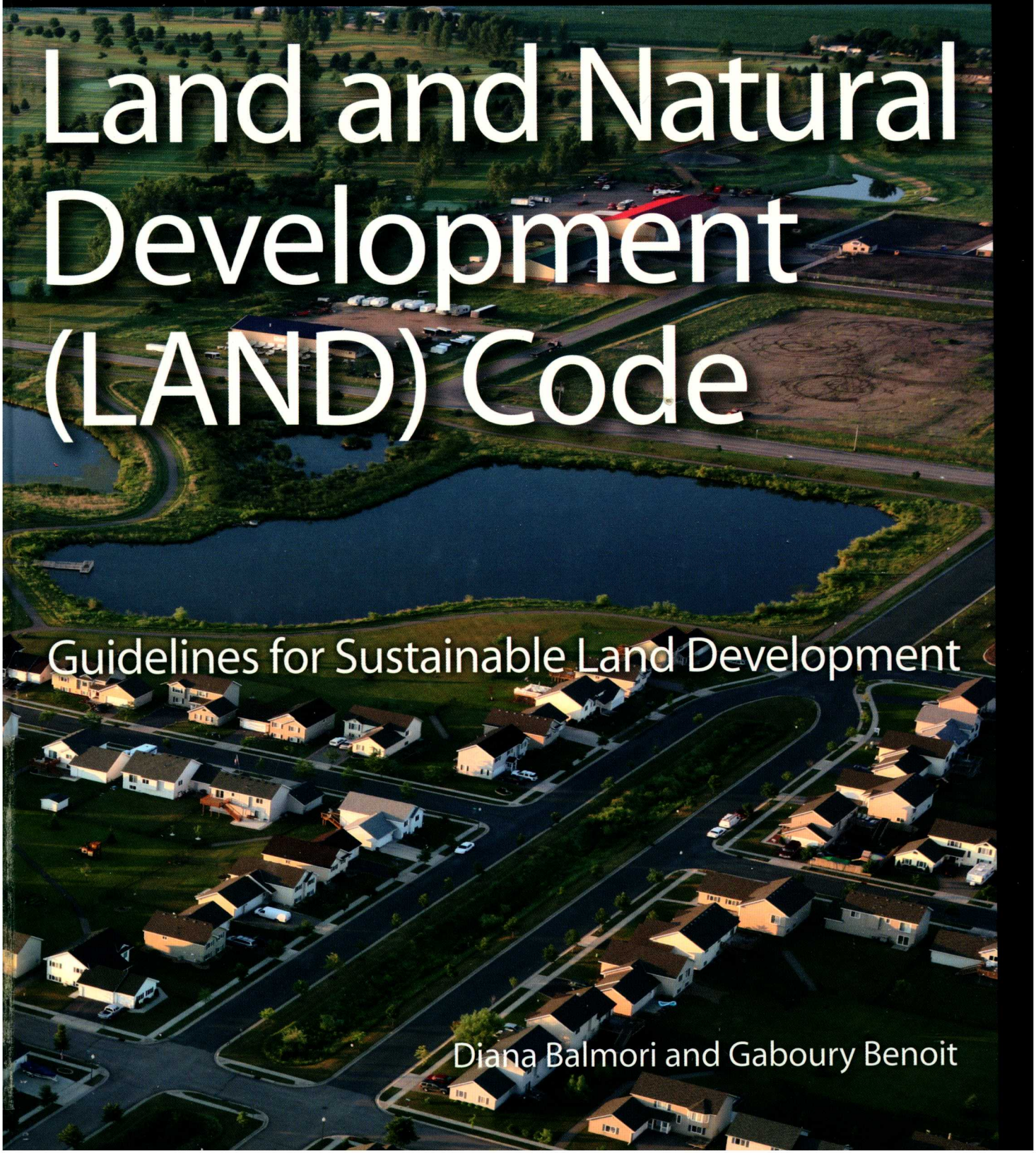
Land and Natural Development (LAND) Code

Guidelines for Sustainable Land Development



Diana Balmori and Gaboury Benoit

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Acknowledgments

This book is intended primarily for design professionals, such as architects, landscape architects, urban planners, and urban designers, as well as civil engineers and developers. It originated at Yale University, as a unique collaboration in the study of landscape design and forestry. Professor Emeritus Herb Bormann inspired this document, bringing Gaboury Benoit and Diana Balmori together to think about guidelines for sustainable development of land. The two authors had equal, if unique, roles in preparing the book; they are listed alphabetically.

Colleen Murphy-Dunning organized and ran the original research seminar that served as the nucleus for this book. A prodigious organizer for this very complex course she juggled outside speakers, in-house critics, and constant adjustments in the subjects in response to reviews and research. Her energy and intelligence were critical to being able to pull this all together into the LAND Code.

We thank developer Ned Foss and his partner Lawrence Linder of CGI & Partners in Delmar, New York, and Margery Groten, Senior Project Manager of Scenic Hudson, the organization that is developing in a sustainable manner with CGI & Partners. They gave of their time and arranged for us to visit the property they are developing in Beacon, New York. This property served as an initial base for the students' work.

We thank very specifically our dedicated graduate students who worked with enthusiasm and seriousness on this uncharted terrain. One or two of them researched and were responsible for each of the topics we laid out for the code. Their work was the kernel for the School of Forestry and

Environmental Studies (SFES) Working Paper that followed and served as the seed for this book. We also would like to thank the many top-notch scholars in each of the specialties this document contains (hydrology, law, etc.), who lectured on the state of the art in their discipline and answered questions by the student team assigned to the topic. In the latter part of the semester, they also critiqued the first summaries of the work of the student teams.

We are grateful, too, for the financial support given to this work by the Hixon Center for Urban Ecology at the Yale School of Forestry & Environmental Studies. A research and outreach organization, Hixon Center objectives are principally pursued through four center programs: the Urban Resources Initiative, the Urban Watershed Program, Public-Private Partnerships for the Urban Environment, and the Program for Sustainable Environmental Design. This course fit the objectives of all the center's programs.

Distinguished Guest Lecturers

Russell Albanese, President, Albanese Development Corporation, Garden City, New York, Developer of the Solaire Building, the first New York City building to be assigned under the new Battery Park City environmental guidelines

Clinton Andrews, Associate Professor, E.J. Bloustein School of Planning and Public Policy, Rutgers University, President, IEEE Society on Social Implications of Technology

Wendi Goldsmith, President and Senior Bioengineer and Geomorphologist, the Bioengineering Group, Inc., Salem, Massachusetts

James Lima, Senior Vice President, Special Projects Division NYC Economic Development Corporation

Ruben Lubowski, Natural Resource Economist, USDA

Edward G. Mitchell, Assistant Professor, Yale School of Architecture

John Nolon, Professor of Law, Pace University Law School. Director, Land Use Law Center

Rafael Pelli, Architect of Solaire Building, New York City

Jonathan Rose, Developer

Tom Schueler, Director of Watershed Research and Practice, Center for Watershed Protection, Ellicott City, Maryland

Yale Faculty and Outside Experts

Erin Mansur and Paul Fisette—Energy
Mark Ashton and Herb Bormann—Ecology
Marian Chertow, Clinton Andrews, and Steven Peck—Industrial Ecology
Jim MacBroom and Wendi Goldsmith—Environmental Engineering
Sheila Olmstead and Ruben Lubowski—Economics, Finance
John Nolon—Law
Gaboury Benoit and Tom Schueler—Hydrology
Jonathan Rose and Russell Albanese—Development
James Lima—Government
Diana Balmori—Design

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Environmental Engineering
Christopher Menone
Terrence Miller

Industrial Ecology
William Pott
Elizabeth Roberts

Legal Strategies
Melanie Cutler
William Finnegan

Saving Time and Money
Loni Gardner
Brian Goldberg

Land and Natural Development (LAND) Code

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chapter 1

Introduction

WHAT THIS BOOK IS ABOUT

The Land and Natural Development (LAND) Code is a research-based guide to ecologically sound land development intended for architects, engineers, landscape architects, developers, city officials, students, and interested individuals. Our goal in creating the LAND Code has been to delineate a clear and practical pathway for developing sites in harmony with natural processes. Land *will* be developed, and this manual shows how that can be done with the least environmental harm. That does not necessarily mean leaving nature alone; sometimes the best results can be achieved with intensively engineered methods. Nevertheless, we try to recommend ways that natural processes can be partly retained or re-created by the use of engineered structures and practices that emulate the natural processes they supplant. These engineered methods cover the gamut from vegetated rain gardens to storage tanks, which gather and reuse drainage water for irrigation or other nonpotable uses. The engineered solution needs to be close in its workings to the natural process it supplants. Each kind of site will require treatment appropriate to its nature and context, and the LAND Code is suited to many kinds of land uses, from greenfields to redeveloped urban brownfields to converted farmlands.

WHY THIS BOOK

Readers may ask: Why the LAND Code? Don't other recent "green" or sustainable guidelines already provide guidance for environmentally sound land

development? Many of the principles of the LAND Code do appear in the U.S. Environmental Protection Agency (EPA) recommendations and in the Leadership in Energy and Environmental Design (LEED) Green Building Council rating system. But the LAND Code has several unique characteristics:

- It has a rigorous scientific basis. LAND draws heavily and almost exclusively on peer-reviewed scientific research to derive its recommendations. Other systems are much more the product of expert judgment.
- It provides a rating scheme that strives to weight each practice according to the scale of its environmental benefit and the difficulty of it implementation. LEED, by comparison, gives 1 point to nearly every recommendation no matter how beneficial and costly.
- It is nearly self-contained. LAND does not rely on several voluminous and complicated external protocols (e.g., the ASTM E1903–97 "Phase II Environmental Site Assessment"; the EPA 832/R-92–005 "Storm Water Management for Construction Activities," Chapter 3; or the EPA-840-B-92–002 "Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters"). Instead, the LAND Code provides a simple and straightforward step-by-step system. Most of its recommendations can be carried out by nonexperts, especially on smaller sites.
- It is comprehensive, covering water, soil, air, energy, materials, and living resources.
- It focuses on the land, not on buildings.
- It makes extensive use of illustrations, both photographs and diagrams, to make many issues clear and understandable.

LAND also can be used readily in conjunction with LEED, EPA, or other guidelines. Perhaps the most important difference between LAND and other documents is the explicit reliance on scientific studies as the basis for its recommendations. It uses the latest research about natural processes and engineering methods; thus, it will necessarily be an evolving document. The field of sustainability is quite new, and its science will continue to reveal new truths about natural processes, which LAND will need to incorporate over time.

HOW TO USE THIS BOOK

The core of the text consists of seven major subject areas that are critical to developing land sustainably: water, soil, air, living resources, energy, and materials. These are followed by a seventh, environmental engineering methods, which presents technical information about some of the tools that are available to achieve sustainable results. At the risk of oversimplifying the distinction, this last chapter deals more directly with urban sites where development density often prevents "natural" bioengineered systems from being constructed. The other chapters place somewhat greater emphasis on less intensively developed lands, whether forests, greenfields, or farmland, where more space is available. Another way of looking at the first six chapters compared to the seventh is that the earlier ones provide recommendations to achieve sustainable development based on scientific research on natural processes. The seventh describes a toolbox of material ways and means to get there.

At the end of the book, Chapter 9, " Different Paths to Sustainability," gives case studies of development projects that aim for sustainability and that have been recently built or are underway now. The projects have been chosen to provide snapshots of a variety of approaches to green development, as well as some specific examples where one of the six main topics (water, soil, air, energy, materials, living resources) has been addressed successfully. The case studies vary in length according to the complexity of the examples—that is, on how many fronts the project has features relevant to our guide. In some, the structuring of the development group may be the point of the example (e.g., the partnership of one developer with a conservation group, Scenic Hudson Inc., to give the green agenda a more prominent place in the development project). In others, it may be how sustainable approaches were used to allow a regional mall developer to build upstream from a water supply reservoir, with benefits to both the developer and the water utility. The examples given in this last section, therefore, give a quick overview of the very fast-growing field of sustainable land development. They are there to demonstrate that real projects succeed at developing land sustainably.

HOW LAND CODE POINTS WERE DETERMINED

It was clear that a rating scheme would greatly increase this book's utility to the user. But how do you compare the environmental benefit of a constructed wetland to that of full cutoff light fixtures or proximity to mass transit? One

approach is to simply assign one point to every action, but, clearly, the benefits of some measures are much greater than others. On the other hand, fully understanding the relative environmental value of each strategy might take years of research and still not yield clear answers. Consequently, we opted for a hybrid system that relates points to total benefits, but doesn't require unrealistically detailed knowledge of ecosystem structure and function. Part of the answer came when we struggled to assign each strategy to single areas of environmental benefit (water, soil, air quality, energy, etc.). Some measures (e.g., retaining mature trees on a site) provide gains in almost every category, whereas others (e.g., providing bike racks) narrowly benefit only one or two. It seemed reasonable to provide a point for each environmental subsystem or function that is protected by a given recommended structure or activity.

Furthermore, some measures are much easier or cheaper to implement than others, and the difficult and expensive ones need to be rewarded, or they will never be implemented. Points are, therefore, awarded for difficulty. Also, some recommended actions have lasting effect, whereas others are temporary or uncertain in their long-term benefit. A point is awarded to any strategy whose effect is probably permanent. Finally, there are some activities that are so clearly necessary that developing land sustainably is impossible without them. These are not given points, but are simply required.

Once the various recommendations had been assigned points by this system, they were sorted by point value and checked for internal consistency. The criterion applied was whether recommendations in a given part of the ranking seemed to provide equivalent environmental benefit. We were gratified to find that the relative number of points were reasonable and required no further adjustment.

The LAND Code has three levels of achievement: silver, gold, and platinum. These three are awarded for achieving 40 to 60 percent, 60 to 80 percent, or 80 to 100 percent, respectively, of the possible total points at a given site. The maximum attainable point total varies from site to site, and this total needs to be calculated along with the number of LAND points awarded. As an example, it is not possible to create migration passageways under roads on sites without roads, so these points should not be included when calculating the achievable maximum for such sites.

Furthermore, in some instances LAND points are awarded for mitigating the effect of what amounts to poor site selection. Examples include leaving buffer zones around sensitive aquatic ecosystems, such as streams, wetlands, and vernal pools. To avoid perverse incentives, selecting sites with such features

triggers the awarding of negative LAND points, which can be canceled partially or entirely through mitigation measures.

Conceptually, using precious metals to signify achievement is antithetical to the spirit of the LAND Code, as these metals are scarce natural resources whose extraction cause severe environmental damage (De Lacerda 2003; Muezzinoglu 2003). Nevertheless, we could think of no environmentally benign trio of substances or objects whose hierarchical ranking is so obvious, and no actual environmental harm is done in awarding these categories.

HOW WE USE THE TERM *SUSTAINABILITY*

Our use of *sustainability* applies exclusively to the environmental aspects of land development. Although economic development and social organization are considered, they are secondary. This text is concerned with natural conditions and their continuity over time; our goal is to keep the long term in the development equation.

Probably the most commonly articulated expression of sustainability is that of the U.N. World Commission in a 1987 report on Environment and Development (WCED) from the publication "Our Common Future." The publication is also known as the "Brundtland Report," and states that sustainable development "meets the needs of the present without compromising the ability of future generations to meet their own needs." While we agree with this definition, its focus is on people, the "generations," rather than the environment; therefore, we adhere more closely the EPA's definition: "the ability of an ecosystem to maintain a defined/desired state of ecological integrity over time."

In this text, we address environmental aspects of land development. We focus on natural systems and processes that are altered by land use, and seek ways for their functions to be aided or replaced by engineered elements for long-term protection of ecosystems. We believe environmental sustainability furthers human sustainability by creating systems that add to people's comfort, enjoyment, and health.

We have also considered aesthetics as part of the broader agenda, for it contributes greatly to people's attachment to a place, an important prerequisite for sustainability. For a time, it seemed most ecological projects were badly designed aesthetically, and only recently has an effort emerged to get them both right. Therefore, we have made an effort—particularly in the case

studies presented in the last section—to choose examples that are both environmentally sustainable and well designed.

HOW THIS BOOK CAME ABOUT

The research for this book was first issued as a Yale School of Forestry and Environmental Studies working paper in order to open up a dialogue and benefit from the insights and experience of its readers. Based on responses to this first document and the opportunity to publish it as a technical manual offered by John Wiley & Sons, Inc., a new text has been written with more thorough development of its topics and additional illustrations clarifying and visually informing the text. And because, in general, science publications have traditionally paid little attention to illustrations and their aesthetic quality, a special effort has been made to heed to the saying that a picture is worth a thousand words. To that end, the illustrations attempt to make the recommended sustainable actions and methods clear and understandable at a glance, as well as being well composed.

The LAND Code grew out of a course taught by faculty members, Gaboury Benoit of the Yale School of Forestry and Environmental Studies, and Diana Balmori of the Yale School of Architecture. The course, "Natural Development: Towards Certification of New Uses of Green and Brownfields," was a graduate seminar in which students were divided into teams to research eight topics decided on by the instructors, with the help of Colleen Murphy-Dunning, program director of the Hixon Center for Urban Ecology. The eight topics were: Water Quality and Hydrology, Air Pollution and Micrometeorology, Plant Ecology and Population/Community Ecology, On-site Energy and Transportation, Industrial Ecology, Environmental Engineering, Legal Strategies for Municipalities and Developers, and Saving Time and Money. The course offered a rich mix of outside specialists who lectured on the eight selected topics. In-house specialists and the course's two teachers critiqued the students' research as it proceeded.

In its evolution from a series of research papers to a text for a broader audience, some topics were subdivided and others eliminated. In particular, soils were given greater prominence, water quality and hydrology were individually given greater prominence, and legal strategies were dropped because they would need a whole volume in themselves. The entire text has been extensively reorganized and rewritten.

chapter 2

Water

SITE DRAINAGE

The flow of water is just as important to an ecosystem as circulation of blood is to the human body. Water carries nutrients in and waste out, modulates temperature, sculpts the landscape, provides habitat, and facilitates reproduction and growth of countless organisms both aquatic and terrestrial. All of these critical functions can be impaired through human alteration of the landscape that takes place when land is developed.

Modern thinking on how to handle drainage has turned 180 degrees from earlier approaches. In the past, the goal was to collect rainwater and move it off the site as quickly as possible. This requires substantial site disturbance and installation of costly infrastructure. Any treatment to improve water quality had to occur at the end of the pipe, but was more often simply neglected. Stormwater was treated essentially as a waste product. Paradoxically, landowners pay for systems to remove water from their property and pay again to import water to use on their land. The modern approach, embodied in systems like low-impact development (LID), is to slow water as it passes across and through the landscape, to retain it in natural or constructed water features, to allow as much as possible to drain into soils or evaporate to the atmosphere, and then to release as little as possible, as slowly as feasible, downstream. Water is viewed as a resource to be saved and used. This approach requires treatment of water at the source, at numerous locations distributed across the landscape—often for less money—and produces cleaner more measured flows in receiving streams.