Land Evaluation and Site Assessment: A Guidebook for Rating Agricultural Lands, Second Edition

Prepared for the U.S. Department of Agriculture's Natural Resources Conservation Service
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Foreword

The Land Evaluation and Site Assessment (LESA) system is rooted in the U.S. Department of Agriculture's (USDA) land capability system and in suitability analysis. Capability and suitability systems "consult the genius of the place," to borrow from Alexander Pope. Such systems identify opportunities and constraints for various land uses. LESA was designed specifically to assess where the best farmlands are located locally. Its use has been extended to identify the best land for forestry, range, and riparian area protection.

The guiding force behind LESA is Lloyd Wright, a committed and idealistic public servant in the Washington, D.C., offices of USDA's Natural Resources Conservation Service (NRCS). In these days, when bureaucrats are subject to much criticism, it is important to remember that, in a democracy, the people are the government. A democratic government should reflect the values and aspirations of its citizens. Lloyd Wright reflects our best instincts as a people. Through times of both Republican and Democratic leadership, he has advanced a simple, common sense idea: The federal government should not be responsible for converting the nation's best agricultural lands without first considering the consequences of such actions.

Mr. Wright is more than a public servant, he is also a partner in a family farm. As such, he has not advocated the use of LESA as yet another federal intrusion into the business of private individuals. Rather, LESA has been promoted as a means for a careful consideration of projects promoted or sponsored by government. The role of Lloyd Wright is important to note because it illustrates that a single individual can make a difference in a democracy. Mr. Wright has been joined by many other individuals in the refinement and development of LESA. These individuals have been confronted with the conversion of farmland as a public policy issue and have found LESA, or some variation of it, a useful tool that gives decision makers a consistent, defensible basis for comparing different parcels of land. This *Guidebook*, written by two of the leading authorities on farmland protection, contains the most current refinement of LESA.

Agriculture, after all, is really one of the very few truly essential industries. Our nation has been blessed with productive soils, favorable climate, and hard working farmers. Agriculture has played an integral role in the development of our culture and in our leadership position in a global economy. Even in this so-called "postmodern information age," people still must eat. As the world's population continues to increase into the next century, agriculture is likely to grow in strategic importance. The good earth is at the base of this industry. Its wise use will determine the health, safety, and welfare of future generations as well as our own.

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Acknowledgments

This LESA project started in 1990, with funding from the USDA Natural Resources Conservation Service (then the Soil Conservation Service). The purpose of the project was to inventory LESA use throughout the United States and evaluate LESA systems in selected case studies. Principal investigators were Frederick Steiner, Arizona State University; Robert Coughlin, Coughlin, Keene and Associates; and James Pease, Oregon State University. Products of this project have included a national LESA conference, a journal article, "The Status of State and Local LESA Programs," in the *Journal of Soil and Water Conservation* (1994); *Agricultural Land Evaluation and Site Assessment: Status of State and Local Programs* (1991), which summarizes the results of a national survey and profiles more than 200 state and local LESA systems; the book, *A Decade with LESA: The Evolution of Land Evaluation and Site Assessment* (1994), which is an edited collection of research articles on various aspects of LESA; and this *Guidebook*. Participants at the national LESA conference cited the need for a new LESA *Guidebook* to incorporate experiences since the publication of the original LESA *Handbook* in 1983.

This project could not have been undertaken without the support and guidance of Lloyd Wright, Director of Conservation and Ecosystem Assistance, Washington, D.C., office of USDA's Natural Resources Conservation Service (NRCS). Lloyd wrote the original LESA *Handbook* and has been a strong advocate for a systematic approach to farmland evaluation and protection. Ann Carey now directs the division responsible for LESA; we appreciate her continued support for our LESA project. Frederick Steiner has worked closely with the authors of this *Guidebook*, providing valuable advice and direction. Our most sincere thanks are given to the reviewers of this manuscript, who provided extremely helpful comments, suggestions, and insights into improving the first draft: Richard Bowen and Carol Ferguson, University of Hawaii; Nancy Bushwick-Malloy, National Center for Food & Agricultural Policy; Lewis Hopkins, University of Illinois, Champaign-Urbana; Herbert Huddleston, Oregon State University; John Keene, University of Pennsylvania and Coughlin, Keene & Associates; Lee Nellis, consulting planner, Pocatello, Idaho; Frederick Steiner, Arizona State University; Charles Tyson, California Department of Conservation, Office of Land Conservation; and Lloyd Wright, NRCS.

For helping organize the national LESA conference and writing a report of discussion sessions, our grateful appreciation is given to

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Our appreciation for their guidance and interest in our project is extended to the Soil and Water Conservation Society, especially to Sue Ballantine and Doug Snyder, the editors who worked closely with us. Finally, our sincere thanks for her skills, patience, and persistence to Janet Meranda, who did the word processing through many drafts of the manuscript and to Nancy Knowlton who helped Jan with layout and design, as well as word processing of the first draft. Without the help of all of these people, and others who contributed documents and other materials, we could not have completed this *Guidebook.*

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Introduction

The Land Evaluation and Site Assessment (LESA) rating system, as presented in this *Guidebook*, is based on a land classification system that was initially designed in Orange County, New York, in 1971, and used on an ad hoc basis to determine the agricultural land value for property tax purposes until 1979. In 1979, the New York State Department of Agriculture adopted the land classification system as the official tool for determining the class of land for agricultural assessment for the entire state.

In the late 1970s and 1980s, many local and state governments were designing programs and policies to protect farmland. Some officials were developing programs to protect all prime farmland with no regard to location, while others proposed to protect only prime farmland with no provisions for other lands important to agriculture. Several county Cooperative Extension Service agents, district conservationists, and state and local planners asked the Soil Conservation Service—now the Natural Resources Conservation Service (NRCS)—for assistance in evaluating which agricultural lands should be protected from conversion to non-agricultural uses.

In 1981, the land-use staff in the NRCS (then the Soil Conservation Service) national headquarters bridged the gap between New York's land classification system for property assessment and the requirements for an evaluation tool for land-use decisions. First, the name of the system was changed from land classification to Land Evaluation and Site Assessment. Land Evaluation could be performed by local NRCS staff working with local officials and farmers. Second, Site Assessment would evaluate non-soil factors, such as parcel size and the geographic setting. The Site Assessment criteria were designed from information presented in the National Agricultural Lands Study (NALS) (Coughlin et al., 1981) and the *Compact Cities* report (Subcommittee on the City, 1980). The NALS reports recommended methods of protecting farmland from conversion, while the *Compact Cities* report documented the ravages of urban sprawl, from the decay of the central cities to the destruction of the nation's best farmland. *Compact Cities* also made recommendations on actions the government could take to prevent such sprawl. NRCS staff used recommendations from both reports to develop Site Assessment criteria that could be used with the Land Evaluation criteria to determine which sites, if converted, would be the least disruptive to the agricultural economy, assuming that some farm sites were needed for development. LESA was created as a tool to assist local officials in identifying farmland for protection by taking into account not only soil quality but also other factors that affect agricultural practices and then rating farmland sites on a relative scale for decision making.

The Site Assessment criteria identified numerous social, geographic, and economic factors that affect land-use decision making, such as proximity to urban centers and the level of agricultural investments and agricultural infrastructure. By adding the Site Assessment portion to LESA, NRCS produced a tool which, when used properly, helps federal agencies make decisions for funding or project development that do not augment urban sprawl or convert prime farmland to other uses.

Pilot tests. Once the LESA concept had been drafted, NRCS tested the concept in 12 counties in six states in the United States. In each county, an NRCS district conservationist teamed up with the county planner and other local officials to create a locally focused Site Assessment system to accompany the local soil and agricultural productivity data in the Land Evaluation part of the system.

The pilot states represented different types of land use and land capability from around the United States. For example, in DeKalb County Illinois, 97 percent of the land was prime farmland in 1980, whereas in Whitman County, Washington, less than 10 percent of the land was prime—mainly because of highly erodible soils

At the end of the pilot test period, all participants in the test program attended a conference in Washington, D.C., to share information and their experiences and to make recommendations on developing a national model. From data collected at the conference and in the field, the 1983 National Agricultural Land Evaluation and Site Assessment *Handbook* was written to provide guidelines for implementing the LESA system in the rest of the nation.

Farmland Protection Policy Act of 1981. In 1984, LESA criteria were included in the federal Farmland Protection Policy Act (FPPA) rule to help federal agencies determine which agricultural land should be protected from development. This marked the first time that federal agencies had guidelines that enabled staff to decide how their funds would contribute to land uses impacting agricultural lands. FPPA requires federal agencies to use LESA criteria to identify and take into account potential adverse effects of federal programs on the preservation of farmland. It also requires agencies to consider alternative actions, and as appropriate, to lessen such adverse effects and ensure that federal programs are coordinated with state, local, and private programs and policies. Under the revisions to the FPPA rules in 1984, LESA is now also used to determine which lands are to be committed to urban uses.

LESA **Handbook** *revisions.* In the 10 years following the development of the first national LESA model, much has taken place at the national, state, and local levels. In 1990, a three-phase research project was initiated to accomplish the following:

1. Conduct a nationwide inventory of existing state, county, and municipal LESA projects.

2. Evaluate the technical reliability of existing LESA systems.

3. Recommend improvements for the design of future LESA systems.

The research project was headed by Frederick R. Steiner, Arizona State University, in cooperation with James R. Pease, Oregon State University, and Robert E. Coughlin, Coughlin, Keene and Associates. All three professors had provided leadership in the development of LESA since the beginning in 1981. The study found that some 212 LESA systems had been developed in 26 states. The study also noted many areas for improvements to the LESA system. The study's findings were presented at a national LESA conference organized by John Keller, Kansas State University, in March of 1992. The revisions to the 1983 LESA *Handbook* and the development of this new *Guidebook* were based on recommendations from participants at the national LESA conference.

Although a number of people have been involved in developing and implementing LESA systems in the past 15 years, special recognition needs to be given to Frederick Steiner, James Pease, and Robert Coughlin for their long-term support in developing and improving LESA concepts and techniques during the 1980s, a period of low national support. This *Guidebook* will provide step-by-step assistance to those developing new state or local LESA systems as well as stimulate new ideas for revitalizing existing LESA systems.

Lloyd Wright
Natural Resources Conservation Service
Washington, D.C.

Overview

"Land classification is providing an essential basis for sound land-use programs. Moving painstakingly, demanding high scientific skill, ... the classification of land assets and liabilities is gradually setting up a general ledger account for the nation's land resources. In some areas, one phase only of the assets and liabilities—the soil—is being recorded with meticulous care. In other areas, a variety of items—soil, climate, vegetation, present use, and misuse—are inventoried on a large and generalized scale. Practical needs have dictated the individual methods." (Excerpt from White, in Planning for America, *1941.)*

This *Guidebook* is intended primarily for persons interested in developing a Land Evaluation and Site Assessment (LESA) system for their state or locality. LESA is a numeric rating system for scoring sites to help in formulating policy or making land-use decisions on farmlands. The system is designed to take into account both soil quality and other factors affecting a site's importance for agriculture. The *Guidebook* explains what steps are involved and how to implement them.

Efforts to classify and evaluate agricultural lands for land-use policy have been undertaken in the United States since at least the 1930s. These early classifications, based on current use or land capabilities, were compiled and profiled by the National Resources Planning Board in a 1940 publication entitled, *Land Classification in the United States* (NRPB, 1940). In Canada, G. Angus Hills developed resource rating systems for agriculture, as well as for forestry and outdoor recreation uses during the 1940s and 1950s. Hills' method combined ratings for land capability, suitability, and feasibility. Capability studies were used to evaluate physical attributes for potential uses, such as agriculture, while suitability studies evaluated the existing conditions, and feasibility studies evaluated costs of bringing land into production (Belknap and Furtado, 1967). Hills' land evaluation system formed the basis for the Canada Land Inventory (Petch, 1986). Ian McHarg's "ecological determinism" method employs suitability analysis for various land uses in an overlay format to evaluate the most environmentally suited locations for development activities (McHarg, 1969). Several of these methods as well as general concepts of suitability analyses are reviewed by Hopkins (1977).

The U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS—formerly the Soil Conservation Service) developed several soil-based systems to classify farmlands. These included the land capability system, which contains eight classes based on limitations to agriculture and, more recently, the important farmland classification system, based on soil qualities and economic importance to state and local economies (see Appendix E). Several other rating systems, such as the Storie Index (Storie, 1933), the Tulare County, California, Agricultural Rating System (Tulare County, 1975), and the Jackson County, Oregon, Farmland Evaluation System (Stockham, 1976), were developed by state and local governments for both farm management and land-use programs.

In 1981, the Soil Conservation Service (now NRCS) developed and began testing the Land Evaluation and Site Assessment (LESA) system. The uniqueness of LESA was that it provided a national model with consistent terminology and a set of classification procedures using soil-based and other site factors while offering a great deal of local flexibility.

In 1984, a generic LESA system was adopted by USDA in federal administrative rules (See Appendix A) to be used by federal agencies in evaluating projects causing agricultural land conversion. More than 200 state and local governments in the U.S. have adapted LESA procedures for their own circumstances and policy objectives. Once certified by NRCS, state or local LESA systems are used in place of the federal LESA system for evaluating projects proposed or reviewed by federal agencies.

LESA is an analytical tool, not a farmland protection program. State or local governments can help preserve lands for agriculture through land-use planning policies, agricultural districts or zoning, acquisition of development rights, or other techniques as well as by strengthening the local farming economy through tax incentives and agricultural development programs (Coughlin et al., 1981; Toner, 1984). LESA's role is to provide systematic and objective procedures to rate and rank sites for agricultural importance in order to help officials make decisions. A LESA system can be useful in addressing many questions, including the following:

- What land should a city, town, or county designate in its comprehensive, master, or general plan or zoning ordinance for long-term continuation in agricultural use?

- How can agricultural lands be ranked into two or more land classes?

- Which farm sites should be given highest priority for purchase of development rights?

- What is the significance of highway project impacts on farmland?

- Should a zoning permit be given to partition farm land or to allow a non-farm use?

- Which site among development project alternatives least impacts agricultural lands?

The primary subject of this *Guidebook* is the development of agricultural LESA systems for state or local use. However, LESA can be adapted to a number of other resources, such as forestland, rangeland, aggregate sites, riparian zones, and wetlands, as well as evaluating land suitabilities for urban or rural development. The application of LESA to forestlands is discussed in Appendix B. Other applications are discussed in Appendix C.

This *Guidebook* builds on the LESA experiences of state and local governments over the past dozen years and on a number of research studies of LESA systems. It addresses the range of topics a state or local government committee will encounter in developing a local LESA system, beginning with the question of whether a LESA system is needed or not. Once it is determined that a LESA system is needed, the *Guidebook* outlines steps for the following:

- appointing a LESA committee,

- specifying one or more factors measuring soil quality for the Land Evaluation component,

- specifying another set of factors relating to non-soil site conditions for the Site Assessment component,

- developing a rating scale for each factor,

- assigning weights to each of the factors,

- tallying the weighted factor ratings to obtain a LESA score, and

- preparing score thresholds for decision making.

The factors and weights will be accepted only if they and the resulting LESA scores make sense to local farmers and officials. Therefore, involvement of knowledgeable local people in formulating a LESA system is vital.

With the help of the LESA committee, a proposed LESA system should be thoroughly field checked and adjusted accordingly before it is adopted. After adoption, it should be reviewed periodically to make sure it continues to provide acceptable results.

This *Guidebook* is organized into the following nine chapters by steps in the LESA development process:

- Chapter 1 sets out the basic concepts and procedures of the LESA system.
- Chapter 2 outlines the procedures for assessing potential users and types of applications for a LESA system.
- Chapter 3 presents process options for working with local committees to formulate a LESA system.
- Chapter 4 addresses the selection and scaling of Land Evaluation factors.
- Chapter 5 addresses the selection and scaling of Site Assessment factors.
- Chapter 6 discusses ways to combine and weight LE and SA factors.
- Chapter 7 explains ways to test a draft LESA system before approving it for general use.
- Chapter 8 explores the problems encountered in setting LESA thresholds for various types of decisions and suggests methods for establishing thresholds.
- Chapter 9 summarizes the key points discussed in the *Guidebook*.

The Bibliography directs the reader to more detail on certain topics. The Glossary defines certain terms used in the *Guidebook*. The appendices provide supporting material for the text, as well as supplemental information on various topics. Appendix A provides the legal framework for LESA in federal administrative rules, including the generic LESA scoring system used for federal projects. Appendix B provides guidelines and examples for forest LESA systems. Appendix C gives examples and references for LESA applications to riparian areas, wetlands, sand and gravel sites, and rural residential suitability. Appendix D discusses the use of computer spreadsheets and geographic information systems in developing and administering LESA systems. Appendix E provides supplemental information for the Land Evaluation component. Appendix F lists LESA contacts by state.

Readers are encouraged to use or adapt any of the ideas presented in this *Guidebook*. Users are also encouraged to consult the following two other recent LESA reference books: *Agricultural Land Evaluation and Site Assessment: The Status of State and Local Programs*, which provides profiles and contacts for LESA systems developed between 1981 and 1993; and *A Decade With LESA: The Evolution of Land Evaluation and Site Assessment*, which contains research papers on various aspects of LESA. Both are cited in the Bibliography section.

Chapter 1
Concepts for LESA development

CONTENTS

The Land Evaluation and Site Assessment (LESA) system helps decision-makers compare sites on the basis of their agricultural value. This is done by quantifying soils and other site factors, then systematically combining them to produce a score for each site. LESA also makes it possible to group sites with similar scores and establish thresholds as a basis for action.

This chapter will discuss briefly the concepts related to developing and using a LESA system. Each of these concepts is elaborated in subsequent chapters. First, it may be helpful to define certain terms used in this *Guidebook*. The term **factor** is used to label a group of attributes, such as soil potential, size, compatibility, or scenic quality. Factor scale or **scaling** refers to the way points are assigned to a factor. For example, farm size may be scaled by assigning points from 0 to 100 to a series of size groups. The number of groups and the method of scaling is left to the local committee, although this *Guidebook* outlines examples for many factors. Factor **rating** refers to the number of points assigned to a factor for a particular site, before weighting. **Weighted factor rating** is used to denote the factor rating after weighting. **Ranking** refers to the relative importance of a site compared to other sites. **Score** is used for the total of all weighted factor ratings, i.e., a LESA score. **Weighting** refers to assigning a weight (for example, 0-1.0) to each factor in order to recognize the relative importance of the factor in the LESA system. **System** refers to all the factors, weights, and scales used in the evaluation of soils and other site conditions.

LESA committees

The LESA system is flexible and can easily be adapted to state or local conditions. As Chapter 3 explains, this is usually done by a LESA committee appointed by elected officials. Figure 1.1 illustrates the general process discussed in this *Guidebook* for developing a local LESA system.

A person trained in LESA procedures can be very helpful in coordinating project activities and assisting the LESA committee. The role of a trained LESA advisor or other LESA project coordinator is discussed in Chapter 3.

It is important that state officials (for a state system) or local officials (for a local system) appoint the members of the LESA committee in order to provide political legitimacy. If it has not been determined whether a LESA system would be useful, assessment

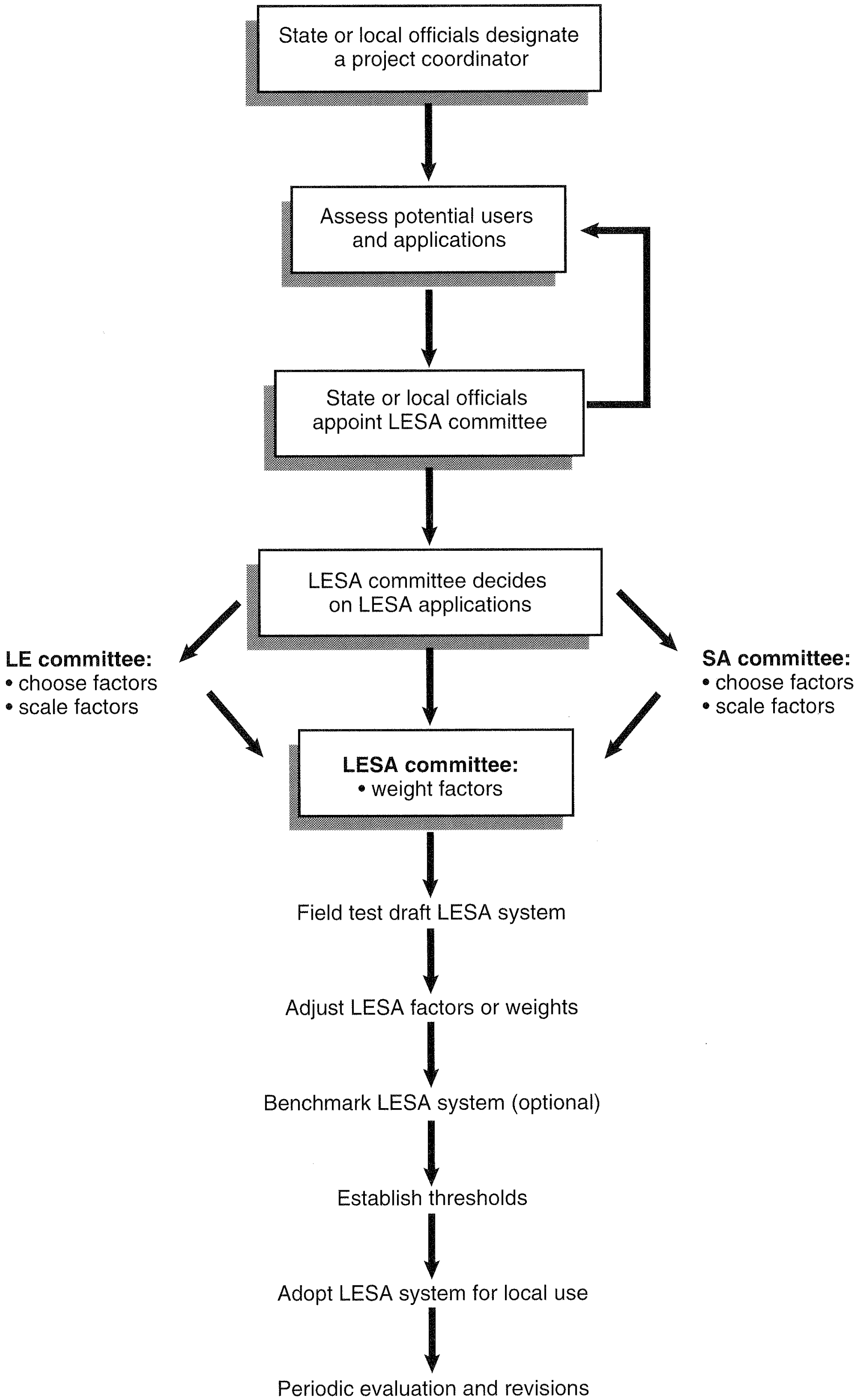


Figure 1.1. Flow chart for developing a local LESA system

of the potential users and types of applications may be done before appointment of a committee. The results can be used to decide whether to proceed with LESA development. If it has been determined, or seems likely, that a LESA system will be useful, the LESA committee could initiate the assessment of potential users and applications. In either case, the committee may need to set priorities or make other decisions on the needs of potential users and the specific applications for which the LESA system will be designed.

The committee may work on both LE and SA as a full committee or have LE and SA subcommittees. To set up the LESA system, factors are selected and defined and a rating scale developed for each factor. The factor scale ranges from 0 to 100, as discussed in the examples in Chapters 4 and 5. While LE factors are based on established methods of assessing soil quality, such as soil potentials or land capability classes, SA factors cover a wide variety of site characteristics. Selection of SA factors will vary according to local needs.

LESA structure

LESA is a system for combining soil quality factors with other factors that affect the importance of the site for continued agricultural use. Soil quality factors are grouped under Land Evaluation (LE). The other factors are grouped under Site Assessment (SA). The SA factors are of three types: non-soil factors related to agricultural use of a site, factors related to development pressures, and other public values of a site. Thus, an agricultural LESA system may contain some or all of the following components:

Land evaluation

- Soil-based factors.

Site assessment

- SA-1: Factors other than soil-based qualities measuring limitations on agricultural productivity or farm practices.
- SA-2: Factors measuring development pressure or land conversion.
- SA-3: Factors measuring other public values, such as historic or scenic values.

This classification is presented in Table 1.1, which shows how LESA scores are computed using arbitrary values for some typical factors. This LESA site is illustrated in Figure 1.2. Table 1.1 is simplified to show a site with one soil type and two LE factors. In actual practice, most sites will have more than one soil type. Soil potential ratings could be used as the sole LE factor or two or more soil factors could be used. The SA factors can be combined in several ways—as discussed in Chapters 4, 5, and 6.

Factor weighting

The committee that formulates the LESA system will typically conclude that some factors are more important than others. Accordingly, the committee will assign a relative weight to each factor (Column 3 in Table 1.1). The approach used in this Guidebook is to use a weight range of 0 to 1.00, so that all weights add up to 1.00 for a particular factor.

Once the system is set up, each site is rated for each factor on a scale from 0-100 (Column 2). Then, each factor rating is multiplied by the corresponding factor weight (Column 3) to obtain a weighted factor rating (Column 4).

Weighted ratings are summed to yield the total LESA score, which

Table 1.1. An example of computing a LESA score

(1) Factor name	(2) Factor rating (0-100)	x	(3) Weighting (Total = 1.00)	=	(4) Weighted factor rating
Land evaluation (site with one soil):					
1) Land capability	68	x	0.30	=	20.4
2) Soil productivity	62	x	0.20	=	12.4
Subtotals			0.50		32.8
Site assessment-1 (agricultural use factors):					
3) Acreage of farm	100	x	0.15	=	15.0
4) Farm investment	80	x	0.05	=	4.0
5) Surrounding uses	60	x	0.10	=	6.0
Subtotals			0.30		25.0
Site assessment-2 (development pressure):					
6) Protection by plan or zoning	90	x	0.06	=	5.4
7) Distance to sewer	70	x	0.05	=	3.5
Subtotals			0.11		8.9
Site assessment-3 (other factors):					
8) Scenic quality	50	x	0.09	=	4.5
Subtotals			0.09		4.5
Total of factor weights (must equal 1.00)	////////////// ////////////// //////////////		1.00		
Total LESA score (sum of weighted factor ratings)	////////////// ////////////// //////////////		////////////// ////////////// /////////////////		71.2

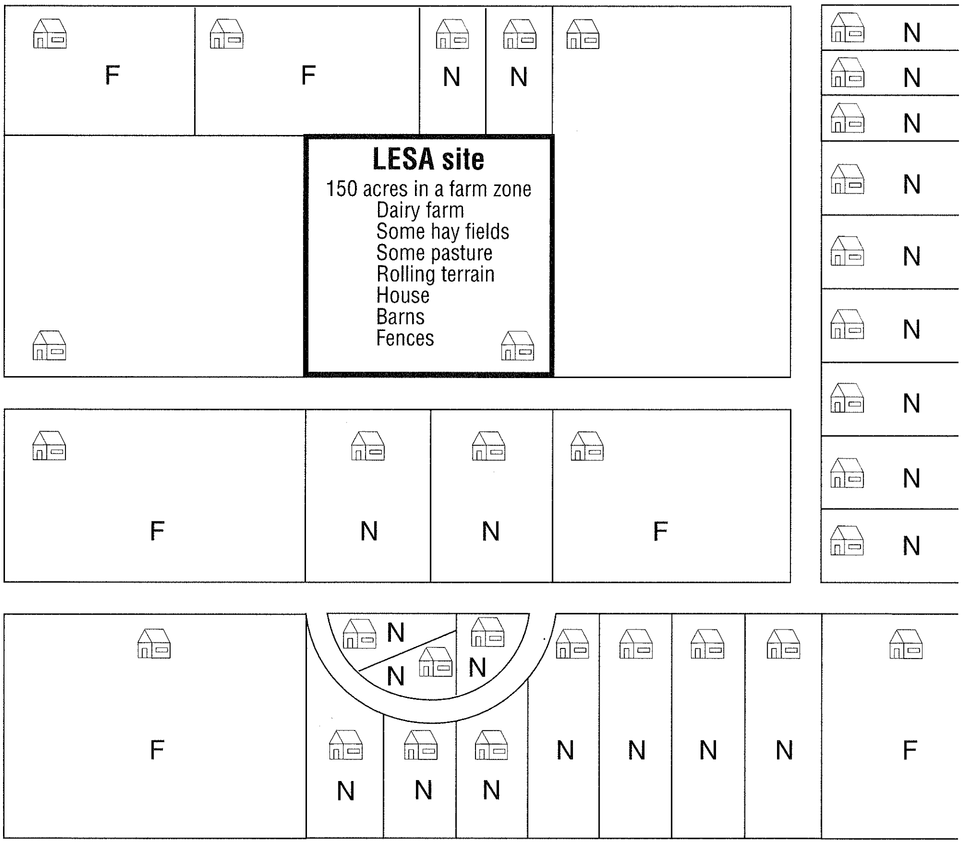


Figure 1.2. Illustration of a farm rated in Table 1.1

will range between 0 and 100.[1] In the example shown in Table 1.1 the total LESA score is 71.2.

The computation described above and in Table 1.1 is set out in a spreadsheet format in Appendix D. Using a computer spreadsheet will ensure that a systematic computation process is followed and that there will be no arithmetic errors. The main work in setting up a LESA system, however, is deciding what factors to include, what rating scales and systematic measurement procedures to use for each, and what relative weights to assign to each factor.

Field testing and thresholds

It is important to field test the draft LESA system, perhaps several times, in order to adjust the factor scales or weights. A comparison

[1] Note that the 100-point scale used in this *Guidebook* differs from the formulation presented in the 1983 LESA *Handbook*, where LESA scores had a possible range of 0-300 points.

of LESA site rankings to an independent ranking of sites (benchmarking) may also be helpful in evaluating the LESA system. Field testing and benchmarking are discussed in Chapter 7.

Thresholds are used to group sites by scores into two or more classes for decision making. Examples of thresholds and methods of setting them are given in Chapter 8.

State or local officials then adopt the LESA system as part of the state or local decision-making process. Usually, LESA scores or classes are used as a guide to aid decision makers, rather than a legally binding requirement. It is important to evaluate the LESA system periodically to adjust for changes in policy, agricultural practices, or new research on LESA techniques.

LESA design criteria

The focus of the system addresses the question, "What are we trying to learn from a LESA score?"

Throughout the LESA development process, committee members should consider the focus of the system, the data sources to support factor scaling, the redundancy of factors, the reproducibility (consistency among users) of the LESA scores, and the replicability of the LESA scores for different sites having similar characteristics.

Focus. The focus of the system addresses the question, "What are we trying to learn from a LESA score?" If the objective of LESA is to evaluate the agricultural value of a particular parcel relative to all other agricultural parcels in the jurisdiction, then LE and SA-1 factors may suffice. If it is important to evaluate development pressure or other public values as well as agricultural value, then SA-2 and SA-3 may be important to the LESA system. The LESA application may be for zoning or special district designation, zoning permits to change the land use, purchase of development rights, or for an impact assessment, but the above objective may be the same. In some cases, the objectives of different applications may vary, requiring different factor weights or different factors.

Chapter 5 outlines a set of SA-2 and SA-3 factors which deal with development pressure and other public values. While SA-2 and SA-3 factors may be combined with SA-1 factors in a LESA system, another option is to rate SA-2 and SA-3 factors separately and overlay or compare the results to an agricultural LESA (LE + SA-1) score. By keeping the focus on a single land use, a clear basis for comparing the agricultural value of one parcel to others on a relative scale will be established. SA-1 factors that directly affect agricultural use of the land include parcel size, percentage of the site suitable for agriculture, and compatibility with surrounding land uses. Incompatible land uses may limit farm practices, as a result of vandalism or complaints about noise, odors, dust, and farm chemicals from nearby residents or users of public or commercial facilities. SA-2 factors such as availability of public water, sewer, or fire protection services, or quality of road systems do not directly affect agricultural practices or production but instead are factors related to the pressure for conversion to other uses.

SA-3 factors, such as scenic or historical values, may represent other important public objectives in preserving agricultural lands. As outlined in Chapter 6, several options are possible for incorporating these factors into a site evaluation for a particular application. If a jurisdiction intends to use its LESA for review of zoning permit applications in a farm zone as well as for purchase of development rights, the LE + SA-1 factors and weights may remain the same for both applications. However, the SA-2 or SA-3 factors may be used differently in each application. For example, SA-2 factors may be omitted from zoning permit review, while for purchase of development rights, they may be used as a separate rating system or built into the LE + SA-1 LESA system as a third set of factors and weights. If the latter approach is used, the committee may wish to set separate LE and SA-1 factor thresholds at levels to assure a desired level of productive capacity regardless of the conversion pressure measured by SA-2 factors. Methods for setting these thresholds are discussed in Chapter 8. More discussion of the question of focus can be found in three chapters contained in the book *A Decade with LESA* (Pease and Sussman, 1994b; Huddleston, 1994; Bowen and Ferguson, 1994).

Data sources. Data sources for factors and their point scaling should be explicit for each factor. As an example of data sources for the factor parcel size, a sample of ownership parcel sizes from assessor rolls can be used to determine the range of parcel sizes and the appropriate size threshold for maximum points (e.g., over 100 acres). Data and maps from other sources, such as local planning or development offices, state departments of agriculture, Census of Agriculture, or Cooperative Extension Service can be helpful in deciding on the point allocation scale for several SA factors. Data may include primary sources, secondary sources, expert opinion, or special surveys. Documentation for some SA factors may be a problem. The LESA committee may decide not to use those SA factors with inadequate data available or to adjust the factor scale to reflect available data.

Data sources for factors and their point scaling should be explicit for each factor.

While the relative rankings of sites may not change significantly, dropping redundant LE factors will simplify the procedures.

Redundancy. Ferguson et al. (1990) reported that in the draft Hawaii LESA, five different measures of soil quality were highly correlated (all were above 0.85 correlation coefficient), even given the diverse soils conditions of the test parcels. This finding indicates that one or two LE factors may serve the purpose. While the relative rankings of sites may not change significantly, dropping redundant LE factors will simplify the procedures.

Redundancy tends to be more of a problem with SA factors. The Ferguson et al. study (1990) found that, while correlation was not high among Hawaii's 10 SA factors, only four were needed to explain 95% of the variability in SA scores. They concluded that the Hawaii system would be less cumbersome and produce nearly the same results if it consisted of four rather than 10 SA factors.

Pease and Sussman (1994b) reported that statistical analysis for a case study LESA system with 10 SA factors showed that correlation at a significant level occurred for all but two factors. Two of the factors had a correlation of 1.0, meaning that use of only one of the factors would provide the same results. Four factors explained about 90% of the variation in total scores. Since two of the four factors were significantly correlated, only two factors remained which were not correlated at a significant level. These two factors explained 74% of variation in total scores. The four factors probably could yield the same relative site rankings as the 10 factors. Factors such as zoning, plan designations, surrounding land use, and proximity to urban services tend to be correlated. Each factor should be selected to measure a distinct quality or attribute of the site.

It should be noted, however, that there could be cases where the unexplained 5% or 10% could be important. In evaluations, as opposed to tests of hypotheses, these outliers represent real differences, not just statistical anomalies. This possibility should be considered by the person doing the correlation analysis.

An analysis of factor correlation may be performed by the LESA advisor or other person familiar with statistical procedures. After discussion among the LESA committee members, factor adjustments can be made to simplify the LESA system and avoid unintentional over-weighting of factors by redundancy.

Reproducibility. In order to obtain consistent factor ratings and LESA scores, measurable factors and clear definitions must be used. The use of unambiguous tables to assign points will help assure consistency. Examples of unambiguous tables are given in Chapters 4 and 5.

Replicability. Different sites with the same or similar factor characteristics should yield the same or similar factor ratings. If ratings are reproducible, in most cases they should also be replicable. Replicability can be evaluated during field testing.

Summary

This chapter discussed LESA terminology, the process for developing a LESA system, a computation model for assigning weights to factors, and key concepts and procedures. More detailed guidelines are presented in other chapters of this *Guidebook*.

Chapter 2
Assessing needs: Users and applications

CONTENTS

Any agency or organization that decides a Land Evaluation and Site Assessment (LESA) system might be useful in its community should conduct an assessment of potential users and applications. The user assessment identifies the needs of all potential users of a LESA system and the applications for which it will be used. The assessment should lead to a better understanding of the existing local, state, and federal policy framework, and the funding and staffing requirements for development and operation of the LESA system. While it may not be possible to answer all of these questions at the beginning of the process, a thorough assessment of potential users and applications will make it easier to develop an effective LESA system.

> The user assessment identifies the needs of all potential users of a LESA system and the applications for which it will be used.

Initiating LESA development

The impetus to consider developing a LESA system for state or local use can come from a variety of sources, such as local or state planners, a planning commission, local elected or appointed officials, U.S. Department of Agriculture agency staff, individual citizens, or organizations concerned about farmland protection. Some existing LESA programs have been initiated by the governor's executive department or state legislature. Legislation in Vermont (ACT 200) provided that LESA be used by local governments for identifying farm and forest lands to be given land-use protection. Illinois developed a statewide farmland protection policy, at the initiative of the governor's office in 1980 and approved by the legislature in 1982. LESA is used at both the state and local levels as a farmland evaluation tool (Riggle, 1994). In 1993, the California legislature directed the state Department of Conservation to develop a set of LESA guidelines for use by local governments as an optional method to assess the significance of farmland conversion. Pennsylvania legislation requires LESA to be used for purchase of development rights programs that use state funds. The Hawaii legislature established a state commission to develop a LESA system to evaluate farmland for statewide zoning. In other cases, as in Bonnevillle County, Idaho, the impetus for LESA development came from a local need for a farmland evaluation tool.

Conducting an assessment of users and applications

The timing and administration of the user assessment may vary according to the circumstances of LESA initiation. If the impetus were a state requirement that LESA be used for certain applications, the LESA committee could be appointed first and the user assessment may be one of the committee's tasks. If it has not yet been determined that a LESA system is needed, a user assessment may be performed before a LESA committee is appointed.

The user assessment may be performed by a designated project coordinator, by staff of a public agency or other organization which administers farmland programs, by members of a soil and water conservation district, by faculty of a college or university, or by consultants. If a LESA committee has been formed, a member of the committee may take the lead in conducting the assessment.

The assessment may be as simple or as thorough as needed. An example of an assessment form is given in Figure 2.1. The form could be mailed to appropriate agencies or other potential users and the results collated for committee use. Another approach would be to hold a short meeting of potential users to explain LESA and then ask attendees to fill out a questionnaire. Interviews may be necessary to clarify or to discuss potential applications; for example, an assessor may need more information to determine potential usefulness of a LESA system.

Identifying the local and state policy framework

State and local policies affecting farmland protection will have some influence on the design of the LESA system. Development of a LESA system could be a plan policy or part of the development of a plan. Where a local government has adopted a comprehensive, general, or master plan, land-use policies will provide an important context for a LESA system. Policies may also relate to growth management, economic development planning, or environmental impact assessment. They may also include specific terminology that helps shape the local LESA system, such as the use of USDA Natural Resources Conservation Service (NRCS) land capability and important farmlands classification systems. For example, a 1993 Oregon law (HB3661, 1993) requires land capability classes I and II and prime and unique lands to be regulated as "high value" agricultural lands with more stringent zoning regulations than non-high value lands. In most cases, the local or state planning or development office can provide information on the local and state policy framework. This information should be summarized for use by the LESA committee.

Dear ________________________________:

We (identity) are currently considering the development of a Land Evaluation and Site Assessment (LESA) system for use in (jurisdiction). LESA is a numerical system for rating the quality of farmland, using both soils and site conditions. All ownership parcels in (jurisdiction) can be given a score on a 0-100 scale. Initially, we intend to use the LESA system to (intended use). However, we would like to design the system so that other potential users will find it useful. Please help us by answering the following questions:

Your agency: ______________________ Date: ______________________

Your name: ______________________ Your position: ______________________

Please check the following types of applications you might make of a LESA system and indicate estimated frequency of use (A = more than 5 times/year; B = 1-5 times/year; C = once every 2 years; and D = other).

	Yes	No	Frequency
1. Designate farm zones	____	____	____
2. Designate farmland districts (voluntary)	____	____	____
3. Other designation purpose (describe briefly):	____	____	____
4. Permit review (list types of permits):	____	____	____
5. Purchase of development rights or conservation easements	____	____	____
6. Transfer of development rights	____	____	____
7. Property assessment for taxation	____	____	____
8. Property evaluation for lending	____	____	____
9. Assess environmental impacts of a project or program	____	____	____
10. Review actions of another agency	____	____	____
11. Program evaluation or other research application	____	____	____

If you have special considerations that you think need to be included in a LESA system, please list them here or attach extra sheets: ______________________

____

Thank you for your help. Please contact (contact person) for more information.

Figure 2.1. Example of a form to identify potential LESA users and applications

Identifying potential LESA users and applications

If the farmland program is administered by a state agency, users may be state agency staff; for locally administered programs, users may be units of local government—land-use or development offices or administors of farmland districts or purchase of development rights programs. Users may also be assessors, lending institutions, or consultants retained by state or local governments for environmental impact assessments or land-use planning studies.

An important question to address at this stage is whether certification by NRCS of the local or state system is intended. The advantage of certifying the local or state system is that it would then be used in place of the generic LESA system (See Appendix A) for all federal environmental impact assessments under the National Environmental Policy Act of 1969 (NEPA) and would provide some degree of local or state influence on federal project decisions. The generic LESA system is contained in the Final Rule for the federal Farmland Policy Protection Act, which is given in Appendix A. To certify a LESA system, the state office of the NRCS will perform an evaluation and determine whether the state or local system meets specified criteria. The state or local NRCS office can provide more information on certification requirements.

While a LESA system may be initially developed for a specific purpose, such as designating agricultural zones or districts, there may be unanticipated other applications of the system after it is developed. Since not all potential applications are clear at this stage, a questionnaire, such as the example given in Figure 2.1, can be useful to identify potential users and applications. The form given in Figure 2.1 is intended only as an example. It may be necessary to provide more information on LESA in a cover letter or at a meeting. The form should be edited to fit local needs.

Staffing and funding for LESA applications

The information from the user assessment can be used to evaluate limitations on data collection and scoring procedures in a LESA system. For example, if LESA is to be used by a rural planning office with one staff person, the factors and scoring procedures probably have to be simple enough to be completed with minimum data collection or other case study research. If no one is available to interpret aerial photographs, as another example, then factor scoring cannot depend on such interpretation.

In some cases, an agency may be interested in LESA but does not have staff time or expertise to administer a LESA system. It may be possible to arrange for one agency to administer LESA for other agencies.

The funding for LESA administration may be considered during needs assessment. However, until a system is developed and tested, costs of administering the system will not be known. Also, budget allocations may be dependent upon a demonstration of LESA's utility.

Summary

The assessment process may be more or less formal than outlined in this chapter, depending on local conditions. Each community should adjust the process to its needs. Often help for this type of project is available through faculty at state or private universities or colleges, local or regional planning agencies, or private consultants. In some cases, the LESA advisor or a member of the LESA committee may be able to perform the user assessment.

After the information from the questionnaire is tabulated, a summary in text and tabular format will be very helpful to the LESA committee. The various applications can usually be accommodated in a single LESA system. However, certain applications, such as purchase of development rights within specified geographic areas, may require more than one set of factors and weights. For example, Lancaster County, Pennsylvania, allots higher factor ratings to farms that are close to certain urban areas in order to create a growth buffer (Daniels, 1994). Many other LESA applications, in contrast, allot lower factor ratings to any farm that is close to an urban area.

All potential users should be invited to have a representative on the LESA committee. This will help build a more credible system with greater potential use. The LESA committee will need to discuss how the results of the user assessment will be used to guide development of the LESA system. The assessment can be used as a reference point at several stages of LESA development, including factor selection, scaling, and weighting.

Chapter 3
Setting up a committee for formulating a LESA system

CONTENTS

One of the key Land Evaluation and Site Assessment (LESA) system concepts is to include knowledgeable local people in formulating the local system. The expertise and experience of farmers and those working with farmers is essential in establishing a sound LESA system. A LESA committee can help establish public credibility and political acceptability for the system. It is best if the committee is appointed by elected officials. However, in some cases, formal appointment may not be necessary. Instead, a local government agency, such as the planning department or planning commission, or a private group, such as a farm bureau or soil conservation district, may provide the legal and political base for the effort.

The expertise and experience of farmers and those working with farmers is essential in establishing a sound LESA system.

The role of the LESA committee should be to provide a range of state or local expertise to help develop a sound LESA system. Committee members cannot be expected to be current on LESA research and technical problems with LESA development and application. This latter role could be performed by a trained LESA advisor, if available, or other LESA project coordinator.

The specific public policy objectives for farmland protection and the types of applications for which LESA will be used should be determined by an assessment of potential users and applications, as outlined in Chapter 2. This assessment will be helpful in deciding whether a single LESA committee will work best or whether LE and SA subcommittees should be used. It will also guide the committee in factor selection, scaling, weighting, SA factor combining, and setting thresholds for decisions.

The overall process for developing a LESA system is outlined in the flowchart in Figure 1.1. This chapter discusses options for organizing local committees, based on experiences of jurisdictions from a national LESA survey conducted in 1991 (Steiner et al., 1991) and user discussion at a national LESA conference held in 1992 (Malloy and Pressley, 1994). The chapter also suggests the use of a trained LESA advisor to assist the committee with technical aspects of LESA development and the use of structured processes to achieve consensus among committee members on issues of factor selection, scaling, and weighting. Local LESA committees must have competent technical assistance to produce a sound, defensible LESA system.

Role of a trained LESA advisor[1]

The assistance of a trained LESA advisor will be immensely helpful to LESA formulation. Various research reports completed since 1981 have increased the knowledge base on formulating rating systems. A trained advisor can bring the benefits of this knowledge to the process and provide technical assistance to the committee. Specifically, a trained advisor can:

- prepare and conduct the user assessment,
- provide focus to meetings. In some cases, it may be desirable to have a person trained in group facilitation lead the meetings if the LESA advisor does not have these skills,
- assist the committee to interpret the assessment of potential users and applications in formulating factors and weights, and
- provide the committee with knowledge of available resources, research studies, other committees' experiences, pertinent studies, and similar applications.

The trained LESA advisor could be a Natural Resources Conservation Service (NRCS) staff person, college or university faculty member, consultant, local or regional planner, or other person with LESA training. If a trained advisor is not available, a person with some LESA experience may be located by contacting the local NRCS office. If no one with experience is available, study of this *Guidebook*, the book *A Decade with LESA* (Steiner et al. 1994), and the publication *Agricultural Land Evaluation and Site Assessment: Status of State and Local Programs* (Steiner et al. 1991) will be very helpful.

Committee appointments

In most cases, a LESA committee will be appointed by state or local officials. In some rural counties or townships, a planning commission may serve as the LESA committee.

[1]Note: At the time of this writing, Natural Resources Conservation Service (NRCS) and the Soil and Water Conservation Society plan to sponsor training workshops on LESA, starting in November 1996. The intent is to provide trained LESA advisors to assist LESA committees. This section and other references to a trained LESA advisor are written under the assumption that such training will be available. The status of training programs should be available from state NRCS offices, listed in Appendix F.

The 1991 LESA survey (Steiner et al. 1991) found that committee members usually consist of NRCS staff, planning commissioners, local planners, county- or university-based Cooperative Extension Service staff, local farmers, people engaged in farm service activities, other citizens, non-NRCS soil scientists, and other college or university faculty with expertise in LESA or agriculture. The committee usually includes public agency staff knowledgeable about agriculture as well as farmers and others representing significant commodity groups and with a broad view of agriculture.

Committee tasks

As outlined in Chapter 2, the LESA committee may oversee the assessment of potential users and applications if it has already been decided to develop a LESA system, because of a legal requirement or other reason. On the other hand, this user assessment may have been completed before appointment of the committee to determine whether or not to proceed with LESA development. In either case, the committee has the important task of deciding how to use the information. It may not be practical to design a system to address all identified applications. The report may present alternatives that require a decision. In some cases, different types of applications may require variations of the basic system. For example, siting and environmental assessment of alternatives for linear corridor projects, such as highways or pipelines, may require a different set of SA factors than would designating lands for agricultural zoning. Illinois uses 16 SA factors for corridor projects and eight factors for site specific projects (Riggle, 1994). The first task of the committee, then, is to make decisions on LESA applications based on the user assessment report.

Another initial task of the local committee is to define the planning area for the land evaluation. If LESA is to be used to designate agricultural zones or agricultural sites of high priority, the planning area will be, in most cases, agricultural lands in the county, township, or state. Part of the jurisdiction may be occupied by urban land or other nonagricultural land uses, and cities may have adopted planned expansion policies (e.g., urban growth boundaries) that would affect important farmlands. Any such land in the proposed planning area that is known to be unavailable for agricultural uses may be excluded from further consideration. For example, urban lands and state and federal lands may be excluded if they are unavailable to agriculture. However, where state or federal lands are used for agriculture or where government land disposal for private agricultural use is a possibility, these lands may be included.

The planning area may also depend on the status of land-use planning in the jurisdiction. If a comprehensive, general, or master plan, zoning ordinance, or farmland district is already in place, LESA may be used to evaluate requests for land-use conversion on lands zoned or otherwise designated for farm use. In farmland purchase or conservation easement programs, the lands to be considered for purchase or easement may be even further restricted to lands within a portion of agricultural zones.

A third task is to decide whether to work as a single LESA committee or as separate LE and SA subcommittees. In many cases, it will be advantageous to have subcommittees, because the tasks of factor selection and scaling will be quite different for LE and SA. Often, there will be some overlap of subcommittee membership. For example, NRCS or Cooperative Extension Service staff could serve on both, as may county planners, planning commissioners, or certain farmers with a broad, countywide perspective.

In some cases, such as an area with a small population and relatively homogeneous characteristics, one LESA committee may prepare both the LE and SA components. However, subcommittees provide sharper focus to tasks and demand less individual time.

The various tasks of the committee are discussed in detail later in this *Guidebook*. Since a fundamental characteristic of LESA is to allow for local flexibility, the specific structure of a LESA system will vary according to state or local conditions and needs. However, the broad tasks the committee will need to address should include the following:

- evaluate the user assessment,
- define the planning area,
- determine LE factors, how the factors will be scaled, and the weights to be assigned (Chapters 4 and 6),
- determine SA factors, how the factors will be scaled, and the weights to be assigned (Chapters 5 and 6),
- field test and adjust the draft LESA system as discussed in Chapter 7,

- optionally apply a benchmark test as outlined in Chapter 7, and

- propose a threshold system as outlined in Chapter 8. The threshold system is a key part of the LESA process in order to establish a consistent basis for applying LESA to policy and administrative decisions.

- Adoption of a LESA system is done by elected officials or other users. However, the committee may be asked to review the LESA system periodically to evaluate the need for revisions.

Committee options for LE formulation

It is possible to rely on NRCS to make LE determinations. According to the 1991 LESA survey cited earlier, one-third of LESA jurisdictions relied on NRCS alone; however, 59 percent of them used a committee of NRCS, local planners, state university Cooperative Extension Service staff, local farmers, local citizens, local public officials, non-NRCS soil scientists, and other persons. Seven percent of the jurisdictions relied on planning commission members or local officials to serve as the committee (Pease et al., 1994).

Chapter 4 presents factor options for the LE component. If land capability, soil productivity, and/or important farmland classes are to be used alone or in combination for the LE component, then a small committee of NRCS staff, local planners, and a few farmers would be appropriate. Since NRCS already has the necessary data available in a networked computer program (See Appendix E, part 3), the technical work could be accomplished by local or regional NRCS staff. The role of the committee would be to decide on factor weighting, participate in field testing the proposed system, and recommend thresholds for decision making. The committee also broadens the base for LESA acceptance in the community. The LE committee would probably need to meet four to six times, including field trips.

If soil potential ratings are to be used, a broader LE committee is needed in order to develop the database and to "endorse" the ratings. NRCS staff can provide valuable data on soil yields for an indicator crop or crops, but selecting indicator crops, calculating market price per unit, and determining costs related to initial and continuing investment to overcome soil limitations (see Table 4.1, in Chapter 4) require a group of knowledgeable local people. For example, the committee could include NRCS staff, Cooperative Extension Service county staff and university specialists, farmers with a broad knowledge of agriculture, farm supply dealers, well drillers, and farm improvement dealers such as those who install tile drains or irrigation works. One or more planning commissioners would also be valuable to have on the committee.

Committee options for SA formulation

While NRCS staff may also be involved in SA formulation, the 1991 survey found that 78 percent of jurisdictions using LESA employed a broad-based committee, while 16 percent relied solely on NRCS for SA formulation. NRCS staff served on SA committees in 54 percent of LESA jurisdictions. In general, SA committees were larger than LE committees, to represent more groups. Certainly, local farmers with a broad view of agriculture and representing significant commodity groups should be included. Involvement of local planners, planning commissioners, or elected officials is essential to successful application of the SA component. Planning staff representation will help in determining the practicality of factor measurements, such as distance to sewer and water lines.

Representatives of those agencies or departments indicating interest in applying LESA in the user assessment should be invited to participate on the committee. Those who have knowledge of data that will be used in the SA component should also be invited to serve on the committee.

Local or university-based Cooperative Extension Service staff can often be very helpful in organizing the sessions and participating as committee members. Citizens representing local environmental groups or farming groups can bring different insights and broaden the political base of the committee.

Using a structured group process

The LESA committee may decide that a structured group process could help with factor scaling, weighting, or other tasks. In some cases, a group facilitator may be all that is needed. In other cases, a more structured group process may be desired. Help with setting up a structured process, such as the three outlined below, may be available through the local or regional planning department, the Cooperative Extension Service, or a nearby college or university.

Delphi. A Delphi process provides a relatively fast and simple method to achieve group consensus on such matters as factor selection, scaling, weighting, thresholds for decision making, and establishing benchmarks for evaluating LESA scores (See Chapter 7 for an explanation of the Delphi method). When the committee gets ready to select numerical values for any of these attributes, a computer-based or a manual tabulation of Delphi results can provide a procedure to obtain group consensus. The members of the committee vote anonymously for a value, such as a weight for site size. The median and interquartile range (values between 25 percent and 75 percent) are then calculated and given to the group. Each person then votes again and can either retain his or her first vote or modify it. Discussion among participants is discouraged during the voting. A third iteration usually is sufficient to achieve a consensus.

Focus groups. Focus group interviewing is another option to understand how participants think about an issue. A series of questions in a logical sequence is posed to the group. The responses are tape-recorded and analyzed later by the project leader. Group discussion is more open-ended than a Delphi process, and focus group interviewing is not intended to lead to group consensus. This process may be more appropriate for deciding among LESA applications, factor selection, and other decisions requiring structured discussion. Where group consensus is desired, such as with weights, thresholds, or benchmarking, the Delphi or some other consensus approach may be more appropriate.

Other. Other options for achieving agreement of a group are available, such as the Analytical Hierarchical Process (Golden et al., 1989). The committee should use whatever method is familiar and most readily available to them.

Summary

Clearly, members of the local committee play a significant role in the LESA development process. An advisor with LESA training and experience, if available, can be very helpful to the committee.

Members of the committee are usually appointed by state or local officials. The various tasks outlined in this Chapter are discussed in more detail in other chapters. As land-use conflicts increase in the jurisdiction, the soundness of the committee's work and its usefulness in providing political acceptability become more and more important for the success of the LESA system.

Chapter 4
Selecting and scaling Land Evaluation factors

C O N T E N T S

The Land Evaluation (LE) component of the Land Evaluation and Site Assessment (LESA) system rates the soil-based qualities of a site for agricultural use. The four most common kinds of classifications used for Land Evaluation are land capability classes, soil productivity ratings, soil potential ratings, and important farmland classes. These classification and rating systems are described in the next section. The Glossary also provides definitions of key terms.

It is important that local people with recognized knowledge of agriculture participate in and understand the LE component in order to provide political acceptability.

In most cases, Natural Resources Conservation Service (NRCS) staff or other soil scientists will play a major role in selecting and scaling LE factors. As discussed in Chapters 2 and 3, the intended applications will affect the composition of the LE committee with whom NRCS will work. Although much of LE formulation is technical in nature, decisions about relative weights of LE factors should be made by the committee. It is important that local people with recognized knowledge of agriculture participate in and understand the LE component in order to provide political acceptability.

The LE component should meet the following objectives:

- LE should be understandable to policy makers and other users.
- LE should establish relative classes of soil-based quality to assist decision makers in setting priorities for sites to be protected for agricultural uses.
- LE should be technically sound, based on the best available data, and in conformance with established NRCS procedures for soil classification systems.
- LE should give consistent results within a given area.
- LE should be appropriate for the level of government at which the Land Evaluation system will be used. For statewide policy planning, the land capability classification system and the important farmlands classes may be most useful since they are available in most states. However, soil potential ratings or soil productivity ratings may have more meaning for county or township planning since they provide finer distinctions in soil-based qualities. At the state level, it may be important to monitor the conversion of prime farmland classes and land in capability classes I

and II to urban uses. At the local level, most lands may be prime or few lands may be prime. Local planners are primarily concerned with the relative differences among local soil-based qualities.

- LE factor selection, scaling, and weighting should be determined within the context of state or local policies. For example, if the prime farmlands definition is part of a state or local program, the important farmlands classification system may be most suitable. If the finer distinctions of land capability classes, soil productivity ratings, or soil potential ratings are desired by the LESA initiator, these systems may be more appropriate. These considerations are discussed in Chapter 2.

Interpreting soil-based qualities

The rating of soil-based qualities is done by applying one or more land classification systems as LE factors. These land classification systems are based upon interpretations of soil survey information, as shown in the example in Figure 4.1. Four different kinds of interpretations are described in this *Guidebook* for use in farmland evaluations: soil potential ratings, soil productivity ratings, land capability classification, and the important farmlands classification. Specific definitions are given in the Glossary. Each includes different considerations in classifying soils. The LE component may use one or several of them. Other classification systems appropriate for local use, while not described in this *Guidebook*, may also be used as LE factors.

- ***Soil potential ratings*** (See Appendix E, Part 1). When they are available or can be developed, soil potentials for specified indicator crops are preferred because they take into account both revenues associated with a soil's productivity and the costs associated with managing soils to achieve desired productivity levels. The use of these ratings enables NRCS staff or local planners to consider the relative economic value of soils to farmers, after soil limitations are overcome.

- ***Soil productivity ratings*** (See Appendix E, Part 1). The use of estimated yields for specified indicator crops, as reported in soil surveys or other sources, provides a measure for Land Evaluation that considers the local agricultural industry from

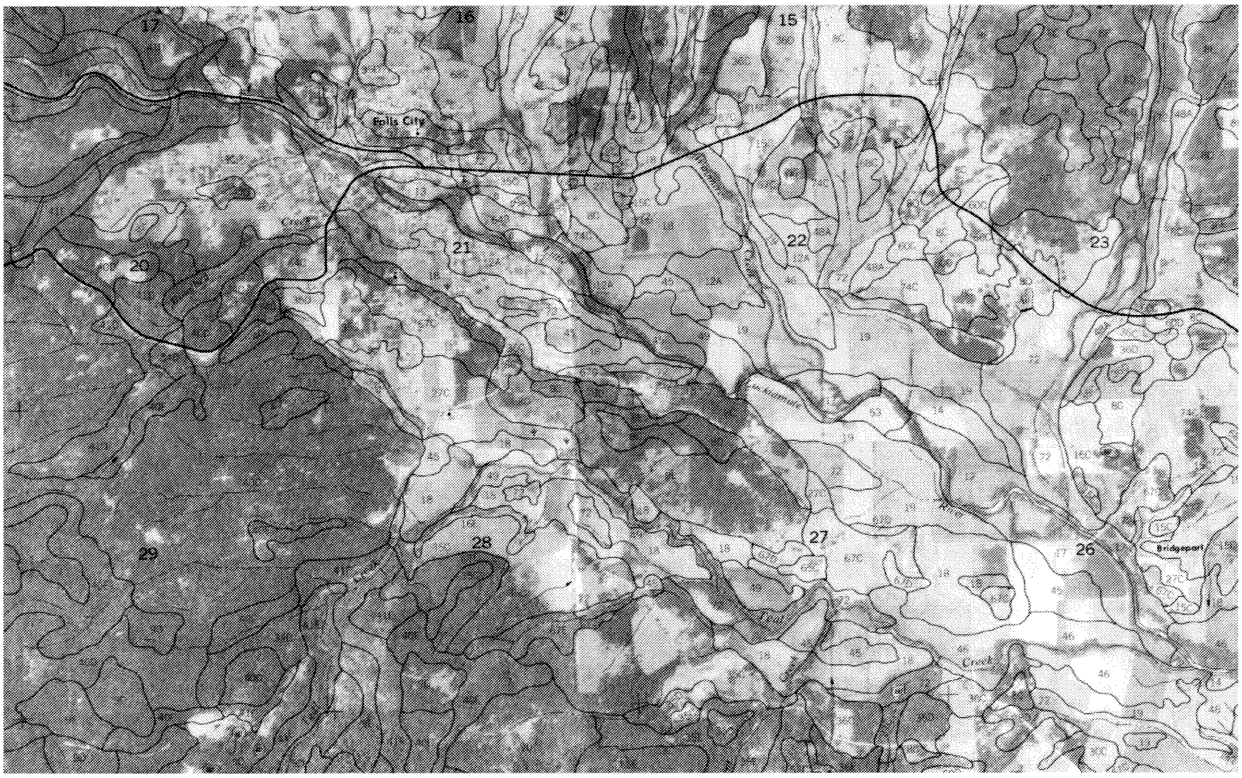


Figure 4.1. Example of a soil survey map, Polk County, Oregon

the standpoint of soil productivity. NRCS staff, local planners, or others could also estimate potential gross sales for each category of soils or each soil type by multiplying yields by current unit prices.

- *Land capability classification* (See Appendix E, Part 1). The USDA land capability classification system identifies the relative degree of limitations for agricultural use inherent in the soils of a given area. Data are usually available at local, regional, and state levels. In general, the fewer the limitations, the more suitable the soil is for agriculture, and the lower the costs of overcoming limitations.

- *Important farmlands classification* (See Appendix E, Part 2). Use of the national criteria for definition of prime farmland and unique farmland provides a consistent basis for comparing state or local farmland with farmland in other areas and for monitoring losses to conversion. Since the categories are broader than land capability classes, some distinctions among soils may be lost.

Soil potential ratings capture the most information, since they include a rating for each soil mapping unit based on its yield potential for certain common indicator crops and the costs of overcoming soil limitations. **Soil productivity ratings** provide the next finest level of detail, but do not consider costs of soil management. **Land capability classes** group soils based on risks of damage to soils by cropping. Soils of different soil potentials or soil productivity may be grouped into the same land capability class. The **important farmlands classes** are the broadest grouping; they also recognize state and local planning designations in the groups.

Indicator crops are used in developing both soil potential and soil productivity ratings. Both soil potential and soil productivity ratings rely on crop yield data, but there are cases where no single crop is grown on all soils in a jurisdiction, or where soils that are highly productive for a particular crop, such as cherries in Lake County, Montana, apples in Adams County, Pennsylvania, peaches in Box Elder County, Utah, wine grapes and ryegrass in Oregon's Willamette Valley, and cranberries in Massachusetts, New Jersey, and Wisconsin, have little value for the crops commonly grown on other soils in the same locality. In such jurisdictions, two or more indicator crops may be needed to accurately reflect the agricultural importance of each soil type.

Locating soil data

Soil maps show locations of mapping units identified through the soil survey.

In many jurisdictions, a published soil survey will be the most important data source. A soil survey is an inventory and evaluation of the soil resources of an area. In the United States, soil surveys are made cooperatively by NRCS, USDA Forest Service, Department of the Interior, state land-grant universities, and state and local officials. Much of the United States has soil survey information available. Information on the availability of soil surveys can be obtained from NRCS state offices, listed in Appendix F.

Published soil surveys contain soil maps, soil descriptions, management information, and interpretations for different uses. The soil maps are published at various scales to fit local needs, mostly 1:20,000, 1:24,000, and 1:15,840. Soil maps show locations of mapping units identified through the soil survey. An example of a soil map is given in Figure 4.1. Each area of soil (mapping unit) is identified by an alphabetic or numeric symbol or a combination of both, i.e., DoB, 18, 20B2, etc. The number of soils in survey areas ranges widely, depending upon the size of the area, the complexity of geology and landscape, climatic differences, and types of vegetation.

Soil descriptions included in soil surveys contain information about soil texture, depth, drainage, structure, color, landscape position, flood hazard, rockiness, stoniness, droughtiness, and other properties useful for planning purposes. Interpretations of soil properties are presented for various uses such as cropland, forest land, rangeland, home sites, recreation, wildlife habitat, and septic tank filter fields.

Soil data for completed soil survey areas of the United States are stored in data bases at state NRCS offices. Using these databases, NRCS staff can help generate land capability classes, estimated soil yields, and important farmland classes for each soil mapping unit in a jurisdiction. Soil potential ratings will have to be prepared by a local committee.

Each state NRCS office generates the data for an individual county or area as requested by the local NRCS district conservationist or by a state or local government official. The NRCS district conservationist, together with the local committee, provides certain information for the state office, such as a list of soil mapping units, indicator crops, available water capacity, soil moisture regime, "C" factor (for erodibility), and possibly other information. This information is verified by the state NRCS soil survey staff before it is entered into the computer program.

Total acreage and the percent of the total represented by each mapping unit should represent land that is available for agricultural use. A land-use map could, for example, be overlaid on the soil map to delineate agricultural areas within the LESA project area. Procedures to identify the LESA project area are discussed in Chapter 3.

LESA can best be developed where soil surveys are complete. In areas that lack a completed survey, the Land Evaluation part of LESA can be designed by the following methods:

- Utilization of information from soil surveys still in progress. This information is held in the files of the local NRCS office conducting the survey.

- Expansion of National Resource Inventory soil information. Data on land and water use, erosion, extent and condition of cropland and grazing land, and soil types are collected for sample points at the county level. While these data are intended for multiple county interpretation, general information on individual county soil types and conditions can interpreted.

- Expansion of general soil surveys used for major land resource areas (MLRAs). An MLRA is a group of geographically associated land resource units. A land resource unit is an area of several thousand acres that is characterized by particular patterns of soil, climate, vegetation, water resources, land use, and type of farming. For details, see *Land Resource Regions and Major Land Resource Areas of the United States* (USDA Soil Conservation Service, 1981).

These options require the assistance of NRCS staff or other soil scientists. The procedures may result in a less precise rating than could be made based on an up-to-date soil survey for the planning area. It is advisable that NRCS soil scientists or their representatives review and approve technical aspects of all Land Evaluations prepared in the development of a LESA system.

Selecting LE factors

About 50 percent of the jurisdictions currently using a LESA system rely upon soil potential ratings for the LE component of LESA.

The key decision in LE formulation is the choice of Land Evaluation factors. Practical considerations in LE (and SA) factor selection include time, budget, and data availability. More readily available factors, such as land capability classes and soil productivity ratings, may be selected if resources and time are serious constraints. The extent and diversity of the planning area is another consideration. For large counties or state-wide systems with diverse soils, simpler LE models might serve the purpose. For smaller areas or areas with more homogeneous soils, the finer distinctions of soil potential ratings may be more appropriate. The policy framework and importance of economic incentives are other considerations. Some state or local applications may require use of a particular land classification system, because of legal mandates. Similarly, economic incentives keyed to certain classification systems may make it necessary to use those classification systems. The LESA committee will need to weigh these considerations in selecting one or more LE factors.

The 1983 LESA *Handbook* (USDA, 1983) recommended using three or four of the classification systems: land capability classification, important farmlands classification, and either soil productivity ratings or soil potential ratings or both. However, these Land Evaluation systems were found to be highly correlated in Hawaii—with that state's diverse soils. Hawaii used five LE factors. Because these measures were closely related, "any two factors taken together can account for at least 95 percent of the overall LE rating" (Ferguson et al. 1990). If more than two LE factors are used, it's useful to do a correlation (interrelationship) analysis on a sample of sites to determine whether fewer factors will yield the same relative site rankings.

The LE committee will need to consider the characteristics of its planning area, the intended applications, and the practical commitment of time and funds to LE formulation. Local NRCS staff can provide significant advice on the selection of LE factors.

If soil potential ratings (SPRs) are available or can be developed by the LE committee, then a soil potential rating for each soil mapping unit in the planning area is recommended as the LE component. Soil potential ratings have the advantage of providing finer distinctions among soils than other classification systems, and they incorporate costs of overcoming soil limitations. The disadvantages are the time and cost of developing the ratings. About 50 percent of the jurisdictions currently using a LESA system rely upon soil potential ratings for the LE component of LESA.

If soil potential ratings are impractical, then a combination of land capability classification and soil productivity ratings may be used. A combination of the two is preferred since it captures both soil limitations and yield potential. For example, if soil productivity were used as the single factor, a class I soil on a 0-3 percent slope might rate the same as a class IIe soil on a 3-8 percent slope, without considering the erosion hazard on the IIe soil. By including the land capability classification in the system, the yield is adjusted to account for costs of overcoming the erosion limitation by placing the soil in a lower group, similar to the ranking of a soil potential rating.

Because the land capability classification system is widely available and accessible by NRCS staff, some jurisdictions may wish to use it alone for LE ratings. It should be recognized, however, that land capability classes group some dissimilar soils together, and they do not account for costs of overcoming soil limitations. The land capability classification should be used as the sole LE factor only when time and funds require it.

In most cases, the important farmlands classification will probably not add new information to the rating. However, each jurisdiction should consider how the addition of the important farmlands groups could change a relative ranking. If soils classified as unique would otherwise be ranked lower than desired, then this classification system could be added to the LE component. For example, soils with essential slope and aspect characteristics for vineyards or orchards may be significant for these crops but not be classified as prime. Also, if the prime or unique farmland terminology, as defined in Appendix E, part 2, is used in policy statements, then the jurisdiction should consider using this classification system as part of LE.

For statewide or regional level LESA applications, important farmlands groups may be appropriate in order to recognize and incorporate legal requirements using these groups of soils, or to compare losses of prime farmlands in sub-areas; however, the relative rankings of specific sites may not change from those without using important farmlands groups.

Preparing soil potential ratings. As noted previously, land capability classifications and soil productivity ratings can be developed by NRCS staff. To obtain the soil potential rating, the LE committee prepares a table of yields, gross returns, management costs, and net returns as outlined in the example in Table

Table 4.1. Example of soil potential data for irrigated sweet corn on Amity silt loam, 0-3% slope, Linn County, Oregon

				Management costs*							
	Yield		Gross return	Tile	Field	Land	Cross-slope	Sub-	Cover		Net return
Crop	t/ac	MT/0.4 ha	($)	drain	drain	smoothing	farming	soiling	crop	irrig.	($/ac/yr)
Irrigated Sweet Corn: $65.00/ton ($71.65/MT)	9.0	8.2	585	99	N/A	N/A	N/A	10	25	146	305

* Management Costs—$/acre/year ($/0.4 ha/year)
Source: Adapted from Huddleston et al., 1987.

4.1. Net return is defined by the LESA committee and may include adjustments for production costs, such as fertilizers, lime, and seed, as well as costs of overcoming soil limitations. Production costs are not included in the Table 4.1 example. Management data for this table are obtained from various sources, such as drain installers, irrigation suppliers, and contractors for land smoothing and sub-soiling. Costs are amortized to provide annual costs per acre. Tile drainage costs, for example, are amortized over a 25-year period at current interest rates to obtain annual per acre costs. Yield data are obtained from soil surveys or farm records. Commodity prices can be obtained from the USDA Agricultural Statistical Reporting Service state office or the Extension Service county or state offices. More detailed information on developing the management cost estimates for this example is given in Huddleston et al., 1987. In some states, state or local examples of SPR documentation may be available from the state NRCS office.

In some states, state or local examples of SPR documentation may be available from the state NRCS office.

Scaling LE factors

Scaling refers to assigning points on a 0 to 100 point scale for each unit of the land classification system or systems to be used as LE factors. The 1983 *Handbook* (USDA, 1983) proposed group-

Table 4.2. Land Evaluation for Latah County, Idaho

Ag. group	Capability class	Farmland importance	Productivity index	Percent of ag. soils	Thousands of acres	Factor scale
1	IIe	Prime	100-82	2.8	13	100
2	IIIe, IIIw	Prime	82-71	5.4	25	82
3	IIIe	Statewide	82-71	21.3	102	76
4	IIIe,IVe	Other	71-65	8.8	42	62
5	IVe,IVw	Statewide	65-47	8.8	42	52
6	IVe,IVw	Other	71-47	16.3	9	49
7	IVe	Other	53-47	2.0	9	43
8	IIIw,IIIe,IVe	Statewide	39-25	4.0	19	38
9	IVe,VIe	Other	39-25	7.8	37	36
10	VII	Other	No crop	22.8	107	0

Source: Stamm et al., 1984.

ing soils into about 10 subgroups to obtain a relative rating for each group. This approach was originally developed for use by local assessors in New York state to obtain soil groups for property tax assessment. Many existing LESA systems use this approach. An example of this classification is given in Table 4.2. These procedures are given in the 1983 *Handbook* for jurisdictions that wish to use them. In most cases, it will be easier to compile and understand the ratings according to the general model presented in Table 1.1 of Chapter 1 and the Land Evaluation examples given in this chapter.

Soil potential ratings are determined on a 100-point scale by setting the highest net return equal to 100, and then determining the percentage of the highest represented by each soil mapping unit, as illustrated in Table 4.3. In this table, the Chapman soil had the highest net return for all soils in the jurisdiction; its SPR is set equal to 100. Ratings for each soil are then based on the percentage of the highest net return represented by each soil. Net return can be calculated by subtracting production costs, such as fertilizers, pesticides, labor, fuel, and equipment repairs, and the costs of initial and continuing limitations from gross returns. Addison County, Vermont, used annual production cost estimates of $225/acre for corn silage and $176/acre for alfalfa (SCS, 1983). In the SPR examples shown in Tables 4.1 and 4.8, production costs were not included because it was assumed they would be about the same for all soils and would not affect relative values. For clarity, the definition of net returns should be included in the LESA documentation.

With each soil assigned a rating in a table, it is then a simple matter to calculate the LE component for a tract by multiplying the percent of the tract in each soil mapping unit by the SPR, as shown in Table 4.4. The next step is to multiply the SPR by its weight to obtain an LE weighted factor rating, as given in Chapter 6. More detailed instructions and references for calculating SPR ratings are given in Appendix E, Part 1.

To scale land capability classes, the first step is to determine which land capability classes are present in the LESA applica-

Table 4.3. Example of converting net return from Table 4.1 to an SPR, Linn County, Oregon

Soil	Net return	SPR
Amity silt-loam	305	71
Chapman silt-loam	429	100
Dayton silt-loam	240	57

Table 4.4. Example of an SPR rating for a site with three soils

Soil	SPR	x	Proportion of site	=	Partial site SPR
Amity	71	x	0.20	=	14
Chapman	100	x	0.50	=	50
Dayton	57	x	0.30	=	17
			Total site SPR	=	81

tion area. In an area with diverse soils, all eight classes may be present. There is no single, best scale for land capability classes. The example given in Table 4.5 is intended only to illustrate the scale. The assignment of a rating to a class is a judgment made by the LESA committee or LE subcommittee. It will reflect the unique conditions of the LESA application area. For example, the committee may decide that a IIIw soil is locally better than a IIs and rate it accordingly.

A soil productivity rating is scaled by definition. If a 0-100 scale is used, the rating for each soil mapping unit may be used. If another scale is used, then it is a simple matter to convert the numbers to a 0-100 scale by setting the highest equal to 100 and determining the percentage all other soils are of the highest, as shown in Table 4.6.

Important farmlands groups are more difficult to scale in that there are only five groups. The example in Table 4.7 rates prime and unique farmlands as equal. LESA committee members may decide to weight unique soils higher or lower than prime soils. Ratings for soils of statewide or local importance will also reflect the values of these soil groups within the LESA application area.

The examples given in this section are for illustration only. The LESA committee will need to determine the rationale for scaling based on local soil characteristics and policy considerations. This local flexibility allows LE adaptation for conditions unique to each jurisdiction.

Table 4.6. Example of a soil productivity scale

Soil	Soil productivity rating (150-point scale)	(100-point scale)
E	150.0	100
C	142.5	95
B	135.0	90
A	90.0	60
D	82.5	55
etc.	etc.	etc.

Table 4.7. Example of an important farmlands scale

Group	Factor scale
Prime	100
Unique	100
Statewide	75
Local	50
None of the above	0

NOTE: The rating assigned to Important Farmlands Groups is determined by the local LESA committee.

Table 4.5. Example of a land capability factor scale

Land capability class	Factor scale
I	100
IIw	95
IIe	92
IIs	90
IIc	90
IIIw	85
IIIe	82
IIIs	80
IIIc	80
IVw	65
IVe	62
IVs	60
IVc	60
V	40
VIw	25
VIe	22
VIs	20
VIc	20
VII	10
VIII	0

NOTE: This scale is for illustrative purposes only. The LESA committee assigns a rating to each unit based on local conditions.

The LE committee should begin by determining those groups of crops that produce the most revenue or use the most acreage. An indicator crop for each group can then be chosen on the basis of sensitivity to soil variations.

Choosing indicator crops

Since both soil potential and soil productivity rating systems are based on indicator crops, it is necessary for the LE committee to select the indicator crops it will use in developing the LE component. Considerations for determining the number and type of indicator crops include soil diversity, the local importance of dryland and irrigated cropping systems, sensitivity of crop types to soil variations, pasture use where this is an important part of the local agricultural economy, and certain types of crops which may be uniquely suited to a soil that has few other crop values.

The LE committee should begin by determining those groups of crops that produce the most revenue or use the most acreage. Crop information is available from the Census of Agriculture, USDA Agricultural Statistics Service state offices, county Extension Service offices, or local assessors. Crops that fall below some threshold, such as 10 percent of acreage or gross sales, could be dropped from further consideration. Next, crop groups can be determined, each group consisting of crops that are essentially interchangeable in terms of soil requirements and local cropping patterns. An indicator crop for each group can then be chosen on the basis of sensitivity to soil variations. For example, sweet corn might be used as an indicator for a wide range of vegetable crops or wheat might be used as an indicator crop for a group of cereal grains. Distribution and local concentration of crops within the jurisdiction should also be considered. Commonly grown indicator crops may vary by geographic sub-areas, such as valley bottomlands, river terraces, and foothill slopes, by other sub-areas with different precipitation and temperature regimes, and by irrigation availability.

Several examples of jurisdictions' use of indicator crops follow:

- Kenai Peninsula Borough, Alaska, used potatoes as its indicator crop. While grass hay could have been used, hay production tends to be constant at one to two tons per acre on a wide variety of soils. Potato production was much more sensitive to the various factors that were used to separate the different soils groups (Resource Development Commission, 1987).

- Marion County, Oregon, a diverse county that leads the state in agricultural gross sales, used five indicator crops: fine fescue, irrigated sweet corn, winter wheat, filberts, and non-irrigated permanent pasture. Fine fescue, because of its importance in terms of acreage and revenue, represents the grass seed crops. It is especially important in the foothill areas. Irrigated sweet corn represents a wide variety of vegetable crops and is grown on bottomland soils. Winter wheat represents cereal grains and other field crops grown without irrigation. Filberts represent a variety of tree fruit and nut crops. Non-irrigated permanent pasture represents a significant agricultural use for some soils not as well suited for other cropping systems (Marion County, 1986).

- Bonneville County, Idaho, used dryland wheat, irrigated barley, and irrigated potatoes as its indicator crops. While barley is a good general indicator for this county, potatoes are an important and more valuable crop on some soils (Nellis, 1989).

- Latah County, Idaho, used winter wheat as its indicator crop. Where this crop cannot be grown because of higher elevations or wet soils, barley and hay were used as indicator crops, and their yields were adjusted to winter wheat yields on the basis of comparable present market values (Stamm et al., 1987). Similarly, in Monroe County, Illinois, corn was used as its indicator crop. Where corn cannot be grown because of steep slopes or shallow soils, an equivalent corn yield was developed using hay, pasture, and woodland (Monroe County, 1988).

- In Hawaii, sugar cane was used for lands historically and currently in that use. Cabbage was used as the typical vegetable crop, and papayas and macadamia nuts were used for orchard lands. In Hawaii's case, these indicator crops were used to reflect current land use for specific land parcels (Hawaii LESA Commission, 1986).

Comparing yields for indicator crops

Once indicator crops are selected, the soils can be scaled to assign ratings. If only one indicator crop is selected, yields, in units such as bushels of corn, tons of grass seed, or AUMs for pasture, may be used in scaling. When several indicator crops are selected, a common scale, such as percentages, gross returns, or net returns, must be calculated. Even when common measurement units are used, such as tons of wheat and tons of grass, the value of the crop may differ substantially, requiring the use of a measurement unit that equalizes this difference.

One method of comparison is to use equivalent yields of a principal indicator crop, such as corn or wheat, for secondary indicator crops. A second method is to average the measurement units. A third method is to use the highest indicator crop value for each soil.

One common measurement unit is to express the yield of a given indicator crop on a given soil as a percentage of the maximum yield obtainable from all soils on which that crop can be grown. For example, a soil that rates in the 70th percentile for corn yield might be considered equivalent to another soil that rates in the 70th percentile for wheat yield. This does not account for differences in market value among different crops, however.

Another is to express the yield of each indicator crop in terms of gross return per acre. This method, however, disregards costs of overcoming soil limitations and weights differences in market value very heavily. It may proportionately downgrade soils that are not suitable for the highest value crop but nevertheless are productive soils for other agricultural enterprises that are important in the agricultural economy of a region.

A better common measurement unit for comparing yields of indicator crops is to compare net returns. In this way, costs of overcoming soil limitations are subtracted from gross returns, and soil productivity can be expressed in terms of the net returns to management. Those soils that produce high yields and respond well to management are rated higher than soils producing lower yields with the same amount of management or soils requiring extra management to achieve the same yields. This is the principle behind the concept of the soil potential rating system. The net returns should be recalculated periodically, perhaps every three years, to reflect commodity price changes.

If the soil potential rating system is used, net returns for each soil type in the jurisdiction are determined by subtracting production costs and costs of overcoming soil limitations from gross returns per acre. The local LE committee determines the pertinent costs per acre per year for various soils. The computation is shown in the example given in Table 4.8, where four soils (Amity, Bellpine, Dayton, and Willamette) are rated for four indicator crops (wheat, ryegrass, pasture, and sweet corn). Yield per acre is obtained from the soil survey or farm records. Gross return per acre is obtained by multiplying yield by unit price. While adjustments for production costs could be included, they were assumed to be about the

Table 4.8. Example of soil potential data for each of four indicator crops, Linn County, Oregon

Crop and Soil	Yield		Gross Return ($)	Management costs—$/ac/yr ($0.4 ha/yr) Tile drain	Field drain	Land smoothing	Cross-slope farming	Sub-soiling	Cover crop	Irrig.	Net return ($)
Winter wheat—											
$3.85/bu ($10.94/hl)	bu/ac	hl/0.4 ha									
Amity	100	35.2	385	99							286
Bellpine, 3-12%*	70	24.6	270				10				260
Chapman	100	35.2	385								385
Dayton	50	17.6	193	155	2						36
Willamette, 0-3%	110	38.7	424								424
Annual ryegrass—											
$0.14/lb ($0.31/kg)	lb/ac	kg/0.4 ha									
Amity	1800	817.2	252								252
Bellpine, 3-12%*	900	408.6	126				10				116
Chapman	1800	817.2	252								252
Dayton	1800	817.2	252		2	9					241
Willamette, 0-3%	1800	817.2	252								252
Permanent pasture—											
$10.00/AUM†	AUM/ac										
Amity	10		100								100
Bellpine, 3-12%*		60								60	
Chapman	12		120							120	
Dayton	8		80		2					78	
Willamette, 0-3%	12		120								120
Irrigated sweet corn—											
$65.00/ton ($71.65/MT)	t/ac	MT/0.4 ha									
Amity	9	8.2	585	99				10	25	146	305
Bellpine, 3-12%*	7	6.4	455				10	10	25	181	229
Chapman	9	8.2	585					10	25	129	427
Dayton	6.5	5.9	423	155	2			10	25	146	85
Willamette, 0-3%	9	8.2	585					10	25	146	404

* Numbers indicate range in slope gradient on which the soil occurs. Soils lacking numbers are nearly level.
† AUM, animal unit month.
Source: Adapted from Huddleston et al., 1987.

same for all soils and were not included in this example. Unit price is obtained from Extension Service commodity estimates, from processors, the USDA Agricultural Statistics Reporting Service state office, or from other state or local sources. To account for price fluctuations, prices per unit can be calculated over a five-year period and adjusted for inflation. In obtaining a unit price, prices can be averaged or, alternatively, the three middle values can be averaged, discarding the highest and lowest values.

Management costs are subtracted from gross returns to obtain net return figures. The net return figures, as given in Table 4.9, provide the basis for calculating SPR. At this point, at least two options are available. In the first option, the soil mapping unit with the highest net return among all indicator crops is set equal to 100 points, such as shown in Table 4.10. The highest net return for other soil mapping units are then assigned a point value by calculating their

Table 4.9. Example of net returns for five soils and four indicator crops, Linn County, Oregon

Soil	Winter wheat	Annual ryegrass	Permanent pasture	Irrigated sweet corn
Amity	$286	$252	$100	$305
Bellpine, 3-12%	260	116	60	229
Chapman	385	252	120	427
Dayton	36	241	78	85
Willamette, 0-3%	424	252	120	404

Source: Adapted from Huddleston et al., 1987.

Table 4.10. Two methods to calculate soil potential ratings on a 100-point scale for five soils, Linn County, Oregon

Soil	Highest net return for four indicator crops	SPR	Average net return for four indicator crops	SPR
Amity	$305	71	$236	79
Bellpine, 3%-12%	260	61	166	55
Chapman	427	100	296	99
Dayton	241	56	110	37
Willamette	424	99	300	100

Source: Adapted from Huddleston and Pease, 1988; Huddleston et al., 1987.

percentage of the highest net return and applying the percentage to a 100-point scale. An alternative approach would be to average the net returns of the four indicator crops for each soil mapping unit and then scale the averages to obtain SPRs, also shown in Table 4.10.

As shown in Table 4.9, a single crop would not work well as an indicator of soil potential in this county because the net values vary considerably by soil mapping unit for different indicator crops. If wheat were chosen as the indicator crop, the Dayton soil would have a very low net return. However, if annual ryegrass were chosen, there would be essentially no difference in net returns between Dayton and Willamette. The truth is somewhere between these two extremes. Willamette is an excellent soil for virtually all crops. Dayton is a valuable soil resource for the grass seed industry, but there is little flexibility for growing crops other than grass seed. Use of techniques that incorporate information from several indicator crops, as shown in Table 4.10, better reflects the true value of the Dayton soil for agricultural use in this county.

In deciding which of the two options given in Table 4.10 is most appropriate, the LE committee should consider several points. Using the highest net return instead of the average recognizes that certain crops, such as ryegrass seed, may be grown successfully on otherwise limited soil. In the example shown in Table 4.9, Dayton soil, a poorly drained soil with a very slowly permeable clay layer just below the surface, clearly produces a low net return for wheat, pasture, and sweet corn. However, the soil occurs in large blocks in the county and supports a very important ryegrass industry. The use of the highest net return places this soil considerably higher on the SPR scale than would averaging. If each soil type is being used to raise those crops which yield the greatest net return, then highest net return is the best representation of land value.

In specifying yields of indicator crops, a "high" sustainable management regime is usually assumed, since this more closely represents the soil's potential than yields obtained under less intensive manage-

The advantage to averaging net returns is that the SPR would then reflect a soil's capacity to support diverse crops. In jurisdictions without a special circumstance, such as the large blocks of Dayton soils and the ryegrass industry, averaging provides a good reflection of the relative value of soils. If, for example, demand is not reliably sufficient to sustain use of most of the land in each soil type to raise its highest net return crop, then average net return is the best representation of land value.

In specifying yields of indicator crops, a "high" sustainable management regime is usually assumed, since this more closely represents the soil's potential than yields obtained under less intensive management. Soil survey yield figures should be reviewed by the LE committee for each soil mapping unit and adjusted as necessary for environmental gradients such as rainfall, slope, and temperature, for rotation requirements, and for other factors such as drainage improvements. Also, the LE committee should determine whether equivalent dates and levels of technology were used in deriving the soil survey yield figures. In cases where there are missing data, estimates of crop yields must be made.

Another option for combining indicator yields is the use of major and secondary indicator crops. In this option, a major indicator crop is chosen and secondary indicator crops are used to adjust the value of the major crop on soils that do not support the major indicator crop. For example, if wheat were the major crop, wheat yields could be adjusted by comparable market values of the secondary crops (see profile for Latah County, Idaho, in Steiner et al., 1991; Stamm et al., 1987). To illustrate this approach using the data in Table 4.8, the wheat yields could be adjusted by using pasture as a secondary crop. The yield can be adjusted by the percentage of wheat gross returns that pasture can produce on soils that can support both uses. For Amity soils, the pasture gross return is \$100/acre/year as compared to \$385/acre/year for wheat (26 bushels/acre), which indicates that pasture returns are 26 percent of wheat returns. Let us consider a soil that could not support wheat, say Dayton, in Table 4.8. Dayton has a gross return of $80/acre/year for pasture, which is 80 percent of the Amity gross return. Applying the 80 percent to the 26 bushels obtained above gives 21 bushels of wheat ($81 gross sales) in a yield adjusted for the secondary crop.

The LE committee should consider carefully both the selection of indicator crops and the method of combining them for a rating scale. Choice of method will depend on the agricultural characteristics of the jurisdiction. Expert opinion of NRCS staff will be valuable in selecting a method. Field tests, as outlined in Chapter 7, will be helpful in refining these procedures.

Summary

The selection and scaling of LE factors are important tasks for the LESA committee or LE subcommittee. The choice of factors will depend on policy objectives, the user assessment, and time constraints. Scaling of LE factors should reflect state or local conditions and the purpose of the LESA system.

The choice of one or multiple indicator crops for soil productivity or soil potential ratings is determined by state or local agricultural commodities, soils, and subclimates. If more than one indicator crop is used, they may be combined in several ways. Chapter 6 discusses combining and weighting LE factors.

Chapter 5
Selecting and scaling Site Assessment factors

C O N T E N T S

Site Assessment (SA) rates non-soil factors affecting a site's relative importance for agricultural use. In this *Guidebook*, SA factors are grouped into the following three types:

- SA-1 factors measure non-soil site characteristics related to potential agricultural productivity or farming practices.
- SA-2 factors measure development or conversion pressures on a site.
- SA-3 factors measure other public values of a site, such as historic, cultural, scenic, or environmental values.

The local SA committee should choose specific factors reflecting the purpose for which the Land Evaluation and Site Assessment (LESA) system is to be used, as determined by the user assessment (see Chapter 2). For some purposes, such as reviewing applications for permits for non-farm dwellings or land divisions in a farm zone, only SA-1 factors may be pertinent since SA-2 and SA-3 factors may already have been addressed in the planning and zoning process. For other purposes, such as choosing sites for purchase of development rights or other easements in an area not adequately protected by farm zoning, SA-2 and SA-3 factors may be important to the decision-making process.

The SA committee will also have to decide how to combine the SA factors. Some jurisdictions may wish to incorporate all factors into a single LESA system. Others may find it more appropriate to combine LE with SA-1 to obtain a ranking of the relative agricultural importance of sites within a jurisdiction and to measure SA-2 and SA-3 factors with a separate rating system; rating results would then be compared or overlaid to evaluate specific sites for the public policy program. Options for combining and weighting SA factors are discussed in Chapter 6. This Chapter discusses the three types of factors and provides scaling examples.

Factor selection and scaling will differ among jurisdictions depending upon the use for which LESA is intended. There are, however, a number of important important points to be used in selecting, defining, and scaling SA factors, including the following:

> Scaling refers to the way points are assigned to units of a factor.

- Scale factors in such a way that more of a desirable attribute and less of an undesirable attribute indicate a stronger argument for keeping the site in agriculture. In other words, the more of a desirable attribute and the less of an undesirable attribute, the higher the rating. In the 100-point scale, zero

Table 5.1. Adams County, Pennsylvania, scale for proximity to protected farmland

	Original	Revised
Adjacent	100	100
Within 1/8 mile		90
Within 1/4 mile	80	70
Within 3/8 mile		50
Within 1/2 mile	60	40
Within 1 mile	40	30

NOTE: Numbers from the original table were converted to a 100-point scale.
Source: Adams County, Pennsylvania, LESA System, 1990.

indicates the least importance for continuation in agriculture and 100 indicates the greatest importance for continuation in agriculture.

- Clear definitions and instructions help attain objective measurements. Each user should obtain the same results when assessing the same site. For example, in the factor measuring compatibility with surrounding land uses, the specific compatible and conflicting uses must be defined as well as distance reference points. An instruction such as "within a quarter-mile" must indicate whether the measurement is taken from the center of a subject site, its corners, or any point on the perimeter. Thinking through specific instructions to the user clarifies the purpose and importance of the factor to LESA committee members.

- Link factor scales to supporting data. For example, be sure that the factor scales correspond to the range of the data for the jurisdiction. Size of farm is a good example. Data for farm sizes are available from the Census of Agriculture, assessor records, USDA Farm Services Agency (FSA) records, and, in some states, Cooperative Extension Service reports. Typical (e.g., median) farm sizes for the principal crop types can be determined from these records, supplemented with interviews of agency staff. Data sources for SA factors may include published books or reports, articles, surveys, or expert opinions. The source should be specified for each factor to clarify questions that may arise in the future.

- Generally, it is best to select factors that apply to most sites. Certain factors may be important to only a few sites, such as presence of mineral leases or historic sites. In this case, these concerns could perhaps be covered separately in the local planning system.

- For uniformity in scales and standardization in computation (see Chapter 1, Table 1.1), it is recommended that each factor be scaled on a scale of 1-100 and then weighted. However, considering the inherent imprecision of most SA factors, one option is to use only an 11-step scale: 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100. The 11-step scale provides a good basis for differentiation among sites. Using more points on the scale could imply more precision than is possible; using fewer (say 0, 20, 40, 60, 80, 100) could result in insufficient differentiation among sites and unnecessarily large gaps between the scores of different sites.

This option could be used for some or all SA factors.

- Be aware that, for some factors, factor scales might correspond linearly (as in Curve A in Figure 5.1) with distance, area, or whatever variable affects the factor. Other factor scales might increase linearly and then level off at some threshold point (as in Curve B in Figure 5.1). For still other factors, scales might start flat, increase rapidly, and then level off (as in Curve C in Figure 5.1). Other curve shapes are possible. Point allocation will vary according to the way each factor affects agricultural use of a site.

For example, consider the proximity factor (Table 5.1), used in the Adams County, Pennsylvania, LESA system. Proximity to farmland protected by perpetual easements or restrictive covenants is used to evaluate proposals for purchase of agricultural conservation easements. Originally, Adams County scaled this factor so that points assigned would drop off more or less linearly up to 1/2-mile from the nearest property under easement. In reviewing this factor, the Adams County Agricultural Land Preservation Board observed that the value of preserving a site is greatly enhanced if it is directly adjacent to land that is already under easement, but drops off rapidly after easement land is not adjacent and levels off at 3/8 1 mile from the site, as shown in Curve D of Figure 5.1. Therefore, the board revised the scaling to more closely resemble an S-shaped curve.

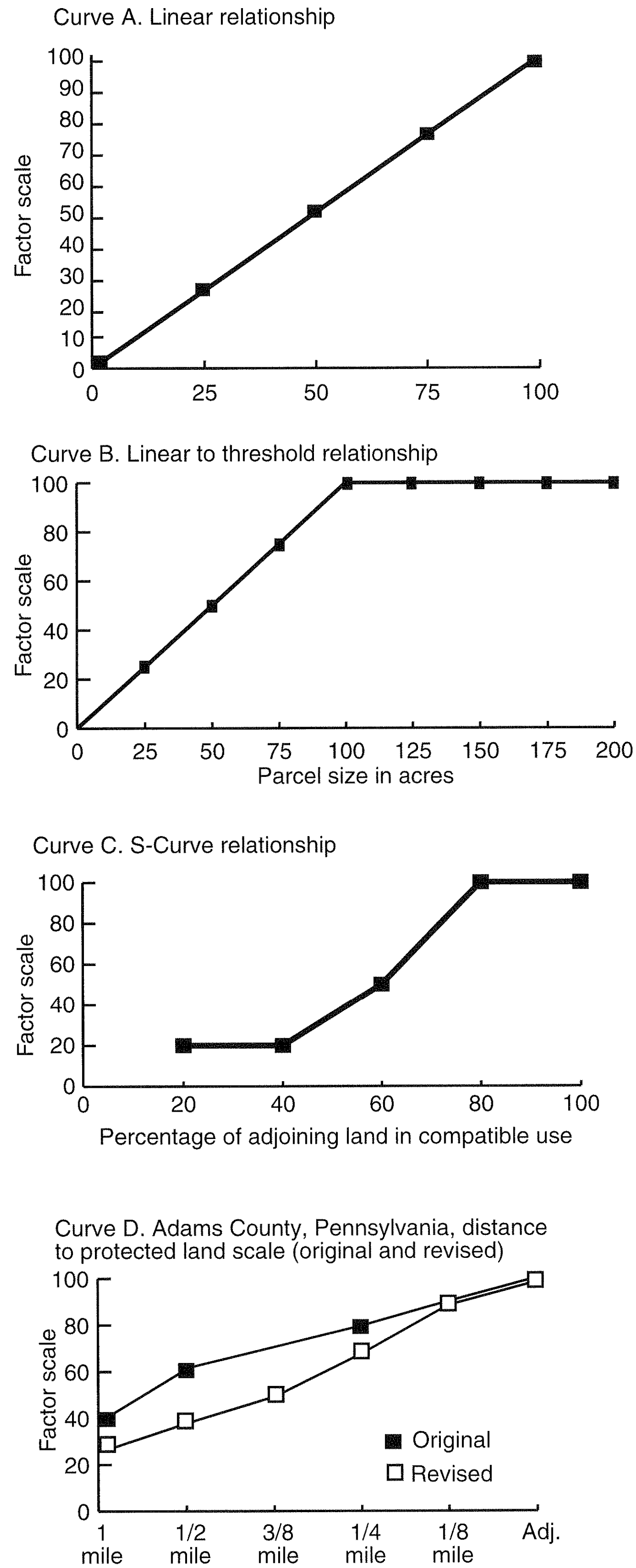


Figure 5.1 (a,b, c, and d). Examples of factor plots

Selecting and scaling SA factors

Table 5.2 lists typical SA factors. The list is meant to be illustrative, not exhaustive. Table 5.2 omits a number of factors that were included in the 1983 *Handbook* (USDA, 1983), such as those that measure the need in the region to develop additional land in order to accommodate projected population and employment and the availability of sufficient less productive land for urban development. Such factors are not recommended because they do not measure site qualities or limitations for continued agricultural use. These urban development demand factors should be considered separately.

SA addresses a much broader range of considerations than does LE. Between three and ten SA factors may be necessary. Committees formulating SA should be aware that the more factors they include, the more costly it is to apply the LESA system to a site and the more difficult it is to explain the system to citizens. Also, formulators should take care that two or more factors are not inadvertently measuring the same underlying concern in different

Table 5.2. Classification of typical SA factors

SA-1 Factors (agricultural productivity):

- Size of site
- Compatibility of adjacent uses
- Compatibility of surrounding uses (impact on farm practices)
- Shape of site
- Percent of site in agricultural use
- Percent of site feasible to farm
- Level of on-farm investment
- Availability of agricultural support services
- Stewardship of site
- Environmental limitations on agricultural practices
- Availability and reliability of irrigation water

SA-2 Factors (development pressures impacting a site's continued agricultural use):

- Land use policy designation
- Percent of surrounding land in urban or rural development use
- Distance to public sewer
- Distance to public water
- Distance to urban feeder highway
- Distance to urban center or urban growth boundary
- Length of public road frontage of site
- Proximity to protected farmland

SA-3 Factors (other public values of a site supporting retention in agriculture):

- Open space strategic value of site (e.g., urban greenbelt)
- Educational value of site (e.g., for sustainable agriculture)
- Historic building or site
- Site of significant artifacts or relics
- Wetlands and riparian areas
- Scenic values
- Wildlife habitat
- Environmentally sensitive areas
- Floodplains protection

ways. Such redundant factors result in inadvertent overweighting of the basic concerns that underlie them, as discussed in Chapters 1 and 7.

This section sets forth some observations and guidelines for typical SA factors used in LESA systems. Bear in mind that these are just examples. Local jurisdictions may include other factors that are more relevant to local conditions and goals.

SA-1 Factors: Agricultural productivity

An important consideration for the LESA committee in selecting SA-1 factors is whether management considerations should be included or whether factors should be limited to farm viability. For example, Clarke County, Virginia, decided not to include "family farm values," "farms that support farm families," and farm "conservation plans" because all of these factors measure the farmer (who could change) and not the viability of the farm. Other jurisdictions have used these factors in their LESA systems. This decision will depend on local conditions and objectives.

Median = middle number in a series ordered from smallest to largest; Mean = total values divided by the number of units; Mode = most frequently occurring number in a series.

Size of site. As noted earlier, data for farm sizes are available from the U.S. Census of Agriculture (done every five years), assessor records, CFSA records, and, in some states, Cooperative Extension Service reports. Generally it is less efficient to farm a small site than it is to farm a large one. Therefore, larger farms should usually be rated higher than smaller ones. The definitions of small and large, however, depend on the crops grown and the types of equipment in use. Each local jurisdiction should devise a scale that recognizes the typical (median, mean, or mode) size for the type of commercial farming dominant in its area. Agricultural productivity can be high on small, intensively farmed operations, such as berry farms or nurseries. In some cases, sub-areas of the jurisdiction may be characterized by different farm sizes and should be scaled separately. One way to accomplish this is illustrated in Table 5.3 with the use of landforms. Soils associated with landforms are generally available from Natural Resources Conservation Service (NRCS) soil survey reports.

It is important to define terms commonly used in discussing farm size. A farm unit, as reported in Census of Agriculture data tables, includes rented, leased, and owned lands, whether contiguous or not. However, it is possible to estimate the size of ownership units

Note: All factor scales in the examples given are "before weighting."

Table 5.3. Example of parcel size scaling by landform (adapted from Linn County, Oregon, LESA system)

Bottomland (in acres)	Terrace (in acres)	Foothills (in acres)	Factor scale
>100	>120	>160	100
90-100	100-120	140-160	95
80-99	90-99	120-139	90
70-89	80-89	100-119	85
60-69	70-79	80-99	80
50-59	60-69	70-79	70
40-49	50-59	60-69	65
30-39*	40-49*	50-59*	60*
20-29	30-39	40-49	30
10-19	20-29	30-39	20
<10	<20	<30	0

* Median field size could be determined from county survey. Fractions are rounded up or down.

by using the Census data for rented and leased acreage to adjust average farm size. Since ownership units may include non-contiguous fields, size of contiguous ownership units cannot be estimated from Census of Agriculture data; however, local assessor maps and databases can usually be used to provide these data. In some jurisdictions, CFSA maps and data also can be used for this purpose. Fields make up a farm unit. A farm may consist of one or many fields, growing the same or different crops. The typical (e.g., median) field size is an important benchmark in setting up a scale, because it represents a size that is economical to farm. In Table 5.3, field size represents a substantial break in point scaling, with points falling off rapidly below the median field size. Data for field sizes can, for some jurisdictions, be obtained from CFSA records. If not available from this source, they can be obtained from original survey or from expert opinion of local USDA field staff and farmers.

For many applications, there is little rationale for awarding additional points for farms larger than the minimum commercial size. Therefore, the scale should be set so that maximum points are awarded for a site of this size or larger. In the Table 5.3 example, this size is 100 acres, 120 acres, and 160 acres for bottomlands, terraces, and foothills, respectively.

In purchase of development rights or conservation easement programs, it is generally preferred to choose a larger farm than a smaller one, because the continuation of farming on a small site may be put at risk when surrounding land is developed for nonfarm uses. A major objective, in most cases, is to place easements on large blocks of land rather than on scattered sites. This can be done either by choosing many small sites or fewer large ones.

Scales designed for use in these programs, therefore, may encompass the entire range of site sizes found in the jurisdiction. In selecting smaller sites, the adjacency requirements for smaller sites should be included in the procedure. Conservation easements may be the same as development rights or they may be used for other purposes, such as protecting forest cover.

Compatibility with adjacent uses. Adjacent land uses affect the ability of a farmer to conduct normal farming practices without incurring complaints and, perhaps, lawsuits. The more compatible the adjacent uses are, the more flexibility a farmer has to change crops and practices and to remain in agricultural use. Therefore, a farm with more compatible uses on the perimeter than another farm will rank higher on the SA scale. This factor should be rated on a scale starting from fully compatible with adjacent land uses (100 points) to high conflict with adjacent land uses (0 points).

Various methods to measure the degree of conflict have been used by LESA developers. In an article describing the development and application of a LESA system for Linn County, Oregon, by Huddleston et al. (1987), the terms "incompatible" and "somewhat incompatible" are used to clarify certain uses.

To measure compatibility objectively, specific definitions of compatible and conflicting uses need to be established. Compatible uses may include forestry, agriculture-related businesses, power stations, and mining. Generally, home-sites on small parcels are the source of most potential problems. One option for "small parcel" definition is to use a typical field size for different areas within the jurisdiction, as given in Table 5.3. If, for example, 30 acres is the typical farm field size, any house on a smaller parcel may be assumed to be potentially conflicting. If a house is located on a larger parcel, it can be assumed to be compatible, since the parcel is large enough to be used efficiently for agriculture. Other parcel sizes may be appropriate (for example, five or ten acres) if supported by local studies, other research, or local expert opinion. The data sources should be documented for later reference.

Certain other uses may be somewhat compatible, such as certain recreational or commercial uses or school grounds. Adjacent sites containing these uses could be rated at one-half (or some other percentage) the penalty of fully conflicting uses. An example of a rating scale for adjacent uses is given in Table 5.4. For details of this rating scale, the reader is referred to Huddleston et al., 1987.

Table 5.4. An Example of a scale for perimeter compatibility

% of Perimeter in conflict	Factor scale
0	100
up to 10	90
11-20	80
21-30	70
31-40	60
41-50	50
51-60	40
61-70	30
71-80	20
81-90	10
91-100	0

NOTE: Fractions are rounded up or down.

In measuring compatibility with adjacent or surrounding (non-adjacent) uses, the percent of compatible uses or of conflicting uses may be used in the scale. In these examples, the percent of conflicting (incompatible) uses are scaled instead of the percent of compatible uses, because this approach allows for incorporating density factors and for distinguishing among uses that may be fully conflicting and those that may be somewhat conflicting. To illustrate, let us assume that all lettered parcels in Figure 5.2 are on five-acre or smaller homesites and are considered incompatible uses. The unlettered adjacent uses are in agriculture. If the percentage of the perimeter in compatible use were calculated, the perimeter of both LESA sites would be 50 percent compatible with agriculture and both would receive the same points. There would be no differentiation between the sites. However, the site in example B is clearly subject to more potential problems with neighbors than is the site in example A.

To overcome this measurement problem, a benchmark can be established for totally conflicting homesites of five-acre parcels with 2:1 rectangular shape. The length of a short side of such a parcel is 330 feet. To account for both the length of perimeter and density of conflict, count the number of conflicting parcels, multiply by the length of the short side of the 2:1 five-acre rectangle (330 feet) and divide by the length of the perimeter of the LESA site (3,734 feet). This number, expressed as a percent, is used in Table 5.4.

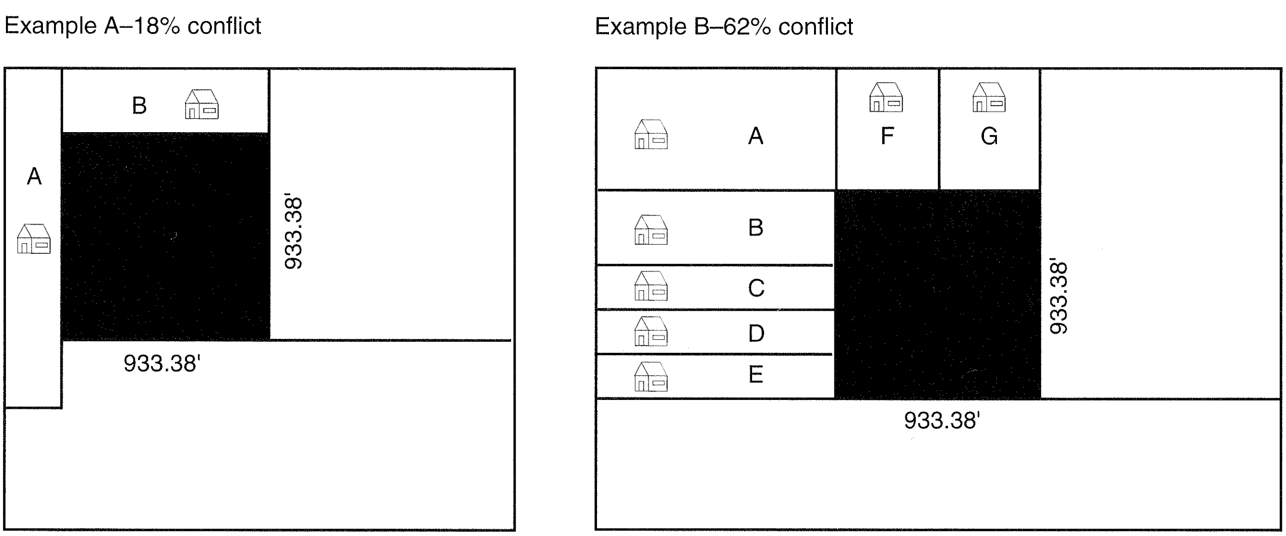


Figure 5.2. Examples of measuring perimeter conflict

Both LESA sites in the examples given in Figure 5.2 would have a perimeter of about 3,733.52 feet. Example A has two conflicting parcels, while example B has seven. For example A, multiplying two by 330 feet equals 660. Dividing 660 by 3,733.52 equals 18 percent, which is scaled for 80 points. Although 50 percent of the perimeter of Example A is in conflicting use, the density is less than the benchmark so that only 18 percent of the perimeter is calculated as in incompatible use. It is, after all, the dwellings which cause the potential problem, not the length of the border of the neighbor's land. In example B, seven dwellings times 330 feet equals 2,310 feet. Dividing 2310 feet by 3,733.52 results in 62 percent of the perimeter in conflict, which is scaled for 30 points. Although only 50 percent of the actual perimeter in example B is in conflict, the density of homesites is greater than the benchmark and the conflicting perimeter is calculated at 62 percent. That is, some of the homesites are smaller than the five-acre benchmark.

Examples of definitions for conflicting and somewhat conflicting are given below:

- Conflicting uses—a contiguous ownership parcel zoned for residential use or zoned for resource use but smaller than the median field size (or some other size) and with an existing dwelling.

- Somewhat conflicting uses—any contiguous ownership parcel that is zoned or used for industrial, commercial, education, or recreational uses, except agriculture-related businesses or services. Somewhat conflicting are rated at one-half the conflict of conflicting uses.

With this procedure, this important factor is adjusted to reflect more accurately the actual potential for conflict and the LESA sites are differentiated more clearly. Application of the procedure is straight-forward with the use of worksheets. However, the LESA committee may decide that a simpler measurement procedure will suffice for local conditions.

It should be noted that as the size of the site increases, the percentage of the site that is shielded from conflict with adjoining non-farm land uses also increases. The LESA committee may wish to discuss and determine the width of a shielding perimeter "band" for local farm practices. Assume, for example, that the major conflicts are experienced by operations on the outer 100 feet (the shielding band) of land. Spraying there is most likely to affect neighbors and

Table 5.5. Conflict in relation to parcel size

Size of site (in acres)	Length of side (in feet)	Shielded area (in acres)	Percentage shielded
23	1,000	15	64%
52	1,500	39	75%
92	2,000	74	80%
207	3,000	180	87%
367	4,000	332	90%

intrusions by neighbors' children or dogs are most likely to occur there also. To see how the area shielded by the outer 100 feet varies, consider square farms of various sizes as shown in Table 5.5.

Different shapes will yield different results, but generally, the larger the site, the larger the percent of site that will be shielded by the perimeter band. In Table 5.5, 90 percent of the 367-acre site is shielded, but only 64 percent of the 23-acre parcel is shielded. This consideration is incorporated into the structure for Table 5.6.

Compatibility with surrounding (not adjacent) uses. While adjacent land uses are an important factor, the character of surrounding uses also affects the ability of a farmer to change crops or conduct agricultural operations. For example, a rural residential development or urban boundary within a one-quarter mile distance could impede a farmer from certain livestock operations, spraying activities, night operations, or moving equipment on highways. Conversely, it could increase problems of trespass or dogs harassing livestock.

As in the previous factor, definitions and clear measurement instructions are important. A trained LESA advisor can help the committee by conducting a review of other user experiences and suggesting appropriate procedures for the local adaptation.

An example of how size and conflict can be scaled is given in Table 5.6. As noted in the discussion of the previous factor, the larger the parcel, the higher relative degree of conflict from the surrounding area it can absorb. The procedure, in this example, is to count the number of conflicting non-adjacent parcels within a certain distance as measured from the perimeter. A distance of one-quarter or one-half mile is usually adequate. The number of conflicting parcels is divided by the size of the LESA site. The ratio of number of conflicting parcels to parcel size is assigned points on a scale starting from conflicting parcels equal to one-half the number of acres in the LESA site. Thus, a 10-acre site could tolerate only five conflicting parcels within one-quarter mile (or other distance)

Table 5.6. Example of a factor scale for surrounding (non-adjacent) land-use compatibility

Ratio of the number of conflicting parcels to parcel size	Factor scale	
0	100	
0.01-0.05	90	(e.g., 4 conflicts and 100-acre
0.06-0.10	80	parcel or 15 conflicts and
0.11-0.15	70	350-acre parcel)
0.16-0.20	60	
0.21-0.25	50	
0.26-0.30	40	
0.31-0.35	30	
0.36-0.40	20	
0.41-0.50	10	(e.g., 50 conflicts and 100-acre
>0.50	0	parcel or 10 conflicts and
		20-acre parcel)

NOTE: Fractions are rounded up or down.

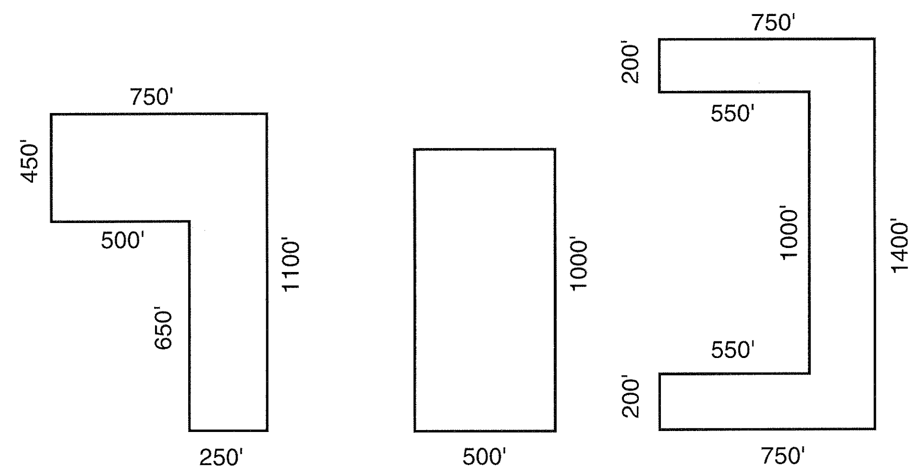
before the factor scale drops to zero, but a 100-acre parcel would have to have more than 50 conflicting parcels within the surrounding area in order to receive zero points.

The compatibility of both adjacent and non-adjacent surrounding uses are important factors affecting agricultural practices and cropping options. The focus of these factors within the SA-1 context is on potential limitations to agricultural productivity and flexibility. In most cases, these compatibility factors will be strongly correlated to SA-2 factors measuring development pressure. In some cases, the LESA committee may find that these more direct measurements of site limitations will encompass some or all of the concerns underlying SA-2 factors.

It is of course true that the type of agricultural use and the nature of surrounding uses may be more important that the number of potentially conflicting uses. However, these combinations vary with each site and to incorporate them would make the LESA system very complex.

Shape of site. Oddly shaped sites are inefficient to farm. Therefore, a number of jurisdictions have included a factor that rates the shape of the site. It is difficult to classify shapes in relation to ease of farming and, therefore, it is difficult to develop a scale for this factor. The effect of the shape of the site on efficiency of farming is less important for larger sites. Therefore, much of this effect is captured in the size-of-site factor.

However, for some jurisdictions or for some sub-areas within a jurisdiction, shape may be important to differentiate a high number of small sites. One approach is to establish a size cut-off below which shape will be rated. Rating may be done, for example, by using a ratio of the perimeter of the site to the perimeter of a 2:1 rectangle having the same area as the parcel. Examples of this approach are given in Figure 5.3.



	Example A	Example B	Example C
Area of the example	500,000 sq. ft.	500,000 sq. ft.	500,000 sq. ft.
Perimeter of subject parcel	3,700'	3,000'	5,400'
Ratio of perimeter of subject site to 2:1 rectangle with same area	1.23	1.00	1.80
Ratio of area to perimeter	135.14	166.66	92.59

Figure 5.3. Ratio of the perimeter of a parcel to perimeter of a 2:1 rectangle of the same area

Other approaches are possible. For example, a simple ratio of area to perimeter could be scaled and used to rate shape. This approach is also illustrated in Figure 5.3. Sites that are divided by a road or waterway will have a longer perimeter to area than sites not so divided and will be rated lower. If shape is not a significant factor for a particular jurisdiction, it should not be included.

Table 5.7. Example of a scale for shape of a site

Ratio	Factor scale
1.00-1.14	100
1.15-1.29	90
1.30-1.44	80
1.45-1.49	70
1.50-1.64	60
1.65-1.79	50
1.80-1.94	40
1.95-2.09	30
2.10-2.24	20
2.25-2.39	10
>2.40	0

NOTE: Fractions are rounded up or down.

Experimentation with this approach on a variety of shapes will help establish a basis for allocating points. As Figure 5.3 illustrates, the closer the shape is to a 2:1 rectangle, as in Example B, the closer the ratio will be to 1.0. Triangular or other very unusual shapes may require a different rating scale. An example of a scaling table for Figure 5.3 is given in Table 5.7.

Percent of site in agricultural use. For a site of any given acreage, the greater the percent of the site in agricultural use, the greater its agricultural productivity and economic importance to the farm economy. This might be determined to be a linear relationship. If so, a scale, such as shown in Table 5.8, would be appropriate.

Table 5.8. Example of a scale for percent of site in agricultural use

Percent of site used (or suitable) for agriculture	Factor scale
90-100	100
80-89	90
70-79	80
60-69	70
50-59	60
40-49	50
30-39	40
20-29	30
10-19	20
0	0

NOTE: Fractions are rounded up or down.

Some jurisdictions may feel it is better to bring the scale to zero at 20, 30, or 50 percent or less. A variant on this factor might be "Percent of Site Suitable to Farm." This formulation puts more emphasis on the long-term resource value of the site as opposed to its current use. It could be measured from soil survey information assembled in the course of preparing the LE rating. A soil survey usually indicates crop or pasture suitability for each soil mapping unit. In states where hunting, fishing, or other recreational uses are commonly part of a farm's revenue producing activity, the LESA committee may choose to include those parts of the farm used for income producing recreation activities.

Level of on-farm investment. A factor indicating the level of on-farm investment reflects the income potential from existing farm operations. It is, however, most difficult to obtain data to measure investment objectively. Furthermore, it should be scaled relative to the optimum or average investment for a farm of its type and size. Assessor records could provide a data source for documenting investments; CFSA and Cooperative Extension Service reports could provide data sources for developing scaling criteria for different cropping areas. An example is given in Table 5.9. In many, if not most, cases, this factor may require more documentation effort than is warranted by useful information added to the LESA system.

Availability of agricultural support services. It is difficult for agriculture to continue if convenient and adequate support services are not readily accessible. Such services include equipment supply and repair, feed mills and feed suppliers, seed and gener-

Table 5.9. Example of a scale for on-site investment, adapted from Bonneville County, Idaho

Investment	Factor scale
Site is an agricultural service facility	100
High level compared to county farms	
More than $ ____________(specify)	100
Average level	
Between $ and $ _____________(specify)	50
Low level	
Less than $_____________(specify)	0

Table 5.10. Example of a scale for support services

Support services	Factor scale
Adequate support service present (List specific areas of jurisdiction)	100
Some limitation on support services (List specific areas of jurisdiction)	50
Severe limitation on support services (List specific areas of jurisdiction)	0

al farm supply stores, veterinarian services, fertilizer, herbicide and pesticide suppliers, integrated pest management associations, spraying and seeding contractors, specialized insurance, banking and credit services, and marketing facilities and services. Because agricultural support services consist of such a variety of services at varying distances from any given farm, this factor is difficult to scale in a replicable fashion. A simple approach would be as shown in Table 5.10.

In this example, specific areas of the jurisdiction are listed with each criterion in order to assure replicable ratings. The areas could be assigned by the SA committee or other group.

This factor produces useful differences among sites when used in a statewide LESA system, but may provide little differentiation when used in a countywide or township-wide system. In many cases, support services are about the same in all areas; therefore, this factor may not be important in differentiating sites, and need not be included in the LESA system.

Stewardship of site. Some LESA systems have included stewardship as an SA factor. This measures the extent to which good soil and water conservation practices are used on the site. An example of a scale for stewardship is shown in Table 5.11. Such practices enhance the capability of the site to sustain agricultural production in the future. It should be kept in mind, however, that these practices are not inherent in the resource and may be changed, particularly if ownership of the site changes. This factor also serves as an example of a factor for which it is difficult to differentiate among more than a few steps on the scale and for which documentation may be difficult. However, since conservation plans are required

Table 5.11. Example of a scale for stewardship

Status of conservation plan	Factor scale
An approved conservation plan has been fully implemented	100
Implementation of an approved conservation plan is on schedule	90
Implementation of an approved conservation plan is behind schedule	40
Implementation of an approved conservation plan has not been started	10
No conservation plan	0

for federal agriculture benefits and have legal standing in some states, it is possible to scale the status of conservation plans. Including a stewardship scale recognizes conserving actions, which contribute to long-term sustainability.

In order to assure consistent rating, the agency responsible for the conservation plan should rate this factor or provide documentation. In most cases, this will be the local NRCS office.

Environmental limitations on agricultural practices. In some jurisdictions, land or water conditions may impose limitations on certain agricultural practices. A parcel with such limitations may rank lower than a parcel without limitations. Some examples follow.

- *Soil properties and groundwater.* Some soils may allow rapid transfer of agricultural chemicals to an underlying aquifer. Crop types and practices may be limited because of these conditions.

- *Topography, soils, and run-off.* The combination of slopes and soil properties may lead to soil leaching, erosion, or chemical run-off, causing pollution problems for nearby water bodies. These conditions could limit crops and practices.

- *Important wildlife or fisheries habitat or plant species.* Certain sites may contain important populations of wildlife, fish, or plants during part or all of the farming season. These conditions could limit the agricultural practices or options on the site.

If this factor is to be included, the local committee will need to devise specific, measurable criteria in order to apply a factor scale. Wording such as "Is important wildlife habitat affected?" cannot be measured objectively and will likely be scored differently by different people. Another point to consider is that a site rated down for soil permeability may also be unsuitable for alternative uses, such as those requiring septic disposal systems. The LESA committee may decide that some of these limitations merit separate consideration in the land-use planning process.

Availability and reliability of irrigation water. In some jurisdictions, the availability and reliability of irrigation water will be an important factor to a site's relative agricultural value. Some sites may have sufficient water available for only part of the site or for part of the growing season. Table 5.12 provides an example of scaling for water availability.

Table 5.12. Example of a scale for irrigation water availability

Percent of site with water	Factor scale
100	100
90-99	90
80-89	80
70-79	75
60-69	70
50-59	60
5-50	50
<5	0

NOTE: Fractions are scaled up or down.

Usually, irrigation water supply is obtained from a local water district, a surface water body, or a well(s). These sources may have certain limitations imposed by local climatic conditions and competing uses. In other cases, the important issues may be the cost of pumping water to the site. Table 5.13 presents one example of how water reliability could be scaled. The SA committee will need to apply local knowledge to develop criteria and point allocation for this factor. Terms such as adequate, reliable, limitations, or occasional will need specific definitions to ensure consistency in ratings.

If costs of water vary by sources, it may be desirable to develop a separate scale for this factor. In an Arizona study, Steiner and Conway (1994) used costs of water as an important factor to differentiate sites. Those sites with higher costs were assigned lower ratings.

In summary, it is important for the LESA committee to determine which SA-1 factors are significant to their state's or community's agricultural economy as well as the data resources for scaling these factors. These state or local determinations are what, in part, make LESA flexible to use in different locations and circumstances.

SA-2 factors: Development pressures impacting a site's continued agricultural use

These factors are intended to address the concern that development pressure can cause conversion of agricultural sites to urban

Table 5.13. Example of a scale for irrigation water reliability

Type of water source	Factor scale
Public systems	
Water district with adequate water quantity	100
Water district with occasional (e.g. 2 of 5 years) limitations on water quantity due to drought or other local conditions	80
Water district with annual limitations on water quantity due to drought or other local conditions	60
Wells	
Well water with adequate quantity for diverse crops	100
Well water with quantity limitations for some crops	70
Well water with inadequate quantity for crops	50
Surface water	
Surface water withdrawal with adequate quantity for crops	100
Surface water withdrawal with some limitations on quantity	80
No reliable irrigation source (e.g., interrupted 1 of 2 years)	0

NOTE: If more than one source is used, assign by highest factor rating or by percentage of site served.

uses. For this reason, sites closer to urban infrastructure (e.g., major roads, sewer, public water) may be rated lower than sites farther away. There are, of course, many examples of highly productive agriculture on the urban fringe. Often, high value crops, such as horticulture, berries, and direct market vegetables, are located near urban areas on prime soils. The book *Sustaining Agriculture Near Cities* (Lockeretz, 1987) gives examples of successful agriculture near urban areas. The SA committee should consider carefully what SA-2 factors will add to LESA ratings within the context of agricultural land-use policies. Potential conflicts between farming and non-farm uses are covered under SA-1 factors because conflicts do limit farming practices, crop options, and potential productivity of a site. Most commonly, development pressure will be an important factor in purchase of development right programs. All other factors being equal, it may be desirable to rate a site under conversion pressure higher than a site with less development pressure to give it priority for purchase of development rights. In this case, SA-2 factors may be combined with LE, SA-1, and perhaps SA-3 factors in a single LESA system. Other alternatives for using SA-2 factors are given in Chapter 6.

Several of these factors are often correlated. When the SA committee tests for factor correlation (See Chapter 7), two or three SA-2 factors may provide similar results to a longer list of factors.

Land-use policy designation. LESA should be consistent with comprehensive, general, or master plan, zoning ordinance, or agricultural district designations. This factor measures whether a site has been designated for agriculture in the local land-use program. One of these designations should be sufficient in most cases, depending on which is considered to be the "ruling" document. In some states, the comprehensive, general, or master plan takes legal precedence over a zoning ordinance and is more difficult to change. In others, the opposite may be true.

The relevance of this factor depends on the LESA system's purpose. If the purpose is to designate farm zones, it is not relevant. If the purpose is to evaluate land division or non-farm permit requests in a farm zone, then it probably is not relevant since all parcels in the zone are planned or zoned for farm use and conditions for other uses are given in the ordinance. If the purpose is to evaluate development proposals in an unzoned but planned area, or for evaluating a zone change request in a jurisdiction with weak zoning or several types of agricultural zones, or for ranking sites for purchase of development rights, it may have some relevance,

Table 5.14. Example of a scale for adjacent zoning, adapted from Boone County, Illinois

Adjacent zoning	Factor scale
All sides zoned for agriculture	100
One side zoned for non-agricultural use	77
Two sides zoned for non-agricultural use	54
Three sides zoned for non-agricultural use	23
All sides zoned for non-agricultural use	20

NOTE: Points are adjusted to a 100-point scale.

Table 5.15. Example of a scale for adjacent zoning, adapted from Bucks County, Pennsylvania

Adjacent zoning	Factor scale
Low density residential/agricultural zoning withing 1/2-mile	100
Medium density residential allowed within 1/2-mile	50
High density residential allowed within 1/2-mile	0

NOTE: Points are adjusted to a 100-point scale.

since the area in which the parcel is located presumably has undergone some scrutiny as part of the planning or zoning designation process. The designation itself is a general measure of a site's relative value to remain in agriculture. Other factors, however, especially SA-1 factors, are more direct measurements of a site's agricultural value and may make this factor unnecessary. Two scaling examples for this factor are given in Tables 5.14 and 5.15.

Percent of surrounding land in urban or rural development use. Compatibility with adjacent and surrounding uses was covered in SA-1 as a measurement of compatibility or potential conflict with a subject site. In contrast, this SA-2 factor measures the relative degree of urbanization or suburbanization occurring in the area around a subject site. Measurement techniques could be similar to those given in SA-1 or a different approach that measures density, type of land use, or patterns of land use could be used. For example, the average housing density per acre in the surrounding area could be scaled, as in Table 5.16.

Table 5.16. Example of a scale for housing density within 1/4-mile

Average number of dwellings/AC	Factor scale
< 0.10	100
0.20-0.10	90
1.00-0.19	80
2.00-0.99	70
4.00-1.99	50
6.00-3.99	30
8.00-5.99	20
10.00-7.99	10
> 10	0

NOTE: Fractions are rounded up or down.

The land-use intensity of the surrounding area could be measured by an impervious surface ratio; that is, the percentage of land that is covered by impervious surfaces, such as buildings, roads, and driveways. The impervious surface ratio could be scaled as in Table 5.17.

Factors measuring conflict in SA-1 are likely to be highly correlated with some SA-2 factors, so it is particularly important that the issues are kept separate by LESA users. The LESA committee may wish to decide whether the degree of compatibility or conflict with agriculture (SA-1) or the degree of development pressure (SA-2) is more important and use the factors measuring land use in the vicinity only once in the LESA system.

Distance to public sewer, public water, urban feeder highway, and urban center or urban growth boundary. These factors have been shown to be correlated to development patterns (Furuseth, 1978), especially in areas without strong zoning or other farmland protection programs. Furthermore, they are easily measured in most cases. Some examples are given in Tables 5.18, 5.19, and 5.20. However, in areas with strong agricultural land protection policies, proximity to facilities may not necessarily indicate likelihood of conversion. In some rural areas, for example, public water districts were organized to service rural residential development before the adoption of farmland protection plans. Similarly, a sewer system may have been extended across productive farmland to service a rural residential neighborhood with failing septic systems. In addition to farmland protection policies, farmers may receive certain disincentives to apply for conversion, such as waivers of front-footage levies for sewer or water lines crossing their property.

Length of road (or type of road) frontage of subject site. The relevance of this factor will depend upon a jurisdiction's road system and land-use policies. If it is relatively easy to obtain land partition permits for property with existing frontage, then the factor may be relevant to a parcel's likelihood for partitioning or conversion. When road frontage is not a significant factor in land partitioning or other land-use permit decisions, as is the case in some jurisdictions, it should not be included in the SA component.

Proximity to protected farmland. This factor is of particular relevance for programs for the purchase of development rights or other agricultural conser-

Table 5.17. Example of a scale for impervious surfaces within 1/4-mile

Percent impervious surface	Factor scale
< 0	100
10-19	90
30-39	60
20-29	80
40-49	40
50-59	20
60-69	10
> 70	0

Table 5.18. Example of a scale for distance to a central sewage or water system, adapted from Champaign County, Illinois

Distance (miles)	Factor scale
> 1.5	100
0.75 to 1.49	80
0.50 to 0.74	60
0.25 to 0.49	40
200 feet to 0.24	20
200 feet or less or on-site	0

NOTE: Fractions are rounded up or down.

Table 5.19. Example of a scale for road access, adapted from Montgomery County, Maryland

Access	Factor scale
Site access to unimproved road	100
Site access to secondary road	50
Site access to primary road	0

Table 5.20. Example of a scale for distance to city, village, fire station, or emergency services; adapted from Henry County, Illinois

Distance (miles)	Factor scale
> 1.5	100
1.1 to 1.5	93
0.76 to 1.0	80
0.51 to 0.75	60
0.26 to 0.50	40
Adjacent	0

NOTE: Fractions are rounded up or down.

Table 5.21. Example of a factor scale for proximity to protected sites

Protected sites	Adjacent	Less than 1 mile	1-5 miles
1 site:			
> 500 acres	100	80	70
100-500 acres	90	70	60
< 100 acres	60	50	30
2-3 sites:			
> 500 acres	100	80	70
100-500 acres	90	70	60
< 100 acres	60	50	30
More than 3 sites:			
> 500 acres	100	80	70
100-500 acres	90	70	60
<100 acres	60	50	30
No protected site within 5 miles	0		

NOTE: Fractions are rounded up or down. Assign maximum points once by proximity.

vation easements. However, it is difficult to scale. A fully adequate scale would take into account the numbers and acreage of protected sites at various distances from the site being rated, giving more weight to properties that are close to protected sites. These three considerations could be put in a table, such as Table 5.21. The point scale could be adjusted to reflect the three variables.

A simpler rating scale may suffice in many cases. Lancaster County, Pennsylvania, uses proximity to a farm with a conservation easement or a pending application for purchase of development rights (Daniels, 1994).

SA-3 factors: Other public values of a site supporting retention in agriculture

Often, land-use policies for farmland include open space, scenic, or wildlife habitat objectives, as well as protection of agriculture as an economic sector. While not a measure of a site's productive value for farmland, these other factors do reflect a broader view of farmland in the landscape. This landscape (or ecosystem) perspective is becoming increasingly important in land-use policy formulation and decision making. These factors may have been addressed in the comprehensive, general, or master plan. SA-3 factors are presented here as an option for the LESA system, but may be more appropriately addressed in other parts of the planning process. SA committee members will need to pay special attention to how these factors can be measured in an objective, reproducible procedure.

Open space strategic value of a site. When seen as part of a larger strategy, such as a plan for an urban greenbelt, certain sites may have a strategic value which should be part of a decision-making process.

Educational value of a site. Some sites may have distinctive educational value, such as a demonstration farm for sustainable agriculture. A combination of proximity to a school and a history of use as a study or research site could give special importance to specific sites.

Historic buildings or archaeological sites. Public policies related to protection of such sites may make this factor relevant in some jurisdictions. Table 5.22 shows an example from McHenry County, Illinois.

Wetlands and riparian values of a site. These resources could be rated separately or combined in a single factor scale. Certain wetlands or riparian areas may be designated in planning documents as important sites.

Scenic values of a site. Often rural landscapes are important for their visual values, especially to urban residents. Various methods to rate visual values have been developed and could be adapted to scaling a LESA factor (Zube et al., 1975; Leineweber, 1977).

Wildlife habitat values of a site. At the landscape level, certain farm sites may have greater wildlife value than other sites. For example, migratory birds, such as doves, or animals with seasonal habitat needs, such as mule deer, may use particular sites every year; a disruption of the site could cause a problem for that population. This factor is different from that listed under SA-1, in that it does not limit farm activities. If it does, it should be covered under SA-1. The presence of an endangered or threatened species could, of course, trigger a separate process by federal agencies. The U.S. Department of Interior Fish and Wildlife Service's Habitat Evaluation Procedure may be a useful reference for scaling. Simpler procedures have been used by Vermont townships and the city of Portland, Oregon. The state of Utah has developed an excellent reference work for evaluating wildlife habitat (Johnson, 1993) as has the state of Maine (Venno, 1991). An Illinois example is given in Table 5.23.

Table 5.22. Example of a scale for historic or cultural features, adapted from McHenry County, Illinois

Presence of a unique feature as determined by a local survey	Factor scale
Yes	100
No	0

Table 5.23. Example of a scale for wildlife habitat, wetlands, unique natural area, or floodplain; adapted from McHenry County, Illinois

Percent of site considered environmentally sensitive	Factor scale
75% or more	100
50% to 74%	75
25% to 49%	50
Less than 25%	0

NOTE: Round fractions up or down. Environmentally sensitive sites should be identified by map and text.

Environmentally sensitive areas (ESA). In some states, ESAs are part of the state or local planning process. ESAs may include several of the resources listed separately in this section.

Floodplain protection on a site. While a farm located in a floodplain usually has productive soils, it may provide public benefits of floodplain protection as well as agricultural benefits. Farming is one of the few uses that may be compatible with retention of floodplain capacity to absorb and convey flood waters. A hypothetical example of a scale for this factor is given in Table 5.24.

Floodplains may, of course, be rated in other ways. If this factor is to be included, the local committee may wish to seek assistance from the local or state planning office that administers floodplain regulations.

SA-3 factors have been used in some LESA systems and clearly have importance in decisions about land-use designation or conversion to another use. The important question for SA committee members to consider is how this information should be combined with measures of a site's agricultural value. The considerations and options for combining SA-3 factors with other LESA factors are discussed in Chapter 6.

Summary

This chapter discussed the selection and scaling of SA-1, SA-2, and SA-3 factors. Parcel size and compatibility with surrounding uses are important factors for most LESA applications. Other factors

Table 5.24. Example of a scale for rating floodplain protection

Type of floodplain	Factor scale
At least 200 acres in a 50-year floodplain	100
At least 100 acres in a 50-year floodplain	90
At least 50 acres in a 50-year floodplain	80
At least 200 acres in a 100-year floodplain	80
At least 100 acres in a 100-year floodplain	70
At least 50 acres in a 100-year floodplain	60
More than 10, but less than 50, acres in a 50- or 100-year floodplain	20
Less than 10 acres in a 50- or 100-year floodplain	0

NOTE: Apply the one criterion that has the highest rating.

will depend on state or local conditions, policies, and intended applications. The simpler the system, the easier it is to understand and the less costly to administer. While some factors may seem important, they may be redundant, and the underlying concern may be adequately addressed by weighting. On the other hand, too few factors may oversimplify and miss important effects. In most cases, three to seven SA factors will capture the important considerations for differentiating sites.

Since the SA process tends to raise the most questions, the LESA committee will usually make tentative decisions on selection and scaling. These decisions may be refined and adjusted as the process proceeds to the field testing stage. The next step is combining and weighting the factors, covered in Chapter 6.

Chapter 6
Combining and weighting factor ratings for a LESA system

CONTENTS

Combining LE factors

Once LE and SE factors are selected and assigned a factor scale, as discussed in Chapters 4 and 5, the next task for the Land Evaluation and Site Assessment (LESA) committee is to decide how to combine the factors into the LESA system. The choices for LE are somewhat simpler than for SA. If soil potential ratings (SPRs) are available or can be developed with assistance from Natural Resources Conservation Service (NRCS) or other soil scientists, then SPRs provide the best measure of soil quality, as outlined in Chapter 4. If SPRs cannot be used, then the second best option will be the combination of land capability classification and soil productivity ratings.

More than two LE factors can be used if the LESA committee finds that state or local conditions and policies are best addressed by this choice. Land capability classes, soil productivity ratings, important farmlands classes, and soil potential ratings could be combined and weighted according to the relative importance of each. However, as noted in Chapter 4, more than two LE factors may be redundant. The fewer the factors, the easier the system is to apply and understand.

Sites with multiple soils

The procedure for rating sites with more than one soil is illustrated in Figure 6.1 and Tables 6.1 and 6.2. This procedure determines the average productivity of the entire site by proportionately weighting the productivity of each soil type on the site. To simplify this discussion, we will assume the site has two soils. Figure 6.1 shows a site with 150 acres of each soil. The soils are of differing quality, as indicated by the ratings given in Figure 6.1 for soil potential, land capability, soil productivity, and important farmland group. In Table 6.1, only one factor is used—SPR. Soil A has an SPR of 60 (on a 100-point scale), a factor weight of 0.50 (or 50 percent of the total LESA score), and comprises 50 percent of the site. Soil B has better soils, with an SPR of 80; the factor weight is the same (0.50), and it comprises 50 percent of the site. If there were more soils on the site, this table would be expanded to include the same calculations for all soils. Of course, the percentage of the site figures would change. All partial ratings are summed to obtain the LE subtotal.

In Table 6.2, land capability classes, soil productivity ratings, and

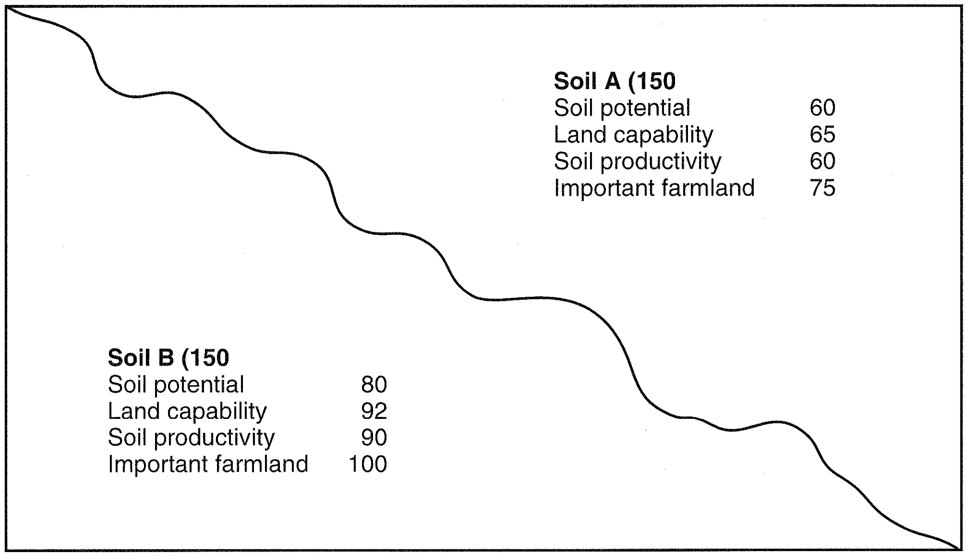


Figure 6.1. Example of a site with two soils

important farmlands classes are combined for each soil type by summing the three weighted factor ratings. The percentage of the site (in this case, 50/50) for each soil type is multiplied by the weighted factor rating to obtain site partial ratings. The site partial factor ratings for the two soil types are summed to obtain the LE subtotal. The procedure would be extended to include more soil types as necessary.

Table 6.1. Calculating LE ratings for sites with more than one soil

Soil name	Factor rating (0-100)	X	Factor weight	=	Weighted factor rating	X	% of site (fraction)	=	Site partial rating
Soil A									
Soil Potential	60	X	0.50	=	30	X	0.50	=	15
Soil B									
Soil Potential	80	X	0.50	=	40	X	0.50	=	20
LE Subtotal	///////////////		///////////////		///////////////		///////////////	=	35

Table 6.2. Calculating LE weighted factor ratings for sites with more than one soil using land capability, soil productivity, and important farmland groups

Soil name	Factor rating (0-100)	X	Factor weight	=	Weighted factor rating	X	% of site (fraction)	=	Site partial rating
Soil A									
land capability	65	X	0.20	=	13.00				
soil productivity	60	X	0.15	=	9.00				
important farmland	75	X	0.15	=	11.25				
Soil A subtotal					33.25	X	0.50	=	16.63
Soil B									
land capability	92	X	0.20	=	18.40				
soil productivity	90	X	0.15	=	13.50				
important farmland	100	X	0.15	=	15.00				
Soil B subtotal					46.90	X	0.50	=	23.45
LE subtotal (add partial site ratings)	//////////////		//////////////		////////////////		//////////////		40.081

Combining SA-1, SA-2, and SA-3 factors with LE

The factors discussed in Chapter 5 are not exhaustive; committee members may decide that another factor is important in their jurisdiction. While there is agreement among LESA developers and users that SA-2 and SA-3 factors are of obvious relevance to land-use decision making, the question is how to organize and use them in the LESA system, since they are not measures of a site's agricultural value. Three options are discussed in this chapter. The state or local LESA committee may decide to use another approach which is not covered under these three options.

Option 1: Separate suitability ratings. One option is to develop separate rating systems for each public policy issue. For example, suitability for urban (or rural) development could be measured in a separate system and compared to the LE and SA-1 rating to give planners a perspective on both relative agricultural value and the direction of growth pressures. The SA-3 factors could be part of the development suitability model or, better, could be another overlay, focusing on certain social and environmental concerns. In Hawaii, separate urban suitability ratings were used for comparing a site's agricultural value to its development suitability in order to make policy decisions on zoning farmlands (DMH, 1987; Ferguson and Khan, 1992). In Vermont, separate ratings were used for forestry LESA applications in order to determine which private lands should be added to a national forest (Bennington County Regional Commission, 1994). Another Vermont study used separate ratings for forestlands and for single family residences to establish zoning boundaries (Soshnick, 1990). Latah County, Idaho, decided to develop rating systems for agriculture, forestry, range, urban, and rural residential uses and compare results for a given site to make policy or permit decisions (Stamm et al., 1987). Other more well-known examples of separate site ratings that are compared for decision-making are described in the book, *Design with Nature* (McHarg, 1969). For example, the Richmond, New York, Parkway Project superimposed scaled values for 16 factors ranging from residential market values to bedrock foundation values to wildlife values. The resulting composite maps were used to make highway alignment recommendations based the least social cost.

Several performance-based land-use permit systems, such as the ordinance for Breckenridge, Colorado, (Wickersham, 1981) and Bucks County, Pennsylvania, (Kendig, 1980) compare suitabilities for development with environmental standards and resource values. In the Breckenridge system, all development proposals must meet basic standards. Above these standards, the development proposal is rated on several site factors in a scoring system. In Bucks County, the density and location of development on a given site is based on carrying capacity and an incentive density bonus system. The book *Flexible Zoning: How It Works* (Porter et al., 1988) includes excellent descriptions and critical reviews of seven performance zoning ordinances.

Separate rating systems could be developed for suitabilities for urban expansion, rural residential development, rural commercial/industrial development, or for the relative quality of wetlands, quarry sites, or whatever other use is important to the jurisdiction. While it may take longer to develop separate rating tools, they each will be stronger because of their focus. Soils, for example, would be specifically rated for each use. Several such rating systems have been developed. Some examples and references are given in Appendix C.

Option 2: Detractor/Bonus points. If the committee decides to use LE and SA-1 factors as the basic LESA system, the results could be adjusted by using a set of bonus or detractor points for selected SA-2 and SA-3 factors. In this way, the LESA score for farmland productivity is clear enough, but development pressure or other public value (such as scenic value) could be used to adjust the basic score. This option would work best when only a few SA-2 and SA-3 factors are important, since the bonus or detractor points should be relatively small. They would be most helpful in borderline cases for decision-making thresholds, as outlined in Chapter 8. Also, it is essential that bonus or detractor points are assigned uniformly and objectively as part of the LESA system to assure consistency among users.

Factors could be assigned either detractor points or bonus points. For example, a distance of 1/2-mile or less to a sewer system could be 5 detractor points to a total LESA score. An outstanding scenic quality or wildlife habitat site (specifically defined) could be assigned 5 bonus points. This approach was used in the forestry LESA system in Columbia County, Oregon. Under parcel size, a site was penalized up to 3 points if the slope averaged more than 30 percent. Under the surrounding land-use factor, the rating was

Table 6.3. Example of a scale for scenic values using detractor/bonus points

Examples of attributes	Factor scale
Agricultural production on a parcel of > 25 acres on a slope of 3%, visible from a state or federal highway	5
Agricultural production on a parcel of < 25 acres on a flat surface, visible from a county road	0
Feedlot of > 100 animals on < 25 acres, visible from state or federal highway	-5

penalized up to 3 points if a public recreation site occurred within one-half mile. While these detractor points are small on the total LESA scale, they could make a difference on a threshold. The detractor or bonus points are also easier to measure by presence or absence than a factor scale.

Alternatively, all sites could be assigned points on a scale of -5 to +5. An example of a scale for scenic value is outlined in Table 6.3.

The Metland Model (Fabos and Caswell, 1977) uses a bonus and detractor scale in its land-use suitability ratings. This model provides a good reference for how to incorporate bonus and detractor points into a rating system. As long as the total number of points, either positive or negative, is kept small, most sites would still fall within the 0-100 point scale.

Option 3: Integrating SA-1, SA-2, and SA-3 factors in the LESA system. In this option certain SA-1, SA-2, and SA-3 factors are selected for the SA component of the LESA system. While this choice may simplify the process over other options, it has the potential disadvantage of making the results unclear. As Huddleston (1994, p. 80) noted about combining SA-1, SA-2, and SA-3, "One could never be sure whether a low SA score was the result of truly poor agricultural suitability, or represented mediocre agricultural land and mediocre development suitability, or implied that excellent development suitability rendered even the best agricultural land useless for continued agricultural production." In order to overcome this potential problem, thresholds could be set on individual factors or on LE, SA-1, SA-2, and SA-3 groups of factors, as outlined in Chapter 8. These thresholds provide a means to clarify the effect of various factors and assure that a site has at least a given threshold level of LE and SA-1 importance. If Option 3 is used, the LESA committee would develop a rating scale, measurement procedures, and a weight for each factor and then test the draft system as outlined in Chapter 7.

As Huddleston (1994, p. 80) noted about combining SA-1, SA-2, and SA-3, "One could never be sure whether a low SA score was the result of truly poor agricultural suitability, or represented mediocre agricultural land and mediocre development suitability, or implied that excellent development suitability rendered even the best agricultural land useless for continued agricultural production."

Weighting the factors

Another important task for the LESA committee is assigning factor weights. Simply adding up the factor ratings and dividing by the number of factors to get a LESA score would imply that each of the factors were of equal importance. That is not typically the case. LESA committees usually consider some factors to be more important than others. To reflect such considerations, the committee may give each factor a weight (a number between 0 and 1.0) that is to be multiplied by the factor rating. As discussed in this *Guidebook*, the weights assigned to all factors should add up to 1.0.

There is no easy formula for assigning weights. They must be based on a consideration of local and state laws, the relative importance of individual factors to the policy objectives for which the LESA system is to be applied, and the characteristics of the application area. For example, if water is a scarce resource, its availability may be weighted higher than in an area with more abundant water resources.

Committee members should take local conditions and goals into account to assign factor weights that adequately differentiate sites for decision making.

In the 1983 LESA *Handbook*, weighting was presented as a two-step procedure. Individual factors were weighted, then LE as a whole and SA as a whole were weighted. This procedure is unnecessarily complex and its results are not always predictable. This *Guidebook* recommends that weighting be applied to factors only, and that each factor be weighted in relation to all other factors. If the 1983 *Handbook* two-step procedure is followed, it should be borne in mind that the weights given LE and SA can have critical effects on the final LESA score. The 1983 *Handbook* suggestion that it is generally desirable to assign 100 points to LE factors and 200 points to SA factors on a 300-point scale (or on a weight scale of 0.0 to 1.00, 0.33 to LE and 0.67 to SA) should be carefully evaluated. Committee members should take local conditions and goals into account to assign factor weights that adequately differentiate sites for decision making.

If soils are generally uniform throughout the jurisdiction, soil factors should probably be given relatively small weights and non-soil factors should be given relatively larger weights. Otherwise, the system might not differentiate (that is, provide a clear difference in point spread) among sites. Alternatively, if soils are varied or if site-related factors such as conflict or parcel size are generally uniform for all sites, it may be advisable to give greater weight to soil factors in order to obtain LESA scores that yield enough differentiation to make land-use decisions on particular sites.

Local and statewide policy objectives may provide some guideposts in assigning weights to LE factors. For example, if land capability classes are used to define high-value farmlands, land capability classes may be given more weight than soil productivity factors. In jurisdictions where agricultural economic factors are important policy considerations, soil productivity may be weighted more heavily. In cases where state or local governments use the "prime" and "unique" farmland terminology (from the USDA Important Farmland Classification; see Appendix E, Part 2) in their policy statements, it may be necessary to weight the important farmland classes more heavily than other factors.

Generally, one weight is assigned to each factor, but some jurisdictions in the United States have adopted more complex weighting systems. Instead of assigning just one weight to each factor, they have assigned different weights to a factor depending on size or location. For example, Clarke County, Virginia, weights soil factors more heavily for sites of more than 40 acres than for smaller sites. In a study for Linn County, Oregon, a panel of local experts assigned high weights to soil factors for sites located on bottomlands, smaller weights to soil factors for sites on terraces, and even smaller weights to sites in foothills. The reasoning was that in areas of generally better soils and commercial farms, such as bottomlands, only a high degree of conflict or a serious limitation of parcel size—and not minor variations in soil quality—should cause a site to be classified in a lower category. Therefore, the Linn County panel recommended a heavy weight for soil factors in bottomlands. On the other hand, in areas of poorer soils, such as in foothills, parcel size, potential conflict with surrounding land uses, and other SA considerations are relatively more important than soils in determining agricultural value. For example, in the foothills, it may be more important to protect larger parcels in areas of commercial farms than small parcels imbedded in areas of existing parcelization, since the types of agriculture (e.g., grains and livestock) in the foothill areas require larger parcels in order to be commercially profitable.

Policy objectives are very important in assigning weights. Different sets of weights may be appropriate depending on the type of program for which the LESA system is to be used. For example, one set of weights may be appropriate for deciding what parcels to include in an agricultural protection zone, while another may be more appropriate for deciding which parcels should be chosen for purchase of development rights or easement. In a zoning program, it is important to identify large numbers of adjacent parcels that could be combined to constitute a zoning district. In an easement program, the goal is to identify a relatively small number of parcels on which the public should spend considerable funds in order to preserve them permanently for agriculture.

If a major policy objective is to protect sites with the best soils, then soil factors should be weighted heavily. If the objective is to preserve commercial-scale farms, parcel size would be weighted accordingly. However, if the objective is to protect sites that are under the most pressure for development, factors measuring development pressure should receive greater weight. If, in addition to agricultural protection, historic or scenic preservation is an important policy objective, then factors that measure historic or scenic value should be given relatively heavy weight. Thus, weights should depend on the policies to be implemented.

In assigning weights, it may be helpful to group factors according to the policy considerations they reflect and run subtotals for the groups. The committee could then see how a proposed change in individual factor weights would relate to more general policy considerations.

The use of subtotals in deciding on factor weights is illustrated in Table 6.4, which is based on data taken from the Clarke County, Virginia, LESA system. The factors have been grouped into logical categories. Soil quality is described by just one factor. Other factors refer to a variety of Site Assessment considerations. They fit reasonably well into four groups. The subtotals make it possible to ask whether the weights make sense at the category level as well as at the specific factor level. If the committee judges that the subtotals are not in accord with their objectives, then it can vary weights on individual factors until they do. This is easy to do if a table like Table 6.4 is set up as a spreadsheet with formulas in the subtotal cells. Evaluation at the category level is particularly useful here, because the Clarke County system has a very large number of factors.

This procedure lends itself to using a multi-attribute utility approach in assigning weights (Chen et al., 1992). This approach ranks the categories in order of importance as a first step. Then each category is given a weight, with all weights totaling to 1.0. The process is repeated for all factors making up a category. This systematic procedure clarifies the relative importance of each category and each factor within each of the categories.

The possibility that a system with many factors could be simplified and clarified by removing some of the factors has been discussed in Chapters 4 and 5. In the Table 6.4 example, factors with weights of .01, .02, and .03 will make very little, if any, difference in relative site rankings. Deletion of these factors (and perhaps others) could help focus the system on factors that make a real difference.

Once a set of weights is tentatively agreed upon, the committee should test the system to be sure that the factor definitions, ratings, and weights are appropriate. The committee can fine-tune the system by varying the tentative weights until the resulting LESA scores are consistent with the policies the jurisdiction is attempting

Table 6.4. Using subtotals to evaluate factor weights

	Factor weights	Subtotals
A. Soil quality	0.33	
Subtotal		0.33
B. Likelihood that farm will be economically viable		
1. Large size	0.06	
2. Reliable irrigation water available	0.06	
Subtotal		0.12
C. Likelihood of little conflict from nearby land uses		
3. Adjacent land use in agriculture	0.07	
4. Far from urban concentration (e.g. >5 miles)	0.03	
Subtotal		0.10
D. Public or private investment that would increase pressure for development		
5. Water/sewer	0.06	
6. Road on boundary	0.04	
7. Isolated remnant	0.03	
8. ROW easement on site	0.02	
9. Subdivision or residential density zoning	0.06	
10. Mineral leases	0.01	
Subtotal		0.22
E. Policy exists for conservation and continuation of agriculture		
11. Comprehensive, general, or master plan designation for agriculture	0.13	
12. In agricultural district or zone	0.07	
13. Scenic/historic values on site	0.03	
Subtotal		0.23
Total		**1.00**

*Adapted from data for Clarke County, Virginia LESA system for parcels larger than 40 acres.
Weights have been adjusted to sum to 1.00.

to implement and the committee's evaluation of the relative importance of sample sites. Such field testing is discussed more fully in Chapter 7.

Summary

The combining and weighting of LESA factors is an important task for the LESA committee. Decisions on how to use SA-1, SA-2, and SA-3 factors are especially important in terms of the system's focus and intended applications. A trained LESA advisor could be helpful in making these decisions. As discussed in Chapter 7, factor correlation analysis, field testing, and optionally, benchmarking, can provide insight into appropriate combinations and weights to yield maximum information with the least complex system. During the field testing process, the draft factor weights may be adjusted several times to account for conditions observed in the field.

Chapter 7
Testing the draft LESA system

CONTENTS

After the Land Evaluation and Site Assessment (LESA) committee has prepared a draft of LE and SA factors, factor scales, and weights and made decisions on how to combine factors, it is essential that the system be tested and evaluated before it is used for decision making. The field tests are usually done in an iterative procedure with field site inspections, discussions, revisions, another field test, and so forth until everyone is satisfied. Benchmarking selected sites—that is comparing LESA ratings to another rating system—can be helpful in making final adjustments.

The LESA committee should be involved in testing because they provide valuable expertise and site knowledge and if they are satisfied with the system, they lend credibility to the LESA ratings. Several preliminary considerations should be addressed by the LESA committee with the assistance of the LESA advisor or other person coordinating the project. These considerations, which were discussed in more detail in Chapter 1, include the following: the focus of the system, the data sources available for documenting the factor scale for each factor, the redundancy of the factors, and the reproducibility and replicability of the results.

Steps in testing LESA

The following steps may be helpful in the preliminary testing process:

Step 1. Select a sample of sites representing the range of agricultural characteristics in the jurisdiction. The sample may either be drawn randomly from tax assessment rolls or selected to represent a variety of site conditions. In many jurisdictions, the sample can be drawn from agricultural tax lots, which are usually coded by the assessor's office for differential property tax assessment. It would be helpful to select sites at the extremes as well as the middle ranges. A sample of sites that includes a zero score, a perfect score, and sites rated at each percentile will help give committee members perspective and understanding of the factor ratings and LESA scores for setting thresholds (covered in Chapter 8) for decision making. The sample should be large enough to adequately represent types and scales of agriculture, as well as typical settings in terms of surrounding land uses. In jurisdictions where geographic conditions vary and in which diversity of agricultural types exists, it may be necessary to stratify the sample by agricultural sub-areas, by distance from population centers, or some other criterion.

In many jurisdictions, the sample can be drawn from agricultural tax lots, which are usually coded by the assessor's office for differential property tax assessment.

Step 2 (focus). Evaluate the focus of the LESA system. The factors, the factor scales, and their relative weighting should be evaluated against the assessment of users and types of applications to assure a good "fit." Special attention should be paid to SA factors. In Chapter 5, options are discussed for selecting SA factors; in Chapter 6, options are presented for combining SA factors. It is especially important for the LESA advisor or project coordinator and the LESA committee to address the question, "What are we trying to learn from a LESA rating?"

Step 3 (data sources). The data sources available for each factor rating scale should be documented in case a question arises at a later date. Data sources may be publications, unpublished materials or databases, or expert opinion. A brief note for each rating scale should be sufficient. Where data are inadequate, the committee should consider dropping the factor or adjusting it to match available data. As new data become available, it may be necessary to change a factor scale.

Step 4 (redundancy). Evaluate the LE and SE factors for redundancy. This refers to two or more factors that provide the same or similar information to the LESA score. Redundancy can cause two problems—unnecessary complexity and unintentional overweighting. Both LE and SA may be affected by redundancy. The LESA advisor or coordinator or at a local college or university can assist in evaluating redundancy through statistical correlation and regression analysis.

Statistical analysis for redundancy could include simple correlation analysis among factors and between factors and the LESA score. Multiple correlation analysis can be done to determine the effect of dropping factors from the LESA system. While stepwise regression could only be done, it would be sensitive to the order in which factors are listed. Multiple correlation analysis compares all possible subsets of factors. By enumerating all factor combinations, decisions on factor inclusion can be made on the basis of both the best correlation to LESA scores and the simplicity of documentation. For a discussion of the use of multiple correlation analyses, see Ferguson et al., 1991 .

Note that the deletion of factors may lead to underweighting. If assessments were initially made correctly, then weights applied to factors considered only the purpose for which that factor was intended. If a factor is deleted because it is correlated sufficiently with another factor so that it is not necessary to measure both, then the weight for the remaining factor should consider the purposes for each of the factors. If there was no overweighting initially, then the new weight will be the sum of the original weights. If there was some overweighting, then, it will be less than the sum.

Step 5 (reproductibility). Evaluate the reproducibility of the LESA scores and procedures. Reproducibility can be easily tested by having five to ten people rate five to ten sites. Consistent ratings by different reviewers are a necessary condition for legal defensibility.

Measurable factors and clear definitions and procedures must be used in order to obtain consistent ratings. In most cases, adjustments are easily made to make factors measurable and objective and the procedures clear to users.

Step 6 (replicability). Replicability refers to whether the LESA system gives similar ratings for factors having similar characteristics on different sites. If measurable factors and clear definitions and procedures are used, this should not be a problem. Field tests should help pinpoint any problems with replicability.

Field testing the draft LESA system

As with any model, LESA systems are generalizations on reality, subject to errors of both commission and omission. The overall goal should be to combine simplicity with maximum information content.

Once the preliminary tests are completed and any necessary adjustments to the LESA system are made, the system should be field tested by the LESA committee. This is essential to fine-tune the selection of factors, the factor scales, the factor weighting, and the measurement procedures. Usually, field tests are done on an iterative basis, requiring two to four field trips to fully evaluate the factors. As with any model, LESA systems are generalizations on reality, subject to errors of both commission and omission. The overall goal should be to combine simplicity with maximum information content. The field tests provide "reality checks" to clarify what refinements are needed to achieve a reasonable reflection of site conditions. In a Lane County, Oregon, case study (Huddleston and Pease, 1988), the field visits helped the committee visualize the differences that parcel size made in rating potential conflict or compatibility with surrounding residential densities. Prior to the field trip, potential conflicts were formulated as a function of the proximity and number of nearby non-farm residences. After the field trip, parcel size was factored in because, clearly, the impact of 10 residences within a given distance (e.g., 0.25 mile) was different for a 10-acre parcel as compared to a 100-acre parcel. Potential conflict was reformulated to be a function of the ratio of the number of conflicting parcels to the parcel size. This procedure is described in Chapter 5 and is given in Table 5.6.

In practice, field testing is an informal exercise using the LESA committee members' expert experience and judgment. The number of parcels evaluated and the number of iterations will vary as to the willingness of participants to work on refining the system. At a minimum, 10 sites and two iterations should be used. An example of a checklist format for use by committee members is given in Figure 7.1. This checklist could be revised and adapted for local conditions.

Benchmarking refers to comparing LESA results to another rating of the same site, which is assumed to be more accurate.

Benchmarking option

In jurisdictions where LESA will be used frequently for decisions that may be challenged, it may be desirable to take the validation testing to the benchmarking stage. In this optional stage, a more formal evaluation procedure is employed after all previous testing has been completed and the system is fully developed.

Several models are available for benchmarking. Calibration of factor scaling and weights, as well as validation of overall LESA scores, can be accomplished as part of the benchmarking process.

The Delphi method. One approach for benchmarking is to use a seven to 15-member Delphi Expert Opinion Panel, as outlined in a paper by Pease and Sussman (1994b). Other options, such as focus groups, may also be used. The members of the group can consist of public employees knowledgeable about agriculture, people in agriculture service industries, and farmers representing different farm sizes, commodity groups, and, possibly, geographic sub-areas of the jurisdiction.

The Delphi method, developed in the 1950s by the Rand Corporation, is a means of systematically collecting and progressively refining information provided by a group of selected experts. Delphi is characterized by response anonymity, controlled feedback, and statistical summary of group responses. Anonymity, accomplished by the use of questionnaires, secret ballots, or online computers, reduces the effect of dominant individuals. Controlled feedback (conducting the exercise in a sequence of rounds, or iterations, between each of which a summary of the previous round is communicated to the participants), reduces the range of answers and focuses on group consensus by use of medi-

	OK? Yes/No	Adjust scale? Yes/No	Adjust weight? Up/Down
LE factors (list):			
Land capability	No	No	Up
Soil productivity	No	No	Up
________	________	________	________
________	________	________	________
________	________	________	________
________	________	________	________
SA Factors (list):			
Size	No	Yes	N/A
Perimeter compatibility	Yes	No	N/A
Distance to sewer	No	No	Down
Wildlife habitat	No	No	Down?
________	________	________	________
________	________	________	________
________	________	________	________

Examples of notes for adjustments:

1. Weight of LE factors may need to be increased for prime soils. Even small parcels are used intensively for commercial agriculture.
2. Size—Adjust scale to give smaller parcels more weight in areas of better soils.
3. Distance to sewer—Parcels near sewers are used intensively for commercial agriculture. Decrease weight?
4. Wildlife habitat—This is difficult to document, even with field inspection.

Figure 7.1. Example of a checklist for field trips

ans and interquartile ranges. The less informed responses tend to gravitate toward the more informed responses on each successive round. The method relies on the assumptions that summary statistics are indicative of true estimates and that persons less confident of their estimates will be more likely to change their estimates than those who are more confident.

Statistical summary of anonymous responses is a way of reducing group pressure for conformity, assuring that the opinion of every member of the group is represented. For a detailed description of the Delphi method see Linstone and Turoff (1975) and Dalkey (1969).

Delphi has been shown to be an inexpensive and efficient method for gathering information on natural resource and land-use data (Nelson, 1985; Pease, 1984; Pease and Beck, 1984). Delphi research has found that expert opinion was highly correlated with mail-out questionnaire data in the characterization of agricultural marketing and processing as well as in identifying agricultural characteristics such as soil types and field sizes (Nelson, 1985; Pease, 1984). Although these studies showed Delphi to be less correlated with certain financial aspects of agriculture, Delphi appeared to be a reliable method to rate agricultural productivity of sites for the purpose of establishing an evaluation benchmark.

LESA ratings can be evaluated by comparing the Delphi panel's rating of a sample of sites to the draft LESA ratings. The Delphi panel ratings can be obtained with a session of two to three hours at which the Delphi panelists rate LE and SA factors for the sample sites, as well as weight the factors, or by a mail-out procedure to obtain the data. It may be necessary to arrange a field trip with site information handouts to allow the panelists to view the sites to be rated. If the factor ratings are to be obtained in a group session, a computer facility with a station for each participant is most efficient. The answers to questions for each site can be tabulated quickly and made available to participants for rounds two and three. By the third round, the median and narrower interquartile range indicate the general agreement of the group. If a computer facility is not available, worksheets and a person assigned to do the calculations also work, although there are slow times as numbers are calculated and worksheets collected and passed out to the group. A Delphi individual recording sheet example is given in Table 7.2. The examples are for weighting factors. The Delphi process can be used for other benchmark tasks. For example, the Delphi panelists can rate several sites, as in the study cited below, to compare their ratings with that obtained from the draft LESA scores. The recording sheet and worksheet examples can be easily adapted for rating sites or other applications.

In an Oregon case study, the Delphi process also revealed certain considerations not made apparent in the field testing. For example, potential conflicts or compatibility with nearby non-farm residents

Table 7.1. Example of Delphi individual recording sheet for factor weighting

Factor	Round one	Round two	Round three	Group consensus
Land capability class	0.60	0.50	0.40	0.35
Parcel size	0.20	0.25	0.30	0.30
Compatibility with adjacent uses	0.20	0.25	0.30	0.35

NOTE: Each Delphi panelist keeps this worksheet to record his or her responses for each round. For each round, each panelist weights each factor. Weights for all factors must add up to 1.0.

Table 7.2. Example of a Delphi response sheet for factor weighting

Factor	Round one
Land capability class	0.60
Parcel size	0.20
Compatibility with adjacent uses	0.20

NOTE: This worksheet is completed by each participant, collected, and tabulated to determine the median and inter-quartile range of respondents. The results are posted so that panelists can consider the group response in each round. After each round, each panelist records his or her response on the individual recording sheet. Separate response sheets are distributed for rounds two and three to avoid confusion.

were discounted by the Delphi panel, especially for highly productive bottomland sites. Panelists said that while some farming practices may be inhibited by nearby residences, farmers could still make highly productive use of these sites. Also, in these bottomland areas, small parcel size was penalized less than it was in the less productive foothill areas. For more detailed information on the Oregon case study using a Delphi Panel benchmarking process, the reader is referred to Pease and Sussman (1994b). As part of the same research project, a second Delphi benchmarking case study was done by Coughlin (1994) for Lancaster County, Pennsylvania.

Focus groups. Another approach is focus group interviewing. Focus groups are usually composed of seven to twelve people, who typically do not know each other. Focus groups have been used previously for marketing research to obtain qualitative data on services or products using a structured group interview approach (Krueger, 1988). Selection of individual farmers can be done by telephone screening, as shown in the Figure 7.2 example, or by local officials or USDA staff. Delphi or focus group participants may be paid a small honorarium (e.g., $50) or treated with a dinner for their participation. A skilled moderator leads the discussion by posing a series of questions in a natural, logical sequence. The responses are tape-recorded, typed, and analyzed later by the project leader.

Delphi or focus group participants may be paid a small honorarium (e.g., $50) or treated with a dinner for their participation.

One important difference between a Delphi process and a focus group is that a Delphi process is intended to produce group consensus, while a focus group process is not. Instead, analysis of focus group interviews is intended "to understand the thought processes used by participants as they consider the issues of discussion" (Krueger, 1988).

Other benchmark options, such as the Analytical Hierarchical Process (Golden et al., 1989), may be developed by LESA committees. The choice will depend to some extent on its specific purpose and the expertise available for the process.

Telephone Screening Questionnaire

Name ______________________________ Date ______________________________

Address ______________________________ Phone (   ) ____________________

Hello, my name is ____________________ and I'm calling from ________________.
[jurisdiction]

We are conducting a short survey of farmers in ______________________________.

Am I speaking to (Mr., Mrs., Ms.) ______________________________?

[IF YES, CONTINUE. IF NO, ASK WHEN WOULD BE A GOOD TIME TO CALL.]

We are conducting a survey of farmers that will take approximately 2 minutes. Is it o.k. to begin?

1. Would you say that most of your income (> 50%) is from farming or non-farming sources?
   (   ) Farming [CONTINUE]
   (   ) Non-Farming [TERMINATE]

2. How many acres do you farm?
   (   ) less than 160 acres
   (   ) 160-320 acres
   (   ) over 320 acres

3. Where do you farm?
   (   ) Subarea A [TRY TO RECRUIT AT LEAST 1 FOR EACH SIZE GROUP ABOVE]
   (   ) Subarea B [TRY TO RECRUIT AT LEAST 1 FOR EACH SIZE GROUP ABOVE]
   (   ) Subarea C [TRY TO RECRUIT AT LEAST 1 FOR EACH SIZE GROUP ABOVE]

We are asking selected people to join us for a discussion about rating farmlands. The discussion will be at the ____________________ on ____________________ at ______________________________ and will last about one and one-half hours. Coffee and rolls will be served. Would you be able to join us at that time?

(   ) IF YES, I will be sending you a letter confirming this information. Should I use the address of ? [CONFIRM ADDRESS] If you need any help with directions or if you need to cancel, please call our office at ____________ ______________. Thank you very much for your cooperation.

(   ) IF NO, Thank you for answering our questions.

Figure 7.2. Example of a telephone screening questionnaire to select farmers for a focus group or Delphi panel (adapted from Krueger, 1988)

Although benchmarking may not be necessary for all jurisdictions, it will broaden the basis for legal defensibility where this is important. If a decision is made to perform a benchmarking validation study, the LESA advisor or LESA committee should seek assistance from a consultant or university faculty member familiar with Delphi, focus group, or other group processes to assure that proper procedures and conditions are followed.

Summary

The various tests discussed in this chapter will help assure that LESA provides a valid decision-making tool. With the participation of LESA committee members, field visits to a sample of sites ranging from those with zero points to those with 100 points will help pinpoint factor, scaling, or weighting problems and provide a basis for setting thresholds for decision making. Benchmarking is an optional step that provides an extra measure of validation. The next phase is to apply the LESA scores in decision making, which is discussed on Chapter 8.

Chapter 8
Interpreting LESA scores for decision making

CONTENTS

Land Evaluation and Site Assessment (LESA) scores are used as a tool to help set policy or to make land-use or other decisions. While LESA scores could be simply arrayed, ranked, and compared for several sites as an aid to decision making, it is often more useful to devise thresholds for applying scores to decision making. LESA score thresholds can be applied to the following:

> The creeping effect refers to situations where case-by-case decisions may lower LESA scores on nearby parcels, thereby justifying more land conversion decisions, causing a creeping boundary to occur.

- Designation of land for agriculture in a comprehensive, general, or master plan.
- Designation of land to be included in an agriculture zoning district.
- Choice of farm tracts for purchase of development rights.
- Land-use permits for rezoning or conditional uses.
- Impact analysis of permit decisions on surrounding parcels to counteract a "creeping" effect of lowered LESA scores.

LESA systems developed following guidelines in the 1983 LESA *Handbook* commonly use two or three total LESA score thresholds on a 300-point scale. For example, 240 points and above may be considered the "best" sites, 200-239 points may be considered "good," and less than 200 points may be considered marginal. For the generic LESA system used by federal agencies as part of the federal Farmland Protection Policy Act of 1981, the 1994 regulations use a threshold of 160 points out of a total of 260 points for the best sites (see Appendix A) .

> A better approach for many situations is to establish separate thresholds for each factor as well as for total LESA scores.

Several problems arise in setting thresholds. Since a LESA system typically consists of five to ten or more factors, a LESA score can reflect a mix of factor ratings that leaves the meaning of the score in doubt. For example, one parcel may have a very low soil rating and very high SA factor ratings, causing it to be in the "good" category while another parcel may have high soil ratings and one or two low SA factor ratings, causing it to fall within the "good" category. A better approach for many situations is to establish separate thresholds for each factor as well as for total LESA scores. A threshold is a cut-off rating or score for ranking parcels into two or more categories. Factor thresholds add information to the interpretation of LESA scores.

Another problem with a specific numerical cut-off is that a precision in LESA scores is implied that is unrealistic. The impre-

Table 8.1. Example of a template for arraying LESA score data for a sample of parcels

Parcel number (or label)	LE weighted factor ratings			Total LE	SA weighted factor ratings			Total SA	LESA score
	Factor A	Factor B	Factor C		Factor A	Factor B	Factor C		
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
etc.									

cise nature of LESA scores can be recognized by using a "fuzzy" threshold range to flag certain parcels. A local committee can then evaluate the parcels within this range for specified site characteristics.

The basis for the thresholds may be expert judgment by the LESA committee and/or an analysis of LESA scores for a sample of sites. In most cases, it will be advisable to have the committee active in the threshold-setting process, since the threshold is usually the link between LESA scores and public policy decisions. It is also advisable to compile data for a reasonable sample (e.g., 20-30) of sites for the testing process.

Several choices need to be made in setting thresholds. The first is how many thresholds to use. Another is whether to set thresholds for individual factors, as well as for the total LESA score. A third choice is whether to use a "fuzzy" score instead of a precise one. These choices are discussed in the following sections.

How LESA is usually used in making decisions

Once LESA scores have been computed for all the sites under consideration, they are used to classify the sites. Threshold scores are chosen and all sites with higher scores are given priority for continuation in agricultural use while sites with lower scores are not. Two or more thresholds may be chosen in order to classify the sites into the desired number of categories.

The appropriate thresholds will depend on the applications for which LESA is to be used and the objectives for using it (see user assessment in Chapter 2). If LESA is to be used for several applications, with differing objectives, it may be desirable to establish different thresholds for each application. For example, using LESA to decide which agricultural lands to protect in a local plan or zoning ordinance may require different thresholds than using LESA to decide which parcels could be granted non-farm dwelling permits as zoning special exceptions or conditional uses.

In order to determine what scores to choose as threshold values, it is helpful to find out what scores are typical in the planning area (Van Horn et al., 1989). To do this, compute and examine scores for a sample of 20 to 30 or more sites. The template in Table 8.1 shows weighted factor ratings and LESA scores arrayed in a computer spreadsheet format to facilitate graph generation.

Tables 8.2 and 8.3 provide an example of a hypothetical set of total LESA scores. The scores are shown graphically in Figure 8.1. Examination of the graph gives a good idea of how many parcels would be selected if the threshold were, for example, 90 as opposed to 80. For simplicity, this example gives only total LESA scores. In practice, LE and SA weighted factor ratings would also be arranged as shown in Table 8.1.

The frequency and statistics tables shown in Table 8.3 give tabular information about the graph in Figure 8.1. The mean, median, and mode, three ways to measure a typical score, are all over 60, indicating that this level of LESA scores is important in setting thresholds. If three thresholds were to be established, using only total LESA scores, the "best" threshold could initially be set at 80, which is about one standard deviation above the average and would capture six of the 30 sites. The "good" lower threshold could be set at 40, which is about one standard deviation below the average. That would leave five sites as "marginal," the lowest class. The 19 sites that fall in the "good" class could be evaluated by a secondary process, discussed later in this chapter. The use of factor thresholds, also discussed later in this chapter, could also change the number of sites in each class.

Table 8.2. Example of a data table for LESA sample sites

Parcel number	Sample LESA score
21	20
2	25
8	30
4	34
27	38
6	45
7	47
3	48
9	51
24	53
11	55
22	56
19	58
30	62
15	63
20	64
29	64
18	65
13	66
16	68
12	71
1	73
23	76
10	78
25	85
26	86
5	89
28	95
17	97
14	100

Table 8.3. Data table and statistics for figure 8.1

LESA score	Frequency of sites	Cumulative % of LESA sites
100	1	100.00%
90-99	2	96.67%
80-89	3	90.00%
70-79	4	80.00%
60-69	7	66.67%
50-59	5	43.33%
40-49	3	26.67%
30-39	3	16.67%
20-29	2	6.67%
<20	0	0.00%

Sample statistics of LESA scores

Mean	62.067
Median	63.5
Mode	64
Minimum	20
Maximum	100
Standard deviation	21.047

The data and graphs may help in setting threshold levels, but the specific policy objectives for the local application will be the deciding factor in assigning thresholds. For purchase of development rights, the amount of funds will influence the threshold level. If funds are very limited, then thresholds could be set very high or funds could be simply allocated by order from highest score to lowest. If the maximum zoning protection of very limited agricultural land is a local policy objective, thresholds could be set low to protect more sites. If residential or other development is an important objective, recognizing that conversion will need to occur, the thresholds will be higher to allow more sites to be converted.

Dealing with the inherent ambiguity of LESA scores: Setting factor thresholds

If a total LESA score is very high, it is clear that all factors rated high; however, it is more difficult to know what a middle level LESA score means, because the total LESA score is made up of the sum of weighted factor ratings as shown in Table 8.4. A high score could mean that the site has excellent soils and poor site characteristics, or mediocre soils and site characteristics, or poor soils and excellent site characteristics.

There is no way to tell from the total LESA scores in Table 8.4 which factors rate high and which low. If the policy is to protect

Table 8.4. Example of weighted factor ratings giving the same LESA score

	Maximum possible points	Site 1	Site 2	Site 3
Soil quality	34	33	21	10
Size	33	20	21	20
Compatibility with surrounding uses	33	10	21	33
Total LESA score	100	63	63	63

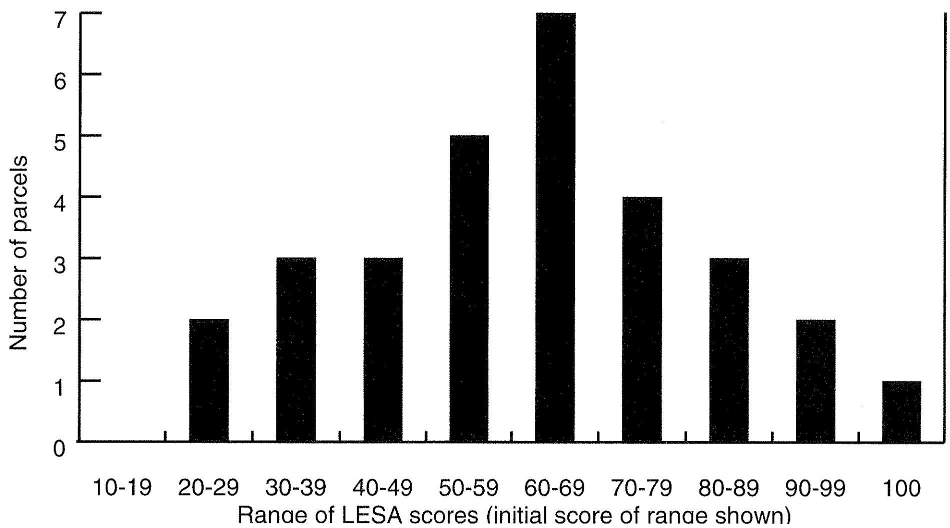


Figure 8.1. Frequency distribution of LESA scores in Table 8.2

sites with the better soils even in areas of conflicting uses, site 1 should be given priority. If the policy is to protect sites with little or no surrounding conflict, site 3 should be given priority. We can make these interpretations from examining the weighted scores for each factor but not from the total LESA score alone. By placing all of the interpretation on one number, i.e., the total score, much of the power of the LESA system to identify potential limiting factors is likely to be lost.

In order to be sure that decision rules reflect the policy they are intended to serve, it may be helpful to set minimum thresholds for individual factors, or groups of factors, in addition to the threshold for the total LESA score. In the above example, the LESA committee might require a minimum weighted factor rating of, say, 25 on soil quality in addition to a total LESA score threshold of, for example, 60 in order for a site to qualify for protection. With such a threshold, site 1 would qualify, while the other two sites would not.

A large site may support important agricultural uses even if it has mediocre soils. For some applications, it may be desirable to reduce factor compensation by setting thresholds for more than one factor. Some examples of threshold setting for both individual factors and the overall LESA score, from Oregon case studies, will help illustrate the procedures. They are taken from a chapter by J. Herbert Huddleston (1994) in *A Decade With LESA: The Evolution of Land Evaluation and Site Assessment*.

Factor compensation refers to one factor, size for example, compensating for another factor, such as soils.

Table 8.5. Example of a LESA system structure, Linn County, Oregon

Factor	Maximum points	Weighted factor ratings Site A	Site B
Land evaluation:			
SPR	50	50	45
Site assessment:			
Land use compatibility	25	24	10
Perimeter	(15)	(15)	(10)
Surrounding 1/4-mile (non-adjacent)	(10)	(9)	(0)
Parcel size	25	17	10
Total	100	91	65

The Linn County, Oregon, LESA system was designed strictly to rate the quality of land for agricultural use. The objective was to help land-use planners identify three general grades of land resource quality.

Table 8.5 gives the framework for the LESA system along with the results of its application to two parcels. Soil potential ratings (SPRs) were used to measure LE, and two factors, compatibility assessment and parcel size, were used for SA.

> = greater
< = smaller
≤ = smaller or equal

Threshold criteria:

- ***Best agricultural land.*** SPR > 27 **and** compatibility > 17 **and** size > 15 **and** total > 67
- ***Good agricultural land.*** SPR >17 **and** compatibility > 6 **and** size > 3 **and** total > 33
- ***Marginal agricultural land.*** SPR < 17 **or** compatibility < 6 **or** size < 3 **or** total < 33

In developing threshold criteria, the LESA committee felt strongly that any single factor should be allowed to control the classification. In order for a site to qualify for the highest class of resource quality, the SPR weighted rating for soils had to be above a specified minimum of 27 points, and the compatibility factor rating had to be above a specified minimum of 17, and the size factor rating had to be above a specified minimum of 15. Any individual weighted factor rating falling below its threshold value caused the parcel to be classified in a lower class. Similar types of thresholds (17 for soils, 6 for conflict, and 3 for size) were established to separate the middle class of resource quality from the lowest class.

In developing threshold criteria, the LESA committee felt strongly that any single factor should be allowed to control the classification.

Factor compensation entered into threshold determinations only with respect to the total LESA score. This was done by setting a minimum threshold for the total score that exceeded the sum of the threshold minimums for each of the three component factors. The upper thresholds for SPR (27), compatibility (17), and size (15) add up to 59 points, but the threshold value for the total LESA score was set at 67 points to make sure that at least one of the principal factors was better than the minimum value. Stated another way, the local committee wanted land rated in the highest class to have resource qualities that were somewhat better than the absolute minimums for each factor.

Site A in Table 8.5 exemplifies a site of excellent agricultural land. Soils are ideal for agricultural production, as indicated by an SPR weighted factor rating of 50 out of a possible 50 points. Land uses adjacent to the site are all fully compatible, as indicated by a perimeter weighted factor rating of 15 out of a possible 15 points. Even in the surrounding 1/4-mile area, most of the land uses are fully compatible (9 of 10 possible). The total weighted factor rating for compatibility is 24 points, which is well above the "best" threshold of 17 points. The site is smaller than ideal, but it is still large enough to operate efficiently and economically, so the weighted factor rating of 17 points exceeds the "best" threshold minimum of 15 points. The total LESA score of 91 is also well above the 67-point "best" threshold. Thus, there are no limiting factors, and the site should be classified in the "best" land resource category.

Site B in Table 8.5 exemplifies a site of lower quality but good agricultural land. The soils are good enough (45 out of 50 points), but there are some conflicting land uses adjacent to this parcel (10 out of 15 points), and the presence of a rural subdivision in the immediate vicinity reduces the surrounding compatibility weighted factor rating to zero. Thus, the total compatibility weighted factor rating of 10 points is below the "best" compatibility threshold of 17 points. Further, the site size is below the "best" threshold (10 out of 25 points), and the total score (65) is a little below the "best" threshold minimum of 67 points. This site, therefore, fails the highest quality classification on three counts: compatibility, size, and total. It should be designated as agricultural land of lower quality than the "best" category.

A different method for specifying thresholds using compensating factors was developed in conjunction with an unpublished agricultural LESA system for Lane County, Oregon (Huddleston and Pease, 1988). The LESA system itself was very similar to the Linn County system. The interpretation objective, however, was to classify agricultural lands into two groups, better lands being labeled primary, and the poorer lands being secondary. In this case, the LESA committee wanted excellent soils to be able to compensate for limitations associated with compatibility or site size, and vice versa. The threshold criterion used to accomplish this objective was quite simple—primary land had to have an LE weighted factor rating of 26 or more and a total LESA score of 67 or more.

This criterion mandates that primary land must have some minimum level of soil resource quality, but allows the compatibility score to vary according to the quality of the soil. In this way, marginal soils can qualify as primary only if they are in large sites virtually free of conflict, while the very good soils can tolerate much higher levels of conflict on smaller sites.

A slight variation of this criterion was used to distinguish between primary and secondary land in a LESA system for forestry in Lane County, Oregon (Pepi, 1989). The structure of the system itself was similar to the agricultural LESA systems described above, except that LE weighted score was allocated only 35 percent of the total points, and compatibility (in SA) was weighted at 40 percent of the total, instead of 25 percent. Given a 100-point total, maximum scores were distributed as follows: soils, 35; parcel size, 25; adjacent land use compatibility, 25; and surrounding land use compatibility, 15.

In setting thresholds for this system, the LESA committee felt that size alone should not be allowed to control the rating. As long as the soils were adequate, and the conflict was low, parcels of any size were deemed suitable for commercial forestry. To accomplish this objective, the following three criteria were written:

1) If site size is less than 11, then total must be greater than 79;

2) If site size is greater than 11, and if soils are less than 18, then total must be greater than 60;

3) If site size is greater than 11, and if soils are equal to or greater than 18, then total must be greater than 53.

Criterion 1 says that in order for a very small site to qualify as primary land, it must have excellent soils and be free of land-use conflicts. Criteria 2 and 3 invoke a threshold for soils, but unlike the agricultural LESA system, there is no absolute minimum of soil quality required. Instead, the poorer soils are allowed to be in the primary class only if the site has large enough size and is sufficiently free of conflict to generate a high total LESA score. As both size and soil quality ratings increase, more conflict can be tolerated, so the threshold for total LESA score decreases.

As can be readily seen from these examples, weighted factor rating thresholds can be used in various ways with a LESA score threshold. Factor thresholds may be adapted to reflect policy objectives for LESA applications and to provide more information than given by total LESA scores. For example, if SA-2 or SA-3 factors (see Chapters 5 and 6) are to be used as part of a LESA system, factor thresholds can be used to assure that parcels with high total LESA scores have appropriate levels of soil and SA-1 qualities, as determined by the local LESA committee. These examples illustrate how LESA can be adapted to local conditions and values.

Considerations for large parcels

Large sites or areas (e.g., greater than 500 acres) present the problem that LE or SA variability could be great in different parts of the site. Case studies in Hawaii showed that developers could manipulate the LESA score by including large areas of low scores with high quality lands (Ferguson et al., 1990) to obtain exemptions from agricultural zones. In cases where the large size of the site could mask significant differences within the site, calculation of scores for sub-areas within the site will provide more information to decision-makers. These sub-areas will need to be determined on a case-by-case basis. However, the LESA committee should establish a general rule as to when sub-areas should be used to assure consistent application of the LESA system.

Dealing with the inherent imprecision of LESA scores: Fuzzy thresholds

Despite all efforts to control the quality of a LESA system, it is a tool to provide a relative rating and ranking of sites within a jurisdiction, not an absolute or precise rating. While using a precise numerical threshold, such as 50 points, is simpler and appropriate for some applications, a "fuzzy" threshold may be preferable. A fuzzy threshold would establish a range, such as 45-55, instead of a single cut-off score, and would be used with a secondary procedure to determine a site's classification. Sites that

Table 8.6. Examples of secondary factors to be evaluated by a local LESA committee for classification of sites

- History of use
- Investment in equipment or improvements
- Market conditions
- Alternative uses
- Potential use by other producers

Table 8.7. Fuzzy thresholds on a 100-point scale

Class	Threashold scale
Best (equal to or greater than 90)	100 95 90
Fuzzy Range (equal to or greater than 75, but less than 90)	89 80 75
Good (equal to or greater than 65 and less than 75)	74 65
Fuzzy Range (equal to or greater than 50 but less than 65)	64 55 50
Marginal (less than 50)	49 40 etc.

fall within the range could, for example, be evaluated by a local technical committee which could apply more site-specific knowledge to the decision. Table 8.6 indicates some factors that may be considered in the secondary evaluation. These factors may be difficult to obtain data on or measure as part of the LESA system or they may be important for only some sites. For this procedure and for other aspects of LESA development, judgment of knowledgeable local people will usually be an important part of the LESA process.

As shown in Table 8.7, a combination of specific thresholds and fuzzy ranges can be used. For the "best" class, a threshold of 90 points is made. The "good" and "marginal" classes are defined by specific point thresholds. However, fuzzy ranges are given for sites falling between best and good and between good and marginal, since sites within these ranges could be classified up or down depending on site factors that are not easily captured within a LESA system. A local committee could review these sites and make a recommendation to local officials.

A local committee consisting of staff of USDA Farm Services Agency, Natural Resources Conservation Service, Cooperative Extension Service, and local soil and water conservation district members can, in many cases, apply pooled knowledge to a list of sites (with maps) in short order. In a resource lands classification project in Oregon, such a committee was able to review and evaluate the history of use of ownership parcels on tax assessment maps covering 200,000 acres in a matter of two to three hours.

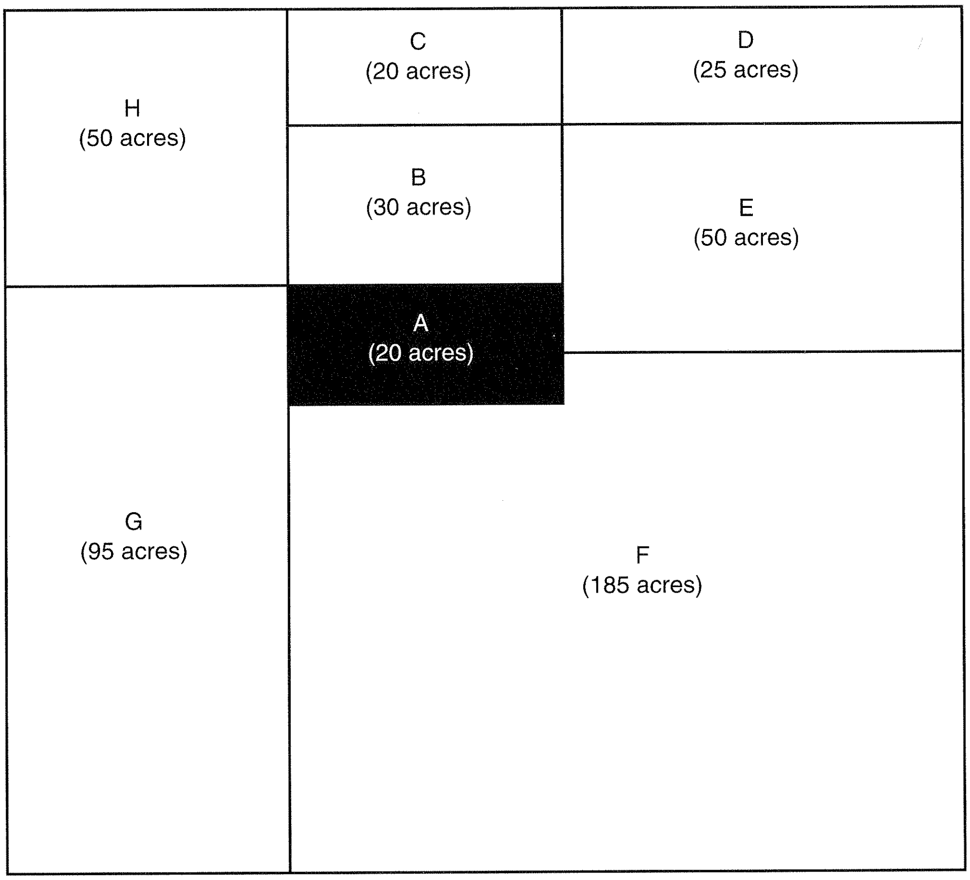


Figure 8.2. Surrounding area impact analysis

The creeping effect

One problem that arises is that case-by-case decisions may lower LESA scores on nearby sites, thereby justifying more land conversion decisions. This "creeping" boundary effect can be addressed by a surrounding area impact analysis of LESA scores. As shown in Figure 8.2, site A is 20 acres. In an area of mixed soils, site A may qualify for a land conversion permit because of poor soils and small size. The conversion may lower the SA score for site B enough that site B would then also qualify for conversion, which in turn could lower the scores of sites C, D, E, H, and possibly G and F.

The LESA system can be used to evaluate this situation by rating all sites within 1/4-mile (or some other distance) in a "before" and "after" sequence at the time a decision needs to be made. Each site is scored by assuming all parcels remain in agriculture. Each site is scored again assuming a proposed land conversion permit is granted. If the ratings in the surrounding parcels drop, it remains to establish some threshold limit above which reductions in LESA scores will not be allowed.

For example, a jurisdiction might establish an "impact" threshold of a 5 percent reduction in the LESA score. For the "before" scenario, it is important that a specific year be established as a baseline. In this way, the impact threshold is relative to the LESA score of each parcel in an agricultural setting before the conversion is granted. The cut-off date is important because the first permit may lower an adjacent site's score by 10 points but still be within the 5 percent reduction threshold. Additional nearby permits may individually also be within a 5 percent threshold but lower the site's score even further, causing cumulative effects on LESA scores. Without a date, the 5 percent threshold would be applied to decreasing LESA scores, still causing a creeping effect. With this procedure, it may be decided that, while site A is marginal as an agricultural unit, it should be kept in agriculture to preserve the integrity of more valuable sites in the surrounding area. If this impact procedure is used, it may be helpful for the LESA committee to establish guidelines for when an impact assessment should be done. For example, sites above or below a certain size may trigger the evaluation, or it could be done for all LESA applications involving a land-use change.

Summary

Using a dataset of local samples and a fuzzy range for thresholds widens the base for site classifications by recognizing local variation and using local expert judgment in the LESA process. Thresholds can be set for individual factors to allow certain factors to compensate for others or to allow certain factors to control the ranking. Establishing factor thresholds as well as total LESA score thresholds provides much more information for the policy and decision making process. Various combinations of these thresholds can then be made for specific objectives or different LESA applications.

There are undoubtedly other ways to set thresholds. It takes only the imagination and creativity of the LESA committee to discover them. Local adaptation of these procedures should both improve the LESA process and provide a firmer base of local support for the site rankings.

Chapter 9
Summary and conclusions

The Land Evaluation and Site Assessment (LESA) system is a numerical rating system designed to aid decision makers in formulating policy and making other decisions on the relative importance of farmland sites. Each site is rated on a scale of 0-100 points. LESA provides a general framework for combining soil and other site factors with the flexibility to select and weight factors that reflect site or local conditions. This *Guidebook* is intended to help users adapt the general LESA system to state or local conditions and applications.

A 1991 LESA survey indicated that about 212 jurisdictions in 31 states have initiated LESA projects since 1981, when LESA was introduced by the USDA Soil Conservation Service, (now the Natural Resources Conservation Service). About 138 are currently in use for farmland evaluation. LESA has also been applied to forestlands and tested for other resources, such as riparian areas, irrigated desert farmlands, wetlands, and gravel aggregate sites.

LESA is not intended to be a stand-alone technique to make decisions about farmland or a technique to protect farmlands. It is intended to be an objective tool to evaluate farmland sites as part of a decision-making process. It can help identify which land should be protected by land-use planning and zoning programs, purchase of development rights, transfer of development rights, or other farmland protection programs. It can also aid in making decisions about which land should be converted from agriculture to other uses by rezoning or land-use permits. LESA has also been used for property tax assessment and by lenders to help evaluate a site's agricultural value.

Since the LESA system is intended as a general model for local adaptation, a committee of local people knowledgeable about agriculture is important in the development process. The committee selects soil and other site factors, develops factor scales, determines the relative importance of each factor by weighting, tests the draft system in the field on a number of farm sites, and develops recommendations for setting thresholds to be used in making decisions. In most cases, the committee receives technical assistance from NRCS and other agencies. If available, a person trained in LESA procedures may also provide technical assistance to the committee. This person may be an NRCS staff person, a local college or university educator, or a consultant.

The general LESA model has been adapted by state, regional, county, and township units of government. A federal LESA system, part of the 1984 federal Farmland Policy Protection Act Rule, is used for evaluating the impact of federal projects and programs on farmlands. A local LESA system can be used in place of the federal system for evaluating federal projects after certification by NRCS.

LESA is a relative rating system on a point scale. This *Guidebook* recommends a 0-100 scale, but another scale could be used. The use of thresholds is a way to rank sites, such as ownership parcels, into two or more relative classes of agricultural importance. The ranking will depend on the scale of application. For example, the lowest ranked site in one county may be the best site in another county in the same state because of differences in soil, climate, and development patterns. Ranking of a particular site in a county could change when the LESA system is applied at the regional or state level. It is therefore important to determine the geographic scale for comparing sites. In most cases, land use decisions are made at the local level and the decisions as to which sites should be protected for agriculture and which should be designated for development are made by local officials.

The interpretation of LESA scores merits some caution. For most applications, it is helpful to set class thresholds on each factor as well as on the total LESA score. The reason for this is that factor thresholds provide more information in interpreting the scores. For example, to qualify for the highest ranking class, thresholds could be set on the soil factor, as well as on size, surrounding land use and other factors. These factor thresholds provide a means to make the LESA system more sensitive to local conditions and objectives.

Developing a LESA system requires a substantial commitment of local official and staff time and volunteer work. The experiences of LESA users over the last 15 years indicate that an agricultural LESA system takes about three to eight months to develop in a sequence of meetings. NRCS staff can usually provide the basic technical assistance for the Land Evaluation component, but the committee still needs to make decisions about factor selection, scaling and weighting. If soil potential ratings are developed, the committee provides valuable help in estimating costs of overcoming soil limitations.

The Site Assessment component often takes more time than the Land Evaluation component because of the wider choice of factors and scaling methods. Testing for factor redundancy and replicability as well as the field site evaluations add time to the development process.

The actual time commitment of staff and volunteers is of course far less than the development process time, since the scheduling of meetings and field trips is usually spread out over several months with a diverse committee. Actual costs to local governments may be low with technical assistance from public agencies and volunteers, except for the time of local government staff.

Most LESA case applications are currently done using tax assessment, soil survey, and other paper maps as well as tabular data and other reports. However, many local governments are initiating geographic information systems (GIS) for use by government agency staff and citizens. GIS is a computer information storage, retrieval, and analysis process to combine maps with attribute data. Where GIS is available, the application of a LESA system to a specific site is made much easier and faster than using non-computer data sources. Some GIS case studies are summarized and referenced in Appendix D and presented in the book, *A Decade with LESA: The Evolution of Land Evaluation and Site Assessment* (Steiner et al., 1994).

As population and development pressures increase, public policy decisions on which lands to develop and which to protect for continued resource use will continue to be made by state and local government officials. LESA provides an objective and consistent tool to aid decision makers in evaluating the relative importance of specific sites for continued agricultural use. Once developed, the system is usually quite efficient to apply. The LESA system is kept current by periodic review and revision. With LESA's help, citizens and officials can improve the basis for public policy decisions affecting the long-term stability of our agricultural land base.

Appendix A
Federal law and the Farmland Protection Policy Act LESA system

The protection of farmland as federal policy has been incorporated into federal legislation [Farmland Protection Policy Act of 1981, PL 97-98 and amendments, 7 U.S.C. 4201(b)] and into federal executive orders (USDA Land Use Policy Department Regulation 9500-3, March 22, 1983). A generic LESA system was included in the FPPA rule published in 1984 and in the final rule, published in the *Federal Register* June 17, 1994 (7CFR Part 658).

These policies and rules, as well as other federal legislation and executive rules, provide the framework for federal agency involvement in farmland protection, especially the role of USDA Natural Resources Conservation Service (formerly the Soil Conservation Service). Background discussion of the policy framework is given in Bridge (1994), Grossi (1994), and Wright (1994), and in the original LESA *Handbook* (USDA Soil Conservation Service, 1983).

This Appendix provides the federal LESA system in Table A-1 and includes a copy of the 1994 *Federal Register* rule.

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request
Name Of Project	Federal Agency Involved
Proposed Land Use	County And State
PART II *(To be completed by SCS)*	Date Request Received By SCS

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply – do not complete additional parts of this form).*		Yes ☐ No ☐	Acres Irrigated	Average Farm Size
Major Crop(s)	Farmable Land In Govt. Jurisdiction Acres: %		Amount Of Farmland As Defined in FPPA Acres: %	
Name Of Land Evaluation System Used	Name Of Local Site Assessment System		Date Land Evaluation Returned By SCS	

	Alternative Site Rating			
PART III *(To be completed by Federal Agency)*	Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly				
B. Total Acres To Be Converted Indirectly				
C. Total Acres In Site				
PART IV *(To be completed by SCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland				
B. Total Acres Statewide And Local Important Farmland				
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted				
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value				
PART V *(To be completed by SCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*				

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b))*	Maximum Points	Site A	Site B	Site C	Site D
1. Area In Nonurban Use					
2. Perimeter In Nonurban Use					
3. Percent Of Site Being Farmed					
4. Protection Provided By State And Local Government					
5. Distance From Urban Builtup Area					
6. Distance To Urban Support Services					
7. Size Of Present Farm Unit Compared To Average					
8. Creation Of Nonfarmable Farmland					
9. Availability Of Farm Support Services					
10. On-Farm Investments					
11. Effects Of Conversion On Farm Support Services					
12. Compatibility With Existing Agricultural Use					
TOTAL SITE ASSESSMENT POINTS	160				
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100				
Total Site Assessment *(From Part VI above or a local site assessment)*	160				
TOTAL POINTS *(Total of above 2 lines)*	260				

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection:

(See instructions on reverse side) **Form AD-1006 (10-83)**

STEPS IN THE PROCESSING THE FARMLAND AND CONVERSION IMPACT RATING FORM

Step 1 – Federal agencies involved in proposed projects that may convert farmland, as defined in the Farmland Protection Policy Act (FPPA) to nonagricultural uses, will initially complete Parts I and III of the form.

Step 2 – Originator will send copies A, B and C together with maps indicating locations of site(s), to the Soil Conservation Service (SCS) local field office and retain copy D for their files. (Note: SCS has a field office in most counties in the U.S. The field office is usually located in the county seat. A list of field office locations are available from the SCS State Conservationist in each state).

Step 3 – SCS will, within 45 calendar days after receipt of form, make a determination as to whether the site(s) of the proposed project contains prime, unique, statewide or local important farmland.

Step 4 – In cases where farmland covered by the FPPA will be converted by the proposed project, SCS field offices will complete Parts II, IV and V of the form.

Step 5 – SCS will return copy A and B of the form to the Federal agency involved in the project. (Copy C will be retained for SCS records).

Step 6 – The Federal agency involved in the proposed project will complete Parts VI and VII of the form.

Step 7 – The Federal agency involved in the proposed project will make a determination as to whether the proposed conversion is consistent with the FPPA and the agency's internal policies.

INSTRUCTIONS FOR COMPLETING THE FARMLAND CONVERSION IMPACT RATING FORM

Part I: In completing the "County And State" questions list all the local governments that are responsible for local land controls where site(s) are to be evaluated.

Part III: In completing item B (Total Acres To Be Converted Indirectly), include the following:

1. Acres not being directly converted but that would no longer be capable of being farmed after the conversion, because the conversion would restrict access to them.

2. Acres planned to receive services from an infrastructure project as indicated in the project justification (e.g. highways, utilities) that will cause a direct conversion.

Part VI: Do not complete Part VI if a local site assessment is used.

Assign the maximum points for each site assessment criterion as shown in §658.5(b) of CFR. In cases of corridor-type projects such as transportation, powerline and flood control, criteria #5 and #6 will not apply and will be weighed zero, however, criterion #8 will be weighed a maximum of 25 points, and criterion #11 a maximum of 25 points.

Individual Federal agencies at the national level, may assign relative weights among the 12 site assessment criteria other than those shown in the FPPA rule. In all cases where other weights are assigned, relative adjustments must be made to maintain the maximum total weight points at 160.

In rating alternative sites, Federal agencies shall consider each of the criteria and assign points within the limits established in the FPPA rule. Sites most suitable for protection under these criteria will receive the highest total scores, and sites least suitable, the lowest scores.

Part VII: In computing the "Total Site Assessment Points", where a State or local site assessment is used and the total maximum number of points is other than 160, adjust the site assessment points to a base of 160. Example: if the Site Assessment maximum is 200 points; and alternative Site "A" is rated 180 points:

$$\frac{\text{Total points assigned Site A}}{\text{Maximum points possible}} = \frac{180}{200} \times 160 = 144 \text{ points for Site "A."}$$

federal register

Thursday
July 5, 1984

Friday
June 17, 1994

Part III

Department of Agriculture

Soil Conservation Service

7 CFR Part 658

Farmland Protection Policy; Final Rule

31110 Federal Register / Vol. 59, No. 116 / Friday, June 17, 1994 / Rules and Regulations

DEPARTMENT OF AGRICULTURE

Soil Conservation Service

7 CFR Part 658

Farmland Protection Policy

AGENCY: Soil Conservation Service, USDA.

ACTION: Final rule.

SUMMARY: This rule amends part 658 of title 7 of the Code of Federal Regulations which implements the Farmland Protection Policy Act (FPPA). The amendments contained in this rule are necessary to enable the Department of Agriculture to effectively implement the FPPA, as amended. They request reports by federal agencies, recognize the statutory authority of a governor of a state to bring legal actions to enforce the FPPA, provide policy direction regarding federal assistance and federal programs, and they restore a subsection of the existing rule that was omitted from publication by clerical error.

EFFECTIVE DATE: This rule becomes effective June 17, 1994.

FOR FURTHER INFORMATION CONTACT: Lloyd E. Wright, Director, Basin and Area Planning, Soil Conservation Service, PO Box 2890, Washington, DC 20013, telephone 202–720–2847.

SUPPLEMENTARY INFORMATION: The regulations of the United States Department of Agriculture (the Department) implementing the Farmland Protection Policy Act (FPPA) are contained in 7 CFR part 658. A proposed rule, setting forth several amendments to these regulations, was published for public comment on January 14, 1987, at 52 FR 1465. The comment period closed February 27, 1987, during which time nineteen sets of comments were received from five federal agencies; four state agencies; seven national organizations in the agricultural, resource conservation, and planning fields; one county board of supervisors; and two individuals.

The proposed rule, as discussed below, contained six amendments to the Department's existing regulations. Of these six amendments, three were being proposed as a result of the specific changes in the FPPA that Congress had enacted in section 1255 of the Food Security Act of 1985, Public Law 99–198, 99 Stat. 1518. Another amendment to the existing rule was to correct a clerical mistake. These four amendments, with minor changes, are made final by this rule.

The two remaining amendments, of the six included in the proposed rule, were not responses to any new direction enacted by Congress, but were the Department's proposals to change its policy in the interpretation of FPPA provisions. These two amendments were a departure from the policy that the Department had announced when the existing regulations were promulgated on July 5, 1984, 49 FR 27716. The existing sections of part 658 that would be changed by these two amendments are §§ 658.2(a) and 658.3(c). The rationale underlying the provisions of the existing regulations is set forth in the preamble of the final rule publication, which is found at 49 FR 27716–27724. The rationale for the proposed changes is set forth in the preamble of the proposed rule at 52 FR 1465–1468. After reviewing the policy considerations that led to the adoption of the existing regulations in 1984, as well as considering the proposed changes and the public comments to the proposed rule, the Department has concluded that the proposed amendments to § 658.2(a) should be adopted with some additional interpretive clarification, as discussed below.

In addition, the Department has concluded that § 658.3(c) should be amended as proposed to comport with the authority of a governor of a state to take action to enforce the provisions of the FPPA with regard to a policy or program of the affected state for the protection of farmland.

I. Background

The FPPA was enacted as Subtitle I, sections 1539–1549, of Title XV of the Agriculture and Food Act of 1981, Public Law 98–98, 7 U.S.C. 4201–4209. In enacting the FPPA, Congress found that the Nation's farmland was "a unique natural resource" and that each year, "a large among of the Nation's farmland" was being "irrevocably converted from actual or potential agricultural use to nonagricultural use," in many cases as a result of action taken or assisted by the federal government. The FPPA directs federal agencies to identify and take into account the adverse effects of federal programs on the preservation of farmland; consider alternative actions, as appropriate, that could lessen such adverse effects; and assure that such federal programs, to the extent practicable, are compatible with state government, local government, and private programs and policies to protect farmland.

In order to guide the federal agencies in implementing the FPPA, section 1541(a) of the Act, 7 U.S.C. 4202(a), directs the Department of Agriculture, in cooperation with other departments, agencies, independent commissions, and other units of the federal government, to "develop criteria for identifying the effects of Federal programs on the conversion of farmland to nonagricultural uses." The Department issued these criteria in its current rule implementing the FPPA at 7 CFR 658.4 and 658.5. The FPPA also authorizes the Department to provide technical assistance to federal, state, and local government agencies to develop programs or policies to limit the conversion of productive farmland to nonagricultural uses, and this is covered in the current rule at 7 CFR 658.7.

In addition, section 1542 of the FPPA, 7 U.S.C. 4203, requires "each department, agency, independent commission, or other unit of the Federal Government" to review its laws, administrative rules, policies and procedures "to determine whether any provision thereof will prevent" the federal entity "from taking appropriate action to comply fully" with the FPPA, and to "develop proposals for action to bring its programs, authorities, and administrative activities into conformity with the purpose and policy" of the FPPA.

The Act does not expressly require a federal agency to modify any project solely to avoid or minimize the effects of conversion of farmland to nonagricultural uses. The Act merely requires that, before taking or approving any action that would result in conversion of farmland as defined by the FPPA, the federal agency examine the effects of that action using the criteria which the Department of Agriculture has supplied and, if there are adverse effects, to consider alternatives to lessen those effects. Once the agency has completed this examination, it may proceed with a project that would convert farmland to nonagricultural uses.

As originally enacted, the FPPA contained a prohibition against the use of the Act as a basis for litigation. Section 1548 states that the FPPA "shall not be deemed to provide a basis" for any litigation "challenging a Federal project, program or other activity that may affect farmland." 7 U.S.C. 4209. In the 1985 amendments to the FPPA, Congress amended this section to allow the governor of a state to bring a suit to enforce compliance with section 1542 (7 U.S.C. 4202) and related regulations.

II. Discussion of the Existing Regulations to Implement the FPPA

The current regulations were promulgated principally to enable federal agencies, with the help of the Soil Conservation Service (SCS), to measure the adverse effects, if any, of

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their programs and projects on farmland. The SCS has developed a Farmland Conversion Impact Rating Form, Form AD–1006, for this purpose. A federal agency considering a project on or affecting farmland completes and submits a Form AD–1006 to a local SCS office. The SCS determines if the proposed site or sites contain farmland subject to the FPPA, i.e., farmland that is "prime," "unique," or of "statewide or local importance," as defined by the FPPA. If SCS determines that the site or sites are not subject to the Act, SCS returns the form to the agency with that determination noted.

However, if SCS determines that the FPPA applies, SCS measures the "relative value" of the site or sites as farmland on a scale of 0 to 100, enters this score on the Form AD–1006 and returns the form to the federal agency. At this stage, the agency prepares a site assessment using twelve criteria set forth in the rule. After scoring each of the criteria and arriving at a total site assessment score, up to a maximum of 160 points, the agency adds this site assessment score to the "relative value" score that was supplied by the SCS on the Form AD–1006. The higher the combined score, the more suitable the site would be for protection as farmland. On the other hand, if a site receives a combined score of less than 160 points, the regulation recommends that it be given only "a minimal level of consideration for protection" and that additional sites do not need to be evaluated as alternatives.

Although the primary purpose of the Department's regulations implementing the FPPA was to impart these criteria and the guidelines for their use by agencies, the rule, in addition, established the Department's policy as to the farmlands that are subject to the FPPA, and as to the effect that the FPPA could have on private parties and nonFederal units of government applying for federal assistance to convert farmland to nonagricultural uses.

With regard to the first matter, the FPPA's definition of "prime farmland," excludes "land already in or committed to urban development or water storage." Section 1540(c)(1)(A), 7 U.S.C. 4201(c)(1)(A). The current regulation, § 658.2(a), provides that prime farmland is "committed to urban development or water storage" if a local zoning code or ordinance or current local comprehensive land use plan designated this land for commercial or industrial use or for residential use that is not intended at the same time to protect farmland.

With regard to the second issue, the current regulation, § 658.3(c), sets forth the Department's determination that the FPPA does not authorize a federal agency to withhold assistance to a project solely because that project was going to convert farmland to nonagricultural uses.

III. Discussion of the Amendments to the Existing Regulations

A. The Two Amendments Necessary for the Annual FPPA Report to Congress

Section 1546 of the FPPA, as enacted in 1981 (99 Stat. 1343–1344), required the Secretary of Agriculture to report to Congress on the progress made in implementing the FPPA. Only one report was required; and it was due within one year after the date of enactment, December 22, 1981. Section 1546 provided that the report should include information on:

(1) The effects, if any, of federal programs, authorities, and administrative activities with respect to the protection of United States farmland; and

(2) The results of the reviews of existing policies and procedures required under section 1542(a) of the Act.

As amended by section 1255 of the Food Security Act of 1985, section 1546 (7 U.S.C. 4207) now requires an annual report due at the beginning of each calendar year. The existing regulation, which was published prior to the amendment of section 1546, does not include any provisions for an annual report to Congress. Further, under the existing regulation, once agencies have completed their site assessments on the Farmland Conversion Impact Rating Form (Form AD–1006), they retain these forms and proceed to make their own decisions regarding the use of the site for the project in question. They do not make a regular practice of returning the form or a copy of it to SCS. Thus, SCS receives no record of the agency's use of the form or the agency's ultimate decision on the project.

Similarly, the existing regulation does not require a federal agency to report regularly to the Department on the progress made with the review of current provisions of law, administrative rules and regulations, and policies and procedures applicable to the federal agency to determine whether any provision thereof will prevent such unit of the federal government from taking appropriate action to comply fully with the provisions of the FPPA. This review is required by section 1502(a) of the Act, 7 U.S.C. 4203(a).

Now that the Act requires an annual report that includes both the effects of federal activities on the protection of farmland and the reviews undertaken by agencies, it is necessary for the Department to modify its existing regulations. Accordingly, the proposed rule in 1987 included two amendments to the existing regulations to enable the Department to carry out its reporting obligations.

The first of these amendments would have added a new § 658.4(g) to request federal agencies to return a copy of their completed Form AD–1006 to SCS after a final decision on a project has been made. This amendment received support in comments from all nongovernmental organizations and individuals, from the State of Rhode Island Statewide Planning Program, and from the Clarke County (Virginia) Board of Supervisors. However, the response was different from federal and state agencies that work with Form AD–1006 and would be responsible for returning it to the SCS.

Two federal agencies, the Federal Highway Administration (FHWA) and the Department of Housing and Urban Development (HUD), and the Michigan Department of Transportation and that of Oklahoma expressed concern that this requirement would generate additional, burdensome paperwork. The FHWA suggested that only those forms in which the selected site had a score of more than 160 be returned to SCS. HUD proposed to advise SCS of any tracts of farmland for which financing of housing subdivisions was being approved, but said it would be hard-pressed to return a Form AD–1006 for each action taken by HUD, especially those involving individual mortgage insurance.

The Michigan Department of Transportation and that of Oklahoma made comments that were almost identical to one another. On federally supported highway projects requiring environmental assessments or impact statements, the Form AD–1006 is included in such documentation and SCS receives a copy of the final document. Lesser projects, on the other hand, do not require an environmental assessment or impact statement, because they are often categorically excluded from review by regulations implementing the National Environmental Policy Act. These projects "usually require only minor amounts of right-of-way and thus have a very minimal impact on prime farmland," the Oklahoma Department of Transportation stated. Both Michigan and Oklahoma objected to having to submit Form AD–1006 on these types of projects.

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The Department recognizes that this change in its regulation may increase the paperwork requirement on federal public works and other federally, assisted programs that are already burdened with reporting requirements. Congress, however, directed that each year the Department is to report on the effects federal programs and actions are having on farmland, and the Department believes that collecting the Form AD-1006 data generated by the affected federal agencies is the best way to compile this information.

The Department has made changes in the final rule to reduce reporting burdens. Under the current rule, SCS determines whether the site or sites in question are of the type of farmland subject to the FPPA. Even in cases where SCS determines the FPPA does not apply and SCS returns a Form AD-1006 to the referring agency, further tracking of agency decisionmaking is carried out with a report back to SCS on the final decision regarding the initial referral. New procedures set forth in § 658.4(g), give agencies the option of referring questions of FPPA applicability to SCS or of making these determinations themselves, and in cases where SCS makes a negative determination, there is no further tracking of matters in which none of the alternatives involve farmland subject to the FPPA.

The second amendment to the existing regulations related to the annual reporting function is a new § 658.7(d). This new paragraph (d) will require each federal agency to report to the Chief of SCS the agency's progress during the prior fiscal year in reviewing its authorities, internal rules, policies and procedures, and the agency's development of proposals to bring its programs, authorities, and administrative activities into conformity with the FPPA, pursuant to section 1542 of the FPPA, 7 U.S.C. 4203.

This second amendment drew a pattern of comments similar to those offered for amendment one. The organizations and individuals who generally supported the amendments in the proposed rule were in support of this subsection. However, three of the federal agencies that would be required to make these yearly reports to SCS were critical.

The Farmers Home Administration (FmHA) proposed that once an agency has demonstrated that its programs, authorities, and administrative activities are in compliance with the FPPA, it should not be required to make an annual report. Rather, The FmHA asserted, such an agency should be requested to report only in a year in which it either plans to change its FPPA compliance process or undertakes a new program that may be subject to the FPPA.

The FHWA commented that a single report from an agency should be sufficient until any future revisions to the FPPA or the SCS regulations are made.

The Tennessee Valley Authority (TVA) asked for additional guidance concerning the type of information in the report, and recommended that the annual report be an assessment of the progress made in implementing the FPPA, without excessive and burdensome documentation of specific farmland conversion or protection activities.

The Department has incorporated the suggestion offered by the FmHA in the final rule. Although the request for an annual report will remain, once the agency has completed the review of its policies and procedures and revised them as needed to comply with the Act, no additional reports are requested. In years in which the agency has changed its FPPA compliance process, a report is requested.

As for the concern expressed by the TVA, the scope of the agencies' reports to SCS under the new § 658.7(d) is that which is established in section 1542 of the FPPA and which is set forth in the unchanged sections of the existing regulations, 7 CFR 658.7(a) and (b). In other words, the annual reports the agencies are to submit to SCS are to be limited to the reviews of laws, regulations, policies, and procedures that the agencies have conducted under section 1542(a) of the FPPA and the proposals for action, if any, that the agency has developed pursuant to section 1542(b). In addition, SCS will be receiving data from the agencies on their individual project decisions involving farmland, but this data will come from the various AD-1006 forms that the agencies are to return to SCS after making their action decisions.

B. Amendment to Recognize Change in Limitation on Litigation

Section 1255(b) of the Food Security Act of 1985, 99 Stat. 1518, amended section 1548 of the FPPA, 7 U.S.C. 4209, which originally prohibited states, local governments, and private parties using the FPPA as a basis to bring actions challenging Federal activities. Prior to the amendment, the language of section 1548 was as follows:

> This subtitle shall not be deemed to provide a basis for any action, either legal or equitable, by any State, local unit of government, or any persons challenging a Federal project, program, or other activity that may affect farmland. 95 Stat. 1344.

As amended, section 1548 (7 U.S.C. 4209) now reads as follows:

> This subtitle shall not be deemed to provide a basis for any action, either legal or equitable, by any state, local unit of government, or any persons challenging a Federal project, program, or other activity that may affect farmland. 95 Stat. 1344.

> This subtitle shall not be deemed to provide a basis for any action, either legal or equitable, by any person or class of persons challenging a Federal project, program, or other activity that may affect farmland: Provided, that the Governor of an affected State where a State policy or program exists to protect farmland may bring an action in the Federal district court of the district where a Federal program is proposed to enforce the requirements of section 1541 of this subtitle and regulations issued pursuant thereto.

Accordingly, § 658.3(d) of the existing regulation, which is simply a restatement of section 1548 in its original form, needs to be amended to conform with section 1548, as amended. None of the commenting parties expressed opposition to the proposal for this change in the regulation, and it is incorporated in this rule.

C. Amendment to restore § 658.7(b)

When 7 CFR part 658 was published as a final rule in 1984, it was intended to include § 658.7(b), which simply incorporates the provision of section 1542(b) of the Act requiring the federal agencies to develop proposals for action to bring their programs, authorities, and administrative activities into conformity with the FPPA. However, in the draft of the rule submitted to the Federal Register, paragraph (b) was inadvertently omitted, leaving a gap between § 658.7(a) and § 658.7(c) as they appeared in the published rule at 49 FR 27727. The proposed rule of January 14, 1987 included an amendment to restore this missing paragraph. None of the commenting parties expressed opposition to this correction, and it is incorporated in the final rule.

D. Amendment to Change Definition of "Prime Farmland Committed to Urban Development of Water Storage"

The FPPA does not include all farmland under its protection. In section 1540(c), 7 U.S.C. 4201(c), the specific farmland covered by the FPPA is defined. This is farmland that is either "prime farmland," "unique farmland," or "farmland, other than prime or unique farmland, that is of statewide or local importance." Each one of these terms is further defined and qualified in the FPPA and, in the definition of "prime farmland, there is an exclusion of "land already in or committed to urban development or water storage." Federal agencies are not required to consider the impact of their projects on prime farmland that is "already in or committed to urban development or water storage," even if this land would otherwise fall within the definition of "prime farmland."

In developing the existing regulations, the Department adopted standards for determining if prime farmland is "already in urban development" and whether land, although not "in urban development," was nevertheless "committed to urban development." Under § 658.2(a) of the current regulation, prime farmland which had been zoned for nonagricultural use by a state or local government with jurisdiction over the land, or which was designated in a current state or local land use plan for nonagricultural use, is regarded as "committed to urban development." This would mean that projects on prime farmland in those areas would not have to be analyzed by agencies for their effect on prime farmland.

The Department noted in the preamble to the 1984 final rule, at 49 FR 27720, that land use planning and zoning "are prerogatives of state and local government, not the Federal Government," and supplied the following rationale for the conclusion that prime farmland under nonagricultural zoning or planning was excluded from the FPPA:

> If a federal agency were required by the Act to assess the impacts of a project on prime farmland not yet in urban development but already designated by the state or local government for urban development through planning or zoning, the only purpose of the requirement would be for that agency to weigh alternative sites that would lessen the impact of the project on farmland. If the agency, based on its assessment pursuant to the Act, should then decide to refrain from building its project on the proposed site, it would be declining itself to use the proposed site for urban development when local or state planning or zoning had already declared urban uses to be acceptable on the site. This would be an intrusion by the Federal Government in the function of land use planning of state and local governments.

In the proposed rule, the Department offered for public comment a proposal that would abrogate the Department's previous interpretation of this question. In the definition of "prime farmland," there would no longer be an exclusion based solely on the designation of the land in a land use plan or zoning code or ordinance for nonagricultural uses. The proposed rule amendment would provide that once a project site had been analyzed and given a combined score of 160 points or less, it would be considered "committed to urban development" and thus no longer covered by the FPPA.

The preamble to the 1987 proposed rule, at 52 FR 1466–1467, cited three reasons for introducing these changes. First, it stated that the existing definition "is inconsistent with the definitions of prime farmland used in almost all other State and Federal programs which use the definition." Second, it noted that the existing definition requires the SCS district conservationists to review local plans and land use regulations and that many of them do not have the background in land use planning to make the proper determinations as to whether a given project site is truly "committed to urban development." Third, because land "committed to urban development" is excluded in the FPPA's definition of "prime farmland" but not from the FPPA's definitions of farmland that is "unique" or "of statewide or local importance," it is an anomaly that this type of "prime farmland" can be so easily and categorically put outside the reach of the FPPA while farmland that is "unique" or "of statewide or local importance" is covered by the FPPA despite the existence of zoning designations or land use plans that would allow urban development of such lands.

The comments on the proposed rule were sharply divided on whether the Department should change the identification of farmland "committed to urban development." The American Farmland Trust "strongly" supported the proposed change, calling the existing rule "confusing and inconsistent with the intent of the legislation." The Natural Resources Defense Council (NRDC) also supported the proposed change since it did not approve of farmland being excluded from the FPPA's coverage just because local land-use plans or zoning ordinances would allow urban development on it. This, the NRDC stated, would be an "arbitrary 'grandfather' exclusion * * * even where there is no current nonagricultural development and the prospect of future nonagricultural development is highly speculative." The American Land Resource Association agreed with the proposed change, claiming that the existing rule worked "inadequately" for protection of prime farmland and caused "unnecessary confusion among Federal agencies implementing the FPPA." The Farmers Home Administration and the Rhode Island Statewide Planning Program supported the change. Other commenting parties agreed with the change as part of their general support of all the amendments being proposed.

However, the Department of Housing and Urban Development (HUD), the Federal Highway Administration (FHWA), and the Michigan Department of Transportation opposed making the change in the Department's interpretation of farmland "committed to urban development." In particular, HUD devoted the principal thrust of its comments to this provision, objecting "strongly" to the change and outlining the importance of retaining the Department's current interpretation that land under planning or zoning for nonagricultural use was "committed to urban development." HUD stated:

> This procedure ignores and undermines a local government's land use decisions made through zoning, comprehensive planning, and subdivision regulations which are adopted to guide and direct urban development and growth * * * By changing the definition of 'farmland committed to urban development' and requiring a Farmland Conversion Impact Rating (AD–1006) be prepared, which must result in an aggregated score of 160 points or less before it is considered 'farmland committed to urban development,' certainly qualified USDA as taking a "big brother" approach to local land use plans and decisions.

HUD explained that whenever an application for project assistance is submitted to HUD, it must receive approval of local authorities. Since 1985, HUD's principal method for issuing mortgage insurance on single, family homes in housing subdivisions has been to wait until the local government has approved the subdivision plan and construction of the necessary streets and water and sewer systems. Under the existing rule, HUD would not have to analyze this land as "prime farmland" under FPPA. HUD argued that under the proposed rule, it would be required to complete the AD–1006 form on this land, which it termed a "useless exercise" at that point.

Aside from the mechanics of the proposed amendment, HUD made these comments about the general problem of farmland protection measures that the agency might undertake:

> In the single family housing program (which actions are most likely to be on the fringes of urban areas), preservation of farmland would require that we would have to either be involved in the local planning and zoning process at the earliest conceptual stages or by prohibitive and restrictive regulations which would withhold assistance for projects which had converted farmland to nonagricultural uses. Taking either action could easily be interpreted as an indirect way to regulate the use of private land or affect the property rights of the owners of such lands. We do not

believe that to be the intent of Congress. Putting a penalty on the land, either directly or indirectly, could result in creating a greater housing shortage, especially for low and moderate income families who are the primary users of HUD mortgage housing programs.

The FHWA, likewise, objected to the proposal on the grounds that it would require preparation of a site assessment on every project that requires rights-of-way. This would require "an enormous amount of time and resources to be provided by Federal, State and/or local agencies" and in many cases there would be "no apparent justification." FHWA suggested that the same exclusion of farmland "committed to urban development" that the Department has applied to "prime farmland" should be applied to the other two categories in the FPPA, "unique" farmland and farmland "of local or statewide importance."

The Michigan Department of Transportation had similar objections. It explained that the current rule "screens out many projects and constitutes a real time savings * * * If the local entities have designated the land for other uses, it doesn't warrant a high degree of protection as resource base at the federal level." On the other hand, if the rule were changed, it would require site assessments of "each project that required rights-of-way."

As noted in the preamble to the proposed rule at 52 FR 1467, the zoning and land use plans that are applicable to a particular site will be considered in conjunction with other criteria that are designed to assess the degree to which the site is committed to urban development. In this way, the prerogatives of state and local government, as exercised in zoning codes and land use plans, will play a role in determining whether a site should be given further FPPA review. Because the amended regulations will neither prohibit the providing of federal assistance to convert farmland nor preclude the conversion of farmland through non-federal means, the Department believes that the amended rule, as proposed, will not interfere with local land use planning, and will assure that prime farmlands will, to the full extent of the law, be given appropriate consideration.

Under the current regulation, sites that contain prime farmland that otherwise would have been exempted due to being "in or committed to urban development" would have still been covered by the FPPA if the site also contained lands of statewide or local importance. The exclusion of lands "in or committed to urban development" would have limited effect. After consideration of the comments, the Department is amending the rule to apply the exemption for farmland "in or committed to urban development" to all four types of farmland. It is clear from the comments provided by a number of federal agencies that they are already applying the exemption to all four types of farmland. Section 658.2(a) is being revised to remove the word "prime" before the word "farmland," thereby, making the exemption apply to all farmland.

An AD–1006 for a site that is located in urban areas need not be sent to SCS for evaluation. In addition, some agencies would like to use available mapped information to make their determinations without sending a Form AD–1006 to SCS. To facilitate the use of such information, § 658.2(a) will be revised to clarify that farmland "already in" urban development or water storage may be identified by an area shown as "urbanized area" (UA) on the Census Bureau map, or shown as an urban tint outline or urban area map on U.S.G.S. topographical maps, or shown as urban-built-up on the USDA Important Farmland Maps. Areas shown as white on the USDA Important Farmland Maps are not farmland and, therefore, are not subject to the Act. In addition, § 658.4(a) is being amended to clarify that federal agencies may determine whether or not a site contains farmland as defined in § 658.2(a) without sending a Form AD–1006 to SCS. Where SCS is asked to complete the land evaluation portion of Form AD–1006 before the Federal agency completes the site assessment portion, and SCS determines that the site is subject to the FPPA, then when SCS returns the form to the agency for completion of the site assessment portion, SCS will at the same time provide the agency with the requested information and data necessary for the Federal agency to complete and score the site assessment factor questions, and where the agency chooses to complete the site assessment portion of the form first, SCS will cooperate in providing timely information and data to enable the Federal agency to score the site assessment factor questions.

E. Amendment to Allow an Agency to Either Provide or Deny Assistance to a Project to Convert Farmland

The existing regulations, at § 658.3(c), interpret the extent to which an agency can use the FPPA as a basis for denying assistance to a project that would convert farmland. The paragraph reads as follows:

The Act and these regulations do not authorize the Federal Government in any way to regulate the use of private or nonfederal land, or in any way affect the property rights of owners of such land. The Act and these regulations do not provide authority for the withholding of federal assistance to convert farmland to nonagricultural uses. In case where either a private party or a nonfederal unit of government applies for federal assistance to convert farmland to a nonagricultural use, the federal agency should use the criteria set forth in this part to identify and take into account any adverse effects on farmland of the assistance requested and develop alternative actions that could avoid or mitigate such adverse effects. If, after consideration of the adverse effects and suggested alternatives, the applicant wants to proceed with the conversion, the federal agency may not, on the basis of the Act or these regulations, refuse to provide the requested assistance.

The proposed rule contained an amendment that would change the Department's interpretation of the effect of the FPPA by revising this paragraph significantly. This amendment would drop the second sentence. In the closing sentence, instead of retaining the language that the federal agency "may not, on the basis of the Act or these regulations, refuse to provide the requested assistance," the new language would state that the agency, after doing the required analysis and following its internal policies or procedures, would be free to deny as well as provide the assistance. See 52 FR 1467.

The rationale for this proposed change, as stated in the preamble to the proposed rule at 52 FR 1466, is that the FPPA leaves to the discretion of each agency "the determination of whether the providing or the denial of Federal assistance for farmland conversion will, in a given situation, comply with the policy and purpose of the FPPA." It was further noted that the rule, as presently written, "may be misread as a limitation on the previously described discretion provided by Congress to Federal agencies," and thus the amendment was needed "to recognize that discretion and the general process through which it is exercised."

Under the current regulation, when private landowners as well as state and local governments apply for assistance for a project involving the conversion of farmland subject to the FPPA, the federal agency is required to examine the effects of the project and alternatives but may not, based on the FPPA, refuse to provide the assistance. The amendment in the proposed rule would avoid making this analysis a pointless exercise by removing the rigid restriction on agency deliberations and allowing the agency to use the FPPA

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analysis as a basis for withholding assistance to the project in order to achieve the policies and objectives of the Act.

None of the parties who commented raised opposition to this proposal to change the existing regulation. A number of them supported it vigorously or proposed that it be made even stronger. The FmHA suggested the rule should provide that "if a clear alternative exists to avoiding a proposed conversion of important farmland and the applicant for Federal assistance is unwilling to pursue such an alternative, the Federal agency cannot provide financial assistance." FmHA went on to argue that if the FPPA did not impose this "affirmative duty" on agencies to deny assistance, "then other significant provisions of the Act become meaningless, such as (1) the ability of a governor to bring action in Federal district court to enforce the requirements of the FPPA, and (2) the requirement that each Federal agency identify and report to Congress any provisions of law, administrative rules, regulations, policies, and procedures applicable to it which prevent it from complying fully with the FPPA. What can governors enforce, what possible legislative or regulatory conflicts can exist, if the FPPA allows a Federal agency total discretion in deciding whether or not to finance an unnecessary conversion of important farmland?"

The Natural Resources Defense Council, the American Land Resource Association, and the American Farmland Trust also supported the change and, like the FmHA, proposed that it contain requirements that federal assistance be withheld from nonagricultural development in cases where alternatives mitigating or avoiding prime farmland conversion are available.

The Department, after considering the comments, believes that the proposed rule amendment is necessary to achieve the intent of Congress under the FPPA and, therefore, adopts that amendment in this rule. The amended § 658.3(c) allows the various federal agencies to consider the particular facts relating to their proposed assistance activities and to decide, in light of the policies of the FPPA and their own authorities, which reasonable alternative action will best achieve their mission and comply with the FPPA.

In similar deference to the agency discretion provided by the FPPA, the Department has determined not to accept the recommendations for a complete withholding of federal assistance to convert farmland in situations where alternatives exists to avoid or mitigate the effects of conversion. There may be, specific situations, compelling reasons of national, state, or local importance that would outweigh the protective policies of the Act. The federal agencies, in exercising the responsibility provided by the FPPA, can best analyze the facts of those situations, and their discretion to do so should not be unnecessarily constrained.

The Department notes that the Congress, during deliberations on proposed amendments to the FPPA as part of the Food Security Act of 1985, Public Law 99–198, considered and rejected a ban on federal assistance to convert farmland in situations where reasonable alternatives to conversion exist. See H.R. Conf. Rep. No. 447, 99th Cong., 1st Sess. 472 (1985), reprinted in 1985 U.S. Code Cong. & Admin. News 2398. The final rule allows the intentions of Congress, as expressed in the FPPA and in the 1985 deliberations, to be carried out.

During consideration of the comments received on the proposed rule and in interagency discussions within the Department, a misunderstanding of the scope of the analysis required by the FPPA and the regulations surfaced. This related to the extent to which federal agencies are required to identify and assess the potential for future conversion of farmland as a result of present activities and assistance.

As with other natural resource or environmental evaluations, such as the analyses required by the National Environmental Policy Act, the scope of the review must be related to the scope of the activity under consideration. In complying with the requirements of section 1542 of the Act (7 U.S.C. 4203) that each federal agency review its programs, authorities, policies, and procedures and take appropriate measures to assure that they conform with the purposes of the FPPA, an agency may properly consider the broader implications that its programs and policies have toward the potential for future conversions of farmland to nonagricultural uses. However, in considering whether a specific project or assistance activity of the agency will result in the irreversible conversion of farmland, the focus will be on those direct and indirect effects of the activity that can be reasonably identified and evaluated. In a review of a specific activity which does not contain proposals for, nor necessarily lead to, future activities that may convert farmland, the potential activities may be too general or speculative to adequately identify and usefully consider. The scope of each evaluation is determined by the scope of the objectives and facts of the agency activity under consideration.

It should be noted that the guidance provided in § 658.3(c), as amended by this rule, regarding the providing of federal assistance to convert farmland clearly applies beyond situations where a federal agency has been requested to provide assistance. Federal activities that are the result of federal initiatives, rather than requests for federal assistance, necessarily involve the same farmland protection policy considerations. In a situation where a Federal agency is contemplating an action that would convert farmland to a nonagricultural use and which is not the result of a direct request for federal assistance, the federal agency may decide, after conducting the analysis required by the FPPA, not to proceed with the action in order to achieve the objectives of the FPPA.

Implementation of the policy objectives of the FPPA in the manner discussed above and as contained in this final rule not only respects the traditional deference to state and local land use decisionmaking reflected in the FPPA, but also comports with and furthers the principles of federalism contained in Executive Order No. 12612 of October 26, 1987, 52 FR 41685. Local zoning and land use plans will be considered in determining if a site has been committed to urban development. Further, a federal agency may support state and local efforts to protect farmland by deciding not to provide federal assistance that would be used to convert farmland.

The wording of § 658.3(c) has been slightly modified from that of the proposed rule to clarify that any agency policies or procedures for implementing the Act may be considered by an agency in deciding how to proceed with an activity.

F. Additional Considerations

Some federal agencies raised concerns as to actions subject to the Act. The current regulation, at § 658.2(c), provides an exemption for federal permitting, licensing, or rate approval programs. Federal regulatory activities are not considered as federal assistance that could convert farmland. Therefore, federal regulatory activities are exempted from the Act. For example, in cases where a Clean Water Act section 404 permittee is required by the Corps of Engineers to perform compensatory mitigation on farmed wetland, thereby converting the wetland actual or potential use of farmland to a nonagricultural use, that conversion is not subject to FPPA. In complying with § 658.7 (a) and (b), Federal agencies may identify those programs that they determine are not subject to the Act and provide details on how other programs will be implemented consistent with the Act.

As further clarification, it should be noted that only those actions that will or could convert farmland to nonagricultural uses are subject to the Act. Assistance provided to purchase, maintain, renovate, or replace a structure that already exists is not subject to the Act, because any conversion of farmland took place at the time the structure was constructed. The addition of minor new ancillary structures, such as garages or sheds, to *serve* existing structures is also not included under the Act. Even in cases where loans are made for new houses, that action is not subject to the FPPA if the request for assistance and commitment by the federal agency was made after the house was constructed. Likewise, once one Federal agency has performed an analysis under the FPPA for the conversion of a site, that agency's or a second Federal agency's determination with regard to additional assistance or actions on the same site do not require additional, redundant FPPA analysis. Section 658.4(h) is being added to the final rule to reflect this clarification.

Several federal agencies cited concern for the application of the FPPA to land acquisitions by these agencies, providing temporary, intermediate ownership by the Federal Government such as through foreclosure, the acquisition of assets of an insolvent thrift institution or through forfeiture in criminal law enforcement proceedings. They expressed concern for potential conflicts between their statutory responsibilities to obtain prompt, high value disposal of these assets and the analysis procedures required under the FPPA.

The definition of "Federal program" in the FPPA, 7 U.S.C. 4201(c)(4), extends the coverage of the FPPA to "acquiring, managing, or disposing of Federal lands and facilities." If an agency determines that its program does not result in a sufficient acquisition of legal or equitable title by the United States to characterize the property as "Federal land or facilities," then the agency may exclude such land through its own policies and procedures for implementing the FPPA.

However, the Department has determined that an interpretive clarification of the term "Federal land and facilities" as used in the definition of "Federal programs" covered by the FPPA would be useful. In that regard, the Department believes that the use of the word "Federal" to modify the words "land and facilities" indicates an intent by Congress to focus the scope of federal programs covered by the FPPA to lands and facilities acquired or managed by federal agencies as necessary proprietary elements of federal programs, such as national forests, national parks, or military bases. The use of the modifier "Federal" is significant; if the intent was to include the acquisition, management, or disposal of any land or facility by a federal agency, regardless of the purpose of the use of the land or facility, Congress could have omitted the modifier and simply stated, "acquiring, managing, or disposing of lands and facilities."

Accordingly, the Department has amended the definition of "Federal program" contained in § 658.2(c) to clarify that, for the purposes of the FPPA and these regulations, the phrase "acquiring, managing, or disposing of federal lands and facilities" refers to lands and facilities that are acquired, managed, or were used by a federal agency specifically in support of a federal activity or program. It does not include lands or facilities that are acquired, managed, or disposed of by a federal agency as the incidental result of actions by that agency through which the agency has temporary ownership or custody of the land or facility, such as acquisition pursuant to a lien for delinquent taxes, the exercise of conservationship or receivership authority, or the exercise of civil or criminal law enforcement forfeiture or seizure authority.

The Department has also incorporated in the definition of "Federal program" interpretive clarification that loan guarantees or loan insurance of the construction of buildings or other structures is covered by the phrase "undertaking, financing, or assisting construction or improvement projects" contained in the definition of "Federal program." This interpretation was previously provided in the preamble of the final rule that promulgated the current regulations. See 49 FR 27720, July 5, 1984. Further in this regard, the Department has clarified that the acquisition, management, and disposal of land or facilities that a federal agency obtains as the result of foreclosure or other actions taken under a loan, loan guarantee, or other financial assistance proved by the agency directly and specifically for that property or facility is likewise within the definition of "Federal program."

A federal agency may develop and use procedures to implement the FPPA for its loan, loan guarantee, or other financial assistance programs on either a specific project/loan basis or on the basis of an entire program. Further, if an agency has conducted a FPPA review of a loan or other financial assistance for the conversion of farmland and the agency or any other federal agency subsequently acquires the property related to that assistance, the previously conducted FPPA review will be sufficient to constitute compliance with the FPPA for the management an eventual disposal of the property.

More importantly, an agency may develop and use specific policies and procedures for the management and disposal of property acquired through foreclosure, forfeiture, or other such means that taken into consideration its primary statutory authorities regarding such properties. Clearly, these determinations can be best made by the particular agencies involved through their respective FPPA policies and procedures, in consideration of the statutory requirements under which they operate. The Department will consult with agencies, pursuant to section 1542 of the FPPA, 7 U.S.C. 4203, to address these concerns.

Some federal agencies would like to exempt certain sites related to the expansion of existing linear projects that would convert only a few acres of farmland but would avoid the conversion of a large number of acres. Some statewide LESA systems currently include exemptions of 10 acres per bridge and 3 acres per mile on existing highways. The construction of bridges and widening of existing highways is a farmland protection method. USDA will consult with Federal Highway Administration, on actions that are designed to improve existing linear projects so as to avoid the conversion of land that would occur if a new linear project were to be constructed.

This rule has been reviewed under USDA procedures established in accordance with provisions of Departmental Regulations 1512-1 and has been designated "non-major."

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List of Subjects in 7 CFR Part 658

Agriculture, Soil conservation, Farmland.

Accordingly, Part 658 is added to Title 7 of the Code of Federal Regulations, Table of Contents and text to read as follows:

PART 658—FARMLAND PROTECTION POLICY ACT

Sec.

§ 658.1 Purpose.

This part sets out the criteria developed by the Secretary of Agriculture, in cooperation with other federal agencies, pursuant to section 1541(a) of the Farmland Protection Policy Act (FPPA or the Act) 7 U.S.C. 4202(a). As required by section 1541(b) of the Act, 7 U.S.C. 4202(b), federal agencies are (1) to use the criteria to identify and take into account the adverse effects of their programs on the preservation of farmland, (2) to consider alternative actions, as appropriate, that could lessen adverse effects, and (3) to ensure that their programs, to the extent practicable, are compatible with state and units of local government and private programs and policies to protect farmland. Guidelines to assist agencies in using the criteria are included in this part. The Department of Agriculture (hereinafter USDA) may make available to states, units of local government, individuals, organizations, and other units of the Federal Government, information useful in restoring, maintaining, and improving the quantity and quality of farmland.

§ 658.2 Definitions.

(a) *Farmland* means prime or unique farmlands as defined in section 1540(c)(1) of the Act or farmland that is determined by the appropriate state or unit of local government agency or agencies with concurrence of the Secretary to be farmland of statewide of local importance. "Farmland" does not include land already in or committed to urban development or water storage. Farmland "already in" urban development or water storage includes all such land with a density of 30 structures per 40-acre area. Farmland already in urban development also includes lands identified as "urbanized area" (UA) on the Census Bureau Map, or as urban area mapped with a "tint overprint" on the USGS topographical maps, or as "urban-built-up" on the USDA Important Farmland Maps. Areas shown as white on the USDA Important Farmland Maps are not "farmland" and, therefore, are not subject to the Act. Farmland "committed to urban development or water storage" includes all such land that receives a combined score of 160 points or less from the land evaluation and site assessment criteria.

(b) "Federal agency" means a department, agency, independent commission, or other unit of the Federal Government.

* * * * *

(c) *Federal program* means those activities or responsibilities of a Federal agency that involve undertaking, financing, or assisting construction or improvement projects or acquiring, managing, or disposing of Federal lands and facilities.

(1) The term "Federal program" does not include:

(i) Federal permitting, licensing, or rate approval programs for activities on private or non-Federal lands; and

(ii) construction or improvement projects that were beyond the planning stage and were in either the active design or construction state on August 4, 1984.

(2) For the purposes of this section, a project is considered to be "beyond the planning stage and in either the active design or construction state on August 4, 1984" if, on or before that date, actual construction of the project had commenced or:

(i) acquisition of land or easements for the project had occurred or all required Federal agency planning documents and steps were completed and accepted, endorsed, or approved by the appropriate agency;

(ii) a final environmental impact statement was filed with the Environmental Protection Agency or an environmental assessment was completed and a finding of no significant impact was executed by the appropriate agency official; and

(iii) the engineering or architectural design had begun or such services had been secured by contract. The phrase "undertaking, financing, or assisting construction or improvement projects" includes providing loan guarantees or loan insurance for such projects and includes the acquisition, management and disposal of land or facilities that a Federal agency obtains as the result of foreclosure or other actions taken under a loan or other financial assistance provided by the agency directly and specifically for that property. For the purposes of this section, the phrase "acquiring, managing, or disposing of Federal lands and facilities" refers to lands and facilities that are acquired, managed, or used by a Federal agency specifically in support of a Federal activity or program, such as national parks, national forests, or military bases, and does not refer to lands and facilities that are acquired by a Federal agency as the incidental result of actions by the agency that give the agency temporary custody or ownership of the lands or facilities, such as acquisition pursuant to a lien for delinquent taxes, the exercise of conservatorship or receivership authority, or the exercise of civil or criminal law enforcement forfeiture or seizure authority.

(d) "State or local government policies or programs to protect farmland" include: Zoning to protect farmland; agricultural land protection provisions of a comprehensive land use plan which has been adopted or reviewed in its entirety by the unit of local government in whose jurisdiction it is operative within 10 years preceding proposed implementation of the particular federal program; completed purchase or acquisition of development rights; completed purchase or acquisition of conservation easements; prescribed procedures for assessing agricultural viability of sites proposed for conversion; completed agricultural districting and capital investments to protect farmland.

(e) "Private programs to protect farmland" means programs for the protection of farmland which are pursuant to and consistent with state and local government policies or programs to protect farmland of the affected state and unit of local government, but which are operated by a nonprofit corporation, foundation, association, conservancy, district, or other not-for-profit organization existing under state or federal laws. Private programs to protect farmland may include: (1) Acquiring and holding development rights in farmland and (2) facilitating the transfer of development rights of farmland.

(f) "Site" means the location(s) that would be converted by the proposed action(s).

(g) "Unit of local government" means the government of a county, municipality, town, township, village, or other unit of general government below the state level, or a combination of units of local government acting through an areawide agency under a state law or an agreement for the formulation of regional development policies and plans.

§ 658.3 Applicability and exemptions.

(a) Section 1540(b) of the Act, 7 U.S.C. 4201(b), states that the purpose of the Act is to minimize the extent to which federal programs contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses. Conversion of farmland to nonagricultural uses does not include the construction of on-farm structures necessary for farm operations. Federal agencies can obtain assistance from USDA in determining whether a proposed location or site meets the Act's definition of farmland. The USDA Soil Conservation Service (SCS) field office serving the area will provide the assistance. Many state or local government planning offices can also provide this assistance.

(b) Acquisition or use of farmland by a federal agency for national defense purposes is exempted by section 1547(b) of the Act, 7 U.S.C. 4208(b).

(c) The Act and these regulations do not authorize the Federal Government in any way to regulate the use of private or nonfederal land, or in any way affect the property rights of owners of such land. In cases where either a private party or a nonfederal unit of government applies for federal assistance to convert farmland to a nonagricultural use, the federal agency should use the criteria set forth in this part to identify and take into account any adverse effects on farmland of the assistance requested and develop alternative actions that would avoid or mitigate such adverse effects. If, after consideration of the adverse effects and suggested alternatives, the landowners want to proceed with conversion, the federal agency, on the basis of the analysis set forth in § 658.4 and any agency policies or procedures for implementing the Act, may provide or deny the requested assistance. Only assistance and actions that would convert farmland to nonagricultural uses are subject to this Act. Assistance and actions related to the purchase, maintenance, renovation, or replacement of existing structures and sites converted prior to the time of an application for assistance from a federal agency, including assistance and actions related to the construction of minor new ancillary structures (such as garages or sheds), are not subject to the Act.

(d) Section 1548 of the Act, as amended, 7 U.S.C. 4209, states that the Act shall not be deemed to provide a basis for any action, either legal or equitable, by any person or class of persons challenging a federal project, program, or other activity that may affect farmland. Neither the Act nor this rule, therefore, shall afford any basis for such an action. However, as further provided in section 1548, the governor of an affected state, where a state policy or program exists to protect farmland, may bring an action in the federal district court of the district where a federal program is proposed to enforce the requirements of section 1541 of the Act, 7 U.S.C. 4202, and regulations issued pursuant to that section.

§ 658.4 Guidelines for use of criteria.

As stated above and as provided in the Act, each federal agency shall use the criteria provided in § 658.5 to identify and take into account the adverse effects of federal programs on the protection of farmland. The agencies are to consider alternative actions, as appropriate, that could lessen such adverse effects, and assure that such federal programs, to the extent practicable, are compatible with state, unit of local government and private programs and policies to protect farmland. The following are guidelines to assist the agencies in these tasks:

(a) An agency may determine whether or not a site is farmland as defined in § 658.2(a) or the agency may request that SCS make such a determination. If an agency elects not to make its own determination, it should make a request to SCS on Form AD-1006, the Farmland Conversion Impact Rating Form, available at SCS offices, for determination of whether the site is farmland subject to the Act. If neither the entire site nor any part of it are subject to the Act, then the Act will not apply and SCS will so notify the agency. If the site is determined by SCS to be subject to the Act, then SCS will measure the relative value of the site as farmland on a scale of 0 to 100 according to the information sources listed in § 658.5(a). SCS will respond to these requests within 10 working days of their receipt except that in cases where a site visit or land evaluation system design is needed, SCS will respond in 30 working days. In the event that SCS fails to complete its response within the required period, if further delay would interfere with construction activities, the agency should proceed as though the site were not farmland.

(b) The Form AD 1006, returned to the agency by SCS will also include the following incidental information: The total amount of farmable land (the land in the unit of local government's jurisdiction that is capable of producing the commonly grown crop); the percentage of the jurisdiction that is farmland covered by the Act; the percentage of farmland in the jurisdiction that the project would convert; and the percentage of farmland in the local government's jurisdiction with the same or higher relative value than the land that the project would convert. These statistics will not be part of the criteria scoring process, but are intended simply to furnish additional background information to federal agencies to aid them in considering the effects of their projects on farmland.

(c) After the agency receives from SCS the score of a site's relative value as described in § 658.4(a) and then applies the site assessment criteria which are set forth in § 658.5 (b) and (c), the agency will assign to the site a combined score of up to 260 points, composed of up to 100 points for relative value and up to 160 points for the site assessment. With this score the agency will be able to identify the effect of its programs on farmland, and make a determination as to the suitability of the site for protection as farmland. Once this score is computed, USDA recommends:

(1) Sites with the highest combined scores be regarded as most suitable for protection under these criteria and sites with the lowest scores, as least suitable.

(2) Sites receiving a total score of less than 160 need not be given further consideration for protection and no additional sites need to be evaluated.

(3) Sites receiving scores totaling 160 or more be given increasingly higher levels of consideration for protection.

(4) When making decisions on proposed actions for sites receiving scores totaling 160 or more, agency personnel consider:

(i) Use of land that is not farmland or use of existing structures;

(ii) Alternative sites, locations and designs that would serve the proposed purpose but convert either fewer acres of farmland or other farmland that has a lower relative value;

(iii) Special siting requirements of the proposed project and the extent to which an alternative site fails to satisfy the special siting requirements as well as the originally selected site.

(d) Federal agencies may elect to assign the site assessment criteria relative weightings other than those shown in § 658.5 (b) and (c). If an agency elects to do so, USDA recommends that the agency adopt its alternative weighting system (1) through rulemaking in consultation with USDA, and (2) as a system to be used uniformly throughout the agency. USDA recommends that the weightings stated in § 658.5 (b) and (c) be used until an agency issues a final rule to change the weightings.

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(e) It is advisable that evaluations and analyses of prospective farmland conversion impacts be made early in the planning process before a site or design is selected, and that, where possible, agencies make the FPPA evaluations part of the National Environmental Policy Act (NEPA) process. Under the agency's own NEPA regulations, some categories of projects may be excluded from NEPA which may still be covered under the FPPA. Section 1540(c)(4) of the Act exempts projects that were beyond the planning stage and were in either the active design or construction state on the effective date of the Act. Section 1547(b) exempts acquisition or use of farmland for national defense purposes. There are no other exemptions of projects by category in the Act.

(f) Numerous states and units of local government are developing and adopting Land Evaluation and Site Assessment (LESA) systems to evaluate the productivity of agricultural land and its suitability for conversion to nonagricultural use. Therefore, state and units of local government may have already performed an evaluation using criteria similar to those contained in this rule applicable to federal agencies. USDA recommends that where sites are to be evaluated within a jurisdiction having a state or local LESA system that has been approved by the governing body of such jurisdiction and has been placed on the SCS state conservationist's list as one which meets the purpose of the FPPA in balance with other public policy objectives, federal agencies use that system to make the evaluation.

(g) To meet reporting requirements of section 1546 of the Act, 7 U.S.C. 4207, and for data collection purposes, after the agency has made a final decision on a project in which one or more of the alternative sites contain farmland subject to the FPPA, the agency is requested to return a copy of the Form AD-1006, which indicates the final decision of the agency, to the SCS field office.

(h) Once a Federal agency has performed an analysis under the FPPA for the conversion of a site, that agency's, or a second Federal agency's determination with regard to additional assistance or actions on the same site do not require additional redundant FPPA analysis.

§ 658.5 Criteria.

This section states the criteria required by section 1541(a) of the Act, 7 U.S.C. 4202(a). The criteria were developed by the Secretary of Agriculture in cooperation with other federal agencies. They are in two parts, (1) the land evaluation criterion, relative value, for which SCS will provide the rating or score, and (2) the site assessment criteria, for which each federal agency must develop its own ratings or scores. The criteria are as follows:

(a) *Land Evaluation Criterion—Relative Value.* The land evaluation criterion is based on information from several sources including national cooperative soil surveys or other acceptable soil surveys, SCS field office technical guides, soil potential ratings or soil productivity ratings, land capability classifications, and important farmland determinations. Based on this information, groups of soils within a local government's jurisdiction will be evaluated and assigned a score between 0 to 100, representing the relative value, for agricultural production, of the farmland to be converted by the project compared to other farmland in the same local government jurisdiction. This score will be the Relative Value Rating on Form AD 1006.

(b) *Site Assessment Criteria.* Federal agencies are to use the following criteria to assess the suitability of each proposed site or design alternative for protection as farmland along with the score from the land evaluation criterion described in § 658.5(a). Each criterion will be given a score on a scale of 0 to the maximum points shown. Conditions suggesting top, intermediate and bottom scores are indicated for each criterion. The agency would make scoring decisions in the context of each proposed site or alternative action by examining the site, the surrounding area, and the programs and policies of the state or local unit of government in which the site is located. Where one given location has more than one design alternative, each design should be considered as an alternative site. The site assessment criteria are:

(1) How much land is in nonurban use within a radius of 1.0 mile from where the project is intended?

More than 90 percent—15 points
90 to 20 percent—14 to 1 point(s)
Less than 20 percent—0 points

(2) How much of the perimeter of the site borders on land in nonurban use?

More than 90 percent—10 points
90 to 20 percent—9 to 1 point(s)
Less than 20 percent—0 points

(3) How much of the site has been farmed (managed for a scheduled harvest or timber activity) more than five of the last 10 years?

More than 90 percent—20 points
90 to 20 percent—19 to 1 points(s)
Less than 20 percent—0 points

(4) Is the site subject to state or unit of local government policies or programs to protect farmland or covered by private programs to protect farmland?

Site is protected—20 points
Site is not protected—0 points

(5) How close is the site to an urban built-up area?

The site is 2 miles or more from an urban built-up area—15 points
The site is more than 1 mile but less than 2 miles from an urban built-up area—10 points
The site is less than 1 mile from, but is not adjacent to an urban built-up area—5 points
The site is adjacent to an urban built-up area—0 points

(6) How close is the site to water lines, sewer lines and/or other local facilities and services whose capacities and design would promote nonagricultural use?

None of the services exist nearer than 3 miles from the site—15 points
Some of the services exist more than 1 but less than 3 miles from the site—10 points
All of the services exist within ½ mile of the site—0 points

(7) Is the farm unit(s) containing the site (before the project) as large as the average-size farming unit in the county? (Average farm sizes in each county are available from the SCS field offices in each state. Data are from the latest available Census of Agriculture, Acreage of Farm Units in Operation with $1,000 or more in sales.) -

As large or larger—10 points
Below average—deduct 1 point for each 5 percent below the average, down to 0 points if 50 percent or more below average—9 to 0 points

(8) If this site is chosen for the project, how much of the remaining land on the farm will become non-farmable because of interference with land patterns?

Acreage equal to more than 25 percent of acres directly converted by the project—10 points
Acreage equal to between 25 and 5 percent of the acres directly converted by the project—9 to 1 point(s)
Acreage equal to less than 5 percent of the acres directly converted by the project—0 points

(9) Does the site have available adequate supply of farm support services and markets, i.e., farm suppliers, equipment dealers, processing and storage facilities and farmer's markets?

All required services are available—5 points
Some required services are available—4 to 1 point(s)
No required services are available—0 points

(10) Does the site have substantial and well-maintained on-farm investments such as barns, other storage building, fruit trees and vines, field terraces, drainage, irrigation, waterways, or other soil and water conservation measures?

High amount of on-farm investment—20 points
Moderate amount of on-farm investment—19 to 1 point(s)
No on-farm investment—0 points

(11) Would the project at this site, by converting farmland to nonagricultural use, reduce the demand for farm support services so as to jeopardize the continued existence of these support services and thus, the viability of the farms remaining in the area?

Substantial reduction in demand for support services if the site is converted—10 points
Some reduction in demand for support services if the site is converted—9 to 1 point(s).
No significant reduction in demand for support services if the site is converted—0 points

(12) Is the kind and intensity of the proposed use of the site sufficiently incompatible with agriculture that it is likely to contribute to the eventual conversion of surrounding farmland to nonagricultural use?

Proposed project is incompatible with existing agricultural use of surrounding farmland—10 points
Proposed project is tolerable to existing agricultural use of surrounding farmland—9 to 1 point(s)
Proposed project is fully compatible with existing agricultural use of surrounding farmland—0 points

(c) *Corridor-type Site Assessment Criteria.* The following criteria are to be used for projects that have a linear or corridor-type site configuration connecting two distant points, and crossing several different tracts of land. These include utility lines, highways, railroads, stream improvements, and flood control systems. Federal agencies are to assess the suitability of each corridor-type site or design alternative for protection as farmland along with the land evaluation information described in § 658.4(a). All criteria for corridor-type sites will be scored as shown in § 658.5(b) for other sites, except as noted below:

(1) Criteria 5 and 6 will not be considered.

(2) Criterion 8 will be scored on a scale of 0 to 25 points, and criterion 11 will be scored on a scale of 0 to 25 points.

§ 658.6 Technical assistance.

(a) Section 1543 of the Act, 7 U.S.C. 4204 states, "The Secretary is encouraged to provide technical assistance to any state or unit of local government, or any nonprofit organization, as determined by the Secretary, that desires to develop programs or policies to limit the conversion of productive farmland to nonagricultural uses." In § 2.62, of 7 CFR Part 2, Subtitle A, SCS is delegated leadership responsibility within USDA for the activities treated in this part.

(b) In providing assistance to states, local units of government, and nonprofit organizations, USDA will make available maps and other soils information from the national cooperative soil survey through SCS field offices.

(c) Additional assistance, within available resources, may be obtained from local offices of other USDA agencies. The Agricultural Stabilization and Conservation Service and the Forest Service can provide aerial photographs, crop history data, and related information. A reasonable fee may be charged. In many states, the Cooperative Extension Service can provide help in understanding and identifying farmland protection issues and problems, resolving conflicts, developing alternatives, deciding on appropriate actions, and implementing those decisions.

(d) Officials of state agencies, local units of government, nonprofit organizations, or regional, area, state-level, or field offices of federal agencies may obtain assistance by contacting the office of the SCS state conservationist. A list of Soil Conservation Service state office locations appears in Appendix A, Section 661.6 of this Title. If further assistance is needed, requests should be made to the Assistant Secretary for Natural Resources and Environment, Office of the Secretary, Department of Agriculture, Washington, D.C. 20250.

§ 658.7 USDA assistance with federal agencies' reviews of policies and procedures.

(a) Section 1542(a) of the Act, 7 U.S.C. 4203, states, "Each department, agency, independent commission or other unit of the Federal Government, with the assistance of the Department of Agriculture, shall review current provisions of law, administrative rules and regulations, and policies and procedures applicable to it to determine whether any provision thereof will prevent such unit of the Federal Government from taking appropriate action to comply fully with the provisions of this subtitle."

(b) Section 1542(b) of the Act, 7 U.S.C. 4203, requires, as appropriate, each department, agency, independent commission, or other unit of the Federal Government, with the assistance of the Department of Agriculture, to develop proposals for action to bring its programs, authorities, and administrative activities into conformity with the purpose and policy of the Act.

(c) USDA will provide certain assistance to other federal agencies for the purposes specified in section 1542 of the Act, 7 U.S.C. 4203. If a federal agency identifies or suggests changes in laws, administrative rules and regulations, policies, or procedures that may affect the agency's compliance with the Act, USDA can advise the agency of the probable effects of the changes on the protection of farmland. To request this assistance, officials of federal agencies should correspond with the Chief, Soil Conservation Service, P.O. Box 2890, Washington, D.C. 20013.

(d) To meet the reporting requirements of section 1546 of the Act, 7 U.S.C. 4207, and for data collection purposes, each Federal agency is requested to report to the Chief of the Soil Conservation Service by November 15th of each year on progress made during the prior fiscal year to implement sections 1542 (a) and (b) of the Act, 7 U.S.C. 4203 (a) and (b). Until an agency fully implements those sections, the agency should continue to make the annual report, but may omit the report upon full implementation. However, an agency is requested to file an annual report for any future year in which the agency has substantially changed its process for compliance with the Act.

Dated: June 8, 1994.

Mike Espy,

Secretary of Agriculture.

[FR Doc. 94-14548 Filed 6-16-94; 8:45 am]

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Appendix B
Guidelines for forest LESA systems

Forest Land Evaluation and Site Assessment (FLESA) systems have been developed for at least 28 jurisdictions in 15 states, according to LESA profiles in *Agricultural Land Evaluation and Site Assessment: Status of State and Local Programs* (Steiner et al., 1991). This set of guidelines is based on forest LESA applications in Vermont and Oregon. In Vermont, the 1988 Growth Management Act (Act 200) encouraged forest lands planning by municipalities through goal statements and guidelines for local planning. Also, a Forest Land Evaluation and Site Assessment (FLESA) system was developed to aid in adding private lands to national forests under the federal Taconic Mountains Protection Act of 1991. In Oregon, several counties developed forest LESA systems to help county officials in zone designations and permit decisions, and as a classification tool for identifying primary and secondary resource lands.

Adaptation of the LESA system to forest lands includes similar procedures to those discussed throughout this *Guidebook*, especially Chapters 2, 3, 6, 7, and 8. A local committee is an important part of the process, as are needs assessment, factor weighting, field testing of a draft FLESA system, and setting thresholds for decision making. The differences lie in the LE measurements and factor selection for SA. This appendix will provide a brief overview of concepts, LE and SA factors, and a discussion of studies and sources of LESA documentation which would be helpful to those developing a LESA system for forest lands.

Basic concepts

As with an agricultural LESA system, a forest LESA committee needs to consider several concepts in developing the system, including the following:

Focus. Forest lands, even more than agricultural lands, provide several public benefits in addition to harvestable forest products, such as recreational opportunities (where access is permitted), visual enjoyment, wildlife habitat, old growth stands, and other unique or scientifically interesting plant or animal associations, as well as water supply protection. While all of these benefits are important to evaluate, if combined into a single FLESA system, the resulting scores may be difficult to interpret. Options are discussed under the SA factors.

Replicability. In order to assure that different scores would obtain the same results, procedures and point scoring need to be clear and objective.

Redundancy. Since simplicity of both use and public understanding is usually a key goal of FLESA committees, selecting and testing factors for redundancy are important considerations.

Data basis for factor scaling. The FLESA committee should attempt to use available data sources and, when necessary, expert judgment in assigning scales and weights to factors. These data sources should be noted in the FLESA documentation.

Field testing and benchmarking. After the FLESA committee prepares a draft system, field evaluation with committee members and benchmarking (comparison to an independent rating—See Chapter 7) will clarify problems and help in making adjustments.

Scale of 100 points. As outlined in Chapter 1 and other chapters of this *Guidebook*, it is recommended that a 100-point scale be used and that each factor be weighted separately.

Land Evaluation for timber products

Land Evaluation for commercial forestry is based on the commercial values of designated tree species. These species will, of course, vary by geographic area. In Vermont, species included sugar maple, white pine, spruce fir, and hemlock. In western Oregon, Douglas fir was used as the indicator species.

Soil potential ratings (SPRs) for forest soils were used in Vermont and Oregon. SPR procedures are discussed in Chapter 4 and Appendix E. SPRs for forestry soils indicate the difference between value of harvested timber and the site management costs over several rotations. Certain assumptions need to be made about management practices and costs, including origin of stand, minimum basal area and diameter to be removed in commercial thinning, the number and spacing of trees to be replanted, site preparation methods, slope limitations for thinning and harvesting operations, and the rotation period.

Where SPRs cannot be developed due to lack of data, other measures of productivity, such as forestry site indices or assessor use value appraisals, may be necessary. This part of the FLESA process can be developed by the USDA Natural Resources Conservation Service (NRCS), with assistance from a local LE committee.

Table B.1. Productivity value

Site index	Slope	Factor scale
I	< 8%	100
	8-25%	75
	> 25%	60
II	< 8%	75
	8-25%	60
	> 25%	50
III	< 8%	50
	> 8%	40
IV	—	0

In Vermont, NRCS has rated soils for northern hardwoods (white pine on glacial outwash soils), along with costs and limitations of managing forests on these soils in a publication, *Soil Potential Study and Forest Land Value Groups for Vermont Soils* (USDA 1991). Specific factors considered in the ratings include soil drainage class, effective rooting depth, erodibility, rock outcrops, seasonal high water table, slope, surface stones or boulders, and surface texture. Another information source in Vermont is the publication, *Planning for the Future Forest, A Supplement to the Planning Manual for Vermont Municipalities* (Bouton et al., 1991). This publication, a guidebook for local governments to use in developing forest LESA systems, includes sections on rating recreation, wildlife habitat, and scenic values as well as commercial timberland values. NRCS has classified Vermont soils into seven forest land value groups. The groups are then classed into high, medium, and low values for mapping and comparison to other forest use ratings.

Where soil potential ratings are not available from NRCS, the *Guidebook* suggests using tax appraiser productivity indices together with slope data, as indicated in Table B.1.

In Oregon, counties have developed forest LESA systems. Since there is no statewide soil potential report, each county developed its own criteria and procedures.

Clatsop County developed the LE component and printed its SPR procedures in a report, *Land Evaluation of Forest Soils* (1990), available from the Clatsop County Planning Department in Astoria, Oregon. In Lane County, "Timber output values for each soil map unit were calculated using the Douglas Fir Simulation Model (DFSIM), developed at Oregon State University. The DFSIM program requires information on site index, existing stand origin, age and trees per acre, the number and timing of precommercial and commercial thinnings, and the age at the time of final harvest. The program then calculates the volume of merchantable timber produced on each soil type over a 60-year rotation. These output values, when multiplied by a price per thousand board feet for saw logs, provide a dollar value for the gross production from each soil." (Pepi and Huddleston, 1988).

Management practices included in the Lane County SPR are stand establishment, thinning, harvest, and road construction and maintenance. Costs for initial and continuing limitations depend on soil depth, coarse fragment content, bedrock type, slope, and erosion hazard. The dollar values assigned to these costs are knowledgeable estimates by a local committee. Costs are subtracted from the dollar value of yields. The soil having the highest net value is assigned an SPR of 100; all other soils are scaled from 0 to 100 by the percentage each soil is to the highest soil (Pepi and Huddleston, 1988; Pepi, 1989).

Site Assessment for timber products

The Vermont guidebook, *Planning for the Future Forest* (Bouton et al., 1991), suggests a number of factors which can be adapted to local needs. The suggested factors are parcel size, contiguous ownership acreage, accessibility, public/private investment in forestry (e.g., USDA cost-sharing practices), adjacent land use (within a 1/2-mile radius from parcel center), forest type or stand value (parcels with species of high market value are rated higher), social factors such as ownership type and pattern and past forest management practices, average stand size and quality, and marketability of stand species. Some of these factors may be redundant, or

Table B.2. An example of customizing FLESA criteria

Town A (Urban with scarce timberland)

Factors	Suggested point range	Assigned weight	Maximum points
Land evaluation:			
Soil potential index	0-100	1	100
Site Assessment:			
Parcel size	0-7	20	140
Accessibility	0-10	2	20
Public/Private investment	0-2	5	10
Forest type	0-4	5	20
Adjacent land use	0-5	2	10
Maximum Score			300

Town B (Rural with large parcels)

Factors	Suggested point range	Assigned weight	Maximum points
Land evaluation:			
Soil potential index	0-100	1	100
Site Assessment:			
Parcel size	0-7	10	70
Accessibility	0-5	4	20
Public/Private investment	0-10	5	50
Forest type	0-2	5	10
Adjacent land use	0-5	10	50
Maximum Score			300

Note: Vermont's *Guidebook* follows a different method from the one suggested in this *Guidebook*: The points could be scaled from 0-100 and the weights from 0-1.0.

intercorrelated. Table B.2 shows how towns with different local characteristics might select and weight the factors.

In the LESA system for Columbia County, Oregon, SA factors were size, adjacent land use, surrounding (within 1/2-mile radius, but not adjacent) land use, stream presence, and power line right of way presence. Presence within 1/2-mile of an urban growth boundary, wildlife refuge, public recreation site, or a downstream domestic water supply caused detractor points to be subtracted from the LESA score (Pease and Huddleston, 1991).

The key points used in Columbia County for scaling these factors are as follows:

Soils. SPRs are used to calculate LESA scores. Management costs are subtracted from dollar value of yields to give a number used to assign soil potential ratings. The soil having the highest difference between output value and input costs (based on 1 acre) is assigned an SPR of 100. All other soils are assigned SPRs on a scale between 0 and 100 according to the difference between inputs and outputs. Each soil in the county is rated in a table provided by a local technical committee. The table is used in the rating worksheet.

Size. Tracts less than 5 acres cannot be feasibly managed for commercial forestry. Tracts between 5 and 20 acres have minimal value for commercial forestry. Tracts greater than 20 acres have increasing value for commercial forestry management, with 40 acres a preferred minimum size, and an optimum minimum management size of 320 acres. Tracts larger than 320 acres will be rated the same.

Shape of parcel is a limiting factor for tracts less than 20 acres but is not used in the model because such tracts receive very few points for size. Slopes of greater than 30 percent invoke a 10 percent penalty in the parcel size matrix.

Adjacent land use. Two types of adjacent land use are rated for conflict potential. Incompatible uses place limitations on management or lead to problems such as trespass. Incompatible uses include tracts zoned for rural residential use or RA 19, which qualify for a dwelling unit (DU); tracts zoned for Exclusive Farm Use (EFU) or Forestry that are less than 20 acres and a DU is present; developed recreation sites such as golf courses or public parks; and right-of-way (ROW) for utilities. Somewhat incompatible uses place some limitation on management. Such uses include nonforestry related commercial uses; educational uses; and tracts in an

EFU or Forestry zone that are between 20 and 40 acres with a DU present. Somewhat incompatible uses are penalized half the points of incompatible uses.

Surrounding land use. A 0.5 mile "radius of influence" from the parcel perimeter is used to determine potential conflicts that could limit commercial forestry management. Maximum LESA points are given if all tracts within the radius are greater than 20 acres and no other limiting factors are present, such as downslope domestic water source, urban growth boundary (UGB), developed recreation site, or wildlife refuge. Rural residential zones and tracts less than 20 acres with a DU cause points to be deducted.

Stream and power line ROW. The presence of a Class I stream or a utility ROW creates problems of tree felling, protective corridors, and trespass access. The significance of these limitations is related to tract size; therefore, they are calculated in a matrix format which includes tract size. A tract crossed by a ROW or Class I stream is rated by using the size of the largest part of the parcel in the parcel size matrix table.

The worksheets used in Columbia County to scale the factors are given in Tables B.3 through B.6.

The Columbia County LESA system was developed by a local committee and assisted by an NRCS soil scientist and two Oregon State University Extension Service faculty members. The local committee selected the factors, decided on factor weights, and participated in several field trips to adjust the scales and weights.

Table B.3. Soil potential rating worksheet, Columbia County, Oregon

Soil map unit	Soil potential rating (from table on a scale of 0-100) * % of Tract	Raw factor rating % of Tract
Total tract SPR factor rating (add last column)		________
LE factor rating = Total raw factor rating * 0.25 (weight) = (weighted factor rating)		

Table B.4. Adjacent land use, Columbia County, Oregon

Incompatible parcels:

- any parcel zoned rural residential or FA 19 that qualifies for a DU
- any parcel in EFU or forestry zones that both:
  is smaller than 20 acres and
  has a DU on it
- developed recreation sites such as golf courses or public parks which provide access to the public on a regular basis

Somewhat compatible parcels:

- any parcel in EFU or forestry zones that both:
  is between 20 and 40 acres in size and
  has a DU on it
- non-forestry related commercial uses
- educational uses

Density adjustment factor:

Adjacent density is adjusted in reference to a "standard level of conflict" defined as that arising from a 5-acre parcel rectangular in shape, with a 2:1 width ratio, and oriented with a short side adjacent to the parcel in question. Any density less than this standard would reduce the penalty; any density greater would increase the penalty.

$$\text{density adjustment} = \frac{\text{number of incompatible parcels}}{\text{potential number of incompatible parcels}}$$

$$\text{potential number} = \frac{\text{total length of incompatible perimeter}}{\text{short side length of 5-acre, 2:1 rectangle (330')}}$$

NOTE: Do not include "somewhat incompatible" parcels in density adjustment.
The general formula for calculating the rating is:

Total perimeter - {(Length incompatible perim. * density adj.) + (Length swc per/2)}/total perim. * 100

NOTE: For measurements in inches on a 1" = 400' map, the following formula can be used:

Total perimeter - {(0.825 * number of incompatible parcels) + (Length swc per/2)}/total perim. * 100

The 0.825 is derived from 300'/400'; * = multiply, / = divide.

Adjacent Land Use Worksheet

Total perimeter length = __________

Total length of incompatible perimeter = __________

Total length of somewhat incompatible perimeter = __________

The length of short side of 5-acre, 2:1 rectangle = 330', or for a map with a scale of 1" = 400' the length is 0.825" or 21 mm.

Number of incompatible parcels = __________

Formula:

$$\text{Potential Number} = \frac{\text{total incompatible perimeter}}{\text{330' or map scale equivalent}}$$

$$\text{Density adjustment} = \frac{\text{number of incompatible parcels}}{\text{potential incompatible parcels}} = \_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_$$

Adjacent Raw Factor Rating formula:

Total perimeter - {(Length incompatible perim. * density adj.) + (Length swc per/2)}/total perim. * 100

Adjacent Raw Factor Rating = __________

Adjacent Factor Rating = Raw Factor Rating * 0.35 (weight) = __________ (weighted factor rating)

Table B.5. Surrounding land use

Radius of Influence = 0.5 mile

NOTE: If UGB present in radius of influence, score = 0.

Exclude adjacent parcels, but count all other contiguously owned tracts in RR zones or FA 19 zones that qualify for a DU and tracts in EFU or Forest zones < 20 acres with a DU within or partially within the area of influence.

RR tracts + EFU or Forestry zone tracts < 20 acres with DU divided by Tract Size = Ratio of Conflicts to Parcel Size.

Ratio of No. of Conflicts to Parcel Size	Raw Factor Rating
> 0-< 0.05	100
0.05-< 0.10	98
0.10-< 0.15	95
0.15-< 0.20	90
0.20-< 0.25	80
0.25-< 0.30	65
0.30-< 0.35	50
0.35-< 0.40	40
0.40-< 0.45	30
0.45-< 0.50	20
> 0.50	0

Ratio Factor Rating = __________

Adjustment Factors (subtract):

Presence of: UGB (100 raw factor rating points)
Wildlife Refuge (50 raw factor rating points)
Public Access Recreation Site (25 raw factor rating points)
Downslope Domestic Water Supply:

% of Tract Affected	Subtract
< 25%	25
25-50%	50
51-75%	75
> 75%	100

Surrounding Land Use Factor Rating = __________

Weighted surrounding SA Factor Rating = Raw Factor Rating * 0.10 (weight) = ___________ (weighted factor rating)

Table B.6. Conversion from raw factor rating to LESA score

	Raw factor rating (scaled to 100 points)	*	Weight (% of 100 points)	LESA weighted factor rating
Soils		*	0.25	
Size		*	0.30	
Adjacent land use		*	0.35	
Surrounding land use		*	0.10	
Total score (add LESA weighted factor ratings)				________

Another reference source for forest LESA systems is the first Land Evaluation and Site Assessment *Handbook* (USDA Soil Conservation Service, 1983). Part 601 of this publication gives a local example of using LE factors of mean annual growth potential, species market value, slope steepness, and soil limitations. Table B.7 illustrates the scales for rating each factor. The LE rating is derived as shown in Table B.8.

Detailed instructions are given in the *Handbook*. As can be seen from these factors, selection, scaling, and weighting of factors are important decisions of a local LESA committee.

Table B.7. Forest land scaling elements, Hanover County, Virginia

Mean annual increment cu ft/acre	Factor scale
>180	1.0
160-179	0.9
140-159	0.8
120-139	0.7
100-119	0.6
80-99	0.5
60-79	0.4
40-59	0.3
20-39	0.2
< 20	0.0

Use site index from SCS-Soils 5 Form and convert to C.M.A.I. for indicator species.

Indicator tree species	Factor scale
Loblolly pine	1.0 Most desirable
Yellow poplar	0.9
Shortleaf pine	0.8
No. red oak	0.7
White oak	0.6 Medium desirable
Sweetgum	0.4
Virginia pine	0.3 Least desirable

Examples:
The West: Douglas fir might be most desirable, hemlock might be medium desirable, etc.
The South: Loblolly pine might be most desirable, and upland hardwoods might be least desirable.

Slope%		Factor scale
0-15	(0-7)	1.0
15-25	(7-15)	0.8
25-35	(15-25)	0.6
35-50	(> 25)	0.4
50+	(NA)	0.1 (NA)

Slope ranges in ( ) modified for coastal plain and piedmont areas of Hanover County.

Soil Characteristic	Factor scale
No limitations	1.0
Fragmental or skeletal	NA
Sandy (aeric subgroups)	0.5
Clayey (sandy)	0.4
Stony or rocky (aquults/toxic)	0.2
Excessive wetness (ponding)	0.1
Other—shallow (droughty)	0.1-1.0

Table B.8. Forest land relative value rating, Hanover County, Virginia

1 Soil mapping symbol	2 Soil series	3 Productivity rating	4 Indicator species rating	5 Slope %	6 Steepness of slope rating	7 Soil limitation	8 Soil limitation rating	9 Composite value (3+4+6+8)	10 Relative factor rating (before weighting)
1B	Abell	0.7	1.0	2-7	1.0	None	1.0	3.7	100
3B	Appling	0.6	1.0	2-7	1.0	None	1.0	3.6	97
8	Augusta	0.7	1.0	0-2	1.0	Aeric	0.5	3.2	86
10C	Bourne	0.5	1.0	7-15	0.8	Droughty	0.1	2.4	65
18	Coxville	0.7	1.0	0-2	1.0	Aquults	0.2	2.9	78
29	Forestdale	0.4	0.4 (Sweetgum)	0-2	1.0	Aqualfs (ponding)	0.1	1.9	48
45B	Mayodan-Creedmoor	0.6	1.0	2-7	1.0	Clayey	0.4	3.0	81
51B2	Pacolet	0.6	1.0	2-7	1.0	None	1.0	3.6	97
75C3	Wedowee	0.5	1.0	7-15	0.8	Clayey	0.4	2.7	73
69D	Udults	0.7	1.0	15-25	0.6	None	1.0	2.3	56

Relative factor rating = $\frac{\text{composite value}}{3.7}$ x 100 (where the highest composite value was 3.7)

Combining LE and SA factors and setting thresholds

The general LESA model presented in Chapter 1 of this *Guidebook* will make combining LE and SA factors easier by scaling all factors to 100 and then multiplying by a weight between 0 and 1.0. The weighted factor ratings are then added to obtain the LESA score.

An Oregon case study will illustrate how thresholds were used for the LE and SA factors to distinguish between primary and secondary forest lands (Pepi and Huddleston, 1988). On a 100-point scale, the factors and maximum factor ratings are given in Table B.9. The thresholds for each factor are given in Table B.10. The classification matrix is given in Table B.11.

The soils threshold was set at about 50 percent of the maximum possible. The size threshold was set to correspond with a size of 10 acres when there are no other limitations due to slope, shape, or class I streams. The adjacent land-use threshold is set at a value in which 50 percent of the perimeter lies adjacent to 5-acre parcels. The surrounding land-use threshold is set at 1/3 of maximum points, which was deliberately low because the LESA com-

Table B.9. Forest lands LESA model, Lane County, Oregon

Factor	Max. raw rating		Weight	Maximum weighted factor rating
Soils	100	*	0.35	35
Size	100	*	0.25	25
Adjacent land use	100	*	0.25	25
Surrounding land use	100	*	0.15	15
Total				100

mittee felt this factor was of least importance. The total score threshold is set higher than the sum of factor thresholds to assure that at least one of the factors will have a value substantially above its threshold. The interaction matrix was worked out with the help of several field trips with the local LESA committee (Pepi and Huddleston, 1988).

Table B.10. LE and SA factor thresholds, Lane County, Oregon

Factor	Primary/Secondary threshold
Soils	18
Size	11
Adjacent use	12
Surrounding use	5
Total score	53

Table B.11. Primary (P)/Secondary (S) classification matrix, Lane County, Oregon

	Adjacent < 12		Adjacent > 12	
	Surrounding <5	Surrounding >5	Surrounding <5	Surrounding >5
Size < 11 and Soil < 18	S	S	S	P if Total > 53 S if Total < 53
Size < 11 and Soil >18	S	S	S	P if Total > 53 S if Total < 53
Size > 11 and Soil < 18	S	S	S	P if Total > 53 S if Total < 53
Size > 11 and Soil > 18	S	S	P if Total > 53 S if Total < 53	P

Summary

This forest LESA appendix is intended to provide some ideas and references to jurisdictions that are developing forest LESA systems. Procedures are similar to developing an agricultural LESA system. Factor selection, scaling, weighting, and combining are all decisions for a local LESA committee, with assistance of NRCS staff or other trained LESA leaders.

Appendix C
LESA adaptations for other uses: Riparian zones, rural residential sites, gravel sites, and wetlands

While not currently in widespread use, local efforts have been made to adapt the LESA model to other resources and land uses. Forestry applications are discussed separately in Appendix B. This Appendix will give some examples of LESA adaptations to riparian areas, rural residential uses, sand and gravel sites, and wetlands. There are undoubtedly many other applications and LESA-like rating systems. The purpose of this Appendix is to provide some ideas for those interested in developing rating systems for other resources and land uses.

Riparian areas

A study by Fry et al. (1994) ranks river segments based on natural functions, values, and benefits, using an adaptation of the LESA system. The ranking is used to set priorities for protection and enhancement of riparian areas, as well as to determine buffer widths for stream corridor protection. The LESA system is renamed the RESA system for Riparian Evaluation and Site Assessment.

The following three criteria are used for determining the Riparian Evaluation (RE in place of LE) component: perennial riparian (50 points), intermittent riparian (25 points), and ephemeral riparian (10 points) SA criteria include: vegetative cover and density, channel morphology, erosion conditions, habitat diversity, land use, surface water quality enhancement factors, groundwater recharge enhancement factors, recreation potential, and upland conditions. The SA component is assigned a maximum 90 points. All SA factors are rated on a scale of 0 to 10 points, with more points indicating a better site.

The SA criteria and point allocation are outlined in Table C.1. The researchers applied the system to 10 transects of Arizona's Agua Fria River. Each of the sites was assigned a score on a scale of 0-140 points. The scores of the test sites ranged from 27 to 122, as shown in Table C.2.

Sites with scores over 100 points qualified for recommended protection buffers of 30 meters on both sides. Sites with scores between 60 and 99 points qualified for maintenance buffers of 23 meters on either side. Sites with less than 60 points qualified for enhancement buffers of 30 meters on both sides. The authors explain the basis for choosing these buffer widths for the study sites. This evaluation tool could be developed similarly to the LESA system discussed in this *Guidebook* and adapted to local conditions.

Table C.1. Site assessment criteria in the RESA system, Arizona

SA category	1-3 points	4-6 points	7-10 points
Vegetative cover	Little or no bank vegetation, no riparian vegetation, uplands devoid of vegetation because of overgrazing or development	Some bank vegetation, remnant riparian vegetation, partial regeneration, medium to good cover on uplands	Banks are well vegetated, riparian vegetation well established and regenerating
Channel morphology	Extensive manipulation by human activity. Poorly developed flood plains, little or no natural vegetation	Channel is mostly or all natural, mostly natural banks, some human impact, some natural and introduced vegetation	Channels in a natural state, well-developed flood plains, well-vegetated banks
Erosion control	Erosion is sever. Bank downcut is 3 feet or more, banks are perpendicular to channel. No structural mitigation	Erosive conditions exist; however, erosion control structures such as gabions or holding ponds are in place	Erosion is being stemmed by vegetation. Upland land does not accelerate erosion
Wildlife diversity	Wildlife is limited to species found in most urban environments such as common birds, insects, few mammals	Wildlife includes several species of birds, reptiles, and mammals. Non-urban species present, but not threatened	Threatened, endangered, or rare species present. Native fish present
Local land use	Graded void of vegetation overgrazed, use of toxic products; sand, gravel, and other mining operations	Developed but re-vegetated, grazed but not overgrazed, impacted but most cases mitigated	Organic farming, low-level human impact, open space, undistributed
Surface water quality	Advanced erosion, high turbitity, toxic products, mining tailings, little or no vegetation to trap sediment or cycle nutrients	Less human impact, healthy upland vegetated, some bank stabilization via natural or human processes, few erosion factors	Banks are well vegetated, trapping sediment and slowing erosion. Aquatic, riparian, and upland plants cycle nutrients
Groundwater recharge	Straightened channel, impermeable channel bottom, banks, or flood plains. Water does not percolate down	Partial straight and partial meander, natural or slightly manipulated channel bed, some vegetation	Natural channel, meander patter, sufficient vegetation to slow water and facilitate recharge
Recreation potential	Channel void of water, vegetation, wildlife, natural values, privately owned, inaccessible	Channel supports birds, mammals, non-game fish, private/public ownership, accessible and close to population center	Outstanding wildlife viewing and recreation opportunity, high durability public ownership
Upland condition	Developed and/or graded void of vegetation, accelerated erosion, overgrazed	Mostly healthy upland vegetation, grazed but no overgrazed, development impacts mitigated	Healthy vegetation that traps sediment, slows run-off, and provides valuable habitat

Table C.2. Results of RESA

Site Number	1	2	3	4	5	6	7	8	9	10
RE: Category/Score	10	10	25	50	25	50	25	25	50	50
SA: Riparian vegetation	0	0	5	7	3	9	6	8	8	9
Channel morphology	5	2	1	5	5	9	6	7	8	8
Erosion control	8	2	5	5	5	9	5	7	8	8
Wildlife diversity	8	2	5	5	5	9	5	7	8	8
Local land use	7	7	3	2	7	9	5	5	7	3
Surface water quality	5	2	2	5	4	8	4	5	5	3
Groundwater recharge potential	8	0	2	5	7	7	7	7	5	5
Recreation potential	5	0	2	2	5	5	5	2	5	7
Upland potential	6	2	2	2	5	7	5	5	3	2
Total score	62	27	52	88	71	122	76	78	107	103

Site no.:
1 Headwaters
2 Fain Road
3 Dewey
4 Humboldt
5 Chauncey Ranch
6 Arcosanti
7 Higgins Ranch
8 Horshoe Ranch
9 Badger Springs
10 Black Canyon City

Rural development suitability

Often, LESA is used in zoning decisions to determine whether land parcels should be protected from conversion or whether other land uses are appropriate. A separate rural residential rating could help local officials make these decisions.

Several LESA studies in Vermont have used a separate development suitability rating system to compare to the resource rating. For instance, in a study for Bennington County (Bennington County Regional Commission, 1994), rating systems for forest potential, development potential, recreation, important wildlife habitats, and public water supplies were developed, mapped, and compared to determine which land tracts should be added to the national forest. The two factors used in this study for development suitability were the capacity of the soil to support on-site wastewater disposal systems, and accessibility from maintained state or town highways. A third factor, proximity of existing development, was dropped because it was correlated to the accessibility factor and was not as important as the other two factors. The project used a geographic information system (GIS) to generate suitability maps for low, medium, and high suitabilities for all five categories.

Table C.3. Rural development suitability, Bennington County, Vermont

Soil evaluation		Highway accessibility	
Soil suitability class for septic systems	Rating	Distance	Factor scale
1-3	high	≤ 250 meters from a state highway or Class 1, 2, 3	high
4-5	medium	town road	
6-7	low	> 250 meters	medium

Note: Any area encompassed within a sewer district received a "high" rating.

Another Vermont study that used a development potential factor was done by the Town of Granby (Hamilton, 1994). In this study, four categories were rated and compared: timber, recreation, wildlife, and development potential. Table C.4 lists the factors and points used for evaluating development potential. The specific criteria and scoring system is given in the report by Hegman and Carbonetti (1991).

Table C.4. Development suitability, Granby, Vermont

Factor	Possible points	On-site limitations	
Access	108	Wetlands	-50
Slope	60	Slope < 20%	-50
Water present	84	Fragile area	-50
Dist. to population	24	Gravel pit	-50
View	6	No access	-50
Electric lines	8	Not on-site but within 500 feet	
Open land	10	Wetland	-25
		Gravel pit	-25
		Power line	-25
Total Possible	300		-325

A Hawaii land development suitability study used the following four main constraint factors: slope, erosion hazard, commuting times, and soil shrink/swell. Secondary factors included flood hazard, airport noise, or dedicated agricultural use. This rating system is outlined in Bowen and Ferguson (1994) and Ferguson and Khan (1992). More details are given in DMH, Inc. (1987).

As shown in Table C.5, eight evaluation factors for constraints to urban development were used. Urban suitability would be the inverse of the constraint ratings; thus, the highest suitability ratings go to sites with the lowest constraint values. The results of the urban suitability analysis are then compared to the results of the agricultural LESA system to select lands suitable for urban development.

Table C.5. Urban development constraint factors, Hawaii

Evaluation factors/constraints	Very high	High	Medium	Low
Slope	Over 20% in 50" rainfall Over 40% if not in 50" rainfall	20-40% if not in 50" rainfall 26-20%	4-15%	less than 4%
Shrink-Swell soils	High	Moderate	Slight	Slight
Erosion	Severe/Very severe	Moderately severe to moderate	Moderate	None to slight
Hydrology	Naturally formed wetlands Floodway district	100-year floodplain Floodway fringe Coastal high hazard General floodplain	No floodplain	No floodplain
Habitat/Use	Endangered/ Threatened species			
Committed ag use		Dedicated ag land		
Travel time to major employment center		Over 60 minutes	45-60 minutes	0-45 minutes
Airport noise zone		65 Ldn and above		

Two other examples of rural residential rating systems were developed by Pease (1989) as part of education programs on land rating. One is intended to be used in conjunction with forestry LESA systems to rate housing suitability in forest zones. The factors and scoring system are given in Table C.6. The results were compared to forest LESA scores to aid in decision making.

The second rating system was developed as an example of comparing rural residential suitability to agricultural LESA scores for decisions affecting agricultural lands. The rating system applied seven factors, as shown in Table C.7. Three case studies were used to compare results.

The case study parameters and scores are given in Table C.8. The final step was to compare scores to agricultural LESA scores, as given in Table C.9. In this table, Case Study III is more suited than the other two case studies for a housing permit. However, Case Studies I and II required further analysis, since both agricultural and housing suitability fell in the number 2 category. Three categories of suitability were used for both agriculture and housing. The factors and associated scoring systems were developed as an example and would need refinement for actual applications.

Table C.6. Rating housing suitability in forest zones

Factor	Maximum points
A. Percentage of the perimeter in industrial or public ownership	60
50-100% = 0 points	
25-50% = 10 points	
10-25% = 30 points	
0-10% = 60 points	
B. Distance of dwelling from conflicting use	40
1000' = 40 points	
750' = 30 points	
500' = 20 points	
<500' = 0 points	
C. Access to the property	30
From state or county highway, or private residential drive = 30 points	
From seldom used haul road = 15 points	
From active haul road = 0 points	
D. Buffer strips (a stand of trees approximately 50' in depth from the property line) on property lines which adjoin public land or land that could be used as industrial forest land	20
In all conflict areas = 20 points	
On 75% of conflict areas = 10 points	
< 75% of conflict areas = 0 points	
E. Lot size	30
> 80 acres = 30 points	
40-80 acres = 15 points	
20-40 acres = 5 points	
< 20 acres = 0 points	
F. Percent of upslope in conflicting use	20
0% = 20 points	
Partial ownership (no likely problems) = 10 points	
> 50% = 0 points	
Total	200

Table C.7. Rating rural residential suitability in agricultural zones

Factor	Factor scale		Factor rating
Residential density (number of dwelling units per square mile)	>61	45	
	46-60	35	
	31-45	25	
	16-30	15	
	0-15	5	
Lot size in acres (optimum buffer size)	>15	10	
	6-15	35	
	2-5	20	
	0-1	5	
Roads	Paved	30	
	Gravel	15	
	Dirt	0	
Natural hazards	No	25	
	Yes	0	
Support services	Yes	25	
	No	0	
Percent of perimiter in agriculture	0-50	20	
	51-75	15	
	76-100	0	
Present use	Other	20	
	Agriculture	10	
Maximum points = 200			
Suitability thresholds:			
160-200=1	Highly suitable		
115-155=2	Moderately suitable		
30-110=3	Poorly suitable		

Table C.8. Case study evaluations

	Data		
	I	II	III
Residential density	74	29	31
Lot size	30	41	13
Roads	Paved	Paved	Paved
Natural hazards	Yes*	No	No
Support services	Yes	Yes	Yes
% Surrounding land	84	70	100
Present use	Agriculture	Other	Agriculture
*Partially located on 100-year floodplain.			
	Factor ratings		
	I	II	III
Residential density	45	15	25
Lot size	10	10	35
Roads	30	30	30
Natural hazards	0	25	25
Support services	25	25	25
% Surrounding land	10	15	10
Present use	10	20	10
Total	130	140	160

Table C.9. Case study (threshold classifications)

Case study	Agricultural LESA score (done separately)	Agricultural category	Residential score	Residential category
Hilicker	192	2 (marginal)	130	2
Main street investments	170	2 (marginal)	140	2
Idler	167	2 (marginal)	160	1

Sand and gravel sites

Aggregate sites often present controversial land-use issues because of potential conflicts with surrounding residential uses, scenic values, agricultural uses, and wildlife habitat. In jurisdictions with LESA systems, it may be helpful to develop a similar rating system for aggregate sites to aid in making land-use designations and decisions.

The study presented here was undertaken over several terms as part of graduate class research projects (Pease, 1992). Students applied and tested the rating system on more than 100 sites in Marion and Benton Counties in Oregon. The aggregate rating system was designed to be an objective and replicable method of rating sites, using the following five factors: quantity of aggregate, quality of aggregate, accessibility, land-use detractors, and the status of the site. Tables C.10 through C.16 give the criteria and associated factor scales for the five factors. The scores are grouped into three value classes to aid in decision making. Other factors, such as overburden depth, proximity to market, and local demand for the product, could also be incorporated. As is the case with agricultural LESA systems, tests of redundancy and consistency should be done to avoid unnecessary complexity. The results of this type of analysis can be compared to other rating systems as part of the total information base to make land-use decisions.

This rating system was scaled to a maximum of 245 points. It would be clearer to rate all factors to 100, then multiply by the appropriate weight, as recommended in Chapter 1 of this *Guidebook.*

Table C.10. Aggregate production quantity, Benton County, Oregon

Category	Future potential (1,000 cubic yards)	Potential	Factor scale
1	above 300	Excellent	100
2	100-300	Good	70
3	11-99	Fair	40
4	1-10	Poor	10
5	0	None	—

Table C.11. Aggregate site quality, Benton County, Oregon

Geologic unit	Useful materials	Location	Quality of unit
Recent river alluvium (Qral)	Gravel, sand	Within active Willamette River channels	Excellent
Quaternary lower terrace (Qtl)	Gravel, sand, clay	Terraces adjacent to Willamette River	Excellent
Quaternary middle terrace (Qtm)	Gravel, sand, clay	Major terraces adjacent to Willamette River	Good
Quaternary higher terrace (Qth)	Gravel, sand, clay	Terraces near foothills	Poor
Oligocene sandstone (Tts)	Sandstone	One outcrop on Highway 99W South	Poor
Spencer formation (Ts)	Sandstone	Foothills	Fair
Fluornory formation (Tf)	Sandstone	Foothills	Fair
King's Valley siltstone (Tsrk)	Siltstone	Foothills	Poor
Siletz River volcanics (Tsr)	Basalt	Hills in north county area	Good
Intrusive volcanics (Ti)	Basalt, gabbro	Hills in south county area	Good

Note: Abbreviations are geology map symbols.

Table C.12. Geologic quality group ratings

Geologic unit	Quality group	Factor scale
Qral, Qtl	1	100
Tsr, Ti, Qtm	2	75
Ts, Tf	3	50
Qth, Tts, Tsrk	4	0

Table C.13. Site accessibility

Category	Distance to road in miles	Factor scale
1	0	20
2	>0-1	10
3	>1-2	5
4	2+	0

Table C.14. Land-use detractor groups/ratings

Land-use type symbol	Land-use detractor group	Detractor scale
TU, AF, AO, F, SG, OM	1	0
T, P, O, N, PF, AD	2	-25
PL, DV, W, UR, UC, WS, UI, UT, UO, OR, D, FB	3	-50

NOTE: Abbreviations are land use map symbols.

Table C.15. Aggregate site status

Category	Status of site	Factor scale
1	Active	25
2	Inactive/Reclaimed	0

Table C.16. Resource value classes

Resource value total score	Value class	Number of sites
150+	I	24
101-149	II	26
0-100	III	56
Total		106

Class I: Resource sites that should be preserved and conflicting land uses constrained.
Class II: Resource sites that have moderate future potential. An attempt should be made to limit future land-use conflicts.
Class III: Resource sites with little or no future potential. Conflicting uses should be allowed.

An adaptation of LESA to wetlands should follow the general guidelines in the main text of this *Guidebook*, be supported by local wetlands experts, and include participation of local citizens.

Wetlands

In recent years, a large number of wetland rating systems have been developed and tested. Many of these systems incorporate social components as well as physical and biological features. For example, the U.S. Environmental Protection Agency's Wetlands Evaluation Technique (WET) system includes factors for recreation, uniqueness, and heritage values as well as physical and biological functions (Adamus, 1987). The province of Ontario, Canada, uses a system that includes resource products with cash value, recreational activities, aesthetics, education and public awareness, proximity to urban areas, and accessibility (Ontario Ministry of Natural Resources and Environment Canada, 1984). These systems tend to be somewhat complex for a local agency to apply. Simpler LESA-based systems can be developed by local citizens as an aid to decision making.

A simple system developed in a few weeks by graduate students as part of a graduate course requirement is presented here as an example of a LESA adaptation to wetlands (Bartsch, 1982; Rosenbaum, 1982). The study area was Linn County, Oregon. The proposed evaluation factors were applied to six wetland sites.

The following factors were used: site size, diversity of wetland types, presence of endangered species, presence of wildlife, presence of human activities, and level of past disturbance. The factors and associated rating scales are given in Table C.17.

Readers may also wish to review a wetlands rating system developed as part of a project to establish management policies for coastal wetlands in Sonora, Mexico. This system was prepared in draft from for review by federal, state, and local officials at a workshop held in San Carlos, Sonora, Mexico, in May 1996. Participants spent two days discussing and revising the criteria (factors) and weights. Staff of ITESM—Campus Guaymas then developed rat-

Table C.17. A wetlands ratings system

Factor	Factor scale	*	Weight	Weighted factor
Site size	< 20 acres	10		
	20-75 acres	30		
	> 75 acres	50	0.15	
Diversity—number of NWI types on site	One	0		
	Two	30		
	Three	50	0.20	
Endangered plant or animal species on site	Yes	100		
	No	0	0.30	
Wildlife presence	None	0		
	Birds (except waterfowl)	30		
	Waterfowl	50		
	Non-domestic mammals	30		
	Domestic mammals	-100		
	Fish, salmonids	50		
	Fish, other	10	0.15	
Human activity	Agriculture	-50		
	Mining or aggregate extraction	-100		
	Commercial, residential industrial, or transportation	-100		
			0.10	
Level of past disturbance	No evidence of past human use	100		
	Evidence of past use but no significant alterations	50		
	Encroachment from adjacent activity	-50		
	Significant past alteration	-100	0.10	

Value class	Points		
1	>40	Class I	Sites that should be protected
2	20-40	Class II	Sites that could have some development on perimeter
3	<20	Class III	Sites that could be converted

ing scales for each factor and applied the rating system to the 13 major coastal wetlands.

A development suitability rating system was also developed in a similar manner. Results of both systems were used as part of the decision-making process to classify the 13 wetland systems into categories of protection, conservation, multiple use, or development. This project was funded by the North American Wetlands Conservation Council (U.S. Fish and Wildlife Service funds), Arizona Game and Fish Department, Packard Foundation, and other sources. Sonoran coastal wetlands are important wintering grounds for U.S. and Canadian waterfowl and shorebirds.

At the time of this writing, the rating systems were subject to revision at a second workshop to be held in July 1996. Readers may obtain more information and a copy of the rating system from Carlos Valdes, Geotecnia International, C/O ITESM—Campus Guaymas, Guaymas, Sonora, Mexico.

While the example given in Table C.17 is inadequate as it stands for a general model, it does provide a starting point to consider wetland values in a LESA context. An adaptation of LESA to wetlands should follow the general guidelines in the main text of this *Guidebook*, be supported by local wetlands experts, and include participation of local citizens. Where wetlands are a land-use issue, this type of analysis and rating could be helpful in making land-use decisions.

Summary

The examples of LESA-like adaptations given in this appendix are intended to stimulate ideas for local LESA committees. The choice of factors, scaling, and weighting is a local decision. While some of the examples do not necessarily reflect the LESA structure recommended in this *Guidebook*, it would not be difficult to adapt them to the recommended scaling and weighting procedures. Results can then be compared to agricultural or forest LESA systems to aid in decision making.

Appendix D
Computer programs for LESA applications

While not necessary for LESA development or application, computer programs can increase ease of testing and evaluation and make site applications much faster than manual applications. For example, a spreadsheet program, such as Excel, Lotus 1-2-3, or Quattro is useful for evaluating the effects of alternate factor weights. Spreadsheet programs can also be used to display results of factor ratings and weights in graphs. Visual aids are often helpful in presenting the LESA system to local officials or citizens. A spreadsheet template for local adaptation is included in this appendix. More complex computer programs, such as geographic information systems (GIS), can be used both for development and for applications to specific sites. A brief overview of GIS applications is given.

Example of a LESA spreadsheet program

Table D.1 illustrates the use of a spreadsheet to compute a LESA score for a site with two soil types. This figure can be used as a guideline for creating spreadsheets in any of the common software programs. The following steps should be taken to construct this type of spreadsheet:

1. Enter row and column headings. Row headings include the factor names, which are not given in this example. For example, a Land Evaluation factor could be soil productivity or soil potential. If soil potential only is used, factors 2 and 3 can be deleted. If a different number of factors or soil types is needed for your application, the formulas displayed in Table D.1 will need to be adjusted accordingly.

2. Enter the appropriate factor ratings and weights in the cells marked with X's in Table D.1.

3. Enter formulas in appropriate cells.

4. Check that the total sum of the factor weights equals 1.00. If all formulas are entered correctly, the total LESA score should be automatically calculated.

5. Enter site specific information on each worksheet, such as site number, tax map number, and parcel number.

6. Spreadsheet examples are given in the main text of this *Guidebook* in Tables 1.1, 4.4, and 4.8.

Table D.1. Example of a spreadsheet program for calculating LESA scores

	A	B	C	D	E	F
1	Factor name	Factor rating (FR)	Factor weight	Weighted	% of site	Weighted FR %
2		(0-100%)	(Total must = 1.00)			
3	**Land evaluation**					
4	Soil A					
5	Factor 1	XXX	XXX	5B * 5C		
6	Factor 2	XXX	XXX	6B * 6C		
7	Factor 3	XXX	XXX	7B * 7C		
8	A subtotal			5D + 6D + 7D	XX	8D * 8E
9	Soil B					
10	Factor 1	XXX	XXX	10B *10 C		
11	Factor 2	XXX	XXX	11B* 11C		
12	Factor 3	XXX	XXX	12B * 12C	XX	
13	B subtotal					13D * 13E
14	LE subtotal		5C + 6C+ 7C			8F + 13F
15	**Site assessment**					
16	Ag productivity					
17	Factor 4	XXX	XXX	17B * 17C		
18	Factor 5	XXX	XXX	18B * 18C		
19	Factor 6	XXX	XXX	19B * 19C		
20	AP subtotal		17C + 18C + 19C	17D + 18D+ 19D		
21	Development pressure					
22	Factor 7	XXX	XXX	22B * 23C		
23	Factor 8	XXX	XXX	23B * 23C		
24	DP subtotal		22C+ 23C	22D + 23D		
25	Other public values					
26	Factor 9	XXX	XXX	26B * 26C		
27	Factor 10	XXX	XXX	27B * 27C		
28	OPV subtotal		26C + 27C	26D + 27D		
29	Total factor weights		14C+20C+4C+8C			
30			(Must = 1.00)			
31	**Total LESA score**			14F+20D+24D+28D		

Site number ___________Tax map number ___________Parcel number ___________

GIS applications

Several articles have been published describing how GIS was used in LESA applications; undoubtedly there are many more GIS applications that have not been published. In the book, *A Decade with LESA: The Evolution of Land Evaluation and Site Assessment* (Steiner et al., 1994), three chapters outline GIS projects ranging from a forestry LESA application undertaken for a small rural township in Vermont (Hamilton, 1994) to more complex modeling efforts (Yangow and Shanholtz, 1994; DeMers, 1994).

The Granby, Vermont, study was used to create maps, score tracts, and analyze data on timber, recreation, wildlife, and development potential aspects of the study. The six-month project cost $10,000. While the GIS advantages of map production and easily changed criteria were acknowledged, data entry was expensive and the technology seemed a bit too "high-tech" for some Granby residents.

Another GIS project was undertaken at the Information Support Systems Laboratory at Virginia Polytechnic Institute and State University (Yagow and Shanholtz, 1994). In this case, the LESA application was part of a cooperative project with the People's Republic of China to analyze land-use change in urban fringe areas. The GIS model allows factors, scoring criteria, and weights to be evaluated and refined through iterations using menu options.

A GIS study by DeMers (1994) attempts to develop a general model for GIS implementation of LESA. The model has two parts—preprocessing and testing. The preprocessing component includes the selection of factors, scoring, criteria, and weights, and the conversion of mapped data. The testing component includes determining whether raster, vector, or both spatial data models will be used, reconciling differences in map scales, and the development of an application prototype for field testing. The authors suggest that in addition to its analysis and rapid processing capabilities, a GIS-based LESA system is a powerful tool for education and conflict resolution among land-use interest groups.

A feasibility study of using GIS for evaluating LESA scores on an area-wide basis for use in rezoning decisions was conducted for Douglas County, Kansas (Williams, 1985). This early study laid some of the groundwork for later studies by DeMers and Yagow and Shanholtz, cited earlier in this appendix. Among the design considerations were choice of vector or raster-based system, choice of coordinate systems, and decisions about minimum mapping unit or grid cell size. This study used a raster-based system, CTM coordinates, and a cell size of 100 by 100 meters (2.5 acres). Some problems were encountered in locating and acquiring data and the conversion of mapped data. However, the digital database allowed rapid manipulations of the LESA factors, scoring criteria, and weights and application over extensive areas

The State of Hawaii used GIS to develop and test a statewide GIS system, beginning in 1987 (Ferguson et al., 1991). The Office of State Planning provided project direction, while data conversion and programming were done by the University of Hawaii. Among the problems encountered were vague definitions in specifying factors (such as "compatible"), Site Assessment factors that were too costly to map, and factors for which no maps existed. It was also noted that the GIS data needs to be reviewed and updated on a regular basis.

Maps of LESA scores have been completed for all of Hawaii's major islands. The GIS-based LESA system allows for area-wide evaluations and for evaluation of changes in factors or weighting in LESA maps.

These brief discussions of GIS applications of LESA are intended as examples and sources for further information for those considering the use of GIS. Following is a partial list of source materials:

DeMers, Michael N. 1988. Policy Implications of LESA Factor and Weight Determination in Douglas County, Kansas. *Land Use Policy* 5(4):408-418.

DeMers, Michael N. 1989. The Importance of Site Assessment in Land Use Planning: A Re-examination of the SCS LESA Model. *Applied Geography* 9:287-303.

DeMers, Michael N. 1989. Knowledge Acquisition for GIS Automation of the SCS LESA Model: An Empirical Study. *Applications in Natural Resource Management* 3(4):12-22.

Ferguson, Carol, Richard L. Bowen, and M. Akram Khan. 1991. A Statewide LESA System for Hawaii. *Journal of Soil and Water Conservation* 46(4):263-267.

Hamilton, Christopher C. 1994. Using GIS in a FLESA Study: Observations from the Woods of Vermont. In: F. Steiner, J. Pease, and R. Coughlin (eds.) *A Decade with LESA: The Evolution of Land Evaluation and Site Assessment*. Soil and Water Conservation Society, Ankeny, Iowa.

Williams, T.H.L. 1985. Implementing LESA on a Geographic Information System—A Case Study. *Photogrammetric Engineering and Remote Sensing* 51(12):1923-1932.

Yagow, Gene, and Vernon Shanholtz. 1994. Extending the Utility of LESA with GIS. In: F. Steiner, J. Pease, and R. Coughlin (eds.). *A Decade with LESA: The Evolution of Land Evaluation and Site Assessment*. Soil and Water Conservation Society, Ankeny, Iowa.

Appendix E
Land Evaluation supplements

This appendix contains an overview of soil classification systems in common use in the United States and of Natural Resources Conservation Service (NRCS) computer programs to help generate comparisons among the classification systems. It also contains a list of soil reference manuals, articles, and handbooks used by NRCS and other soil scientists.

Part 1. Soil classification systems based on soil surveys

Land capability classification

Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops. The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive land-forming that would change slope, depth, or other characteristics of the soils; and it does not apply to rice, cranberries, horticultural crops, or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, or forest land, or for engineering purposes.

In the capability system, all kinds of soils are grouped at the following three levels: capability class, subclass, and unit. The capability classes and subclasses are defined in the following paragraphs. A soil survey area may not have soils of all classes.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

1) Class I soils have few limitations that restrict their use.

2) Class II soils have moderate limitations that reduce the choice of plants or that require special conservation practices, or both.

3) Class III soils have severe limitations that reduce the choice of plants, or that require very careful management, or both.

4) Class IV soils have severe limitations that reduce the choice of plants, or that require very careful management, or both.

5) Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

6) Class VI soils have severe limitations that make them generally unsuitable for cultivation.

7) Class VII soils have very severe limitations that make them unsuitable for cultivation.

8) Class VIII soils have very severe limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class; they are designated by adding a small letter e, w, s, or c to the class numeral, e.g., IIe. The letter "e" means that the main limitation is risk of erosion, unless close-growing plant cover is maintained. The letter "w" means that water in or on the soils interferes with plant growth or cultivation (in some soils, the wetness can be partly corrected by artificial drainage). The letter "s" means that the soil is limited mainly because of inherent soil properties. The letter "c" (used in only some parts of the United States) means that the chief limitation is that the climate is either too cold or too dry. Class I has no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by w, s, or c because the soils in class V are subject to little or no erosion, although they may have other limitations that restrict their use to pasture, rangeland, forest land, wildlife habitat, or recreation.

Soil productivity rating system

Besides their direct use by farmers and others, predicted yields give a measure of soil productivity. The combined effect of all growth factors is reflected in the crop even though the scientist is unable to explain all the interrelationships. Clearly, any precise statement about soil productivity must be in terms of a specific kind of soil, a specific kind of crop or combination of crops, and a specific set of management practices.

Soil productivity is both an economic and a soil science concept. Some soils are more productive than others and more able to respond to management. It is these differences that are important in rating soil productivity.

Soil productivity is the capacity of a soil to produce a specified plant or sequence of plants under a physically defined set of management practices. It is measured in terms of inputs of production factors in relation to outputs or yields. Thus, soil productivity is not entirely an inherent quality of the soil. All the chemical, physical, and biological properties of a soil, together with the associated climate, determine its response to management inputs of labor and materials. Modern soil surveys predict, for locally grown crops, yields that are possible to achieve under specified high-level management. Differences in yields of a specific crop on different soils provide a measure of comparison among the soils.

Soil potential rating system

Soil potential ratings indicate the relative quality of a soil, compared with other soils in the area, for a particular crop. Considered are predicted yields, the relative cost of applying modern technology to minimize the effect of any soil limitation, and the adverse effects of continuing limitations, if any, on social, economic, or environmental values.

The classes developed by NRCS for soil potential ratings are based on a soil potential index developed for each soil. The soil potential index (SPI) is a numerical rating of a soil's relative suitability or quality for a specified crop or use. The SPI can be expressed by the following equation:

$$SPI = P - (CM + CL)$$

where:

P = index of performance or yield as a locally established standard,

CM = index of costs of corrective measures to overcome or minimize the effects of soil limitations, and

CL = index of costs resulting from continuing limitations.

There are differences in methods for developing SPRs. The user is referred to Huddleston et al. (1987) for a method used for several Oregon counties and to the USDA Soil Conservation Service

(1983a) for a somewhat different method used in the town of Vernon, Vermont, and other Vermont towns.

Part 2. Important farmlands[1] classification

The following definitions are contained in Secretary of Agriculture Memorandum No. 9500-2 dated March 10, 1982. This classification has been mapped for may parts of the United States.

Prime farmlands

General criteria. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is also available for these uses (the land could be cropland, pastureland, rangeland, forest land, or other land but not urban built-up land or water). It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding. Examples of soils that qualify as prime farmland are Palouse silt loam, 0-7 percent slopes; Brookstone silty clay loam, drained; and Tama silty clay loam, 0-5 percent slopes.

Specific criteria. Prime farmlands must meet all the following criteria. Terms used in this section are defined in the following USDA publications: *Soil Taxonomy, Agriculture Handbook 436, Soil Survey Manual, Agriculture Handbook 18, Rainfall-Erosion Losses from Cropland, Agriculture Handbook 282, Wind Erosion Forces in the United States and Their Use in Predicting Soil Loss, Agriculture Handbook 346, and Saline* and *Alkali Soils, Agriculture Handbook 60.*

[1][1 7 C.F.R. 657.5]

(a) The soils have:

(1) Aquic, udic, ustic, or xeric moisture regimes and sufficient available water capacity within a depth of 40 inches, or in the root zone (root zone is the part of the soil that is penetrated by plant roots) if the root zone is less than 40 inches deep, to produce the commonly grown cultivated crops (cultivated crops include, but are not limited to grain, forage, fiber, oilseed, sugar beets, sugarcane, vegetables, tobacco, orchard, vineyard, and bush fruit crops) adapted to the region in seven or more years out of 10; or

(2) Xeric or ustic moisture regimes in which the available water capacity is limited, but the area has a developed irrigation water supply that is dependable (a dependable water supply is one in which enough water is available for irrigation in eight out of 10 years for the crops commonly grown) and of adequate quality; or

(3) Acidic or torric moisture regimes, and the area has a developed irrigation water supply that is dependable and of adequate quality; and

(b) The soils have a temperature regime that is frigid, mesic, thermic, or hyperthermic (pergelic and cryic regimes are excluded). These are soils that, at a depth of 20 inches, have a mean annual temperature higher than 32ºF. In addition, the mean summer temperature at this depth in soils with a 0 horizon is higher than 47ºF.

(c) The soils have a pH between 4.5 and 8.4 in all horizons within a depth of 40 inches or in the root zone if the root zone is less than 40 inches deep; and

(d) The soils either have no water table or have a water table that is maintained at a sufficient depth during the cropping season to allow cultivated crops common to the area to be grown; and

(e) The soils can be managed so that in all horizons within a depth of 40 inches or in the root zone if the root zone is less than 40 inches deep, during part of each year the conductivity of the saturation extract is less than 4 mmhoc/cm and the exchangeable sodium percentage is less than 15; and

(f) The soils are not flooded frequently during the growing season (less often than once in two years); and

(g) The product of K (erodibility factor) times the percent slope is less than 2.0, and the product of I (soils erodibility) times C (climatic factor) does not exceed 60; and

(h) The soils have a permeability rate of at least 0.06 inch per hour in the upper 20 inches, and the mean annual soil temperature at a depth of 20 inches is less than 50ºF; the permeability rate is not a limiting factor if the mean annual soil temperature is 59ºF or higher; and

(i) Less than 10 percent of the surface layer (upper six inches) in these soils consists of rock fragments coarser than three inches.

Unique Farmlands

General criteria. Unique farmland is land other than prime farmland that is used for the production of specific high-value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to produce sustained high-quality and/or high yields of a specific crop when treated and managed according to acceptable farming methods. Examples of such crops are citrus, tree nuts, olives, cranberries, fruit, and vegetables.

Specific criteria. Unique farmland is used for a specific high-value food or fiber crop. It has a moisture supply that is adequate for the specific crop; the supply is from stored moisture, precipitation, or a developed irrigation system. It combines favorable factors of soil quality, growing season, temperature, humidity, air drainage, elevation, aspect, or other conditions

Additional farmland of statewide importance. This is land, in addition to prime and unique farmlands, that is of statewide importance for the production of food, feed, fiber, forage, and oilseed crops. Criteria for defining and delineating this land are to be determined by appropriate state agency or agencies. Generally, additional farmlands of statewide importance include those that are nearly prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods. Some may produce as high a yield as prime farmlands if conditions are favorable. In some states, additional farmlands of statewide importance may include tracts of land that have been designated for agriculture by state law.

Additional farmland of local importance. In some local areas, there is concern for certain additional farmlands for the production of food, feed, fiber, forage, and oilseed crops, even though these lands are not identified as having national or statewide importance. Where appropriate, these lands are to be identified by the local agency or agencies concerned.

Prime forest lands[2]

Because of the multiple use of forested lands, several categories of forest land use, i.e., timber, wildlife, and recreation, may be developed. These uses are not considered in the definition of prime forest land. Only that use associated with wood production is evaluated. For purposes of this memorandum only, the following timberland definitions will apply.

Prime timberland. Prime timberland is land that has soil capable of growing wood at the rate of 85 cubic feet or more/acre/year, under proper management (at culmination of mean annual increment), in natural stands and is not in urban or built-up land uses or water. Generally speaking, this is land currently in forest but does not exclude qualifying lands that could realistically be returned to forest. Delineation of these lands will be in accordance with national criteria.

Unique timberland. Unique timberland is land which does not qualify as prime timberland on the basis of producing less than 85 cubic feet/acre/year, but is growing sustained yields of specific high-value species or species capable of producing specialized wood products under a silvicultural system that maintains soil productivity and protects water quality. Delineation of these lands will be in accordance with national criteria.

Timberland of statewide importance. This is land, in addition to prime and unique timberlands, that is of statewide importance for the growing of wood. Criteria for defining and delineating these lands are to be determined by state forestry planning committees or appropriate state organizations.

[2] Prime Forest Land Definition and Criteria, U.S. Forest Service, May 26, 1977

Timberland of local importance. In some local areas, there is concern for additional forest lands for the growing of wood, even though these lands are not identified as having national or statewide importance. Where appropriate, these lands are to be identified by a local agency or agencies concerned.

Part 3. Computer-assisted checks for coordination of important farmland, land capability, and soil productivity ratings

Farmland criteria have been programmed to produce tables that should help states and NRCS national technical centers coordinate soil map units that qualify as prime farmlands, evaluate placement of soil map units into the Land Capability Classification System, and develop soil productivity ratings. Many of the same soil and environmental characteristics that are used as prime farmlands criteria also are used to place soils into the Land Capability Classification system and also influence soil productivity ratings. The prime farmlands criteria are used as the basis for the farmland criteria table.

For coordination purposes, it is useful to look at all the soils within a Major Land Resource Area (MLRA). MLRAs should have generally uniform geomorphology, climate, water resources, natural vegetation, and land uses. Thus, many environmental differences are suppressed and differences among soils become more apparent.

Computer programs maintained by NRCS state offices can produce soil interpretation tables of all the soils within an MLRA. Tables can also be prepared for counties, but a list of series names used in the county must accompany the request. Contact the state NRCS office for more information (see Appendix F).

Part 4. References for soil survey and land-use interpretations

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The list also includes the USDA Natural Resources Conservation Service (NRCS) state office. For help in locating a trained LESA leader, contact the NRCS state office or Frederick R. Steiner (listed under Arizona).

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Glossary

ASCS: U.S. Department of Agriculture-Agricultural Stabilization and Conservation Service [now part of the Farm Service Agency (FSA)].

Comprehensive, Master, or General Plan: These are all terms for a document that contains policies for the general development of a jurisdiction.

Delphi: A technique to obtain group consensus. Details are given in Chapter 7.

Differentiation: The application of the LESA score to rank sites relative to one another. The choice of factors, as well as their weighting, generally has to be adapted to local conditions in order to provide clear distinction among sites.

Factor: The term is used to label a group of attributes, such as soil potential, size, compatibility, or scenic quality.

Factor Rating: The number of points assigned to a factor, before weighting, on a 0-100 point scale.

Factor Scale: The way points are assigned to a factor on 0-100 point scale.

Focus Group: A technique to enable group discussion and resolution of a given problem. Details are given in Chapter 7.

Important Farmland Class: A classification system developed by the USDA NRCS. A description is given in Appendix E, Part 2.

Land Capability Classification: Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops. The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. See Appendix E, Part 1.

Land Resource Unit: An area of several thousand acres characterized by particular patterns of soil, climate, vegetation, water resources, land use, and type of farming. Land Resource Units are the basic map units on state land resource maps, which are usually mapped at a scale of 1:1,000,000. The USDA compiles data on land resource units for the publication Land Resource Regions and Major Land Resource Areas of the United States.

LE: Land Evaluation. For LESA applications, soil quality factors are grouped in a category called Land Evaluation.

LESA: Land Evaluation and Site Assessment. LESA is a weighting system for combining soil quality factors with other factors that affect the importance of the site for continued resource use.

MLRA: Major Land Resource Area. A major land resource area is a group of geographically associated land resource units. This description is used by NRCS for creating general maps and text as part of the publication Land Resource Regions and Major Land Resource Areas of the United States.

NRCS: U.S. Department of Agriculture-Natural Resources Conservation Service (formerly the Soil Conservation Service).

NRI: National Resource Inventory. A report developed by NRCS of the nation's resources. The report includes data on surface area of land and water, land cover and use, prime farmland, erosion statistics, conservation treatment needs, potential cropland, and pasture and rangeland conditions.

NTC: National Technical Center. There used to be four centers to service NRCS technical needs. The centers have since been replaced by the regional offices listed in Appendix F.

Parcel: In this *Guidebook*, parcel designates a unit of ownership. A parcel may consist of contiguous or non-contiguous tax lots or fields.

PDR: Purchase of Development Rights. This is similar to a conservation easement, where certain uses of land are restricted by purchase of those rights by public or private agencies or organizations.

Ranking: This term refers to the relative importance of a site compared to other sites.

Riparian Area: Area relating to or located on the bank of a natural water course, or lake, or tidewater.

SA: Site Assessment. For LESA applications, non-soil factors are grouped into a category called Site Assessment. In this *Guidebook*, SA factors are of three types: SA-1, non-soil factors related to agricultural productivity or farming practices; SA-2, factors measuring development pressure; and SA-3, factors measuring other public values, such as historic or scenic values.

Scaling: See factor scale.

Score: This term is used for the total of all factor ratings, i.e., a LESA score.

SCS: U.S. Department of Agriculture-Soil Conservation Service (now the Natural Resources Conservation Service).

Site: In this *Guidebook*, site designates a unit of observation for rating. The site may be a field, an ownership parcel, or a set of fields or parcels.

Soil Productivity Rating: Soil productivity is the capacity of a soil to produce a specified plant or sequence of plants under a physically defined set of management practices, measured in terms of inputs of production factors in relation to outputs or yields (See Appendix E, Part 1).

SPR: Soil Potential Rating. Soil potential ratings indicate the relative quality of a soil, compared with other soils in the area, for a particular crop and considering predicted yields, the relative cost of applying modern technology to minimize the effect of any soil limitation, and the costs of continuing limitations.

Suitability Analysis: An examination of physical, economic, and social characteristics of a site to determine limitations or desirable features for a particular use.

System: This term refers to all the factors, weights, and scales used in the evaluation of soils and other site conditions.

TDR: Transfer of Development Rights. This term refers to a program where a land-owner is permitted under local or state regulations to transfer development rights from one site to another.

USDA: United States Department of Agriculture.

Weighting: This term refers to assigning a weight (for example, 0-1.0) to each factor in order to recognize the relative importance of each factor in the LESA system.

Weighted Factor Rating: This term is used to denote the factor rating after weighting.

Zoning Ordinance: Specific regulations for the development of a jurisdiction.

Zoning Permit: A land-use permit obtained through a regulatory process at the local or state level.

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