The Environmental Impacts of Sprawl

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The next time you sit down to a breakfast plate brimming with pancakes and you reach for the pure maple syrup, think about sprawl. Hard to perceive, but there is a connection. When you admire the work of Frank Lloyd Wright, when you curse the sport-utility vehicle bearing down on you, when you wonder what to do about the dandelions in your lawn, when you think about the Exxon Valdez, and when you see a deer carcass on the side of the road, contemplate sprawl. There is a connection between sprawl and all of these things.

The problems of land use are not just problems for land. Land use is the key factor behind the remaining water and air quality issues we face. Air and water pollution originate from two kinds of sources. "Point" sources come from a limited number of easily identifiable places—often the end of a pipe discharging into a waterway or a smokestack spewing emissions into the air. "Nonpoint" sources are usually harder to find and control because small amounts of pollutants seep into the air and water from such sources as farm fields, lawns, construction sites, parking lots, roads, and the tailpipes of millions of vehicles. Pollution from point sources of air and water pollution has been dramatically reduced. The remaining problems are, to a greater extent than ever before, issues of nonpoint sources and these nonpoint sources are strongly related to land use. Auto and truck travel are a leading source of air pollution despite cleaner running engines; we are giving back some of our clean air...
benefits by driving more and we are driving more because of development patterns that demand it. Runoff from construction site erosion, chemicals used on sprawling suburban lawns, and gasoline and oil residue from parking lots and roads are leading causes of water pollution.

This chapter explores the role sprawl plays in energy consumption, climate change, land use, air and water pollution, and biological diversity. To a large extent, to determine the environmental impacts of sprawl we need to simply follow the cars.

Energy: The Valdez Sailed for Us

Auto and truck travel has exploded in the United States since World War II. That explosion is the key force behind the energy consumption, air quality impacts, and climate changes brought about by sprawl. It has also greatly contributed to the decline in water quality and biological diversity that we have experienced in recent decades. Auto travel has increased far beyond what simple population increases would predict. Vehicle miles traveled in the United States increased 140 percent between 1950 and 1990, while population rose 40 percent during the same period.

The United States, with not quite 5 percent of the world’s population, consumes one-third of its transportation energy (Benfield et al. 1999, 50; OTA 1994b). The environmental implications of this came crashing into our living rooms on March 24, 1989, when the Exxon Valdez rammed a reef in Alaska’s pristine Prince William Sound. Before it was over, 240,000 barrels of oil had spilled, the shoreline was covered in heavy crude, and images of dying wildlife filled national news casts (Yergin 1991, 785). Thousands of enraged Americans drove to rallies to denounce Exxon.

But simply blaming the callous corporate giant is too easy. Certainly, there is historical impetus in the oil industry to constantly expand markets and Exxon was found guilty of negligence. Still, it is right to ask why the giant tanker was in Prince William Sound that morning at all. To a large extent, American consumers put it there because American land use patterns demand more oil consumption every year.

Land: Broadacre Nightmare

In the early 1930s Frank Lloyd Wright predicted—and heartily endorsed—almost every major change in the American landscape that would take place over the next six decades. He understood how cars, which he loved with unbridled passion, would change our sense of space. He predicted—and applauded—the decline of cities, the advent of rural subdivisions and super highways, and even the coming of “Stop ‘n Go.” (Wright actually designed a convenience store–gas station in Minnesota.) His mistake was to believe that all of this would be wonderful, healthful, aesthetically pleasing, and morally and culturally uplifting. Wright’s idea of Utopia was “Broadacre City,” where every family would have at least one acre of property (Wright 1932).

Unfortunately, Frank Lloyd Wright’s vision of the future was all too clear and his prescriptions were followed all too carefully. The most ubiquitous form of modern American congestion is the suburban freeway. This congestion exists because we faithfully applied Wright’s prescription for what to do about congestion in the city. We built Wright’s dream of broad highways and broad-acre cities and his dream became our nightmare.

Certainly, we should expect that with a growing population some land will be consumed for development. The problem is that we are consuming far more land than simple population growth would predict. For example, between 1970 and 1990, the population of the Milwaukee metropolitan area increased by 3 percent while the amount of land it consumed for development went up 38 percent. That pattern is repeated in every major metropolitan area in America whether it is rapidly growing or shrinking. Over that same period in Los Angeles, the population expanded by 45 percent while land area growth increased by 300 percent. Cleveland lost 11 percent of its population, but picked up 33 percent in land consumed for development (Benfield et al. 1999, 7; Diamond and Noonan 1996).

It is sometimes argued that land consumption is not a problem, simply because there is so much of it. Frank Lloyd Wright himself made this argument, claiming that there were 57 acres for every person in America. That was in 1932, however, when there were 130 million Americans. In 1999, with 275 million Americans, there were 26 acres per person in the continental United States. That figure counts every acre of prime farmland as well as Yellowstone and Yosemite national parks, deserts and mountains, and every acre of protected park, habitat area, and green space in the nation.

The view that the American landscape is so vast that it does not demand any constraint on development does not take into account the
need for agricultural and recreational land and the need for open space in order to maintain natural systems, biological diversity, and even the American myth of "wilderness." Ironically, one of the key tenets of American folklore—the room to roam and to be independent—is being obliterated by that same desire to live apart. As more of us move out into the "wide open spaces," they become less wide open.

The simple consumption of more land is not the only problem. The way in which land is developed is also an issue. Virtually every new development since World War II has been designed for ease of auto travel. By strictly dividing land into vast "large-lot," single-family-home subdivisions connected to ever larger shopping malls and business "parks" by wide highways and streets, we have made driving mandatory in virtually every new development built in America in the last half of the 20th century. In fact, this development pattern means even short trips demand auto travel. One in four automobile trips is less than one mile in length (Benfield et al. 1999, 42; Oge 1995).

Americans drive much more than Europeans, but the reason is not just related to the greater spaces of the American countryside. In the United States, the pattern of development itself leads to more driving for even short distances. Both in the United States and in Europe, about 90 percent of all trips are less than 10 miles. Yet per capita vehicle miles driven in Europe are about 40 percent of those driven in the United States. The key difference is not so much that Americans have farther to go, but that they drive more frequently; Europeans tend to substitute walking, biking, or mass transit for these short trips (Nivola 1999, 18). Compact European development patterns make this possible.

In addition to the amount and the manner in which land is developed in America, another important factor is the locations where most development is taking place. There is an unfortunate coincidence between sprawling suburban areas and some of our best farmland. Many cities grew up precisely because of their proximity to good farmland. They were the interface between farmers and their markets. In addition, land that is good for farming is very often also good for development. Deep, well-drained soils and modest slopes are attractive for both farming and development (Buttel et al. 1994, 1).

According to the American Farmland Trust, counties with high levels of both prime farmland and development pressure account for 79 percent of our nation's fruit, 69 percent of our vegetables, 52 percent of our dairy products, and over one-fourth of our meats and grains. The Trust calculates that we are losing prime farmland at the rate of 46 acres per hour (Benfield et al. 1999, 65). As farms are pushed from these more productive soils by the sprawling suburbs being spun out from cities, agriculture demands more chemical inputs to increase its production per acre.

Climate: Sprawl and Maple Syrup

On a bright March morning a Wisconsin farmer tramps into his woodlot and drives a bit about an inch and a half into a mature maple tree. He withdraws the bit and inserts a spile (a small spout), hangs a bucket to catch the sap, and moves on to the next tree. After he has tapped about 15 trees, the farmer returns to the first to see how the sap is running, but barely a drop has oozed from the tree. The time-honored ritual of maple syrup production in Wisconsin is over.

This imaginary scene of a syrup-dry future may come to pass if global warming continues at its present pace. Maple syrup depends on cold because sugar maple trees need sustained winter temperatures below 40 degrees Fahrenheit to survive. A report by the Office of Technology Assessment (1994a) predicts that, because of global warming, maple syrup production will end in the entire continental United States except for the very northern tip of Maine. Under this scenario, Wisconsin's climate and the species of plants and animals dependent on it will shift to one not unlike present-day Kansas. Cool northern forests will give way to dry prairie and oak savanna.

Already, scientists at Aldo Leopold's farm in south central Wisconsin, repeating observations he made over 50 years ago, are finding that spring is arriving about one week earlier now than it did then. For some species, the season has advanced even more rapidly. When Leopold walked his farm in the 1930s, Canada geese returned each year around March 22. For the last 20 years, the average return date has been February 28 (Lavendel 1999).

There is no question that the earth's climate is getting warmer. The earth's mean surface air temperature has increased 0.5 to 1.1 degrees Fahrenheit in the last 100 years, and the National Oceanic and Atmospheric Administration reports that the 20th century was the warmest in history (Warrick 1998). While there has been disagreement in the scientific community about the causes of that warming, a strong consensus is rapidly developing toward the point of view that most of this warming is human caused. The Intergovernmental Panel on Climate Change (IPCC), an organization of thousands of scientists from 120 nations that assesses the peer-reviewed climate change literature, has reached this conclusion.
The primary culprit is carbon dioxide, which is produced when fossil fuels are burned for industry and for transportation. Carbon dioxide (CO₂) traps solar heat at the earth's surface. Levels of carbon dioxide in the atmosphere have increased from 280 particles per million (ppm) in 1850 to 370 ppm today and they are expected to double over the next century (Fauber and Vandenbrooke 2000).

Transportation accounts for one-third of all the greenhouse gases produced in the United States and the contribution from the transportation sector is growing faster than the others. The average car burns 550 gallons of gasoline per year and produces 8,800 pounds of carbon dioxide. Light trucks (sport-utility vehicles and minivans) burn about twice as much gas and produce twice as much carbon dioxide. Light truck sales now account for about half of all vehicle sales. Indeed, the greenhouse gas emissions produced by cars and light trucks are projected to leap by 55 percent over the next 10 years if current trends in increased travel and vehicle preference continue (Benfield et al. 1999, 48–51; Office of Air Quality Planning 1998; Oge 1995; Office of Mobile Sources 1993; National Vehicle and Fuel Emissions Laboratory 1995).

The U.S. responsibility for the greenhouse gases suspected in global warming is far out of proportion to other nations. Of all the mobile sources of greenhouse gases in the world, the United States, with not even 5 percent of the world's population, contributes 34 percent of the pollutants (Benfield et al. 1999, 50–52; IPCC 1995). This is due in part to U.S. land use patterns. Even New York City has a population density only one-third that of Frankfurt and one-fifth that of Tokyo (Nivola 1999:4). In addition, suburban Denver residents, in turn, now consume gas at a rate 12 times greater than the citizens of Manhattan (Benfield et al. 1999, 60) because of the spread-out development pattern there.

So the chain is very real. Sprawling land use patterns in the United States require more driving. This leads to the production of more greenhouse gases that fuel global warming, which in turn leads to changes in our very landscape and even to the culture that is shaped by it.

**Air: Squandering the Gains**

Air quality in the United States has improved in the last three decades, but this improvement has been in spite of and not because of our land use patterns. Lead in our air is down 97 percent since 1977, carbon monoxide is down 61 percent, and smog has been reduced by 30 percent. (Improvements are notably absent for carbon dioxide, the leading greenhouse gas.) These gains are largely due to government-mandated improvements in vehicle emissions and from improvements in point sources such as utilities and industry (Benfield et al. 1999, 48; Oge 1995). These gains would have been even greater, however, if we had held increases in vehicle miles traveled to the rate of increase in the driving population.

Today's cars produce 70 percent less nitrogen oxides and 80 to 90 percent less hydrocarbons than 1960s models. While each car was becoming cleaner, however, the number of cars and the number of vehicle miles driven was skyrocketing. Between 1969 and 1990, the U.S. population increased by 21 percent, but the number of miles driven per capita went up 72 percent (Benfield et al. 1999, 51). As a result, the U.S. Department of Energy predicts that U.S. carbon emissions will grow at an average rate of 1 percent per year, with transportation sources growing 20 percent faster than the average. The U.S. Environmental Protection Agency (EPA) has found that total hydrocarbon emissions could reverse their decline and start to edge up again in the next several years because of increased driving. Total nitrogen oxide emissions from vehicles are already at higher levels then they were 20 years ago, even with the much cleaner burning engines in each vehicle. Ozone and particulate pollution are also both projected to rise (Benfield et al. 1999, 58; Office of Mobile Sources 1993).

We are starting to give back air quality gains because sprawling development patterns demand more driving. Table 2.1 compares the land and air impacts of development at densities of one lot per five acres (a typical rural subdivision in Wisconsin), one lot per one acre (Frank Lloyd Wright's "broadacre city"), eight lots per acre (a typical suburban neighborhood built in the early part of the 20th century), and 50 units per acre (an urban development by Wisconsin standards, but trivial compared with New York City). The table projects the impacts if all 400,000 new housing units projected to be built in Wisconsin over the next 20 years were built at each density. It demonstrates that development at the density of even the relatively leafy suburban neighborhoods of 80 to 100 years ago would have half the air quality impact and only 2.5 percent of the land consumption of the five-acre-lot scenario. One important aspect of these early suburbs was that they were often referred to as "streetcar suburbs," meaning that they were built at densities that were
The environmental impacts of sprawl.

Ozone is also a problem for plant life. For example, studies suggest that white pines in southeast Wisconsin, a "severe non-attainment area" under the Federal Clean Air Act, are experiencing signs of stress related to pollution. The air quality problem here is the result of high levels of ground level ozone, which are caused in large part by automobile use that is demanded by the sprawling Milwaukee and Chicago suburbs—a typical situation for most major metropolitan areas in the United States. Ozone damages vegetation by attacking the coating of a leaf, decreasing its productive qualities. According to a University of Wisconsin Extension study: "Ozone can also damage the guard cells, which control the opening and closing of stomates. This reduces the ability of the guard cells to close the stomates and keep air pollutants from entering a plant through the surfaces of its leaves. When atmospheric pollutants enter leaves and damage plant tissues, plants can lose nutrients that are vital to their growth and maintenance." (Morton, Johnson, and May 1997, 1). The study notes that exposure to ozone concentrations of 16 ppm or greater over a short period of time can visibly injure most plant species. Every summer, ozone levels in southeast Wisconsin exceed this level. Indeed, a study in Maryland found that ozone damage to crops amounted to a $40-million-per-year problem (Benfield et al. 1999, 56; Office of Mobile Sources 1993).

Some hope that new technological advances will make up for the dramatic increases in vehicle miles driven. For example, in late 1999, Honda introduced the Insight, a small car that features an electric motor combined with a three-cylinder gasoline engine. The gas engine can be smaller and lighter because the electric motor supplies additional power

Table 2.1 Projected Environmental Impact of 400,000 New Housing Units

<table>
<thead>
<tr>
<th>Density (acres/county)</th>
<th>Land Use (in thousands of acres)</th>
<th>VMT (in thousands)</th>
<th>Fuel Use (in thousands of gallons)</th>
<th>Emissions (in thousands of tons per year)</th>
<th>Carbon Monoxide (CO)</th>
<th>Nitrogen Oxides (NOx)</th>
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Source: Extrapolated from projections of VMT based on housing density in research done by John Holscaw (1999) and from pollution figures cited by Benfield et al. (1999).

Notes: VMT = vehicle miles traveled per year; CO = carbon monoxide; NOx = nitrogen oxides; CO2 = carbon dioxide; and VOC = volatile organic compounds.

Air pollution has implications for human health. Carbon monoxide is linked to reduced work capacity and manual dexterity, poor learning ability, and difficulty in performing complex tasks. Nitrogen oxides and volatile organic compounds are precursors to ozone, which poses health risks to the elderly, the young, and to persons with respiratory problems. It damages lung tissue, aggravates asthma, and induces coughing, choking, and stinging eyes (Benfield et al. 1999, 56–58; Office of Air and Radiation 1995; Office of Mobile Sources 1993). Even healthy people are advised to refrain from strenuous outdoor exercise during times of high ground level concentrations of ozone.
when needed. Meanwhile, the electric batteries never need recharging because the motor acts as a generator when the car is decelerating. Honda combined this technology with the latest in lightweight construction to achieve EPA mileage ratings of 61 miles per gallon in the city and 70 miles per gallon on the highway. The Insight meets California’s ultra low emission vehicle standard, which is driving the industry toward greater fuel efficiency. Still, even Honda only claims improvements for emissions that cause smog, but not greenhouse gases (Honda 2000).

Moreover, fuel efficiency that brings lower operating costs is likely to simply result in still more driving. One expert, the Brookings Institute’s Pietro Nivola, asserts that only higher gas prices will result in less energy consumption (Gilbert 2000).

Water: Missing the Point

Much like air pollution, great progress has been made in the United States over the last three decades in cleaning up “point sources” of water pollution. Point sources are pollutants that come from a single source, often the end of a pipe discharging into a waterway. Examples include municipal sewage treatment plants and industries like paper making. The remaining water quality problems we face largely originate from “nonpoint” sources or places like farm fields, lawns, roads, parking lots, and construction sites. Nonpoint or runoff pollution is now the leading cause of water pollution in America, impacting 40 percent of the nation’s surveyed waterways (Benfield et al. 1999, 80; Arnold and Gibbons 1996).

Studies indicate that negative impacts result when impervious surfaces like roads, parking lots, and rooftops exceed 10 percent of the area inside a watershed. The problem is amplified if the makeup of the impervious surface is more transportation related (roads, parking lots, and driveways) than it is rooftops. This is because transportation-related surfaces often contain oil, grit, and road salt and are usually interconnected, allowing pollutants to accumulate and flow down into streams and lakes.

The attempt to solve the problem of water pollution caused by transportation-related hard surfaces through the use of large lot sizes only makes the ultimate problem even worse. In fact, large-lot developments have been estimated to deliver up to three times more sediment than traditional, dense urban developments (Benfield et al. 1999, 84; South Carolina Coastal Conservation League 1995). The better solution is probably to direct more intense development to already highly developed watersheds and away from those that are sparsely developed. A watershed that has a high percentage of impermeable surfaces is not likely to be further degraded by more development, but one that is hovering around 10 percent impermeable surface can be saved if development that would have happened there is instead redirected to an already degraded watershed.

There is at least one positive water quantity impact of sprawl: if development occurs on private septic systems, then groundwater levels remain relatively stable. In some large municipal water systems, water is drawn from high-capacity wells, used, and then sent to municipal sewage treatment plants where it is treated and discharged to a river or stream flowing out of the watershed. As a result, groundwater is drawn down, which can reduce springs, stream flows, and surface water levels. This, in turn, can harm species like trout, which depend on cool, rapidly moving streams. Sprawling rural developments on private septic systems return the effluent to the same groundwater table and watershed. As a result, they provide a closed system and therefore there is no net loss of groundwater or reduction in surface water flow rates and levels (Hall 1998).

These closed systems are far from perfect, however. Because they do not treat nitrates, private septic systems, when they are concentrated in close proximity, contribute to significant increases in nitrate levels in drinking water. Moreover, their land use impacts can be substantial. For example, the proposed introduction of new system types in Wisconsin is predicted to increase development pressure on nine million acres (25 percent of the Wisconsin landscape) because thin soils and steep slopes, which restrict the use of conventional systems, are not barriers to the new technology (Wisconsin Department of Commerce 1997, 81).

Biodiversity: Deer and Development

The diversity of plant and animal species on earth is declining at a rapid rate as habitat is destroyed and as certain species become overrun by a few dominant species. Very often these species are not native to the area and so they lack natural predators. Sprawl plays a role in the loss of biological diversity.
The rising deer population is not just a problem for suburban commuters. It is also a problem for biological diversity because deer have a voracious appetite for trees, shrubs, and herbaceous plants. Deer have been described as a "keystone species" because heavy browsing by dense deer populations reduce not just the diversity of plants, but also the diversity of mammals that depend on them. Studies indicate that some bird species disappear in areas of high deer concentrations (Waller and Alverson 1997).

Another example of the role sprawl plays in the reduction of biodiversity is the loss of habitat for neotropical migrant songbirds. These birds, such as warblers, winter in Central America and pass through the Midwest on their way to and from Canada. An important stopover point is the Baraboo Hills, a block of relatively untouched deciduous forest in south central Wisconsin, not far from Aldo Leopold's farm. As suburban sprawl creeps up from Madison, about 30 miles south, the relatively untouched forest is becoming fragmented with homes, roads, and power lines. This fragmentation creates points of entry for non-native species of plants like buckthorn and honeysuckle, which choke off native plants and trees. In addition, they help introduce predators like house cats, which account for an alarming number of songbird kills. Perhaps 39 million birds are killed by cats in Wisconsin each year (Coleman et al. 1997).

Finally, our problems circle back on themselves. As mentioned at the start of this chapter, to take the measure of environmental problems caused by sprawl, we need to follow the cars. The dramatic increase in driving caused by our sprawling, auto-dependent development patterns force the exploration for oil into increasingly environmentally sensitive areas. The attack on biological diversity in Prince William Sound caused by the Valdez can be traced back to our need for gasoline to power the vehicles that we must drive to get around the places we have built thousands of miles away. The Valdez sailed for us.

The Environmentally Good City

Cities are the antidote to the problems of sprawl. Their benefits are described in Milwaukee Mayor John Norquist's book, The Wealth of Cities, where he writes:

Cities are, on balance, good for the environment. New Yorkers pollute far less, on average, than their suburban neighbors. More gasoline is needed to support the auto-dependent lifestyle; more electricity must be generated to heat and cool the large, stand-alone homes; more resources must be used to provide roads, pipes,
and utility lines to the scattered sites; more energy must be consumed to supply water and return sewage from homes farther and farther away from municipal plants; more trucks must use more gas to move products farther and farther; more chemicals are applied to control weeds on larger and larger lawns and more water to keep those lawns green; and, most important, more land must be cleared and leveled to accommodate the same amount of living. (Norequist 1998, 139)

The policy answers to sprawl are numerous and complex, but few of them are possible in a practical political sense until we resolve the fundamental confusion that predominates popular discussion—and even discussion among sophisticated environmental activists—about sprawl, cities, and the environment. Polls show that Americans oppose two things—sprawl and greater density. A recent survey by the Pew Center for Civic Journalism found that sprawl came out at the top of an open-ended question about the most important issues facing Americans in their own communities (Greenberg 2000). A survey of Wisconsin residents found, however, that while 34 percent believed that most development should take place in Wisconsin's largest cities, only 6 percent wanted to live there themselves. Meanwhile, a national survey found that 77 percent of Americans would oppose building even single-family homes at higher densities in their neighborhoods (Gould 2000; National Association of Home Builders 1999).

In other words, we oppose only the affliction and the cure. We will not solve the problems of sprawl until we resolve this contradiction and we learn to embrace city life—living in places of real, compact urban form with all of their advantages as well as disadvantages—as the most positive environmental choice an individual can make.

REFERENCES


Sprawl, Concentration of Poverty, and Urban Inequality

Paul A. Jargowsky

Two trends dominated the evolution of metropolitan areas in the second half of the 20th century. First, at least until the recent economic boom, the majority of the central cities of major U.S. metropolitan areas were in a decades-long period of decline relative to the suburbs. Second, metropolitan areas simultaneously experienced rapid development in their outer suburban rings. These two central facts, in themselves, are uncontroversial. Nevertheless, there is a lively debate about the causes of these trends and about their social and economic significance. Some argue that the recent suburban explosion is simply a manifestation of growth, rising incomes, and a general preference for suburban living. Others argue that growth is out of control and results from foolish government policies and perverse incentives to local governments, developers, and homeowners.

Disagreement also persists about the causal ordering of these two central facts. Did the decline of the central cities inspire suburban sprawl by giving the middle class ample reason to flee the frightening poverty and social disorder of the inner city? Or did suburban sprawl erode the tax base and siphon off middle-class families and institutions, thereby destabilizing central-city neighborhoods and causing their decline? The ultimate significance of the pattern of suburban growth and central-city decline for poverty and inequality is poorly understood and subsequently underweighted in policy debates about metropolitan development.
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