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The Center of the American West at the University of Colorado strives to bring together, for meaningful conversation and interaction, people as diverse as the American West itself. With the participation of ecologists and engineers, poets, professors and policymakers, students and scientists, musicians and lawyers, foresters, filmmakers, and physicians, the Center’s events have become a model of interdisciplinary debate. Issues long held to be black and white reveal their nuanced shades of gray when examined from these multiple perspectives. Minds change, information is exchanged, and conversations begin. To understand the region, we believe that the exploration of the minds of its residents is as important as the inquiry into the workings of its cultures and ecosystems.

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Enterprising and inclusive in its embrace of a wide range of disciplines and strategies of communication, the Center strives to illuminate the challenges and opportunities facing this complicated geographic and cultural area. Ultimately, we want to help citizens of the West become agents of sustainability—citizens who recognize that their actions determine the region's future and who find satisfaction and purpose in that recognition.

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Western Futures

A Look into the Patterns of Land Use and Future Development in the American West

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Introduction

The American West is the fastest-growing region of the country, but it is also a place endowed with great open spaces that offer important ecological and social values. This juxtaposition, and the region’s rapidly changing land use patterns, attract a lot of interest and evoke a lot of emotion. Residential and commercial development is spreading across the landscape. The region is home not only to some of the most sprawling cities in the country, but to a more dispersed “exurban” pattern of low density development in rural areas, especially near charismatic landscapes like national parks. Westerners watch these changes and grieve over lost open space while simultaneously appreciating the benefits of economic and population growth, and the land development, expanded services, and property value appreciation that naturally follows.

Western growth has boomed and slowed through history, but the landscape effects of growth are cumulative. Economic prosperity may advance and retreat, but its physical edifices hold their ground. Each developed acre is subtracted from the fount of open lands that have long marked this region as a special place and have allowed the West to maintain much of its natural endowment of biodiversity. Because development is carved predominately out of lands used for agriculture, it also inevitably reflects a reduction of the agrarian and pastoral economy and culture that once formed the core of Western rural society. Letters to the editors of newspapers in Boise, Phoenix, and Denver, and even in rural valleys like the Bitterroot and Payette, speak to a sense that development is spreading too fast, consuming the view, habitat, and sense of community that Westerners have valued for so long. Of course, many of us who complain about growth and land development are ourselves part of the problem. We gravitate to the edge of the suburbs, attracted by views of the mountains and cheap land, or we take the next step and build our homes out in the exurbs—out in the so-called wildland-urban interface where people and nature coexist uncomfortably.

A few key facts of western land use are important. First, half the land between the front ranges of the Rockies and the Pacific coast is federally owned, and not subject to residential or commercial development (it may have gas wells, roads, lodges, and clear-cuts, but it won’t have shopping malls or cookie-cutter subdivisions). And much of the West’s private land is not likely to be developed in the foreseeable future—it is too dry or too remote. But there’s reason to believe that a lot more development is coming. The West has grown faster than the country as a whole for much of the last century, and is likely to outpace national growth for the foreseeable future. The “New West” is increasingly attractive to migrants and to investors. Western land owners will certainly continue to respond to market forces, and to their own preferences, by transforming lower value land uses, like agriculture, into more financially-rewarding options like subdivisions and shopping malls. Finally, Westerners will continue to buy homes in suburbs distant from city centers and to build second homes in the forests and on ridge tops. They will demand highways, water systems, and other utilities. They will also continue to complain about the sprawl, traffic, interrupted views, and lost sense of community that growth brings.

Over the last decade, Westerners have witnessed remarkable change, have watched whole mountainsides develop, and found their commutes lengthening. But we all still find it hard to imagine what the land will look like in twenty, thirty, or forty years, when the region’s population is likely to have grown by 50 percent or more again. So we at the Center of the American West set out to project land use patterns so that Westerners might take a look at their region’s future. These are just projections, not exact predictions. Many unpredictable events and forces will make the future turn out differently than our maps suggest. Still, we are confident that in general we have captured the broad patterns of likely future development in the West.

Our Projections

Our model for projecting land development has its virtues, but like much of the growth in the West it is not very smart. It assumes that all private land that is technically buildable in the West is on the real estate market. It does not know that some owners have placed conservation easements on their land, nor that many ranchers and farmers are not interested in selling, even if the price is right. And it does not know where state or local governments have enacted effective growth limits. Still, very little private land is permanently protected from development, and very few effective growth limits exist in the West. Outside of Oregon, no state has statewide growth limits strong enough, in our view, to significantly affect large-scale development patterns. Local communities with land use regulations backed by effective incentives or disincentives are sufficiently rare that they are repeatedly cited as case studies (e.g., open space programs in Boulder, Colorado, or Davis, California) of either effective growth management or, according to their critics, of ill-conceived interventions in the land market. Most land development in the West thus stems from a mixture of market forces and individual preferences, often aided by government investments in highways and other infrastructure. The model simply spreads development out across the landscape based on population growth (which drives demand for land and development). It calculates only residential development, which we offer as a surrogate for all that comes with it, including infrastructure and commercial land uses.
You can read more about the technical details of the model in the appendix at www.centerwest.org/futures. But, briefly: the model's database includes population and housing counts by census tracts for 1960, 1970, 1980, 1990, and 2000. It uses these empirical data points to "learn" how development, expressed in housing density, spreads with population growth. In this way the model is somewhat smart because if, indeed, a mix of preferences and growth policies have shaped the pattern of land use, then the model will "see" that in the actual data and extrapolate that process into the future. Next, we feed it population projections. Most states have some type of population projection, calculated for one or two decades into the future by a state demographer or university research center. Wherever we could find such "official" estimates, we used them. We then extended the projected population for all counties in the West out to the year 2040, distant territory into which most state demographers did not tread. We did this by simply adding increments (not rates) of population equal to the increment of the last official time-step. Thus, for example, if Nevada had projections to 2020, we then took their projected growth for 2020–2040, and added that increment again in 2020–2040 and again for 2040–2040. This method yielded, we believe, conservative projections that are not unreasonably skewed by extremely high rates of growth that occurred in many parts of the West during the 1990s.

Population is translated into housing units (maintaining the historical mix of single and multi-family housing), and housing density is then allocated across the landscape according to geographical rules in the model. Those geographical rules mostly reflect a simple logic: new growth spreads out from the vicinity of existing development. But we try also to recognize that development can spread faster in some areas, so, for example, we spread growth out faster along highways.

The result is a scenario of the future in map form. These maps are not destiny: parts of the West will grow in different ways than we project, some might sprawl more. Others might rein in growth or be visited by economic and social conditions that slow it down. And the mapping is limited by our inability to know all of the many types of ownership patterns that exist. For example, while we can reasonably predict that federal lands will not be developed, we have few insights into how development will play out on the large tribal lands in the West. We also cannot predict government actions and investments that create new development opportunities: new highways, airports, or water projects. And, of course, we can't predict the Western economy, next year or forty years from now. But we believe that the West will continue to grow relatively rapidly, as it has for a century.

We believe that these maps offer a credible vision of the future, one that can be used to anticipate the effects of growth and land use, and, we hope, a view that helps Westerners think about, and reach out and change (if they are so moved), the future.

**Patterns and Rates of Development**

Our projections add 39.5 million people to the West by 2040, a 65 percent increase over the 2000 census number. California absorbs the largest number of new Westerners, but Nevada, Arizona, Washington, and Colorado grow at the fastest rate in the near-term. Table 1 compares population growth to the rate of spread of land development for each twenty-year period during 1960–2000 (actual data) and 2000–2040 (projected). Due to its low density, exurban land development tends to grow faster than population overall, meeting a simple definition of sprawl (development spreading faster than population growth). Nevada stands out because its land devoted to residential uses expands at about the rate of population growth.

The view of all eleven western states (Figure 1) reveals a few realities about regional growth patterns. First, much of the land is not open to residential or commercial development (white areas on the maps). At this scale the West seems to retain its wide-open landscape even in 2040. The region hosts large swaths of public lands (white) that will not be developed, and extensive tracts of private lands that will remain always rural (green). Many of the West's sprawling metro areas will eventually be constrained by public lands. They are situated in private land islands or archipelagos (shown in green while they're still at rural densities), which become filled with development over time. This is illustrated by the Phoenix area (shown in more detail on page 13). A swath of green in 1960 and 2000 reflected the undeveloped private lands around Phoenix. But most of that area shifts to higher densities by 2040 in our projections. The southern California conurbation runs into its public lands boundaries along the Santa Monica and Tehachapi mountains, so growth jumps out into the eastern deserts and up into the Central Valley. Public lands appear to put real constraints on sprawl around Las Vegas, the fastest-growing large city in the country from 1990 to 2000. Elsewhere in Nevada, though, the Reno area has more room to spread out.

Oregon is a special case of development geography: it has a long-standing, legislated commitment to growth management via urban growth boundaries, which our model does not take into account. So we only give the historical data for Oregon in Table 1, which indicates that land developed about as fast as population grew over the last four decades.

The maps also indicate why Montana's exurban area grows so much faster than its population: its small cities barely expand, but areas of low density development spread into several of the open valleys in the western part of the state.

Two features stand out on the Pacific Coast. First, California's Central Valley becomes an important growth pole (on page 8 we take a closer look at the Sierra Nevada foothills), and the Puget Sound conurbation grows to fill essentially all of the buildable land in the region by 2040 (at least at low densities; see page 10 for a closer look).

In some parts of the West the land available for development lies mostly in valley bottoms, bordered by public lands on the higher slopes. Though rather inconspicuous
on maps at this scale, the pattern especially occurs in
mountain areas of the West. A good example is visible in
western Montana: the Bitterroot Valley is becoming a sub-
urban and exurban extension of Missoula.

Depending on your point of view, our 2040 scenario
can be seen as offering either positive or negative futures.
The public lands figure prominently as a reserve of open
space that Westerners will come increasingly to value as the
buildable lands develop. But several areas face projected
growth that is sure to cause contention. Phoenix continues
to sprawl across the desert; cities along Colorado’s Front
Range merge into one another and send exurban sprawl
into the nearby mountains; and development in California’s
Great Central Valley, so rich in productive farm land,
expands to dominate the landscape.

A few places step into the land-use limelight:
Spokane spreads out, and towns in Idaho’s Upper Snake
River Valley grow and begin to merge, as do several small
towns on the west side of Washington’s Cascade Range.
On the eastern border of our maps, though, a huge
swath of the Great Plains in eastern Montana,
Wyoming, Colorado, and New Mexico that is mostly
private land stays green (rural) even in 2040. Population
growth and spreading development concentrates in the
mountain, desert, and coastal parts of the West, while
avoiding the Great Plains.

In the following pages we take a closer look at
selected parts of the West.

**Overview of the West**

At this scale, the West is dominated by undeveloped
rural land, both private (green) and public (white). The
private open lands concentrate in a swath along the east-
ern edge of the maps—out on the Great Plains—in the in-
terior Columbia Basin, on Indian Reservations in New
Mexico and Arizona, and within the fertile valleys along
the West Coast. Much of this rural land hosts houses,
rural land hosts houses, roads, fences, crops, and other developments that you
would notice through the car windshield, but such signs
of human use still fall into our rural category. Public
lands dominate the Intermountain West, especially the
Great Basin in Nevada and Utah.

Actual census data show development spreading be-
tween 1960 and 2000, especially along the Pacific Rim. In
our projection for 2040, development stands out as a big
swath paralleling the West Coast, and the footprints of

**FIGURE 1: (pages 4–5)**

Actual and projected
housing densities for the 11
Western states.
the larger interior cities like Phoenix, Denver, and Salt Lake City, which blossom into significant urban sprawls. Rural valleys across the mountain West, for example in western Colorado, exhibit marked exurbanization by 2040. You can see these maps in motion at www.centerwest.org/futures.

A few caveats: Our maps are just one way to look at Western development, but we hope they generate more searching discussions about how citizens want the region to evolve. Any projection is uncertain, and even the empirical data for 1960 and 2000 required some manipulation to reflect housing density (as described in the appendix at the end of this report and at www.centerwest.org/futures). Our maps do not reflect private land conservation or open space owned by local governments (most such parcels are too small to show up at this scale). Finally, many development features that affect wildlife habitat and other land values, like highways, military operations areas, industrial complexes, and mines, are not reflected by maps of housing density, so the total footprint of development is larger than we depict here.
Colorado Front Range

At the foot of the Rockies, where the mountains meet the plains in Colorado, lies an urban swath anchored by Pueblo on the south and Fort Collins on the north. The urban corridor is paralleled by an exurban zone in the foothills, a place made famous in recent years by several large wildfires. Our view of the region includes most or all of Denver, Boulder, Gilpin, Jefferson, Douglas, and Teller counties; the western portions of Weld, Adams, Arapahoe, Elbert, and El Paso counties; and the eastern portions of Larimer, Fremont, Park, and Clear Creek counties. The population of the area in 2000 was roughly 3.4 million. The larger cities include Denver, Colorado Springs, and Fort Collins, with populations of 554,636, 380,890, and 118,662 respectively.

The corridor is aligned along the north-south axis of I-25, and the spreading footprint of suburban cities around Denver is shaped by a new ring-road (470). We do not try to project road construction, but surely there will be more highways by 2040, the location of which could enhance the spread of development.

The 2000 map shows rural areas still separating some of the cities, between, for example, Denver and Colorado Springs, and Greeley and Loveland-Fort Collins. By 2040 some rural (green) areas still pinch in the corridor north of Colorado Springs, but the triangle formed by Greeley, Fort Collins, and Loveland fills in completely at exurban and suburban densities. Indeed, growth is so strong in the northern part of this metropolitan corridor that it spills out into less desirable, but cheaper, Great Plains localities east of the corridor.

Given a limited amount of private land for development in the foothills to the west, the model bumps several foothill areas to at least low-density suburban development, especially west and southwest of Denver, along I-70 and U.S. 285 (which recently has been expanded). We certainly cannot predict whether the exurban neighborhoods in this area will actually in-fill to suburban density, and in many cases we think they won’t. But unless more people are repelled by the wildfire hazard, foothills living (within sight of, and easy access to, a major city) would seem likely to remain attractive to home buyers and builders.

This close-up view also reveals some of the weaknesses of the model. We know, because we live there, that Boulder city and county have purchased an open space buffer around the town of Boulder. The model does not know this and wants to fill in those land units with development. It happens that Boulder’s open space program is one of the few local land acquisition efforts in the entire West large enough to actually affect the patterns we project. Another interesting feature of the Colorado Front Range maps is the persistence of rural areas between Pueblo and Colorado Springs. Much of this land has been in the hands of a few large ranches for decades, and Pueblo’s population has grown much more slowly than the other Front Range cities, so the model has empirical reasons to allocate less density to that rural swath. The biggest development action over the next few decades looks to be between Denver and Fort Collins. Whether the northern edge of this might creep up the highlands that slope up to Cheyenne, Wyoming, and the Laramie Range is anyone’s guess.
FIGURE 2. Actual and projected housing densities for the Colorado Front Range.
Sierra Nevada Region

The spread of urban development up and down the centerline of California’s Central Valley is not surprising and has been predicted by several land use models. But it is more difficult to assess what is happening and will happen in the Sierra Nevada foothill zone, which may well be the premier case of exubria in the West. University of California landscape architect Timothy Duane wrote about the exurbanization of this area in his book, Shaping the Sierra (University of California Press, 1998). The foothill zone is difficult to define, but in general the elevation ranges from about 1,000 to 3,000 feet, bordered by the valley-bottom farmlands and, at the top, by national forests and other public lands. Our look focuses on the foothills region that stretches from Plumas County in the north down to Fresno County in the south, and encompasses large portions of more than fourteen counties (Figure 3). This was traditionally “cattle country,” and has been since the first Spanish settlers and the gold rush, when large numbers of sheep and cows were grazed in the foothill zone to feed and clothe the miners. This land tenure evolved into relatively large spreads that were a combination of farm/ranch/timber properties.

The foothill region has a population of some 950,000 (2000 census), and covers approximately 24,048 square miles of Butte, Plumas, Yuba, Sierra, Nevada, Placer, El Dorado, Amador, Calaveras, Alpine, Tuolumne, Mariposa, Merced, and Fresno counties (because large portions of these counties are federally owned public lands, the populated area is much smaller). This area includes only a few larger towns like Placerville, but hosts dozens of smaller settlements like Mariposa, Murphys, Three Rivers, and Porterville, some of which are growing into suburban towns in their own right.

The 2000 map, based on actual census data, already shows the exurbanization of the Grass Valley/Nevada City areas. Over the next four decades this merges into a large swath of suburban and exurban foothills from the towns along U.S. Highway 50 (e.g., Placerville and Pines) north to the Lake Oroville vicinity. Other splotches of suburban and exurban development emerge around the Oakhurst and Mariposa areas.

The model concentrates future development along roads, and those leading into the foothills thus anchor new growth. This process creates a few areas that remain less developed even into the middle of the century, such as the foothills above Lake McClure. This is just a scenario, not a prediction, but the remaining green areas on the 2040 map obviously represent landscape pockets where agriculture and wildlife might hold out.
FIGURE 3. Actual and projected housing densities for the Sierra Nevada region.
Puget Sound Region

Built on shipping and the harvesting of salmon, fir, and timber, the Puget Sound region, anchored by Seattle, experienced a technology boom during and after World War II, as the Boeing Aircraft Corporation expanded its operations there, and more recently as computer software (e.g., Microsoft) and dot-com companies (e.g., Amazon) made it their home.

We focus on a swath from near Centralia on I-5 south of Olympia north to Mt. Vernon and Burlington on the Skagit River (Figure 4). We include almost all of Kitsap, Island, Pierce, and Thurston counties in this view as well as western portions of Skagit, Snohomish, King, and the eastern portions of Mason, Jefferson, and Clallam counties. Population for this region is roughly 3.8 million (2000 census). The elevation ranges from sea level to 14,392 feet at the summit of Mount Rainier. Cities range from populations of 563,374 in Seattle and 197,553 in Tacoma, to mid-sized towns like Bainbridge Island (20,308) and Bremerton (26,232), as well as small towns like the Victorian coastal towns of Port Townsend and Poulsbo (a.k.a. Little Scandinavia) which both have fewer than 10,000 year-round residents. There is significant private forest land in this view, some of it owned by corporations and some by individuals.

The area was already a significant urban swath in 1960, but it also featured extensive private timberlands. These rural landscapes still exist east of Seattle-Tacoma, and on the southern fringes of our view, though subdivision of many forest tracts is underway. Growth from 1960 to 2000 occurred pretty much in all directions from Seattle-Tacoma, including the west side of the sound, around Bremerton and Port Orchard and in suburbs and exurbs north of Tacoma served by the Tacoma Narrows Bridge. In 2000 the trans-Cascade roads like I-90, U.S. 2 and State Highway 20 show up as linear suburban salients into the foothills of the Cascades.

The 2040 scenario is an eye-opener, and many residents of the region will either deny that it could happen as mapped, or will hope dearly that it does not come about. By 2040 most of the private rural land in our window is built at least at lower suburban densities, and new urbanizations emerge east of the I-5 corridor as towns like Redmond and Snohomish are articulated into the urban footprint.
FIGURE 4. Actual and projected housing densities for the Puget Sound region.
Southeastern Arizona

The deserts of southeastern Arizona host the largest city in the interior West (Phoenix, at 1,321,045 inhabitants in 2000) and its smaller partner to the southeast (Tucson with 486,699 residents). Both are growing and spreading fast, and three Phoenix area suburbs ranked among the ten fastest-growing cities in the United States from 2000 to 2002: Gilbert came in first, Chandler placed fourth, and Peoria came in fifth.\(^2\)

We focus on a large region in the southeast corner of Arizona that stretches from Sun City in the northeast down to Douglas on the U.S./Mexican border. This encompasses all of Pinal, Graham, Cochise, and Santa Cruz counties as well as most of Maricopa, Gila, and Pima counties, and the southernmost portions of Apache and Navajo counties.

To some, Phoenix is the exemplar of sprawl. But sprawl is difficult to measure in a way that allows comparisons among cities; some analysts would say that Atlanta and other eastern cities sprawl more than their western counterparts, presumably an effect of public lands that hem in some western cities. And a recent study showed that Phoenix has remained quite dense even as it grew.\(^3\) Still, at this writing (in 2004) Phoenix was sending out amoeba-like appendages in several directions simultaneously. The widely touted planned community of Anthem was developed in the late 1990s, 32 miles north of downtown. Other major residential and commercial developments extending the edge of suburban Phoenix include: Estrella Mountain Ranch, 33 miles to the southwest; various developments around Queen Creek, 36 miles southeast; and Douglas Ranch, a planned 83,000-home development, 45 miles to the east of downtown.\(^4\)

Arizona State University’s Morrison Institute for Public Policy calculated Phoenix’s urban area as 9,200 square miles in 1998; the city’s circumference was some 150 miles and the average new home was built 19–21 miles from the city center.\(^5\) What is probably the largest planned community in the Interior West, Douglas Ranch, is sited some 45 miles from downtown, causing a large bulge in the urban footprint across the Hassayampa River.

Our 2040 scenario shows Phoenix’s development footprint filling pretty much all of the available private land, at least at lower suburban densities. That growth has to find its way around a couple of major military bases (which are, themselves, threatened by encroachment), and the Gila River Indian Reservation, which is less likely to see major suburbanization.

Tucson also begins to fill the available private land by 2020, and it too impinges on tribal lands (the San Xavier Indian Reservation), which are not likely to exhibit suburban-density development. In 2000 Tucson was already pressed up against the Coronado National Forest to the north and east, so future growth tends to push south and west. Our scenario suggests a significant exurbanization or “ranchette-ization” of rural valleys outside Tucson (e.g., the Altar Valley) and south along the Santa Cruz River, an important riparian corridor.

Between Phoenix and Tucson the Casa Grande area, relatively inconspicuous in 2000, blossoms to fill the Santa Cruz Flats by 2040, while spilling down the Gila River.
FIGURE 5. Actual and projected housing densities for southeastern Arizona.
Conclusion: A “Business-As-Usual” Future?

The West will continue to grow faster than the nation as a whole for the foreseeable future. The region is attractive to people and to capital investment, especially in an economy where both are mobile and quality of life increasingly guides business and individual decisions about location. The economic and political forces behind the growth of recent decades are powerful, and most community leaders continue to see growth as success, and to view any decline of housing starts or jobs as somehow a “failure.”

Our projections offer a view of the future that we think of as “business-as-usual.” But will growth inevitably result in suburban and rural sprawl that eats up open space and wildlife habitat and blurs sense of community? This depends, of course, on decisions made by each state, each community, and each land owner. Tools are available for making growth “smarter.” Open space protection, downtown revitalization, alternative transportation, and comprehensive plans that reflect residents’ visions of good communities (and that are actually enforced) can all alter the outcome. In some Western places such tools have already made a difference, and our projections understate their success. Oregon and a few Western communities have effective growth management. But we think these projections still capture the overall growth patterns of most of the West.

Nevertheless, our projections are certain to be wrong, in one way or another. Our population estimates might be too conservative, or the way our model spreads development on the landscape may not adequately account for the growing demand for rural residences, larger lots, and multiple homes. Alternatively, some political, economic or cultural change might slow regional in-migration or reduce the region’s fertility. Maybe more Westerners will discover the joys of living “downtown” rather than out on the suburban edge.

Growth and land use are largely local issues. Growth occurs in everybody’s backyard, most new subdivisions attaching to existing ones and wiping out someone’s open space view. So Westerners fret over development even as they enjoy both the benefits of growth and the region’s enduring legacy of great open spaces. The vision and power to alter the future, somehow to balance the benefits of both growth and land conservation, must come from the local level.

Our projections also suggest that there is value in coordinating growth and land use patterns among communities and across regional landscapes. The pattern and rate of growth matter as much as its total footprint. Growth tends to follow riparian areas, to fill in spaces between communities, and inevitably to fragment natural and agricultural landscapes. Protection of community separators, viewsheeds, agricultural land, and wildlife corridors could yield a new blueprint for the West in which the settlement landscape at last matches the region’s incomparable beauty.

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Thanks to John Fielder and the Colorado Sprawl Action Center for use of aerial photographs of development.
The Western Futures Growth Model (WFGM) projects future housing density as a main surrogate of overall growth and land development. It applies population estimates and a set of spatial rules to distribute future housing across the landscape. The model assumes that all land except federal or state lands (also minus some private land that is covered by water or on especially steep slopes) is open to development. Thus it does not “know” where land-use tools like conservation easements, urban growth boundaries, or local open space programs have already protected land from development. The model produces scenarios of the future that can be compared to expectations or goals, and tested for the effects of land-use planning.

The maps are based on 2000 U.S. Census Bureau block-group and block-mapping units. Current (2000) patterns of housing density were based directly on the block-level estimates of housing units. Historical patterns (prior to 2000) of housing density were based on block-group level estimates of the number of housing units, which were then spread to blocks based on the 2000 distribution. Population projections (which drive the housing density) were based on county-level population forecasts by state demographers where available, which we extended by adding an increment of population for each future decade equal to the population growth (total, not rate) in the last available decade of official estimates (because official estimates do not extend as far into the future as we wished, to 2040).

The model uses these basic rules in projecting future patterns: (1) Growth is computed as the average growth in each of four density classes (urban, suburban, exurban, and rural), and these are computed locally within a radius of about 1,000 meters from the center of each census unit. (2) Growth estimates are then spread throughout the entire unit so that future growth is not constrained to occur where it had previously, though areas that grew in the past are first to get additional density. This approach means that future growth rates occur in a similar way as they have in the past, but since growth is parameterized locally, not within some artificial analytical unit like a state or county, different valleys or regions within a county can grow in a unique way. (3) The distribution of new growth is adjusted according to accessibility to the nearest urbanized area. That is, urbanization and conversion to suburban and exurban land use typically occurs in locations that are accessible to urban areas, but on the fringe, where land is undeveloped. Accessibility is computed as minutes of travel time from urban areas along the transportation network (major roads and highways). (4) The number of housing units is forced to meet the demands of the new population within a county. That is, the number of new units in a county is proportional to the number of additional people in a decade. Housing density is not allowed to decline over time, even in the few areas of the West that are not growing or are actually losing population.
Endnotes

1 American Farmland Trust. 1995. *Alternatives for Future Urban Growth in California’s Central Valley*. Washington, DC.


Biographies

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