8
Alternative Futures for Monroe County, Pennsylvania: A Case Study in Applying Ecological Principles

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Several years before the Ecological Society of America's principles and guidelines were published, Monroe County, Pennsylvania, was the subject of a study conducted by researchers from the Harvard University Graduate School of Design in collaboration with representatives of the U.S. Environmental Protection Agency and the county government. That study analyzed the trends of growth in Monroe County, determined the possible effects of that growth, and provided some insight into how that growth might best be managed. The study was conducted from a planning perspective and an ecological perspective, but it reflected a number of ecological concerns. It identified six key issues (geologic landscape, biologic landscape, visual landscape, demographics, economics, and politics) as necessary points of discussion, decision, and action. The research derived six alternative futures for a time 25 years hence. These alternative futures were determined by modeling the results of (1) following the county's comprehensive plan, (2) allowing development to be market-driven, (3) pursuing the strategic development of each township, (4) adopting a policy of land conservation with an emphasis on outdoor recreational opportunities, (5) concentrating new development in a corridor served by public transportation, and (6) conserving all existing undeveloped land. These six possible patterns of future land use reflected a spectrum of natural resource uses over a broad area. Models of the six selected processes of growth and development produced maps of expected development outcomes, allowing the citizens to visualize the consequences of such changes and to progress through a series of decisions in an informed manner. This process allowed decision makers to consider how changes to the environment would affect the future of their county.

Monroe County in northeastern Pennsylvania lies in the "heart of the Poconos." Its beautiful scenery and year-round recreational opportunities have made it an ideal destination for tourists for the past 100 years. Recently, these valuable landscape resources and improved transportation have attracted new residential development, making Monroe County the second-fastest-growing county in Pennsylvania. An estimated 90,000

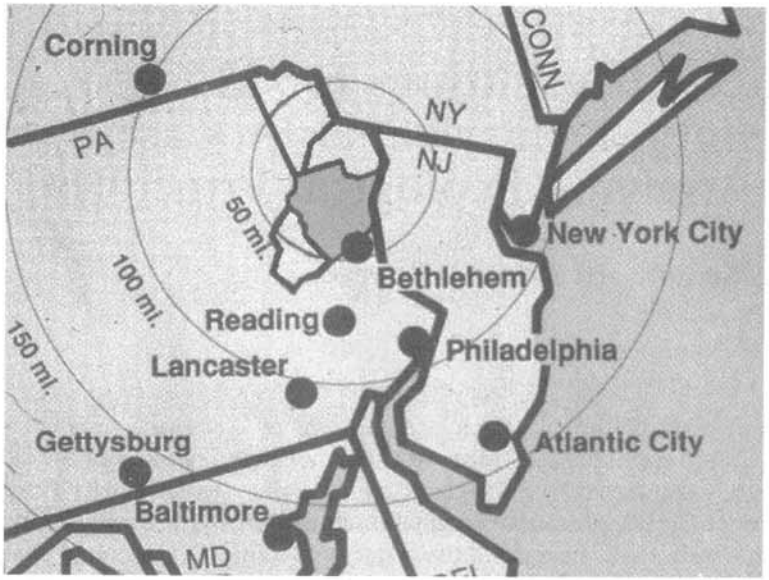


FIGURE 8.1. The Pocono Mountains area.

additional people are expected to locate there by the year 2020, doubling the current population. As a result, Monroe County faces a crisis, the classic dilemma of conservation versus urban development. In addition, New York City and Philadelphia are only 90 miles away, putting 60 million people within a 4-hour drive of the recreational attractions of the area (Fig. 8.1). The question arises, How will historical, current, and future land-use practices influence tomorrow's landscape? The county needed to take a hard look at its future.

Monroe County and the U.S. Environmental Protection Agency (EPA) asked Professor Carl Steinitz of the Harvard University Graduate School of Design to conduct a study that would enable the county and its citizens to visualize the ramifications of its land-use policies, development patterns, and transportation strategies and their subsequent impact on the conservation of its natural diversity and landscape features. The study was also to consider the realities of Pennsylvania's Home Rule, state municipal-planning codes, and a system of local (municipal) government that is entrenched in county and local politics. This political environment will affect future actions.

8.1 Background

The study was based on a framework offered by Steinitz (1990, 1994) that allowed Monroe County to evaluate alternatives to current land-use

planning. The subsequent analyses provided a set of options that would help remedy existing policies and practices that are leading to a fragmented landscape, degraded ecological processes, and the loss of important species and networks. The study framework, when combined with ecological principles and guidelines such as those described in Dale et al. (Chapter 1, this volume), can be used by county or municipal planners and by land managers overseeing public or private lands, especially if direct or adjacent development is foreseen. In this chapter, we consider the consistency between the Monroe County analysis and the Ecological Society of America (ESA) principles and guidelines. Although the work by the ESA Land-Use Committee was completed after the Monroe County Study, the two approaches are similar, especially with regard to the landscape context and the focus on preserving rare elements of the ecological system. Indeed, casting the Monroe County case study in the light of the ESA principles and guidelines demonstrates the relevance and applicability of those principles while showing how alternative-future approaches can be used to apply or expand the ESA principles and guidelines. The case study presented here also reviews subsequent actions taken by Monroe County and its municipalities.

8.2 The Study

In October 1993, the study team, comprising graduate students and faculty advisors with interests that spanned landscape architecture, urban planning, urban design, ecology, and law, visited Monroe County to gain firsthand knowledge of the issues surrounding the future development of the area. Six key sets of decision-related issues were identified: geologic landscape, biologic landscape, visual landscape, demographics, economics, and politics. These issues defined the content and methods of the study and formed the basis for evaluating the existing conditions of Monroe County and comparing alternative futures.

8.2.1 The Study Framework

The framework within which this study was organized (shown schematically in Fig. 8.2; Steinitz 1990, 1994) identifies six questions:

1. *How should the state of the landscape be described in terms of content, boundaries, space, and time?* This level of inquiry leads to representation models.
2. *How does the landscape operate, and what are the functional and structural relationships among its elements?* This level of inquiry leads to process models.
3. *Is the current landscape functioning well?* The metrics of judgment (whether ecological health, beauty, cost, nutrient flow, or user satisfaction) lead to evaluation models.

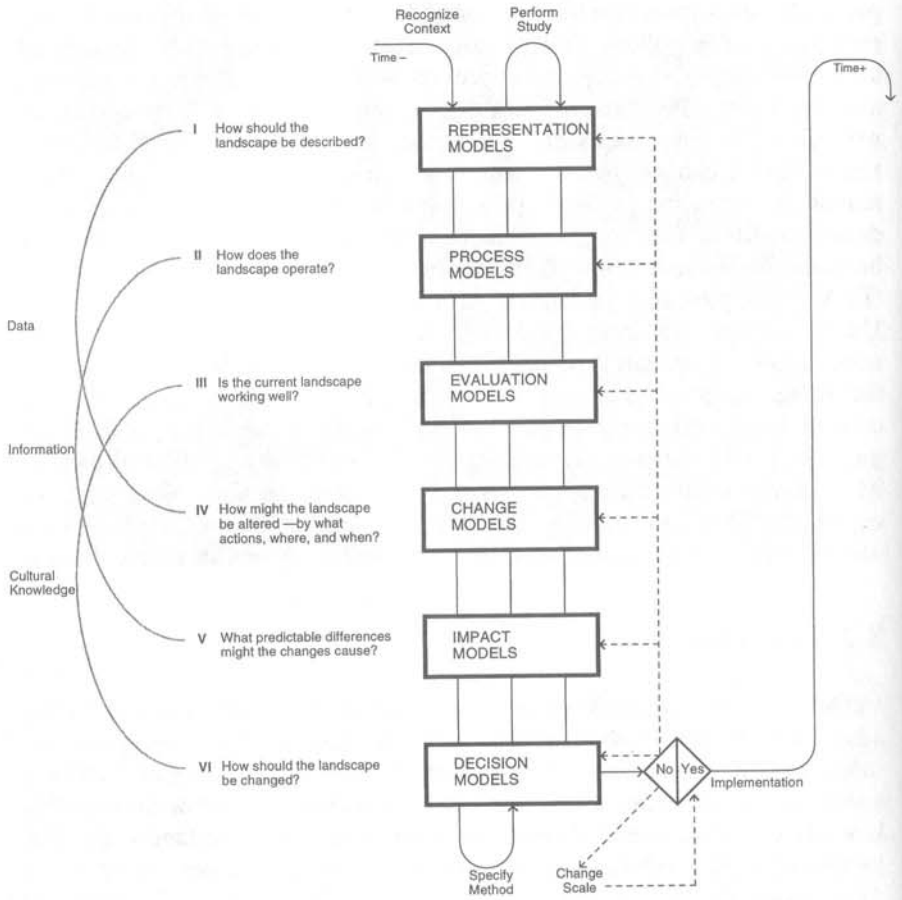


FIGURE 8.2. The framework used in the study.

4. *How might the landscape be altered; by what actions, where, and when might it be altered?* This fourth level of inquiry leads to change models. These changes must be described in the same terms as used in the representation models that evolve from question 1. At least two important types of change should be considered: change by current projected trends and change by implementable design, such as plans, investments, regulations, and construction.
5. *What predictable differences might the changes cause?* This fifth level of inquiry shapes impact models, in which the process models from question 2 are used to simulate change.
6. *Should the landscape be changed, and if so, how is a comparative evaluation among the impacts of alternative changes to be made?* This sixth level of inquiry leads to decision models and is similar to question 3 in that both are based on knowledge and on cultural values.

Each of these questions is related to a modeling type, which must be based in usable and valid (or presumed to be valid) theory. The six questions are applicable to, but not limited to, the issues encompassed by the ESA's ecological principles. The framework is "passed through" at least three times in any project. The first step is downward in defining the context and scope of a project (defining the questions) by passing through each level of inquiry:

- Representation
- Process
- Evaluation
- Change
- Impact
- Decision

The second step is upward in specifying the project methodology (how to answer the questions). And the third step is downward again in carrying the project forward to its conclusion (getting and providing the answers). Implementation could be considered another level, but this framework considers it as a forward-in-time feedback to the first question, the creation of a changed representation model.

The six levels are presented in the order in which they are normally recognized. However, considering them in reverse order is a more effective way of organizing a landscape-planning study and specifying its method. A project should be organized and specified upward through the levels of inquiry, with the output of each model being defined by the input requirements of the next model above it in the framework:

- To decide about proposing or making a change (or not), one needs to know how to compare alternatives.
- To compare alternatives, one needs to predict their impacts from having simulated changes.
- To simulate change, one needs to specify (or design) the changes to be simulated.
- To specify potential changes (if any), one needs to know the current conditions.
- To evaluate the landscape, one needs to understand how that landscape works.
- To understand how a landscape works, one needs a representational schema to describe it.

At the extreme, two decision choices present themselves: "no" and "yes." A "no" implies a backward feedback loop and the need to alter a prior level. All six levels can be the focus of feedback; "more research"

and "redesign of the proposed changes" are frequently applied feedback strategies.

A "contingent yes" decision (still a "no") may also trigger a shift in the scale or size or timing of the study. In a scale shift, the study will again proceed through the six levels of the framework and continue until it achieves a positive ("yes") decision. (A "do not build" conclusion can be a positive decision). A "yes" decision implies implementation, and (one assumes) a forward-in-time change to new representation models.

When repeated and linked over scale and time, the framework may be the organizing basis of a very complex study. Regardless of complexity, the same questions are posed again and again. However, the models, their methods, and their answers vary according to the context in which they are used. While the framework looks orderly and sequential, it frequently is not so in application. The passage through any design project is not a smooth path; it has false starts, dead ends, and serendipitous discoveries. But it does go through all the questions and models of the framework before a "yes" can be achieved.

8.2.2 Representation

To describe Monroe County, a geographic information system (GIS) was prepared. The available data resources included a digital terrain model, interpreted satellite images, the national (digital) highway map, the national (digital) wetlands inventory, infrastructure plans, and maps with field notes showing areas of ecological sensitivity. These uncoordinated data sets were registered to a raster with a spatial resolution of 25 m, and each map of the county has about 5 million sampling points. Monroe County is roughly 30 miles long from north to south and 35 miles across from east to west. From the air, and on the Vegetation Cover Map, which was derived at Cornell University from interpreted satellite imagery, it appears that much of Monroe County is covered by trees. But, a closer look based on other data reveals that the area under much of that tree canopy is actually developed and that little of the undeveloped land is protected from future development.

8.2.3 Key Issues

Six key issues (geologic landscape, biologic landscape, visual landscape, demographics, economics, and politics) were identified as necessary points of discussion, decision, and action. These issues overlap with the ecological principles of time, space, species, landscape, and disturbance; and dealing with these issues required taking many of the principles into account. However, several of the issues considered go beyond the ecological principles and deal with social concerns, such as landscape aesthetics, population, economics, and politics.

8.2.3.1 The Geologic Landscape

Monroe County has been shaped by glaciers. Evidence of this natural process is seen in the county's landforms, soils, wetlands, and unique bogs. These landforms have afforded Monroe County both an environment capable of supporting a wide array of plant and animal species and a high quality of life: good drinking water, diverse scenic quality, and substantial outdoor recreational opportunities. The quality of surface water is dependent on stream-bank vegetation, which absorbs pollutants that would otherwise be carried into the water systems through runoff and errosion. A portion of this buffer zone is regulated by the state, but its management can become ineffective in the face of overuse, development, or unregulated activities.

Because most of the county's drinking water is supplied by underground wells, it is important to actively protect the quality of the groundwater supply. Although the county's groundwater quality is currently rated high, it is extremely vulnerable to contamination in areas of development that are neither constructed on suitable soils nor sewered. Much of this development already exists in Monroe County. The southwestern zone of Monroe County has sizable areas of active agricultural soil with very high productivity. These agricultural areas contribute to the local economy in two ways: directly by the crops they produce and indirectly by attracting tourists to their landscapes. An evaluation of the geologic landscape reveals the most sensitive geologic sites are in the agricultural regions of the southwest.

8.2.3.2 The Biologic Landscape

The special biologic quality of Monroe County is widely recognized. The EPA has identified Monroe County as one of the areas of highest biodiversity within the Middle Atlantic Region of the United States. Biodiversity is defined by the EPA as "the variety and variability among living organisms and the ecological complexes in which they occur." One strategy to keep plants and animals off the Endangered Species List is to preserve areas of existing species richness as a part of landscape planning rather than to engage in crisis management after a species has been identified as threatened. This strategy meshes with the ESA principles and guidelines to preserve rare landscape elements and associated species. The biodiversity evaluation for Monroe County is based on estimates of species richness and was derived from interpreted satellite data of ground cover and a model of habitat capability (Smith and Richmond 1994).

Of special importance to Monroe County is the black bear. The county's bear population is among the most prolific in the nation and boasts the largest average size of the species's individuals in the country. From school mascots, to postcards, to regional advertising campaigns, the bear is Monroe County's image of choice. Because of this, bear habitat, which consists of

wetlands and low shrub areas, was included as a special concern in the biologic-landscape analysis. Through working with local experts and using the GIS, all known bear habitats were combined with all similar habitat areas in Monroe County. This analysis resulted in a patchwork habitat pattern, which must be connected in a network of movement corridors. Most of the wetland habitat is regulated, but the linking corridors, which are essential for bear survival, are seriously threatened by development pressure. The resulting pattern identifies key areas needed to maintain the bear's existence in Monroe County. They are typically stream corridors, wetlands, large and diverse habitat areas, and connection corridors for wildlife movement.

Another source of biologic analysis was the Natural Areas Inventory, which was previously prepared by the state and county. For example, the pine woodland on the Pocono Plateau in the northwestern part of the County has been identified as the only mesic pine barren in the world that is partially dry and partially wet. The unique environment that allows this ecosystem to work was also the result of glaciation 10,000 years ago.

8.2.3.3 The Visual Landscape

The county's visual character has, for many years, served as a destination for the tourist trade, and in recent years as an attraction for new residents. And, because most people's understanding of the landscape is through what they see, the visual landscape of Monroe County is an issue of great concern. As part of our study, several areas were identified as being "visually sensitive" and should be protected to maintain the existing and highly valued aesthetic character of the county. Views of scenic landscape elements include lakes, streams, wetlands, steep slopes, and open landscapes, including farmland and grassland.

For most people, the landscape is seen from roads and major public viewing points. Scenic roads in the county, as listed in the many official tourist guides of the area, and view sheds from accessible high elevations and roads along ridge tops were considered especially important.

8.2.3.4 The Demographic Landscape

Accelerating demographic change has occurred in Monroe County since 1890. The population has doubled in the past 20 years and will double again in the next 20. Within the county itself, the population is shifting from the older town centers to a more diffuse and sprawling pattern.

8.2.3.5 The Economic Landscape

Economic factors must be assessed when considering Monroe County's future, for current land value that will change as a function of future policies and investments. The highest-valued land is that near interstate highway

access points, adjacent to state and county roads, having sewer service or septic capability, and having important landscape amenities, such as water access or scenic views. These locations are also the areas of greatest recent development.

8.2.3.6 The Political Landscape

William Penn organized Pennsylvania politically around the idea of the township. Today, the townships provide the most immediate level of government, responsible for education, public safety, planning, zoning, water management, sewage treatment, and some roadway construction. While there are obvious benefits to a localized decision-making process, there are also serious limitations and potentially dangerous disadvantages. Township borders are discrete, but the landscape is continuous; ecological and visual processes do not normally recognize political boundaries. Coordination among political entities is required to take into account issues larger than the township. Thus, the ESA guideline of examining local decisions on a broad context should be heeded.

8.3 The Use of Ecological Principles in Alternative-Future Analysis

In retrospectively considering the Monroe County study in terms of the ESA principles and guidelines, several of those principles can be observed coming into play. Paradoxically, the time principle is at once critical to the study and irrelevant to it. This strange situation arises because the study was designed and conducted from a planning perspective rather the ecological perspective adopted by the ESA principles. The study was called for because social processes like population growth, transportation advances, and the economy of land use and ownership were changing at a rapid rate, far outstripping the rates of change of geologic or biologic processes. From a planning perspective, 25 years is a mid- to long-term horizon for decisions and investments; instead of the hundreds of years involved in the successional change of a forest, the study group was faced with large changes in the built environment occurring in a decade or two. It was clear that, to preserve the landscape elements that change at geologic or long biologic time scales, action must focus on the forces acting at the greatest rate of change. It was also clear that the major changes to the ecosystem would result not from ecological processes but from social processes. Although not taking sides in the debate between development and preservation, the study sought to aid the local decision makers in striking a balance that would reflect the long-term best interests of the county (i.e., for the next 25 or so years) and its citizens. In dealing with changes in ecological processes, the study had to focus on those that occur at short time scales, such as

groundwater recharge and surface-water cleansing. Conservation, degradation, or loss were the endpoints for ecological processes that occur at long time scales, such as land cover and wildlife diversity.

The species principle was a major concept in the study in that much concern was directed at the preservation of plant and animal species, both wild and domesticated. Obviously, the crops and herds of local farms are important to the local population. But the study noted that the game fish, large mammals, low-lying vegetation, and forests also play an important role in the economic and social life of Monroe County. For example, the Pocono black bear population, an umbrella species, has one of the highest reproductive rates in the country (Gary Alt, personal communication). However, to support this black bear population, the county and surrounding areas must retain a mosaic of wetland and upland habitats and preserve the wildlife corridors that the black bear uses. These same ecological features contribute to good water quality, flood retention, and recreational opportunities. The public and private lands, stream corridors, and wetlands that currently serve to provide the necessary habitat and these ecological services are threatened by future development. The case study shows how local land-use decisions will influence the county and the Pocono region's ability to maintain the habitat requirements of key wildlife species and other natural infrastructure that is necessary for a high-quality environment.

The place principle was central to the framework adopted by the study. To different degrees, it examined the local climatic, hydrologic, edaphic, and geomorphologic factors as well as the biotic interactions that affect ecological processes and the abundance and distribution of species in Monroe County. These assessments underlaid an effort to understand what makes Monroe County be Monroe County. The unique geography, geology, history, soil types, stream locations, and habitat patterns were analyzed to determine their historical development and contribution to the current conditions. Moreover, those conditions were modeled and projected into several versions of the future to allow the citizenry to understand the effects of their actions on the setting of their community.

In terms of the disturbance principle, the study was, by necessity, again focused on changes brought about by social and economic pressures rather than ecological disturbances like wind and fire damage. Disturbances created by 100-year floods paled in comparison to the changes that could be brought about in a decade by unconsidered development.

Conversely, the study was acutely aware of and intensely interested in the landscape principle. The projections of potential change within the county were framed largely in terms of the size, shape, and spatial relationships of land-cover types, considering the ecological, agricultural, and built landscapes alike. In analyzing the effects of changes in these landscapes, the study took particular note of (1) the influences visited upon populations of flora and fauna, communities of organisms, and ecosystems and (2) the resultant feedbacks on the quality of life of the county's residents.

In summary, the alternative futures derived and described for Monroe County strove to examine the impacts of local decisions in a regional context as well as on a local or site-by-site basis. They did not plan for long-term change and unexpected events; rather, they were concerned solely with the short term, with all contingencies expected to be known and expected. A central motivation for conducting the study and deriving the alternative futures in the first place was to preserve rare landscape elements, critical habitats, and associated species. The alternative futures represented a variety of land uses that reflected a spectrum of depletion of natural resources over a broad area, allowing the citizens to visualize the consequences of such changes. Several of these alternative futures retained large contiguous or connected areas that contain critical habitats. However, no consideration was given to the introduction and spread of nonnative species. The alternative futures depicted a variety of landscapes that sometimes avoided or compensated for the effects of development on ecological processes and implemented land-use and land-management practices that are compatible with the natural potential of the area, but sometimes did not; again, the purpose was to show the decision makers and residents the different outcomes from different actions. Thus, although this study predates the ESA ecological principles, it can be seen to be generally consistent with those principles and other published conservation-planning objectives and landscape-ecology principles (e.g., Forman and Godron 1986).

8.4 Change: The Alternative Futures

Any alternative future is the product of the interaction of private and public actions over time. There are substantial public interventions in landscape and infrastructure policy that can influence the urban pattern. The public actions listed in Table 8.1 were considered and selectively combined to produce each alternative.

Starting from existing conditions circa 1993 (Fig. 8.3), six possible alternative futures for Monroe County in the year 2020 were prepared. Two were derived by extending and extrapolating current development practices. Four were derived from alternative policy/plan actions. For each alternative, the 2020 land-use pattern and a computer-produced aerial view of the future landscape are shown. The aerial perspective of existing conditions (Fig. 8.4a; see color insert) is a view facing north toward I-80 between Bartonsville and Stroudsburg. Interstate-80 and the large cranberry bog can be seen in the background. For reference, the view spans approximately 2 miles from left to right.

The Plan-Trend Alternative continues the development practices currently used in the county and is guided by the Monroe County Comprehensive Plan (Fig. 8.5). It assumes that only what is currently publicly owned

TABLE 8.1. Public interventions in landscape and infrastructure policy.

Existing conservation	The enforcement of laws and regulations, especially on public lands
Proposed conservation	A proposed pattern for the acquisition of conservation land or rights
Billboard policy	The prevention of, and removal of, "unrooted" signs
Recreation	The expansion of commercial recreation and "ecotourism"
Pocono Raceway	A plan that expands this facility while not harming nearby Long Pond
Road improvements	Three priority projects
Railroad service	Restoration of service or a new route
Railroad stations	Six new station possibilities
Sewer service	Several alternative proposals
Zoning	New low-density and mixed-use types
Development guidelines	Several innovative suggestions

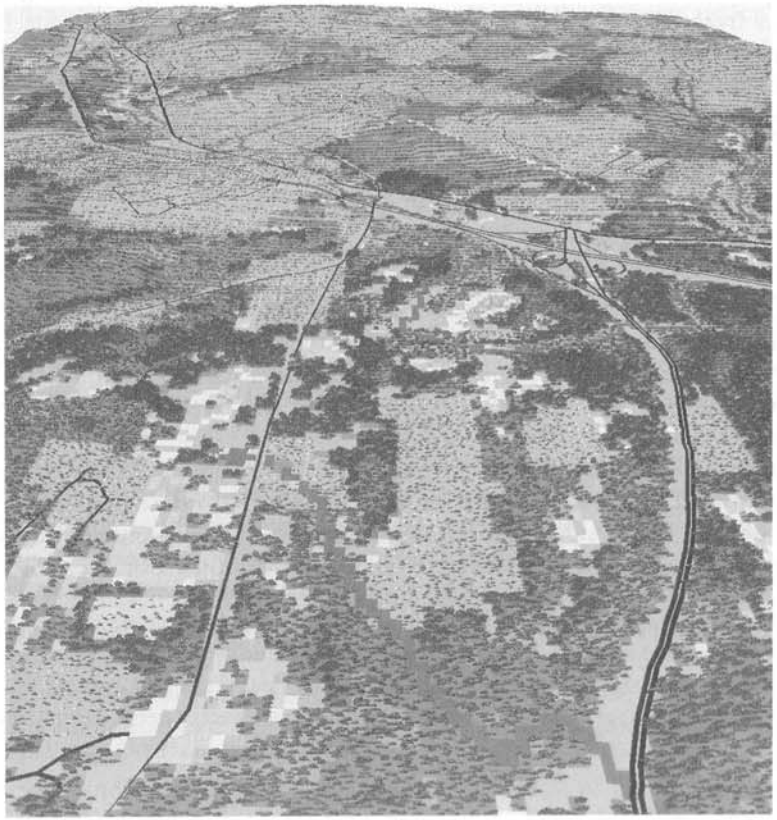


FIGURE 8.3. Existing land uses, land covers, and landscape features.

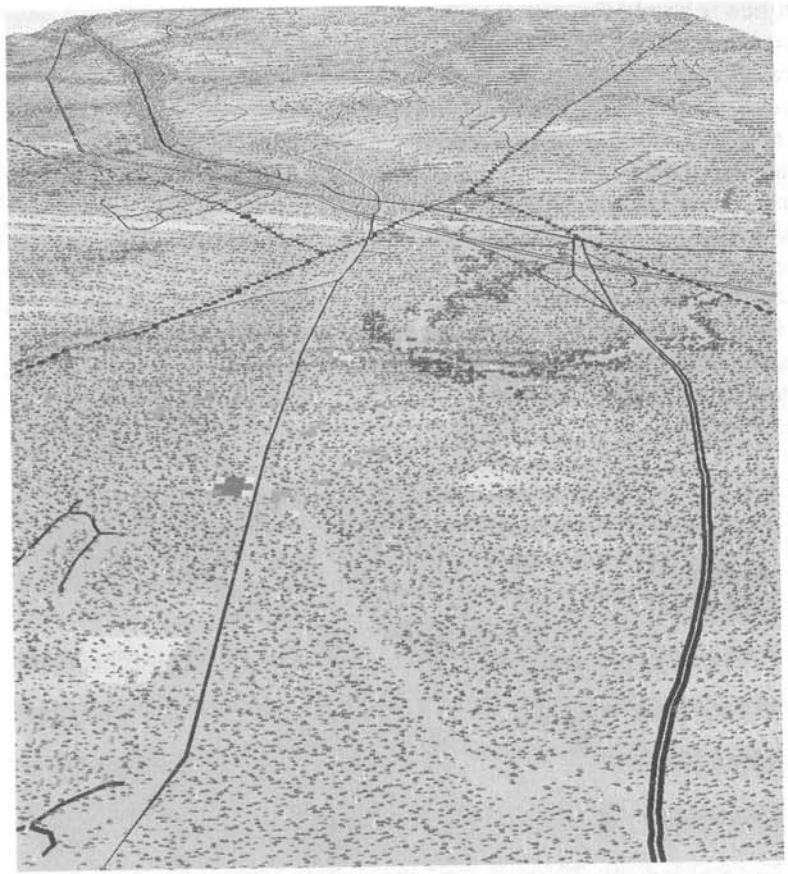


FIGURE 8.5. Land uses, land covers, and landscape features projected for the Plan-Trend Alternative.

or regulated will be conserved. Its infrastructure assumes that (1) only townships that have already proposed sewer plans will implement wastewater-management improvements, (2) the existing railroad alignment will be used, and (3) no major road improvements will be undertaken. Residential development in this alternative follows the same patterns of broadly dispersed low-density housing that have been characteristic of the past decade. In this alternative, all land that can be developed will be developed, primarily at low density, as proposed by the Plan. Higher densities are allocated only to land within prior township sewer plans. Almost all trees are lost in the almost fully developed landscape. This alternative does not take into consideration the impact of increased development (and population growth) on the health and integrity of those existing conservation areas, nor does it seek to maintain or protect existing wildlife corridors (unless in otherwise protective status). For the black bear, planned development will

continue to erode the matrix of upland and wetland habitats it uses unless those areas are part of the current inventory of conservation lands (public or private). The loss of wetlands and associated upland habitats will contribute to lower water quality and a decline in biological diversity and will threaten the existence of rare animal and plant associations, such as bogs, tannic streams, and scrub oak/pitch pine barrens. This alternative will not prevent future degradation of ecological processes *without the intervention of new policies, subdivision regulations, and ordinances that specifically target these issues.*

The Build-Out Alternative is the most pessimistic view of Monroe County's future by assuming that market-driven development will overwhelm the planning and investment abilities of the townships and the county (Fig. 8.6). Only existing conservation is maintained. The infrastructure projection

FIGURE 8.6. Land uses, land covers, and landscape features projected for the Build-Out Alternative.

assumes that the townships will not fulfill their transportation or sewer plans and that extensive low-density development, which is economically and technically feasible, will result. The land-use pattern of this alternative will look like any other metropolitan suburb, with low-density housing everywhere. As a result, the aerial perspective view could be mistaken for many areas near New York or Philadelphia.

The Township Alternative maintains local political control and proposes strategic development of each township, while minimally threatening its most valued landscape features (Fig. 8.7). It assumes the implementation of the proposed acquisition of conservation land or rights. For developable lands, exurban density rezoning is proposed near existing or proposed conservation lands. Innovative wastewater treatment and sewer technology is proposed for each town in areas with higher-density development. Because most existing residential developments are not connected to a central sewage

FIGURE 8.7. Land uses, land covers, and landscape features projected for the Township Alternative.

treatment plant or occur on lands that do not percolate well enough for standard in-ground septic systems (hence the high use of sand mounds), using new technologies for wastewater treatment would help to reduce the impact of development on water quality. These new technologies would serve small groups of houses or residential developments and thus would not induce the additional sprawl development that often follows the pipeline leading to the sewage treatment plant.

This alternative assumes the implementation of the new I-80 railway alignment and road improvements. The proposal envisions higher-density development in existing subdivisions and new higher-density residential and urban mixed-use development near existing town centers. This strategy promotes compact development while allowing more residents access to large natural areas. The aerial perspective (Fig. 8.7) shows a new exurban residential area in the foreground. Near the new railroad station along I-80, new high-density mixed-use development can be seen.

The Township Alternative, however, will not allow the ESA ecological principles to be fully implemented. Township government, as practiced in Pennsylvania, provides few opportunities or incentives to coordinate with neighboring townships and municipalities, coordination that is necessary to "retain large contiguous or connected areas that contain critical habitats." Nor does this political system allow planners and decision makers to easily view their individual land-use decisions and associated impacts (positive or negative) within a regional context. Unless townships work together, any attempts toward achieving conservation measures that are meaningful and that address problems at the landscape ecological scale would be piecemeal and ineffective.

The Southern Alternative addresses the two distinct characters of Monroe County, and offers each area the benefits of maintaining its uniqueness (Fig. 8.8). The northern part of the county is typified by areas of high scenic quality, high biodiversity, and other sensitive geologic and biologic areas. Despite this, development there continues. The less fragile southern part of the county has remained underdeveloped because of inadequate infrastructure. The proposed alternative assumes implementation of the new proposed conservation plus an additional area for extensive outdoor recreational opportunities in the north. The planned infrastructure upgrades southern roads and has alternative-technology sewer systems, especially in developable locations adjacent to conserved agricultural areas. This alternative results in extensive conservation in the north and, by introducing road improvements and sewer service to selected locations in the south, promotes compact and environmentally responsible growth. The aerial perspective (Fig. 8.4b; see color insert) shows new development directed toward already developed areas, in which some existing residential areas have been rezoned for increased density and mixed-use development.

The Southern Alternative goes far in recognizing the special landscape and geologic features that result in areas of high biodiversity and/or areas

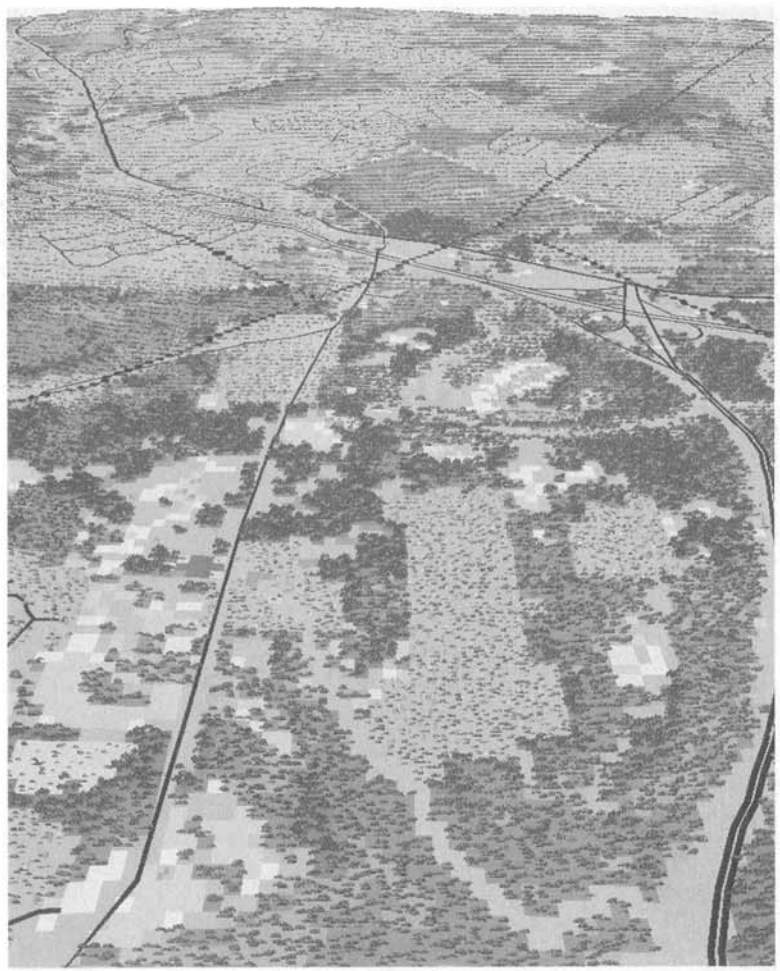


FIGURE 8.8. Land uses, land covers, and landscape features projected for the Southern Alternative.

of unique habitat and species associations. By encouraging growth in the southern part of the county through various techniques (such as the transfer of development rights, conservation easements, and conservation design of residential development), the county can minimize development impact on its more sensitive ecosystems and retain the natural character of the county. However, this alternative would require that new ordinances be adopted that would allow for increased density in existing residential areas or the use of conservation designs that promote open space within the developments; see, for example, Arendt (1994, 1996).

This alternative does spark controversy. The southern part of the county is where most of the farms operate. Although not a major economic source,

these farms have some of the richest soils in the county. It will be necessary to have policies in place that will allow the southern part of the county to accommodate new development while ensuring that the active farms themselves are not sacrificed in the process.

The Spine Alternative recognizes the interdependencies of Monroe County with the metropolitan New York–Philadelphia areas and, to an increasing degree, the new employment centers in the suburbs of New Jersey (Fig. 8.9). The most efficient strategy to accommodate the county's anticipated growth, promote tourism, and protect the natural landscape is to concentrate new development in the corridor between Mount Pocono and Stroudsburg and

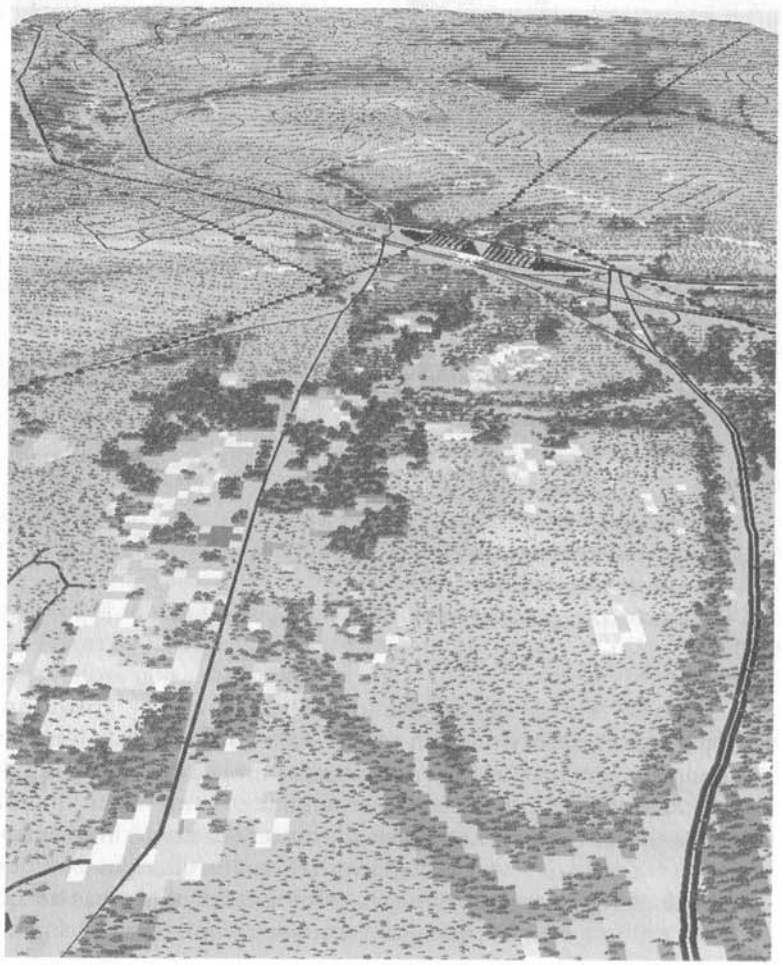


FIGURE 8.9. Land uses, land covers, and landscape features projected for the Spine Alternative.

maintain the rural character of the rest of the county. A key decision is increased dependence on high-speed rail transportation. The design for this alternative assumes the implementation of the proposed new conservation plan and also hopes to draw development away from the sensitive areas by making it much more attractive to locate in the central corridor between Stroudsburg and Mt. Pocono. The infrastructure is based on the new I-80 rail alignment with four new station stops. The roads serving this more intensely developed urban corridor would be improved. Sewered areas in Pocono and Stroud townships would be upgraded. The central urban spine would be the focus of future urban growth and zoned as high-density residential, with mixed use allowed along the principal state and county roads. The perspective view (Fig. 8.4c; see color insert) shows the railroad station and concentrated development located east of the I-80/railroad corridor with new conservation and park lands on the western side.

This alternative provides the greatest opportunity for the conservation of developable lands that have not succumbed to the pressure to be the next residential or resort development. This alternative builds upon the existing infrastructure and, in the process, minimizes opportunities for sprawl and its associated outcomes: traffic congestion and increased vehicle miles travelled, "green field" development, and loss of habitat and biodiversity. These conserved lands can help preserve the natural ecological systems and corridors that link the more valuable habitats in other parts of the county. By concentrating growth and development along the "spine" corridor, the county can focus its conservation efforts on areas that will enhance stream quality, protect its underground aquifers, restore the riparian buffers and forested watersheds, and better preserve irreplaceable landscape features.

The Park Alternative (Fig. 8.10) advocates conserving all of the existing undeveloped land in Monroe County. It envisions the county following an updated vision of Warren Manning's National Landscape Plan of 1923 (Manning 1923) and the creation of a major landscape reserve for the northeastern United States. All undeveloped land not already in conservation would be bought for further conservation and for recreational development. The infrastructure adopts the new I-80 railroad alignment with one station stop. Sewers would be extended to high-density residential and mixed-use commercial and residential zones. The proposal enables preservation of the last unprotected northeast-metropolitan corridor of such a large size and high quality. The management of this reserve would be directed both to the protection of Monroe County's natural habitats and to the development of its recreational possibilities without neglecting the needs of the present and future county residents. The perspective (Fig. 8.4d; see color insert) shows a landscape similar to that of today. Given the rate of change, now may be the last chance for such a bold approach.

Not all of these alternatives can be considered to fully include the ecological principles described by Dale et al. (Chapter 1). Indeed, several of them clearly violate those principles because, in the real world, there are

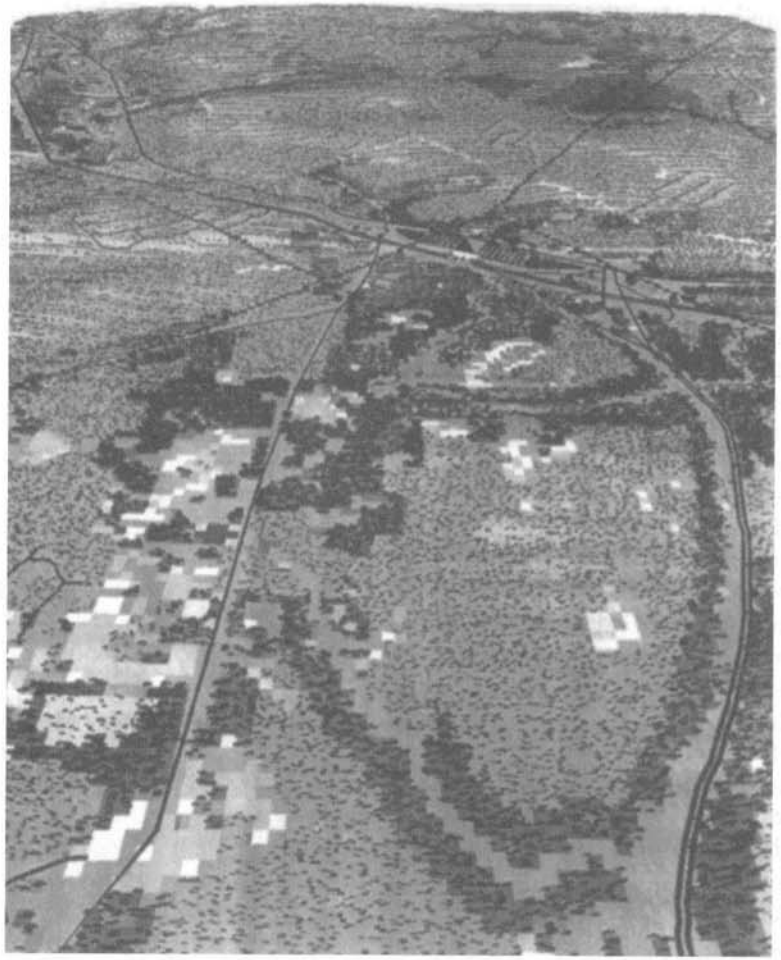


FIGURE 8.10. Land uses, land covers, and landscape features projected for the Park Alternative.

times when any set of objectives (including ecological principles and guidelines) will have internal incompatibilities. As a result, some of the alternative futures intentionally sacrificed some concerns to derive other, preferred benefits.

The alternative futures were devised to show the different outcomes that may occur when different approaches, policies, and values are employed in making decisions about the growth, development, and occupation of Monroe County. The results of the study were used to graphically portray to the citizens and decision makers of the county what would likely happen if ecological and other concerns were or were not thoroughly considered in decisions regarding the county's future. The adherence to the ecological

TABLE 8.2. The ecological priniciples and alternative futures for specific issues in Monroe County.

	Alternative futures					
Concerns	Plan-Trend	Build-Out	Township	Southern	Spine	Park
Principles						
Time				Y	Y	Y
Species				Y	Y	Y
Place	Y		Y	Y	Y	Y
Disturbance						Y
Landscape	Y		Y	Y	Y	Y
Issues						
Geologic	Y	Y	Y	Y	Y	Y
Biologic				Y	Y	Y
Visual	Y		Y	Y	Y	Y
Demographic	Y	Y	Y	Y	Y	Y
Economic	Y	Y	Y	Y	Y	Y
Political	Y	Y	Y	Y	Y	Y

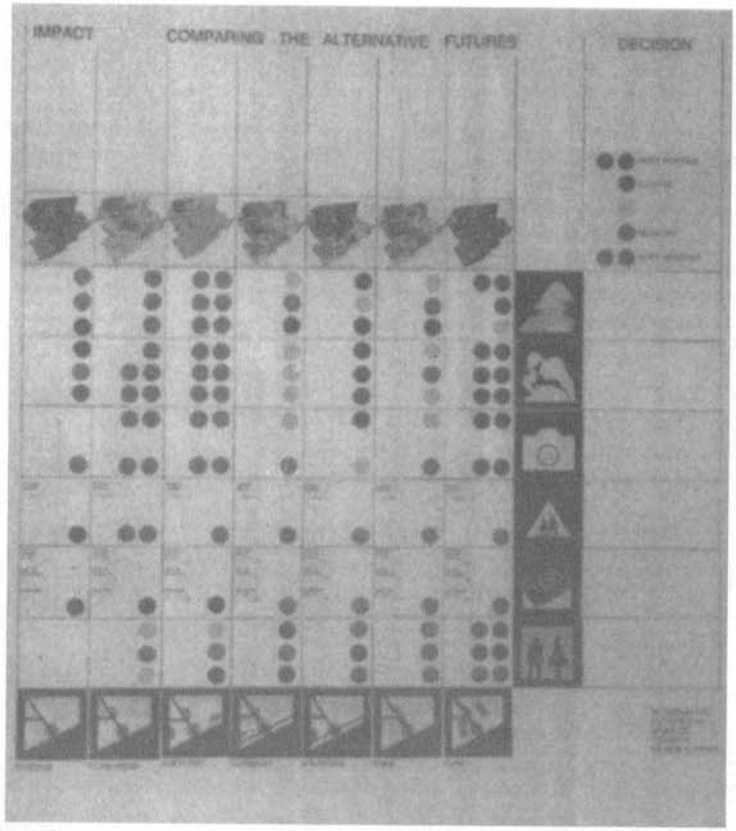
principles and the concern with specific issues in the different alternative futures are roughly sketched out in Table 8.2.

8.5 Impacts of the Alternative Futures

The future alternatives presented here are complex. To highlight their relative impacts, the alternatives were compared with the six criteria sets used in the earlier evaluations: the geologic landscape, the biologic landscape, the visual landscape, demographics, economics, and politics (Fig. 8.11). Some impact highlights:

- The Plan-Trend Alternative and Build-Out Alternative have the most negative landscape impacts because both cause widespread development. Simply stated, existing conservation policy does not sufficiently protect the sensitive landscape areas of Monroe County.
- The Southern Alternative strategy of dividing the county into two areas for planning purposes may successfully protect the landscape of the area.
- By concentrating development in the central section of the county, the Spine Alternative protects much of the existing undeveloped land. However, the preservation of this open space comes at the expense of severe impacts in the expanded Route 611 corridor, which will be irrevocably urbanized.
- The Park Alternative provides the greatest protection for the landscape because it proposes conservation of the largest amount of land and uses the strategy of densification in several areas.

At the time of the study, the population of Monroe County was about 100,000 people. None of the alternatives was designed with the intention of



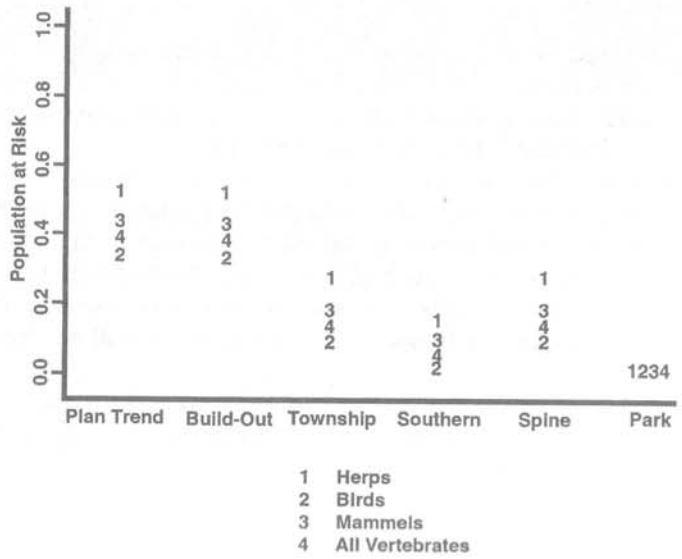


TABLE 8.3. Annual costs of the alternative plans.

Alternative	Population capacity	Annual cost (millions of dollars)
Plan-Trend	600,000	1
Build-Out	400,000	1
Township	300,000	104
Southern	350,000	106
Spine	350,000	120
Park	300,000	At least 135

limiting Monroe County's growth or arriving at any particular population capacity. However, each alternative would sustain a different optimum population and would come at a different cost (Table 8.3). Most of the capital expenditures for roads, railroad, and the cost of land conservation would be shared among the county and other sources. Annual costs associated with each alternative were calculated under the assumption that the county issued a 20-year bond for its share.

8.6 Decision

There is a "bottom line." In the long term, and in full awareness of the costs, any of the four designed alternatives is a better long-term decision than continuing the trend toward build-out. This is especially true of the ecologic considerations. However, this study does not present a recommendation. Its purpose was to present alternatives, not a single answer. The many decisions needed for any of the alternatives are clearly the responsibility of the people of Monroe County. Given the enthusiastic initial responses to this study, it was clear that we enabled the people of Monroe County to see more clearly some of the important issues they will face during the next 25 years.

Three of the ecological principles are exemplified by this case study. First, the study clearly encourages land managers to examine the ecological impacts of local decisions within a regional context. The case study also illustrates the difficulty in implementing this principle. The public and private decisions that accumulate to form the 2020 alternatives are almost all local, mainly because the level of government responsible for land-use planning in Pennsylvania is the township or borough. The allocation of future land use

FIGURE 8.11. A decision-aiding matrix that compares the existing conditions and the six altenatives in terms of the six key decision-related issues that were identified: geologic landscape, biologic landscape, visual landscape, demographics, economics, and politics.

in the six alternatives was guided by local zoning, sewer, road, and conservation proposals. The Plan-Trend Alternative and Township Alternative were based on the allocation of each individual township's forecast population. In this way, the Monroe County study exemplifies the guideline regarding local decisions, or, as faculty advisor Michael Binford would describe it, "the tyranny of small decisions."

However, there are also decisions taken at a regional or larger context that must be examined at the local level. When long-term changes are being considered, these decisions may be of even greater impact. Perhaps of greatest importance when assessing long-term ecological change are national and international trends in demographics. State-level activities, such as the promulgation and enforcement of various environmental regulations and the acquisition of state parks and reserves, come into play. Actions supported at the federal- and state-government levels, such as major infrastructure investments, also must be considered. In this study, and with the exception of the Plan Alternative and Township Alternative, all of the alternatives were produced on a regional basis, in this case at a county level. All of their impacts were assessed both on county and township levels.

The reader should also consider that this particular case study was designed within the parameters of several technical decisions that required that the "region" be defined as Monroe County, with a politically defined boundary. These decisions were made, in part, because of how data were made available and also because of the tradition of reporting politically sensitive studies within the spatial limits of the relevant decision-making levels of government. Neither of these reasons is particularly compelling. Indeed, they lead to a spatial limitation that is inconsistent with the more appropriate geographical bases of ecologically oriented studies, such as river basins or arbitrary boundaries that more than encompass both ecologically and politically relevant areas. However appropriate these geographically based analyses may be, the ability to connect "data and analysis" to local land-management decisions will be constrained by the reality of political boundaries. At best, the results of these ecologically based studies must still be delivered as products that are relevant to the local land-use decision maker.

The second guideline that this study exemplifies calls for the preservation of rare landscape elements, critical habitats, and associated species. Indeed, an underlying theme of the alternative futures was the conservation of biological diversity. In an associated study, White et al. (1997) examined the impacts of the possible future land-development patterns of each alternative on the biodiversity to the Monroe County landscape. The species data included lists of all bird, mammal, reptile, and amphibian species in the study area; their habitat associations; and area requirements for each. The measures of biodiversity were species richness and habitat abundance (Fig. 8.12). Species richness was based on the presence of diverse natural habitat, and it changed little from present to future. There were distinctly

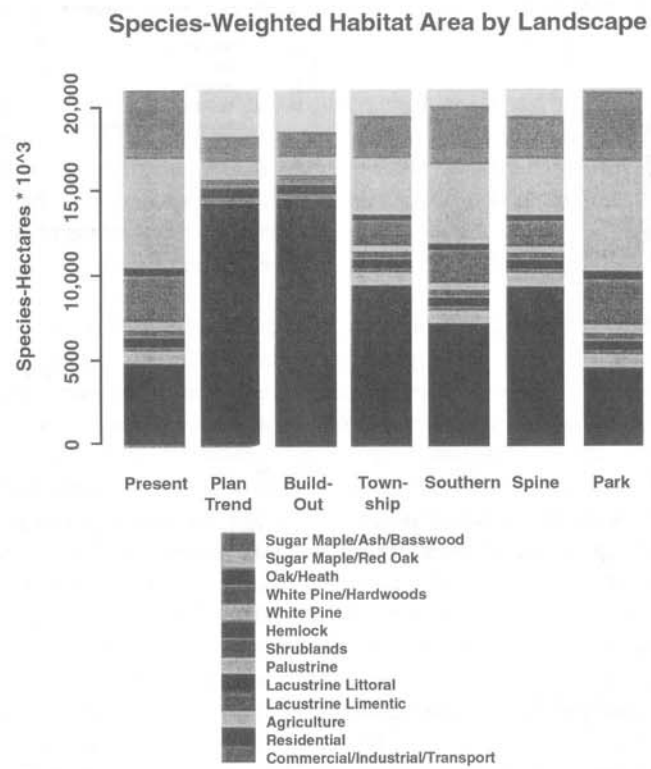


FIGURE 8.12. Area in each of four aggregated habitat classes for the present and future landscapes.

greater risks to habitat abundance in landscapes that extrapolated from present trends or zoning patterns, as opposed to landscapes in which land-development activities followed more constrained patterns (Fig. 8.13). These results were stable when tested with Monte Carlo simulations and sensitivity tests on the area requirements.

Finally, the ecological guidelines encourage land-use and land-management practices that are compatible with the natural potential of the area. The citizens, decision makers, developers, businesses, and local, state, and federal agencies are attempting to do just that. In the next section, we describe how the study has influenced policies and actions that will move Monroe County toward a more desirable and sustainable future. The reader should note that the changes described below *are significant* when considered within the political, economic, and social context of Monroe County and the Commonwealth of Pennsylvania. Furthermore, it was this study that prompted, explicitly or implicitly, the actions that have occurred.

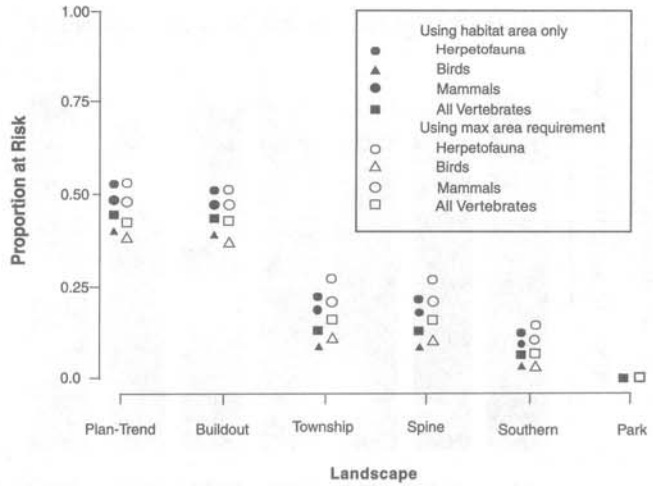


FIGURE 8.13. Risk to terrestrial vertebrate habitat, by future landscape and by taxonomic group, estimated from (1) total habitat area only and (2) maximum area requirements.

8.7 A Catalyst for Change

When the Alternative Futures Study for Monroe County was undertaken, the time was ripe for a vast awakening by residents and local officials. The U.S. Environmental Protection Agency, Region III, had been working with Monroe County on a demonstration project aimed at habitat protection. The opportunity arose to bring Harvard University Graduate School of Design into the project. The key players involved in the overall EPA project believed that a more comprehensive analysis of the county was needed to help frame subsequent conservation and land-use decisions. The nexus of opportunity and need was timely, and the educational value derived from this study far exceeded any expectation.

Once the public meetings were held and the Harvard University report was published, the scenario-based, data-driven study served as a catalyst, a call to action, as many would come to view it. In 1993, Harvard University presented stark, yet believable, visions of the future for Monroe County. Faced with the possibility of a future that would hasten environmental degradation, increase traffic congestion, further fragment wildlife habitat, and burden local governments with increased infrastructure costs, the residents of Monroe County under the leadership of the county commissioners and planning commission, heeded the call to action. The alternative scenarios that the study designed provided a backdrop and reference for county leaders and citizens as they began to take ownership of the tasks that

faced them. Several significant outcomes can be attributed to this catalytic project:

- The initiation of Monroe 2020, a stakeholder-driven process that helped to formulate the basis for a new County Comprehensive Plan
- A commitment to use a GIS and the data derived from the study
- The successful passage of a $25 million Open Space Referendum in 1998
- The initiation of municipal community audits
- The addition of two new county planning positions

The legacy of the Alternative Futures Study is impressive. Several earlier attempts at broad-based planning and design had failed to inspire change. The county and its local governments continued along the path they had embarked upon 30 to 50 years ago, developing residential and commercial properties with little consideration to the constraints of the landscape and the environmental services it provided. As Alan Price Young, Chairman of the Executive Committee for Monroe 2020, described it, "the Harvard University study provided a credible foundation for change... it provided a major impetus for the resulting Monroe 2020 [comprehensive planning] process." According to Young, the study enabled Monroe County to enhance the "acre by acre, project by project review and made us see the interconnectedness of the natural landscape with the fiscal realities of the County.... Questions about where development is appropriate and how to balance environmental quality and growth became the issues upon which to focus. When all interests are blended, the real priority becomes quality of life and 'we all have a fundamental interest' to enhance quality of life."

Monroe 2020, begun in 1996 by the county commissioners and the planning commission, followed on the heels of *Alternative Futures for Monroe County, Pennsylvania* and the county's *Fiscal Impact Study*. The call to action afforded by the study brought together local officials, school administrators, business men and women, public interest and environmental groups, and long-time residents. The Monroe 2020 process organized into school-district-based task forces that were charged with recommending policies and practicable ways to protect the natural and built landscape in concert with sensible development and growth. A draft *Comprehensive Plan* was made public in March 1999. Recommendations from the Monroe 2020 Task Forces encouraged

- Direct growth and development along the existing infrastructure corridors and centers of population (similar to the Spine Alternative)
- Environmentally friendly economic enterprises to locate in the county
- Recycle vacant and underutilized buildings and sites
- Implementation the Open Space Policy, which specifies additional lands to be protected or added to the open-space inventory
- Improving the visual character of the county through landscaping and signage-improvement measures

The Harvard University study's effective integration of natural-resource, demographic, land-use, infrastructure, and fiscal data gave the county a unique opportunity to "see into the future," based on existing conditions and projected trends. It presented the county in a different light, showing the connection between its natural landscape features and the impacts associated with unplanned or poorly integrated policies that allowed inappropriate development (residential, industrial, and commercial) to occur. In addition, the study and its associated GIS databases that were provided to the county gave the incentive for the development of the county's own GIS capabilities. A GIS was developed and applied concurrently with the county's comprehensive planning process, Monroe 2020.

The Open Space Referendum, passed in 1998, reflects a coming together of citizens' interests. It served to recognize that Monroe County's continued wealth and well-being depend largely on the protection and conservation of its natural landscape. The Harvard University study provided a visual and analytical way for people to think differently about the natural and built environment and to see the connectedness. John Woodling, Director of the Monroe County Planning Commission, states "the Open Space Referendum's successful passage had more to do with quality of life issues rather than habitat protection. However, the resulting Open Space Policy that will direct the use of the funds will indeed go far in protecting critical and sensitive landscape elements and habitats. County leaders and residents recognize the financial and aesthetic value of clean trout streams, hiking and biking trails, healthy game and other wildlife resources, open vistas, and outdoor recreational areas." Janet Weidensaul, County Commissioner, eloquently summed up the import that the Harvard University study had on the future direction of the county, saying "we took our environment for granted and didn't recognize that it was so critical to our success... leaders are far more sensitive today to the preservation of the splendor that is Monroe County for future generations."

Acknowledgments. This study of Alternative Futures for Monroe County, Pennsylvania, is the product of a graduate-level studio at the Harvard University Graduate School of Design. It was sponsored by the U.S. Environmental Protection Agency, Region III; the Monroe County Commissioners; the Monroe County Conservation District; the Monroe County Planning Commission; and the USDA Forest Service, Pacific Northwest Research Station. The participants were Elke Bilda, John Ellis, Torgen Johnson, Ying-Yu Hung, Edith Katz, Paula Meijerink, Allan Shearer, H. Roger Smith, Avital Steinberg, and Douglas Olson. The authors especially thank Allan Shearer, Craig Todd, Janet Weidensaul, Denis White, John Woodling, and Alan Price Young for their contributions toward this report of the study. The figures in this chapter are republished from the original report, which is copyrighted by the President and Fellows of Harvard College.

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