

chapter 1

Shaping the Built Environment

Sustainable design balances human needs (rather than human wants) with the carrying capacity of the natural and cultural environments. It minimizes environmental impacts, and it minimizes importation of goods and energy as well as the generation of waste.

—United States. National Park Service (1993, p. 55)

1.1 INTRODUCTION

About 82 percent of the 312 million U.S. residents—and 50 percent of the planet’s 7 billion inhabitants—now live in urbanized areas (United Nations, 2010). Cities and their suburbs today import vast quantities of both raw and processed resources (for example, energy, water, food) and they export—often to rural areas—massive quantities of wastes (for example, plastics, paper, metals).

Yet, the global economy—with its 12,000-mile supply chains—increases international dependencies and, potentially, reduces the resilience of communities to distant political disturbances and natural disasters (for example, Japan’s 2011 earthquake and tsunami). Sustainability is a global challenge requiring context-specific changes in the structure and function of our built environments. Urban population growth heightens the need for comprehensive interdisciplinary solutions to this contemporary challenge.

1.2 ECOSYSTEM SERVICES

Advances in telecommunications technologies, combined with extensive highway networks and sprawl-inducing land use regulations and subsidies, have greatly loosened the geographic constraints on population distribution and land development spatial patterns.

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Transportation costs, markets, and raw materials no longer determine the location of economic activities. We have developed an information-based economy in which dominant economic activities and the people engaged in them enjoy unparalleled locational flexibility. In this spatial context, amenity and ecological considerations are more important locational factors than in the past. Cities located in amenity regions of North America are growing more rapidly than others and such trends will intensify as society becomes more footloose.

(Abler et al., 1975, p. 301)

The earth's ecosystems perform functions that are essential to human health and welfare. In *Functions of Nature*, deGroot (1992) classified nature's functions into four life-supporting categories: production, regulation, carrier, and information services (Table 1-1). Nature's "infrastructure" helps protect the quality of the air we breathe and the water we drink, and it provides an abundance of other "goods and services." These include food, fiber, water, biodiversity, and energy production as well as the provision of cultural, recreational, and spiritual experiences (Daily et al., 1999; Reid et al., 2005).

The value of nature's services to human well-being, and the implications of different management approaches over space and time, are not widely appreciated or even well understood. Consequently, environmental management practice has suffered from an incorrect assumption (Folke et al., 2002, p. 437): that "*human and natural systems can be treated independently*" [emphasis added]. Many human activities, however, impose detrimental impacts on the earth's capacity to sustain life. The World Resources Institute (WRI) tracks global environmental trends, and the following findings—among many others—reinforce the global sustainability imperative:

TABLE 1-1 Ecosystem services support human civilization by providing a broad range of "goods and services."

Function	Goods or Services
Production	Oxygen Water Food and fiber Fuel and energy Medicinal resources
Regulation	Storage and recycling of organic matter Decomposition and recycling of human waste Regulation of local and global climate
Carrier	Space for settlements Space for agriculture Space for recreation
Information	Aesthetic resources Historic (heritage) information Scientific and educational information

Source: Adapted, in part, from deGroot (1992, Table 2.0-1).

- Tropical forests are shrinking, and the rates of plant and animal species extinction are increasing.
- Groundwater tables are falling as water demand exceeds aquifer recharge rates, and groundwater continues to be contaminated with pesticides and other contaminants.
- Global climate change and warming are occurring, and the sea level is projected to rise by as much as 3 feet (0.91 meter) by 2100.

Source: <http://earthtrends.wri.org/>

Hurricanes, floods, and other natural hazards continually threaten human health, safety, and welfare. Yet, many disasters causing the loss of life and property can be prevented, or at least mitigated, by better land use decisions that reduce these risks (H. John Heinz Center for Science, Economics, and the Environment, 2000; Mileti, 1999). Dennis Mileti, who led the Heinz Center’s natural hazards risk analysis, concludes in a press release from the National Science Foundation (1999, p.1):

The really big catastrophes are getting large and will continue to get larger, partly because of things we’ve done in the past to reduce risk. . . . Many of the accepted methods for coping with hazards have been based on the idea that people can use technology to control nature to make them safe.

In the United States, hurricanes, flooding, and severe storms contribute about three quarters of the total damages from natural hazards. Per capita losses from natural hazards are outpacing population growth, and if the trend of the past two decades continues, direct losses of \$300 to \$400 billion are probable within the current decade (Gall et al., 2011).

1.3 PLACE-BASED STEWARDSHIP

The World Commission on Environment and Development (1987, p. 40) suggests that “sustainable development seeks to meet the needs and aspirations of the present without compromising the ability of those to meet those of the future.” Concern over climate change, in particular, has precipitated advances in “sustainability science”—which seeks to understand the complex dynamics of interconnected human and environmental systems. Actions to reduce greenhouse gas emissions (climate mitigation) and increase cities’ resilience to extreme weather events (climate adaptation) are applications of sustainability science. Yet, the most ambitious application of sustainability science, is “*the integrative task of managing particular places where multiple efforts to meet multiple human needs interact with multiple life-support systems in highly complex and often unexpected ways*” [emphasis added] (Clark, 2007, p. 1737).

The built environment—the three-dimensional arrangement of buildings, transportation and utility networks, and green spaces—influences community health and sustainability across the urban-to-rural continuum. As the theoretical concepts guiding sustainability science are translated into actions, the built environment’s transformation will require closer collaboration of architects, landscape architects, urban planners, engineers, and other allied professionals. There is a critical need for planning and design professionals who can bridge

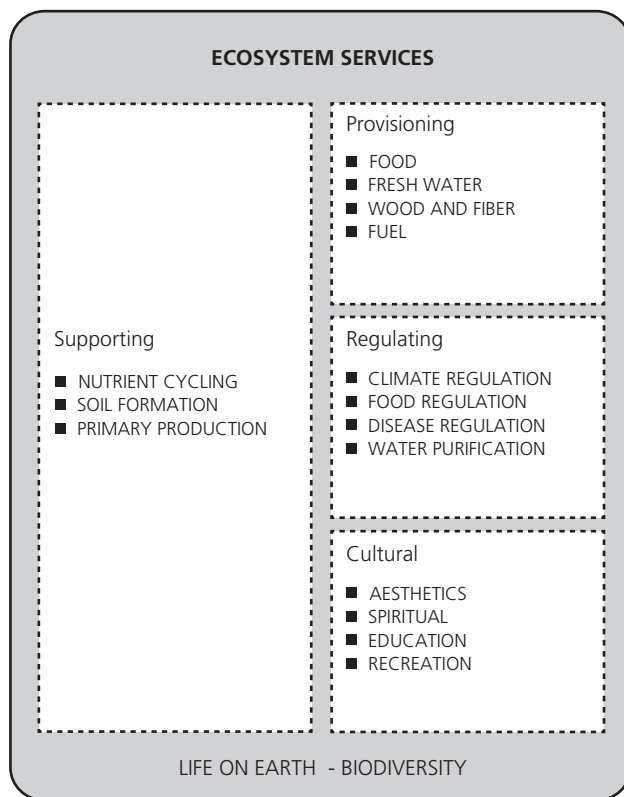


Figure 1-1 Ecosystem services support a hierarchy of human needs. Source: Adapted, in part, from Millennium Ecosystem Assessment (2005).

States has been planned, financed, and constructed while largely ignoring the associated social, economic, and environmental externalities (Soule, 2006). Since World War II, the interplay of local land use planning and federal and state policies has produced abundant “driveable suburban” landscapes but far fewer “walkable urban” neighborhoods (Leinberger, 2008). Besides diminishing the nation’s energy security, the consequences of this land development paradigm include a litany of public health impacts (Frumkin and Jackson, 2004), economic impacts (Burchell et al., 2005), and environmental impacts (Johnson, 2001).

Public policy plays a significant role in shaping the built environment (Ben-Joseph and Szold, 2005). In the United States, local development regulations have not only encouraged low-density sprawl but also have inhibited other, more sustainable forms of development. Zoning codes, for example, emerged in the early twentieth century to protect public health, safety, and welfare (Platt, 2004). These land use controls were effective in separating new residential areas from polluting industries and ensuring that new housing construction met basic health and safety standards. But zoning codes also routinely separated residential development from shops, restaurants, and other commercial uses, often with detrimental consequences for community health and well-being. There is an urgent need in the United States for land use planning and regulatory reforms (Schilling and Linton, 2005).

Because public policies play significant, yet often hidden, roles in shaping the built environment, planning and design professionals should be leaders in formulating better

professional “silos” and lead multidisciplinary teams in creating policy, design, and technology solutions to local, regional, and global sustainability challenges.

Sustainability initiatives at the federal level currently include the *Partnership for Sustainable Communities*—an inter-agency initiative of the U.S. Environmental Protection Agency (EPA), the U.S. Department of Transportation (DOT), and the Department of Housing and Urban Development (HUD). This collaboration has been a catalyst for integrated sustainability planning at the local and regional scale (www.sustainablecommunities.gov/). Along with efforts by the U.S. Centers for Disease Control and Prevention (CDC), this partnership explicitly recognizes that the spatial structure of the built environment—the location and design of buildings, transportation systems, and green spaces—influences not only economic prosperity and environmental quality, but also public health (Figure 1-1).

Our quality of life is dependent on many factors, including our safety and sense of security, our individual freedom and physical and mental health, and our opportunities for self-expression as individuals (Kaplan and Kivy-Rosenberg, 1973). Most, if not all, of these factors are affected by the design of the built environment. Sprawling development patterns, for example, tend to reduce people’s housing choices and limit their opportunities for healthy, active living (Frumkin et al., 2004).

Over the past six decades, suburban sprawl in the United

public policy. Professional associations are, in fact, taking a greater advocacy role. These changes are reflected in recently launched sustainability initiatives by the American Society of Landscape Architects (ASLA) *Sustainable Sites Initiative*[™], the American Institute of Architects (AIA) *Sustainable 2030 Toolkit*, the American Planning Association (APA) *Sustaining Places Initiative*, and the American Society of Civil Engineers (ASCE) *Institute for Sustainable Infrastructure*. These sustainability initiatives express strong values and advocacy positions—concerning social equity, for example—that are reflected in each profession’s continuing professional education programs and competency exams.

The ASCE, for example, defines “sustainability” as follows:

A set of environmental, economic and social conditions in which all of society has the capacity and opportunity to maintain and improve its quality of life indefinitely without degrading the quantity, quality or availability of natural, economic, and social resources. (<http://www.asce.org/Sustainability/ASCE-and-Sustainability/ASCE---Sustainability/>)

The ASLA’s Sustainable Sites Initiative defines “site sustainability” as

design, construction, operations and maintenance practices that meet the needs of the present without compromising the ability of future generations to meet their own needs. <http://www.sustainable-sites.org/>

Suburban sprawl has not only degraded environmental quality in the United States, but has also produced low-density, auto-oriented communities that contribute to sedentary lifestyles and diminished public health (Frumkin et al., 2004). Communities aspiring to become more prosperous, livable—and sustainable—are taking steps to retrofit their built environments in several important ways (Dunham-Jones and Williamson, 2011). “Smart Growth,” “New Urbanism,” and “sustainable design” are three related development paradigms that focus attention on the physical configuration, or design, of the built environment. Key attributes are the following:

- Mixed and integrated uses (i.e., diverse housing, shops, workplaces, schools, parks, and civic facilities encompassing interconnected indoor and outdoor environments)
- Clustered, compact buildings (i.e., architecture that enriches public open spaces, especially streetscapes, and creates neighborhoods and urban districts with a strong sense of place)
- Open space systems (i.e., connected natural areas and other outdoor places that provide linear recreational opportunities)
- Transportation networks (i.e., integrated systems safely serving pedestrians, bicycle riders, public transit, and automobiles)

Achieving these objectives involves coordination on a community-wide, and even regional, scale. Yet, these efforts must also be coupled with good design at the site, or parcel, level. Site-scale development—usually on privately owned property—is the primary way in which most communities change, for better or worse. And there are significant consequences of poor site planning. Detrimental impacts range from exposing people to safety and property risks to making people endure an unhealthy—even ugly—public realm. For

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these reasons, protecting public health, safety, and welfare is the primary reason for licensing professional landscape architects, architects, and engineers.

In the past decade, the number of local sustainability efforts has accelerated, focusing increasingly on integrated approaches to achieving multiple social, economic, and environmental goals. In Ottawa, Canada, for example, in the process of developing the city's Official Plan ("A Vision for Ottawa"), citizens agreed to a set of community sustainability principles that addressed both the natural and cultural environments. These include:

- Minimize harm to the natural environment by recognizing that growth is ultimately limited by the environment's carrying capacity.
- Respect other life forms and support biodiversity.
- Use renewable and reliable sources of energy and foster activities that use materials in continuous cycles.
- Do not compromise the sustainability of other communities (a geographic perspective) or the sustainability of future generations (a temporal perspective).
- Value cultural diversity,

Source: www.web.net/ortee/scrp/20/23vision.html

Sustainability is a complex technical, scientific, political, and social challenge, however, and efforts to advance this new paradigm must address this complexity systematically and holistically (Graffy, 2008). New policies, institutional structures, and professional cultures are needed to respond to sustainability challenges in ways that protect environmental quality, increase community resilience, and improve the quality of life for both current and future generations.

Sustainability initiatives can benefit from an in-depth understanding of natural and cultural assets. Diamond and Noonan (1996, p. xix) call for recognition of a broad set of community resources.

A constituency for better land use is needed based on new partnerships that reach beyond traditional alliances to bring together conservationists, social justice advocates, and economic development interests. These partnerships can be mobilized around natural and cultural resources that people value.

Natural and cultural resources that should be assessed at the community level include (Arendt, 1999):

- Wetlands and wetland buffers
- Floodways and floodplains
- Groundwater resources and aquifer recharge areas
- Woodlands
- Moderate and steep slopes
- Significant wildlife habitats
- Historic, archaeological, and cultural features
- Productive farmland
- Scenic viewsheds from public roads

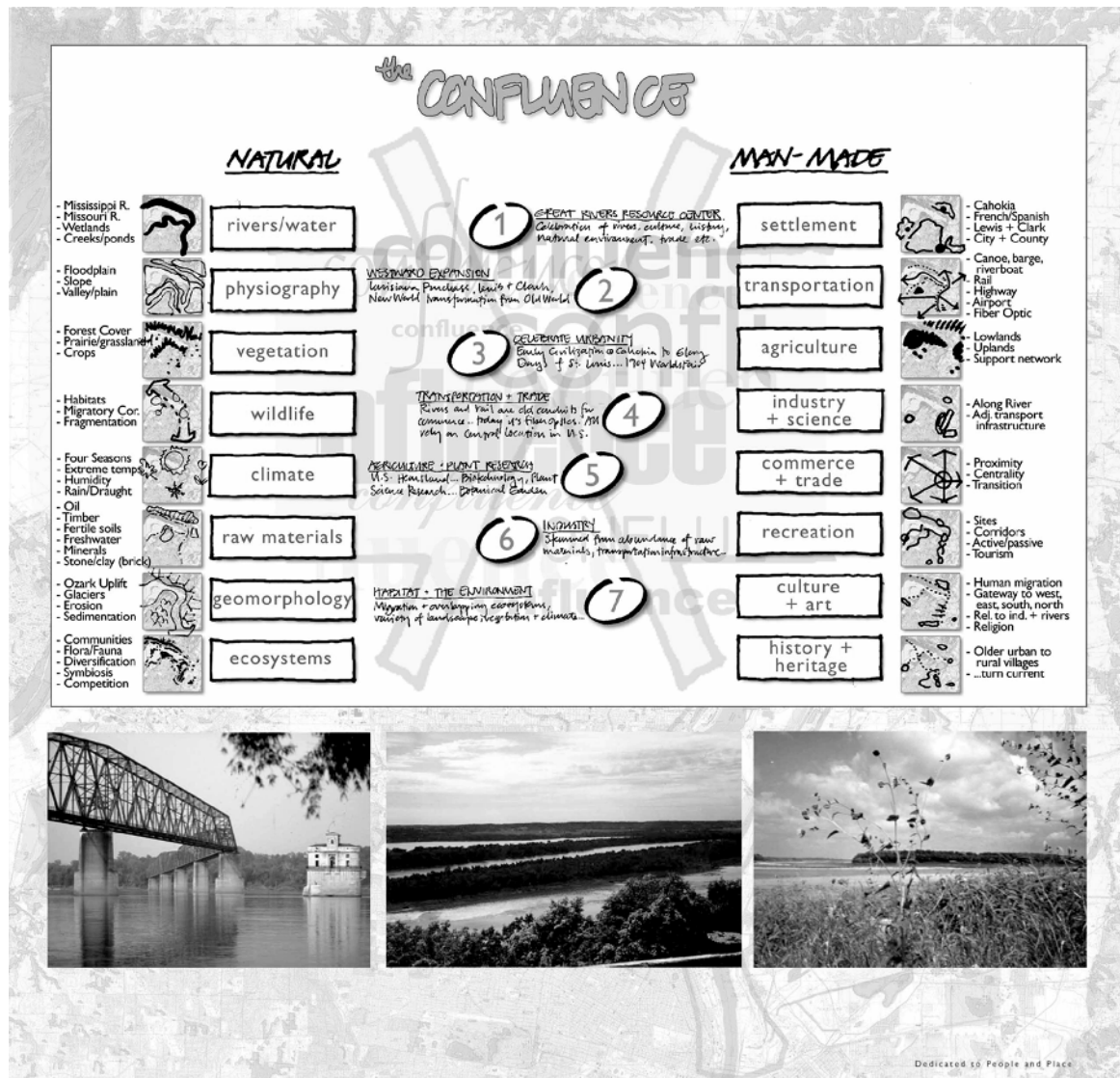
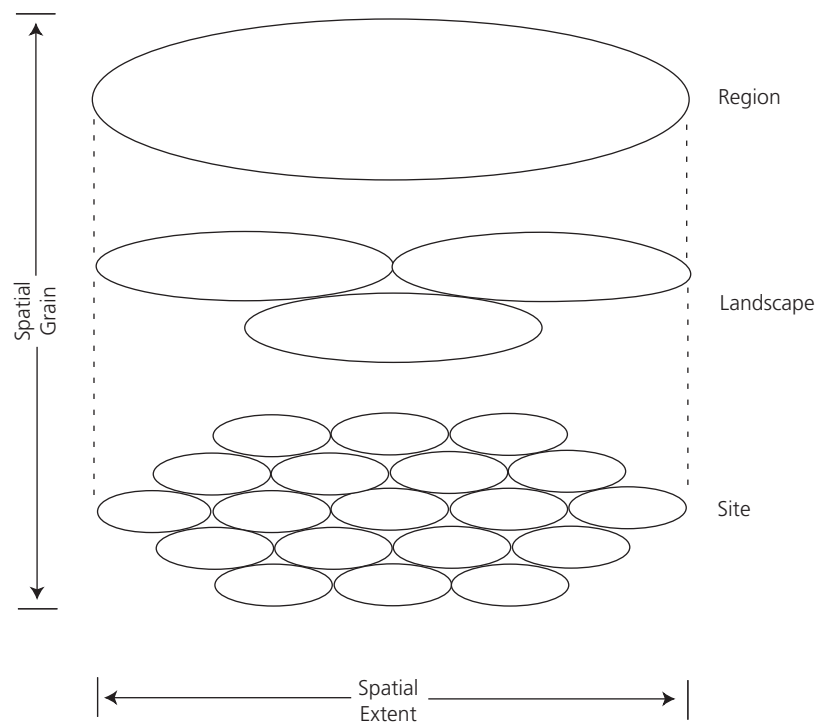


Figure 1-2 Natural and human-made factors influencing a greenway planning project along the Mississippi River in St. Louis, Missouri. Source: The HOK Planning Group. Used with permission of The HOK Planning Group.

Collectively, these resources form a unique spatial pattern or “signature” that helps to define a community’s sense of place (Figure 1-2). Given their ecological, economic, and psychological importance to human well-being, these patterns must be carefully considered in designing the built environment, from the regional to the site scale (Figure 1-3).

In the context of the built environment, real-world problem solving involves the “stewardship of place” (Beatley and Manning, 1997; Stewart, 2010). The arrangement of streets and buildings involves “design decisions” that—for better or worse—shape the built

Figure 1-3 Spatial hierarchy—regions, landscapes, sites.



environment. Some designs, however, are far better than others, and the solution to contemporary placelessness is often simply better design. Stewardship depends not only on analyzing what is or has been, but also on imagining what could be, i.e., futures scenarios (Duderstadt, 2000). Net-zero energy buildings—and other aspirational goals for buildings as well as sites, communities, and regions—can lead to important policy, design, and technological breakthroughs.

The average citizen may think that design excellence is a frill or that it simply costs too much. But there are many reasons to justify the expense of investing in skilled planning and design. In *Designing the City: A Guide for Advocates and Public Officials*, mayors, real estate developers, and others who were interviewed expressed the following opinions about the quality of design in the built environment (Bacow, 1995):

“Good design promotes public health, safety, and welfare.”

“Good design makes a city work better, not just look better.”

“Good design attracts people to a city, and those people help pay for essentials that help instill pride and satisfaction in what citizens get for their taxes.”

“Well-designed [real estate] products will succeed in tight markets where poorly designed products will not.”

Good design also reduces the long-term life-cycle costs of operating and maintaining buildings’ infrastructure. For example, up-front building design costs may represent only a

TABLE 1-2 Benefits of context-sensitive site planning and design.

Society	<ul style="list-style-type: none"> Enhances pedestrian/bicyclist mobility and safety Creates opportunities for active living Promotes a sense of community Creates attractive surroundings Increases neighborhood safety Improves access to public services Minimizes negative impacts on surrounding properties Protects cultural and historic resources
Economy	<ul style="list-style-type: none"> Attracts visitors, tourists, and investment Increases property value Creates marketable “experiences” Speeds real estate sales and rentals in tight markets Attracts high-skilled employees and employers Reduces commuting times Uses land efficiently
Environment	<ul style="list-style-type: none"> Conserves energy Protects biodiversity Reduces air and water pollution Protects ecosystem processes and reduces urban heat islands

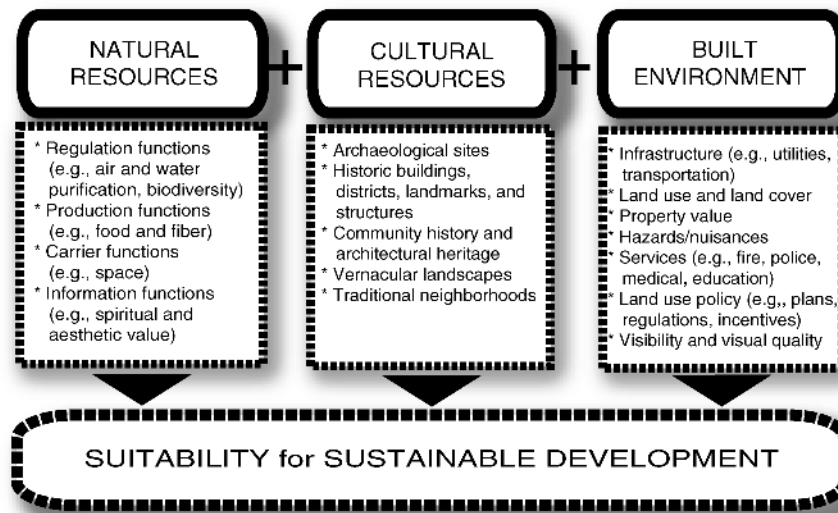
fraction of the building’s life-cycle costs. Yet, when just 1 percent of a project’s up-front costs are spent, up to 70 percent of its life-cycle costs may already be committed; when 7 percent of project costs are spent, up to 85 percent of life-cycle costs have been committed (Romm, 1995). Consequently, design excellence enhances community livability and sustainability, which benefits society, the economy, and the environment (Table 1-2).

1.4 EVIDENCE-BASED DESIGN

Communities change incrementally through a continual process of land development and redevelopment, largely through private sector real estate projects at the site scale. The development of unsuitable sites—or poorly designed development on otherwise suitable sites—can negatively affect a broad array of natural and cultural resources (Sanford and Farley, 2004). On-site impacts, for example, may diminish visual quality and reduce native plant and wildlife biodiversity. Off-site impacts may include traffic congestion, flooding, or pollution of local surface waters (Arnold and Gibbons, 1996). Because these externalities degrade the quality of life, local governments must play an active and informed role in guiding the location, intensity, and character of land development and redevelopment.

Each site’s carrying capacity is a measure of the type and intensity of development that can be supported without imposing detrimental effects on society, the economy, or the environment (Figure 1-4). A context-sensitive and sustainable approach to site planning pays close attention to development location. Site planning that is responsive to inherent environmental constraints can reduce construction costs, enhance critical ecosystem services,

Figure 1-4 Suitability for sustainable development is determined by existing patterns of natural and cultural resources, as well as by the built environment's physical attributes.



and protect intrinsic cultural resources. In *Guiding Principles of Sustainable Design*, the U.S. National Park Service (1993, p. 45) analyzes the potential environmental impacts of new park facility construction by seeking answers to these questions:

What inputs (energy, material, labor, products, and so on) are necessary to support a development option, and are the required inputs available?

Can waste outputs (solid waste, sewage effluent, exhaust emissions, and so on) be dealt with at acceptable environmental costs?

Can development impacts be minimized?

Sustainable design is inherently context-sensitive, minimizing negative development impacts by respecting the landscape's natural and cultural patterns and processes (Figure 1-5). In "Fostering Living Landscapes" (1997, p. 275), Carol Franklin writes:

It is the growing realization of the interconnectedness of development and environmental processes worldwide and within our communities that drives the evolution of sustainable design. At every scale, sustainable design is fundamentally about integrating the natural structure of the site with the built environment.

Visual literacy—the capacity to graphically communicate design problems, relevant contextual information, and potential solutions—is an essential skill in the planning and design professions. The ability to integrate ideas from different disciplines into a coherent whole and to communicate that information to others is also an important leadership skill (Gardner, 2006). Decision-support systems, which are commonly deployed in medicine and other applied professions, can help interdisciplinary teams make better decisions in planning



Figure 1-5 Sustainable planning, design, and management is a holistic approach to creating environmentally sensitive development and mitigating environmental degradation.

and designing the built environment. Analytical tools—including geographic information systems and three-dimensional modeling—can reveal relevant spatial and temporal patterns among interconnected natural and human systems.

The city of Portland, Oregon, has an Office of Sustainable Development whose mission is “to provide leadership and contribute practical solutions to ensure a prosperous community where people and nature thrive, now and in the future” (www.portlandonline.com/osd). Through research, outreach, technical assistance, and policy, the Office of Sustainable Development works to increase the use of renewable energy and resources, reduce solid waste and conserve energy and natural resources, and prevent pollution, and improve personal and community health.

The worldwide sustainability movement gained substantial momentum in the 1990s and 2000s by focusing on design principles and quantitative performance measures, or metrics at the community, neighborhood, site, and building scales. Five significant milestones in this transformative process are briefly summarized below.

1.4.1 Smart Growth

Making the built environment more sustainable and livable—through smarter land use planning and policymaking—creates more transportation options, more housing choices, and more walkable, mixed-use neighborhoods. Smart Growth principles can guide both public and private sector decision making (International City/County Management Association, 2002). These goals for shaping—and reshaping—the built environment are summarized below.

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- Preserve open space, farmland, natural beauty, and critical environmental areas by directing development toward existing communities.
- Foster distinctive, attractive communities with a mix of land uses, compact building design, and a strong sense of place.
- Create a range of housing opportunities and choices in walkable neighborhoods that provide a variety of transportation choices.
- Make development decisions predictable, fair, and cost-effective, and encourage community and stakeholder collaboration in development decisions.

Source: www.smartgrowth.org

Smart Growth, New Urbanism, and Landscape Urbanism are complementary—and, in many ways, converging—paradigms for shaping more livable and sustainable built environments. Each approach encourages the development of pedestrian-friendly communities that not only conserve but celebrate local cultural and natural resources. Certification systems have been developed to promote these goals by quantifying design outcomes. A small number of these systems is summarized on the following pages.

1.4.2 Leadership in Energy and Environmental Design (LEED)

In the United States, the Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ provides benchmarks for the design, construction, and operation of green buildings and related site development (see www.usgbc.org). LEED promotes sustainability by focusing on building and site performance in five areas affecting human and environmental health:

- Sustainable site development
- Water savings
- Energy efficiency
- Materials selection
- Indoor environmental quality

Green buildings are healthy places, in part, because natural daylight, good air quality, and plants tend to improve health and healing (Ulrich, 1991). Green buildings also improve educational outcomes, enhance employee job satisfaction and productivity, and cost substantially less to operate and maintain than conventional buildings (Russell, 1997; Stein, 1997).

Choosing locally sourced construction materials and implementing energy- and water-conserving technologies also reduce building impacts on the environment. Green design is good for business in other ways as well, such as improving market competitiveness by enhancing the customer's "experience" (Pine and Gilmore, 1999). Because unsustainable business practices can reduce profitability and competitiveness, sustainability is now an integral component of a business school education (Burch, 2001).

LEED's rating systems are voluntary guidelines that are incrementally improving the sustainability of the U.S. built environment. Current LEED guidelines for green construction include the following areas:

- New commercial and retail construction
- Existing building operations and maintenance
- Multiple buildings and on-campus building projects
- Neighborhood development
- Schools, homes, and healthcare facilities
- Major commercial renovation projects

1.4.3 LEED for Neighborhood Development (ND)

LEED for Neighborhood Development (ND) was created through a collaboration of the U.S. Green Building Council (USGBC), the Congress for the New Urbanism, and the Natural Resources Defense Council. This neighborhood rating system integrates the principles of Smart Growth, traditional neighborhood design, and green building design. Building and neighborhood performance are measured in several categories, including two that are particularly relevant to site analysis and related issues examined in this book.

Locations and Linkages

The Locations and Linkages credits encourage developers to build homes away from environmentally sensitive places and to locate them instead in previously developed and other preferable sites. These credits reward homes that are built near already-existing infrastructure, community resources, and transit facilities, and they encourage access to open space for walking, physical activity, and time spent outdoors.

Sustainable Sites

The Sustainable Sites category discourages development on previously undeveloped land, minimizes a building's impact on ecosystems and waterways, and encourages regionally appropriate landscaping. LEED-ND credits reward smart transportation choices, low-impact stormwater management, and efforts to reduce erosion, light pollution, the heat island effect, and construction-related pollution.

1.4.4 SITES™

Another set of voluntary guidelines and performance benchmarks has been recently developed for site design, construction, and maintenance practices. The Sustainable Sites Initiative™ (SITES™) is an interdisciplinary effort by the ASLA, the Lady Bird Johnson

Wildflower Center at The University of Texas at Austin, and the United States Botanic Garden. The guidelines and performance benchmarks established by SITES are expected to be incorporated into future revisions of the USGBC's LEED Green Building Rating System. The prerequisites and potential credits that can be earned through sustainable site design are summarized below.

Prerequisites and Credit Categories of the SITES Guidelines and Performance Benchmarks

1. **Site Selection** (21 possible points) Select locations to preserve existing resources and repair damaged systems.
2. **Predesign Assessment and Planning** (4 possible points) Plan for sustainability from the beginning of the project.
3. **Site Design—Water** (44 possible points) Protect and restore processes and systems associated with the site's hydrology.
4. **Site Design—Soil and Vegetation** (51 possible points) Protect and restore processes and systems associated with the site's soil and vegetation.
5. **Site Design—Materials Selection** (36 possible points) Reuse/recycle existing materials and support sustainable production practices.
6. **Site Design—Human Health and Well-Being** (32 possible points) Build strong communities and foster a strong sense of stewardship.
7. **Construction** (21 possible points) Minimize effects of construction-related activities.
8. **Operations and Maintenance** (23 possible points) Maintain the site for long-term sustainability.
9. **Monitoring and Innovation** (18 possible points) Reward exceptional performance and improve the body of knowledge on long-term sustainability.

Source: <http://www.sustainablesites.org>

1.4.5 STAR Community Index

A certification system that focuses on the community scale is the STAR Community Index, launched in 2012. It has been developed through a partnership between ICLEI-Local Governments for Sustainability (formerly the “International Council for Local Environmental Initiatives”), the USGBC, and the Center for American Progress (CAP). STAR Community Index is a consensus-based rating system for community sustainability (<http://www.icleiusa.org/sustainability/star-community-index>):

Much as LEED transformed the building industry, STAR will transform the way local governments set priorities and implement policies and practices to improve their sustainability performance. It will become the definitive means by which local governments measure and “certify” their achievements.

STAR indicators and metrics fall within three broad categories:

- *Natural systems* (ecosystems and habitat, water and stormwater, air quality, waste, and resource conservation)
- *Planning and design* (land use, transportation and mobility, and parks, open space, and recreation)
- *Energy and climate* (energy, emissions, renewable energy, and green building)

As the STAR system is implemented, participating communities can be expected to give greater scrutiny to the costs and benefits of land development and redevelopment proposals. This is likely to increase attention on the site plan review process—and on policies to ensure context-sensitive site planning and design.

1.5 SITE-PLANNING PROCESS

Site planning is the art of arranging the external physical environment to support human behavior. It lies along the boundaries of architecture, engineering, landscape architecture, and city planning, and it is practiced by members of all these professions. Site plans locate structures and activities in three-dimensional space and, when appropriate, in time.

—Lynch (1971, pp. 3–4)

Context-sensitive site planning is a multiphase process for making choices about where to build—and where *not* to build (Figure 1-6). It involves location-specific problem solving, based on a thorough understanding of the site’s cultural, legal, physical, and ecological milieus.

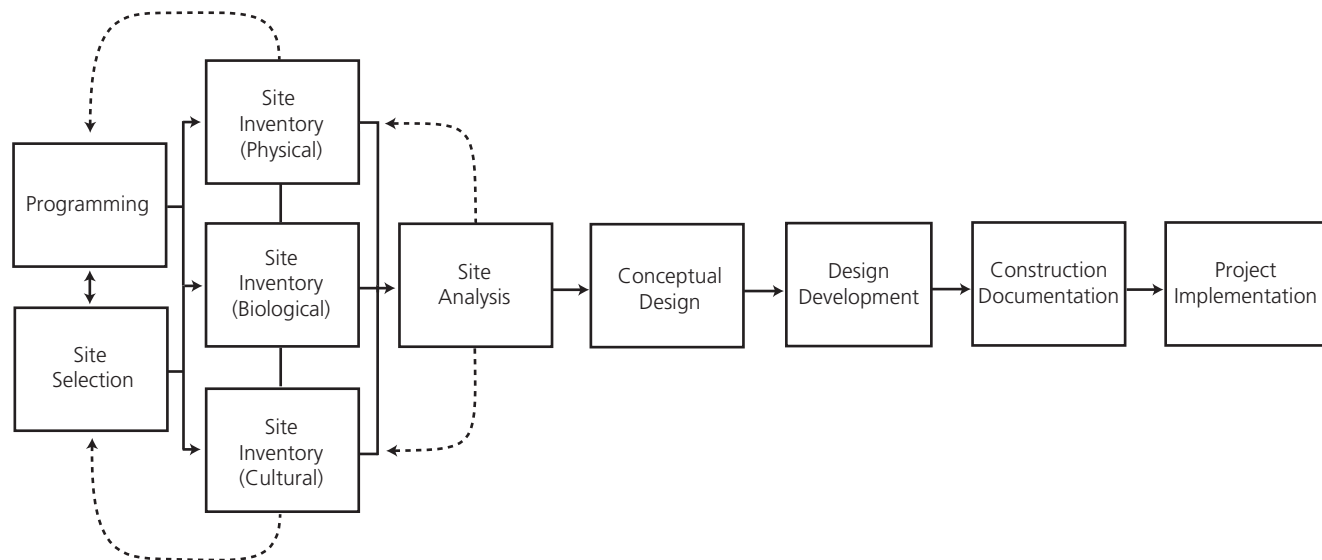


Figure 1-6 Site-planning and design process.

The combination of unique site conditions and multiple project objectives creates a complex design problem that may have dozens of potentially satisfactory solutions that meet all of the program's functional requirements. Yet, some of these solutions are better than others. Poor site planning often has unintended consequences, such as pedestrian-vehicle conflicts, human exposure to natural hazards, or pollution of streams and lakes.

Site-planning projects typically fall into three categories:

- Projects with no buildings
- Projects with one building
- Projects with two or more buildings

Projects with no buildings include parks, greenways, and other recreation areas. Introducing green infrastructure into the built environment is an increasingly important percentage of professional site-planning work. Yet, projects involving the siting of one or more buildings are probably more common. The design of these buildings and sites requires close coordination—particularly during the site analysis and conceptual design phases—between the project's landscape architects, architects, and engineers.

Context-sensitive site planning requires a broad set of knowledge and technical skills as well as a land use ethic to protect environmental quality and create healthy, livable, and sustainable places. A context-sensitive approach to land planning and management has a long tradition of prominent proponents and ideas, ranging from Aldo Leopold's "Land Ethic," a chapter in *A Sand County Almanac*, to Ian McHarg's classic *Design with Nature*, and, more recently, Jan Gehl's *Cities for People*.

1.5.1 Project Initiation

The growth and development of the built environment occur incrementally and may be initiated by clients in the private or public sector. Clients may be individuals, partnerships, or corporations, nonprofit organizations, or federal, state, or local governments. In some cases, a client may simply choose a firm that it has worked with in the past. Or the firm may be chosen for its reputation from prior completed projects, its specializations in the types of projects and services provided, or its proximity to the client and/or the site. In other cases, a client—especially if it is a government agency—may solicit firms with a Request for Qualifications (RFQ) or a Request for Proposals (RFP). Once the firm is selected, a contract for professional services defines the work to be completed. Typically, this contract includes a scope of services, a schedule for delivering the services, and a budget and payment schedule.

1.5.2 Site Selection and Programming

Land development typically occurs in one of two ways: clients have a site and then determine what and when to build on that site, or clients have a set of land use objectives and then find a site for those uses. Across the urban-to-rural continuum, parcels of land vary broadly in size, shape, character, and context. Site selection involves identifying and evaluating alternative sites and selecting the best site for the project's intended uses.

TABLE 1-3 Sample program elements for a housing project.

Building Height	Unit Density*	Number of Units (by type)			
		Studio	1BR	2BR	3BR
Three-Story	20 DU/AC	10	30	50	10
Five-Story	40 DU/AC	15	45	75	15

*DU = dwelling units. AC = acre (or hectare)

Source: Adapted from Affordable Housing Design Advisor (www.designadvisor.org).

Site-planning projects vary not only in their location within the urban-to-rural continuum but also in their planned site uses. A project on a large site, for example, might involve the construction of new streets, walkways and buildings. Another project might have no new construction but might focus instead on the conservation, restoration, and management of natural areas. Programming refines the project's objectives and defines its functional requirements, such as the proposed land uses, the area allocated for each land use, and the spatial relationships among those uses.

The program may be developed by the client alone, or with the help of consultants who have programming expertise. Programming often includes market analyses or user demand studies, and studies of relevant precedents. Once defined, the project's program helps to focus the subsequent site inventory and analysis and design process. The program for a multifamily housing project, for example, might include the number, type, and density of housing units planned for the site (Table 1-3). More details on site selection and programming are provided in Chapter 2.

1.5.3 Site Inventory

Good site planning requires an understanding of relevant contextual factors or attributes. In some contexts, a single site attribute will determine the suitability—or feasibility—of the site for a particular use. For any combination of program and site, there are always attributes that can be ignored to make the process more efficient. Deciding which attributes to assess and which attributes to ignore depends on at least four factors:

- Proposed site uses
- Existing on-site and off-site conditions
- Requirements for permits and approvals
- Costs of data collection and analysis

Collectively, these factors determine the scope of the site assessment, which may consider a broad variety of physical, biological, and social or cultural factors. These include existing pedestrian circulation patterns and vehicle traffic volumes, locations of underground utilities, and architectural styles within the surrounding built environment. Ecologists,

hydrologists, anthropologists, and other experts may participate in collecting, mapping, and evaluating site and contextual attribute data. On large sites, attribute mapping and analysis are particularly well suited for applications of computer-based geographic information systems.

Chapters 3, 4, 5, and 6 examine the site inventory process in greater detail.

1.5.4 Site Analysis

A site inventory—the process of mapping the site’s relevant physical, biological, and cultural attributes—is not a site analysis. A vegetation map, for example, may show the site’s existing conditions for a single attribute—the locations of plant communities and, perhaps, individual specimen trees. This map, like other inventory maps, is valid, regardless of the uses that might be considered for the site. The fate of the existing vegetation depends, in part, on the intended uses or program for the site.

Site suitability for a *specific* land use or combination of land uses is a function of the site’s assets and liabilities—or opportunities and constraints. Many physical, biological, and cultural factors can influence the site’s suitability for the project under consideration. Site assets (Table 1-4) may be unique natural or cultural resources that contribute to the site’s sense of place within the community or region. Conversely, site liabilities could include soil contamination from prior commercial or industrial uses. In this case, the site analysis can assess whether environmental remediation is needed, what action should be taken to protect adjacent properties from contamination, and what buildings and infrastructures can be used or recycled (Platt and Curran, 2003).

Information from the site inventory must be integrated and synthesized to assess the site’s suitability for specific program objectives (Figure 1-7). Design influences may range from municipal development regulations to biophysical and cultural features on or near the site. Mapping the project’s opportunities and constraints helps to inform sustainable site planning. A good site analysis can also encourage collaboration among the allied professions working on the project (Figure 1-8). More detailed information on this process is provided in Chapter 7.

1.5.5 Conceptual Design

Conceptual design, the process of adapting the program to the unique features of the site, flows directly from the site analysis. Concept plans spatially organize the project’s proposed uses on the site. Major program elements—and important existing conditions—are shown diagrammatically on the concept plan. Circulation pathways are often portrayed as arrows, and major uses or activity zones are portrayed as polygons, or bubbles.

Creating two or more concept plans, or bubble diagrams, is helpful in exploring site design options. If one concept is superior to the others, then the evidence supporting the best alternative will be more persuasive when compared to feasible, but less desirable, alternatives. Frequently, the best concept is a hybrid plan that is created by merging features from two or more alternative concepts. Chapter 9 includes examples of concept plans and a more detailed discussion of conceptual site design.

TABLE 1-4 Hazards, constraints, or nuisances that may influence site selection and site planning and design.

Categories	Hazards	Constraints	Nuisances
Physical	Flooding Storm surge Hurricane Earthquake Landslide Volcano Avalanche	Shallow bedrock Shallow water table Erosion susceptibility Hardpan soils Expansive clay soils Open water Wetlands Aquifer recharge areas Springs and seeps Steep slopes	
Biological	Wildfire	Endangered species	Insects
Cultural	Toxic waste Unstable fill	Wellheads Historic sites Archaeological sites	Harsh views Odors Noise

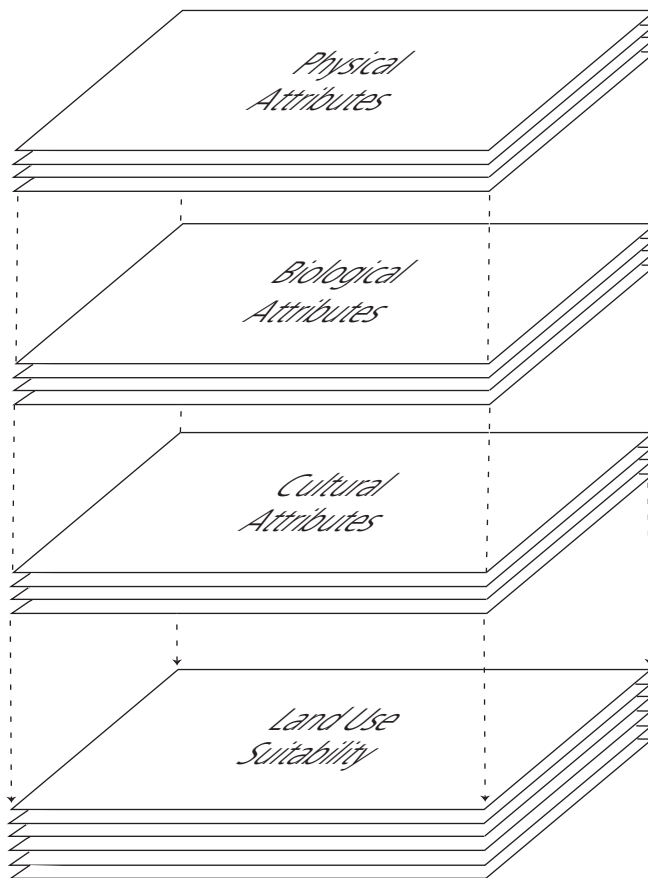


Figure 1-7 Relationship between attribute mapping and land use suitability analysis.

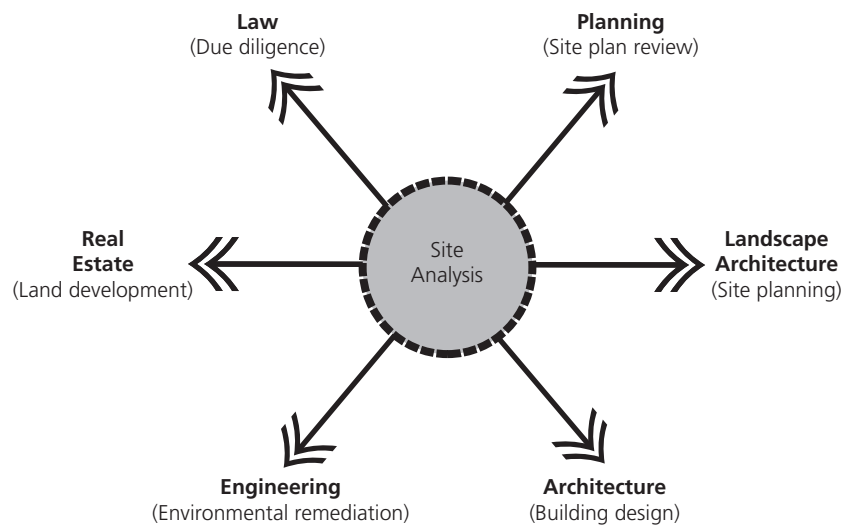


Figure 1-8 Information from the site analysis is used by many professions engaged in the site planning, design, and development process.

1.5.6 Design Development

The design development process refines the site concept plan. Regardless of the project's program, design development involves documenting—usually with plans, sections, elevations, and three-dimensional perspectives—how the plan's components functionally relate to one another. Subsequent design iterations refine the organization and articulation of buildings, walls, parking lots, pathways, and other “hard” and “soft” spaces on the site.

Depending on the location and scope of the project, approvals and permits may be required from government units at the local, state, or provincial and national levels. Local governments, especially, play a significant role in shaping the built environment through the site plan and development review process. More information about the design development phase is presented in Chapter 9.

1.5.7 Project Implementation

Project implementation is the process of converting a design vision into a real built environment. Typically, this requires construction documents (CDs), which consist of construction drawings and written construction specifications. CDs serve as the basis for construction cost estimates and construction contracts. Once this documentation is complete and the necessary financing and approvals are acquired, the project can be built. The CDs can also ensure that the constructed project accurately reflects the approved designs.

Construction Drawings

Construction drawings include plans, sections, elevations, and details. Four plans, in particular, provide essential information about the site's existing and proposed conditions:

Layout plan (horizontal control): locates buildings, streets, and parking areas, walkways, utility lines, and other site elements in relation to the site's boundaries and other existing built and natural elements.

Grading plan (vertical control): locates existing contours (dashed lines), proposed contours (solid lines), and proposed spot elevations at high and low points, and locates pavement corners in relation to a local elevation benchmark. Drainage swales and storm drain systems are also included.

Utilities plan (subsurface and surface utilities): locates sanitary sewer systems, on-site wastewater disposal and treatment systems, drinking water distribution lines, electrical supply lines, lighting, and telecommunication cables. Typically, the utility plan specifies type (for example, sanitary sewer) and size or capacity (for example, pipe diameter).

Planting plan (trees, shrubs, vines, and groundcover): locates existing and new vegetation, including the desired spacing between new plantings. Plant quantities, sizes, and root conditions are included in a table or schedule.

Other plans that may be included in the site construction documents are as follows:

Demolition plan (site preparation): for infill sites especially, identifies the buildings, utility structures, and other site elements that will be either removed, protected, or retrofitted.

Irrigation plan: locates the site irrigation system, although sustainable site design minimizes the need for supplementary irrigation by specifying well-adapted native and naturalized plant materials.

Erosion and sediment control plan (ESC): in some jurisdictions, an ESC must be submitted before development permits can be issued (United States Environmental Protection Agency, 1993). Typically, an ESC includes a description of predominant soil types and provisions for preserving topsoil and limiting soil disturbance.

In addition to these plans, construction details provide supplementary information on the specified construction materials and methods (Strom et al., 2004). Depending on the site structure or element designed, construction details may be in the form of plans, sections, or elevations.

Construction Specifications

Construction specifications supplement the construction drawings and include information that is typically conveyed in report form rather than on the construction drawings. The *general specifications* cover bidding requirements, required insurance and bonding, as well as incentives for completing construction before the final completion date. Competitive bidding is practiced by public clients for all but small projects and by private clients for most large projects (Sauter, 2005). Contractors bid to complete the project that is conveyed by the construction documents.

The *technical specifications* are written descriptions of the procedures and materials required to build the project. They include information about the quality of materials, construction

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methods and standards, and work safety requirements. Many of these requirements are based on government or industry standards, including those of the American Society for Testing and Materials (ASTM).

Contract Administration

Construction supervision is the responsibility of the general contractor and the various subcontractors building the project. This work may involve earth moving and demolition of existing buildings; construction of new buildings, roads, utilities, and other site structures; and plant community restoration and landscaping. Typically, the designers, whether landscape architects, architects, or engineers, work on behalf of the client. These consultants or agents protect the owner's interests through contract administration, which ensures that the project's implementation reflects the approved plans and construction documents.

Permitting and Approvals

If design skills were easy to acquire and universally applied in shaping the built environment, there would be little need for land development controls. In the real world, however, poor design is far too common, resulting in assorted social, economic, and environmental impacts.

Local government's primary purpose is to protect public health, safety, and welfare. Municipalities may try to achieve these objectives in four ways (Chapin and Kaiser, 1985):

- *Land use planning* (for example, a comprehensive plan and a capital improvements plan)
- *Public investment* (for example, transportation and utility system infrastructure, parks, and open spaces)
- *Regulations* (for example, zoning and subdivision ordinances and building codes)
- *Incentives* (for example, preferential taxation and zoning bonuses)

Collectively, these plans and policies determine if, when, where, and how land development can occur. If the work is not completed as approved, the local governing agency can require that the deficiencies be adequately addressed before issuing the project's "Certificate of Occupancy."

1.6 PROFESSIONAL COMPETENCY

Several professional licensing and certification exams assess the knowledge, skills, and values that inform the practice of competent site planning and design. Competency is tested on the professional licensing exams for architects (NCARB, 2005), landscape architects (CLARB, 2006), and civil engineers (NCEES, 2009) and on the certification exam for urban planners (AICP, 2011). These exams recognize the complexity of site planning and test for competence in several relevant areas, as briefly illustrated below, that vary by profession.

1.6.1 Landscape Architecture Registration Exam (LARE)

The Landscape Architect Registration Exam (LARE) covers several topics integral to site planning, including the following:

Problem Definition (for example, techniques to elicit client and user intentions and needs)

Programming (for example, how to develop a project's design program)

Inventory (for example, knowledge of planning and land use laws including zoning, development restrictions and design guidelines, accessibility regulations, natural features, cultural features, characteristics of plant material, land information sources, and the political and regulatory approval processes)

Analysis (for example, factors influencing the selection of plant materials; human and natural factors influencing design; social and cultural influences on design)

Site Design (for example, developing site or land use plans that take into consideration the off-site and on-site influences on development; creating a site design that considers various codes, consultant studies, and principles of sustainability)

The Council of Landscape Architectural Registration Boards (CLARB) conducted a task analysis of the profession of landscape architecture in North America to determine the types of work performed by practicing landscape architects. The respondents were asked to identify their work tasks and rank them in terms of each activity's perceived contribution to the protection of public health, safety, and welfare (the primary justification for state licensing laws for landscape architects, architects, and other professions). Five of the 11 most important tasks—including 2 of the top 3—involve site selection, programming, or site analysis (Table 1-5).

1.6.2 Architect Registration Exam (ARE)

According to the National Council of Architectural Registration Boards (NCARB, 2005, p. 36), the Architect Registration Exam (ARE) tests for the ability to

TABLE 1-5 Partial results of a survey of more than 2000 randomly selected landscape architects: Self-assessment of work tasks (by rank) that affect public health, safety, and welfare.

<i>Rank</i>	<i>Task</i>
2	Identify relevant laws, rules, and regulations governing the project.
3	Evaluate natural site conditions and ecosystems (for example, slopes, wetlands, soils, vegetation, climate).
6	Identify required regulatory approvals.
10	Evaluate the capability of the site and the existing infrastructure to support the program requirements.
11	Elicit user's intentions and determine needs.

Source: CLARB (1998, p. 7).

[d]elineate areas suitable for the construction of buildings and other site improvements responding to regulatory restrictions and programmatic requirements . . . and define a site profile and maximum buildable envelope based on zoning regulations and environmental constraints.

The ARE also expects registered architects to integrate “human behavior, historic precedent, and design theory in the selection of systems, materials, and methods related to site design and construction.” Subjects tested on the ARE include:

Programming Planning and Practice

Site Planning and Design

1.6.3 Fundamentals of Engineering (FE) Exam

According to the civil exam administered by the National Council of Examiners for Engineering and Surveying (NCEES), examinees are tested on multiple subjects that influence—or are impacted by—site planning, design, and construction in the built environment. These include:

Hydraulics and Hydrologic Systems (for example, infiltration, runoff, detention, watersheds, storm sewer collection systems)

Soil Mechanics and Foundations (for example, soil-bearing capacity, slope stability, soil stabilization, retaining walls)

Environmental Engineering (for example, ground and surface water quality, environmental regulations)

Transportation (for example, traffic analysis and control, street intersection design, pavement design)

1.6.4 Certified Planners Exam (CPE)

There are 3142 counties and thousands more municipalities in the United States. Although the names vary from state to state, government bodies that review land development proposals include city councils, planning commissions, urban design commissions, village and town boards, and zoning boards of appeals. A recent APA survey of training programs for planning commissioners found that 69.5 percent of the APA-sponsored programs addressed site plan review.

The site development permitting and approval process requires support from qualified staff members who perform site plan reviews and advise the planning commissioners. Typically, many of these professionals are, by training, urban planners.

The Comprehensive Planning Exam (CPE) administered by the American Institute of Certified Planners (AICP) expects planners to be familiar with a broad range of site-planning issues. The CPE includes the following topics:

Plan Making and Implementation (for example, environmental analysis; development plan and project review; program evaluation; communication techniques)

Spatial Areas of Planning (for example, corridor planning, neighborhood planning, waterfront planning, and downtown planning)

1.7 CONCLUSION

Land use suitability is not uniformly distributed across the earth's surface. Each site has a unique set of physical, biological, and cultural attributes, and some of these attributes limit the site's suitability for certain uses. Consequently, a comprehensive understanding of each site and its context is a necessary precursor to good site planning and design. If the site's existing contextual conditions are poorly understood, the site's development may detrimentally impact people, property, and the environment. Or, more commonly, opportunities to maximize the site's social, economic, and environmental value will be missed.

QUESTIONS

1. What distinguishes sustainable design of the built environment from more conventional design paradigms?
2. How does a site inventory differ from a site analysis?
3. What additional competencies could be tested on professional licensing exams to potentially improve the design of the built environment?

