has a lower value in residential use, as predicted by the hedonic model. This trend may be attributed to the exaggerated beta significance of these variables as determined by the model. Alternatively, we may be accounting for the lack of future development potential, due to the fact that these lands already support high density uses. In addition, the lands near coastal zones and water sources exhibit lower values in residential use.

As mentioned above, the population density variable, included in Runs 2 & 4, significantly affects our results. In comparison with the current land values, the inclusion of the population density variable results in higher values in residential use. Conversely, in Runs 1& 3, the hedonic residential land value in high population density areas proves to be lower than current land value. This may be due to the fact that population density plays a very important role in the regression; therefore significance may have been overstated.

Residential and agricultural predicted values had a fairly similar range, with the exception of four parcel pages in agricultural use. These top values exceeded $425,639 and were located within urban reserve lines. We have therefore excluded these values as outliers.

While values in agricultural use may be taken directly from this model, residential value must also account for the cost of conversion to developed use, in order to directly compare these predicted values. This cost of development does not involve the actual cost of house construction, but land specific conditions that may result increased cost of conversion to developed use, such as presence of infrastructure, slope, elevation, and soil type. Because the calculation of development cost using these separate predictor variables would have complicated the land use model, a linear model for development cost was constructed, such that costs of conversion are assumed to increase with distance from the urban center. While this does not explicitly account for variables such as slope and elevation, we can assume that, because urban areas are generally located in valleys, areas in closer proximity to urban centers will be situated on flatter land. Additionally, land closer to city centers is more likely to have access to public infrastructure, further decreasing the costs associated with conversion. Therefore, values in residential use all include a linear component of cost associated with distance from urban use. Urban use was chosen over the urban center variable to account for services that often extend outside of specific city borders.

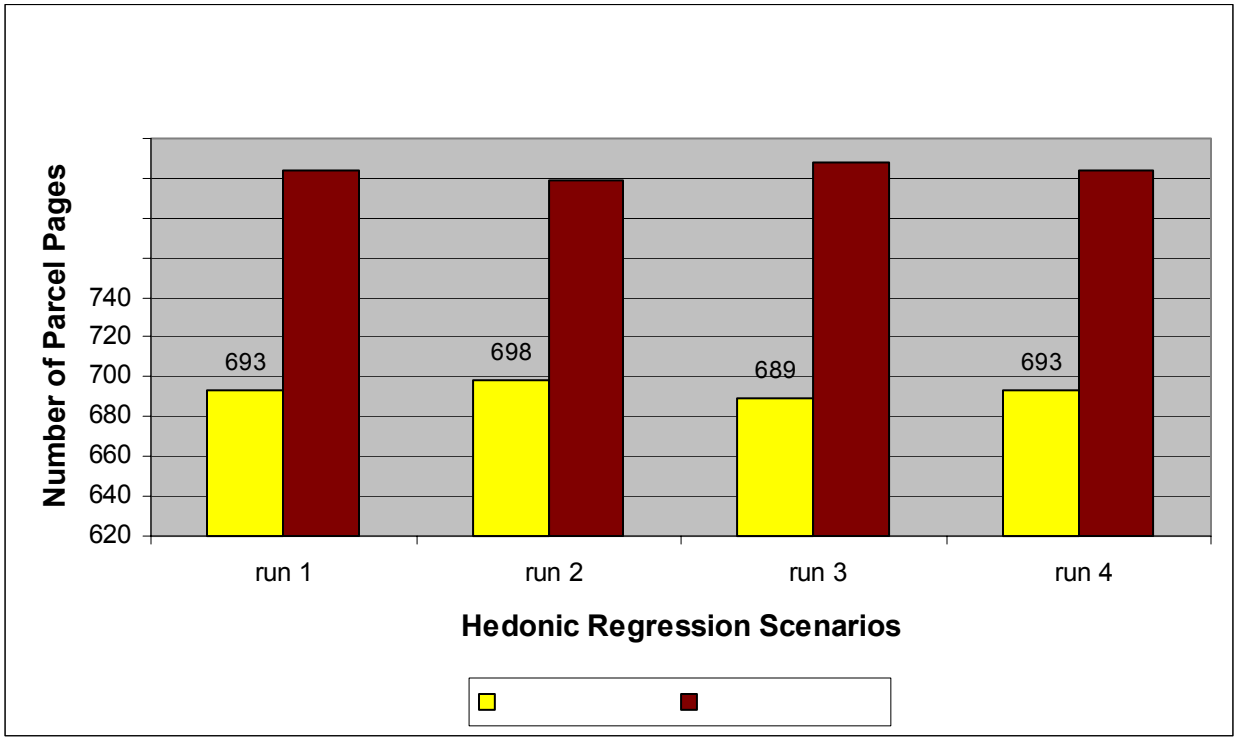
Following the calculation of residential and agricultural use values for each parcel page, these values[178] are then compared using an *IF* function in Excel. *If* value in residential use is greater than value in agricultural use, the function returns a value of *residential*. In this way we are able to determine if there is sufficient

[178] Hedonic model data and calculations are available upon request in Excel format.

development pressure on land to result in land use conversion.[179] Figure 4, below, shows a visual representation of the IF function output. Of course, this model assumes that land being analyzed may be developed and does not account for any zoning or LCP restrictions that may impede conversion to developed use.

While it appears the all the scenarios resulted in very similar development pressures (similar numbers of parcels falling into both categories), the location of pressured parcels actually proves to be quite different when mapped (see GIS output for more details). However, the fact that 650+ parcels in a county with only 4% of land currently in urban use[180] are facing development pressure is significant. This fact, coupled with a predicted population increase of 79,000 by the year 2010[181] makes the threat of rural land conversion very real.

Figure 6: Results of *IF* function: Parcel pages falling in either Residential or Agricultural Use



In order to further determine the relative pressure faced by the land within each of these parcel pages, a *severity of development pressure*[182] was calculated. This calculation simply created a gradient based on the difference between land value in

[179] Alternately, if value in agricultural use exceeds hedonic value in residential use, we can assume that the land will remain in its current use and does not face significant pressure for land use conversion.

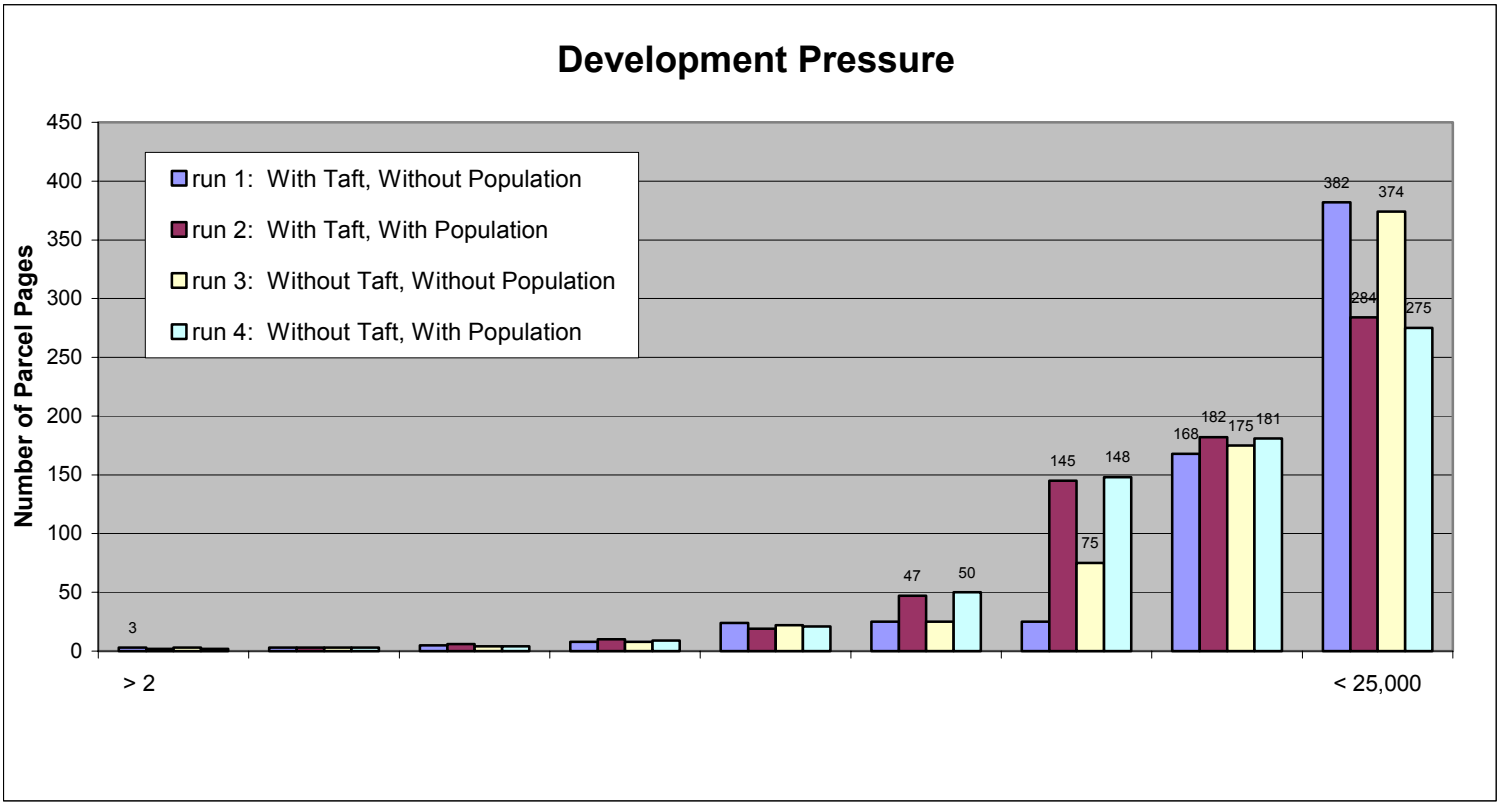
[180] See GIS Output in the following section for more details on how this number was calculated.

[181] Williamson, Christopher. "Land Use, Growth, and Trends: Tough Choices." San Luis Obispo County 2002 Economic Forecast Seminar Proceedings, 2002.

[182] Calculations of development pressure for each run are available upon request.

residential use and value in agricultural use. The greater the difference between residential value and agricultural values, the greater the development pressure in that particular parcel page.[183] Figure 5 is a visual representation of the severity of development pressure, calculated in this manner.

Figure 7: Development Pressure on Parcels Showing Probability for Conversion



Severity of pressure is divided into 9 value-based categories to determine the relative number of parcel pages facing varying level of development pressure. On the high end of development pressure (›$100,000) all four scenarios show similar results. However, Runs 2 & 4 show a greater number of parcels facing pressures with values between $50,000 and $100,000.[184] These two runs included the population density variable. A related pattern is obvious for runs 1& 3, showing more parcel pages with development pressure of less than $25,000. However, this analysis again simply looks at the total number of parcel pages facing varying levels of pressure and does not look at the distribution of this land throughout the county.

[183] Severity of pressure was only calculated for land showing the probability of conversion to residential use, as we assume little to negative pressure in areas with a probability of open space preservation.

[184] Such a pressure gradient means that predicted value in residential use was $50,000-$100,000 greater than predicted value in agricultural or open space use.

Therefore, our next step was to input this data into the GIS for a spatial analysis of development pressure.

GIS Output

Because the final analysis actually considered four model runs (Runs 1-4), separate maps were created for each scenario. Additionally, San Luis Obispo has approved 6 sending for development credits transfer in addition to 4 receiving sites. The locations of these sites are included on all maps in this portion of the analysis. The purpose of mapping these approved sites is to determine whether or not existing sending sites fit the Transferable Development Credits ordinance criteria. Additionally, we can determine whether approved receiving sites fall within urban areas, or at least areas receiving the greatest development pressures.

Predicted land value from hedonic model

The hedonic model output, described in the previous section, includes both the predicted value of land in residential and agricultural (open space) use. Again, the units of measurement used for the analysis were assessor parcel page units (described in detail in "Selection of Appropriate Unit of Land Measurement," pg. 81).

Residential value (minus cost of development)

(Map M-2-A-1.1, run 1; Map M-2-A-1.2, run 2; Map M-2-A-1.3, run 3; and Map M-2-A-1.4, run 4)

In general, the residential hedonic shows that areas closer to urban areas and major roads have a higher predicted value in residential use, most likely attributed to the neighborhood amenity locations seen in the Pre-Analysis Study (Map M-1-D). Even in the less urbanized eastern part of the county, this pattern of greater value bordering major roads is maintained.

In order to accurately compare predicted values in alternative uses, cost of development was subtracted from the residential land values to determine true value in developed use. Furthermore the inclusion of the population density variable resulted in higher values in residential use.

Agricultural value

(Map M-2-A-2)

The distribution of agricultural values varied from the residential value map. Ag values did not follow the same pattern (higher values near major roads) as strictly as the residential values. The distribution of Ag values, however, revealed a degree of

clustering, with higher predicted agricultural use values closer to the urban fringe areas. These areas typically coincide with the existence of agricultural commodities and other existing ag/ranch uses. While residential values varied by scenario, the same agricultural model was used in all four runs.

Land change probability

The probability of land conversion is derived from the calculations of land value in alternative uses. The probability model determines whether residential or agricultural use would be of higher value for a specific area. If value for a particular parcel page is higher in residential use (than in agricultural use) then the map displays the area as a residential designation; meaning that this land will be likely to be converted to residential if it hasn't been already, and vice versa for agriculture.

Probable land use: Residential vs. Agriculture

(Map M-2-B-1.1, run 1; Map M-2-B-1.2, run 2; Map M-2-B-1.3, run 3; and Map M-2-B-1.4, run 4)

The display of development probability provides an in-depth assessment of not only where development pressures are located, but where residential development might seem the most reasonable given the specific land characteristics of the land unit.

Additionally, Significant Resource Areas (SRAs) are included on the map in an effort to compare the location of these areas with development pressure. When SRAs overlap with predicted areas of development (residential areas on the map) these areas are likely to receive pressure from development, and should possibly receive planning priority, if resource preservation remains a goal of the agency. There are many areas that SRAs are showing development pressures and are displayed in Map M-2-B maps.

The probability of land conversion displayed an interesting pattern. The land most likely to be converted to residential (developed) land[185] did appear close to urban use areas and major roads. There were, however, areas away from urban centers that showed a tendency towards residential conversion. This can be attributed to the specific amenity variables such as infrastructure availability and other services ideal often associated with optimal residential locations.

The inclusion of the population density variable, because it has such a strong influence in the regression analysis, overwhelms the model with density driven land pressure. While such conversion pressure is certainly important when considering land use decisions, some areas will face development pressure extraneous from population influences. Whether this pressure stems from inclusion of a particular

[185] Land most likely to be converted to residential use includes parcel pages where value in residential use exceeds value in current, or open space use.

parcel in an antiquated subdivision, or the proximity of land to a particularly attractive environmental amenity, this land may face just as much, if not more, pressure for land conversion, as a parcel facing population density driven development pressure.

Additionally, the inclusion of the Taft city center, in scenarios does show a slight increase in development pressure in the eastern portion of the county. However, any changes in development pressure are minimal, and possibly contain some bias due to the reliance on distance measurements. Therefore, while these maps may indicate that the inclusion of Taft may be pulling some density to the east, Taft certainly does not exert such pressure that it would draw development pressure away from the other major urban centers considered in this analysis.

Developed/Undeveloped Land

(Map M-2-B-2)

This map displays the current patterns of development that exist within the county, indicating the percentage of each parcel page that contains developed use. Pages shown in blue are considered completely developed, while those in darker oranges have the highest percentages of development. This map could be useful in determining target areas for future receiving sites. Areas in the mid-orange ranges are only partially developed. Those pages falling in close proximity to urban centers could therefore receive increased density without venturing too far into the open space reserve. Comparing this map to the maps showing development pressure (Appendices M-2-B-1 & 3) could help a planning agency to focus future targets for increased density throughout the county.

Severity of development pressure

(Map M-2-B-3.1, run 1; Map M-2-B-3.2, run 2; Map M-2-B-3.3, run 3; Map M-2-B-3.4, run 4)

The severity of pressure is calculated by subtracting the predicted value in agricultural use from the predicted residential use value. Resulting values therefore may indicate the degree of likelihood that land within a particular parcel page, if pressured for development, will actually be converted. Higher values indicate a greater probability that land will be converted – value in residential use is much greater than value in its current agricultural use, and therefore from an economic and financial standpoint, it makes sense for the owner to develop this land. This map can therefore be used by a planning agency to determine areas where the greatest pressure for conversion exist. If these areas also fall in areas targeted for preservation, priorities can be set.

In contrast, areas showing the greatest negative values are the most likely to remain in current (open space or agricultural) use for the longest period of time. Because

value in agricultural use is so great, the threat of land conversion is minimal (or in this case, negative). Therefore, a planning agency can ignore any threat of conversion related to these areas, at least in the short term.

Conclusions

The GIS model produces a development pressure gradient and identifies probable sites for future land conversion. After analyzing the TDC ordinance and integrating our GIS model, we are able to observe current approved sending sites for appropriateness of designation.

Sending Site Criteria

Do approved sites fall within the designated land use ordinance?

Sending Sites are aimed at preserving and protecting:

-Agricultural Resources
-Natural Resources
-Antiquated Subdivisions

The TDC committee has approved six sending sites throughout San Luis Obispo County.

1. Bonnheim Sending Site

The site is composed of 7,200 acres and includes 52 certified legal underlying parcels.
Bonnheim is located on Chimney Rock road west of Paso Robles and is bordered on the north by Lake Nacimiento. Zoning for this property includes both agricultural and rural lands designations. If built-out the lot could hold 104 single-family homes.

After running the land conversion probability model, the Bonnheim Site is clearly prone to development pressures (see map M-2-B-1.1). The pressure varies slightly, however, in the four scenarios. The Bonnheim site is not being pressured by the forces typically associated with urban amenities but affected more by the rural residential amenities (scenic, large lots) usually proliferating rural fragmentation.

This site meets the criteria for protecting antiquated subdivisions, not to mention many natural resources. Despite not being located within a significant natural resource area, the Bonnheim Ranch has been identified by the California Department of Fish and Game as precious oak woodland wildlife habitat. Retiring development credits from this site easily meets the TDC sending site criteria.

2. AJM Properties Sending Site

The AJM property consists of 726 acres and is located east of the City of Paso Robles. The uses on the site are equestrian-related and include barns, stables, and irrigated pastures. There are 76 underlying legal lots from a 1924 subdivision.

The land conversion probability model showed the AJM properties as having moderate development pressures (see map M-2-B-1.2). The development pressures can be attributed to the location of major roads in close proximity to the site as well as other services such as transmission lines, and other rural amenities.

The site did not vary in development pressure with or without the presence of population density. The site does not fall within a significant natural resource area, and does not specifically merit protection regarding environmental threats. The County considers the area an Agricultural Preserve.

The AJM site meets the TDC criteria primarily due to the high level of antiquated subdivisions on the property that divide the property into 10-acre lots. 122 Credits were assigned to the property using the assessed value method.

3. Wilkins Sending Site

The Wilkins property is composed of 160 acres containing 16 legal parcels. This site is adjacent to the AJM property listed above. Like AJM the Wilkins property displays moderate pressure of land conversion (see Map M-2-B-1.2). The development pressures can be attributed to the location of major roads in close proximity to the site as well as other services such as transmission lines, and other rural amenities. Population density does not seem to have a significant effect on the development pressure associated with this specific property.

There are no significant natural resource areas within the properties limits. There are open grasslands, vineyards and alfalfa uses on the Wilkins site. The agricultural criteria of the ordinance could be met, however, the sending site designation is justified primarily through the presence of antiquated subdivision.

4. Denny Sending Site

The Denny sending site, located southeast of Paso Robles, contains 52 acres and one underlying parcel. The land characteristics include both flat and rolling terrain composed of grassland, oaks, and riparian habitat. The site in question displays significant pressure (see map M-2-B-1.3), both with and without the population density variable.

The Denny property qualified as a sending site due the threatened agricultural resources, namely productive soils that are currently used as vineyards. Despite

not being located within a significant natural resource area, the area did merit protection under general criteria for wildlife and scenic resources. The property did not qualify through the antiquated subdivision criteria.

5. Laetitia Winery Sending Site

The Laetitia Winery is located on Highway 101 southeast of Arroyo Grande. The property contains 1,995 acres of grassland, oak woodland habitat, riparian habitat and vineyard land. The property contains 21 underlying legal lots, with a potential for 40 new homes. The property does not show significant land conversion pressure in accordance with the probability model (see map M-2-B-1.2). Additionally, population density is not a factor in determining development pressure for this site.

The TDC committee approved the site based on the general criteria of wildlife and scenic resources being present on the property. Portions of the property were also considered ideal for protection due to extreme slope and erosion possibilities. Additionally, this property is ideal for protecting open space between urban communities (buffer), though that goal is not listed as a part of the TDC criteria.

6. Jafroodi Sending Site

The Jafroodi sending site is located in Nipomo. The property contains 40 acres and one underlying lot. The property met the counties goal for "preserving areas with micro-climates that support specific agricultural crop types." The property does seem to have moderate pressure in relation to the land conversion probability model (see map M-2-B-2.4), however it is extremely close to the urban use of Nipomo, and could be debated as to whether it would serve a residential or agricultural use more efficiently.

This sending site did encounter intense local debate due to the fact that: the nursery would still generate traffic, greenhouses shouldn't be considered agricultural preserves, and the transfer of development would not decrease the demand on water in the region.

Potential Locations of Concern for Development Pressure

Based on our model, certain areas stand out for potential preservation, either because of proximity to a designated significant resource area (SRA), because of potential to enhance already natural areas, or because of the want to preserve agricultural areas. Under a TDR program, the following would be the locations where sending sites would be more effectively targeted, or where alternate development plans could be considered.

- Paso Robles West – Atascadero West (Adelaida)
  The areas just west of Atascadero and Paso Robles show potential development impact among all of our models. The area west of Atascadero suggests possible development near Los Padres National Forest, potentially cutting off ecological corridors from Los Padres National Forest toward Lake Nacimiento. In our highest development model (Run 1, see Map M-2-B-1.1), this pressure extends all the way to Adelaida, containing much of the area between Los Padres and Lake Nacimiento, including some SRA regions. This area contains numerous nut farms and some vineyards, making this a potential region for targeting agricultural preservation. The Bonnheim sending site is located in the western edge of development pressure in this region on average (see, for example, Map M-2-B-1.3). Some smaller development is suggested a little further west and northwest from this region, including the vicinity of Klau, which potentially threatens a small SRA nearby and connections to other SRAs further northwest (common to all our models).
- Cayucos Northeast
  Varying levels of pressure are shown in the area around Cayucos, but all models show some chance of possible development along Old Creek Rd.

north from Cayucos to State Hwy. 46. There is some sparse farming here of avocados and vegetables. In most of the models, this growth is contiguous with the previous (Adelaida) region, suggesting that Los Padres National Forest has the potential of being surrounded by development, a significant setback to ecological values, which would like a potential corridor north to other sections of Los Padres, and would prefer a buffer region between development and the boundaries of the National Forest.

- Morro Bay – San Luis Obispo
  Medium development pressures are suggested in the area around Morro Bay, particularly extending southeast toward Los Osos and San Luis Obispo along Los Osos Valley Rd. Significant amounts of vegetable farming and ranching occur along this road, making it potentially useful for agricultural preservation. This area contains several piecemeal SRAs, particularly concerning coastal development, and these SRAs have a good chance of being converted to light residential development under current standards because of coastal access and proximity to Los Osos, Morro Bay, and San Luis Obispo. Again, there is pressure along the borders of Los Padres National Forest in all models; development along the borders of the National Forest will have potential problematic effects for wildlife in the region.
- Pismo Beach – Arroyo Grande – Nipomo Northeast (Huasna)
  This area is currently facing medium (Map M-2-B-1.4) to heavy (M-2-B-1.1) growth in the region east of Arroyo Grande and northeast of Nipomo. Potential development intensity generally remains highest around the town of Huasna across the models, and mostly ignored the coastal regions near Arroyo Grande. The Laetitia Winery sending site sits in this region, in an area directly between Nipomo and Arroyo Grande, which helps to preserve some open space between the two cities. Northeast of Laetitia Winery are smaller vegetable farms and vineyards. The Jafroodi sending site is also located near Nipomo, though away from the main area of development pressure. The northeastern sections of this region also border Los Padres National Forest and SRAs located there.
- Pippin Corner – Pozo – Santa Margarita Lake
  Our models show significant development pressure on the eastern and northern sides of Santa Margarita Lake, near the towns of Pippin Corner and Pozo. This land would be particularly valuable for its proximity to Los Padres National Park and fishing at Lake Margarita. The region has fields and a couple of small vineyards. Much of this land has already been designated as rural lands by San Luis Obispo County, but portions outside the rural land designation do exist in the area, and it is close to, if not including, one of the significant natural resource areas of the county.
- Atascadero East/Northeast – Paso Robles East (South El Pomar/Estrella Planning Area)
  Some development is indicated in areas east and northeast of Atascadero near State Hwy. 41 and east of Paso Robles along State Hwy. 46. This area currently contains significant farmland and vineyards, among the largest concentrations in the county, making it the best place to focus efforts on

agricultural conservation. This includes some central and southern regions of the El Pomar/Estrella Planning Area, which has been studied for the development of a possible new city to focus residential growth in the area. (Some northern potential growth is also suggested in our larger development models, see Map M-2-B-1.1 and Map M-2-B-1.3.) While there are several options in developing this area, our comments derive from the current status alone. Our models suggest that, save the creation of a new urban center, growth near Atascadero will stay relatively close to the city limits; growth near Paso Robles is spread more to the east, out toward the town of Whitley Gardens. The Denny, AJM & Wilkins sending sites are located in this area, and the latter two are located on the fringe of potential residential development pressures. If a new city site were to be located in the region, it is suggested that location be sited just south of State Hwy. 46, 2-3 miles west-southwest of Whitley Gardens, absent other considerations. (This site, however, may be located in potential habitat for the San Joaquin Kit Fox.)

- Southeast of Cholame (Annette)
  All our models show some minor pressure in a corner of San Luis Obispo County with some agricultural development and little current residential development. The closest development is the Kern County town of Annette; while we did not include Annette as a central business district (population was too small), residential development might be possible around Annette or as a result of increased agricultural development. While there are no SRAs designated in the area, one nature website notes the area in neighboring Kern County as a "northwestern grassland offer[ing] unique birding (bird-watching) opportunities."[186]
- California Valley Reserve Area South/West

  While this land does not currently face much pressure from residential intrusion, and currently is used almost exclusively for cattle ranching, our models suggest the possibility of low-level residential settlement in the region, particularly due to its proximity to State Hwy. 58, which serves as a conduit to Atascadero, San Luis Obispo, and Santa Margarita Lake. This, or the possibility of expanded agriculture or more cattle in the region, potentially threatens a large SRA stretching west from the Reserve Area to Los Padres National Forest near Martinez Place and Todd Place. The region to the south of the Reserve Area could potentially serve as a corridor for wildlife migrating to/from Kern County; a reserve has already been established by the Nature Conservancy in this area, along Soda Lake Road, so additional land would potentially boost the reserve's effectiveness.
- State Hwy. 166 East of Los Padres National Forest (New Cuyama)
  Our models (see Map M-2-B-1.4) suggest a small chance of low-level development, perhaps agricultural, along the Cuyama River and State Hwy. 166. Because we did not include New Cuyama in Santa Barbara County as a central business district (its population is too low), this pressure likely

[186] http://natureali.com/birding.htm

relates to the presence of Hwy. 166 over other factors. A large SRA lies just to the north of Hwy. 166, stretching from Los Padres National Forest to Kern County, and this could possibly be threatened by development, presuming the terrain would be feasible to develop. Although there is some agriculture here, namely apple farms, the land is mostly devoted to pasture, and its relatively low development pressure makes it a poor target for agricultural preservation.

Final Commentary

Once again looking at our project objective and question: "Predicting the Spatial Pressure of Development in San Luis Obispo County: Is the Transferable Development Program Controlling Urban Sprawl?," we reexamine our findings and conclusions.

Conclusions

Our project has produced a meaningful approach for land use planners to account for development pressures associated with specific land characteristics. The analysis used a model that incorporated a variety of predictive variables, associated with both environmental and socio-economic characteristics, to portray the probability of land use conversion throughout the county.

The final output from our model shows specific trends for development occurring on the fringes of current urban uses and nearby road networks, as expected. What was unexpected, however, was the influence of lesser-known variables, such as scenic amenities, hospitals, schools and other infrastructure, which can exert strong influences on choices for land conversion. Additionally, the inclusion of these other variables also predicted a pattern of rural fragmentation, a primary concern in San Luis Obispo County, not associated with typical urban amenities. This pattern of fragmentation actually poses an even greater threat to ecologically sensitive areas and open space lands by virtue of its potential to disrupt existing natural corridors and the extent of viable habitats. Utilizing the development pressure output we were able to examine the sending site criteria listed in the TDC ordinance and assess their effectiveness.

The TDC criteria, as listed in the County ordinance, seem to be adequate in addressing the areas of concern: agricultural resources, natural resources, and antiquated subdivisions. The subjective nature of the criteria does necessitate, however, additional factual information regarding specific land characteristics. There seems to be ambiguity in how specific sending and receiving sites are approved under the specific and/or general criteria. Having either a land rating

system pertaining to soil, slope, residential/agricultural amenities, and development pressures could make the process more concise and decisions more valid.

It is not apparent that all of the approved sending sites are strong candidates for protecting the resources listed in the ordinance, and on occasion these sites only very weakly meet criteria. While this may be an inevitable tradeoff for a voluntary TDC program, some effort should be made to establish specific target areas beforehand to avoid haphazard sending and receiving site designation, as well as to recognize the marginal nature of some participant sites. Additionally, the process by which the sending sites are approved can incorporate the land conversion probability model we have included to assess the location of the most severe development pressures and areas that would best be suited in alternative uses. In addition, this tool can provide future forecasts of development as local conditions change.

The San Luis Obispo County TDC program may be revoked in the future, as a result of a series of public meetings and Grand Jury proceedings. It is possible that the use of development pressure model in designating future sites could increase the chances of the success of the program. It may be most appropriate to limit the scope of the TDC program to target low-density development in rural areas, in combination with other growth control mechanisms. However, regardless of the future of the TDC program, this tool can and should be considered future land use decisions and policy making.

Pre-determining transferable credit amounts for potential sending and receiving sites could also prove extremely useful. These amounts could then be used to construct maps showing both the County Government and the public the potential number of credits a site can generate and why. GIS-based maps can be provided to sending and receiving site applicants allowing them to not only assess their credit options, but to become more involved in the "voluntary" program.

Given our analysis, a TDC program in San Luis Obispo County can be successful in protecting small amounts of land from rural fragmentation and urban sprawl. This program, however, should be utilized as one of the many conservation tools employed by the County. Furthermore, the County should not attempt to use this program as the primary conservation tool,[187] and should instead encourage communities (similar to Cambria, and Nipomo) to develop regional based TDC programs to supplement their planning efforts. In this way, the TDC program can efficiently allocate growth, due to its preferential use as a small-scale conservation tool.

[187] The Boulder County, Colorado transfer program could serve as a template for San Luis Obispo County, given that Boulder uses the program as one of the tools in a toolbox (primarily during recession years), relying on other programs to carry the weight of conservation.

APPENDIX

List of Acronyms

AHP – Analytical Hierarchy Process
BCCP – Boulder County (Colorado) Comprehensive Plan
CaSIL – California Spatial Information Library
CCA – California Coastal Act
CCC – California Coastal Commission
CEQA – California Environmental Quality Act
CURB – City Urban Restriction Boundary
DDES – Department of Development and Environmental Services
DEM – Digital Elevation Map
EIR – Environmental Impact Report
EPA – Environmental Protection Agency
ESA – Endangered Species Act
FH – Flood Hazard
GAP – Geographical Approach to Planning (generally just referred to as GAP)
GIS – Geographical Information Systems
GMA – Growth Management Act
GMM – Generalized Method of Moments
GSA – Gross Structural Area
H - Historic
IGA – Intergovernmental Agreements
LCP – Local Coastal Plan
LUBA – Land Use Board of Appeals
LUP – Land Use Plan
MDR – Marketable Development Rights
NAD – North American Datum
NCNUPUD – Non-contiguous NUPUD
NIMBY – Not In My Backyard
NUPUD – Non-Urban Planned Unit Development
OLS – Ordinary Least Squares
PBRS – Public Benefit Rating System
RDI – Residential Density Incentives
ReCAP – Regional Cumulative Assessment Project
RUM – Random Utility Model
SEA – Significant Ecological Areas
SRA – Sensitive Resource Area
SLO – San Luis Obispo
SLOCDPB – San Luis Obispo County Department of Planning and Building
SMMNRA – Santa Monica Mountains National Recreation Area
SOAR – Save Open Space and Agricultural Resources
SSURGO – Soil Survey Geographic Database
TDC – Transferable Development Credits, specifically concerning San Luis Obispo County's program.
TDR – Transfer of Development Rights

TRPA – Tahoe Regional Planning Agency
UGB – Urban Growth Boundary
URL – Urban Reserve Line
USGS – United States Geological Survey
UTM – Universal Transverse Mercator
WTP – Willingness to Pay

Regression R- 1: Residential Hedonic Run 1, With Taft, Without Population Density

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.777[a]	.604	.597	.334010

a. Predictors: (Constant), CBD-M&T, PRESUMED, WATERBODIE, FAULT, TRAN_LINE, PARKS, RUAL, FLOOD, GOV_OWN, Coastal-z, ROADS, LANDSLIDE, FIRE_STATI, SCHOOL, IND, VINEYARD, SLOPE, HIGHWAY, RAILROAD, AG_COMM, AIRPORTS, GOLF, HOSPITALS, DEM, LAW_ENF

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	250.510	25	10.020	89.819	.000[a]
	Residual	164.108	1471	.112		
	Total	414.618	1496			

a. Predictors: (Constant), CBD-M&T, PRESUMED, WATERBODIE, FAULT, TRAN_LINE, PARKS, RUAL, FLOOD, GOV_OWN, Coastal-z, ROADS, LANDSLIDE, FIRE_STATI, SCHOOL, IND, VINEYARD, SLOPE, HIGHWAY, RAILROAD, AG_COMM, AIRPORTS, GOLF, HOSPITALS, DEM, LAW_ENF

b. Dependent Variable: V100000_log

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	8.275	.375		22.044	.000
	AIRPORTS	-1.8E-02	.051	-.012	-.346	.729
	SCHOOL	-.304	.037	-.226	-8.230	.000
	HOSPITALS	-.129	.065	-.090	-1.975	.048
	GOLF	-.151	.057	-.100	-2.658	.008
	Coastal-z	-1.6E-03	.011	-.005	-.144	.886
	FIRE_STATI	-9.6E-03	.045	-.006	-.214	.831
	WATERBODIE	5.85E-02	.030	.048	1.982	.048
	ROADS	-.163	.031	-.140	-5.277	.000
	SLOPE	3.04E-02	.029	.031	1.057	.291
	DEM	6.35E-02	.062	.044	1.019	.308
	HIGHWAY	.145	.029	.136	4.917	.000
	RAILROAD	-3.2E-02	.031	-.038	-1.043	.297
	IND	9.60E-02	.059	.074	1.631	.103
	FLOOD	2.50E-02	.021	.028	1.212	.226
	LANDSLIDE	-4.2E-03	.010	-.010	-.422	.673
	FAULT	.150	.031	.115	4.838	.000
	PRESUMED	1.54E-02	.007	.047	2.330	.020
	PARKS	4.85E-02	.009	.112	5.413	.000
	GOV_OWN	1.72E-02	.015	.027	1.148	.251
	RUAL	-6.6E-02	.013	-.109	-5.217	.000
	VINEYARD	-.169	.026	-.189	-6.479	.000
	AG_COMM	-.236	.039	-.211	-6.110	.000
	TRAN_LINE	1.60E-02	.017	.018	.939	.348
	LAW_ENF	-.140	.071	-.112	-1.961	.050
	CBD-M&T	1.31E-02	.069	.008	.189	.850

a. Dependent Variable: V100000_log

- Model Fit
  The R^2 measures how well the chosen model fits the data under analysis.
- Adjusted R^2
  The adjusted R^2 accounts for any random "fit" that may exist between x (dependent) and y (independent) values simply by chance. This random portion is removed and the adjusted R^2 value should therefore indicate the true goodness of fit of the model. The value of the adjusted R^2 for the four models, ranging from 0.597 to 0.662, still indicates that the model fairly accurately fits the data under analysis. Additionally, whenever the population density variable is included in the models, the values of adjusted R^2 increase to an extra 6.4% (.661 plus .597 & .662 plus .598) and the effects of population density in both models are significantly different from zero.

Hence, it is reasonable for us to draw a conclusion that the dependent variable is positively affected by population density.

- Standard Error of the Estimate
  Standard error depends on the sample size,[188] and indicates how far the estimate is likely to be from its expected value, given repeated scatter plots of the data.[189] The sample size used in this analysis was the total number of assessor parcel pages for the County of San Luis Obispo, and data points within those pages. Therefore, the sample size could not have been increased within the constraint of the unit of analysis. For the purposes of this project, a standard error of 0.3062 to 0.3340 is reasonable, especially given the value for the adjusted R^2.
- F Statistic
  Comparing the four scenarios, the ANOVA results are similar. For example, a value of 89.819 for the F statistic in Run 1 indicates that the difference between the sum of squares for the regression (250.510) is significantly different from the sum of squares for the residuals (164.108) and the null hypothesis (that there is no association between independent and dependent variables) can therefore be rejected.[190] The corresponding significance (0.000) for the F statistic indicates that this conclusion is in fact warranted.
- Degrees of Freedom (df)
  Degrees of freedom refer to the number of independent pieces of information within the analysis that are "free" to vary. In the case of this analysis, df for the regression indicates the number of parameters[191] used to estimate the dependent variable. Df for the residual indicates the total number of data points (parcel pages) included for each parameter. The total degrees of freedom, therefore, indicates the total number of independent pieces of information that were allowed to vary within this analysis.[192]
- Unstandardized Coefficients
  B (beta): b values for each parameter are the coefficients used as multipliers against the variable values to determine the relative influence of each independent variable on the dependent land value.[193] The majority of the parameters are locational variables, such that the value for each point is a distance. Therefore, variables with a negative value for b actually have a

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[188] Generally, the larger the sample size, the smaller the standard error.

[189] Standard error measures the scatter about the regression curve, and is given by the equation $S_{xy} = \sqrt{\frac{\sum (y - y_{est})^2}{n}}$ where n is the number of observations.

[190] The further the F statistic deviates from 1, the more reasonably we can reject the null hypothesis.

[191] Parameters are variables such as urban center, school, railroad, etc.

[192] Number of parameters + number of parcel pages = total degrees of freedom for the analysis.

[193] Recall the form of the hedonic equation such that the associated values for b will determine the relative importance of each variable in the relationship: $\log P = \beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2 + \ldots\ldots\ldots + \beta_n \log X_n + \varepsilon$

positive relationship between proximity and land value (close proximity is directly proportional to increased land value), which translates into an inverse relationship between distance and hedonic land value. Those variables with positive values for b indicate that a direct relationship exists between distance and land value (greater distance from the parameter in question results in increased land value). The more strongly negative (or positive), the greater the influence that particular variable will have on the dependent land value. This influence may also be determined by looking at the standardized value for beta, discussed below.

Standard Error: Standard error for the unstandardized beta simply estimates the likelihood that the estimated beta is off from its true value, given repeated scatter tests.

- Standardized Coefficients

  Beta: The value for b indicates the relative importance that a particular variable brings to the overall relationship between the independent and dependent variables. That is, parameters with low values for beta will not exert a great deal of influence on the regression relationship, and the omission of these variables will result in little change in the overall result. On the other hand, parameters with large values for beta have more bearing on the regression relationship and their omission would result in a large (or at least significant) change to the overall result. It is therefore obvious from the regression results that those variables exerting the most influence (+/- 0.10 or greater value for beta) on the value of land in residential use include: schools, hospitals, golf course, roads, highways, parks, rural land, agricultural land, vineyards, and law enforcement.

- t-statistic

  The t-statistic tests the hypothesis that a particular regression coefficient, b, is zero. The value for t is equal to the ratio of the sample regression coefficient to its standard error.[194]

Regression R- 2: Residential Hedonic Run 2, With Taft, With Population Density

Model	R	R Square	R Square	the Estimate
1	.817[a]	.667	.661	.306488

a. Predictors: (Constant), CBD-M&T, PRESUMED, WATERBODIE, FAULT, TRAN_LINE, PARKS, RUAL, FLOOD, GOV_OWN, Coastal-z, ROADS, LANDSLIDE, FIRE_STATI, SCHOOL, IND, VINEYARD, SLOPE, HIGHWAY, RAILROAD, AG_COMM, POPD, AIRPORTS, GOLF, HOSPITALS, DEM, LAW_ENF

[194] t = estimate/standard error

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	276.534	26	10.636	113.226	.000[a]
	Residual	138.085	1470	9.394E-02		
	Total	414.618	1496			

a. Predictors: (Constant), CBD-M&T, PRESUMED, WATERBODIE, FAULT, TRAN_LINE, PARKS, RUAL, FLOOD, GOV_OWN, Coastal-z, ROADS, LANDSLIDE, FIRE_STATI, SCHOOL, IND, VINEYARD, SLOPE, HIGHWAY, RAILROAD, AG_COMM, POPD, AIRPORTS, GOLF, HOSPITALS, DEM, LAW_ENF

b. Dependent Variable: V100000_log

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.519	.382		14.442	.000
	AIRPORTS	-1.0E-02	.047	-.007	-.218	.828
	SCHOOL	-.161	.035	-.120	-4.606	.000
	HOSPITALS	-.154	.060	-.107	-2.554	.011
	GOLF	3.32E-02	.053	.022	.623	.534
	Coastal-z	-2.5E-03	.010	-.007	-.237	.813
	FIRE_STATI	7.54E-02	.042	.043	1.808	.071
	WATERBODIE	7.88E-02	.027	.065	2.905	.004
	ROADS	-9.9E-02	.029	-.085	-3.459	.001
	SLOPE	3.34E-02	.026	.034	1.266	.206
	DEM	5.62E-02	.057	.039	.982	.326
	HIGHWAY	.149	.027	.140	5.516	.000
	RAILROAD	7.81E-02	.029	.092	2.679	.007
	IND	-2.1E-02	.054	-.016	-.386	.699
	FLOOD	8.48E-03	.019	.009	.448	.654
	LANDSLIDE	-2.8E-02	.009	-.065	-3.059	.002
	FAULT	.153	.028	.118	5.401	.000
	PRESUMED	-1.0E-03	.006	-.003	-.170	.865
	PARKS	2.82E-02	.008	.065	3.395	.001
	GOV_OWN	-6.8E-03	.014	-.011	-.489	.625
	RUAL	-4.8E-02	.012	-.080	-4.144	.000
	VINEYARD	-.101	.024	-.112	-4.131	.000
	AG_COMM	-.147	.036	-.132	-4.097	.000
	TRAN_LINE	3.11E-02	.016	.035	1.988	.047
	LAW_ENF	-3.3E-02	.066	-.026	-.503	.615
	POPD	.201	.012	.510	16.644	.000
	CBD-M&T	-7.0E-02	.064	-.043	-1.092	.275

a. Dependent Variable: V100000_log

Regression R- 3: Residential Hedonic Run 3, Without Taft, Without Population Density

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.777[a]	.604	.598	.333883

a. Predictors: (Constant), CBDW-M, RUAL, PARKS, Coastal-z, TRAN_LINE, FLOOD, PRESUMED, FAULT, ROADS, GOV_OWN, WATERBODIE, LANDSLIDE, FIRE_STATI, VINEYARD, IND, SCHOOL, SLOPE, HIGHWAY, AG_COMM, RAILROAD, AIRPORTS, GOLF, HOSPITALS, DEM, LAW_ENF

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	250.634	25	10.025	89.931	.000[a]
	Residual	163.984	1471	.111		
	Total	414.618	1496			

a. Predictors: (Constant), CBDW-M, RUAL, PARKS, Coastal-z, TRAN_LINE, FLOOD, PRESUMED, FAULT, ROADS, GOV_OWN, WATERBODIE, LANDSLIDE, FIRE_STATI, VINEYARD, IND, SCHOOL, SLOPE, HIGHWAY, AG_COMM, RAILROAD, AIRPORTS, GOLF, HOSPITALS, DEM, LAW_ENF

b. Dependent Variable: V100000_log

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	8.245	.374		22.050	.000
	AIRPORTS	1.78E-03	.053	.001	.033	.973
	SCHOOL	-.298	.037	-.221	-7.984	.000
	HOSPITALS	-9.7E-02	.067	-.068	-1.452	.147
	GOLF	-.118	.059	-.078	-2.014	.044
	Coastal-z	-4.5E-03	.011	-.012	-.389	.697
	FIRE_STATI	-1.3E-02	.045	-.007	-.282	.778
	WATERBODIE	5.93E-02	.029	.049	2.031	.042
	ROADS	-.164	.031	-.140	-5.296	.000
	SLOPE	2.75E-02	.029	.028	.958	.338
	DEM	7.26E-02	.062	.050	1.169	.243
	HIGHWAY	.149	.030	.140	5.039	.000
	RAILROAD	-2.2E-02	.032	-.025	-.675	.500
	IND	8.24E-02	.060	.063	1.384	.166
	FLOOD	2.45E-02	.021	.027	1.191	.234
	LANDSLIDE	-2.7E-03	.010	-.006	-.270	.787
	FAULT	.149	.030	.114	4.925	.000
	PRESUMED	1.60E-02	.007	.049	2.412	.016
	PARKS	4.92E-02	.009	.114	5.498	.000
	GOV_OWN	1.99E-02	.014	.031	1.410	.159
	RUAL	-6.4E-02	.013	-.108	-5.152	.000
	VINEYARD	-.173	.026	-.194	-6.579	.000
	AG_COMM	-.239	.039	-.214	-6.210	.000
	TRAN_LINE	1.72E-02	.017	.019	1.012	.311
	LAW_ENF	-.109	.073	-.088	-1.503	.133
	CBDW-M	-9.8E-02	.091	-.068	-1.073	.284

a. Dependent Variable: V100000_log

Regression R- 4: Residential Hedonic Run 4, Without Taft, With Population Density

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.817[a]	.668	.662	.306218

a. Predictors: (Constant), POPD, PRESUMED, LANDSLIDE, TRAN_LINE, FLOOD, PARKS, RUAL, FAULT, WATERBODIE, GOV_OWN, HIGHWAY, Coastal-z, IND, FIRE_STATI, SCHOOL, SLOPE, ROADS, VINEYARD, HOSPITALS, RAILROAD, AG_COMM, GOLF, AIRPORTS, DEM, LAW_ENF, CBDW-M

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	276.777	26	10.645	113.526	.000[a]
	Residual	137.841	1470	9.377E-02		
	Total	414.618	1496			

a. Predictors: (Constant), POPD, PRESUMED, LANDSLIDE, TRAN_LINE, FLOOD, PARKS, RUAL, FAULT, WATERBODIE, GOV_OWN, HIGHWAY, Coastal-z, IND, FIRE_STATI, SCHOOL, SLOPE, ROADS, VINEYARD, HOSPITALS, RAILROAD, AG_COMM, GOLF, AIRPORTS, DEM, LAW_ENF, CBDW-M

b. Dependent Variable: V100000_log

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.519	.380		14.530	.000
	AIRPORTS	1.37E-02	.049	.010	.280	.780
	SCHOOL	-.152	.035	-.113	-4.306	.000
	HOSPITALS	-.129	.062	-.090	-2.087	.037
	GOLF	5.86E-02	.055	.039	1.068	.286
	Coastal-z	-4.7E-03	.011	-.013	-.446	.656
	FIRE_STATI	7.28E-02	.042	.042	1.746	.081
	WATERBODIE	8.61E-02	.027	.071	3.207	.001
	ROADS	-.101	.029	-.086	-3.520	.000
	SLOPE	3.17E-02	.026	.032	1.203	.229
	DEM	6.00E-02	.057	.042	1.053	.293
	HIGHWAY	.154	.027	.144	5.666	.000
	RAILROAD	8.94E-02	.030	.105	2.986	.003
	IND	-3.5E-02	.055	-.027	-.631	.528
	FLOOD	6.76E-03	.019	.007	.358	.721
	LANDSLIDE	-2.6E-02	.009	-.060	-2.833	.005
	FAULT	.142	.028	.109	5.143	.000
	PRESUMED	3.69E-05	.006	.000	.006	.995
	PARKS	2.87E-02	.008	.066	3.455	.001
	GOV_OWN	-9.3E-03	.013	-.015	-.711	.477
	RUAL	-4.8E-02	.012	-.080	-4.170	.000
	VINEYARD	-.106	.025	-.118	-4.321	.000
	AG_COMM	-.148	.036	-.133	-4.137	.000
	TRAN_LINE	3.21E-02	.016	.036	2.053	.040
	LAW_ENF	-8.4E-03	.067	-.007	-.125	.900
	CBDW-M	-.163	.084	-.113	-1.946	.052
	POPD	.201	.012	.510	16.697	.000

a. Dependent Variable: V100000_log

Regression R- 5: Agricultural Hedonic Run 1

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.710[a]	.504	.502	.371341

a. Predictors: (Constant), URBANUSE, WATERSOURC, VINEYARD, ROADS, SLOPE, AG_COMM

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	209.156	6	34.859	252.799	.000[a]
	Residual	205.462	1490	.138		
	Total	414.618	1496			

a. Predictors: (Constant), URBANUSE, WATERSOURC, VINEYARD, ROADS, SLOPE, AG_COMM

b. Dependent Variable: V100000_log

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	8.649	.120		72.078	.000
	ROADS	-6.6E-02	.025	-.056	-2.626	.009
	SLOPE	-6.8E-02	.022	-.069	-3.073	.002
	VINEYARD	-.302	.019	-.338	-15.756	.000
	AG_COMM	-.425	.028	-.381	-15.181	.000
	WATERSOURC	-1.9E-02	.024	-.016	-.803	.422
	URBANUSE	-1.3E-02	.006	-.046	-2.132	.033

a. Dependent Variable: V100000_log

Regression R- 6: Agricultural Hedonic Run 2

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.616[a]	.380	.378	.415360

a. Predictors: (Constant), AR+VINE, WATERSOURC, URBANUSE, ROADS, SLOPE

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	157.385	5	31.477	182.451	.000[a]
	Residual	257.233	1491	.173		
	Total	414.618	1496			

a. Predictors: (Constant), AR+VINE, WATERSOURC, URBANUSE, ROADS, SLOPE

b. Dependent Variable: V100000_log

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	7.207	.119		60.552	.000
	ROADS	-9.0E-02	.027	-.077	-3.270	.001
	SLOPE	-.120	.024	-.121	-4.927	.000
	WATERSOURC	-9.2E-02	.026	-.079	-3.473	.001
	URBANUSE	-3.7E-02	.006	-.133	-5.671	.000
	AR+VINE	-.300	.016	-.422	-18.187	.000

a. Dependent Variable: V100000_log

- R^2
  The regression relationship that separated land (differentiated between agriculture and vineyard open space use) use resulted in a higher value for R^2 (0.504), indicating that there are significant differences in the land suited for each type of use, which then translate into effect on use preference.[195] Additionally, the agricultural hedonic model again employed the double log relationship, so that results could be compared to numbers from the residential hedonic model.
- Adjusted R^2

[195] Some grapes "prefer" poor soil, while most other cash crops require nutrient-rich soils. Therefore, land best suited for each disparate use may be different, even though both pursuits are considered agriculture.

Removing the random portion of the relationship results in an adjusted R^2 value of 0.502, indicating that the model fairly accurately fits the data under analysis.

- Standard Error of the Estimate
  The sample size for the agricultural hedonic is equal to the sample used in the residential model, and standard error (0.3713) is therefore similar to the error inherent in the residential hedonic (0.3062 – 0.3340).
- Unstandardized Coefficients
  1. B (beta): Just as in the residential hedonic, variables with a positive value for b have a direct positive relationship between distance and land value (increases in distance are directly proportional to increased land value).
  2. Standard Error: Estimates for standard error indicate that the regression is fairly accurate (low values indicate a low probability that values for beta are off).
- Standardized Coefficients
  Beta: Parameters with the greatest influence on land value in agricultural use (parameters with large values for beta have more bearing on the regression relationship and their omission would result in a significant change to the overall result) include: urban centers, vineyards and agriculture.
- t-statistic
  The t-statistic tests the hypothesis that a particular regression coefficient, b, is zero. Values for vineyard and agriculture seem a little high (at –15.756 and –15.181 respectively), but simply indicate a greater influence of these parameters on the regression relationship (rather than a higher standard error).

Table 2: Variables Included in the Hedonic Analysis

File Name	Description	Significance to Analysis
Ag Commodities	Farmland in San Luis Obispo County. It can be considered as a kind of open space, and only involves land already in agricultural use	This variable was included because of concerns over current land value.
Airports	Point locations of airports in San Luis Obispo County	This variable was included because of concerns over noise pollution, we would expect land in close proximity to be inversely affected by the addition of this variable, however because proximity to airport is also a convenience for commuters, land outside the boundaries of the noise contours may be positively affected by its presence.
Fire Stations	Locations of fire stations across San Luis Obispo County	This variable was chosen since it concerns public service and safety. The distance to a fire station relates to the response time required to reach and control a fire hazard. Occasionally, the location of a fire station is settled near fire hazard zones.
Flood	Generic locations of potential flood hazards that are in conjunction with designated creeks county wide	The data provides suitable land use designation information. We use 100-year flood hazard data to determine the potential risk of flooding on a particular piece of land.
Fault	Various fault lines located within San Luis Obispo County	The variable was included in our model because it designated the geologically sensitive areas. Considering safety as an amenity, we would expect land in close proximity to be inversely affected by the addition of this variable.
Landslide	Locations of areas that have a greater risk for landslide within San Luis Obispo County	The variable was included because of concerns regarding geologically sensitive areas, for safety purposes. We would expect land values in close proximity to be inversely affected by the addition of this variable.
Digital Elevation Map	The elevation variable shows the gridfile data	The elevation of the land can limit the land development. Most developed lands are in the lower elevation. The cost of

	manually combined from USGS 7.5-degree quads covering San Luis Obispo County using Arc/INFO.	development activities in the higher elevations should increase because of the inconvenience associated with transportation. For the purposes of the model, all elevation values of 0 were considered as 0.01.
Golf	Locations of golf courses in San Luis Obispo County	Golf courses have recreational values and desirable views that contribute to land value of the neighborhood in which they are located. We would expect land in close proximity to be affected by the addition of this variable.
Hospitals	Locations of hospitals in San Luis Obispo County	This variable was included in the model because hospitals provide an important public service. We would expect land in close proximity to be affected by the addition of this variable.
Law enforcement	Locations of law enforcement facilities ranging from police, sheriff, to park rangers countywide	This variable provides public service and safety information for a location and may affect land values.
Railroads	The Southern Pacific Railway, running from one end of San Luis Obispo County to the other	This variable provides suitable transportation and noise pollution information. We would expect land in close proximity to be inversely affected by the addition of this variable, however because proximity to railroad is also a convenience for commuters, land outside the boundaries of the noise contours may be positively affected by its presence.
Schools	Locations of schools including elementary, jr. high, and high schools across San Luis Obispo County	This variable was included because of concerns over public service. Proximity to a school is a convenience and educational quality for a family. We would expect land in close proximity to be affected by the addition of this variable.
Transmission lines	The location of prime transmission lines along important corridor ways through San Luis Obispo County	This variable provides suitable utility information that proximity to railroad is a convenience for human use.
USGS Highways	Major state highways across San	This variable was included because of concerns over noise pollution: we would

	Luis Obispo County	expect land in close proximity to be inversely affected by the addition of this variable, however because proximity to a highway is also a convenience for commuters, land outside the boundaries of the noise contours may be positively affected by its presence.
USGS Roads	All significant[196] roads in San Luis Obispo County	This variable was included because proximity to roads is a convenience for commuters and eases transportation demands. Although the variable also involves concerns over noise pollution, land outside the boundaries of the noise contours may be positively affected by its presence. Additionally, we would not expect noise pollution to be as much of a problem in close proximity to roads, as we might in close proximity to highways.
Vineyards	Registered vineyards within San Luis Obispo County. This variable represents on type of open space. The lands were in use as vineyards at the time of analysis	This variable was included because of concerns over current land value. Land used for vineyards may sell for as much as $20,000 over the selling price of land utilized for row crops, and $34,000 over rangeland.[197]
Industry	Locations of industrial areas in San Luis Obispo County	This variable was included because of concerns over convenience for commuters who work in the area. Therefore, land prices in close proximity might increase with the addition of this variable, however because proximity to industrial areas may also be associated with air and water pollution, land values may actually decrease as they near industrial areas.
Slope	Calculated from the USGS DEM file, shows the land slope information of San Luis Obispo County	The slope of the land may limit the land development. On steeper land, the development becomes more difficult and the cost would increase. For the purposes of the model, all slope values of 0 were considered as 0.01

[196] Significant roads include national and state highways in the county, as well as other connecting thoroughfares.
[197] http://www.calasfmra.com/landvalues/2001/region6_b.htm

Government Owned	All lands owned by the Bureau of Land Management or other government agencies that are not parkland as defined otherwise	These lands are considered as open space in terms of developability, but are not developable currently. They don't have recreation value and no probability for development. Therefore it was important that we exclude them from the analysis of probability of land conversion.
Water source	Major rivers and creeks in San Luis Obispo County	Land in proximity to these water bodies may be eligible for TDC credits based on inclusion of riparian habitat. Additionally, these resources may increase the value of land in rangeland or agricultural use.
Parks	This variable combines the land holdings from county parks, Los Padres National Forest, and local wildlife preserves	This land was treated as undevelopable, with some benefit from scenic and tourist values. Land under parkland designation has recreation value and no probability for development. Proximity to park is a desirable amenity, in terms of access to recreational opportunities. We would therefore expect land in close proximity to be affected by the addition of this variable.
Rural land	Rural non-government lands as designated by San Luis Obispo County, that were not otherwise designated as currently growing crops or for vineyards	They can be developed, but not likely to be. This variable is another category of open space.
Presumed Private Rangeland	Privately-held land that is designated for agricultural use by San Luis Obispo County, that is not currently used to grow crops or for vineyards	We assume that this land is used currently for cattle grazing, and so is developable for agricultural or other uses (other factors notwithstanding). The lands can be developed and have high probability for development. This is another aspect of open space in the county.
Urban Center	Points in the center of all centers of population greater than 15,000 people. Some contiguous cities were grouped together as one	We expect that urban centers will serve as commerce centers and as foci for further development. For the agriculture model, the urban centers were expected to serve as havens for commerce, and so there should be some incentive to locate closer to the urban centers. This was meant to be

	geographic center (Arroyo Grande/Five Cities region). Taft, population less than 15,000, was tested as a potential focus for development in eastern sections of the county.	separate from the urban use designation, which we thought might have separate impacts due to direct proximity to development.
Urban Use	A combination of land set aside by San Luis Obispo County for Urban and Village Reserve Areas and land currently designated for residential and recreational use.	Value of land in agricultural use may be affected by proximity to urban uses, directly with regard to the ease of transport of goods produced, as well as inversely with regard to continuity of use. This file was used for the agricultural model to test whether proximity to already developed land (either urban/village zones or zones designated for residential use) had an effect on agricultural development. It was thought that this proximity might either discourage agricultural use due to encroaching residential development, or alternately, that this proximity might encourage agricultural development because of proximity to housing or increased land values.
Coastal Zones	Designated coastal zone areas for San Luis Obispo County as established by the passage of the Coastal Act of 1976	The land use polices are different between the coast and the inland areas of the County (policies within the coastal zone tend to be more stringent than those governing inland use). Additionally, proximity to the coast is a desirable amenity with regard to access for recreation.

Table 3: List of Source Files for Analysis[198]

File	Description
Baseline Geographic Files	
Categ_rural_lu.shp	Zoning designation map for San Luis Obispo County, including agriculture, rural, and residential land uses. Not parcel-specific. (SLOCDPB, February 2001)
Census_blocks_2000.shp	A map containing the distribution of census blocks for the year 2000 within San Luis Obispo County, originally from the Census TIGER database. (SLOCDPB, April 2001)
Co_bndry.shp	Shows the borders of San Luis Obispo County. (SLOCDPB, October 1998)
New_slo_parcelpage.shp	Shows all designated parcels in San Luis Obispo County, converted from a file from the Land Conservancy of San Luis Obispo.
Ownership_boundaries.shp	Originally created for the California GAP database by the U.S. Fish and Wildlife Service and UCSB, this file shows whether land in San Luis Obispo County is held in government or private hands. (SLOCDPB, June 1998)
Files Containing Examined Variables	
Ag_commodities.shp	A map of farmland in San Luis Obispo County, created from rough data from the Agricultural Commissioner's Office. (SLOCDPB, March 2000)
Airports.shp	Point locations of airports in San Luis Obispo County. (CaSIL, September 1993)
Cemetaries.shp	Locations of cemeteries and missions across San Luis Obispo County, created for the Park and Recreation Element Update to the County

[198] SLOCDPB – San Luis Obispo County Department of Planning and Building; CaSIL – California Spatial Information Library; USGS – United States Geological Survey

	General Plan. (SLOCDPB, August 2001)
Co_fire_stations.shp	Point data showing locations of fire stations across San Luis Obispo County, originally created under a contract to update the county Safety Element. Digitized by the California Polytechnic University Landscape Architecture GIS Lab. (SLOCDPB, May 2000)
Des-coastal_zone.shp	Areas designated as coastal areas (per the Coastal Act of 1976) by San Luis Obispo County. (SLOCDPB, January 2000)
Des-flood.shp	Flood zones designated by the Federal Emergency Management Agency (FEMA). (SLOCDPB, March 2000)
Des-sra.shp	Designated Significant Resource Areas for San Luis Obispo County. This file contains general areas of concern across the county. (SLOCDPB, May 2000)
Des-wetland.shp	Designated wetlands within San Luis Obispo County. (SLOCDPB, January 2000)
East_landslide.shp West_landslide.shp	Landslide potential data, originally created under a contract to update the county Safety Element. Digitized by the California Polytechnic University Landscape Architecture GIS Lab. (SLOCDPB, August 2001)
Fault_lines.shp	Various fault lines within San Luis Obispo County, originally created under a contract to update the county Safety Element. Digitized by the California Polytechnic University Landscape Architecture GIS Lab. (SLOCDPB, July 2000)
Fema_flood_zones.shp	Federally designated flood areas (100-Year, 500-Year, No Flood Potential) from the Federal Emergency Management Agency. (SLOCDPB, October 1998)
Finaldem1 (grid)	Digital Elevation Map (DEM) gridfile manually combined from USGS 7.5-degree quads covering San Luis Obispo County using Arc/INFO. For the purposes of the model, all elevation values of 0 were considered as 0.01. (USGS, source dates 1948, 1963; revised 1994, 1997, 2001)
Golf.shp	Point locations of golf courses in San Luis Obispo County. (SLOCDPB, August 2001)
Hospitals.shp	Point locations of hospitals in San Luis Obispo County. (SLOCDPB, August 2001)
Law_enforcement.shp	Point locations of law enforcement agencies across San Luis Obispo County, originally created under a contract to update the county

	Safety Element. Digitized by the California Polytechnic University Landscape Architecture GIS Lab. (SLOCDPB, May 2000)
Parks.shp	Shapefile containing county and local parkland for San Luis Obispo County. Does not include Los Padres National Forest. (SLOCDPB, August 2001)
Prisons.shp	Point locations of adult correction facilities in San Luis Obispo County. (CaSIL, February 1999)
Schools.shp	Point locations of schools across San Luis Obispo County. (SLOCDPB, August 2001).
Transmission_lines.shp	Line data containing the major transmission lines through San Luis Obispo County. (SLOCDPB, August 2001)
USGS_hwys.shp	Line data showing major state roads across San Luis Obispo County, originally from the U.S. Geological Survey. (SLOCDPB, April 2001)
USGS_roads.shp	Line data showing all significant roads in San Luis Obispo County, originally from the U.S. Geological Survey. (SLOCDPB, April 2001).
Vineyards.shp	A map of registered vineyards within San Luis Obispo County, created from data from the Agricultural Commissioner's Office. Information may not be complete. (SLOCDPB, May 2000)
Waterbodies.shp	Line data showing the borders of all lakes in San Luis Obispo County, as well as the coastline for the county. (SLOCDPB, October 1998)
Files Created for the Project (derived from other files)	
Finalslope1 (grid)	Slope gridfile calculated from the USGS DEM file. For the purposes of the model, all slope values of 0 were considered as 0.01.
Govt_owned.shp	Contains all lands owned by the Bureau of Land Management or other government agencies (from the GAP ownership database) that are not parkland as defined otherwise. These lands are considered as open space in terms of developability, but are not developable currently.
Main_rivers.shp	A selection of the major rivers and creeks in San Luis Obispo County, culled from the SLOCDPB database of water bodies for the county.
New_parks_3.shp	A file combining the land holdings from county parks, Los Padres National Forest, and local wildlife preserves. This land was treated as undevelopable, with some benefit from scenic and tourist values.

Rural_non_govt_land.shp	Land that is designated by San Luis Obispo County as rural land, that is not otherwise designated as currently growing crops or for vineyards. These lands are mostly open-space lands.
Presumed_private_rangeland.shp	Privately-held land that is designated for agricultural use by San Luis Obispo County, that is not currently used to grow crops or for vineyards. We assume that this land is used currently for cattle grazing, and so is developable for agricultural or other uses (other factors notwithstanding). Our model treats the Hearst Ranch area as potentially developable except for Hearst Castle itself, which is currently held in a trust with the California Parks Service, although this may no longer be the case[199].
Urbancenters.shp	Point data showing the locations of major urban areas (>15000 population) in and around San Luis Obispo County. These areas ended up designating the cities of Atascadero, Paso Robles, San Luis Obispo, and Santa Maria, as well as the geographic center of Arroyo Grande, Grover Beach, Pismo Beach, and Oceano, which are more or less contiguous. The city of Morro Bay was included in some calculations to represent the area containing Los Osos, Baywood Park, Morro Bay, and Cayucos, which are relatively contiguous and together exceed the 15000 population threshold. The city of Taft (in Kern County), although containing less population than the 15000 requirement, was also included in some calculations; Taft was considered a potential business district for eastern reaches of San Luis Obispo County and possible impetus for residential development there.
Urban_use.shp	A combination of land set aside by San Luis Obispo County for Urban and Village Reserve Areas and land currently designated for residential and recreational use.

[199] Also see the discussion of the Subdivision Map Act for further explanation concerning the Hearst Castle region.

Table 4: Weighted Preferences for Unit Criteria

Criteria	Weight
Units used in land-use decision-making and/or transactions v. Ecological continuity with regard to boundaries	7: Very Strongly Better
Data available on a consistent basis for all units v. Ecological continuity with regard to boundaries	3: Weakly Better
Data available in useable form v. Ecological continuity with regard to boundaries	4: Moderately Better
Units large enough to manage for ecological goals v. Ecological continuity with regard to boundaries	2: Barely Better
Ecological continuity with regard to boundaries v. Not too many units	3: Weakly Better
Small enough to capture local gradients in values v. Ecological continuity with regard to boundaries	7: Very Strongly Better
Uniform Shape and Size v. Ecological continuity with regard to boundaries	4: Moderately Better
Planning units compatible with data available v. Ecological continuity with regard to boundaries	4: Moderately Better
Context of planning unit (as related to ecological management) v. Ecological continuity with regard to	3: Weakly Better

boundaries	
Units used in land-use decision-making and/or transactions v. Data available on a consistent basis for all units	4: Moderately Better
Units used in land-use decision-making and/or transactions v. Data available in useable form	3: Weakly Better
Units used in land-use decision-making and/or transactions v. Units large enough to manage for ecological goals	7: Very Strongly Better
Units used in land-use decision-making and/or transactions v. Not too many units	9: Absolutely Better
Units used in land-use decision-making and/or transactions v. Small enough to capture local gradients in values	2: Barely Better
Data available in usable form v. Data available on a consistent basis for all units	2: Weakly Better
Data available on a consistent basis for all units v. Units large enough to manage for ecological goals	2: Weakly Better
Data available on a consistent basis for all units v. Not too many units	5: Definitely Better
Small enough to capture local gradients in values v. Data available on a consistent basis for all units	2: Barely Better
Uniform shape and size v. Data available on a consistent basis for all units	3: Weakly Better
Planning Units compatible with data available v. Data available on a consistent basis for all units	4: Moderately Better
Data available on a consistent basis for all units v. Context of planning unit (as related to ecological management)	4: Barely Better
Data available in usable form v. Units large enough to manage for ecological goals	5: Definitely Better
Data available in usable form v. Not too many units	7: Very Strongly Better
Data available in usable form v. Small enough to capture local gradients in values	2: Barely Better
Data available in usable form v. Uniform size and shape	2: Barely Better
Planning units compatible with data available v. Data available in usable form	2: Barely Better
Data available in usable form v. Context of planning unit (as related to ecological management)	3: Weakly Better
Units large enough to manage for ecological goals v. Not too many units	3: Weakly Better
Small enough to capture local gradients in values v. Units large enough to manage for ecological goals	5: Definitely Better
Uniform shape and size v. Units large enough to manage for ecological goals	5: Definitely Better

Planning units compatible with data available v. Units large enough to manage for ecological goals	4: Moderately Better
Context of planning unit (as related to ecological management) v. Units large enough to manage for ecological goals	1: Equal
Small enough to capture local gradients in values v. Not too many units	8: Definitely Better
Uniform shape and size v. Not too many units	6: Strongly Better
Planning units compatible with data available v. Not too many units	7: Very Strongly Better
Context of planning unit (as related to ecological management) v. Not too many units	4: Moderately Better
Small enough to capture local gradients in values v. Uniform shape and size	4: Moderately Better
Small enough to capture local gradients in values v. Planning units compatible with data available	2: Barely Better
Small enough to capture local gradients in values v. Context of planning unit (as related to ecological management)	4: Moderately Better
Uniform shape and size v. Context of planning unit (as related to ecological management)	2: Barely Better
Uniform shape and size v. Planning units compatible with data available	1: Equal
Planning units compatible with data available v. Context of planning unit (as related to ecological management)	3: Weakly Better

Table 5: Ranked Alternatives

Criterion	Alternatives	Ranking
Ecological Continuity with Regard to Boundaries	Planning Watersheds v. Census Block Groups	8: Critically Better
	Planning Watersheds v. Assessor's Parcel Pages	9: Absolutely Better
	Planning Watersheds v. Uniform Grid	9: Absolutely Better
	Census Block Groups v. Assessor's Parcel Pages	3: Weakly Better
	Census Block Groups v. Uniform Grid	3: Weakly Better
	Assessor's Parcel Pages v. Uniform Grid	1: Equal
Units Used in Land-Use Decision Making	Census Block Groups v. Planning Watershed	6: Strongly Better
	Assessor's Parcel Pages v.	8: Critically Better

	Planning Watersheds	
	Uniform Grid v. Planning Watersheds	7: Very Strongly Better
	Assessor's Parcel Pages v. Census Block Groups	4: Moderately Better
	Uniform Grid v. Census Block Groups	3: Weakly Better
	Assessor's Parcel Pages v. Uniform Grid	2: Barely Better
Data Available on a Consistent Basis for all Units	Planning Watersheds v. Census Block Groups	1: Equal
	Planning Watersheds v. Assessor's Parcel Pages	4: Moderately Better
	Planning Watersheds v. Uniform Grid	5: Definitely Better
	Census Block Groups v. Assessor's Parcel Pages	4: Moderately Better
	Census Block Groups v. Uniform Grid	5: Definitely Better
	Assessor's Parcel Pages v. Uniform Grid	2: Barely Better
Data Available in Usable Form	Planning Watersheds v. Census Block Groups	1: Equal
	Planning Watersheds v. Assessor's Parcel Pages	1: Equal
	Planning Watersheds v. Uniform Grid	3: Weakly Better
	Census Block Groups v. Assessor's Parcel Pages	3: Weakly Better
	Census Block Groups v. Uniform Grid	4: Moderately Better
	Assessor's Parcel Pages v. Uniform Grid	3: Weakly Better
Units Large Enough to Manage for Ecological Goals	Planning Watersheds v. Census Block Groups	6: Strongly Better
	Planning Watersheds v. Assessor's Parcel Pages	5: Definitely Better
	Planning Watersheds v. Uniform Grid	5: Definitely Better
	Census Block Groups v. Assessor's Parcel Pages	1: Equal
	Census Block Groups v. Uniform Grid	2: Barely Better
	Assessor's Parcel Pages v.	1: Equal

	Uniform Grid	
Not too Many Units	Planning Watersheds v. Census Block Groups	3: Weakly Better
	Planning Watersheds v. Assessor's Parcel Pages	4: Moderately Better
	Planning Watersheds v. Uniform Grid	4: Moderately Better
	Census Block Groups v. Assessor's Parcel Pages	4: Moderately Better
	Census Block Groups v. Uniform Grid	4: Moderately Better
	Assessor's Parcel Pages v. Uniform Grid	1: Equal
Small Enough to Capture Local Gradients in Values	Census Block Groups v. Planning Watersheds	5: Definitely Better
	Assessor's Parcel Pages v. Planning Watersheds	3: Weakly Better
	Uniform Grid v. Planning Watersheds	3: Weakly Better
	Census Block Groups v. Assessor's Parcel Pages	3: Weakly Better
	Census Block Groups v. Uniform Grid	3: Weakly Better
	Assessor's Parcel Pages v. Uniform Grid	1: Equal
Uniform Shape and Size	Planning Watersheds v. Census Block Groups	2: Barely Better
	Assessor's Parcel Pages v. Planning Watersheds	7: Very Strongly Better
	Uniform Grid v. Planning Watersheds	8: Critically Better
	Assessor's Parcel Pages v. Census Block Groups	6: Strongly Better
	Uniform Grid v. Census Block Groups	7: Very Strongly Better
	Uniform Grid v. Assessor's Parcel Pages	2: Barely Better
Planning Units Compatible with Data Available	Census Block Groups v. Planning Watersheds	3: Weakly Better
	Assessor's Parcel Pages v. Planning Watersheds	4: Moderately Better
	Uniform Grid v. Planning Watersheds	4: Moderately Better
	Assessor's Parcel Pages v. Census Block Groups	3: Weakly Better

	Uniform Grid v. Census Block Groups	2: Barely Better
	Assessor's Parcel Pages v. Uniform Grid	2: Barely Better
Context of Planning Unit (Related to Ecological Management)	Planning Watersheds v. Census Block Groups	6: Strongly Better
	Planning Watersheds v. Assessor's Parcel Pages	7: Very Strongly Better
	Planning Watersheds v. Uniform Grid	7: Very Strongly Better
	Census Block Groups v. Assessor's Parcel Pages	3: Weakly Better
	Census Block Groups v. Uniform Grid	3: Weakly Better
	Assessor's Parcel Pages v. Uniform Grid	1: Equal

Table 6: Residential Predictor Variable Significance

Variable name	Run 1 Coefficient	(t-statistic		Coefficient	(t-statistic)	Run 3 Coefficient	(t-statistic)	Run 4	(t-statistic)
Constant	8.2750	* (22.04)		*	(14.44)	8.2	* (22.05)	5.51900	* (14.53)
Airports	-0.0177	(-0.346)			(-0.218)	0.0018	(0.033)	0.01370	(0.28)
Schools	-0.3040	* (-8.23)		*	(-4.606)	-0.2980	* (-7.98)	-0.15200	* (-4.306)
Hospitals	-0.1290	* (-1.975)		*	(-2.554)	-0.0	(-1.45)	-0.12900	* (-2.087)
Golf	-0.1510	* (-2.658)			(0.623)	-0.1180	* (-2.01)	0.05860	(1.068)
Coastal Zone	-0.0016	(-0.144)			(-0.237)	-0.0	(-0.39)	-0.00470	(-0.446)
Fire Stations	-0.0096	(-0.214)			(1.808)	-0.0127	(-0.28)	0.07280	(1.746)
Water Bo	0.0585	* (1.982)		*	(2.905)	0.0	* (2.031)	0.08610	* (3.207)
Roads	-0.1630	* (-5.277)	-0.0991	*	(-3.459)	-0.1640	* (-5.30)	-0.10100	* (-3.52)
Slope	0.0304	(1.057)			(1.266)	0.0	(0.958)	0.03170	(1.203)
DEM	0.0636	(1.019)			(0.982)	0.0726	(1.169)	0.06000	(1.053)
Highways	0.1450	* (4.917)		*	(5.516)	0.	* (5.039)	0.15400	* (5.666)
Railroad	-0.0322	(-1.043)		*	(2.679)	-0.0215	(-0.68)	0.08940	* (2.986)
Industry	0.0960	(1.631)			(-0.386)	0.0	(1.384)	-0.03480	(-0.631)

Flood	0.0250	(1.212)	0.0085	(0.448)	0.0	(1.191)	0.00680	(0.358)
Landslides	-0.0042	(-0.422)	*	(-3.059)	-0.0027	(-0.27)	-0.02630 *	(-2.833)
Fault	0.1500 *	(4.838)	*	(5.401)	0. *	(4.925)	0.14200 *	(5.143)
Presumed Rangelan	0.0154 *	(2.33)		(-0.17)	0.0160 *	(2.412)	0.00000	(0.006)
Parks	*	(5.413)	0.0282 *	(3.395)	0.0492 *	(5.498)	0.02870 *	(3.455)
Governm Owned	172	(1.148)	-0.0068	(-0.489)	0.0199	(1.41)	-0.00930	(-0.711)
Rural (Rangeland)	-0.0655 *	(-5.217)	*	(-4.144)	-0.0644 *	(-5.15)	-0.04800 *	(-4.17)
Vineyard	-0.1690 *	(-6.479)	*	(-4.131)	-0. *	(-6.58)	-0.10600 *	(-4.321)
Agriculture	-0.2360 *	(-6.11)	*	(-4.097)	-0.2 *	(-6.21)	-0.14800 *	(-4.137)
Transmission Lines	0.0160	(0.939)	*	(1.988)	0.0173	(1.012)	0.03210 *	(2.053)
Law Enforcement	-0.1400 *	(-1.961)		(-0.503)	-0.	(-1.5)	-0.00840	(-0.125)
Urban Centers**	0.0131	(0.189)		(-1.092)	-0.0977	(-1.07)	-0.16300	(-1.946)
Population Density***			*	(16.64)			0.20100 *	(16.7)
R^2 (Adjusted R^2)	0.604	(0.597)	0.667	(0.661)	0.604	(0.598)	0.668	(0.662)

*Indicates statistic significant at the 5% level

**Taft cluster is added in the calculation distance to urban center for Run 1 and Run 2

*** The Population Density variable is only added in the Run 2 and Run 4

Table 7: Agriculture Predictor Variable Significance

Variable name	Coefficient	(t-stati	Variable name	Coefficient	(t-sta
Constant	8.649*	(72.	Urban Use	-0.013*	(-2
Roads	-0.066*	(-2.626)	Vineyard	-0.302*	(-15.76)
Slope	-0.068*	(-3.073)	Agriculture	-0,425*	(-15.18)
Water Source	-0.019	(-0.803)			
R^2	0,504		Adjusted R^2	0.502	

*Indicates statistic significant at the 5% level

Table 8: Generalized Method of Moments Model, Run 4[200]

Variable	GMM Estimate	t-statistic	p-value
Airports	0.058	0.77	0.44
Schools	-0.078	-1.21	0.23
Hospitals	0.084	1.00	0.32
Golf	0.457	5.21	0.00
Coastal Zone	0.011	0.48	0.63
Fire Stations	0.163	2.33	0.02
Water Bodies	0.244	5.94	0.00
Roads	-0.103	-2.40	0.02
Slope	0.0002	0.00	0.99
Elevation	-0.212	-2.50	0.01
Highway	0.212	4.58	0.00
Railroad	0.077	1.44	0.15
Industry	-0.076	-0.96	0.34
Flood Zones	0.032	0.96	0.34
Landslide Zones	-0.044	-2.26	0.02
Fault Lines	0.394	9.68	0.00
Rangeland	0.015	1.87	0.06
Parks	0.049	3.22	0.00
Government-owned	0.054	2.79	0.01
Rural Lands	-0.023	-1.55	0.12
Vineyards	-0.039	-1.05	0.29
Agriculture	-0.069	-1.24	0.21
Transmission Lines	0.036	1.15	0.25
Law Enforcement	-0.043	-0.42	0.67
Population Density	0.276	14.22	0.00
Urban Centers	-0.249	-1.73	0.08

[200] Run 4 excludes the Taft cluster and includes the population density variable.

Table 9: Variable Comparisons Across Hedonic Models

	Our Model (OLS, Run 1: Taft)	Our Model (OLS, Run 2: Taft + Population Density)	Our Model (OLS, Run 3, No Taft)	Our Model (OLS, Run 4, No Taft + Population Density)	Our Model (GMM from Run 4)	Bockstael and Bell (OLS, 1997, no significances noted)	Geoghegan *et al.* (OLS, 1997, *** not noted)	Irwin and Bockstael (OLS, 2001)
R-Squared Value	0.604	0.667	0.604	0.668	-	0.5316	0.4744	0.706
Constant	8.275 (22.044) ***	5.519 (14.442) ***	8.245 (22.050) ***	5.519 (14.530) ***	-0.249 (-1.73) *	11.988 (117.596)	12.8 (285.42) **	4.21876 (0.11223) ***
Local Centers	0.0131 (0.189)	-0.07 (-1.092)	-0.098 (-1.073)	-0.163 (-1.946) *		-0.29 (-7.834)		
Population Density		0.201 (16.644) ***		0.201 (16.697) ***	0.276 (14.22) ***			-0.03057 (0.00103) ***
Road Access	-0.163 (5.277) ***	-0.100 (-3.459) ***	-0.164 (-5.296) ***	-0.101 (-3.520) ***	-0.103 (-2.40) **		0.016 (8.09) **	
Highway Access	0.145 (4.917) ***	0.149 (5.516) ***	0.149 (4.925) ***	0.154 (5.666) ***	0.212 (4.58) ***			
Pasture	0.0154 (2.330) **	-0.001 (-0.170)	0.016 (2.412) **	<<0.001 (0.006)	0.015 (1.87) *	0.012 (2.133)		-0.00824 (0.00531) #
Parks	0.0485 (5.413) ***	0.0282 (3.395) ***	0.0492 (5.498) ***	0.0287 (3.456) ***	0.049 (3.22) ***			0.214 (0.0737) ***#
Government-owned Land	0.0172 (1.148)	-0.0068 (-0.489)	0.020 (1.410)	-0.0093 (-0.711)	0.054 (2.79) ***			0.0284 (0.01362) **#
Very Low Density Residential / Rural Lands	-0.066 (-5.217) ***	-0.048 (-4.144) ***	-0.064 (-5.152) ***	-0.048 (-4.170) ***	-0.023 (-1.55)	0.077 (1.547)		
% Open Space (0.1km)							0.0189 (2.66) **	
% Open Space (1.0km)							-0.034 (-5.34) **	
Vineyards	-0.169 (-6.479) ***	-0.101 (-4.131) ***	-0.173 (-6.579) ***	-0.106 (-4.321) ***	-0.039 (-1.05)			#
Cropland	-0.236 (-6.11) ***	-0.147 (-4.097) ***	-0.239 (-6.21) ***	-0.148 (-4.137) ***	-0.069 (-1.24)	-0.002 (-0.771)		#
Coastal Access	-0.0016 (-0.144)	-0.0025 (-0.237)	-0.0045 (-0.389)	-0.0047 (-.446)	0.011 (0.48)	0.006 (2.073)	&	
Waterbodies	0.0586 (1.982) **	0.0788 (2.905) ***	0.0693 (2.031) **	0.0861 (3.207) ***	0.244 (5.94) ***		0.317 (6.21) **&	
Slope	0.0304 (1.057)	0.0334 (1.266)	0.0275 (0.958)	0.0317 (1.203)	0.0002 (0)			
Elevation	0.0635 (1.019)	0.0562 (0.982)	0.0726 (1.169)	0.06 (1.053)	-0.212 (-2.5) ***			
Airports	-0.018 (-0.346)	-0.01 (-0.218)	0.00178 (0.033)	0.0137 (0.280)	0.068 (0.77)			
Schools	-0.304 (-8.23) ***	-0.161 (-4.606) ***	-0.298 (-7.984) ***	-0.152 (-4.306) ***	-0.078 (-1.21)			
Hospitals	-0.129 (-1.975) **	-0.154 (-2.554) **	-0.097 (-1.452)	-0.129 (-2.087) **	0.084 (1.00)			
Golf Courses	-0.151 (-2.658) ***	0.0332 (0.623)	-0.118 (-2.014) **	0.0586 (1.068) *	0.457 (5.21) ***			
Fire Stations	-0.0096 (-0.214)	0.0754 (1.808) *	-0.013 (-0.282)	0.0728 (1.746) *	0.163 (2.33) **			
Law Enforcement	-0.140 (-1.961) **	-0.033 (-0.503)	-0.109 (-1.503)	-0.0084 (-0.125)	-0.043 (-0.42)			
Railroad	-0.32 (-1.043)	0.0781 (2.679) *	-0.022 (-0.675)	0.0894 (2.966) **	0.077 (1.44)			
Industry	0.096 (1.631)	-0.021 (-0.386)	0.0824 (1.384)	-0.035 (-0.631)	-0.076 (-0.96)			
Flood Zones	0.025 (1.212)	0.00848 (0.448)	0.0245 (1.191)	0.0068 (0.358)	0.032 (0.96)			
Landslides	-0.0042 (-0.422)	-0.028 (-3.059) ***	-0.0027 (-0.27)	-0.026 (-2.833) **	-0.044 (-2.26) **			
Fault Zones	0.150 (4.838) ***	0.153 (5.401) ***	0.149 (4.915) ***	0.142 (5.143) ***	0.394 (9.68) ***			
Transmission Lines	0.016 (0.939)	0.0311 (1.988) **	0.0172 (1.012)	0.0321 (2.053) **	0.036 (1.15)			

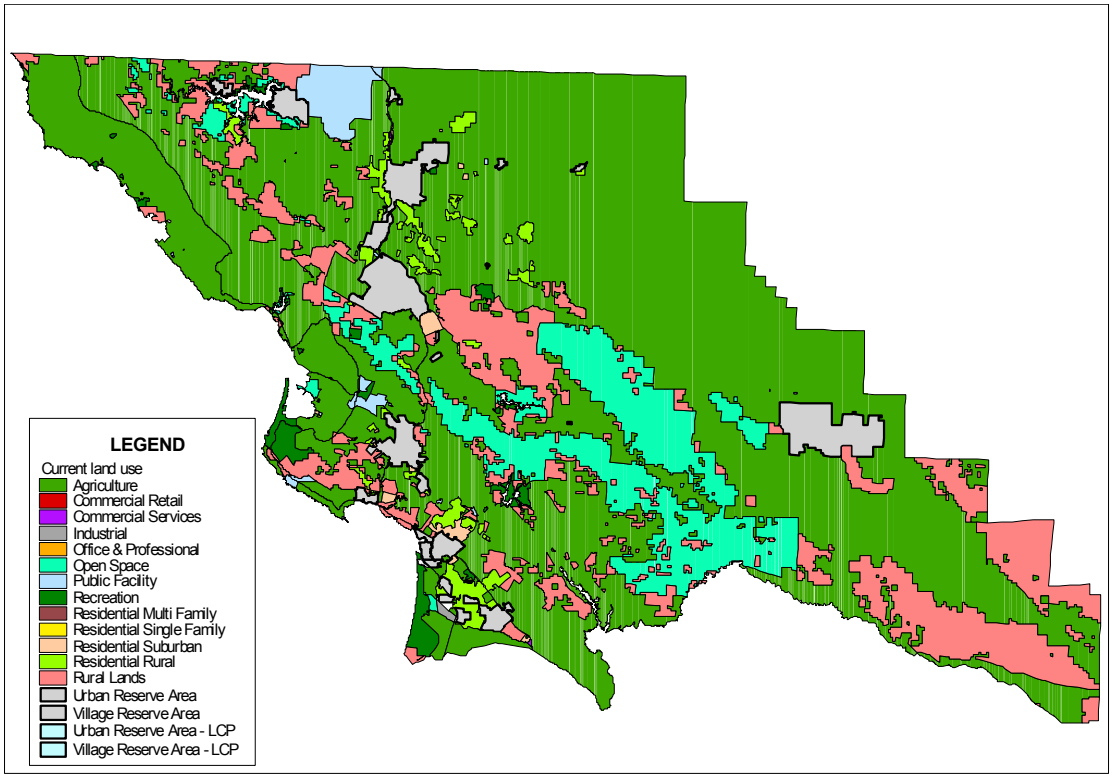
	Our Model (OLS, Run 1: Taft)	Our Model (OLS, Run 2: Taft + Population Density)	Our Model (OLS, Run 3, No Taft)	Our Model (OLS, Run 4, No Taft + Population Density)	Our Model (GMM from Run 4)	Bockstael and Bell (OLS, 1997, no significances noted)	Geoghegan *et al*. (OLS, 1997, *** not noted)	Irwin and Bockstael (OLS, 2001)
Lot Size						-0.263 (-32.383)	0.172 (70.90)**	0.0316 (0.00144) ***
Commercial						-0.008 (-0.841)		
Forest						0.005 (2.398)		
Medium Density Residential						0.016 (5.640)		
High Density Residential						0.081 (8.539)		
Anne Arundel Co.						1.015 (22.280)		
Calvert Co.						0.417 (5.897)	-0.301 (-10.59) **	-0.282 (0.00566) ***
Prince George's Co.						0.344 (9.608)	-0.125 (-8.87) **	
Annapolis							0.167 (5.06) **	
Montgomery Co.							0.559 (37.77) **	
Howard Co.							0.109 (10.58) **	-0.141 (0.00354) ***
Charles Co.							-0.156 (-13.33) **	-0.239 (0.00533) ***
In subdivision						0.520 (7.233)		
Distance to Large Shopping Center						-0.015 (-7.304)		
Distance to Small Shopping Center						-5.154 (-0.274)		
Age of House							-0.124 (-27.40) **	-0.020 (0.00104) ***
Distance to D.C.						-0.011 (-11.38)	-0.172 (-19.49) **	-0.0636 (0.00472) ***
Distance to Baltimore								0.0582 (0.00331) ***
Wood Structure							-0.013 (-1.79) *	
Diversity (0.1 km)							0.005 (0.081)	
Diversity (1.0 km)							0.006 (1.46) *	
Fragmentation (0.1 km)							0.0036 (1.26)	
Fragmentation (1.0 km)							-0.0013 (-0.65)	
% Residential Use (0.1 km)							0.0081 (0.912)	
% Residential Use (1.0 km)							-0.030 (-3.55) **	
% White Population							0.207 (15.26) **	
% Black Population								-0.054 (0.00906) ***
% Low Income							-0.464 (-12.91) **	
% Middle Income							-0.389 (-9.43) **	
% High Income							0.456 (10.46) **	
% High School Grad.								0.175 (0.0097) ***
Full Bathrooms								0.068 (0.00221) ***
Half Bathrooms								0.046 (0.00239) ***
House Footprint								0.102 (0.0056) ***
House Grade								0.161 (0.00243) ***
Detached House								0.166 (0.00389) ***
Sale Year of House								0.0227 (0.00076) ***
Size of House								0.344 (0.00503) ***

* - 0.1 significance; ** - 0.05 significance; *** - 0.01 significance

& - Geoghegan et al. used waterfront housing as a dummy variable, which may account for the large difference between their model and ours.

- Irwin and Bockstael used three measures of open space: private rangeland and farmland; private land restricted from development, such as easements, and public land. As such, the variables are similar but not the same as the ones used in our model.

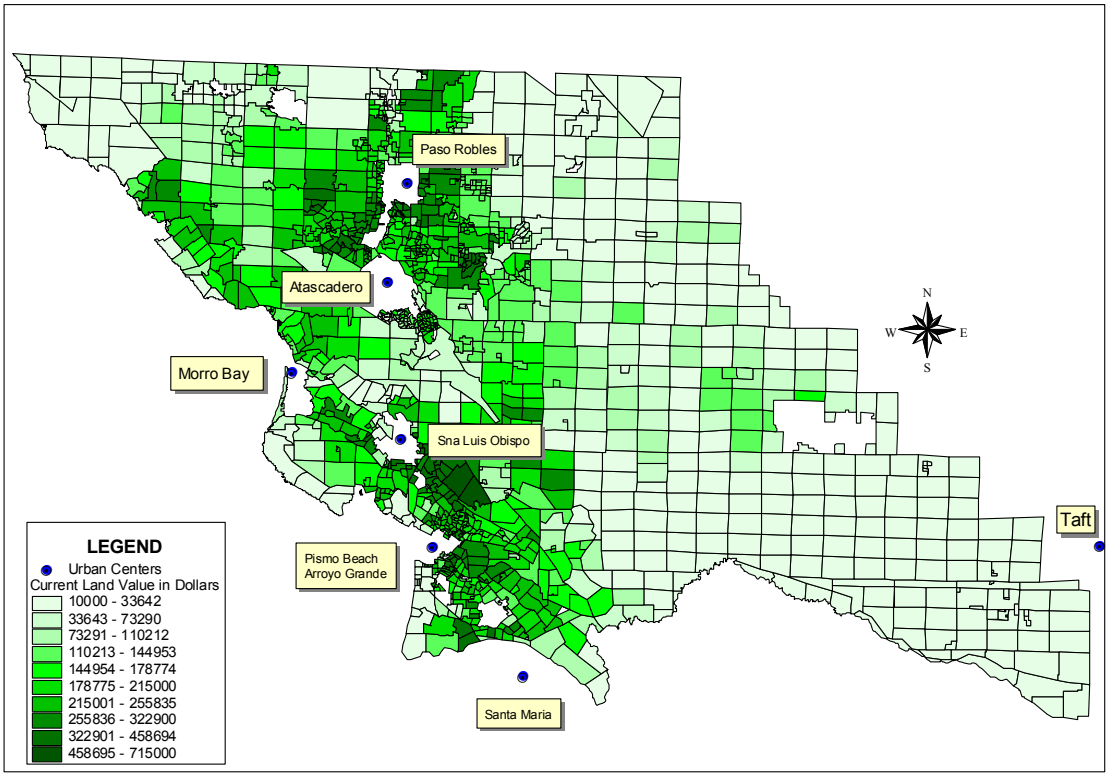
Map M-1- A: Current Land Use



Current Land Use Map
Map M-1-A

Current Land Use Map
g:\work\chuang\landuse0223.apr
2/28/02

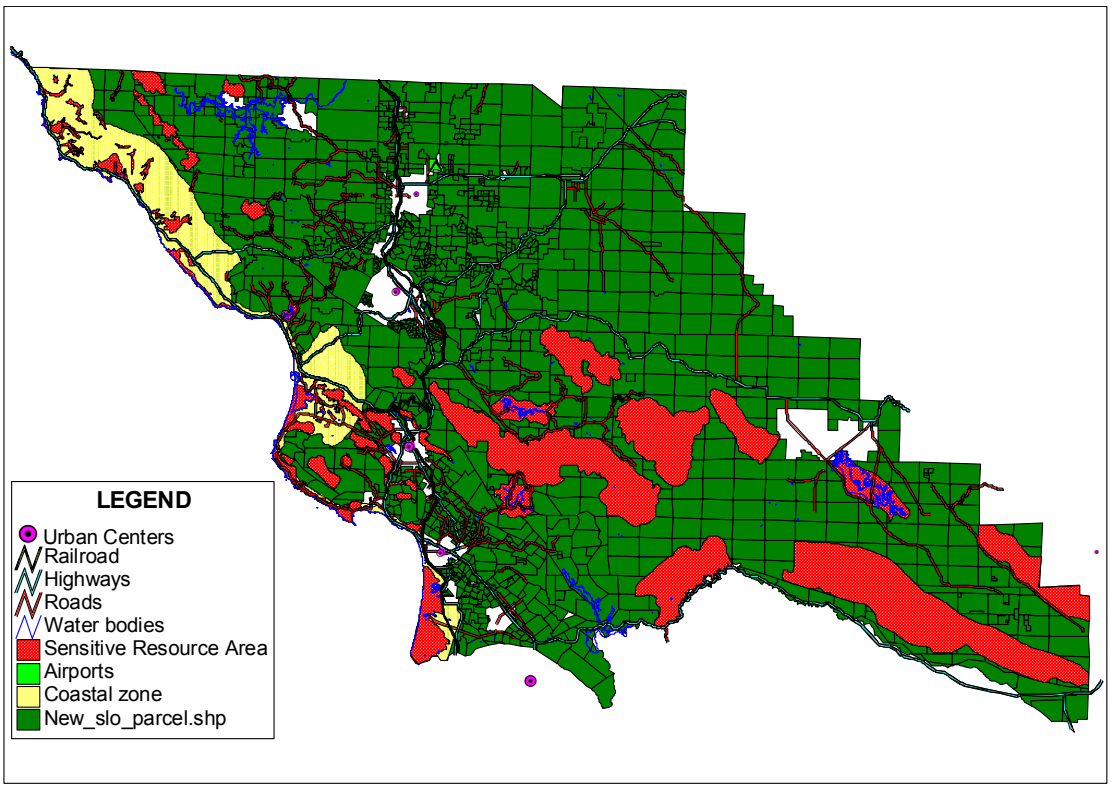
Map M-1- B: Current Land Value Map



Current Land Value Map

Map M-1-B

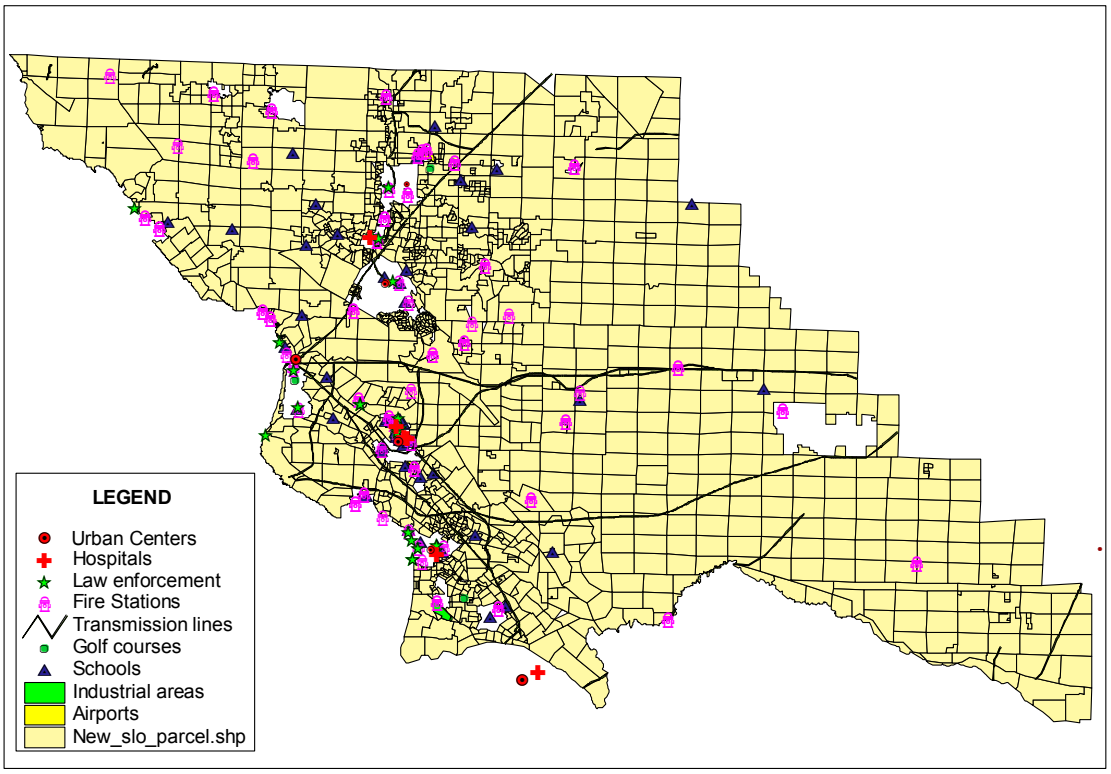
Map M-1- C: Environmental Map



Environmental Map
Map M-1-C

Env Map
g:/work/jdietenhofer/final.apr
2/28/02

Map M-1- D: Neighborhood Amenities



Neighborhood Amenities

Map M-1-D

Neighborhood Amenities
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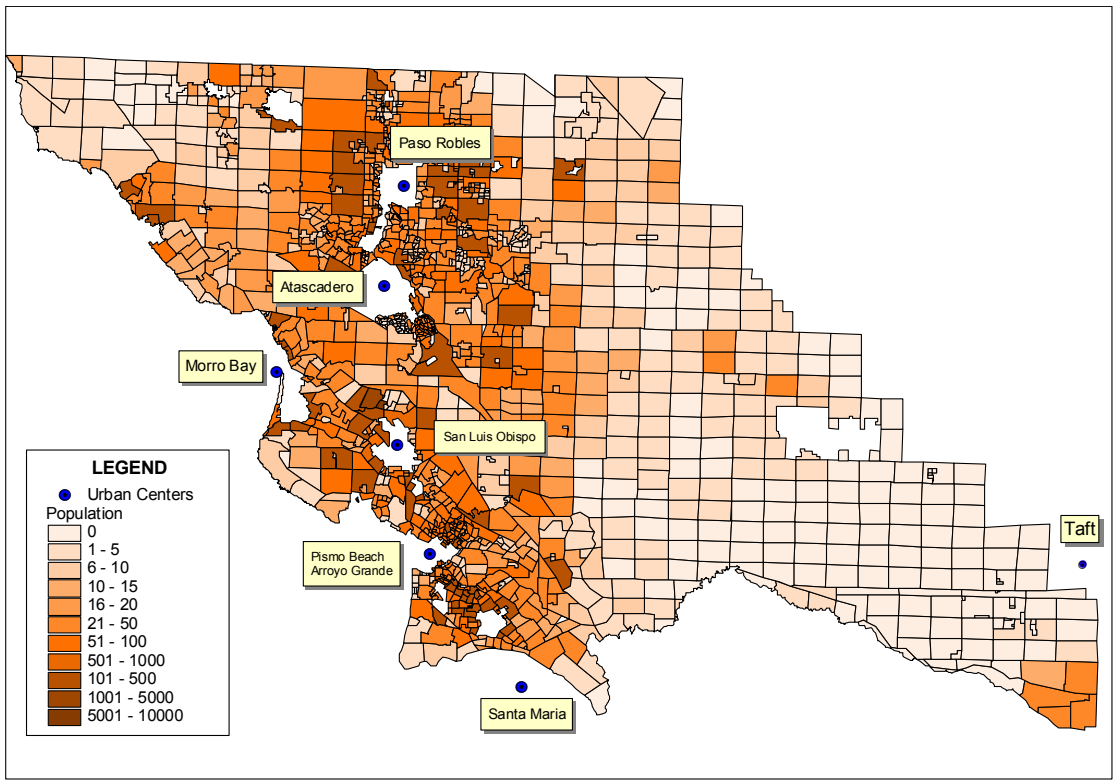
2/28/02

Map M-1- E: Population Map



Population Map

Map M-1-E

Pop Map
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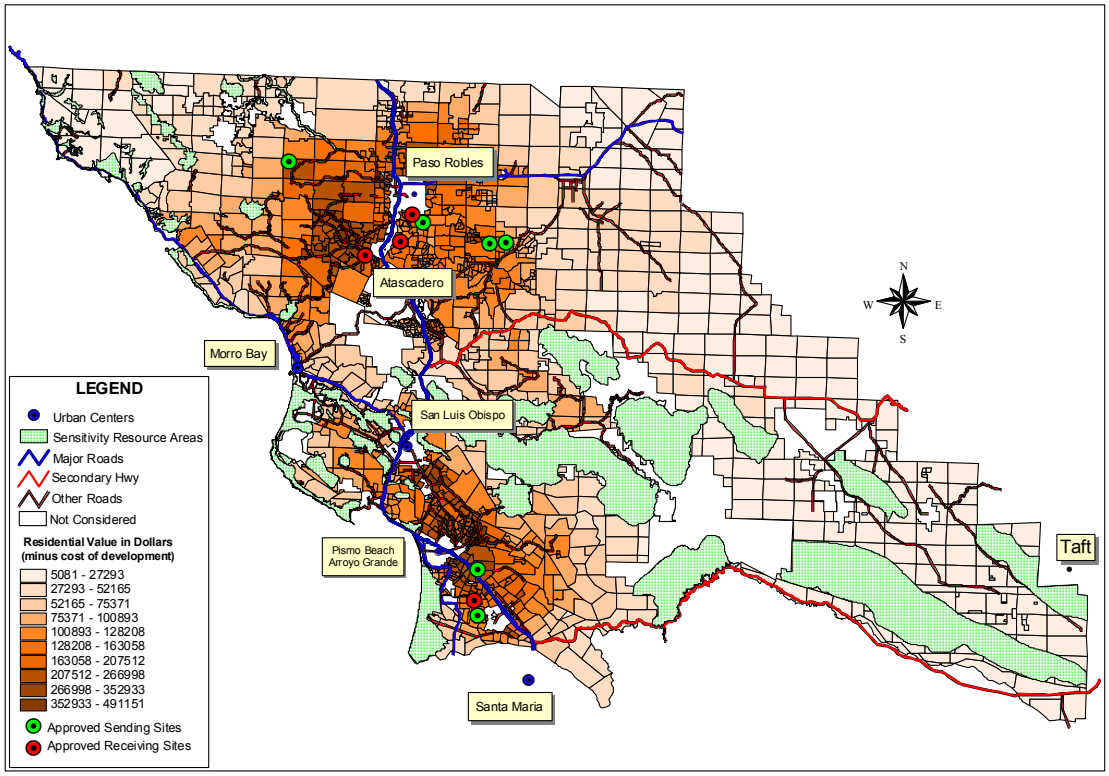
2/28/02

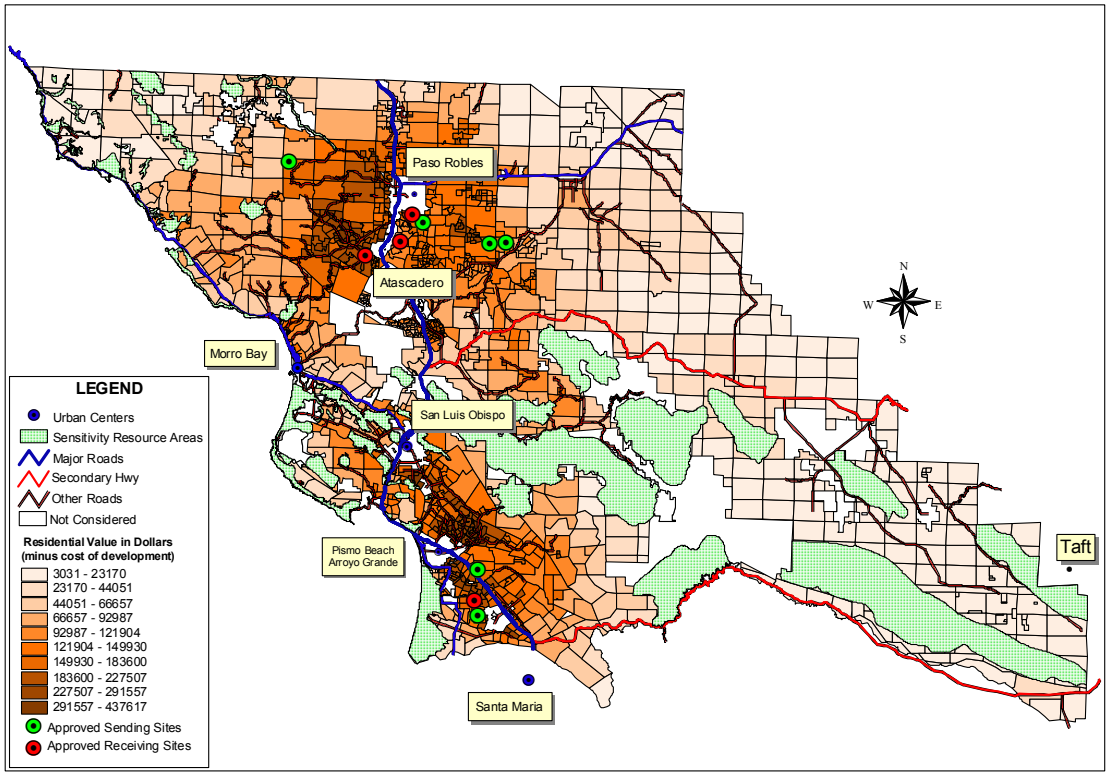
Map M-2-A-1. 1: Residential Value, Run 1



Residential Value
(including Taft)
Map M-2-A-1.1

Residential Value / Run 1
Urban Sprawl Group
g:/work/jdietenhofer/final.apr
2/28/02

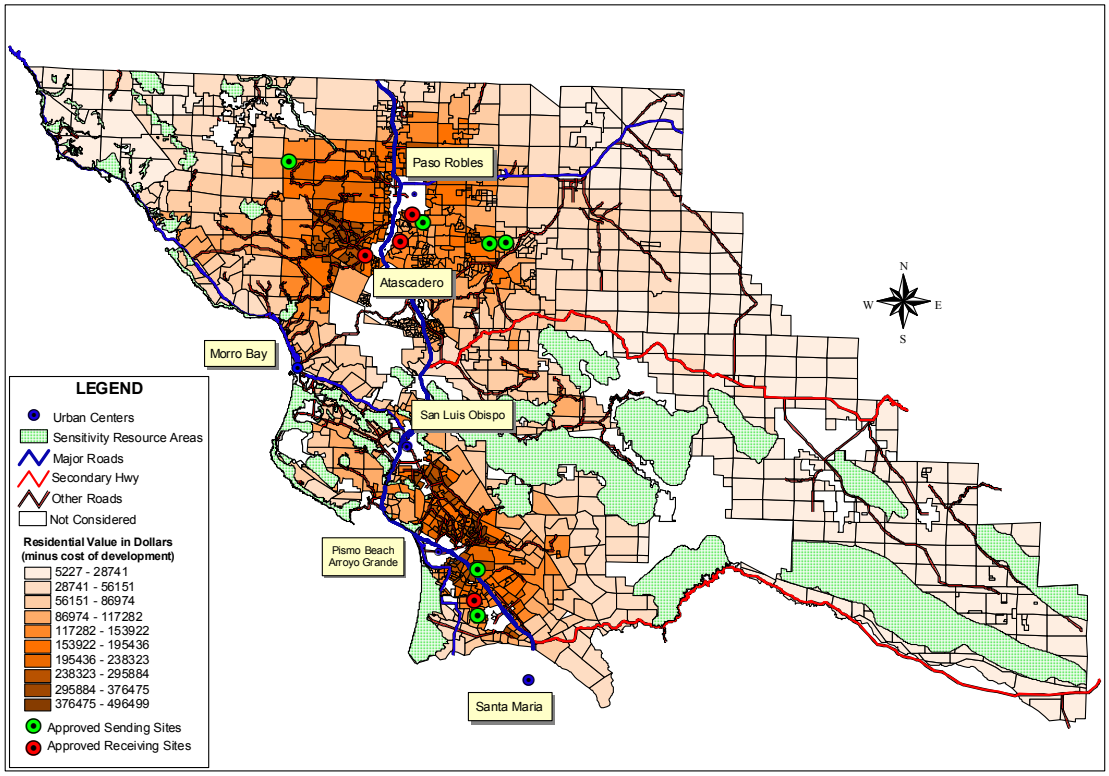
Map M-2-A-1. 2: Residential Value, Run 2



Residential Value
(including Taft cluster and Population Density)
Map M-2-A-1.2

Residential Value / Run 2
Urban Sprawl Group
g:/work/jdietenhofer/final.apr
2/28/02

Map M-2-A-1. 3: Residential Value, Run 3

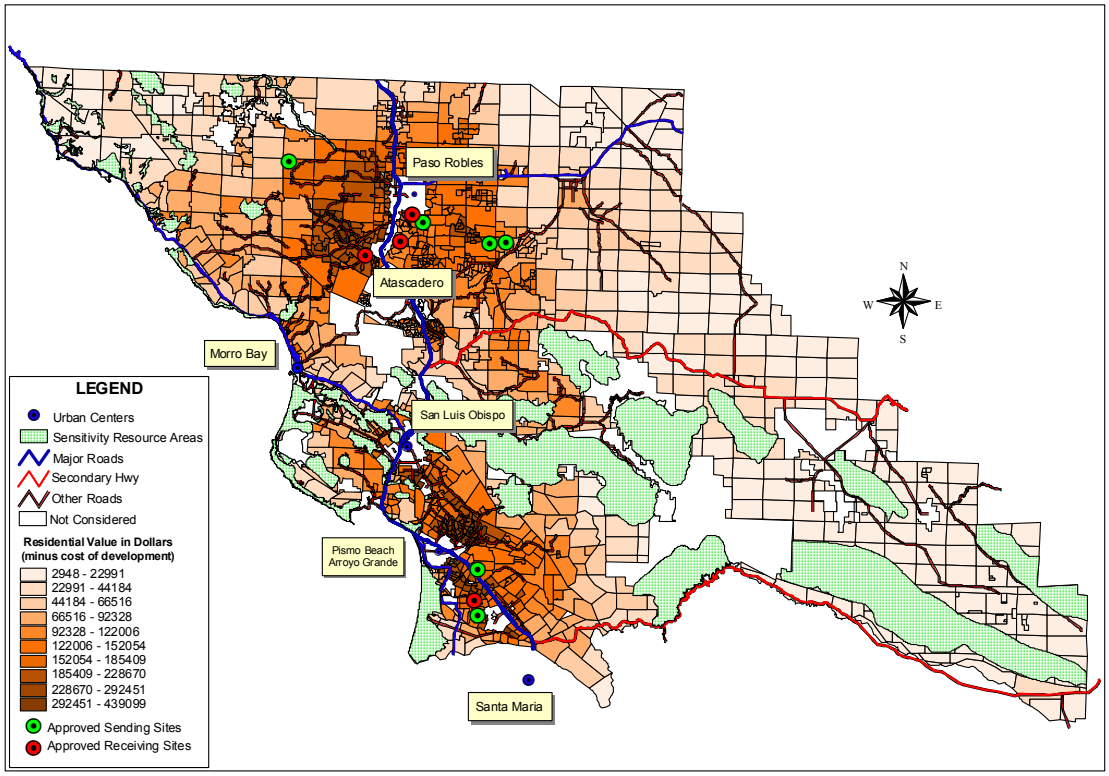


Residential Value

Map M-2-A-1.3

Residential Value / Run 3
Urban Sprawl Group
g:/work/jdietenhofer/final.apr
2/28/02

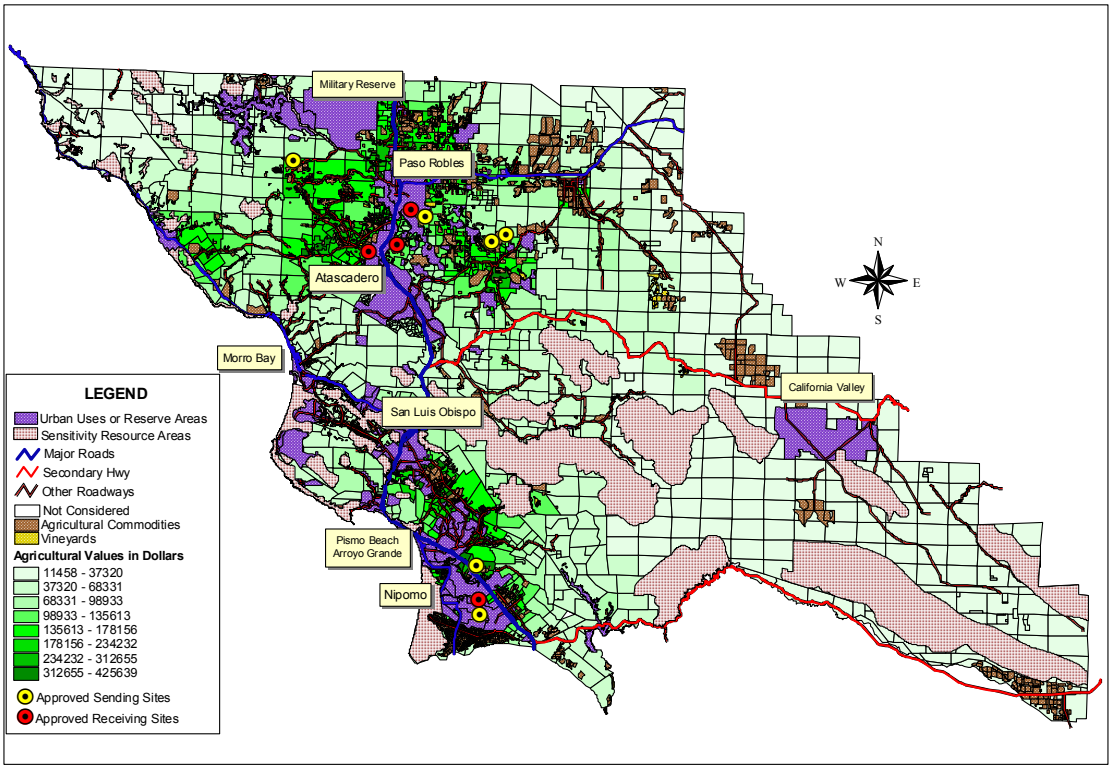
Map M-2-A-1. 4: Residential Value, Run 4



Residential Value
(including Population Density)
Map M-2-A-1.4

Residential Value / Run 4
Urban Sprawl Group
g:/work/jdietenhofer/final.apr
2/28/02

Map M-2-A-2: Agricultural Value

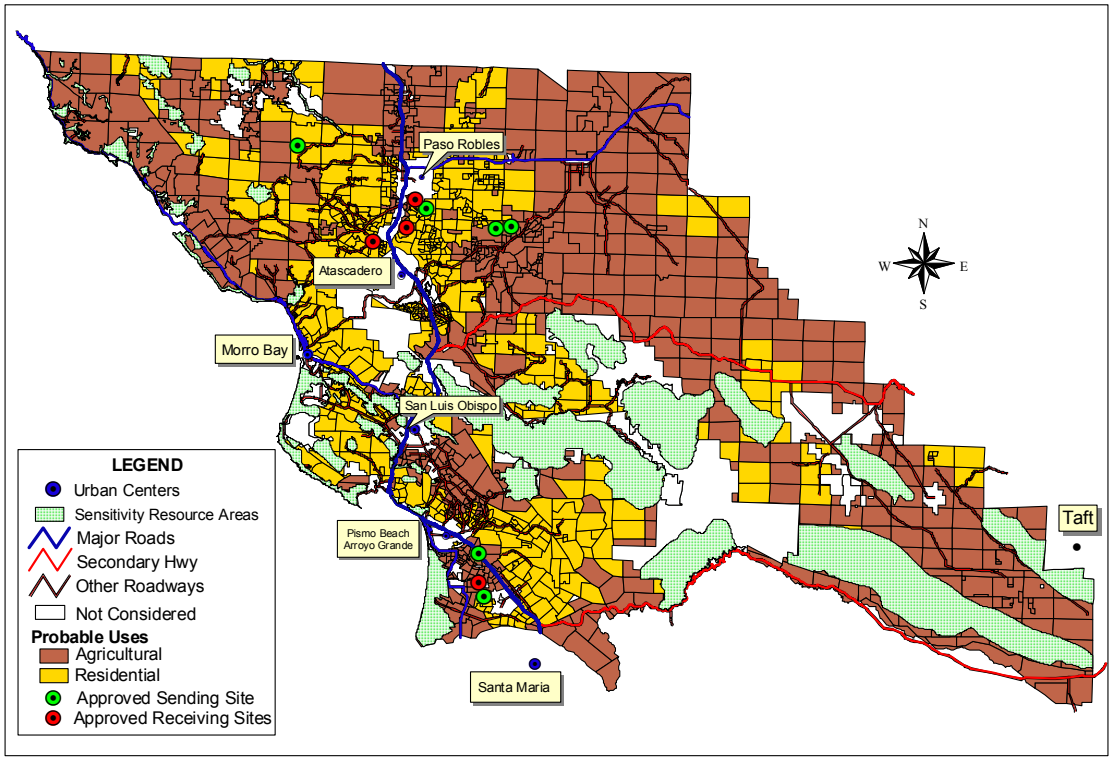


Agricultural Value

Map M-2-A-2

Ag Value
Urban Sprawl Group
g:/work/jdietenhofer/final.apr
2/28/02

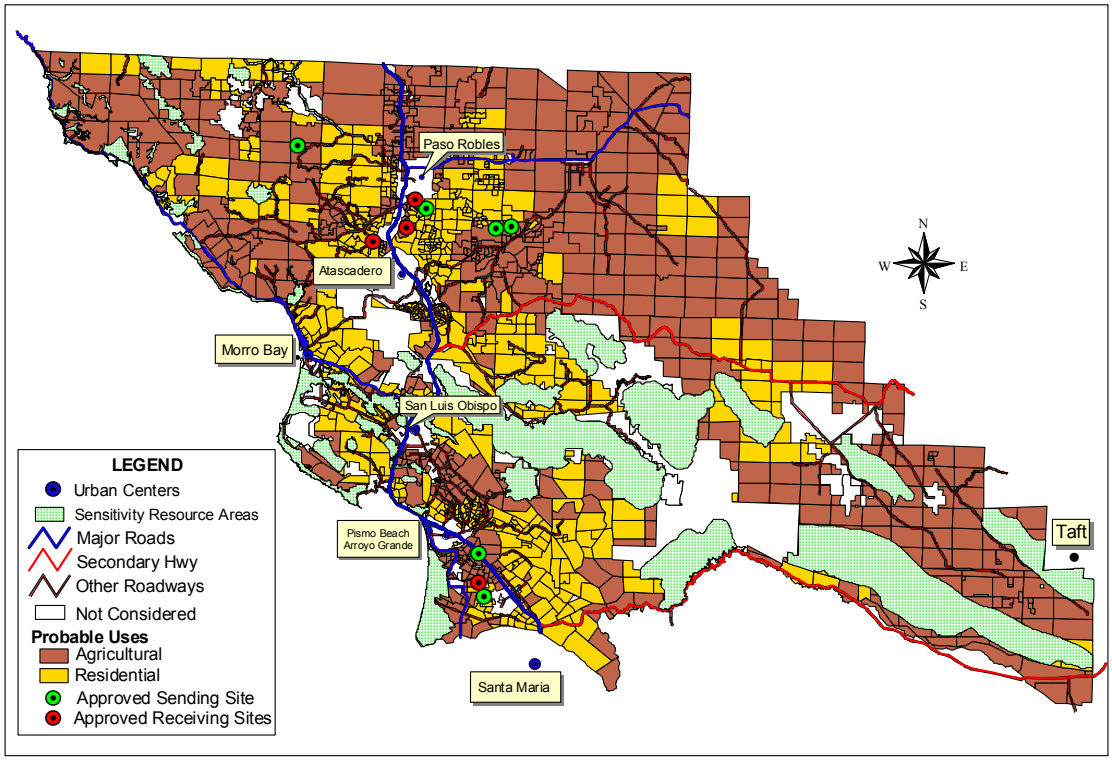
Map M-2-B-1. 1: Probable Land Use, Run 1



Land Conversion Probability
(including Taft)
Map M-2-B-1.1

Land Probability Run 1
Urban Sprawl Group
g:/work/jdietenhofer/final.apr
2/20/02

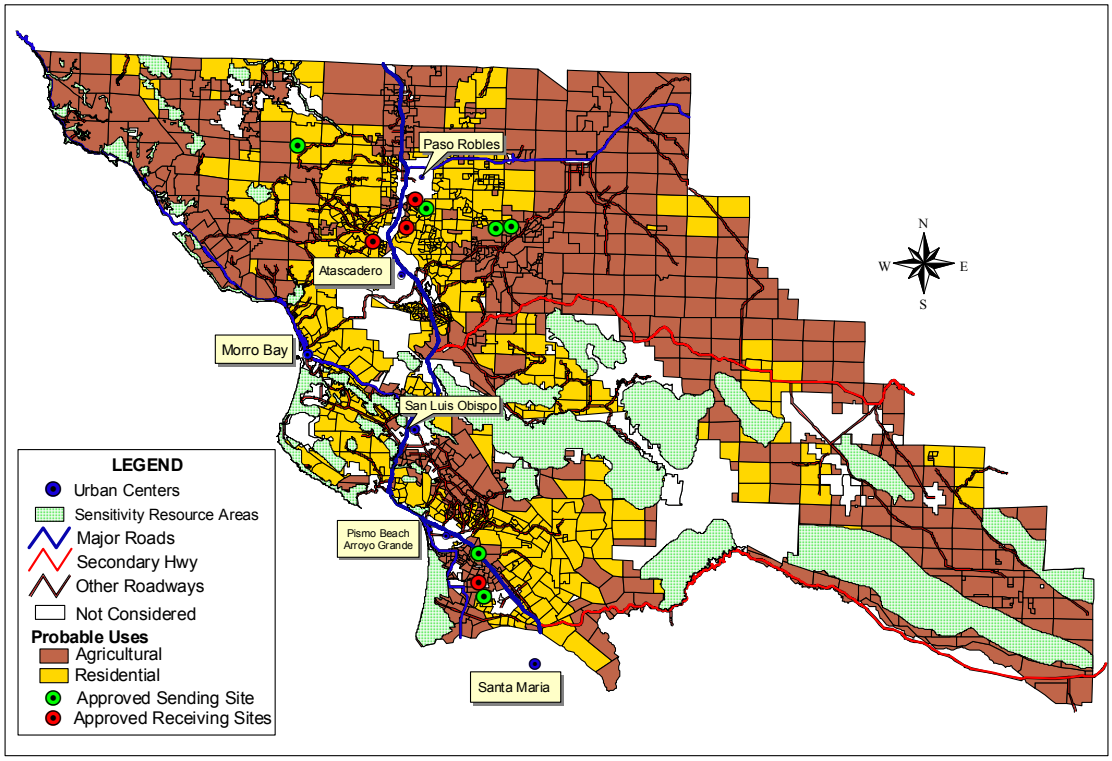
Map M-2-B-1. 2: Probable Land Use, Run 2



Land Conversion Probability
(including Taft cluster and Population Density)
Map M-2-B-1.2

Land Probability Run 2
Urban Sprawl Group
g:/work/jdietenhofer/final.apr
2/20/02

Map M-2-B-1. 3: Probable Land Use, Run 3

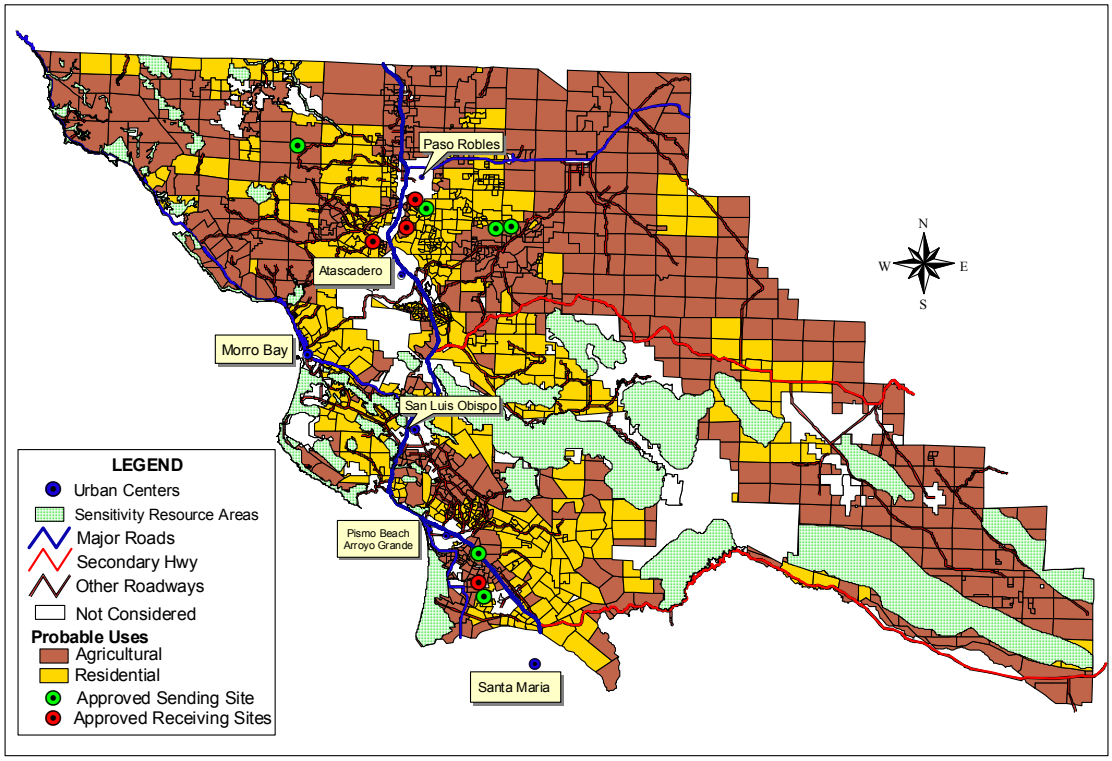


Land Conversion Probability

Land Probability Run 3
Urban Sprawl Group
g:/work/jdietenhofer/final.apr
2/20/02

Map M-2-B-1.3

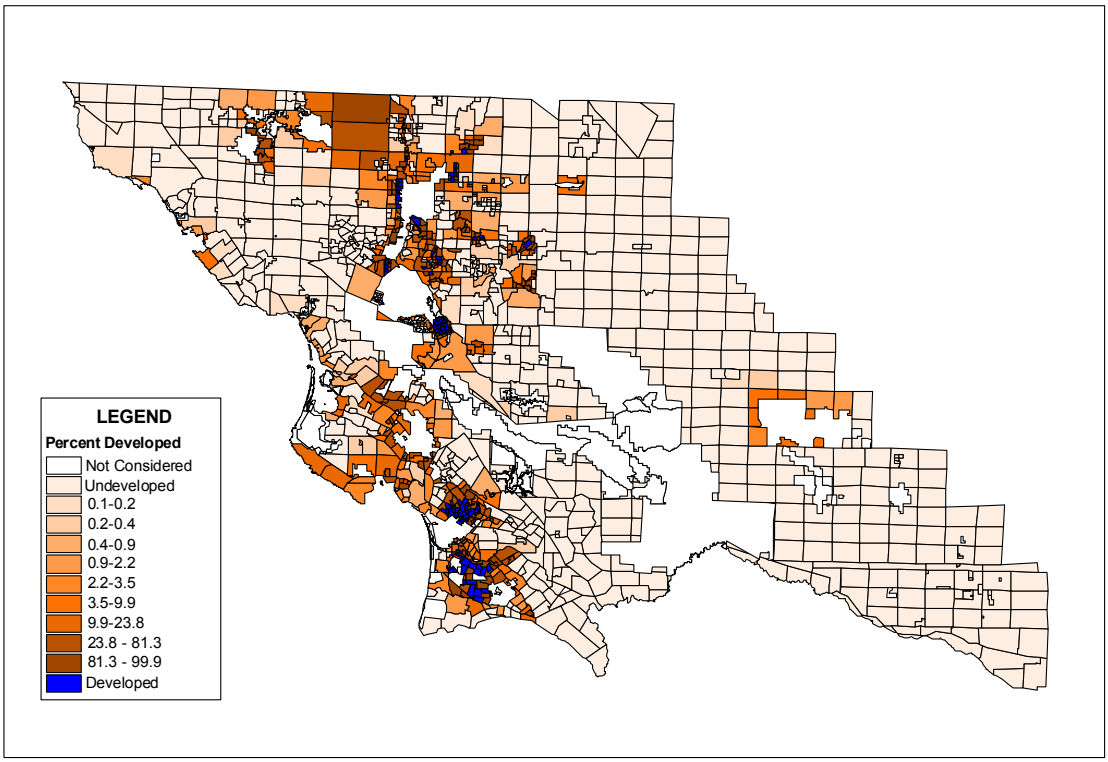
Map M-2-B-1. 4: Probable Land Use, Run 4



Land Conversion Probability
(including Population Density)
Map M-2-B-1.4

Land Probability Run 4
Urban Sprawl Group
g:/work/jdietenhofer/final.apr
2/20/02

Map M-2-B- 2: Developed/Undeveloped Land

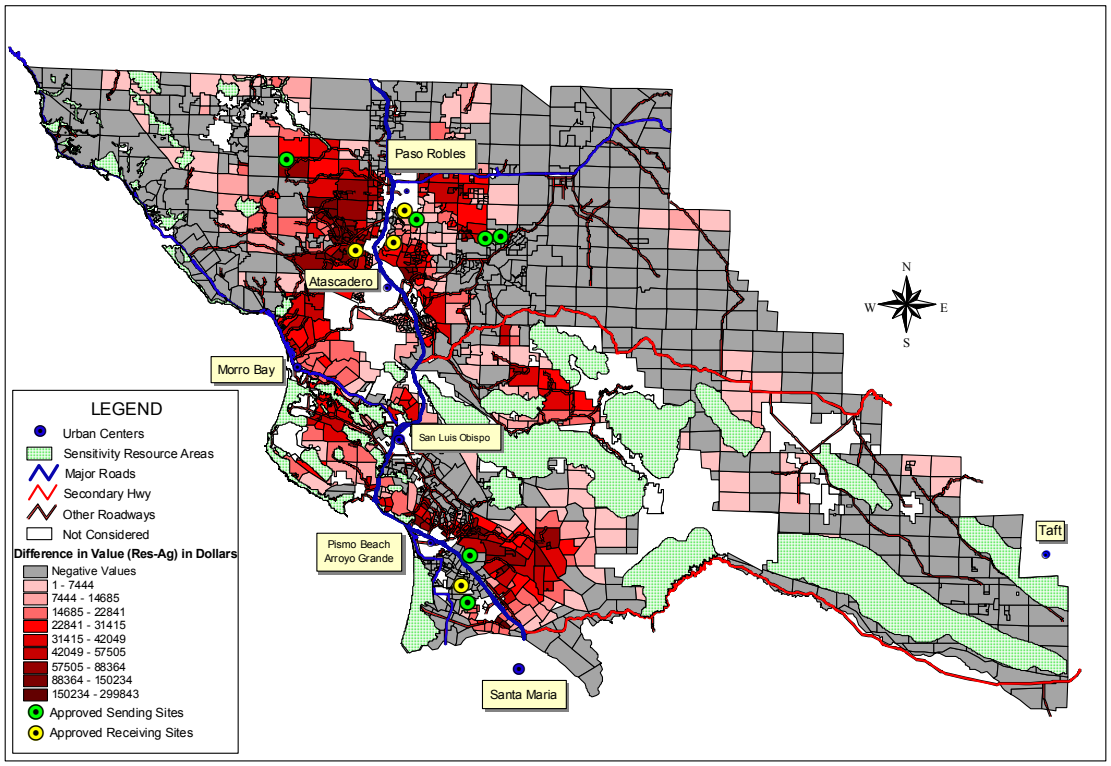


Developed / Undeveloped Land

Map M-2-B-2

Dev / Undev
g:/work/jdietenhofer/final.apr
Urban Sprawl Group
2/20/02

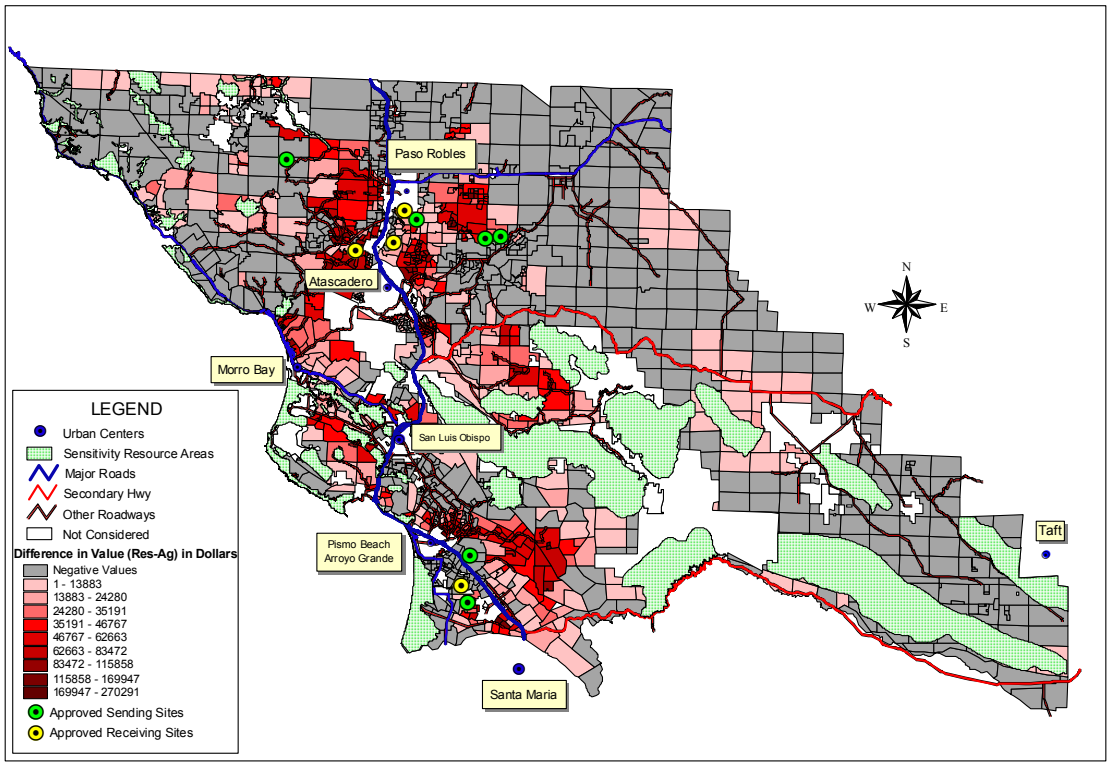
Map M-2-B-3. 1: Severity of Development Pressure, Run 1



Land Conversion / Pressure Gradient
(including Taft)
Map M-2-B-3.1

Lnd Conv / Run 1
Urban Sprawl Group
g:/work/dietmhofer/final.apr
2/28/02

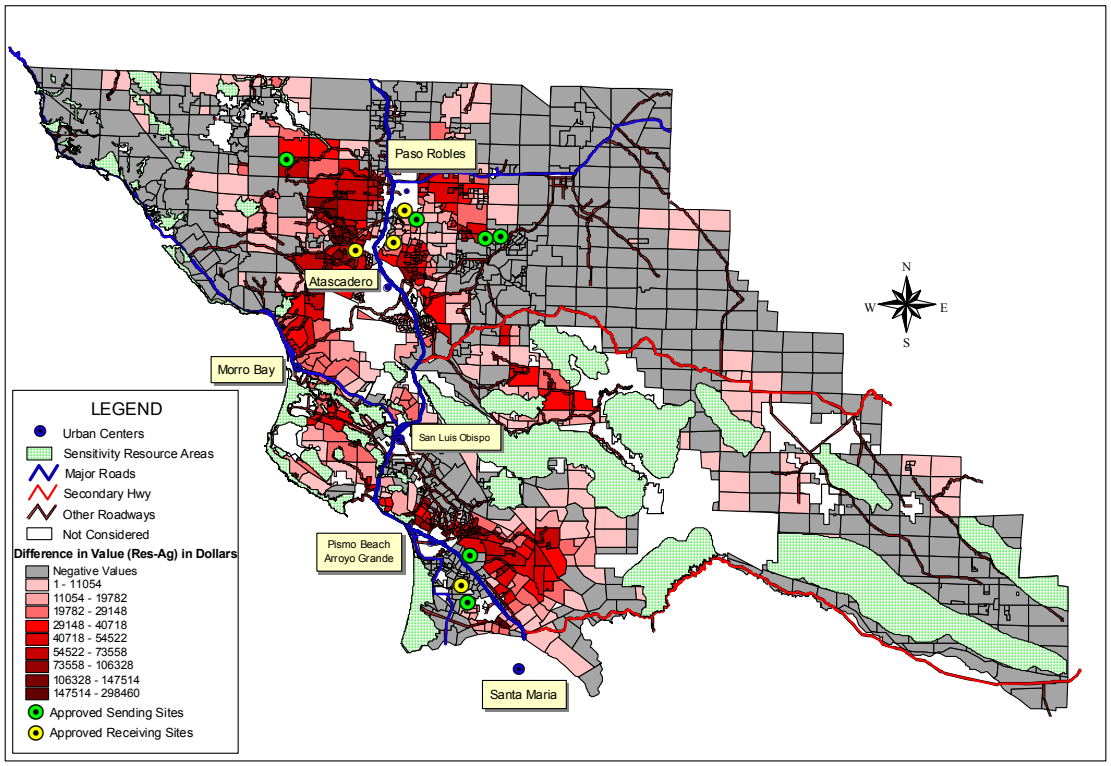
Map M-2-B-3. 2: Severity of Development Pressure, Run 2



Land Conversion / Pressure Gradient
(including Taft and Population Density)
Map M-2-B-3.2

Lnd Conv / Run 2
Urban Sprawl Group
g:/work/dietenhofer/final.apr
2/28/02

Map M-2-B-3. 3: Severity of Development Pressure, Run 3

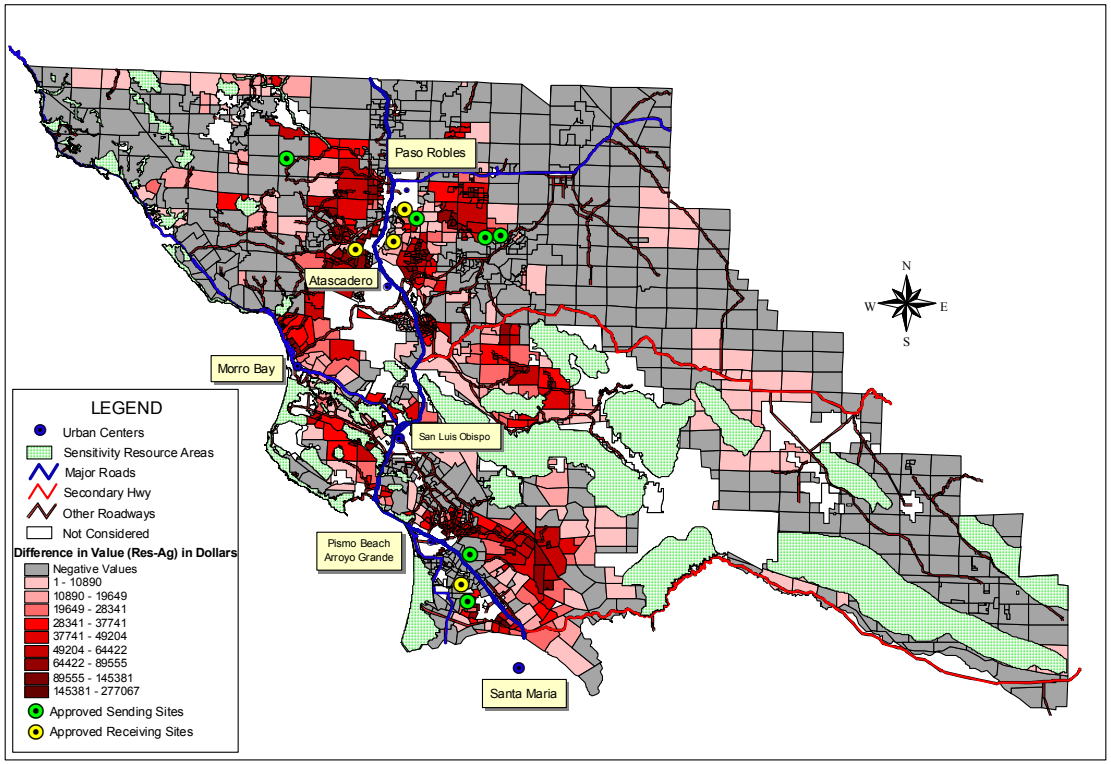


Land Conversion / Pressure Gradient

Lnd Conv / Run 3
Urban Sprawl Group
g:/work/dietenhofer/final.apr
2/28/02

Map M-2-B-3.3

Map M-2-B-3. 4: Severity of Development Pressure, Run 4



Land Conversion / Pressure Gradient
(including Population Density)
Map M-2-B-3.4

Lnd Conv / Run 4
Urban Sprawl Group
g:/work/dietenhofer/final apr
22802

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