Race to the Middle:

The Homogenization of Population Density and What It's Costing New Jersey

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Executive Summary

Over the past 50 years, New Jersey has moved away from both the compact urban and open rural densities which laid the foundation for today's high quality of life and made our state unique.

Instead, we have engaged in a "race for the middle" of the density scale. The spread-out developments proliferating today across the state's midsection are wasteful of land, money, and time, and are generating costs that will make demands on New Jersey's taxpayers for decades to come:

- **Exurban densities dedicate large amounts of land to relatively few residents**. Whereas older, compact communities like Princeton could theoretically house the entire state's population using only 15 percent of its land, exurban places like Montgomery, Raritan and Harrison Townships would require two to three times the state's land area to house the same population. With an expected one million new residents coming to New Jersey by 2020, such exurban densities are not only wasteful, but unsustainable.

- **Exurban densities cost more to serve.** Compact densities mean more residents share the costs of roads, sewers and other public services such as schools. Whereas in densely populated Hudson County only one mile of road is required to serve 1,000 residents, it takes 11 miles of road to serve 1,000 residents in sprawling Hunterdon County. The provision of infrastructure to low-density areas is often subsidized by taxpayers elsewhere in the county or state.

- **Exurban densities waste more time in travel.** Annual hours of traffic delay are actually lower in more densely designed urban areas, where other options for travel become feasible, including walking and public transit. Increases in density initially can lead to more traffic, but at some point higher densities actually alleviate traffic congestion.

Reversing the drift toward density's middle ground will involve down-zoning in some places and up-zoning in others. Changes to the municipal land use law are also needed, to help municipalities better plan for and manage growth. The State Plan stands ready as a guide in determining what density and zoning changes are appropriate for what areas and in identifying the areas that are most appropriate for absorbing new growth

It is precisely the lack of compact density in our most recent development that is propelling us so rapidly towards build-out. We must be smarter about how we use our remaining buildable land and arrest the state's degeneration into inefficient middle-range densities. New Jersey is not full yet, but that day is fast approaching unless we reclaim the advantages of our historic density patterns and relearn the wisdom of building higher-density, pedestrian-friendly, mixed-use communities.

Introduction

As observers of the debate over land development are fond of noting, both in New Jersey and nationally, "The only thing people hate more than sprawl is density."

To public officials, real estate developers, and interest groups involved in determining how land is used, the observation is amusing because of the ring of truth to it. But to much of the general public, the terms "sprawl" and "density" are vague and fluid, meaning different things to different people, sometimes even overlapping in definition. Some conceive "sprawl" as simply low-density development of any kind, while others, in a seeming contradiction, cite New Jersey's status as the most densely populated state in the nation as proof that we are also the most sprawling.

So which is it? Does sprawl mean low density, or does it mean high density? And what exactly do we mean by *high* density, anyway?

Perhaps the confusion arises from the fact that density is not well understood. This report focuses on density *per se*, what it means and why it plays a critical role in New Jersey's economic, environmental, and social future. The spread-out developments proliferating today across the state's midsection – from Hunterdon County southeast to northern Ocean County, and to a lesser extent at the urban fringes of the Philadelphia metropolitan area in southern New Jersey – are wasteful of land, time, and money, and are generating costs that will make demands on New Jersey's taxpayers for decades to come. As development surges outward toward the metropolitan fringe, New Jersey is simultaneously abandoning its older, higher-density cities, towns, and first-generation suburbs while scattering new housing developments and office campuses across its very low-density rural areas. The result is a wasteful middle ground, both too dense and not dense enough, with implications not only for long-term costs but also for quality of life.

> New Jersey, in its race toward the middle of the density continuum, is squandering the advantages bestowed upon it by its historical pattern of high density development.

This paper seeks first to clarify exactly what population density means, how it is measured, and how the geographic scale at which it is measured can affect people's perceptions of it. The next three sections then describe how higher densities can help save land (by reducing per capita land consumption), money (through economies of scale in the provision of infrastructure and distance-dependent services), and time (by reducing travel distances and by creating alternatives to automobile travel). Finally, the paper illustrates how New Jersey, in its race toward the middle of the density continuum, is squandering the advantages bestowed upon it by its historical pattern of high-density development. Recommendations are offered for reversing this dangerous trend before our remaining land is prematurely exhausted.

Density Deconstructed

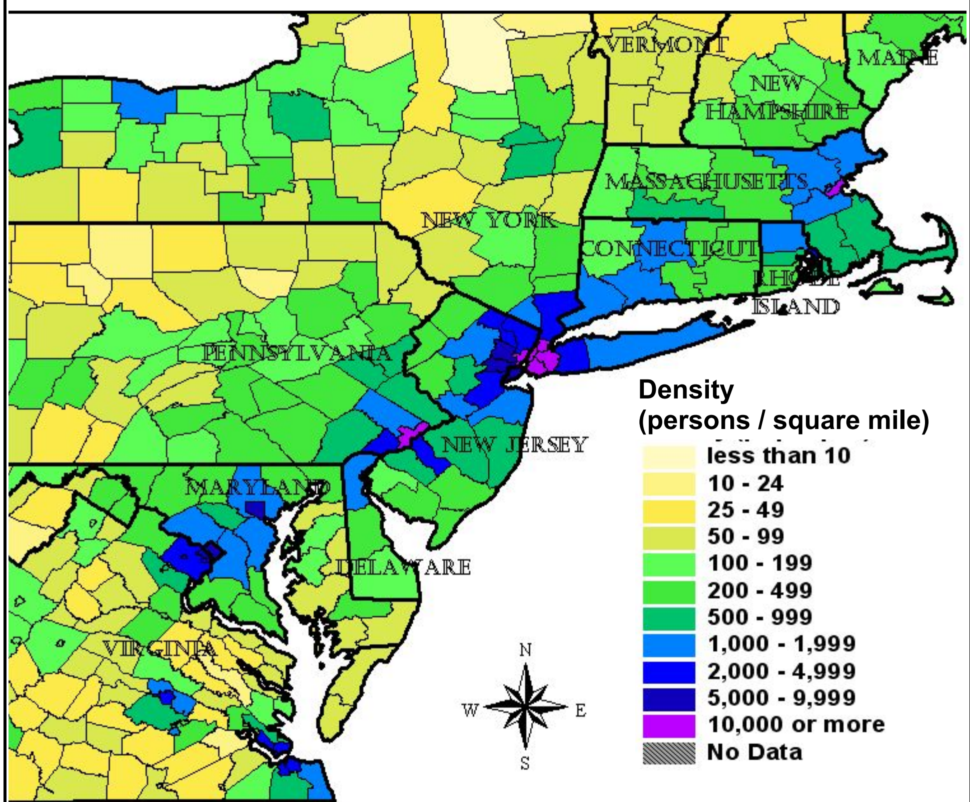
New Jersey, India, and Japan

Unlike sprawl, population density has a straightforward definition: It measures population per unit land area, most frequently expressed as persons per square mile.

New Jersey's statewide population density is more than 1,100 persons per square mile, the highest of the 50 states. This is more than 10 times the density of the United States as a whole, which stands at a mere 80 persons per square mile. It is higher, in fact, than the densities of Japan (878/square mile) or India (911/square mile)[1], two countries frequently noted for their sardine-like settlement patterns.

But what does 1,100 persons per square mile actually look like on the ground? It is roughly the density of Manalapan and Marlboro townships in Monmouth County, or Montville and Roxbury townships in Morris County, or Florence and Eastampton townships in Burlington County. These places hardly invite comparisons with Tokyo or Calcutta. The reality is that 1,000 persons per square mile looks like low-density suburbia, or even – by the standards of the Northeast Corridor, at least – almost rural. And yet, of the country's more than 3,000 counties and county equivalents[2], only 104 of them exceed 1,000 persons per square mile, including fewer than half (10 out of 21) of New Jersey's counties. Even in the densely populated Northeast Corridor, many counties fail to meet even this relatively low threshold (see Figure 1).

Figure 1. Population Density by County in the Northeast Corridor



Counties with a population density of 1,000 persons per square mile or more are the exception rather than the rule. Even in the densely populated Northeast Corridor, some counties do not exceed even this modest threshold.

Data source: U.S. Bureau of the Census

Apparently, most of the country and even much of New Jersey is not very densely populated after all. How, then, could New Jersey be more densely populated than Japan?

The secret to reconciling these seeming contradictions lies in recognizing that geographic entities as large as a country or state, or even a county or large municipality, are rarely internally homogeneous. That is, population is rarely distributed uniformly over such large areas; most of Japan does not look like Tokyo. New Jersey's overall density is 1,144 persons per square mile (2002 estimate), but the densities of its counties range from a low of 189 persons per sq. mi. in Salem County to a high of 13,052 persons per sq. mi. in Hudson County, 70 times higher than Salem. Within Hudson County, densities of individual municipalities range from 2,690 in Secaucus to more than 50,000 in Guttenberg and Union City. In Salem County, the density of Lower Alloways Creek Township is a mere 40 persons per square mile, while the borough of Penns Grove manages 5,424, more than 100 times higher.

The phenomenon is often even visible at the municipal level, especially in geographically large municipalities. The density of the inhabited part of Secaucus, for example, actually more closely resembles that of its neighboring municipalities, but the municipal average density is pulled down by Secaucus's many acres of undevelopable and uninhabited (by humans) wetlands. Moorestown Township in Burlington County contains the village of Moorestown, with its grid street network and modest lot sizes, but also incorporates many large-lot subdivisions as well as a substantial amount of undeveloped land. Even in Newark, the municipal-wide density of 11,407 is an understatement of the density of Newark's residential areas, because Newark's total land area – the denominator used in computing its density – includes vast tracts of land occupied by port facilities, rail yards, the airport, Branch Brook Park, and downtown office buildings, all of which contribute nothing to Newark's population total. These land uses thus dilute Newark's density calculation, though they certainly contribute to the *appearance* of density.

Reporting population density for a large geographic area can thus mask substantial internal variability. Japan's interior is mountainous and largely uninhabitable, meaning its population is overwhelmingly concentrated along the coasts. India contains an extensive desert as well as a portion of the Himalayas, two vastly different climatic zones that are equally inhospitable. On the other end of the spectrum, Tokyo and Osaka, Calcutta and Delhi are among the most densely populated places anywhere in the world. In computing national-level densities, the extraordinarily high densities of Tokyo and Calcutta are counterbalanced by the large areas of sparsely populated territory, with the result that the national statistic is not representative of the kinds of places that come to mind when one hears "density" in the same sentence with "Japan" or "India."

New Jersey's statewide population density figure is likewise misleading. New Jersey, like Japan and India, contains large expanses of sparsely settled territory. The Pine Barrens, the largest stretch of undeveloped land in the crowded Boston-to-Washington megalopolis[3], is the most obvious example[4], but there are other sparsely populated areas along the Delaware Bayshore in Salem and Cumberland counties and in the ridge-and-valley system near the Delaware Water Gap in the northwest[5]. In contrast, Guttenberg, Union City, West New York, and Hoboken (all in Hudson County) are the top four most densely populated municipalities in the United States, and Hudson County itself is the sixth most densely populated county in the country[6]; Essex, Union, and Bergen counties also make the national top 25. To cite only New Jersey's statewide population density is to miss this internal diversity.

The retention of New Jersey's internal diversity, and specifically our ability to replicate in new development the characteristics of our existing higher-density communities, are key to controlling sprawl and protecting our remaining open and rural lands.

Density conserves land and saves money, and if properly designed, it can also save time. New Jersey needs to reacquaint itself with the advantages that density has bought us, so that we do not continue down our present path toward a future characterized by an undifferentiated landscape of sprawling subdivisions, ever-increasing property taxes, and chronic, ubiquitous traffic.

Density Saves Land

Housing More People, Using Less Land

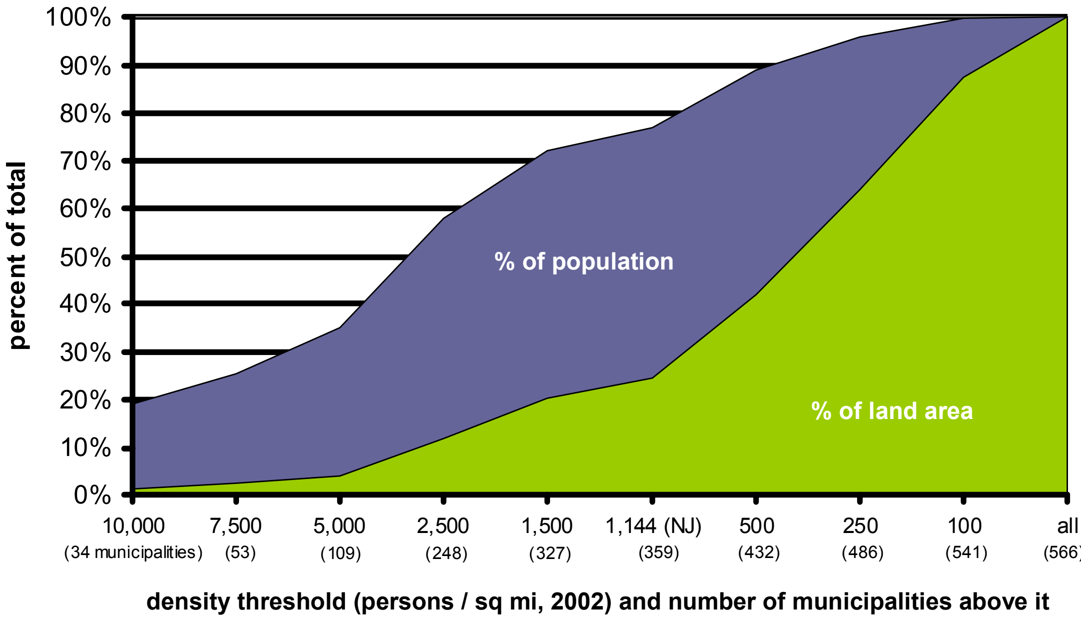
As discussed above, a single density statistic contributes little to the discussion of sprawl in New Jersey because it obscures the fact that New Jersey contains many compact, high-density cities and towns and some large swaths of near-wilderness in addition to its stereotypical sprawling newer suburbs. To illustrate, recall that New Jersey's overall population density is 1,144 persons per square mile, equal to the density of Manalapan or Eastampton Township. But imagine taking New Jersey's current population and redistributing it uniformly across the state – statewide density would remain identical, but all parts of the state would now have the low-density suburban look of Manalapan, including the Pinelands and the Highlands and the Delaware Bayshore and every other natural area that New Jersey residents cherish. Gone also would be the state's major centers of activity, cities like Newark, Jersey City, Trenton, or Atlantic City, as well as higher-density towns like Montclair, Morristown, Westfield, Red Bank, Princeton, Bordentown, Haddonfield, or Hammonton.

The contrast between the present configuration of New Jersey's population and the scenario in which the entire state is developed uniformly at a low suburban density illustrates an important point: the retention of low-density rural areas, farmland, and undeveloped open spaces is dependent upon the fostering of higher-density communities elsewhere in the state. In other words, in the fight against sprawl and the effort to preserve open space, density is an asset rather than a liability, because it makes room for a part of the population that would otherwise spread into less-developed areas. Thus, lamenting New Jersey's high density as part of a critique of sprawl doesn't make sense, since it is precisely our density that allows us to be less sprawling than most places. Criticizing density may be an effective tactic in arguing for stopping growth altogether – "we're already packed in too tightly" – but not for eliminating sprawl or preserving open space.

Density is an asset rather than a liability, because it makes room for a part of the population that would otherwise spread into less-developed areas.

High-density places concentrate population on relatively little land, allowing land elsewhere to remain only sparsely populated or entirely undeveloped. To illustrate, consider that if New Jersey's municipalities are sorted from most dense to least dense, the most densely populated 30 percent of municipalities contain 44 percent of the state's total population but take up only 6.6 percent of the land. As the density differential grows more pronounced, the contrasts become more dramatic in terms of how much of the population fits onto a small percentage of the land. Figure 2 indicates what percent of the state's total population and what percent of land area are accounted for by municipalities above a given density level. For example, the 109 municipalities with a population density of at least 5,000 persons per square mile together house 35.0 percent of the state's population on only 4.1 percent of its land. If the threshold is lowered to 1,500 per square mile, there are 327 municipalities that are at least that dense, and together they hold 72.3 percent of the population on 20.2 percent of the land. But clearly, the higher the density, the more striking the disparity between the percentage of people living at that density and the

Figure 2. Cumulative Percent of State Population and Land Area Accounted for by Municipalities at or Above Certain Density Thresholds



The heterogeneous nature of the distribution of New Jersey's population means that the denser municipalities make up a considerably larger percentage of the state's population than they do of the state's land area. The higher the density, the more dramatic the disparity. For example, the 53 municipalities with densities higher than 7,500 persons per square mile contain 25.5 percent of the state's population but take up only 2.3 percent of the land area, less than one tenth of their share of total population. Using a lower threshold, the 359 municipalities with densities higher than the statewide average (1,144 persons per square mile) contain 77.1 percent of the state's population and comprise 24.5 percent of total land area, about one third of their share of population.

Data sources: U.S. Bureau of the Census (population); NJ Office of Smart Growth (land areas)

amount of land they need.

It is this same trade-off – raising densities in some places in order to keep them low in others – that forms the basis of the concept of transfer of development rights (TDR), employed successfully in Chesterfield Township in Burlington County and very recently approved by the legislature for use statewide. To accommodate new residents, a developer purchases the development rights to a piece of farmland but builds the actual housing units in a designated "receiving area" elsewhere in the township. The result is a higher housing density in the receiving area than would otherwise have been allowed, but in return the farmland remains undeveloped and in production.

How Much Land Do New Jerseyans Need?

As an extreme illustration of density's power to conserve land, consider that if everyone in New Jersey lived at the density of Guttenberg, Union City, or West New York – New Jersey's (and the country's) three most densely populated municipalities – the state's entire population as of the 2000 Census would fit on a little over 100,000 acres, or less than 3 percent of the state's total land area. In fact, the *entire population of the United States* would fit within New Jersey's borders, leaving the whole rest of the country as unpopulated wilderness. At a more typical urban density like that of Trenton or Newark (both slightly more than 11,000 persons per sq. mi.), New Jersey's total population would fit on only 10 percent of its land area.

Even modest small-town and older suburban densities produce instructive results. At a density of 7,500 persons / sq. mi., characteristic of such compact, walkable towns as Maywood, Highland Park, Princeton, and Collingswood, only about 15 percent of the state's total land area would be needed to house all of New Jersey's residents. And if everyone lived at a "dense suburban" density of about 4,500 persons per sq. mi., similar to that of such places as Cranford, Westfield, Metuchen, Woodbridge Twp., Willingboro, Haddonfield, and Lindenwold, we would still need only about 25 percent of the state's land. It should be noted that this 25 percent would also contain some open space and non-residential land uses, in the same proportions typical of the example municipalities, while the remaining 75 percent of the state would be completely undeveloped.

Fast-growing townships in formerly rural parts of New Jersey provide an interesting counterpoint. Consider, for example, a trio of townships (Readington, Raritan, and Clinton) in the I-78 and US 202 corridors in eastern Hunterdon County that saw rapid growth in the 1990s. Raritan Township's 2000 municipality-wide density (525 persons per sq. mi.) is such that if the entire state's population were to configure itself like Raritan Township, retaining the township's same proportion of undeveloped territory, we would need more than double the state's land area (214 percent) to accommodate everyone. At Clinton Township's density, we would need nearly three New Jerseys (296 percent of the state's land area); for Readington Twp. the figure is 339 percent. (It is true that these townships all retain large tracts of undeveloped land, which lower their overall density figures, but it is precisely these low densities and open spaces that current residents wish to preserve, if the number and success of local open space initiatives are any indication.)

Municipal land use regulations determine the density at which new territory in a municipality is settled.

In South Jersey, Harrison Township (the Mullica Hill area) was the third fastest-growing municipality in the state in the 1990s. But the rural environment that drew so many people to the township cannot be enjoyed by all – at Harrison Twp.'s 2000 density, we would need 243 percent of the state's land area to hold all the state's residents. And Montgomery Township in Somerset County, the fourth fastest-growing municipality in the 1990s, stands in striking contrast to neighboring Princeton. Whereas Princeton borough's density could accommodate the state's entire population on only 15 percent of the land, to house everyone at Montgomery Township's 2000 density (537 per square mile) would require more than double the state's land area.

"McMansions": Market Forces or Zoning?

Although large houses on large lots in quasi-rural settings, known pejoratively as "McMansions," appear to dominate today's residential growth[7], it is fantasy to say that "market forces" are solely responsible for this accelerating per-capita consumption of land. The economics of the home-building industry are such that, generally, developers maximize their profits by maximizing the number of housing units that can be built on a given tract of land. That is, all other things being equal, developers prefer higher densities (more units per acre[8]). This is why a "density bonus" (in which, in exchange for some concessions, a developer is allowed to build more units on a tract than would otherwise be permitted) is called a bonus.

Rather, it is municipal land use regulations, which are a product not of current market forces but of the desires of existing residents and their elected officials, that determine the density at which new territory in a municipality is settled. Increasingly, existing residents desire to keep property taxes under control by limiting the number of new school children that their municipality must pay to educate[9]. Large-lot zoning – the requirement that each new housing unit must be surrounded by a lot comprising multiple acres – serves this purpose in two ways. First, larger minimum lot requirements mean that fewer units can be built on a parcel of land of any given size (more acres per unit = fewer units per acre = fewer total units). Fewer new units mean fewer new school children. A secondary effect is that, when faced with tight restrictions on how many total units

The Role of the State

New Jersey has delegated to municipal governments the responsibility of controlling land use and rationing the "rural" lifestyle, without regard for the wider regional consequences of such profligate land consumption. But only state and county governments have a broad enough perspective to address issues like loss of farmland, wildlife habitat fragmentation, housing costs, and infrastructure provision that are engendered by widespread low-density development but that cut across municipal borders.

Over the last five years, the New Jersey state government has indeed taken a very active role, and invested considerable effort and money, in the preservation of open space and farmland. But there has been little corresponding attention devoted to increasing population densities in places where development is considered appropriate, either through revitalizing existing communities to make them attractive to new residents or through encouraging smaller lot sizes and mixed uses in new developments. While planning and zoning are powers entrusted to local governments, the state government could nonetheless bring its influence to bear on the problem through the creation of new incentives or regulations that would encourage municipalities to adopt higher-density zoning in appropriate areas.

The promotion of compact, higher-density development (and redevelopment) is the necessary but often neglected complement to open space preservation. Without higher densities in targeted growth areas, we must continually revise downward the number of new households – and their contributions to the state's economic vitality – that New Jersey will be able to accommodate as more land is taken off the market. (This logic applies not only to in-migrants to New Jersey from other states or countries, but also to current New Jersey residents seeking to form their own households.) The best smart-growth tool New Jersey currently has at its disposal, the State Development and Redevelopment Plan (the "State Plan"), is structured around this fundamental interdependence, but the State Plan remains sadly on the sidelines in discussions of most state and local government policies that influence development patterns. In contrast, Maryland actively influences its land-use patterns by setting specific density targets that when met, qualify the development and its host municipality for state support and special funding assistance.

If smart growth is about both where and how we grow, the State Plan does contain answers and guidelines on both counts. The State Plan Map attempts to delineate what parts of the state are appropriate for future development and what parts are not – the "where" component. And the Plan also contains design standards that show how to make efficient use of the land we do develop, through such things as higher densities, mixing of uses, and well-connected street networks – the "how" component. If we want to learn how to use density as a tool to protect those open lands that are most worth protecting, the State Plan is at present our best available resource, even if it lacks Maryland's explicit system of incentives. Incorporating the principles of the State Plan into more of its policies and regulations would be an excellent way for the state government to have a positive influence on the way municipalities plan and zone for growth.

can be built, the developer's motive now becomes the maximization of the profit *per unit*. The developer may ideally prefer to build and sell many modest-sized houses rather than a few large ones, making less profit per unit but compensating by having more units to sell. But if only a few units are allowed, a few large houses will produce more profit than a few small ones (provided there are enough potential buyers for those large houses). This works to the municipality's advantage, as well, because larger, higher-valued houses produce greater property tax revenues. While residential development generally does not pay for itself[10] – the costs of providing municipal services to the new houses' residents usually exceed the property tax revenues generated – more expensive homes at least come closer to breaking even on municipal books.

It is fantasy to say that "market forces" are solely responsible for the accelerating per-capita consumption of land.

Today's low-density development pattern, then, is largely the aggregate product of many decisions made by many individual municipalities, each acting in its own self-interest. But while it may be true that semi-rural densities are attractive to some homebuyers, it is also true that there is simply not enough room in the state for everyone to live in such surroundings; what might be good for a few is not good, or even possible, for all. New low-density development is foreclosing opportunities for future residents by consuming large amounts of land per capita (not to mention producing a supply of new housing that is out of the price range of many New Jerseyans), a practice made all the more shortsighted by the fact that this same dwindling supply of land is also increasingly being removed from circulation by numerous preservation initiatives. So where should the decision lie as to how to divide up this limited resource?

Preserving Environmental Resources

Development or "land use change" has been ranked as the number one threat to New Jersey's environment and its residents by the New Jersey Comparative Risk Project, an independent panel of experts commissioned by the state.[11] At the same time, shutting down all development and growth is a prescription for economic stagnation and a reversal of New Jersey's prosperity.

While it can be argued that all development impacts the environment to some degree, not all development is equal in this regard. Spread-out development consumes and fragments wildlife habitat and farmland much more rapidly, on a per-capita basis, than the more compact development typical of New Jersey's small towns. It also increases the per-capita amount of impervious cover (rooftops, driveways, sidewalks, etc.), which means more rainwater ends up in storm drains, rather than recharging aquifers and replenishing reservoirs.

In contrast, by consuming less land per person, dense development reduces these negative environmental side effects.

Density Saves Money

It stands to reason that density saves land because the less developed land consumed per person, the less total land is needed by a given population, or, equivalently, the more people can be accommodated on a given supply of land. What is less intuitively obvious is that density also saves money. The key lies in analyzing costs on a per capita basis, rather than per acre. Even absent any state-level action, cost savings alone ought to be an incentive for municipalities to consider higher-density development patterns.

Controlling Infrastructure Costs

Consider the example of roadway lane-miles.[12] The fact that New Jersey has more lane-miles of road per square mile than any other state besides Rhode Island is often used, appropriately, to illustrate the intensity with which New Jersey is developed. However, this same statistic is also sometimes misapplied to suggest that New Jersey is more sprawling, more congested, or more dependent on automobile travel than most other states, when in reality it implies no such thing.

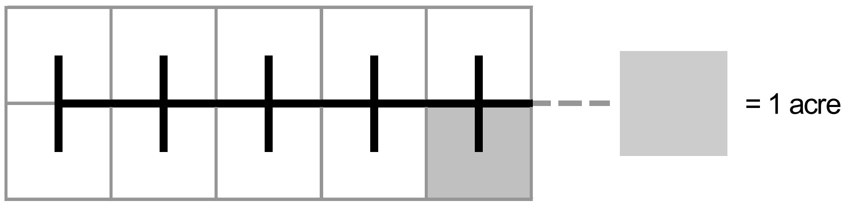
High roadway density (lane-miles per square mile) is simply a natural consequence of high population density, but to determine whether New Jersey has a disproportionate amount of roadway, we must look instead at the number of lane-miles *per capita*. When evaluated on this basis, New Jersey ranks 49th among the 50 states; only Hawaii has fewer lane-miles of road relative to its population. So, perhaps counterintuitively, New Jersey actually has disproportionately *few* miles of road serving its population, particularly where the population is concentrated, compared to the rest of the country.

The phenomenon is perhaps most discernible within New Jersey when comparing at the county level. Among New Jersey's 21 counties, Hudson, Essex, Union, and Bergen have the most route-miles of road[13] per square mile, but these are certainly not the counties that best typify New Jersey sprawl; in fact, they happen to be the four most densely populated counties in the state, so their high roadway density is not surprising. Of more significance is that the seven densest counties[14] – Hudson, Essex, Union, Bergen, Passaic, Middlesex, and Camden – are also the seven with the *fewest* route-miles of public road *per capita*, and nearly in the same order[15] (see Table 1, page 29). Hudson, the densest county by far, with a density more than twice that of second place Essex, also has by far the fewest roadway miles per capita, with fewer than half that of Essex, the second lowest.

At the other end of the scale, the seven counties with the lowest densities – Salem, Sussex, Hunterdon, Warren, Cumberland, Cape May, and Atlantic – are also the seven with the most roadway route-miles per capita, with Salem in last place on both lists. A direct comparison of the extremes illustrates the differences dramatically: high-density Hudson County, with 13,000 residents per square mile, has only 1.0 total road miles per 1,000 residents, while exurban Hunterdon County has a population density of only 289 persons per square mile with far more road miles per capita – about 11.5 miles per 1,000 residents, more than 10 times Hudson County's rate. The implications for per-capita construction costs immediately suggest themselves.

Because public infrastructure is funded by tax revenues, and because taxes are essentially collected on a per-capita basis, having fewer miles of roadway per capita translates directly into lower personal/household tax expenditures to build those roads. Assuming a constant per-mile cost for road construction, the net result is that higher densities reduce the number of miles of road

Figure 3A. Water pipe needed to service 10 homes on one-acre lots.



Total length of pipe is 1,983 ft.

needed by a given population, thereby reducing the cost (and thus the per-capita or per-household cost) of providing those roads.

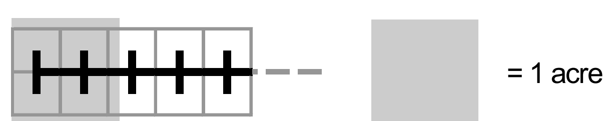
The fundamental precept at work here is that the provision of physical infrastructure becomes more economical when people live closer together. The same logic applies to water and sewer pipes, power lines, sidewalks, street lights, and other types of physical facilities. To illustrate, imagine two scenarios in which a water authority wants to extend service to a new development of 10 homes. In one scenario (Figure 3A), the homes are on one-acre lots, typical of contemporary exurban sprawl. In the other (Figure 3B), they are on 0.2-acre lots (i.e., 5 units to the acre), characteristic of traditional small towns and older suburbs. For purposes of simplifying the comparison, it is assumed that lots are square and that each house is positioned in the center of the lot.[16]

In this example, the length of pipe needed to service the houses on larger lots is more than double the corresponding length required by the houses on smaller lots, precisely because the houses are farther apart. The more the houses are spread out, the more physical infrastructure is needed to service them, and the more that infrastructure is going to cost.

These higher per-unit costs of providing and maintaining utilities to low-density developments are generally not financed by means of a differentially higher rate on the new units. Rather, they are absorbed by the utility company and passed on to all of the utility's customers, irrespective of any actual density-dependent variation in costs, in the form of higher overall rates. A recent study by the Environment Colorado Research and Policy Center provides one example, finding that "the cost to provide public infrastructure and services for a specific population in new sprawling development is higher than to service that same population in a smart growth or infill development." Furthermore, "The cost of building and servicing infrastructure for new sprawling development is ultimately subsidized by the whole community. Local government generally bills the cost of new services and infrastructure on an average basis, rather than an incremental basis. That is, new costs are spread evenly among all taxpayers rather than charged only to those who generate the costs."[17] Thus customers living in more compact neighborhoods, in modest-sized houses on smaller lots, are effectively subsidizing residents of large-lot sprawl.

The diagrams can also be used to illustrate the cost difference in servicing the two developments with local roads, sidewalks, and street lights, which would be located around the perimeter of each block (the perimeter in each case is 14 times the lot width). The perimeter of the block in Figure 3A is 2,922 feet, while the perimeter of the block in Figure 3B is only 1,307 feet[18], so the first block requires more than double the length of local road and sidewalk than the second block to serve an identical number of people. The fact that much of the older, developed part of New Jersey more closely resembles Figure 3B than Figure 3A is the reason that New Jersey needs fewer miles of road per capita than almost any other state

Figure 3B. Water pipe needed to service 10 homes at five units to the acre (0.2-acre lots).



Total length of pipe is 887 ft.

in the country. As new development in New Jersey begins to resemble that in other states (and Figure 3A), however, we are effectively surrendering the infrastructure cost advantages initially bestowed by our traditionally compact development patterns.

Distance-Dependent Services

Economies of scale that derive from higher densities are not limited to physical infrastructure; they also apply to services that are distance-dependent[19]. The effectiveness of firefighting and ambulance services hinges on response times, which depend directly on physical proximity. A given number of firefighters or paramedics will be able to serve a greater population if that population is clustered closer together, because higher-density settlement patterns put more people within the response time radius, assuming the firehouse or hospital is centrally located. Conversely, as development spreads out, residents must either resign themselves to a decline in response times as their dispersed locations make it harder for the fire truck or ambulance to reach them, or else they must invest money and time in building an additional firehouse, buying additional fire trucks and ambulances, and recruiting additional rescue personnel. In either case, the per-capita costs of these services have increased in real terms, either by increasing the actual costs of servicing the same number of people or by decreasing the quality of those services while keeping the cost fixed.

School buses are another service whose costs are distance-dependent. For a given number of school students, the costs of collecting them on a bus will increase as they are spread farther apart. Either the same bus will now have to travel farther to pick them up, thereby increasing costs for diesel fuel, bus maintenance, and bus driver hours (not to mention the time costs borne by the students, who must now endure a longer bus ride), or additional routes will have to be established, meaning more buses will have to be purchased and more drivers hired. At the other extreme, a school in a compact, dense neighborhood may not even need buses at all if the students all live close enough to walk or bike to school and can do so safely.

Police protection provides an even better example, thanks to the preventive dimension that distinguishes it from the purely reactive fire, ambulance, and school bus services. Not only do the foregoing arguments about response time still obtain, but incidents now become more likely if police protection is spread too thin. Configuring residences (and, not inconsequentially, commercial and industrial properties) closer together allows a police force of a given size to monitor more buildings and public areas simultaneously, thus deterring crime, than would be possible if

> "Additionally, the cost to provide public infrastructure and services for a specific population in new sprawling development is higher than to service that same population in a smart growth or infill development. Sprawling and "leapfrog" developments (those built far away from the current urban area) tend to be dispersed across the land, requiring longer public roads and water and sewer lines to provide service. Such developments also impose higher costs on police and fire departments and schools."
>
> . . . .
>
> "The costs of building and servicing infrastructure for new sprawling development are ultimately subsidized by the whole community. Local government generally bills the cost of new services and infrastructure on an average basis, rather than an incremental basis. That is, new costs are spread evenly among all taxpayers rather than charged only to those who generate the costs. This is, in effect, a subsidy from the whole community to new development. Existing residents, who were sufficiently served by the established infrastructure, must pay a share of the costly new infrastructure required to meet the expected demand of newcomers."
>
> *The Fiscal Cost of Sprawl: How Sprawl Contributes to Local Governments' Budget Woes,* Environment Colorado Research and Policy Center

those buildings were widely dispersed. In other words, higher density allows more people and businesses to be protected by fewer police officers, reducing the per-household (and per-business) cost. Conversely, when people and businesses spread out, they require more police officers to provide the same level of protection, increasing the costs to everyone through increased numbers of officers, squad cars, and possibly even substations.

The costs of servicing low-density development patterns are often supported through hidden subsidies. Many rural parts of New Jersey rely on State Police protection because they lack a critical mass of residents (that is, they lack sufficient population density) to cost-effectively sustain a local police force. This is a sub-optimal solution that leaves these communities more vulnerable to crime because of high response times and the lack of a visible police presence acting as a deterrent. (Although crime may be less likely, the consequences are more severe if a crime does occur.) At the same time, even this reduced level of service is still being subsidized by taxpayers elsewhere in the state (many of whom are already paying for their own police protection, and must now pay for someone else's), in that it diverts resources away from the state-level functions that are the State Police's designated responsibilities and for which all of the state's citizens pay.

Density Saves Time

Density and Traffic

Another growth byproduct that frequently vexes rapidly developing, low-density, formerly rural municipalities is traffic. The relationship between traffic and density is often misunderstood. The default assumption is that as population density increases, traffic congestion must also increase, because more people living in a given land area will result in more cars in that same area. This appears at least superficially true in the lower reaches of the density continuum, where travel takes place almost exclusively by car. In such an environment, each additional trip taken by each additional resident does indeed put an additional car on the road.

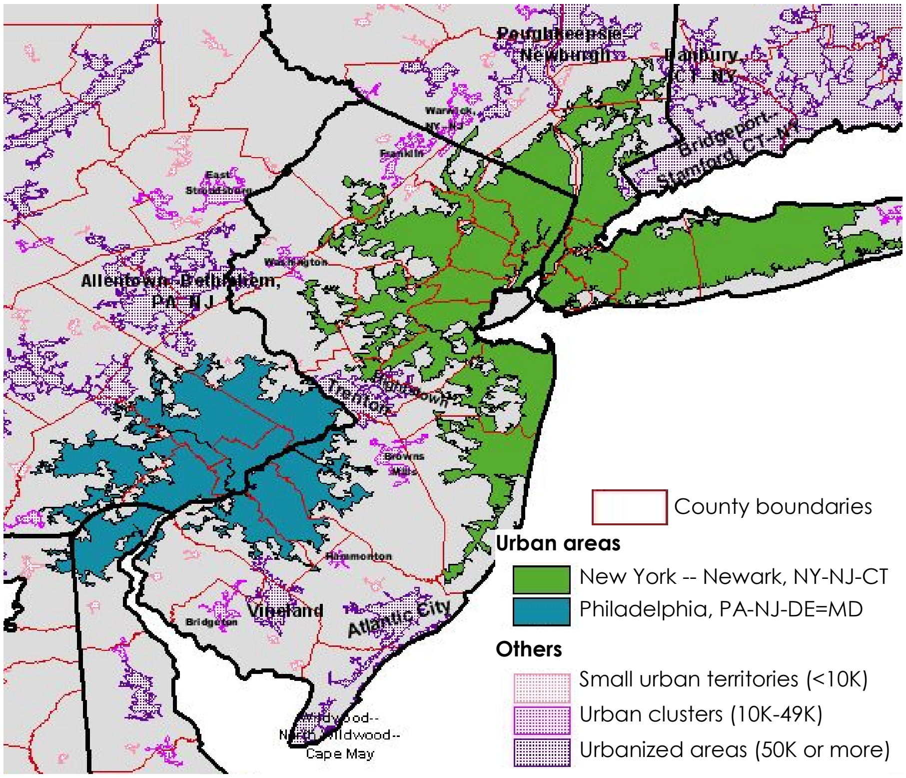
But the logic breaks down when densities become high enough to allow some trips to be taken by means other than the private automobile. Every person who is able to walk or use public transportation – modes of travel that only become viable at higher densities – represents one fewer car on the road. Moreover, as density increases, some trips become shorter because origins and destinations are closer together. Because of this, even those in cars can often reach their destinations in less time than is possible in a low-density environment, albeit probably at a lower speed, because the total required travel distance is reduced. Finally, and not unimportantly, higher-density places tend to have been designed with more grid-like road networks that disperse traffic by allowing for multiple routes. Thus, for all these reasons, the relationship between density and traffic can at some point transform from a direct relationship to an inverse one.

A look at America's largest cities illustrates this surprising result. The cities most plagued with traffic problems, as measured by several indicators, are not always the most densely populated. Consider the 49 metropolitan areas with 2000 Census populations of one million or more. Each of these county-based MSAs (Metropolitan Statistical Areas) has as its core a Census Bureau-defined urbanized area[20] (UA), a geographic entity for which government agencies and academic institutions maintain various measures of traffic and road use. (An urbanized area generally comprises not only the central city or cities of its MSA but much surrounding territory that is settled at lower, more typically suburban densities.)

The Texas Transportation Institute compiles multiple indicators of congestion for urbanized areas[21], among them three that are readily comprehensible and will be used here for comparison to density: 1) annual hours of delay per person resulting from congestion; 2) percent of lane-miles on urban expressways (including Interstates) that are congested during the peak period; and – recognizing that congestion is not just a rush-hour phenomenon – 3) percent of daily travel in congestion. If traffic congestion were directly related to density, one would expect any given UA would appear in roughly the same position in a ranking based on density as in a ranking based on one of the congestion indicators. Certainly, one would expect that a UA would rank at least as high or higher on at least one of the congestion measures as on the density list.

Instead, we find in general that there is no clear relationship between density and congestion. Of the 49 urbanized areas belonging to MSAs of a million people or more (see Table 2, page 30), 17 of them – more than a third – defy expectations[22] by ranking higher on density than on any of the three congestion indicators. And among the 10 densest UAs, four of them – New York–Newark, New Orleans, Las Vegas, and Miami – fail to crack the top 10 on any of the congestion indicators. In fact, New York–Newark's highest rank is

Figure 4. Urbanized Areas in New Jersey



The New York--Newark and Philadelphia urbanized areas cover a substantial portion of New Jersey's land area and together contain 83.4 percent of the state's population.

a tie for 19th place on two of the indicators, and New Orleans doesn't even make the top 30 on any of the congestion measures. Some UAs apparently have less of a problem with congestion than would be expected from their high density. Clearly, high population density does not automatically condemn an urban area to gridlocked traffic.

Nor does sheer size. It is worth looking separately at the UAs with the largest total populations (see Table 3, page 32) because for very large UAs an area-wide density measurement can mask substantial internal variation (much as New Jersey's statewide density statistic does). So while they may not appear at the top of the overall density ranking, many large UAs nonetheless have very dense older cores, surrounded by newer, lower-density suburban areas that pull down the UA-wide average density. Among the 20 largest UAs (all of which contain roughly 2 million residents or more), there are nine that do not rank in the top 10 on any of the three congestion measures, including four – Tampa–St. Petersburg, Baltimore, St. Louis, and Philadelphia – that miss the top 20 on all three measures. Of these nine, only Tampa fails to appear in the top 20 when the 49 UAs are ranked in order of the density of their largest city. Thus the populous urban areas that have relatively less severe traffic problems tend also to have relatively dense central cities. In particular, the two urbanized areas that together cover much of New Jersey (see Figure 4) – New York–Newark and Philadelphia, each with a very dense core city – perform much better than might be expected. New Jersey's congestion problems are actually markedly less severe, on the whole, than what is experienced in other urban areas of similar population, though conditions certainly vary within the UA.

Automobile Dependence

Density is not necessarily the cure for traffic problems, however. Some of the densest urbanized areas also appear near the top of the list for each of the congestion indicators, notably Los Angeles–Long Beach–Santa Ana and San Francisco–Oakland. Los Angeles, counterintuitively, anchors the most densely populated urbanized area in the country, yet it unsurprisingly (given its reputation) ranks first on all three congestion measures. It is thus necessary to look beyond density to explain congestion or the lack thereof.

The best insight into the root of the congestion problem can perhaps be gained by looking directly at the most onerous of the three congestion measures – annual hours of delay per person[23]. The top 10 urbanized areas on this measure (see table 4, page 33) all exceed 30 hours of delay per person annually (compared to 25 for New York–Newark and only 17 for Philadelphia), and all are indeed nationally notorious for their traffic, but not all are particularly large or particularly dense. Conspicuously absent from the list are some very large urban areas with dense cores (New York, Chicago, Philadelphia, Miami, and Boston, all among the 10 largest UAs and with central cities among the 10 densest), as well as some smaller but high-density UAs (New Orleans, Las Vegas, and Sacramento, all among the 10 densest).

Instead, the list of the most delay-plagued urbanized areas is a mixed bag, with some very low-density UAs (Orlando, Atlanta), some moderate-to-high density UAs with proportionately lower-density central cities (Los Angeles–Long Beach–Santa Ana, Houston, Denver, Dallas–Fort Worth, Riverside–San Bernardino, San Jose), and two large, dense-core UAs (San Francisco–Oakland and Washington DC). What do these high-congestion cities have in common? Most are relatively new urban areas that experienced their most significant growth in the age of the automobile. In such places, travel is presumed to be (and is) almost exclusively by automobile, with walking and transit use representing only a very small fraction of travel. What's more, the "dendritic" (branching, as opposed to grid-like) road networks typical of these places ensure that most of the traffic will be funneled onto the same handful of urban expressways and suburban arterials, resulting in chronic overload.

In contrast, many of the older cities in the Northeast and Midwest are surrounded by rings of compact, well-connected suburbs that developed in an era when walking and streetcars were the primary means of getting around, and most are still well-served by public transportation. Older metropolitan areas generally have much higher rates of walking and transit use, and even though the majority of travel is now by automobile even in these places, the legacy of their mixed-use land use patterns and their grid-like road networks is that trips are often shorter and alternate routes more numerous than in the cities that came of age after the rise of the automobile. It is their history that keeps them off the list of cities with the worst congestion-related delays.

The two conspicuous exceptions to the above characterization – San Francisco–Oakland and Washington DC – are also the most instructive for the future. Like New York, Philadelphia, Chicago, and Boston, they are older urban areas with dense cities at their cores, cities that initially developed before the automobile. Even today they lend themselves to walking, and they are served by extensive public transit networks that are well patronized. What distinguishes San Francisco and Washington is that they have continued to grow rapidly in the post-industrial age, while the others have experienced only modest growth, even when considering the entire metropolitan area and not just the central cities (see Table 4, page 33, again). While not typically considered part of the Sun Belt, San Francisco and Washington are growing like Sun Belt metro areas. They may retain at their hearts the same advantages as New York or Philadelphia, but the substantial new growth that has accreted to those hearts over the last 50

years more closely resembles Atlanta or Phoenix.

To be sure, just about every metropolitan area in the country continues to add new developed territory, most of it low-density and automobile-dependent. And just as surely, congestion has gotten worse just about everywhere. The cities with the worst congestion are simply the ones that have grown new low-density rings the fastest. Almost all urban areas are getting less dense, or are at least dissipating their formerly dense cores; the ones that are gaining population on top of the underlying decentralization are the ones with the worst traffic.

Older, more compact urban areas whose newer suburbs seek to emulate the low-density, automobile-dependent likes of Houston and Atlanta are courting disaster, effectively eroding the historical advantages that keep them off the list of national congestion leaders. Spreading out is not the answer to congestion woes. Yet Los Angeles should stand as a stern warning against developing simultaneously at high densities and in an automobile-dependent style. (The area in Edison and Woodbridge townships around the confluence of the NJ Turnpike, Garden State Parkway, I-287, and Route 1 perhaps serves as a New Jersey example of the questionable wisdom of the L.A. combination of density and car culture.) The best strategy for warding off congestion is to build at higher densities but with mixed uses, connected street networks, and a design paradigm that emphasizes walking and public transportation rather than the supremacy of the automobile – in short, to build in a style that resembles the older parts of New Jersey.

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The Insidious Middle Ground

"De-Densification"

Today most new growth in New Jersey does not mimic the older parts of the state. In fact, in most remaining undeveloped areas of New Jersey, it would be illegal to create a new Princeton or Collingswood or Montclair from the ground up; the zoning simply would not allow the "high" densities or mixed uses. New Jersey seems determined to ignore the lessons of Dallas and Atlanta and Orlando – that low-density, automobile-dependent development is a prescription for a gridlocked future. It is busily squandering the congestion-fighting, money-saving, and community-building strengths of its older, denser cities, towns, and first-ring suburbs, choosing instead to redistribute its population more uniformly, spreading out and covering over its rural edges.

When large-lot residential development arrives in formerly rural areas, it consumes large swaths of open space and frequently brings with it rapidly rising tax rates (to cover the higher per-capita costs for new infrastructure) and worsening traffic. But citing "low" density as the culprit is too imprecise an argument. Consider the examples of western Kansas, the mountains of West Virginia, or the interior of the Pine Barrens in southern New Jersey. None of these places look like sprawl, nor or they plagued with traffic, nor are they characterized by houses on one- or two-acre lots, yet they most certainly have low population densities. In fact, they have *very* low densities, and this is the key to understanding New Jersey's current problems.

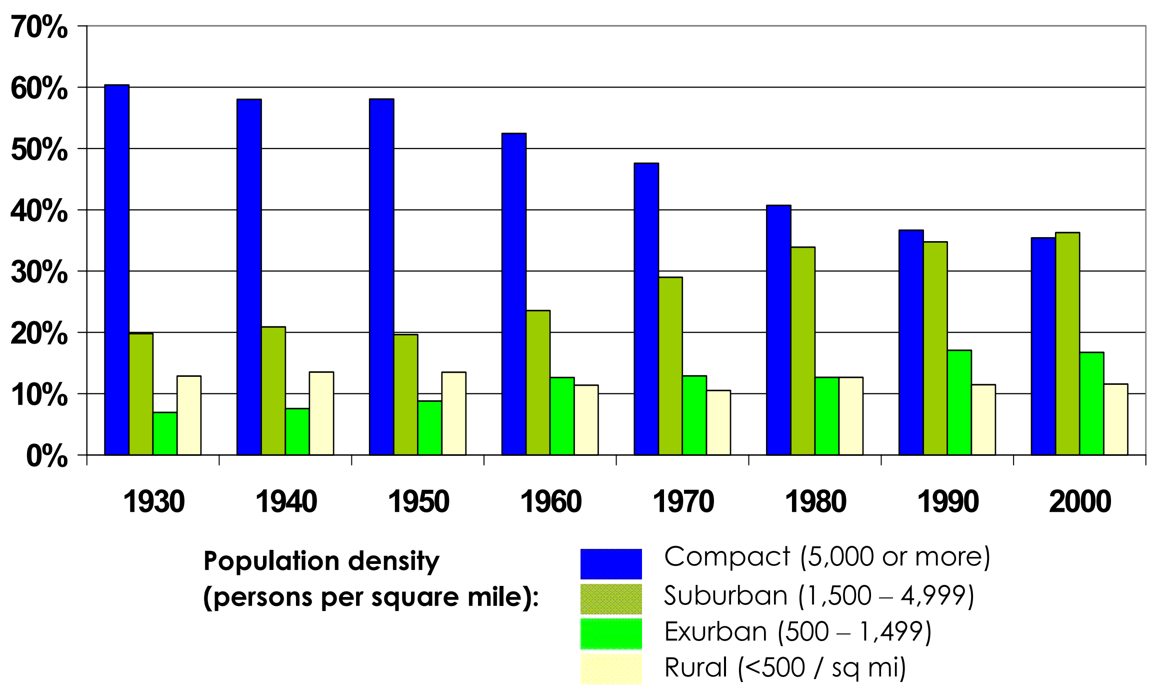
> Rapidly suburbanizing areas like Mullica Hill, Montgomery Township, and Readington are dense enough to create traffic and carve up farmland or wildlife habitat, but not dense enough to support transit or make efficient use of infrastructure.

Characterizing houses on one- or two-acre lots, or even 10-acre lots, as "low density" only works in a relative sense, to the extent that such residential densities are much lower than those found in New Jersey's older settlements. But these "low" densities are, after all, much higher than that of the rural land they are replacing. In truth, such densities are both too low and too high. Rapidly suburbanizing areas like Mullica Hill, Montgomery Township, and Readington are dense enough to create traffic and carve up farmland and wildlife habitat, but not dense enough to support transit or make efficient use of infrastructure. These places occupy an insidious middle ground that accomplishes neither the preservation of land – in fact, land gets devoured faster and results in extremely fragmented patches of residual open space – nor the creation of walkable, mixed-use communities that reduce dependence on the automobile and keep per-capita infrastructure costs (and thence municipal tax rates) under control. They thus work against the principles of smart growth on two fronts. Additionally, though difficult to quantify, living at middle-range densities creates a similar social dilemma for its residents – the neighbors' houses are physically proximate enough to shatter the illusion of splendid isolation that draws so many people to rural areas in the first place, but not close enough to engender regular social contact and foster a sense of community and collective security.

Unfortunately, New Jersey is currently engaged in a stampede toward this middle ground. Figure 5 indicates the percentage of New Jersey residents living at various densities each decade, going back to 1930. (There are no hard and fast definitions for what constitutes a "rural" or "exurban" density, for example; the category cutoffs are based roughly on the types of municipalities that tend to fall into each category[24].) Up through 1950, New Jersey residents lived predominantly at compact densities of 5,000 people per square mile or more, typical not only of large cities but of small towns and denser suburbs like Teaneck, Union, Somerville, Freehold, Merchantville, or Point Pleasant. But after 1950 there commenced a "de-densification," a steady decline in the percent of New Jerseyans living at these more compact densities, to the extent that as of 2000 it is now exceeded by the percent living at moderate suburban densities of between 1,500 and 5,000 persons per square mile (as exemplified by boroughs like Newton, Ridgewood, Metuchen, Hightstown, Haddonfield, and Pitman, and by suburban townships like Scotch Plains, Parsippany-Troy Hills, Edison, Brick, and Cherry Hill). This latter percentage has nearly doubled since 1930, from about 20 percent to over 36 percent in 2000.

Perhaps more ominous is the rise in the percentage of people living at lower suburban or "exurban" densities between 500 and 1,500 per square mile. These are the densities that have the most serious implications for infrastructure costs, loss of open space, and traffic born of automobile dependency. This percentage has more than doubled over the last 70 years, rising from 7 percent in 1930 to 17 percent in 2000. The percent living at truly rural densities of 500 per square mile or less (as in the Pinelands, along the Delaware Bayshore, and in most of Sussex and

Figure 5. "De-Densification": Percentage of New Jersey's Population Living at Various Densities, 1930 to 2000



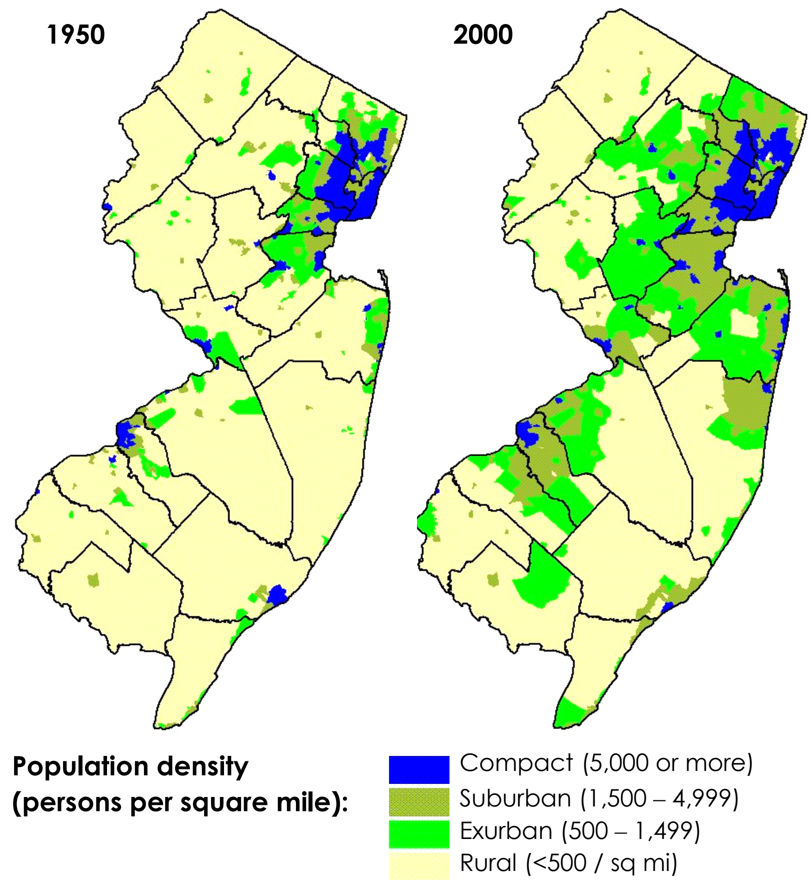
The percentage of New Jersey's population living at suburban and exurban densities has been on the rise since 1950, while the percent living at compact, land-conserving densities has steadily declined, and the rural percentage has remained stagnant. People living at middle-range densities – dense enough to create traffic and consume open space, not dense enough to facilitate walking or transit use or to make economical use of infrastructure – now outnumber those at the upper and lower ends of the density spectrum.

data sources: U.S. Bureau of the Census (population); NJ Office of Smart Growth (land area)

Warren counties), meanwhile, has remained relatively constant over the entire period, hovering around 12 or 13 percent, and has been overtaken by the exurban percentage.

Each cluster of bars on Figure 5 in effect represents a possible vision of how New Jersey's population can be arrayed on the ground. From 1930 through 1950, the reality was primarily a center-based configuration, with most of the population living in cities and towns, leaving the bulk of the state's land relatively sparsely populated. Such a population distribution enables a wide variety of economies of scale to be realized in the densely populated areas, from low per-capita infrastructure and service costs to transit viability. And it allows much of the state's land area to remain rural. (See Figure 6.) This type of center-based distribution may look familiar – it is the animating spirit behind the State Plan.

Figure 6. Population Density by Municipality, 1950 and 2000



Lower densities at the fringes of urban areas are to be expected, as outer municipalities are only beginning to develop their land and will eventually fill in. Today, however, prevailing low-density development patterns are such that, unlike the suburbs that developed during the 1950s, 1960s, and 1970s, many currently-developing suburbs will likely remain in the "exurban" density category even when fully built out. That is, the green municipalities on today's map are not likely to be olive in another 50 years.

data sources: U.S. Bureau of the Census (population); NJ Office of Smart Growth (land area)

In contrast, the 2000 scenario depicts a more uniform distribution of population, with a much less dramatic demarcation between town and countryside. More people living at intermediate densities means they are going to take up more land, incur higher infrastructure costs, and create more traffic by eliminating walking and public transit as transportation options. If these trends continue, the result will increasingly resemble the extreme case of perfect internal homogeneity – a New Jersey whose macro density of about 1,100 people per square mile is replicated at the micro level throughout the state, a New Jersey where every place looks like Manalapan. As just one implication of such a scenario, consider that if everyone lived (and worked) at such a transit-inhibitive density, most of New Jersey Transit's 250,000 bus riders and 100,000 rail commuters would be forced into their cars, adding that many more vehicles to the rush hour crush.

Abandoning the Ends for the Middle

New Jersey's pattern mirrors, to a certain extent, a national phenomenon of abandonment of both the high and the low ends of the density spectrum in favor of the middle ground. Nationally, most of what were the largest cities in 1950 have steadily lost population since then, with a fortunate few having been able to reverse the trend only in the last decade. What's more, many of these cities' first- and second-generation suburbs have begun to decline as well. At the same time, a massive population drain is underway throughout the Great Plains and in other very rural areas like the Appalachian Mountains and along the lower Mississippi River, areas that are far removed from any urban centers. Instead, population growth has gravitated toward new low-density cities and to the suburbs and exurbs, creating enough density to aggravate traffic problems and consume vast swaths of open space but not enough to produce significant economies of scale in the provision of services and infrastructure or to create alternatives to travel by private automobile.

In New Jersey, it is well documented that large urban centers have been in trouble for some time. Like industrial-era cities elsewhere in the country, New Jersey's "big 6" cities (Newark, Jersey City, Paterson, Elizabeth, Trenton, and Camden) began a long-term decline in the 1950s, losing nearly a quarter (23.6 percent) of their collective population between 1950 and 2000. (Jersey City and Elizabeth managed to reverse their population losses in the 1990s, but the other four continued losing.) And as disinvestment spread to the inner suburbs, many nearby municipalities lost population between 1980 and 2000, including nearly half the municipalities in Bergen County, slightly more than half of those in Union County, nearly two-thirds in Essex County, and more than two-thirds in Camden County. (Many of these recovered slightly in the 1990s but are still below their 1980 populations.) Bergen County, consisting primarily of older, moderate-density suburbs, actually reached its peak population in 1970.

What is less well known is that population stagnation and even sustained losses have also been occurring in Salem and Cumberland counties and in the heart of the Pine Barrens. These areas are New Jersey's closest analog to the Great Plains, though considerably denser, in that they are still largely agricultural and are remote from most population and employment centers. Salem County was the only county in New Jersey to lose population in the 1990s, and over the 20-year period from 1980 to 2000, the only counties other than Salem to grow more slowly than its rural neighbor Cumberland County were the urban-core counties of Bergen, Passaic, Hudson, Union, and Essex in the north and Camden in the south. Three large Burlington County townships located

The Rhetoric of "Overdevelopment"

Many public opinion leaders in New Jersey, both inside and outside of government, frequently use the term "overdevelopment" to describe land use projects or policies they disfavor. In most contexts, this particular term is simply a rhetorical crutch devoid of meaning. If "overdevelopment" connotes a place that has developed most of its buildable land, then sought-after addresses like Princeton, Collingswood and Maplewood are "overdeveloped" because they are all 99 percent built out. If "overdevelopment" means a high concentration of jobs, then Weehawken and Morristown are "overdeveloped" because they host more than 10,000 jobs per square mile. If "overdevelopment" simply implies high density, then all of Hudson County is "overdeveloped." Yet many of these places are often cited as paragons of smart growth, because they offer a host of housing and transportation options and make efficient use of their land.

Perhaps paradoxically, the word "overdevelopment" is more typically employed to describe new low-density development appearing in formerly-rural places. Large-lot subdivisions and strip commercial centers may bring the appearance of development to places previously unaccustomed to it, but these places might more truthfully be termed "*under*developed", since their densities fail to support walkable communities or take advantage of infrastructure economies. Instead of decrying *any* new development as "overdevelopment", we should be working to establish lower densities (or indeed a halt to development) in some places, to save the open spaces that are the most critical, and higher densities in other places, so that growth can be accommodated in a way that protects the environment and saves time and money.

in the heart of the Pinelands – Washington, Woodland, and Pemberton townships – have been losing population steadily since 1980, and they were joined by two others – Tabernacle and Bass River townships – in the 1990s.

In New Jersey as in the rest of the United States, then, both urban (including dense suburbs) and rural areas are being forsaken in favor of low-density, usually "centerless" suburbs and exurbs. One implication of this trend suggests itself in New Jersey's congestion patterns. According to a 2001 study by the NJ Institute of Technology[25] that examined annual hours of delay per driver at the county level, drivers in the most densely populated counties in the state – Hudson, Essex, and Union – experienced less congestion-related delay in 1998 than those in lower-density suburban Monmouth, Morris, and Somerset counties. (Dense-suburban Bergen County had the worst delays.) The lowest annual per-capita delays were found in the still-rural southern end of the state – Cape May, Atlantic, Cumberland, and Salem counties held the lowest four rankings. Overall, the study's results indicate that the density extremes perform better than the middle. Thus the rapidly suburbanizing counties of Somerset, Ocean, and Hunterdon can probably look forward to worsening traffic in the future, as they enter the middle density range primarily by adding new low-density, single-use developments. And the next wave on the growth frontier – Warren and Sussex counties in the north and Gloucester and northern Burlington counties in the south – should take heed.

Conclusion

New Jersey's race toward the middle of the residential density spectrum is imposing costs on its residents – in terms of time, money, and the loss of open land – that do not augur well for the state's future quality of life. The solution is simply stated, but politically challenging. Reversing the drift toward density's middle ground will involve down-zoning in some places and up-zoning in others. That is, some places need to become less dense and others need to become more dense by changing the future as prescribed by zoning. Counties (and geographically large municipalities) need to become more internally heterogeneous, concentrating their new development in designated areas rather than smearing it indiscriminately across the landscape.

The concept of increasing densities in some places while decreasing them in others is central to the land stewardship vision of the Pinelands Comprehensive Management Plan.[26] The plan keeps densities fixed at their current very low level – by not allowing any further development at all – in the most critical areas, denoted as "preservation areas." In "agricultural production areas", the next most important category, the minimum lot size is 40 acres for any new development not directly connected to agriculture. Note that this is a far lower density than what most municipalities label as "downzoning"; the Pinelands Commission clearly recognized that 2-, 3-, or even 10-acre zoning was not going to accomplish its preservation goals.

On the other hand, the plan calls for increasing densities to between one and 3.5 units per acre in "regional growth areas", and it "allows traditional development under certain rules" in the seven Pinelands towns[27], essentially meaning that some new development can take place in the Pinelands' handful of pre-existing mixed-use centers, provided the new development retains the compact character of the existing town. The idea is that instead of allowing development to spread uniformly throughout the Pinelands, population growth would be concentrated in higher-density centers, allowing new residents to be accommodated while still keeping the bulk of the land within the Pinelands undeveloped. Actual experience in the Pinelands has taught us that simply identifying growth areas with higher densities is not enough to stop sprawl. Municipalities must also heed the "how" development happens by planning and zoning in ways that encourage a mix of uses (retail, office, residential) where walking is an option, over single-use developments that require car travel and so add to traffic congestion.

> A fundamental assumption of the State Plan is that New Jersey's population will continue to grow – at issue is how best to configure the new growth, growth that is coming one way or another.

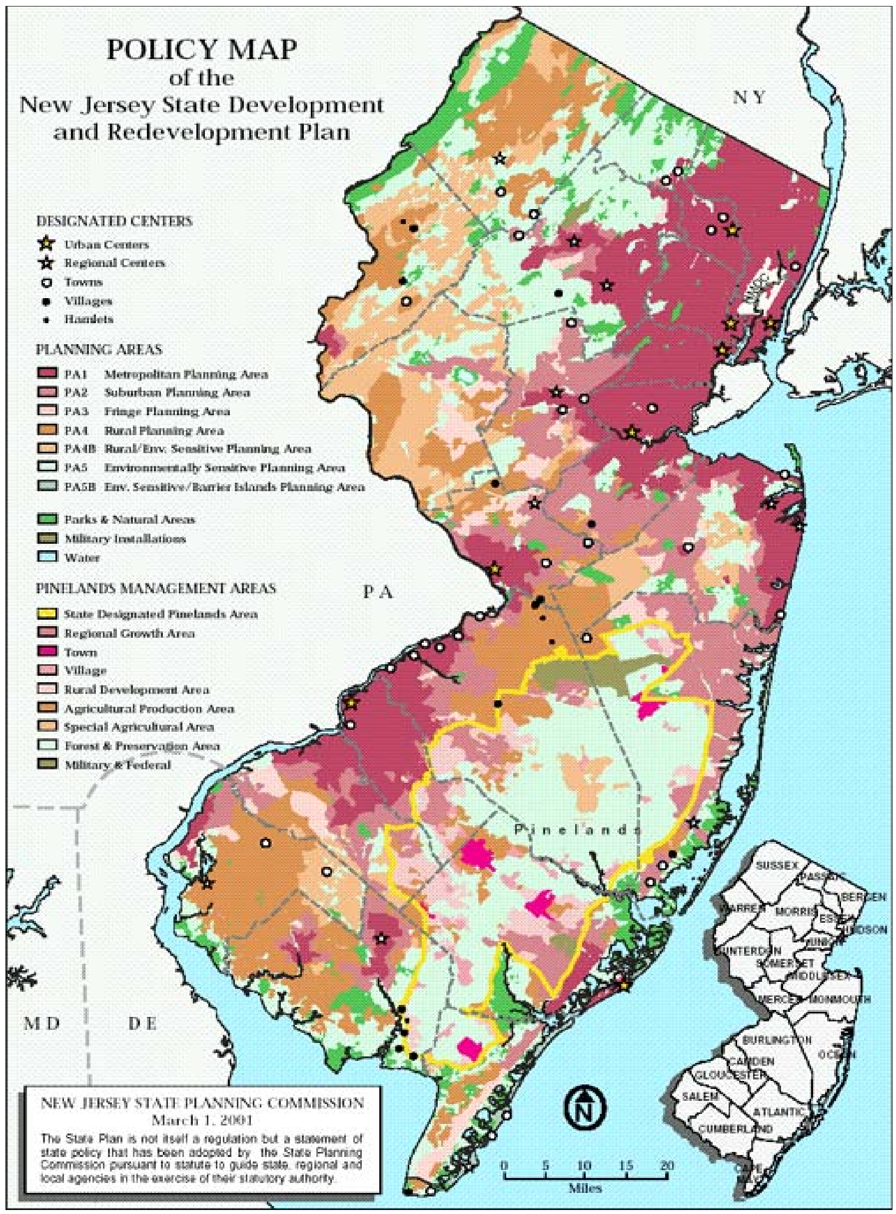
At the statewide level, the State Plan stands ready as a guide in determining what density and zoning changes are appropriate for what areas and in identifying the areas that are most appropriate for absorbing new growth. It is important to note that the goal of the State Plan is not to stop growth, vital to the state's economic and social health, but rather to encourage it to assume a different form. The counties that are currently growing most rapidly – Somerset, Ocean, Hunterdon – will likely continue growing rapidly, but many of the negative impacts of growth can be mitigated if the new growth takes a more compact form, reminiscent of the older towns in Union, Essex, or Camden counties, for example. A fundamental assumption of the

State Plan is that New Jersey's population will continue to grow – at issue is how best to configure the new growth, growth that is coming one way or another.

The State Plan incorporates design recommendations to help ensure that density actually produces its inherent benefits instead of creating small versions of Los Angeles, places with moderately high density but without mixed-use centers or transportation options. Los Angeles's citywide density is actually fairly high (around 7,900 per square mile), comparable to that of Princeton or Collingswood; the difference is that Princeton and Collingswood are not automobile-oriented. Density is an important part of the equation, but it is not the entire equation, as the State Plan recognizes. Density must be well designed in order to yield its full range of potential payoffs.

As the prospect of full build-out looms on New Jersey's horizon, the judicious use of our remaining land will become progressively more critical. With the supply of land available for development decreasing daily, as both low-density subdivisions and open space preservation programs take more of it off the market, one direct result is a net reduction in the number of new housing units that homebuilders will be able to create, if present zoning does not change. This constriction will in turn produce a secondary result: escalating home prices throughout the state as the ultimate finiteness of the housing supply closes in. Both of these effects are exacerbated by current land-hungry development patterns. The disappearance of land could be alleviated by increasing the density of new developments, which will allow more housing units to be built on the remaining supply of land and thereby reduce upward pressure on home prices.

It is precisely the lack of density in most recent developments that is propelling us so rapidly towards build-out. We must be smarter about how we use our remaining buildable land and arrest the state's degeneration into inefficient middle-range densities. New Jersey is not full yet, but that day is fast approaching unless we reclaim the advantages of our historic development patterns and relearn the wisdom of building higher-density, pedestrian-friendly, mixed-use communities.



Recommendations

To Save Land and Protect the Environment

Amend the Municipal Land Use Law (MLUL) to require municipal growth targets and build-out analyses. In order to plan for proper densities, municipalities should be required to adopt growth targets based on the growth projections that accompany the State Development and Redevelopment Plan (State Plan). Moreover, municipalities should be required to conduct a build-out analysis to clearly understand their current zoning yields. Such analyses would enable local officials to make better decisions on what densities are appropriate to accommodate future growth.

Approve municipal petitions for State Plan endorsement only if the local master plan and zoning contain adequate density requirements. The State Planning Commission's State Plan endorsement process will be a powerful tool in coordinating local land use regulations with the State Plan. But a petitioning municipality should be required to demonstrate sufficiently high-density zoning in areas identified for growth and sufficiently low-density zoning in areas designated for preservation, to ensure that an endorsed plan actually meets the goals and policies of the State Plan, and therefore entitles the petitioner to the manifold benefits of Plan endorsement.

Amend the MLUL to enable municipalities to mandate cluster-type development, and promote cluster development in environmental permitting. Cluster developments typically offer small lot sizes on any given parcel of land to be developed, in order to preserve a portion of the parcel as parkland, farmland or open land. The Municipal Land Use Law should be amended to expressly authorize municipalities to mandate cluster development where appropriate in their local land use regulations.[28] In addition, many new developments, especially housing developments built on undeveloped land, require permits from the state's Department of Environmental Protection (DEP). To ensure that new developments use land efficiently, the DEP should amend its regulations as necessary to encourage clustered developments, whenever appropriate.

Amend the MLUL to expressly authorize conservation planning and preservation zoning. To ensure that municipalities have the right tools to protect open space and natural resources, including the natural resources in highly developed communities, the MLUL should be changed to require (not simply permit) the inclusion of a conservation element and, where appropriate, a farmland preservation element in each municipality's master plan. Moreover, the zoning provisions of the MLUL should be amended to expressly authorize farmland and open space zoning (of at least 20 acres) for preservation purposes, as found in other states with successful preservation programs.

Record lot sizes when building permits or certificates of occupancy are issued for new homes. Addressing the rapid disappearance of land is an expressly stated land use goal of New Jersey; and yet is impossible to track under current recordkeeping. The state should compile lot size data – aggregated by municipality and county – to ensure policy makers have a better understanding of actual land use patterns in New Jersey. Quantifying the rate at which new land is developed would provide an unambiguous basis on which to evaluate the extent of the problem, and the necessity and appropriateness of proposed remedies.

To Save Money

Adopt and aggressively implement the Board of Public Utilities' proposed rules curtailing the subsidization of sprawl. Currently all existing rate-payers cover the cost of expanding utilities (electricity, gas, water, telephone, etc.) to sprawling developments. Proposed rules would limit this invisible subsidy and assign more of the true costs of low-density living to those who actually choose to live there.

Amend the MLUL to allow the expanded use of impact fees if linked to State Plan endorsement. Impact fees can be used to help recover the cost of new development as well as serve as an incentive for more compact growth. But impact fees divorced from planning may simply lead to well-financed sprawl. Expanded impact fees should be available only to towns with municipal plans endorsed by the State Planning Commission. This would ensure that impact fees will be used in areas where land use regulations support smart growth.

Enact the "smart growth tax credit bill." A bill designed to provide a tax credit to developers who build in areas designated for growth has been introduced in both houses of the Legislature. The amount of tax credit depends on how the project is designed, so that compact mixed-use development near transit is afforded the most credit. This financial tool perfectly complements expanded impact fees and the combination of the two will help foster growth that makes more efficient use of land and infrastructure.

To Save Time and Ease Traffic

Require a "contractual" agreement between state transportation agencies and local communities before undertaking new transportation construction or improvements to ensure state transportation spending and local land-use decisions are compatible. Today, any community can appeal to the State to build or widen a road, fix an intersection or improve its rail service, without changing the local zoning that encourages additional traffic problems. Similarly, the State can launch a major road or rail project within a community paid for by taxpayers statewide, with no assurance that local zoning won't spur – or discourage, as the case may be – future growth that undermines the investment. State taxpayers should have assurance that tax dollars spent for transportation improvements aren't undermined by local zoning and work to serve appropriate densities.

Implement tools that create pedestrian-friendly and healthy communities. In addition to zoning for mixed-use developments, communities can use appropriate design standards to bring walking back as a transportation option. Pedestrian amenities and traffic-calming devices like raised crosswalks, narrower streets with fewer lanes, and buildings that front directly on the street rather than behind a sea of parking, can all make walking a safer and more pleasant experience and thus help ensure that higher densities actually do translate into less vehicular traffic.

To Address a Major Driver of Land Use Decisions

Reform the property tax system. Reforming the municipal land use regulations that drive today's density patterns will only carry New Jersey so far. If we are serious about saving land, money and time through better use of density, then we must also address a major driver of land-use decisions: the property tax system. Without substantial reform of today's tax system, local officials will continue to favor commercial and low-density McMansion-style housing in an attempt to keep the demand for local services low, and property taxes down. A regional solution, such as tax-sharing between municipalities, could help eliminate this problem.

Tables

Table 1. Population Density vs. Per Capita Roadway Route-Miles for New Jersey Counties

County	2002 Population density (persons / sq mile)	Rank (hi to lo)	Miles of road per thousand population	Rank (lo to hi)
Hudson	13,052.40	1	1.01	1
Essex	6,251.70	2	2.1	2
Union	5,119.00	3	2.67	4
Bergen	3,743.20	4	3.15	6
Passaic	2,524.50	5	2.6	3
Middlesex	2,476.70	6	3.05	5
Camden	2,287.90	7	3.81	7
Mercer	1,583.40	8	4.47	8
Monmouth	1,326.70	9	4.87	10
Somerset	1,016.60	10	5.02	11
Morris	996.8	11	4.77	9
Ocean	838.1	12	5.31	13
Gloucester	800.3	13	5.17	12
Burlington	540.3	14	5.77	14
Atlantic	459	15	7.43	15
Cape May	393.9	16	10.23	18
Cumberland	298.6	17	8.6	16
Warren	298.5	18	11.06	19
Hunterdon	288.6	19	11.53	20
Sussex	277.9	20	9.52	17
Salem	188.8	21	13.59	21
New Jersey	**1,144.20**	**[-]**	**4.26**	**[-]**

The most densely populated counties require the fewest miles of road per capita.

data sources: U.S. Bureau of the Census (population); NJ Dept. of Transportation (road miles)

Table 2. Urbanized Area Density and Congestion Statistics for 49 Large Metropolitan Areas

Urbanized Area Name	Population	Rank	Density (pop/sq mi)	Rank	Largest city	City population	City density (pop/sq mi)	Rank	Annual hours of delay per person #	Annual hours of delay per person rank	% of freeway lane-miles congested in peak period %	% of freeway lane-miles congested in peak period rank	% of daily travel in congestion %	% of daily travel in congestion rank	Highest congestion rank
Atlanta, GA	3,499,840	12	1,783.3	46	Atlanta	416,474	3,161.2	35	34	7.5	75	4	41	3.5	3.5
Austin, TX	901,920	40	2,835.1	23	Austin	656,562	2,610.4	40	30	11	55	24	34	19.5	11
Baltimore, MD	2,250,952	17	2,868.2	20	Baltimore	651,154	8,058.4	9	22	24	55	24	33	22.5	22.5
Birmingham, AL	663,615	49	1,692.5	49	Birmingham	242,820	1,619.7	45	15	37.5	25	47.5	21	41.5	37.5
Boston, MA--NH--RI	4,032,484	7	2,322.6	38	Boston	589,141	12,165.8	4	29	12.5	60	16.5	38	11	11
Buffalo, NY	976,703	38	2,663.5	28	Buffalo	292,648	7,205.8	11	5	48	30	44	11	48.5	44
Charlotte, NC--SC	758,927	46	1,745.0	47	Charlotte	540,828	2,232.4	42	21	26	50	27.5	32	25	25
Chicago, IL--IN	8,307,904	3	3,913.6	9	Chicago	2,896,016	12,750.3	3	27	17.5	65	11.5	40	5.5	5.5
Cincinnati, OH--KY--IN	1,503,262	26	2,237.8	39	Cincinnati	331,285	4,249.0	23	20	28	55	24	31	28	24
Cleveland, OH	1,786,647	21	2,761.4	24	Cleveland	478,403	6,166.5	17	7	45.5	35	39.5	19	43	39.5
Columbus, OH	1,133,193	36	2,849.3	22	Columbus	711,470	3,383.6	31	17	34	40	34.5	26	33	33
Dallas--Fort Worth--Arlington, TX	4,145,659	6	2,946.4	19	Dallas	1,188,580	3,469.9	30	36	4.5	55	24	32	25	4.5
Denver--Aurora, CO	1,984,889	20	3,979.1	8	Denver	554,636	3,616.8	29	36	4.5	60	16.5	39	8	4.5
Detroit, MI	3,903,377	10	3,094.4	17	Detroit	951,270	6,855.1	14	27	17.5	65	11.5	37	13	11.5
Hartford, CT	851,535	43	1,814.3	45	Hartford	121,578	7,025.5	12	10	42	40	34.5	21	41.5	34.5
Houston, TX	3,822,509	11	2,951.1	18	Houston	1,953,631	3,371.7	32	37	3	60	16.5	34	19.5	3
Indianapolis, IN	1,218,919	33	2,204.5	41	Indianapolis	791,926	2,160.9	43	23	23	60	16.5	34	19.5	16.5
Jacksonville, FL	882,295	41	2,149.2	42	Jacksonville	735,617	970.9	48	15	37.5	35	39.5	24	37.5	37.5
Kansas City, MO--KS	1,361,744	29	2,330.1	37	Kansas City	441,545	1,408.2	46	9	44	30	44	16	44.5	44
Las Vegas, NV	1,314,357	31	4,597.1	6	Las Vegas	478,434	4,222.5	24	16	36	60	16.5	33	22.5	16.5
Los Angeles--Long Beach--Santa Ana, CA	12,492,983	2	6,719.7	1	Los Angeles	3,694,820	7,876.8	10	52	1	85	1	44	1	1
Louisville, KY--IN	863,582	42	2,207.0	40	Louisville	256,231	4,124.9	26	19	29.5	40	34.5	26	33	29.5
Memphis, TN--MS--AR	972,091	39	2,431.3	33	Memphis	650,100	2,327.4	41	17	34	40	34.5	25	35.5	34
Miami, FL	4,919,036	5	4,407.4	7	Miami	362,470	10,160.9	6	29	12.5	56	21	35	17	12.5
Milwaukee, WI	1,308,913	32	2,687.5	26	Milwaukee	596,974	6,214.3	16	14	39	60	16.5	29	30.5	16.5

Table 2. *(continued)*

Urbanized Are Name	Population	Rank	Density (pop/sq mi)	Rank	Largest City	City Population	City density (pop/sq mi)	Rank	Annual hours of delay per person #	Annual hours of delay per person rank	% of freeway lane-miles congested in peak period %	% of freeway lane-miles congested in peak period rank	% of daily travel in congestion %	% of daily travel in congestion Rank	Highest congestion rank
Minneapolis--St. Paul, MN	2,388,593	16	2,671.2	27	Minneapolis	382,618	6,970.3	13	28	15	60	16.5	36	15	15
Nashville-Davidson, TN	749,935	47	1,740.9	48	Nashville	569,891	1,134.6	47	21	26	35	39.5	24	37.5	26
New Orleans, LA	1,009,283	37	5,101.6	5	New Orleans	484,674	2,684.3	39	10	42	40	34.5	23	39	34.5
New York--Newark, NY--NJ--CT	17,799,861	1	5,309.3	3	New York	8,008,278	26,402.9	1	25	19.5	55	24	34	19.5	19.5
Oklahoma City, OK	833,481	44	2,363.9	34	Oklahoma City	506,132	833.8	49	6	47	30	44	16	44.5	44
Orlando, FL	1,157,431	35	2,554.0	31	Orlando	185,951	1,988.9	44	33	10	45	30	31	28	10
Philadelphia, PA--NJ--DE--MD	5,149,079	4	2,861.4	21	Philadelphia	1,517,550	11,233.6	5	17	34	45	30	31	28	28
Phoenix--Mesa, AZ	2,907,049	13	3,638.3	11	Phoenix	1,321,045	2,781.9	37	28	15	70	8	36	15	8
Pittsburgh, PA	1,753,136	22	2,056.7	43	Pittsburgh	334,563	6,019.0	19	7	45.5	20	49	13	47	45.5
Portland, OR--WA	1,583,138	24	3,340.3	15	Portland	529,121	3,939.2	27	24	21.5	70	8	39	8	8
Providence, RI--MA	1,174,548	34	2,332.2	36	Providence	173,618	9,401.7	7	21	26	40	34.5	25	35.5	26
Richmond, VA	818,836	45	1,874.8	44	Richmond	197,790	3,292.6	33	10	42	30	44	15	46	42
Riverside--San Bernardino, CA	1,506,816	25	3,434.1	12	Riverside	255,166	3,267.2	34	34	7.5	75	4	38	11	4
Rochester, NY	694,396	48	2,352.7	35	Rochester	219,773	6,132.9	18	3	49	25	47.5	11	48.5	47.5
Sacramento, CA	1,393,498	28	3,776.1	10	Sacramento	407,018	4,189.2	25	19	29.5	75	4	39	8	4
San Antonio, TX	1,327,554	30	3,257.3	16	San Antonio	1,144,646	2,808.5	36	18	31.5	45	30	26	33	30
San Diego, CA	2,674,436	15	3,418.7	13	San Diego	1,223,400	3,771.9	28	25	19.5	75	4	40	5.5	4
San Francisco--Oakland, CA	4,015,398	8	5,297.8	4	San Francisco	776,733	16,634.4	2	42	2	75	4	41	3.5	2
San Jose, CA	1,622,932	23	5,438.7	2	San Jose	894,943	5,117.9	21	34	7.5	60	16.5	36	15	7.5
Seattle, WA	2,826,577	14	2,751.8	25	Seattle	563,374	6,717.0	15	28	15	69	10	38	11	10
St. Louis, MO--IL	2,132,947	18	2,504.4	32	St. Louis	348,189	5,622.9	20	18	31.5	50	27.5	29	30.5	27.5
Tampa--St. Petersburg, FL	2,062,339	19	2,570.6	30	Tampa	303,447	2,707.8	38	24	21.5	30	44	32	25	21.5
Virginia Beach, VA	1,394,439	27	2,647.0	29	Norfolk	234,403	4,362.8	22	13	40	35	39.5	22	40	39.5
Washington, DC--VA--MD	3,933,920	9	3,400.8	14	Washington	572,059	9,316.4	8	34	7.5	70	8	42	2	2

data sources: Texas Transportation Institute (congestion); U.S. Bureau of the Census (population and density)

Note: In the case of ties, ranks are determined as the average of the ranks that would have been assigned to each UA if their values had been distinct, thus allowing fractional ranks. A rank of 19.5, for example, can derive from a tie for 19th place, in which case two UAs that would have ranked 19 and 20 are each assigned a value of 19.5, the average of 19 and 20. This prevents ranks from being skewed upward when comparing to ranks on other variables.

Table 3. Highest Congestion Rank and Density of Largest City for the Most Populous Urbanized Areas

Urbanized Area Name	2000 UA Population	rank	highest congestion rank[1]	largest city	city density (pop / sq mi)	rank
New York--Newark, NY--NJ--CT	17,799,861	1	19.5	New York	26,402.9	1
Los Angeles--Long Beach--Santa Ana, CA	12,492,983	2	1	Los Angeles	7,876.8	10
Chicago, IL--IN	8,307,904	3	5.5	Chicago	12,750.3	3
Philadelphia, PA--NJ--DE--MD	5,149,079	4	28	Philadelphia	11,233.6	5
Miami, FL[2]	4,919,036	5	12.5	Miami	10,160.9	6
Dallas--Fort Worth--Arlington, TX	4,145,659	6	4.5	Dallas	3,469.9	30
Boston, MA--NH--RI	4,032,484	7	11	Boston	12,165.8	4
San Francisco--Oakland, CA	4,015,398	8	2	San Francisco	16,634.4	2
Washington, DC--VA--MD	3,933,920	9	2	Washington	9,316.4	8
Detroit, MI	3,903,377	10	11.5	Detroit	6,855.1	14
Houston, TX	3,822,509	11	3	Houston	3,371.7	32
Atlanta, GA	3,499,840	12	3.5	Atlanta	3,161.2	35
Phoenix--Mesa, AZ	2,907,049	13	8	Phoenix	2,781.9	37
Seattle, WA[3]	2,826,577	14	10	Seattle	6,717.0	15
San Diego, CA	2,674,436	15	4	San Diego	3,771.9	28
Minneapolis--St. Paul, MN	2,388,593	16	15	Minneapolis	6,970.3	13
Baltimore, MD	2,250,952	17	22.5	Baltimore	8,058.4	9
St. Louis, MO--IL	2,132,947	18	27.5	St. Louis	5,622.9	20
Tampa--St. Petersburg, FL	2,062,339	19	21.5	Tampa	2,707.8	38
Denver--Aurora, CO	1,984,889	20	4.5	Denver	3,616.8	29

1 Congestion data were computed under the old urbanized area definitions, which were revised as of 2003. Population data refer to the redefined areas. The new definitions do not differ drastically from the old, except in a few cases where formerly separate UAs were combined. These places are so noted.
2 Congestion data for Miami have been combined with the formerly separate UAs of Fort Lauderdale-Hollywood and West Palm Beach.
3 Congestion data for Seattle also include the formerly separate UA of Tacoma.

Note: In the case of ties, ranks are determined as the average of the ranks that would have been assigned to each UA if their values had been distinct, thus allowing fractional ranks. A rank of 19.5, for example, can derive from a tie for 19th place, in which case two UAs that would have ranked 19 and 20 are each assigned a value of 19.5, the average of 19 and 20. This prevents ranks from being skewed upward when comparing to ranks on other variables.

Among the most populous urbanized areas in the country, the ones with very dense principal cities tend to have fewer congestion problems, relative to their size, than the ones without a high-density core. With the notable exceptions of San Francisco and Washington DC, the UAs whose highest congestion rank is higher than their overall size rank (that is, they have worse congestion problems than might be anticipated from their total population) also tend to rank far lower in terms of the density of their largest city than they do in overall population.

Table 4. Urbanized Areas With Worst Congestion Delays

Urbanized Area Name	annual hours of delay per person	rank	UA density rank	UA total population rank	largest city	density of largest city (rank)	MSA pop growth, 1970-2000
Los Angeles--Long Beach--Santa Ana, CA	52	1	1	2	Los Angeles	10	46.1%
San Francisco--Oakland, CA	42	2	4	8	San Francisco	2	32.6%
Houston, TX	37	3	18	11	Houston	32	115.3%
Dallas--Fort Worth--Arlington, TX	36	4.5	19	6	Dallas	30	122.1%
Denver--Aurora, CO	36	4.5	8	20	Denver	29	90.6%
Atlanta, GA	34	7.5	46	12	Atlanta	35	144.2%
Riverside--San Bernardino, CA	34	7.5	12	25	Riverside	34	185.7%
San Jose, CA	34	7.5	2	23	San Jose	21	57.9%
Washington, DC--VA--MD	34	7.5	14	9	Washington	8	57.8%
Orlando, FL	33	10	31	35	Orlando	44	262.8%
New York--Newark, NY--NJ--CT	25	19.5	3	1 .	New York	1	7.4%
Philadelphia, PA--NJ--DE--MD	17	34	21	4 .	Philadelphia	5	6.8%

Note: In the case of ties, ranks are assigned as the average of the ranks that would have been assigned to each UA if their values had been distinct. For example, the two UAs tied for 4th place would otherwise have ranked 4 and 5, thus each has a rank of 4.5 (the average of 4 and 5) assigned to it. This prevents ranks from being skewed upward when comparing to ranks on other variables.

The urbanized areas with the worst congestion delays are not generally the densest, nor are they typically large UAs with dense principal cities. But they do tend to be fast-growing and automobile-dependent. Despite high densities (whether at the UA-wide level or in the principal city), the two urbanized areas that cover most of New Jersey have comparatively less severe problems with congestion-induced delays

Endnotes

[1] Source: CIA World Factbook (www.odci.gov/cia/publications/factbook/index.html). Populations for both Japan and India are 2002 estimates.

[2] The state of Virginia contains 40 independent cities that are not part of any county. To maintain comparability with other states, in this report these cities have been combined with a neighboring county where practical, particularly in the case where a city is completely surrounded by the adjacent county. Of the 40 cities, 29 have been combined with a neighboring/surrounding county, while the remaining 11 did not obviously lend themselves to such a combination. Including these combinations, the total number of counties and county equivalents – parishes in Louisiana, boroughs and Census areas in Alaska, the remaining independent cities in Virginia and a small handful in other states – in the U.S. came to 3,112.

[3] NJ Pinelands Commission, at http://www.state.nj.us/pinelands/index.html

[4] Three Burlington County townships in the heart of the Pine Barrens illustrate the area's very low population densities: Bass River Township has only 20 persons per square mile, Woodland Township only 14, and Washington Township, at 6.2 persons per square mile, actually meets the Census Bureau's definition of "frontier" (fewer than 7 persons / sq. mi.).

[5] The lowest population density of any municipality in New Jersey – 1.8 persons per square mile – belongs to Walpack Township in Sussex County, located within the Delaware Water Gap National Recreation Area.

[6] The top 5 densest counties are New York, Kings, Bronx, and Queens counties in New York, and San Francisco County in California. The first 4 are the New York City boroughs of Manhattan, Brooklyn, the Bronx, and Queens, respectively (each borough comprises its own county), and San Francisco County is coextensive with the city of San Francisco. So Hudson County is actually the most densely populated county in the country that does not consist merely of a single city (or portion thereof).

[7] The assertion that lot sizes are increasing is based purely on anecdotal evidence, as the New Jersey state government does not systematically compile data on lot sizes in new residential developments. The proliferation of large houses can be documented, however: between 1990 and 2000 the number of housing units in New Jersey with 9 or more rooms grew by 23.3 percent, vastly outstripping the 7.6 percent growth in housing units overall.

[8] In residential development terms, density is often expressed as housing units per acre rather than as persons per square mile. The two quantities essentially measure the same thing – population per unit area - since the housing units will ultimately be occupied by people. The chief difference is in the total land area of interest in the measurement. At the individual development scale, the denominator of the density fraction consists only of those acres that will actually be in residential use, whereas when reporting density at the municipal level the denominator includes the total land area of the municipality. A density statistic that is computed using only land that is actually in residential use is sometimes referred to as a "net" density, while a "gross" density is computed using all land belonging to a geographic entity, whether inhabited or not.

[9] See, for instance, Mansnerus, Laura, "Great Haven for Families, but Don't Bring Children," *New York Times*, August 13, 2003.

[10] See, for instance, the American Farmland Trust's "Cost of Community Services" study of Monmouth County

[11] Final Report of the New Jersey Comparative Risk Project, 2003. Available at the New Jersey Department of Environmental Protection.

[12] Data on lane-miles are from the Federal Highway Administration's Highway Statistics series. Figures include all classes of roads, from Interstates down to local roads. Data from 2002 are available at http://www.fhwa.dot.gov/policy/ohim/hs02/index.htm.

[13] County-level data are from the NJ Dept. of Transportation and refer to route-miles rather than lane-miles. Route-mileage considers only the length of the road, irrespective of the number of lanes. For reference, New Jersey has 79,442 *lane*-miles of public road statewide but only 36,556 *route*-miles.

[14] Both population data and public road route-mileage are from 2002.

[15] Passaic and Middlesex are the two counties that throw off the otherwise perfect relationship, thanks to their internal heterogeneity. The lower neck of Passaic County is considerably more densely populated than the northwestern section; northern Middlesex is considerably denser than the part of the county south of New Brunswick. Thus despite being less densely populated overall than the more internally homogeneous Bergen County, their respective denser halves are dense enough to give them the advantage over Bergen.

[16] The shape of the lots affects the length of pipe needed to service them, because pipe length is a function of the lengths of the edges of the lot rather than of the area. For a fixed area, a wider frontage (that is, an elongated rectangular lot with the long edge facing the road) increases required pipe length by increasing the distance from the neighboring house. The position of the house on the lot can likewise affect the required pipe length. Square lots represent the most generic case for purposes of comparison (mathematically, a square has the minimum perimeter among all rectangles of a given area, or has the maximum area among all rectangles of a given perimeter). It should also be noted that a square lot of one acre in area will have a side length of 208.7 feet, while a 0.2-acre square lot will have a side length of 93.3 feet. The assumption that each house is centered on its lot means that these distances also represent the distance between any two adjacent houses and thus the length of each perpendicular pipe segment.

[17] Coyne, William, *The Fiscal Cost of Sprawl: How Sprawl Contributes to Local Governments' Budget Woes*, December 2003. The report can be viewed at http://www.environmentcolorado.org/envcogrowth.asp?id2=11566

[18] Again, results will vary depending on the shape of the block, because the perimeter of a rectangle is not a function of the rectangle's area but only of the side lengths, and there are many length/width combinations that can produce a given area.

[19] For a thorough bibliography of studies highlighting the cost savings of compact development, both for infrastructure and for services, see Muro, Mark, and Robert Puentes, *Investing in a Better Future: A Review of the Fiscal and Competitive Advantages of Smarter Growth Development Patterns*, The Brookings Institution Center on Urban and Metropolitan Policy, March 2004.

[20] Roughly speaking, an urbanized area is contiguous territory composed of Census blocks having a population density of 1,000 persons per square mile or more (dropping to 500 at the periphery) and with a total population of at least 50,000. Urbanized areas form the cores around which MSAs are constructed. See http://www.census.gov/geo/www/ua/ua_2k.html for definitions.

[21] Schrank, D.L., and T.J. Lomax, *The 2003 Annual Urban Mobility Report*, Sept. 2003, at http://tti.tamu.edu/product/product_details.asp?book_id=27290

[22] For the technically inclined, these expectations can be elaborated upon. Allowing for minor variations in the data that amount essentially to noise, it is not unreasonable to expect that any given UA's rankings on the respective lists will not match up perfectly, even if there were a clear relationship between density and congestion. For example, if a UA's ranking on the density list was #10, it is certainly plausible that the UA would rank at #9 or #12 on one of the congestion lists. If we suppose that there truly is a relationship and that any deviations are due to random noise, then a UA has at most a 50 percent chance of ranking higher on density than on any one of the congestion indicators; that is, ranking higher on density and ranking lower on density are equally likely. (In fact, the probability of ranking higher on density is less than 50 percent, since there is clearly a non-zero probability of the ranks matching exactly.) The probability of the UA ranking higher on

density than on all three of the congestion indicators, then, is the product of the individual probabilities, each of which is 0.5 (max). This product is 0.5 x 0.5 x 0.5 = 0.125, or one-eighth. Thus if there really were a demonstrable relationship between density and congestion, we would expect that minor, non-systematic variations would cause *at most* one out of every eight UAs to rank higher on the density list than on all three congestion indicators. The actual result of one out of three is considerably higher than one out of eight.

[23] The other two measures merely indicate the presence of congested conditions but offer only limited insight into how much of a nuisance these conditions represent to individual drivers. Annual hours of delay per person, however, is an unambiguous measure of the time penalties imposed by congestion. Consider that a dense, mixed-use land use pattern may create congested conditions but at the same time allow trips to be shorter, thereby minimizing the total amount of delay imposed. This appears to be the case in Portland – not particularly infamous for traffic – which ranks in the top 10 on both percent of daily travel in congestion and percent of freeway lane-miles congested in the peak period, but which fails to make even the top 20 on annual hours of delay per person. Annual hours of delay appears best to capture the frustration with which drivers view congestion.

[24] Any such municipal-level classification is inevitably an oversimplification, on account of the large geographic size of many townships in the less-developed parts of the state, not all of which are internally homogeneous. Any internal variations in density are impossible to capture in classifying at the municipal level.

[25] National Center for Transportation and Industrial Productivity / International Intermodal Transportation Center, New Jersey Institute of Technology, *Mobility and the Costs of Congestion in New Jersey: 2001 Update*, July 2001, available at http://www.njit.edu/publicinfo/publibrary/researchreports.php

[26] The Pinelands Comprehensive Management Plan can be viewed on the Pinelands Commission's website at http://www.state.nj.us/pinelands/cmp.htm#thecmp.

[27] The Pinelands towns are Buena, Egg Harbor City, Hammonton, Lakehurst, Tuckerton, Whiting, and Woodbine.

[28] Although the MLUL does not explicitly authorize *mandatory* clustering, the Rumson decision (Rumson Estates, Inc. v. Mayor & Council of the Borough of Fair Haven et al. 177 N.J. 338; 828 A.2d 317(2003) implies local authority to do so.

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New Jersey Future

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