chapter 3

Sustainable Land Planning

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To get it right, it is essential to start green office development with sustainable land planning for the site. Doing so can produce positive benefits for all aspects of project development—energy use, water conservation, the indoor environment, open space, and alternative choices of transportation. Planning a site with sustainability in mind can also help ensure easier approval and entitlement in environmentally minded jurisdictions with green requirements, and it can reduce costs over the life of a project.

To take full advantage of these benefits, green planning and design require the professional expertise of landscape architects and planners plus a multidisciplinary analysis of the full spectrum of site issues, large (global, regional, and community) to small (property specific), followed by a collaborative process in which the developer, architect, planner, landscape architect, engineer, and other consultants are partners in environmentally responsible planning and design decisions.

The site of the San Rafael Corporate Center required environmental remediation, but it offered easy access to regional transportation and downtown San Rafael's shops and restaurants. Tom Fox, SWA Group

Site Selection

Ideally, the first step in green site planning is to select a site appropriate for sustainable office development. In many cases, the site may have already been purchased or selected, but in those cases where a property has not yet been acquired, site selection is one of the most powerful tools for a truly sustainable development.

In selecting a green site, the developer should examine regional and community issues that could affect development, including the location of the site in relation to man-made community facilities and transportation and natural systems such as open-space networks. Preferably, office sites should be near existing residential areas or within a compact development to lessen employees' commutes and to lower the resulting energy use and air pollution. The community's utility capacity should be examined to ensure that capacity is sufficient to support office development on the site. Utility capacity that must be enhanced with on-site or off-site measures directly affects the green land plan and potentially lessens the project's sustainability.

Recognizing the city's interest in reducing vehicular traffic, Veritas Software's corporate campus was oriented toward the southeast corner of the property, directly across from the light-rail station. In addition, pedestrian pathways provide direct circulation to destinations within the campus, to the transit station, and to adjacent businesses so Veritas employees and nearby workers can walk to work, lunch, and meetings. Tom Fox, SWA Group

Choosing to build within an existing community or on previously developed land helps to avoid sprawl and to maintain existing open-space patterns, both key environmental considerations. Many infill sites and brownfields, for example, have excellent access to both public transportation and utilities, and they may be large enough to also provide good solar access. The site analysis addresses whether environmental remediation is needed, what action should be taken to protect adjacent properties from contamination, and what buildings and infrastructure can be recycled or used.

The 15-acre (six-hectare) site selected for the 450,000-square-foot (41,800-square-meter) San Rafael Corporate Center in Marin County, California, for example, was adjacent to a regional transportation center and within walking distance of downtown shops and restaurants. The property, however, had previously been used by an electric substation, leaving behind many different toxins in the soil that had to be remediated. In addition to environmental remediation, the green land plan also included restoration of the adjacent Mahon Creek habitat, which provides new recreational opportunities, primarily trails, along the creek.

Any green office development should be planned to enhance the surrounding neighborhood. To that end, site selection should examine issues such as the impact of the development on surrounding areas and on local streets.

Veritas Software, the single largest vendor of storage management software, built its corporate campus in Mountain View, California, south of San Francisco, on a 20-acre (eight-hectare) site adjacent to a new light-rail station. As the property was surrounded by offices but no shops or restaurants, the land plan provided commercial services (a café, a health club, and convenience retailers) in an on-campus public zone adjacent to the station. Pedestrian pathways throughout the campus now enable Veritas and nearby workers to walk to lunch rather than drive.

Site Analysis

Whether a property has been acquired specifically for the development of a sustainable office project or the land was already part of a developer's or corporation's portfolio and is now slated for development, green land planning and development begin with a comprehensive site analysis before a single plan is drawn.

An environmental sensitivity analysis begins with a site survey that looks at the property's geology, climate, topography, soils, hydrology, and biology. An effective tool for the site survey is Geographic Information Systems (GIS), which identifies regional and site issues that should be addressed in the sustainable land plan. One product of the analysis is a development suitability map of the site, of paramount importance for a green land plan. The map guides decisions about where development should be located on the site.

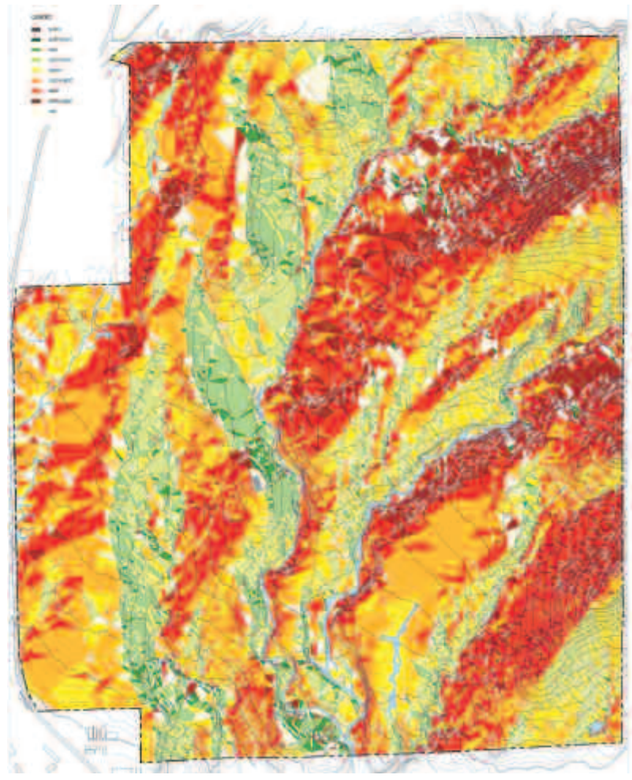
Careful study of the property's natural systems helps to determine the carrying capacity of the land and the site's sensitivity to development. Some portions of the property, for example, will likely be more suitable for buildings and parking than others. Determining the most appropriate land for development also usually ensures an easier permitting process and helps to begin defining the property's open space.

The site analysis should also include a sensitive lands assessment to identify plant and wildlife habitats and set aside (or create) habitat conservation areas, safeguard indigenous plants and trees, and specify areas for office development on noncritical habitat lands. The law requires developers to protect endangered species, but green land planning should go far beyond the law to protect site-specific species.

A site survey identifies potential hazards—earthquake faults, slide areas, underground caverns, rock outcrops—as well as the location of the water table and groundwater and aquifer recharge areas. It also helps to locate and record topographical features, including subsurface rock formations (which are expensive to build on), elevations, utilities that serve or cross the property, trees, rights-of-way, property lines, and other issues that directly affect green land planning. The site survey should include a slope analysis that details how the site's topography connects to larger landforms as well as the property's sun and view orientation. Thus, the green planning team can use the land's features to establish the site's development patterns and help save dominant ridges, prominent high points, and the overall integrity of the land and its environment.

Soil borings provide data on the condition and weight-bearing capacity of the land, which affect building foundation and roadway design, and identify the presence of hazardous materials, salinity, fertility, compaction, and ease of grading. Healthy soils that are full of life and appropriate for development can support strong vegetation, easier on-site drainage systems, and more reasonable development costs.

The regional hydrology systems—from the watershed to underground aquifers, streams, lakes, and floodplains—affect a site in many ways, from supplying water that can be pumped by wells, to creating wetlands that cannot be developed but can provide an important amenity, to periodic flooding. Land development can also affect the



An aspect map, such as the one shown here for Stone Ridge Ranch in Chico, California, provides an analysis of solar conditions at various points throughout a site to guide the design

Exxon Mobil preserved existing woodlands and wetlands, added new water features, and reforested greenways at the company's headquar-

regional hydrology system in many, usually negative, ways by, for example, draining an aquifer, paving over a floodplain (which increases flooding), and redirecting water flow outside the natural system.

Conducting a watershed analysis helps to identify the prevailing hydrologic patterns of the region and how they affect a particular site. The EPA now has a Web site (www.epa.gov/surf) that locates any property's watershed. Essential data include the quantity of water entering and leaving the site and identification of any natural waterways, streams, or drainageways on or adjacent to the property, as well as flood zones and FEMA (Federal Emergency Management Agency) mapping or other sources that provide insight into periodic upstream events. By understanding these patterns, the planning and design team can quickly and easily determine what hydrology strategies are necessary and what development is and is not appropriate for the land to minimize or avoid any negative impact to the regional watershed.

Green land planning also includes preserving the water regime or, if it has been altered or damaged, restoring the natural system. This requirement could involve renovating drainageways, revitalizing stream corridors, and reintroducing appropriate vegetation to filter and retain any additional runoff created by planned buildings and parking. A site survey helps to determine if such work is necessary.

Rainfall patterns affect green land planning. A property in an area that has a heavy annual rainfall, for example, needs engineering water systems like detention basins and bioswales to retain and clean the water and help avoid flooding. In drier climates, engineering water systems are needed to capture rainfall and recycle water for irrigation. As the green land plan must ensure a zero net increase in stormwater runoff, a rain analysis is of great importance and can be extensively used in planning the site's hydrology and stormwater management systems.

Green land planning includes the promotion, maintenance, and perhaps the restoration or reestablishment of native vegetation on the site. Thus, the environmental sensitivity analysis should include a study of the historic patterns of native vegetation and critical habitat on the site and a survey of existing native plants and invasive vegetation that may harm the quality of the habitat. This analysis guides land planning and design so that they provide high-quality habitat for terrestrial species, aquatic species, and underground species in the form of corridors and patches (stopping places for hunting and migratory species).

A site's animal species require a certain character of ecosystem in which to live or move through. A regional study identifies endangered species and their habitats, and local environmental agencies determine what habitat planning and design should be done. Nonendangered species also require a specific ecosystem. A study of those species on site will form the basis for the planning and designing of suitable habitat.

Sustainable Site Planning

Once a site suitable for sustainable development is acquired and the various site analyses have been studied, the planning team can begin creating a site plan for the project using information provided by those analyses in conjunction with market research, a tenant needs assessment, and an understanding of broader regional issues.

The USGBC's LEED program can help guide the project. LEED evaluates and certifies a facility's sustainability and environmental performance over a building's life cycle based on five broad categories: site, water, energy, materials, and indoor air quality (see Chapter 1). To earn LEED certification, new office facilities must address six different categories—sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation and design process—potentially earning a total of 69 points. "Sustainable Site" makes up 14 of those points.

LEED criteria address major site planning issues—erosion and sedimentation control, alternative transportation and public transportation access, brownfield redevelopment, the reduction of light pollution—and they provide guidance on how to earn the necessary points for certification. LEED, for example, requires that the office site be located within one-half mile (0.8 kilometer) of a commuter rail, light-rail, or subway station or within one-quarter mile (0.4 kilometer) of two or more public or campus bus lines.

To meet the goal of reduced site disturbance, LEED requires limiting greenfield site earthwork and the clearing of vegetation to 40 feet (12 meters) beyond the building perimeter, five feet (1.5 meters) beyond the primary roadway curbs, walks, and main utility branch trenches, and 25 feet (7.6 meters) beyond constructed areas with permeable surfaces. To reduce light pollution, LEED requires that the project meet or provide lower light levels and uniformity ratios than those recommended by the Illuminating Engineering Society of North America by using full cutoff luminaries, low-reflectance surfaces, low-angle spotlights, and appropriate building orientation, interior design, and landscaping.

Additional LEED products are now under development, including one that will address neighborhood development, Smart Growth criteria, and site criteria for streets, infrastructure, and historic and ecological restoration.

Building Location and Orientation

Sustainable site planning balances the environmental sensitivity and amenities of the site with building configuration, parking needs, access, views, and regulatory requirements (maximum density, height, and setback) to create a green

land plan that is functional and also responsive to users' needs. The developer, architect, engineer, and other project consultants must collaborate on siting the buildings and their overall form and orientation. A critical goal in this exercise is to allow for flexibility in the site and building program for future uses in anticipation of shifting priorities and changing market dynamics.

By following the footprint of the industrial building previously on the site, site grading was minimized in the construction of Kunming Communities in Kunming, Yunnan Province, China. Tom Fox, SWA Group

Buildings and other major structures should be located only on those portions of the site found suitable in the site analysis for intensive development. If the overall site is adjacent to transit or compatible mixed uses, buildings should be located to reinforce those positive relationships and forge connections to adjoining developments.

When land planning green on a previously developed site, look for opportunities to locate facilities on already disturbed lands to conserve existing open space. Disturbed lands can range from building foundations to parking lots or exotic landscape. In Kunming, China, for example, the land plan for a 20,000-square-foot (1,860-square-meter) multiple-use building on the site of a former brick-making factory follows the same footprint as the factory, which saves existing ravines and open meadows on the site from grading and potential degradation.

Solar intensity, exposure, and orientation on the land partially determine where buildings and other facilities are sited on the property. In cooler climates, buildings and main outdoor spaces should be given a southern orientation to reap the sunlight's warmth. In hot climates, buildings and main outdoor spaces should be given a northern or east-west orientation (with the use of sunshades on facades with the most solar exposure) to avoid the greatest impact from the sun.

Depending on regional wind patterns, the green land plan should orient internal streets, pedestrian paths, and other facilities to take advantage of the wind or to protect those facilities from the wind. Generally, tenants and visitors need to be protected from northerly and other prevailing winter winds and cooled by summer breezes. If the site has hillsides, for example, or is adjacent to hillsides, buildings can be sited so that the hills provide protection from the wind.

Views and opportunities for access to open space, whether a hill, meadow, river corridor, or woods, are important amenities for building occupants. A viewshed analysis helps determine building location and orientation to reap the best views from locally or regionally significant land forms. The Gap building in San Bruno, California, for example, was oriented to give tenants views of the nearby golden hills.

When green land planning a major office project, remember that how much you build is just as important as what you build. Sustainable planning should minimize the amount of on-site infrastructure, from roads to utilities, limit large areas of impermeable paving to reduce peak stormwater runoff flows and promote groundwater recharge, reduce the development footprint, and focus on compact building development. LEED criteria for urban redevelopment (building, roads, parking) encourage a minimum density of 60,000 square feet per acre (13,775 square meters per hectare) or a floor/area ratio of 1.38, which in most cases would require structured parking.

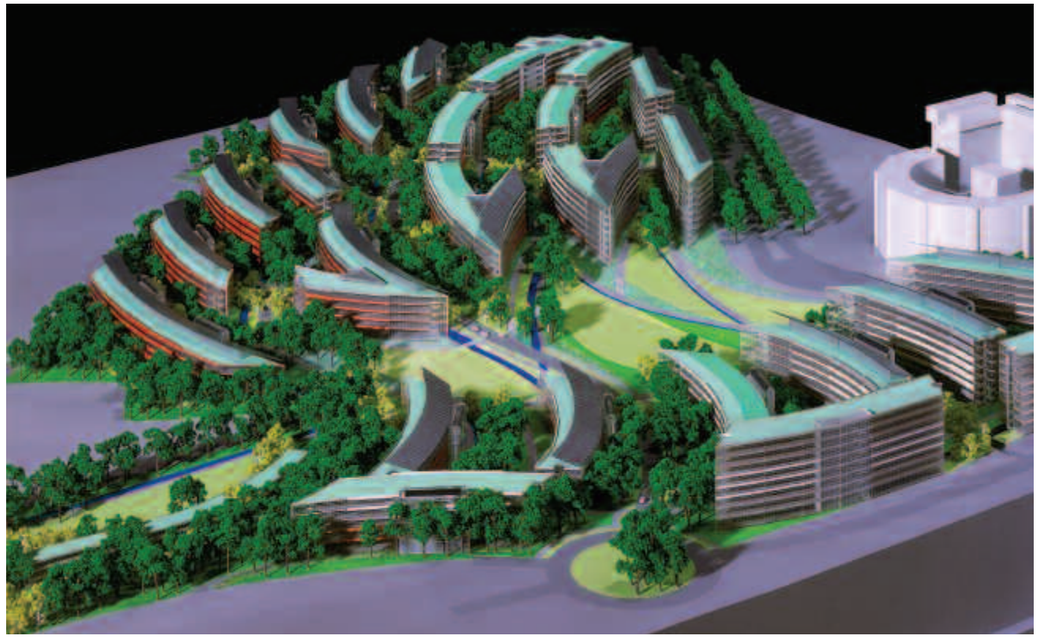
Density in a green land plan is about creating a smaller development footprint and increasing the opportunities for high-quality, connected open space. Building up rather than sprawling out is typically the best choice for a sustainable site plan, because it helps mitigate potential environmental, regional, and neighborhood issues.

Topography and Grading

The property's topography—including slopes, dominant land forms, and soil composition—has a dramatic impact on green office development. The green land plan should create an office development that seems to have grown out of the land, which is achieved primarily through landscaping and grading that respects and mimics the surrounding landscape. A slope analysis and elevation study provides a critical guide for how the site should be used and where development should occur to minimize any negative impact from development.

More and more often, office construction takes place on previously developed land or on land previously used for agriculture. Thus, the green land plan should include (in some jurisdictions it is mandated) reconstruction of the site's natural topography and replanting of the native vegetation. This reconstruction also affects where development occurs on the property and how it is built so that the property once again becomes part of the functioning regional open space and habitat system.

The former Orlando Naval Training Center in Florida is being redeveloped into a 1,100-acre (445-hectare) mixed-use community that includes business parks. A key component of the master plan is the restoration and expansion of wetlands and lakes on the former base and the extension of that system to a larger regional lake and park system, creating important wildlife habitats, open-space corridors, and community amenities.



At the Horizon Paris mixed-use development outside Paris, buildings are placed along the natural contours of the sloping site to min-

Sustainable land planning sets a building into the site in a manner that causes the least possible disturbance to the land. The less grading required by building construction, the less money is required to import dirt and restore the natural conditions of the site. LEED criteria limit site disturbance to less than 50 percent of the property.

Grading can be minimized with strategies like locating buildings on less steep land and using contour grading; that is, roadways and building sites follow the topographical contours of the land, reducing the amount of grading, maintaining a sense of the natural land forms, avoiding large retaining walls, and supporting revegetation and thereby reduce erosion, protect the natural environment, and maintain natural hydrology processes, open-space patterns, and wildlife habitat.

Grading can also be used to strengthen a green land plan by creating drainage swales to handle stormwater runoff or building berms that can act as noise and/or wind barriers. The grading strategy for the 68-acre (27.5-hectare) McCarthy Ranch business campus in Cupertino, California, met the city's mandate for no net increase in stormwater runoff through a series of gently graded surfaces that meet at drainage swales, where water is polished and allowed to settle before groundwater is recharged. This grading strategy worked with the landscape plan to create a pattern of terrain—a series of fingers at the lowest elevation—in a landscape plan that gives the parking areas a softer aesthetic. It also saved construction costs on infrastructure components such as pipes.

In most metropolitan areas, much of the prime flat land has already been developed, so design teams often must create a green land plan for a hillside parcel. In this case, the land plan and architectural design must work together. A thorough slope map should help clarify what portions of the property have the capacity to support development.

Strategies to minimize the negative impact of development on a hillside include pier-on-grade foundations (in which the uphill side of a building is on grade and the downhill side is supported by piers), retaining walls, and split-level architecture.

The Horizon Paris is a mixed-use development under construction on a 53-acre (21.5-hectare) infill parcel at the eastern end of Marne-la-Vallée near Mont d'Est outside Paris, France. The site has slopes of up to 10 percent, quite steep for the high-density development planned for the property, and clay soils that exacerbate stormwater runoff from the site, causing flooding into the nearby Marne River. The land plan, however, has successfully surmounted these challenges. First, to mitigate the steep slope without leveling it, the planners specified the development of traditional European-style office buildings, which are usually just 50 to 60 feet (15 to 18 meters) wide. The architects then elongated and curved the buildings and located them along the natural contours of the slope, minimizing both the grading and excavation that had to be done.

Second, to better manage stormwater, the planners again turned to French tradition. The drainage system is a series of flat surface canals that move back and forth across the site along the natural contours of the hill. Cascades (stairs or steps) also carry water down the slope. Holding or detention basins further slow the flow of water through Horizon Paris. A walkway system ties the canals and cascades together, helping to both unify the site and provide an important pedestrian amenity. This combination of old and new stormwater management systems not only helps prevent flooding but also creates a distinct identity for the mixed-use development.

Erosion Control

Erosion can be controlled during and after construction with green strategies like silt fencing (a textile fence attached to wooden stakes) and straw bails to reduce sediment runoff during construction. In addition, rapidly growing but temporary plants help hold the slopes. Over the long term, it is helpful to implement erosion control strategies that provide dual benefits. Landscaping with deep-rooted plants, for example, helps hold the slopes and beautifies the property.

A manmade system of lakes, wetlands, and a central greenway serves as both an amenity and a stormwater management system at the Meridian Business Campus

Bioengineering—the use of groundcovers, shrubs, and trees—can help control erosion on sloped areas. Live-staking uses bundles of natural materials held in place, or staked, by deep-rooted plants to help hold the slope in place. Willow waddles, for example, combine willow cuttings with quick-growing willow plantings.

Erosion control devices such as open-core concrete blocks or textile fences can hold the slopes while plants are developing root systems. Geosynthetic materials like Enkamat are an alternative to the use of rigid concrete or rip rap to stabilize the slope and control erosion. These products support the growth of strong vegetation for permanent erosion protection of slopes, rivers, banks, ditches, channels, spillways, landfills, shorelines, and other vulnerable or erosion-prone areas.

Bioswales, water detention devices, gravel filters, and other stormwater management strategies can reduce the velocity of water flowing over the site, minimizing erosion and supporting absorption.

Stormwater Management

The overall goal of a green land plan's stormwater management system is no net increase in the rate and quantity of stormwater runoff from the site. The basic strategy is to reduce the amount of stormwater peak flow, runoff volume, sediments, and pollutants generated on site.

Several planning strategies discussed earlier can support this strategy; for example, a reduced development footprint, which allows the natural processes of evaporation and infiltration to continue on site, or the reduction of impervious surfaces. Other solutions include the construction of water detention and retention systems on site.