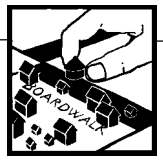


Gray City, Green City

New thinking and new settlement patterns can bring about urban sustainability.

BY MARK DEKAY AND MICHEAL O'BRIEN

The American city, if one can still call such a sprawling, gray metropolis a city, is an ecological disaster. The way cities use land and resources profoundly alters the quality of the local and global environment. Uncontrolled growth devours land, water, and energy from the surrounding landscape. Contemporary settlement patterns create auto dependence, high energy demands for buildings, water pollution from excessive toxic runoff, air pollution, and such other adverse environmental effects as increased health risks caused by coal mining, nuclear waste, and fuel burning.

For their exorbitant ecological price, these urban patterns do not even buy a high quality of life. Early 21st century Americans are separated from the aesthetic and ecological experience of nature while spending hours every day commuting and several more hours working to pay for their cars. Neighbors are not friends, community is not tied to place, and millions, too poor to own cars, are disenfranchised. The city is noisy, congested, frustrating, and unhealthy. Our society has created this habitat for ourselves.

In addition to the global macroecological problems caused by or contributed to by cities, current settlement patterns create a host of local ecological problems. Wildlife habitat in cities is scarce; native species are replaced with consumptive exotics; streams are channelized, piped and buried; wetlands are filled and aquifers depleted. Urban heat islands drive up energy use for cooling and trap air pollutants in the city. Downstream areas are flooded and polluted by quick runoff from acres of paved surfaces. Each of these local problems reduces the ability of local ecosystems to accomplish their ecological functions. Local ecological systems are rapidly losing their ability to produce clean water, air, and food, and to maintain a rich variety of inhabitants—in short, they are losing the ability to sustain life.

Each of these environmental problems is related in some way to the design of cities, to our settlement pattern, to our urban spatial structure. Changes in land-use patterns take decades, so if our cities are to be ready for mid-21st-century energy and resource scarcities, increasing population, and potential extinctions, structural changes must be initiated almost immediately. Human habitat must be restructured so that we live within the limits imposed by our life-sustaining ecosystems and follow the organizing principles by which all life flourishes.

Green City Consciousness

To correct the ecological damage caused by today's gray city, we first have to shift our perceptions. It is impossible to get us out of the urban ecological crisis with the same kind of thinking that created it. We have to learn to think ecologically. We also have to learn to integrate multiple new, and sometimes seemingly paradoxical, ways of thinking and perceiving.

A sustainable city can be built on three interrelated mental models, each depending on a different set of values for what counts as success.

■ **The city as a living system**. This way of thinking asks, What form would the city take if we understood it as a manifestation of natural process?

The central insight of the living city concept is that cities and landscapes are living systems. A city is a

human ecosystem set in a landscape. Because living systems have been organized through 4 billion years of evolution, they constitute a design model for what sustains life on our planet. In particular, local ecosystems tell us what works well in our particular part of the planet. So, we can look at living systems to learn how to design buildings, neighborhoods, cities, and regions.

To an ecologist, the order of an ecosystem is made up of two interrelated and inseparable patterns: structure and function. The structural pattern of a living system is the form, composition, distribution, and configuration of its parts—rocks, soil, plants, animals. Ecological function is the pattern of relationships among these parts, involving the movement and transformation of energy, materials, and information. Form does not simply follow function. Form guides flow, which, in turn, shapes form.

The landscape seen in this way is more than a political boundary, site, or location for buildings and streets. It is a complex of seen and unseen elements and forces, below ground, on the ground, and in the atmosphere.

Seen from the perspective of function, ecosystems provide many goods and services required for our basic existence. These have recently come to be called *ecosystem services*, and include such functions as pollination, protection from ultraviolet rays, purification of water, oxygen supply, protection from floods, and climate moderation, among others.[1] (See Table 1.) These ecosystem services are essential to civilization and are increasingly imperiled by large-scale human activities, such as urban sprawl, wetland destruction, deforestation, and pollution.

Taking the long view, society has to ask, How shall we build cities to preserve ecosystem services? What would the city look like if its form were in part a manifestation of these underlying life processes?

■ **The city as an experience of nature**. This way of thinking asks, What form would the city take if we understood nature as a crucible for human development?

Ecosystem services do not just provide our basic needs. The biosphere nurtures our mind and soul, as well as our stomachs and lungs. The city is natural, but it is a nature degraded. Restoration of a healthy ecosystem in the city will contribute to the restoration of human health and support the development of our human and cultural potential. In the green city, nature will be experienced positively.

Interaction with nature has a restorative power on our physiological and psychological well being.[2] Patients recover faster when able to view natural scenes, stress is reduced, and mental calming occurs.[3] In the gray city, however, humans are caged in a concrete jungle, much like the lion in the zoo, pacing frantically and acting out their darker emotions.

The *biophilia hypothesis* suggests that humans have an innate tendency to affiliate with other living organisms and living processes.[4] Humans require contact with a biodiverse world to stimulate the development of their emotional, cognitive, and social potential. Growing up in a denatured environment leads to a society of childish adults.[5]

As the living community of other organisms is reduced and human interaction with that community is lost, there is an extinction of experience that results in a loss of real ecological knowledge and emotional attachment to nature.[6] In the midst of the greatest extinction crisis since the last asteroid collision, the nurturing of human attachment to the natural world is critical for biological conservation. It is our relationships with our environment and other species that make us part of an ecosystem.

The healthy functioning of natural systems, including their life-sustaining processes, depends on all species participating in a coordinative way. Therefore, direct experience of the natural world is necessary to nurture an ecologically literate society that values nature and has the competence to conserve it, the citizenship to work collaboratively, and foresight to plan ahead.[7]

In the green city, we would have frequent interaction with nearby nature, providing us freedom of movement and opportunity for immersion.[8] The green city must reconnect us with our innate biophilia. If we built our cities in such a way that children could play in creeks, we could watch the sunset and the night sky, and sometimes there was quiet, we would begin to know nature again. If wildlife could navigate the landscape, and the raindrop's path from roof to river was manifest, then most of us would care about nature's health. If our parks grew local trees and walking to work was convenient, if we saw our wastes become soil and plants clean our water, then the patterns that connect could establish in our minds and create a positive feedback loop of collective ecological consciousness.

Taking the long view, society has to ask, How shall we build cities to manifest living connective patterns? What would the city look like if its form were conceived to appeal to our innate ecological aesthetic?

■ **The city as a particular place**. This way of thinking asks, What

Table 1. Urban Strategies for Ecosystem Services

Ecosystem Service	Gray City Strategy	Green City Strategy
Energy production	Centralized production: fossil fuels, nuclear power	Multi-scalar, regionally fitted renewable energy: solar, wind, hydro, biofuels, cogeneration, conservation
Food production	Remote monoculture: industrial farms	Diversified urban, suburban, and regional agriculture: community gardens, productive parks
Air supply	Mechanical systems in buildings; no urban strategy	Wind planning: green corridors, staggered and dispersed buildings, windbreaks
Water supply	Municipal supply pipes and sewers, irrigation, stream channelization and burial	Rainwater catchment onsite and buildings; natural swales and streams; creek restoration
Nutrients/materials supply	Centralized production; grocery, gardening, and construction industries; national truck distribution	Local production; cascading uses: restaurant to community garden, sewage to fertilizer, neighborhood compost
Waste removal	Trucks and landfills, incineration, sink disposers, sanitary sewers	Composting, recycling, eco-industrial parks, composting toilets, neighborhood sewage treatment
Biodiversity	Serious habitat fragmentation from land development	Landscape ecology patterns: corridor, patch, matrix
Water purification	Chemicals, mechanical filters	Graywater filtration/reuse; living filters; soil percolation and recharge; constructed wetlands
Waste processing	Settling ponds, chlorine, chemicals, landfills	Constructed wetlands; composting
Flood mitigation	Downstream export: flood walls, levees, channelization; centralized retention: dams and reservoirs	Locating out of flood zones; green roofs, permeable cover; recharge zones: wetlands, site retention
Drought mitigation	Centralized reservoirs; interbasin pumping; aquifer extraction; watering bans	Conservation; cisterns, site detention, local ponds and lakes; xeriscape, native plants
Erosion control	Physical barriers, seawall, erosion fence	Acceptance of natural changes; planting, ground cover, avoiding erosion zone development
Energy storage	Gas/oil reserves	Matched demand/supply cycles; buildings' structure; ice, phase-change materials; reservoirs, forests, biofuels

form would the city take if we understood it as part of a larger whole?

Contextual thinking, according to the science theorist Fritjof Capra, is one of the two great strands of ecological thinking, *process thinking* being the other.[9] In contextual thinking, we place something in its larger containing system to understand it. The ecological approach to context is based on the observation that the structure and processes of ecosystems vary with location. The pattern of human activities should fit the pattern of underlying landscape characteristics, including the avoidance of natural hazards, the preservation of stored resources for the future, and the suitability for various land uses, such as agriculture, housing, or recreation.

Moreover, the intensity of human activity on the land should be based on the land's *carrying capacity*—that is, its ability to maintain the healthy functioning of landscape processes.

Unfortunately, sensitive location of human activities does not inherently protect wildlife habitat, population sustainability, or biodiversity. We have the opportunity during this century to halt mass extinction. To do so, we have to make some fairly radical changes in land use and management, using applied landscape ecology. We must not only preserve existing, mostly fragmented, wildlife habitat, but also reconstruct and restore many wild lands and multiple-use habitat areas.

Some of us, to use Wendell Berry's terms, only *reside*, while others *inhabit* their places. The same might be said for cities. The green city can never remain only a set of abstract, portable, formulaic ideas. The green city is located in a particular place that forms the territory of our life's activities. Its topography and natural features form powerful perceptual containers for consciousness. The *bioregion* is a city's life-place, and that of all its citizens. In common use, it is a geopolitical, geocultural region defined as land areas constituting similar ecosystems, usually defined by watershed boundaries or similar habitat associations. The imbedded intelligence of bioregional thinking comes from the observation that most energy, materials, and information occur within an ecosystem's own bound-

Photo: M. DeKay

FIGURE 1. Block Scale Biological SewageTreatment, Kolding, Denmark. The Fredensgade block's buildings and site in Kolding, Denmark, were renovated in 1996 with a variety of ecological and energy conservation measures. The Bioworks, a glass pyramid in the center of the block, is used to treat sewage, grow fish, and cultivate ornamental plants. Rainwater is collected from roofs, stored in a pond and cistern, and used for toilets. Water is treated by algae ponds, ultraviolet light, and ozone before circulating to a fish nursery. Effluent circulates to outdoor reedbed wetlands and a seepage pond, finally returning to the ground. The project reduced water consumption costs by 50 percent and treatment costs by 40 percent.[10]

aries. Each process has a spatial dimension, each creature, its own range.

Taking the long view, society has to ask, How shall we build cities to connect them to larger ecological patterns? What would the city look like if its form truly fit to its lifeplace?

Shape of the Green City

Each of the three modes of green-city consciousness generates a substantial list of overlapping design strategies. Each mode can inform almost any design question; yet, alone, any of the singular perspectives would be insufficient and potentially fail or even cause damage. The integration of these three mental models—living systems, landscape experience, and native context—generate a set of five patterns necessary for the emerging green city:

■ **Hydrologic city**. Cites have historically had a transformative effect on their local hydrologic systems. The green city makes an alliance with nature to provide hydrologic services to humans and the landscape. The green city must collect, store, and process water, as much as possible, within its own watershed boundaries.

Imagine every day drinking, showering in, and watering your tomatoes with soft, solar-distilled, pesticide-free, nonchlorinated rain water from your own roof.

In the subterranean city is a network of engineered waterways carrying away as much as 90 percent of urban rainfall. Nature can do this work cheaper and more aesthetically. Our streams were covered because they were used as open sewers and they often flooded. Today, we separate sanitary and storm sewers, and we have learned not to build in flood zones. So, over 50 years or so, we could resettle our cities using a renaturalized hydrologic armature with restored streams, brought back to the surface. In the process, we would vastly increase groundwater recharge and reduce downstream pollution and flooding.

Imagine a "blueway network" where streams meander through our neighborhoods, carrying away runoff and slowing its flow, providing rich natural habitat, increasing property values, and providing hundreds of miles for childhood memories.

The green city can use natural biological processes to treat the little waste it produces. Since graywater can be reused for low-grade water requirements, such as landscape irrigation, only black water from toilets needs to be processed. Many households will use efficient and odorless composting toilets, reaping a rich garden fertilizer, and some neighborhoods will proudly display the "No-Pipe Neighborhood" designation. Others will treat their sewage in local constructed wetlands. In denser areas, biological processes can be speeded up in land-efficient, solar-heated greenhouses. (Figure 1.)

■ **Productive city**. The mechanistic gray city is mostly dead. It produces almost nothing in ecological terms. It is a once-through system that depends on remote sources for food and ignores the valuable organic resources in its waste stream.

Urban agriculture in the productive city can grow a significant portion of a city's food close to where people live. Its goals are to reduce the environmental impact of the food production system, reduce cost, increase self-sufficiency, improve quality by reducing transportation, create employment, reduce chemical and energy inputs, and

eliminate much industrial processing and distribution. The city planning theorist Richard Meier predicts that about a third of the caloric value and two-thirds of the economic value of the urban dweller's diet will eventually be produced in the city. (Figure 2.)

Imagine a springtime Saturday morning conversing with a dozen neighbors over coffee as you plant spinach and peas in your plot of the community garden at the south edge of your block.

Several comprehensive visions have been put forth for urban landscapes that include agriculture at a wide range of scales. The most successful example is China, where 50 percent of vegetables consumed in major cities are grown there. Integrated agricultural visions generally pair small-scale production in kitchen and community gardens with larger-plot farming in the suburbs or at the urban fringe.

Imagine productive parks of fruit trees and fish ponds, street trees of pecan and walnut, and urban forests supplying local industry with agroforest products. Imagine some public lands leased to urban farmers that you actually know and some orchard yields reserved for public consumption.

■ **Bioclimatic city**. Buildings use about a third of the energy consumed in the United States and are responsible for an equal amount of global climate change. Yet we know how to make buildings that use vastly less energy and cost the same or less. Cities exacerbate rather than moderate local climate, creating urban heat islands without summer shade, windswept winter streets, and dense conditions that block light and air. Bioclimatic design—the use of the natural climatic forces to provide human comfort in and around buildings—can have profound effects on the way we consume resources and on our relationships to the natural cycles around us. The design of the city often determines whether a building can actually make use of the free energy it receives from the sun, wind, sky, and ground.

Imagine your home with no noisy machines running, except in the coldest and hottest weeks, to make you cool or warm. No nasal-drying, dust-distributing air whirling around your head. Imagine the gourmet thermal experience of winter breakfast in your toasty-warm sunroom, which also heats most of your house, and summer dinners in a shaded, breezy, screened porch.

The green city must provide access to sun, wind, and light by its very patterning. Through zoning and development controls, buildings can be shaped and positioned, according to the path of the sun, to prevent winter shadows from reaching adjacent buildings. Streets can be oriented to move prevailing wind through the city, and green spaces can be interwoven with buildings to reduce summer temperatures. Neighborhoods can be laid out with buildings staggered and spaced so that breezes flow to each building. (Figure 3.)

The design of the city scale, in combination with the design of the buildings in the public realm, determines the microclimates in which we spend time outdoors. Parks and plazas can be designed to be summer places or winter places, sunny and calm—or breezy and shaded.

Imagine an evening stroll down the vegetated radial ventilation corridors

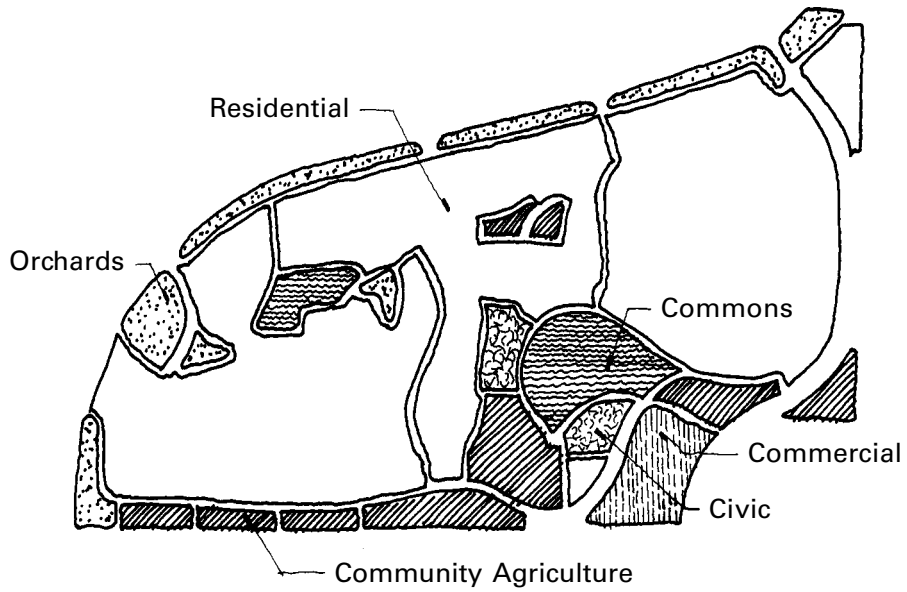


FIGURE 2: Productive Zones in Village Homes. Village Homes, in Davis, California, offers an example of a residential landscape where 50 percent of the land is in agricultural production, by combination of edible landscaping, private and community gardens, neighborhood orchards, and commercial farming.[11]

Graphic: M. DeKay[12]

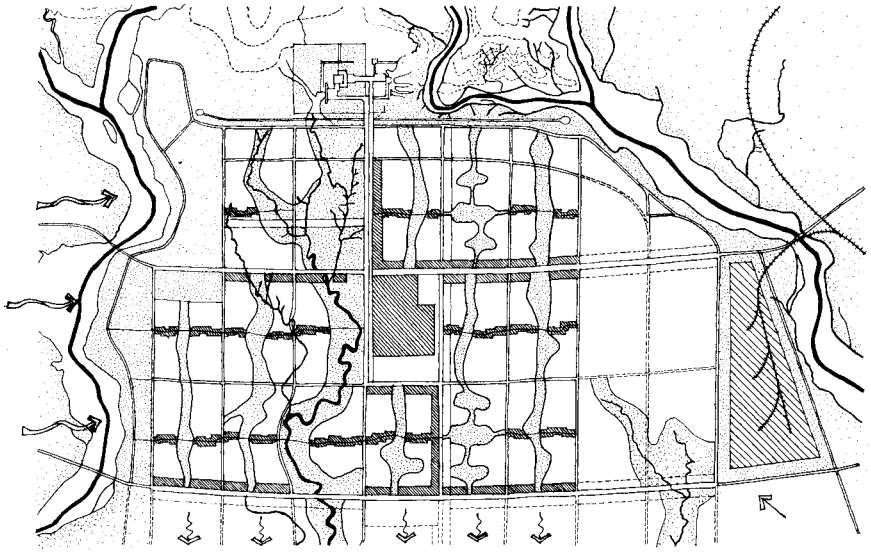


FIGURE 3: Plan of Chandigarh, Punjab, India. In Chandigarh, India, major streets are oriented along the prevailing winds, while a system of linear open spaces cuts through the center of each superblock, allowing night drainage down the gently sloping plain during the often calm evenings.[13]

Graphic: G.Z. Brown and M. DeKay[14]

that take advantage of cool-air drainage from upslope and direct night thermal currents into the denser and warmer centers of activity.

■ **Transit city**. Sprawl is bleeding our cities and devouring their hinterlands. The population of St. Louis is only 40 percent of what it was half a century ago, while the metro area, with a slight population increase, now occupies 13 times as much land area. St. Louis is not unique.

We know that public transit requires certain densities and that mixed uses—as opposed to single-use zoning—promote fewer auto trips and support pedestrians by reducing distances between home, work, school, and shopping. We know that, when given a choice, people like living in small scale, medium density, traditional town-like settings. We know 20 other things like this.

All this has spawned two important and related movements in urban design: New Urbanism and Transit-Oriented Development (TOD). New Urbanists advocate traditional town planning based on street grids, high levels of public open space, and a traditional mix of building types.[15] The TOD movement advocates higher density, mixed use, pedestrian-scale development centered on bus and light-rail stops.[16] (Figure 4.)

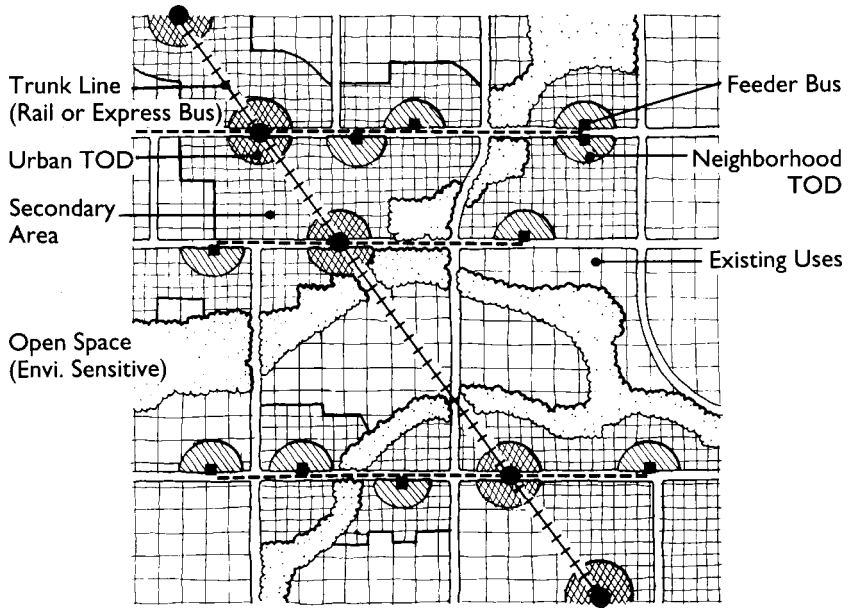
Imagine driving your car only for trips out of town. You can walk to the neighborhood center in five minutes, even with small children, to access all your daily services. Your commute is a pleasant 5-minute walk again, and perhaps a ride on the light rail, down a couple of stops, to one of the office, arts, or light-manufacturing centers.

Numerous transit-based metropolitan proposals exist, some of which have been around for a long time.[17] Copenhagen's finger plan, for example, in which light rail lines fan out from the city like the spokes of a wheel, and Paris's satellite towns, which are connected by rail to city center, were built during the late 19th century. Today, the regional city, with one or more central cities, several edge cities, and numerous urban villages, all linked together by a rich transit network, is perhaps the most adaptable to current settlement patterns and performs better for a range of sustainability criteria than older models.

No green city should be without a bicycle plan. The bicycle is the most economical and energy efficient form of human transport ever invented. Cycling can play an important role, even in societies with high living standards. Cycling accounts for 20 percent of passenger trips in Basel; 25 percent in Tokyo; 50 percent in Groingen, Netherlands; and up to 77 percent in such Chinese cities as Tianjin and Shenyang.[18]

Imagine the delight, character development, and mobility of a child who leaves home in the morning, riding the neighborhood bike lanes in a clear route to the dedicated bikeway paralleling the local creek and leading to the elementary school. Imagine the freedom of the parents and the need for one less car as the same child bikes safely to after-school ballet.

■ **Habitat city**. In recent years, the discipline of landscape ecology has generated an entirely new way of seeing the landscape—as a spatial structure of life processes forming



Graphic: P. Calthorpe[20]

FIGURE 4. TOD Urban Form Diagram. In a transit-oriented development, housing, services, and jobs are clustered around transit stops. Within a TOD zone, each building is located within a radius of a quarter mile, or about a 5-minute walk. A hierarchy of TODs, based on a network of trunk and arterial transit lines, along with development restrictions in environmentally sensitive zones, can create a regional pattern for guiding development. Feeder transit lines are within a 10-minute ride of an express rail or express bus service. Urban TODs can be located on trunk lines while neighborhood TODs are on the arterials. In the United States, up to 40 percent of all trips under such a system could use the transit lines.[21]

the habitat for many species. We are beginning to develop a language to describe beneficial habitat patterns—for example, corridors, patches, matrix, mosaics. And we are beginning to understand the formal characteristics—in terms of size, number, edge configuration, degrees of connectivity, mesh size—of these patterns.[19]

Imagine human society living, not in a sea of suburbia with a few island parks, but rather in islands of settlement connected by transit corridors and surrounded by green space.

Parks alone, even large regional parks or river corridors, do not create ecosystem health. It does not take a keen observer to see that the land-hungry monster of uncontrolled sprawl devours prime agricultural land and habitat and leaves the remaining bits fragmented and disconnected from each other. The habitat city consists of three important networked components: preserves for critical areas, such as wetlands, steep slopes, riparian corridors, endangered species territory, watersheds, and shorelines; preserves for representative habitat areas for all ecosystem types in a region; and networks of greenways linking these nondeveloped areas. (Figure 5.)

Imagine that the neighborhood, urban village, and city are fractals of the larger regional structure. Parks of varying scales and degrees of human activity are distributed throughout the city and linked with corridors ranging from tree-lined boulevards to broad paths for larger mammals. Imagine the city as a participatory ecological museum with living, functioning examples of each local habitat type.

Challenges

The shape of the green city that follows from ecological theory is quite different from current and developing forms. The hydrologic city asks us to unengineer the pipes and chemicals of the city-as-machine and to reengineer it in partnership with nature. The productive city requires new forms of public-private partnerships to manage the civic landscape and more collective action between property owners. The bioclimatic city has significant impacts on land rights and an expanded vision of the role of the city's streets and open spaces. The transit city requires a reinvention of zoning laws and an integration of local and regional infrastructure planning. The habitat city requires a major restructuring of the social organization of land use. All of these have profound planning, design, and policy implications; the old way of thinking that created the gray city can not create the new green city.

Many of the green city concepts are being implemented by hundreds of cities via comprehensive plans, new forms of development rules, regional coordination, policy incentives, fee and tax structures, citizen action, energy codes, habitat conservation plans, innovative stormwater planning, creek restoration projects, community garden pro-

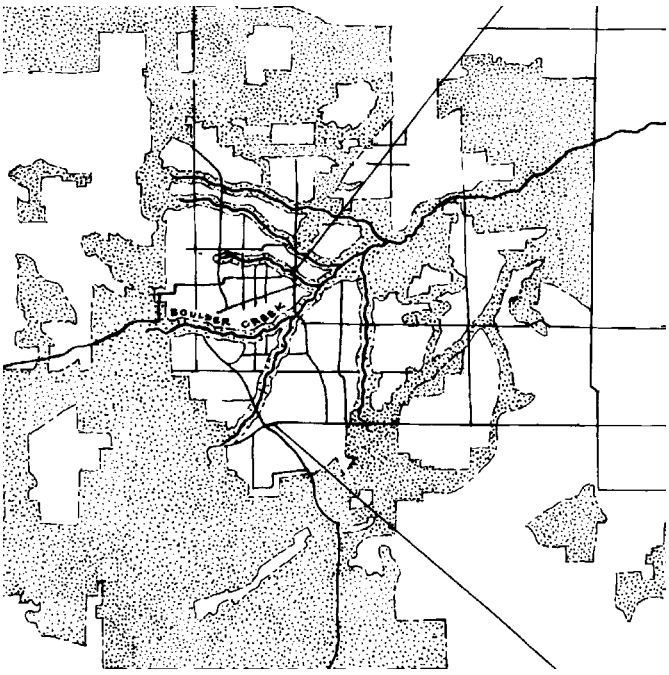


FIGURE 5. Open Space in Boulder, Colorado. Boulder has implemented both a greenways program along its urban creeks and an open-space plan. The open-space plan restricts development in a greenbelt around the city, protecting habitat, providing recreational access, and constraining urban sprawl. Its greenways program seeks coordination and integration of riparian, floodplain, and wetland protection and restoration; water quality enhancement; storm drainage; alternative transportation routes for pedestrians and bicyclists; recreation; and protection of cultural resources.[22]

Graphic: D.S. Smith and P.C. Hellmund[23]

grams, solar access ordinances, light-rail building and new transit-oriented development, bicycle planning, and greenway networks. Many cities are implementing one or two of the green city patterns, mostly in fledgling, pilot efforts. For a sustainable green city, we will need all five patterns acting together, each operating at the scales of region, city, and neighborhood.

Beyond Sustainability

Because the green city is really a living system, it is never static. Cities change over time, just as ecosystems and landscapes do. As the underlying processes change, the form of the city itself will also shift and should exhibit successional and evolutionary characteristics of complex living systems. The key to managing the green city's development will lie in distinguishing what nature can do on its own, given the right conditions, from what humans must orchestrate. Our success will depend on our ability to:

- raise individual and social awareness of our participation in life processes,
- receive timely feedback about system behaviors that affect human activities,
- increase our understanding of the nonlinear and counterintuitive aspects of the behavior and development of complex systems.

Sustainability is standardly defined as acting today in a way that does not diminish the quality of life and options for future generations. It's a nice idea but a limited vision. In the green city, our investment today is love for future generations of humans and other species that share our life-place with us.

The green city is a city *beyond sustainability* in one other way. Maintaining the current life quality and options is really bequeathing to our descendents the same diseased environment we live in. Do we really want dead soil, lifeless streams, urban monocultures, and eight-lane freeway knots in 100 years?

If the future really matters to us as a society, we will build the restorative, regenerative green city, one in which the life and options of all future generations are *better* than ours.■

Mark DeKay is an assistant professor of architecture at the University of Tennessee, Knoxville. Micheal O'Brien is a landscape consultant and principal of Newland Geographic, in Boulder, Colorado.

NOTES

1. Gretchen C. Daily, ed., *Nature's Services: Societal Dependence on Natural Ecosystems* (Washington, DC: Island Press, 1997).

2. Rachel Kaplan and Stephen Kaplan, *With People in Mind: Design and Management of Everyday Nature* (Washington, DC: Island Press, 1998).

3. Roger S. Ulrich, "Biophilia, Biophobia, and Natural Landscapes," in Stephen Kellert and Edward O. Wilson, eds., *The Biophilia Hypothesis* (Washington, DC: Island Press, 1993).

4. Ulrich, "Biophilia, Biophobia."

5. Paul Shepard, *Encounters with Nature: Essays by Paul Shepard* (Washington, DC: Island Press, 2000).

6. Gary Paul Nabhan and Sara St. Antoine, "The Loss of Floral and Faunal Story: The Extinction of Experience," in Kellert and Wilson, *The Biophilia Hypothesis*.

7. David Orr, *Ecological Literacy: Education and the Transition to a Postmodern World* (Albany, NY: State University of New York Press, 1992).

8. Kaplan and Kaplan, *With People in Mind.*

9. Fritjof Capra, *The Web of Life: A New Scientific Understanding of Living Systems* (New York, NY: Anchor, 1996).

10. Margrit Kennedy and Declan Kennedy, eds., *Designing Ecological Settlements: Ecological Planning and Building: Experiences in New Housing and in the Renewal of Existing Housing Quarters in European Countries* (Berlin, GER: Dietrich Reimer, 1997).

11. Michael N. Corbett, *A Better Place to Live: New Designs for Tomorrow's Communities* (Emmaus, PA: Rodale, 1981).

12. Mark DeKay, "Implications of Community Gardening for Land Use and Density," Proceedings of the 14th International Conference on Making Cities Livable (Charleston, SC, March 8-12, 1993).

13. Norma Evenson, *Chandigarh*, Environmental Design and Development Series (Berkeley, CA: University of California Press, 1966); Yukio Futagawa, ed., *Chandigarh, the New Capital of Punjab, India, 1951-/Le Corbusier*, Global Architecture No. 30 (Tokyo, JPN: A. D. A. EDITA, 1974).

14. G.Z. Brown and Mark DeKay, *Sun, Wind, and Light: Architectural Design Strategie*s, 2nd edition (New York, NY: John Wiley, 2001).

15. Peter Katz, *The New Urbanism: Towards an Architecture of Community* (New York, NY: McGraw-Hill, 1994).

16. Michael Bernick, *Transit Villages in the 21st Century* (New York, NY: McGraw-Hill, 1997); Judy Corbett and Paul Zykofsky, *Building Livable Communities: A Policymaker's Guide to Transit-oriented Development* (Sacramento, CA: Center for Livable Communities, 1996).

17. See Kevin Lynch, *A Theory of Good City Form* (Cambridge, MA: MIT Press, 1981); Kisho Kurokowa, "New Tokyo Plan, 2025," *Japan Architect* 367/368 (November/December 1987), pp. 46-63; Peter Calthorpe, *The Next American Metropolis* (New York, NY: Princeton Architectural Press, 1993); Ebenezer Howard, *Garden Cities of To-Morrow,* F. J. Osborn, ed. (Cambridge, MA: MIT Press, 1898); Frey Hildebrand, *Designing the City: Towards a More Sustainable Urban Form* (New York, NY: E & FN Spon, 1999).

18. Marcia D. Lowe, *The Bicycle: Vehicle for a Small Planet*, Worldwatch paper 90 (Washington, DC: Worldwatch Institute, 1989).

19. Wenche E. Dramstad, James D. Olson, and Richard T.T. Forman, *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning* (Washington, DC: Island Press, 1996); Richard T.T. Forman and Michel Godron, *Landscape Ecology* (New York, NY: Wiley, 1986); Richard T.T. Forman, *Land Mosaics: The Ecology of Landscapes and Regions* (New York, NY: Cambridge University Press, 1995); Zeev Naveh, *Landscape Ecology: Theory and Application* (New York, NY: Springer-Verlag, 1984).

20. Calthorpe, *The Next American Metropolis*.

21. Ibid.

22. Daniel S. Smith and Paul Cawood Hellmund, eds. *Ecology of Greenways: Design and Function of Linear Conservation Areas* (Minneapolis, MN: University of Minnesota Press, 1993)

23. Ibid.