Access LCTA

A Microsoft Access Land Condition Trend Analysis User Interface

Users Guide

By William Sprouse

Version 1.0.4
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1 Acknowledgements

Writing a program and a technical manual is a large job which is greatly simplified by the help of others. I would like to acknowledge those that assisted in the writing of the Access LCTA program and this manual.

Alan Anderson for providing source code for the LCTA Program Manager program, which Access LCTA was adapted from. Also for his assistance with the power Analysis module in the program and providing documentation for the power analysis section in this manual. David Jones for his contribution on diversity indexes and ideas for the program. Mark Easter for writing the handheld data loading module. Kathryn Northcut for editing this manual.

This project was funded by the U.S. Army Environmental Center (AEC) and the National guard Bureau.
2 Introduction

Land Condition Trend Analysis (LCTA) is an inventory, monitoring, and evaluation of natural resources on Army lands. Using LCTA, land managers collect, store, retrieve, and analyze data related to topographic features, soil characteristics, climatic variables, vegetation, and wildlife.

In December 1991, several installations collecting LCTA data received a Beta Version of the LCTA Program Manager. The Beta release prototype was a DOS character-based program having all of the statistical capabilities of the current release, Version 1.1. This Beta release provided the developers of LCTA Version 1.1 with vital user responses and requirements. The responses acquired from the Beta version helped to establish software design specifications for Version 1.1.

By using a graphical user interface (GUI), the infrequent user can utilize the system to the fullest because of its ease of use and reduced training requirements. Providing standardized analysis ensures proper error checking. In addition, a report of errors found in the data during processing provides increased data integrity. By minimizing complex operations of data management and analysis, the land manager has more time to interpret the results.

Since the development of the LCTA Program Manager, many new database tools have become available. Some of these new tools are packaged with complete office software solutions and are now very popular. Microsoft Access, for example, has risen to the forefront of popularity in the database arena. Many installations have expressed interest in a Microsoft Access LCTA database and user interface because of its ease of use and availability.

To respond to this desire, the Center for Ecological Management of Military Lands (CEMML) has developed an LCTA database and user interface in Microsoft Access. The decision to develop such a program was entirely fueled by installation requests and not because of any shortcoming in the original version of the LCTA Program Manager. Much of the development of this database was facilitated by the groundwork done by Alan Anderson and others at The U.S. Army Construction Engineering Research Laboratories (CERL) in Champaign, IL.

2.1 Program Requirements

The following are required to successfully run the Access LCTA application:

- Microsoft Windows 95 or NT
- Access 8.0 (Access 97)

2.2 Before You Begin

This manual assumes the reader is familiar with the Microsoft Windows environment and the methods and requirements of LCTA data collection. Refer to Microsoft Windows documentation and tutorials for further information. More information on the methods and requirements of the LCTA data collection are found in USACERL Technical Report N-92/03, *U.S. Army Land Condition-Trend Analysis (LCTA) Plot Inventory Field Methods*. 
2.3 Installation

Access LCTA comes with an installation program and is available on the CEMML web site at http://www.cemml.colostate.edu/accesslcta/accesslcta.htm. Installation instructions are also available on the web site. This installation program will only install the Access LCTA application and required components. Microsoft Access must be installed on the computer before proceeding further.

2.4 Document Conventions

This manual uses the following syntax conventions to describe user interaction with the program.

*Italic text* written between angle brackets `< >` is text that is entered at the computer.

Normal text written between brackets `< >` indicates menu options.

*Bold italic text* indicates command buttons and form elements.
3 General Description

3.1 Starting the Program
Start Access LCTA from the icon created by the installation program. This icon will launch Microsoft Access, specifying the correct workgroup file, and load the application database. The workgroup files contain rights and permissions for the application and related databases.

The shortcut for the icon will look similar to the one listed below:

"C:\Program Files\Microsoft Office\Office\MSACCESS.EXE" /wrkgrp
C:\itam\lctasys.mdw c:\itam\lcta.mdb

When starting the application for the first time, no data tables are attached to the application database and the following message is displayed:

"You are missing some key LCTA data tables - you must attach all LCTA data tables to this application. Would you like to open the connection manager?"

Select “yes” to open the attachment manager. Select the path and database to attach to the application database and select the Attach Table(s) button. Refer to section 6.5 (Attachment Manager) for further information.

3.2 Navigating the Program
When open, the Access LCTA application will display the introduction screen. Single click on the arrow icon on the right of the dialog box and the main navigation form will appear. From this form, all major components of the application can be reached by selecting the appropriate button.

3.3 Options, Buttons, and Other Controls
Throughout the application, form controls are used as interaction tools. Form controls consist of buttons, option boxes, list boxes, and text fields. Buttons are used to begin execution of particular elements of the application or to open and close forms. Most buttons have text denoting the function of that button while others display icons. The icons are standard throughout the application and are listed below.

- **Exit the application and Microsoft Access.**
- **Close the current form.**
- **Send a report to the printer.**
- **Open the data filter form (refer to section 4.1.5).**
Open the graph manager (refer to section 4.1.5).

Option boxes are used to toggle options on or off. For example, the control below indicates that all years will be analyzed. Single clicking the box to the left of the option will toggle the option on (checked) or off (unchecked).

Analyse all years

List boxes are of two types: drop-down and simple. To view all the available items in a drop-down list box, single click the down arrow to the right of the field.

If more items exist for a simple list box than can be displayed, scroll down the list using the vertical scroll bar. When an item has been selected in a list box, it will appear highlighted.

A text field control accepts characters entered from the keyboard. Place the mouse cursor over the field, single click, and type.

### 3.4 Tables, Queries, Reports, and Forms

All tables found in the LCTA database can be opened from the Data Management Form (see Data Management, section 5). Alternatively, the Access database window provides access to tables as well as queries, reports, and forms. If the database window is not visible, press the F11 function key. To open a table select the Tables tab, select a table from the list, and select Open. Queries are opened in the same way after selecting the Queries tab. Refer to Microsoft Access documentation for further information on creating/opening tables and queries. Access rights and privileges may restrict the user from changing the design of any base query, form, report, macro, or module.

Most of the analyses use queries to summarize the data. The queries are available from the database window. They can be beneficial in investigating the LCTA data. Information on tables and queries is found in the data dictionary and query dictionary applets. Refer to the respective sections for information on using these applets (sections 6.3 and 6.4).
4 Program Components

The Access LCTA application has four main components that are available from the Main Navigation Form (Figure 1): analyses, data management, utilities, and program registry. All data analyses are contained within the analysis component. Built-in database management, including error checking and correction, is located in the data management component. Utilities allow the user to set the working environment by changing the menus and toolbars shown during program use. The program registry component provides information such as version number and technical support contact information. All of these components will be discussed in detail in the following sections. In addition to the four main components available on the Main Navigation Form using the Open Data Database button will open the LCTA data database. This allows the user to work in the LCTA data database outside of the Access LCTA program. After selecting this button the Access LCTA application database is closed and the LCTA data database (i.e. LCTAJUS.MDB) is opened. This is beneficial when the user wishes to create new tables and queries that are to be saved in the data database and not the Access LCTA application database. This will prevent the loss of such tables and queries in the event the Access LCTA application database is updated. Please note, an LCTA data database must be attached to the Access LCTA application before this option will work. Refer to section 6.5 (Attachment Manager) for information on attaching a database.

To close the Main Navigation Form, click the close button in the lower right portion of the form. The form will be closed, the menu and toolbar reset to the default Access menu and toolbar, and the database window will open. The database window is used to open, edit, and create tables, queries, forms, macros, reports, and modules. Also, a large button will appear in the upper left portion of the Access Window. This button is used to start Access LCTA again. To remove the button from the screen click Remove This Button.

Figure 1: Main Navigation Form.

4.1 Data Analyses

Available data analyses include the following, described below:
• land use summaries
• ground disturbance summaries
• ground cover summaries
• aerial cover summaries
• woody vegetation summaries
• Universal Soil Loss Equation (USLE) calculations
• diversity indexes
• power analysis
• plot summaries

4.1.1 Analysis Options

All of the summaries listed above are available from the Analyses Form (Figure 2). To reach the Analyses window, select Analyses from the Main Navigation Form (Figure 1). After selecting an analysis, the form for the particular analysis will appear. This form is used to set analysis options, execute the analysis, view the results, and navigate to data management options. The option settings are similar in all analysis forms except power analysis and plot summary. Figure 3 shows the options portion of an analysis form. Not all analyses will have the same options. Options are described below.

Figure 2: Analyses Form.
Figure 3: Analyses Options.

**Analyze all years**  
When checked, all years found in the database tables will be used. To select a specific year, select this option to remove the check mark and then select a year from the year list box.

The analyses that contain this option are land use, ground disturbance, ground cover, aerial cover, woody vegetation, USLE, and diversity indexes.

**By plot**  
When checked, results are presented by plot; when unchecked, results are presented by year.

The analyses that contain this option are land use, ground disturbance, ground cover, aerial cover, and woody vegetation.

**Core pots only**  
When checked, only core plots are included (those plots marked as C or Core in PlotSurv). All plots are included when unchecked.

The analyses that contain this option are land use, ground disturbance, ground cover, aerial cover, woody vegetation, USLE, and diversity indexes.

**Analyze by groups**  
To present results by a user-defined grouping element, this box should be checked. Select the grouping element from the Group By list box. To edit groups, select the Edit Groups button on the Analysis Form. Groups are stored in the PlotMast table as new columns with the name grp_???, where ??? is the user-defined name.

The analyses that contain this option are land use, ground disturbance, ground cover, aerial cover, woody vegetation, USLE, and diversity indexes.

**Convert to short-term**  
When checked, the results are presented in categories common between initial inventory, long-term inventory and short-term monitoring. For example, short-term monitoring aerial data does not contain vegetation codes but only the life of the plants above a point (Annual, Perennial, or AP combined). If this option is selected, the data from the initial inventory and long-term inventory are reduced to A, P, or AP above a point rather than the vegetation code recorded above a point.

The analyses that contain this option are ground cover, aerial cover, and woody vegetation.

**Recalculate**
When checked, all working tables are recreated. By default this option is true when the application is first opened and false after the tables have been built. This option should be checked any time that data in the LCTA database tables have been changed.

The analyses that contain this option are land use, ground disturbance, ground cover, aerial cover, woody vegetation, USLE, and diversity indexes.

4.1.2 Errors

All errors encountered during an analysis are written to the error box on the Land Use Analysis Form (Figure 4) and can be printed by selecting the printer icon in the lower right corner of the form. In addition, all errors are written to a text file in the /files directory below the directory containing the Access LCTA application database. The naming conventions for these files are as follows:

<table>
<thead>
<tr>
<th>Summary/Analysis</th>
<th>All Years Analyzed</th>
<th>Single Year Analyzed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Use</td>
<td>LUALL.ERR</td>
<td>LUYYYY.ERR</td>
</tr>
<tr>
<td>Ground Disturbance</td>
<td>DISTALL.ERR</td>
<td>DISTYYYY.ERR</td>
</tr>
<tr>
<td>Ground Cover</td>
<td>GNDALL.ERR</td>
<td>GNDYYYY.ERR</td>
</tr>
<tr>
<td>Aerial Cover</td>
<td>AERALL.ERR</td>
<td>AERYYYY.ERR</td>
</tr>
<tr>
<td>Woody Vegetation</td>
<td>BELTALL.ERR</td>
<td>BELTYYYY.ERR</td>
</tr>
<tr>
<td>USLE</td>
<td>USLEALL.ERR</td>
<td>USLEYYYY.ERR</td>
</tr>
<tr>
<td>Diversity Indexes</td>
<td>DIVALL.ERR</td>
<td>DIVYYYY.ERR</td>
</tr>
</tbody>
</table>

where YYYY equals the selected year.

Note that each time an analysis is run, these files are rewritten. All options selected are also written to the file.

4.1.3 Type of Analysis

Some analyses contain a number of types of analysis. For example, land use summaries consist of land use, maintenance activities, and observed wind/water erosion. Select the desired type from the drop-down list box at the top of the form.

4.1.4 Buttons

Buttons for execution of the analysis and navigation to data management tools are on the right side of the form. The Exit button is located in the lower right corner. In some analyses the Analyze button is disabled (gray) until the required options are selected. The View Data button will become enabled after the analysis calculations are complete.

4.1.5 Operation Notes

In most cases, three main steps occur during the execution of an analysis. These include:

1. build working tables if the Recalculate option is selected,
2. check for errors, and
3. build queries based on options selected.
After these steps are performed, the View Data button is enabled which links to a form containing the results of the query in step 3. The results are not stored in a table; only the preliminary data used in the queries are. This helps to reduce the amount of disk space occupied by the database and provides access to this data for further investigation.

Once the View Data Form is open, there are several options for handling the data. Select the Pivot Data button to present the data in a pivot table. This table will show variables along the side and years across the top. Select the Export button to export the results to another file format. The file name is assigned automatically as well as the output path. Selecting the Select New Path button changes the path. Select the graph icon to open the graph manager for creating horizontal charts. Because most data sets contain too much data to display in a normal graph, this program produces horizontal charts created as forms. Select the printer icon to send the results to the printer. To filter the result sets, select the filter icon. The filter manager will aid in reducing the data in the data view to only information of interest. Tips for the use of the filter manager are displayed on the Filter Manager Form.

For each following analysis section the input tables, working tables, working queries, assumptions, and result queries are listed in section 8, Appendix: Analyses Reference.

4.2 Land Use Analysis

The land use analyses summarize military and non-military land uses, maintenance activities, and observed water/wind erosion recorded on LCTA plots. Unlike the original LCTA Program Manager, this program will summarize all values found in the database. No error checking is done on these values. This will allow installations to expand the items recorded from the original LCTA data collection methods.

To begin summarizing the data, select Land Use from the Analyses Form (Figure 2). The Land Use Analysis Form will appear (Figure 4).
4.3 Ground Disturbance Analysis

The ground disturbance analysis summarizes military disturbance recorded at each point along the LCTA plot transect. Unlike the original LCTA Program Manager, this program will summarize all values found in the database. No error checking is done on values. This will allow installations to expand the items recorded from the original LCTA data collection methods.

To begin summarizing the data, select *Ground Disturbance* from the Analyses Form (Figure 2). The Ground Disturbance Analysis Form will appear (Figure 5).
4.4 Ground Cover Analysis

The ground cover analysis summarizes basal cover recorded at each point along the LCTA plot transects. Two analyses are available: ground cover and percent cover. The ground cover analysis summarizes basal vegetation by vegetation code. Percent cover summarizes only percent of cover. Select the desired analysis from the Type of Analysis list box. In addition, data can be reduced to short-term monitoring categories by selecting the Convert to Short-Term option.

During initial inventory and long-term monitoring, data collection basal vegetation is recorded as the vegetation code and litter and duff cover is recorded as the type of litter or duff (i.e. shrub, tree, grass or forb). Short-term monitoring data only includes the code of P for vegetation cover and L for litter cover. By converting to short-term monitoring, results are presented using similar codes for basal cover.

Unlike the original LCTA Program Manager, this program will summarize all values found in the database. No error checking is done on the values. This will allow installations to expand the items recorded from the original LCTA data collection methods.

To begin summarizing the data select Ground Cover from the Analyses Form (Figure 2). The Ground Cover Analysis Form will appear (Figure 6).
4.5 Aerial Cover Analysis

The aerial cover analysis summarizes aerial cover intercepts recorded at each point along the LCTA plot transect. Two analyses are available: aerial cover and percent cover. The aerial cover analysis summarizes aerial vegetation by vegetation code. Percent cover summarizes only percent of cover. If the aerial cover analysis is selected the results will contain both total hits and presence/absence (PA) summaries. Select the desired analysis from the *Type of Analysis* list box. In addition, data can be reduced to short-term monitoring categories by selecting the *Convert to Short-Term* option. During initial inventory and long-term monitoring data collection aerial vegetation intercepts are recorded as the vegetation code at each height. Short-term monitoring data only include the code for the life of the vegetation above a point (i.e. A=annual, P=perennial, AP=annual and perennial), one code for each point along the transect. By converting to short-term monitoring, categories results are presented using similar codes for aerial cover. Correct data must exist in the PlntList table before converting to short-term nomenclature.

To begin summarizing the data, select *Aerial Cover* from the Analyses Form (Figure 2). The Aerial Cover Analysis Form will appear (Figure 7).
4.6 Woody Vegetation Analysis

The woody vegetation analysis summarizes woody vegetation from the LCTA belt transect. Two analyses are available: all belt data or defined height categories. Selecting the All Belt Data option will summarize the data by five predefined height categories (Min-1m, 1m-2m, 2m-3m, 3m-4m, and greater than 4m). These height categories correspond to those used in short-term monitoring. Analyzing by defined height categories summarizes by user-defined height categories. Select the desired analysis from the Type of Analysis list box.

During short-term monitoring, data are recorded as tallies within the predefined height categories above. In contrast, the data from initial inventories and long-term monitoring records individual plant heights. Short-term monitoring data are not conducive to height category definitions and thus are excluded from the defined height category analysis.

Selecting the Defined Height Categories analysis will open the User Defined Height Categories Form (Figure 9). Use this form to set the ranges of the height categories. To return to this form, select the Height Cats button on the Woody Vegetation Analysis Form (Figure 8). Height categories defined during the current session will appear in the User Defined Height Categories Form when it is opened. All defined categories are stored in the table tmp_Belt_HtCats. Use the navigation buttons on the form to see other categories. Select the Create Cats button on the form.
to update the working table with the new height categories. When the *All Belt Data* analysis is selected, all height categories are reset to the predefined height categories.

All results are expanded to 600 square meters. If the belt width for a species was reduced to three meters, following data collection guidelines, the numbers presented in the results reflect the original total multiplied by two. The original plot size is 6 x 100 meters or 600 square meters.

To begin summarizing the data select *Woody Vegetation* from the Analyses Form (Figure 2). The Woody Vegetation Analysis Form will appear (Figure 8).

![Figure 8: Woody Vegetation Analysis Form.](image-url)
4.7 Universal Soil Loss Equation (USLE) calculations

The Universal Soil Loss Equation (USLE) analysis estimates soil loss in tons/acre/year due to sheet and rill erosion. Two analyses are available: erosion estimates and erosion estimates (K calc). Selecting the erosion estimates option will produces estimates of erosion using the published K value (see explanation below for USLE factors). Erosion estimates (K calc) use the K value calculated from plot soil samples, found in the SoilSmpl table. Select the desired analysis from the Type of Analysis list box.

Erosion is estimated using the Universal Soil Loss Equation (USLE) adapted from Wischmeier and Smith (1978):

\[ A = R \times K \times LS \times C \times P \]

Where
- \( A \) = estimated annual soil loss (Tons/Acre/Year)
- \( R \) = rainfall erosivity
- \( K \) = inherent soil erodibility
- \( LS \) = topographic factor
- \( C \) = cover factor
- \( P \) = conservation factor

Factors \( R \) and \( K \) are derived from published data and factors \( LS \) and \( C \) are calculated from data collected on LCTA transects. Increases in the actual values for any factor result in increased soil
loss estimates. Estimates of annual soil loss are calculated for each LCTA transect using the data collected at that transect.

The rainfall and runoff factor (R) reflects precipitation patterns of an area. This includes total precipitation and precipitation characteristics. High intensity rainfall has more erosive force than lower intensity. R values can be found in USDA soil surveys.

The natural erodibility of a soil (K) is largely determined by its texture. Soils with high silt content are the most erodible. Generally the published K value should be used when available. However, some installations do not have access to published K values. If soil sample data are available in the SoilSmpl table, the program will calculate a K value when the erosion estimates (K calc) analysis option is selected.

Required elements for calculating a K value include percent sand, percent silt, percent clay, percent organic matter, and percent very fine sand. Two additional elements are used if present in the SoilSmpl table: permeability class and structure code. Usually permeability class and structure code are unknown and assigned default values of 3 and 2 respectively. An average K value for a soil series is stored in the SoilMast table of the database. A K value for each soil sample is stored in the SoilSmpl table of the database.

The LS factor is calculated from measured slope and slope lengths. Increasing slope and slope length result in greater soil loss from increased overland flow of water. The LS factor is a ratio of soil loss per unit area for a field measured slope to that of a standard 72.5 ft of uniform 9% slope under otherwise identical conditions. Slopes and slope lengths are measured on each LCTA transect.

The cover factor (C) describes the density and structure of the plant canopy cover and soil cover. The cover factor is calculated from two subfactors: ground cover (C1) and canopy cover (C2). Values for the two subfactors are derived from LCTA line transect data and a C value is assigned to the transect. The calculation of a C factor also involves the calculation of a minimum drip height. An increase in the cover factor actually represents a decrease in ground and/or canopy cover.

Conservation practices (P) usually applied with the USLE include conservation tillage, contour tilling, and other practices associated with cropping systems. For LCTA USLE calculations, P is assumed to be 1.

During inventory or long-term monitoring designated years, all data to calculate erosion loss are obtained from the current year. During short-term monitoring years not all the required data are available. For short-term monitoring years, the required missing information is obtained from the most recent year that the information was collected.

To help interpret soil loss estimates soil loss tolerance (T) for a soil type is provided. T denotes the maximum level of soil erosion that will permit a high level of soil productivity to be sustained economically and indefinitely. T values range from 1 to 5 tons/acre/year. T values are based on soil depth, rooting depth, seeding losses, soil organic matter reduction, and plant nutrient losses. These values are available from USDA soil surveys.

Erosion status (ES) is an easy way to assess plot erosion status. Erosion status expresses estimated soil loss as a percentage of tolerance (T). Values less than a 100% are good, while values greater than 100% are cause for concern.

Erosion index (EI) describes the erodibility of a soil. Erosion status is useful for making land management decisions. Erosion status uses a subset of the USLE factors. Values between 1 and 8
represent stable soils. Values between 8 and 16 represent moderately erodible soils. Values greater than 16 represent highly erodible soils.

$$EI = \frac{R*K*LS}{T}$$

Before running any USLE calculations, data must exist in the SoilMast table. This table contains soil series, soil name, K value (soil erodibility index), and T value (tolerance level). In addition, each plot must be assigned a soil series name in the PlotMast table. R values (climate factor) also must be added to the PlotMast table. This information is not recorded in the field and usually can be obtained from the USDA soil survey manuals.

To begin summarizing the data, select USLE from the Analyses Form (Figure 2). The USLE Analysis Form will appear (Figure 10).
4.8 Diversity Indexes

The information presented in this section was researched and compiled by David Jones (CEMML).

The diversity indexes analysis summarizes presence/absence aerial vegetation data from the LCTA line transect. Five diversity metrics are calculated: Margalef's index, Berger-Parker index, Simpson's index, Shannon index, and Shannon evenness.

4.8.1 The Importance of Diversity in Management

Biological diversity -- biodiversity -- can be defined as the diversity of genes, species, and ecosystems. Traditionally, compositional diversity is examined most often. Biodiversity is a simple general concept that rapidly becomes complex with attempts at measurement and comparison. Each level of biodiversity has three components: compositional diversity, structural diversity, and functional diversity.

Considerable evidence suggests that biodiversity is being lost at a rapid rate. Most management approaches to minimize loss focus on species, often when an organism is nearing extinction. This species approach, however, can be inefficient and expensive, often focusing on symptoms rather than the underlying causes. Habitat management and protection is essential to species population stability and survival. Therefore, a successful management program should attempt to maintain an array of representative ecosystems. Also, both species- and ecosystem-level approaches are necessary because ecosystem classification systems are often not comprehensive enough to encompass every species.

By examining the spatial and temporal distribution of different ecological communities, managers can evaluate the influence of management activities on community processes, species dispersal and migration (e.g., habitat linkages and migration corridors), or loss of habitat and artificial habitat fragmentation. For example, trends in herbaceous plant diversity can be examined following the introduction, cessation, or change in grazing regimes or burning prescriptions. Impacts to woody vegetation can be similarly examined following forest management activities. Additional examples of how diversity analyses can be applied and integrated with resource management include how neotropical migrant birds are affected by management activities over time and how land use activities adversely impact endangered species habitat. Factors influencing populations outside installation boundaries cannot be accounted for or controlled, thus creating additional challenges for military land managers. Moreover, caution must be exercised when inferring cause and effect from only several years of data. Long-term data may be required to reveal trends, especially in arid environments where year to year variability can be high.

Monitoring is a necessary link in the “adaptive management” cycle that continuously refines management practices on the basis of cause and effect data. Monitoring is generally most useful and cost effective when it addresses specific questions that are guided by overall management goals and objectives. Is the ratio of native to exotic grasses increasing or decreasing? Are populations of Neotropical migrant birds stable? Are endangered species populations recovering? Posing these types of questions leads to the need for policy-makers and managers to specify quantitative thresholds at which changes in management practices or regulations will be implemented.
4.8.2 How can LCTA data be used to measure the ‘diversity’ of a plot or habitat type? and what method should I use?

These questions are often asked but difficult to answer partly because the measures of species richness, evenness, and diversity are themselves diverse and cannot be applied universally. Different installations may prefer different measures because of the distribution of habitats or relative abundance of species. The choice of statistic may also be influenced by the methods chosen by other land management agencies in the region to facilitate comparison of results.

Species diversity measures can be divided into three main categories. Species richness indices are a measure of the number of species in a defined sampling unit. Secondly, species abundance models describe the distribution of species abundance. The third group of indices (e.g. Shannon, Simpson) is based on the proportional abundance of species and integrates richness and evenness into a single number.

The following table summarizes the performance and characteristics of a range of diversity statistics showing relative merits and shortcomings. The column headed “Discriminant ability” refers to the ability to detect subtle differences between sites or samples. The column headed “Richness or evenness dominance” shows whether an index is biased towards species richness, evenness, or dominance (weighted toward abundance of commonest species). Those marked in bold are included in the Access LCTA program. Reprinted from Ecological Diversity and Its Measurement by Anne E. Magurran, Princeton University Press, 1988.

<table>
<thead>
<tr>
<th>Diversity Statistic</th>
<th>Discriminant ability</th>
<th>Sensitivity to sample size</th>
<th>Richness or evenness dominance</th>
<th>Calculation</th>
<th>Widely used?</th>
</tr>
</thead>
<tbody>
<tr>
<td>α (log series)</td>
<td>Good</td>
<td>Low</td>
<td>Richness</td>
<td>Simple</td>
<td>Yes</td>
</tr>
<tr>
<td>λ (log normal)</td>
<td>Good</td>
<td>Moderate</td>
<td>Richness</td>
<td>Complex</td>
<td>No</td>
</tr>
<tr>
<td>Q statistic</td>
<td>Good</td>
<td>Low</td>
<td>Richness</td>
<td>Complex</td>
<td>No</td>
</tr>
<tr>
<td>S (species richness)</td>
<td>Good</td>
<td>High</td>
<td>Richness</td>
<td>Simple</td>
<td>Yes</td>
</tr>
<tr>
<td>Margalef index</td>
<td>Good</td>
<td>High</td>
<td>Richness</td>
<td>Simple</td>
<td>No</td>
</tr>
<tr>
<td>Shannon index (H')</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Richness</td>
<td>Intermediate</td>
<td>Yes</td>
</tr>
<tr>
<td>Brillouin index</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Richness</td>
<td>Complex</td>
<td>No</td>
</tr>
<tr>
<td>McIntosh U index</td>
<td>Good</td>
<td>Moderate</td>
<td>Richness</td>
<td>Intermediate</td>
<td>No</td>
</tr>
<tr>
<td>Simpson index</td>
<td>Moderate</td>
<td>Low</td>
<td>Dominance</td>
<td>Intermediate</td>
<td>Yes</td>
</tr>
<tr>
<td>Berger-Parker index</td>
<td>Poor</td>
<td>Low</td>
<td>Dominance</td>
<td>Simple</td>
<td>No</td>
</tr>
<tr>
<td>Shannon evenness</td>
<td>Poor</td>
<td>Moderate</td>
<td>Evenness</td>
<td>Simple</td>
<td>No</td>
</tr>
<tr>
<td>Brillouin evenness</td>
<td>Poor</td>
<td>Moderate</td>
<td>Evenness</td>
<td>Complex</td>
<td>No</td>
</tr>
<tr>
<td>McIntosh D index</td>
<td>Poor</td>
<td>Moderate</td>
<td>Dominance</td>
<td>Simple</td>
<td>No</td>
</tr>
</tbody>
</table>

To calculate diversity statistics from LCTA plot data, plots should first be grouped by desired criteria. The chosen diversity statistic is then calculated for each plot, and then averaged by group. To best interpret patterns of diversity, plant life forms such as woody and herbaceous, trees and shrubs, should be considered separately in diversity studies (Huston 1994). While some actual or theoretical situations may cause commonly used diversity statistics to give contradictory
results, for most sample data from natural communities the values for all diversity statistics are highly correlated (Huston 1994).

The Access LCTA program calculates an average diversity index grouped by a user-defined grouping element. For each group the diversity index values are given for 15 guilds, listed below. Aerial vegetation presence/absence data are used for these calculations.

Table 2: Diversity Index Guilds.

<table>
<thead>
<tr>
<th>Guild ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GI</td>
<td>grass introduced</td>
</tr>
<tr>
<td>GN</td>
<td>grass native</td>
</tr>
<tr>
<td>FI</td>
<td>forb introduced</td>
</tr>
<tr>
<td>FN</td>
<td>forb native</td>
</tr>
<tr>
<td>TI</td>
<td>tree introduced</td>
</tr>
<tr>
<td>TN</td>
<td>tree native</td>
</tr>
<tr>
<td>SI</td>
<td>shrub introduced</td>
</tr>
<tr>
<td>SN</td>
<td>shrub native</td>
</tr>
<tr>
<td>ALLG</td>
<td>all grasses</td>
</tr>
<tr>
<td>ALLF</td>
<td>all forbs</td>
</tr>
<tr>
<td>ALLT</td>
<td>all trees</td>
</tr>
<tr>
<td>ALLS</td>
<td>all shrubs</td>
</tr>
<tr>
<td>ALLI</td>
<td>all introduced</td>
</tr>
<tr>
<td>ALLN</td>
<td>all native</td>
</tr>
<tr>
<td>ALL</td>
<td>all combined</td>
</tr>
</tbody>
</table>

4.8.3 Equations

Following are the equations utilized by the Access LCTA program.

S = number of species recorded
N = the total number of individuals summed over all S species

Margalef's diversity index

\[ D_{Mg} = (S - 1) / \ln N \]

Berger-Parker diversity index

\[ d = N_{max} / N \]

where:

\[ N_{max} = \text{number of individuals in the most abundant species} \]

To ensure the index increases with increasing diversity the reciprocal form of the measure is usually adopted (1/d).

Simpson's index

\[ D = \sum \frac{n_i (n_i - 1)}{N (N - 1)} \]
where:
\( n_i \) = number of individuals in the \( i \)th species

To ensure the index increases with increasing diversity the reciprocal form of the measure is usually adopted (1/D).

**Shannon diversity index**

\[
H' = - \sum p_i \ln p_i
\]

where:
\( p_i \) = proportional abundance of the \( i \)th species \((n_i / N)\)

**Shannon Evenness**

\[
E = \frac{H'}{\ln S}
\]

where:
\( H' \) = Shannon diversity index

### 4.8.4 Some general guidelines for the analysis of diversity data

The following guidelines are taken from Magurran (1988) and Southwood (1978):

1. Ensure where possible that sample sizes are equal and large enough to be representative.

2. Calculate the Margalef and Berger-Parker indices. These straightforward measures give a quick measure of the species abundance and dominance components of diversity. Their ease of calculation and interpretation is an important advantage.

3. If one study is to be directly compared with another, the same diversity index must be used.

To begin summarizing the data, select **Diversity Analysis** from the Analyses Form (Figure 2). The Diversity Analysis Form will appear (Figure 11). For this analysis, the selection of a grouping element is required.
4.9 Power Analysis

To begin, select Power Analysis from the Analyses Form (Figure 2). The Power Analysis Form will appear (Figure 12). For this analysis, the selection of a first year, second year and variable to test are required. You also have a choice of using a one-tailed or two-tailed test for the alpha level. Use the drop-down list boxes to change the values for alpha and beta.

To perform power analysis on a set of data not listed in the Variables to Test list select Own Data from this list. To view and enter data select the Enter Your Own Data button. After the table is opened enter the variable identification, first year mean, and second year mean. The difference of the means (MeanDelta) is calculated by the program. After closing the table select Reopen Power Analysis Form on the dialog box that appears.
The procedures used for power analysis in this application and the documentation below are from Anderson et al. 1996. The information given below is excerpted from the publication listed above and was included with the authors’ consent. Refer to that publication for more detailed information.

4.9.1 Background

Power analysis is a statistical technique useful in quantifying the ability of a monitoring program to detect change in the monitored resource. A preponderance of literature recommends an increased use of power analysis techniques in the design and analysis stages of controlled studies and monitoring programs (e.g. Toft and Shea 1983; Rotenberry and Wiens 1985; Hayes 1987; Peterman 1990a; Peterman 1990b). Power analysis techniques have not been used with existing installation LCTA vegetation and disturbance data. However, investigators have successfully applied these techniques to LCTA wildlife protocols (Rice et al. 1995; Rice and Demarais 1995; Hayden and Tazik 1993), LCTA line transect methodology (Mitchell et al. 1994; Brady et al. 1995), and other military installation monitoring efforts, including Golden-cheeked Warbler studies at Fort Hood, Texas (D.K. Niven, 1994, unpublished report). The use of power analysis techniques in these studies has proven useful in evaluating current data collection methods and providing insight into the effects of modifications to those methodologies.

Power analysis techniques are not commonly used with LCTA data, in part because installation personnel may not be aware of the consequences of Type-II errors, of procedures to conduct power analysis, or that the results of power analysis can strengthen statistical inferences from the data. However, power analysis techniques require only limited data such as those currently

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**Figure 12: Power Analysis Form.**

The procedures used for power analysis in this application and the documentation below are from Anderson et al. 1996. The information given below is excerpted from the publication listed above and was included with the authors’ consent. Refer to that publication for more detailed information.

4.9.1 Background

Power analysis is a statistical technique useful in quantifying the ability of a monitoring program to detect change in the monitored resource. A preponderance of literature recommends an increased use of power analysis techniques in the design and analysis stages of controlled studies and monitoring programs (e.g. Toft and Shea 1983; Rotenberry and Wiens 1985; Hayes 1987; Peterman 1990a; Peterman 1990b). Power analysis techniques have not been used with existing installation LCTA vegetation and disturbance data. However, investigators have successfully applied these techniques to LCTA wildlife protocols (Rice et al. 1995; Rice and Demarais 1995; Hayden and Tazik 1993), LCTA line transect methodology (Mitchell et al. 1994; Brady et al. 1995), and other military installation monitoring efforts, including Golden-cheeked Warbler studies at Fort Hood, Texas (D.K. Niven, 1994, unpublished report). The use of power analysis techniques in these studies has proven useful in evaluating current data collection methods and providing insight into the effects of modifications to those methodologies.

Power analysis techniques are not commonly used with LCTA data, in part because installation personnel may not be aware of the consequences of Type-II errors, of procedures to conduct power analysis, or that the results of power analysis can strengthen statistical inferences from the data. However, power analysis techniques require only limited data such as those currently
available with most LCTA data sets. Power analysis calculations also are relatively simple to conduct and are quite easily interpreted.

4.9.2 Power Analysis

A tool commonly used in the statistical analysis of data are the test of a hypothesis (a test of significance) (Snedecor and Cochran 1980). The hypothesis under test is usually referred to as the null hypothesis ($H_0$) and is tested against the alternative hypothesis ($H_a$). For each hypothesis, the data are examined to see if the sample results support the hypothesis. The null hypothesis for many monitoring programs is that no change has occurred in the monitored resource. The alternative hypothesis is that a change has occurred.

Two types of errors are associated with any statistical test (Table 3). Type-I error ($\alpha$) is the probability of rejecting the null hypothesis when the null hypothesis is true. Type-II error ($\beta$) is the probability of failing to reject the null hypothesis when the null hypothesis is false. If a resource manager interprets the output of a monitoring system as indicating that a biologically important change has occurred, some action will be taken. If a real change has occurred, the correct decision was made. If no real change has occurred, the manager is probably reacting to inherent variability in the process monitored; a false change (or Type-I) error would have been made and the manager would have taken actions that were not required. If a manager interprets the output of a monitoring system as indicating that no change has taken place, no action will be indicated. If, in reality, no change has taken place, this action would be the correct decision. However, if there really were a change that the monitoring system missed, a missed-change (or Type-II) error would have been made. Missed-change errors mean that a change, usually detrimental, was missed and that remedial actions will be delayed until a time when they may be more expensive or less effective.

Table 3: Statistical Decision and Error Probability Table.

<table>
<thead>
<tr>
<th>Truth</th>
<th>Reject $H_0$</th>
<th>Fail to reject $H_0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H_0$ True</td>
<td>Type-I error ($\alpha$)</td>
<td>No error ($1-\alpha$)</td>
</tr>
<tr>
<td>$H_0$ False</td>
<td>No error, Power ($1-\beta$)</td>
<td>Type-II error ($\beta$)</td>
</tr>
</tbody>
</table>

Statistical power ($1-\beta$) is the probability that a particular test will reject the null hypothesis at a particular level ($\alpha$) when the null hypothesis is false (Gill 1978). For monitoring programs, this is the probability that a change will be detected when a change has really occurred. A common misunderstanding of statistics often leads resource managers to interpret a failure to reject the null hypothesis to mean that the null hypothesis is true. Whether the null hypothesis can be considered true depends on the power of the test (Cohen 1977). If a monitoring program has high power and a change in a resource has not been detected, a manager can conclude that no change has occurred in the resource. If the monitoring program has low power and a change has not been detected, the manager cannot conclude that a change has or has not occurred.

Failure to employ power analysis may result in the development and continuation of monitoring programs that are incapable of meeting monitoring objectives or the misinterpretation of results from existing monitoring programs. As a result, increased use of power analysis in both the design and analysis stages of monitoring programs is called for (Toft and Shea 1983; Rotenberry and Wiens 1985; Hayes 1987; Peterman 1990a; Peterman 1990b). Hayes (1987) reviewed the toxicology literature and found high power in only 19 of the 668 reports that failed to reject the null hypothesis. In many cases conclusions were made as if the null hypothesis was proven to be true. However, only in those studies with high power should the null hypothesis have been
accepted as true. In the studies with low power, the results should have been interpreted as inconclusive. Numerous surveys of the power associated with studies reported in specific journals and representing many topic areas have shown similar results (Cohen 1977; Reed and Blaustein 1995; Forbes 1990).

4.9.3 Types of Power Analysis

Power analysis can be used *a priori* or *a posteriori* (Peterman 1990a). *A priori* power analysis is used in the design stage to determine the appropriate sample size required to yield a specified power (Peterman 1990b; Rotenberry and Wiens 1985; Toft and Shea 1983). *A posteriori* power analysis is used after data have been collected to determine the minimum detectable effect size for an existing survey (Rotenberry and Wiens 1985). The two approaches differ only in the data required and the parameters solved for in the equation.

The *a priori* use of power analysis is an important consideration when implementing a new LCTA program at an installation. Although the best sample size is the largest sample size, the rate of increase in precision and power decreases with increasing sample size (Green 1979). The question of concern with limited funds and manpower is not what is the best sample size but rather how many samples are required to meet management objectives. The original sample allocation protocol used in LCTA was based on the population size (land area) rather than the population variance (Diersing et al. 1992). As a result, recommended sampling intensity protocols may not be optimal because budgetary and logistic constraints are usually the primary factors dictating the magnitude of change that can be detected. Power analysis techniques using LCTA data from similar installations or preliminary surveys could be used to estimate desired sampling intensity based on ecological considerations.

The *a posteriori* use of power analysis is an important consideration for existing LCTA programs. The use of power analysis allows installation natural resource managers to determine minimum detectable effect sizes. Only by knowing the minimum detectable effect size for important variables can installation managers determine if the monitoring program is fulfilling management objectives. The *a posteriori* use of power analysis is emphasized in this report because a large number of installations have had LCTA programs for several years. Emphasis at these installations has shifted from the monitoring design and data collection phase to the data analysis and interpretation phase.

4.9.4 Biological Significance and Minimum Detectable Effect Size

Statistical significance is a statement about the magnitude of a variable without regard to the importance of the value. Biological or ecological significance is a statement about the magnitude of a value of a variable based on management considerations. Biological significance is related to statistical significance by considering the stability, power, and robustness of the survey methods employed in the monitoring program. Biological significance is more important than statistical significance when drawing a conclusion from sample data (Yoccoz 1991).

Effect size in power analysis is the degree of change one wants to detect by the test. The choice of effect size should be based on an understanding of the biology of the system and the economic and implementation constraints associated with the survey. Minimum detectable effect size is the smallest effect size that can be detected for a given sampling intensity and specified error levels. Determining the minimum detectable effect size helps ensure that statistical significance more closely corresponds to biological significance. If the minimum detectable effect size of a survey is larger than the effect size that would be considered biologically significant, the study design is considered to be weak (Cohen 1977). In weak study designs, small but biologically significant changes in the resource may not be detected. If the minimum detectable effect size of a survey is
smaller than the effect size that would be considered biologically significant, the study design is considered to be strong. In strong study designs, biologically significant changes in the resource should be detected. Without specifying the minimum detectable effect size associated with a test, land managers are not provided the information necessary to judge the strength of the evidence provided (Peterman 1990b).

Effect size can be reported as absolute or relative. Absolute effect size is the change that can be detected regardless of the abundance of the variable being measured. The ability to detect an absolute change of 10 in the population implies that the protocols will detect a change of 10 when the mean is 10 and a change of 10 when the mean is 20. Relative effect size implies that the effect size will depend on the mean value of the variable being monitored. The ability to detect a 25 percent change in the population implies that the protocols will detect a change of 2.5 when the mean is 10 or a change of 5 when the mean is 20. The choice of reporting format is important and depends on the abundance of the variable being reported. Smith et al. (1995) reported that, for a given species of bird, greater than 200 plots were required to detect an absolute change of 0.25 birds and less than 50 plots were required to detect a relative change in population of 25 percent. Smith et al. (1995) also reported that, for a different species of bird, less than 50 plots were required to detect an absolute change of 0.25 birds and more than 200 plots were required to detect a relative change in population of 25 percent. The main difference between the two species of birds was the relative abundance of each species.

4.9.5 Statistical Tests and Power Analysis

The determination of statistical significance and the estimation of the probability of error in the statistical conclusion are made within the framework of a particular statistical test. As such, the statistical test is one factor that determines the statistical power (Lipsey 1990). Numerous statistical tests are applicable to LCTA data trend analysis. Power equations for many of these tests are available. Population change over time and associated power can be estimated with two sample tests and paired tests using individual years (Cohen 1977). The same tests using the means of blocks of years before and after an event also can be used to make the tests less sensitive to random annual environmental variation (Cohen 1977). Gerrodette (1987, 1991) provides power equations for regression tests for linear and exponential change. Green (1989) provides power equations for multivariate tests. Bernstein and Zalinski (1983) provide power equations for monitoring programs that also employ control plots. Although a number of power analysis models are available for use, Kendall et al. (1992) concluded that power estimates using data from the first and last years (two sample data) is a reasonable and robust procedure and is a good indicator of power, even for other trend tests.

For purposes of this program, paired plot comparisons (t-test) between two years are selected to determine the power of LCTA sampling protocols. This type of test was selected because paired tests are appropriate for repeated measurements associated with permanent sample plots (Snedecor and Cochran 1980). This type of analysis requires only two years of data. As such, it is applicable to the majority of installations currently implementing LCTA. This applicability is especially true for data summaries that are available from long-term survey data collected only every three to five years (Tazik et al. 1992; Price et al. 1995). A requirement of only two years of data also may encourage installation personnel to employ the techniques early in the implementation process, when the results are most useful. The power associated with paired plot comparisons is more easily calculated than other methods so installation personnel may be more likely to make use of the technique during data analysis. This general type of analysis is applicable to many questions of interest to installation personnel. Power estimates associated with these tests are reasonable and robust indicators of the power associated with other types of tests (Kendall et al. 1992).
The null and alternative hypotheses associated with paired plot comparisons are shown in equations 1 and 2 (Green 1989). The null hypothesis is that there is no change in the monitored resource. The alternative hypothesis is that a change has occurred in the monitored resource.

\[ H_0: \mu_1 = \mu_2 \]

**Equation 1: The null hypothesis.**

\[ H_a: \mu_1 \neq \mu_2 \]

**Equation 2: The alternative hypothesis.**

where
- \( \mu_1 \) = first year mean
- \( \mu_2 \) = second year mean.

The power equations for paired plot comparisons used in this program are shown in equations 3 and 4 (Green 1989). Equation 3 is used to calculate the number of plots required to detect a specified effect size with specified values of \( \alpha \) and \( \beta \) and an estimated variable variance. This equation represents the *a priori* use of statistical power analysis techniques. Equation 4 is used to calculate the minimal detectable effect size for specified values of \( \alpha \), \( \beta \), sample size, and estimated variable variance. Equation 4 represents the *a posteriori* use of statistical power analysis techniques.

\[ n = \frac{(t_\alpha + t_\beta)^2}{\Delta^2} \frac{S^2}{2} \]

**Equation 3: Power equation to estimate sample size (**a priori**).**

\[ \Delta = \sqrt{\frac{(t_\alpha + t_\beta)^2}{n} \frac{S^2}{2}} \]

**Equation 4: Power equation to estimate minimum detectable effect size (**a posteriori**).**

where
- \( n \) = sample size
- \( \alpha \) = Type-I error level
- \( \beta \) = Type-II error level
- \( t_\alpha \) = student t value associated with \( \alpha \)
- \( t_\beta \) = student t value associated with \( \beta \)
- \( \Delta \) = effect size
- \( s^2 \) = variance of the differences between measurements.

### 4.9.6 Minimum Detectable Effect Sizes for Selected \( \alpha \) and \( \beta \) Error Rates

Careful thought should be given to the consequences of both Type-I and Type-II statistical errors and the appropriate rates of errors that are accepted. A Type-I error means that a management practice such as site rehabilitation may be implemented where it is not necessary. A Type-II error
means that a necessary management practice may not be implemented because the problem is not detected. The more stringent the standard set for Type-I error, the more likely a Type-II error will occur for a given sampling intensity.

Determination of appropriate $\alpha$ and $\beta$ levels should be based on the relative cost of committing Type-I and Type-II errors and should be based on criteria external to the data (Cohen 1977; Toft and Shea 1983; Rotenberry and Wiens 1985; Green 1989). In some circumstances the ecological/management consequences of wrongly concluded change in a variable when none has occurred (Type-I error) may be equivalent to the consequences of failing to detect change (Type-II error). Under those conditions, the errors should be treated equally in the analysis of data. In natural resources management, Type-II errors often are considered more costly than Type-I errors (Hayes 1987; Peterman 1990a; Thompson and Schwalbach 1995). Setting $\beta$ lower than $\alpha$ implies that the cost of Type-II errors are higher than the cost of Type-I errors (Toft and Shea 1983). The relative costs will determine the acceptable error levels for each type of error and are likely to be installation and management-objective specific. For example, the cost of an extensive rehabilitation program may outweigh the costs of increased monitoring efforts required to detect a problem early when rehabilitation may be less expensive. The cost of not modifying training levels and rotating training areas when needed may or may not exceed the cost of modifying training prematurely and implementing other rehabilitation programs.

4.9.7 Minimum Detectable Effect Sizes for One-tailed and Two-tailed Tests

The use of one-tailed (directional) tests can increase the efficiency of a study by reducing the required sample size or decreasing the minimum detectable effect size for an existing study. One-tailed tests are used only when there is reason to expect results in one direction (Snedecor and Cochran 1980; Sokal and Rohlf 1981). When analyzing LCTA data, there are many instances in which results in only one direction may be expected and are of concern. Military impacts frequently result in decreased vegetation cover, increased soil exposure, and increases in introduced species (Severinghaus et al. 1979, 1980; Shaw and Diersing 1990; Thurow et al. 1993; Trumbull et al. 1994; Wilson 1988). One-tailed tests may be justified when testing for the effects of increased training.

4.10 Plot Summary

Plot summary will produce a report summarizing most LCTA data on the plot and plot metadata. To begin summarizing the data select Plot Summary from the Analyses Form (Figure 2). The Plot Information Form will appear (Figure 13). Select a year and/or plot from the list boxes on the form then choose a reporting option.
4.11 Plot Soil Samples

The **Plot Soil Samples** button is found under the **Information** tab of the Data Analysis form (Figure 2). This will plot the percent sand, silt, and clay of the soil samples on the USDA soil texture triangle. The soil sample data is found in the SoilSmpl table.

After selecting the **Plot Soil Samples** button, the form shown in Figure 14 will appear.

To select samples from a particular year, uncheck the **Plot all years** box and select the year from the **Year** list. To only include samples from a particular group, check the **Plot group** box and select the group from the **Group by** list. After all options are selected click the **View Graph** button. If any samples are missing data a message box will appear stating this.
5 Data Management

To access all the database management components of Access LCTA select the Data Management button from the Main Navigation Form (Figure 1). All data management modules are available from the Data Management Form (Figure 15).

Data management modules for performing the following tasks include the following, each of which is discussed below:

- VegID correction
- land use value correction
- ground disturbance value correction
- LCTA plot metadata
- check tables for missing plots
- check tables for missing data
- check tables for null values
- open tables
- update local species lists (PlntList and VertList)
- export the entire database
- load data from the handheld data loggers output files

Management of LCTA data can be a time-consuming and frustrating process. The data management modules of the Access LCTA program have been designed to address the most common, and difficult, data management issues. In order to produce accurate analysis results from the LCTA data, the quality of the data must be ensured.

![Data Management Form](image)

Figure 15: Data Management Form.
5.1 Vegetation Codes

Selecting Vegetation Codes from the Data Management Form (Figure 15) will open the VegID Correction Form (Figure 16). Use this form to make corrections to the VegID found in the tables AerCover, GndCover, BeltTran, BeltMon, and BeltSurv. Select the desired table from the list box at the top of the form. Before the form opens the program must search for a list of VegIDs found in the first table, AerCover. There is a pause before the form opens during this process.

Figure 16: Unknown VegID Correction Form

Select the VegID to change from the Unknown VegID list. All values shown in this list either have no matching entry in the PlntList table or have missing family information in PlntList. Enter the new value in the Change To field and select either Correct in Selected Table or Global Change. By default the Verify changes option is true. Remove the check mark from this option to make changes without verification.

To locate the tables, plots, and dates for the selected unknown VegID, select the Find All Locations button. The location form, Vegetation Code Summary (Figure 17), will open. The table list shows all tables where the specified VegID is found. Select a table to see a list of plot numbers containing the VegID. Select a plot number to find the specific date. To change the value of the VegID for a specific table and/or plot and date, enter the new value in the Change To field and select the Make Correction button.
5.2 Land Use Values

Selecting Land Use Values from the Data Management Form (Figure 15) will open the Unknown Land Use Management Form (Figure 18). Use this form to make corrections to the values found in the tables LandUse, MaintAct, and ErosEvid. Select the desired table from the list box at the top of the form. Before the form opens, the program must search for a list of values found in the first table, LandUse. There is a pause before the form opens during this process.

Select the value to change from the Land Use Values list. All values found in the selected table are shown in this list. Enter the new value in the Change To field and select the Make correction button. By default, the Verify Changes option is true. Remove the check mark from this option to make changes without verification.
5.3 Disturbance Values

Selecting Disturbance Values from the Data Management Form (Figure 15) will open the Unknown Disturbance Management Form (Figure 19). Use this form to make corrections to the values found in the tables GndCover and LineMon. Select the desired table from the list box at the top of the form. Before the form opens the program must search for a list of values found in the first table, GndCover. There is a pause before the form opens during this process.

Select the value to change from the disturbance value list. All values found in the selected table are shown in this list. Enter the new value in the Change To field and select the Make Correction button. By default the Verify Changes option is true. Remove the check mark from this option to make changes without verification.
5.4 Plot Metadata

Figure 20 shows the Plot Metadata Form. This form is accessed from the Data Management Form (Figure 15) by selecting the **Plot Metadata** button. The plot metadata module provides easy access to LCTA plot information from the tables PlotMast and PlotSurv.

The data on the form cannot be edited due to the source query and restrictions in Access. However, data can be edited directly in the table by selecting either the **Edit PlotSurv Data** or the **Edit PlotMast Data** buttons. After one of these buttons is selected, the appropriate table will open and display only the data for the selected plot and date from the Plot Metadata Form. Selecting the print button will print the plot summary report for the selected plot and date (refer to section 4.10, Plot Summary, in the previous Analyses section). The Plot Metadata Form may not reflect changes made in the table view. To update the form, select another plot from the list and then reselect the plot that contains the changed information.
5.5 Check for Missing Plots

Selecting *Check for Missing Plots* from the Data Management Form (Figure 15) will open the Missing Plots Form shown in Figure 21. Use this module to check all LCTA data tables for missing plots. The program builds a list of plots from the PlotSurv table and compares this to a list of plots from each data table.

After the *Check Database* button is selected, the program will begin searching for missing plots. When errors are found, a check mark will appear to the left of the appropriate description and an error message is written to the screen. Select the printer button to print these errors.
5.6 Check for Missing Data

Selecting *Check for Missing Data* from the Data Management Form (Figure 15) will open the Missing Data Form (Figure 22). The data checked in this module represent data that are not collected in the field (required manual data entry) or data that are not required by the database system. However, these data are required by the USLE analysis and therefore are an important component of the database.

After the *Check Database* button is selected, the program will begin searching for missing data. When errors are found, a check mark will appear to the left of the appropriate description and an error message is written to the screen. Select the printer button to print these errors.
5.7 Check for Null Data

Selecting **Check for Null Data** from the Data Management Form (Figure 15) will open the Null Data Form (Figure 23). The data checked in this module represent data that are not required by the database system. However, these data are required by the many of the analyses and therefore are an important component of the database.

After the **Check Database** button is selected, the program will begin searching for missing data. When errors are found, a check mark will appear to the left of the appropriate description and an error message is written to the screen. Select the printer button to print these errors.
5.8 Check Other Errors

To check for other errors, select Check for Other Errors from the Data Management Form, Figure 15. The Miscellaneous (other errors) Form (Figure 24) will open. The data are scanned for the following errors:

- Duplicate entries in LandUse, MaintAct, and ErosEvid
- Unknown VegID in AerCover
- Missing species information in PlntList for species found in AerCover
- Unknown VegID in BeltMon
- Unknown VegID in BeltSurv
- Missing or multiple R values in PlotMast

After the Check Database button is selected, the program will begin searching for missing data. When errors are found, a check mark will appear to the left of the appropriate description and an error message is written to the screen. Select the printer button to print these errors.
5.9 **Open Selected Table**

To open a table for viewing or editing, select the table from the *Tables* list on the Database Management Form (Figure 15) and then select the *Open Selected Table* button. This is similar to using the Access database window, selecting the tables tab, and selecting the *Open* button.

5.10 **Update Local Species Lists**

The PlntList table represents the installation's LCTA species list. This table contains plant information for all valid vegetation codes (VegID) found in the LCTA database. A list of all unique VegIDs from the LCTA data tables is compared to the Species database PLANTS table for matching values. The same procedure is done for wildlife codes (VertID) found in the LCTA wildlife tables.

The Species database contains data from the 1982 version of the United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS) PLANTS database (USDA SCS-TP-159 1982). The PLANTS database is a single source of standardized information about plants for of the USA and its territories (refer to the PLANTS web site at http://plants.usda.gov/plants/plntmenu.html for more information). As mentioned, the PLANTS table of the Species database contains an older representation of the NCRS PLANTS database. These data are the original database used when LCTA started, and is provided to be backward-compatible for installations using this list. For recommendations on using more recent PLANTS data, please contact the LCTA support center.

The Species database also contains the Verts table. This table was adapted from the U.S. Fish and Wildlife Service *Checklist of Vertebrates of the United States, The U.S. Territories, and Canada*.
Data from the Birds, Mammals, and Herps LCTA tables are compared to this data for valid entries.

Select **Update Local Species Lists** from the Data Management Form (Figure 15) to update the PlntList and VertList tables. Select **Update Now** from the Update Local Species Tables Form (Figure 24) to begin the process. All messages are written to the error section of the form. This includes unknown values as well as values added to the PlntList and VertList tables.

![Update Local Species Tables Form](image)

**Figure 25: Update Local Species Tables Form.**

### 5.10.1 Species Database Copyright Information

Please refer to the United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS) PLANTS National Database Copyright Information web site, [http://plants.usda.gov/plants/plants_copyright.html](http://plants.usda.gov/plants/plants_copyright.html), for copyright information on the database provided in the Species database.

### 5.11 Export Database

The export database module facilitates the process of exporting data and database structure. This can prove useful when other offices, agencies, or researchers who are not using Microsoft Access require information. Begin the export database module by selecting **Export Database** from the Data Management Form, Figure 15. Figure 26 shows the options available for this module.

First, select either the table name from the tables list or the **All Data Tables** check box. If the **Save Column Names** option is selected, the first line of the export file for spreadsheets and text files will contain the column names; dBase files are not affected by this option. To export only the database structure, select the **Structure Only** option. The structure is automatically exported when data are exported. Select the target database for the structure definition. The path to export the files to is automatically selected. Change the path by selecting the **Select New Path** button. Choose the type of export file: dBase, spreadsheet, or delimited text file. Then select the **Export** button to begin the process. In addition to the data file and structure file, a log file is generated. The log file contains database dictionary information for the selected table or tables. This includes table description, data element descriptions, data type and length, and data element requirement constraints.
The structure file contains data definition language (DDL) syntax for creating the tables in the selected target database. DDL scripts are similar to structured query language (SQL) scripts and are executed from within the target database. Check the target database documentation for proper DDL syntax before executing the files provided by this program.

The file naming convention for all files exported by the export database module are listed in Table 4. File names will consist of the first eight characters of the table name, if file names would conflict the first 6 characters of the table name are used and a unique number is added to the end. The log file is named ExportDB.LOG and is found in the /Files directory.

Table 4: Export File Extensions.

<table>
<thead>
<tr>
<th>Export Type</th>
<th>File Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>DBase</td>
<td>DBF</td>
</tr>
<tr>
<td>Excel version 3.0</td>
<td>XLS</td>
</tr>
<tr>
<td>Excel versions 5.0-7.0</td>
<td>XLS</td>
</tr>
<tr>
<td>Excel version 97</td>
<td>XLS</td>
</tr>
<tr>
<td>Text</td>
<td>CSV</td>
</tr>
<tr>
<td>Structure files</td>
<td>DDL</td>
</tr>
</tbody>
</table>

Figure 26: Export Database Form.
5.12 Export Data for NED

The export data for NED (National Environmental Database) module facilitates the process of exporting data for the NED LCTA ArcView Extension Version 1.0. Utah State University developed NED for the Army National Guard. For information visit the NED web site (http://www.nr.usu/ned/). Begin the export database module by selecting Export Data for NED from the Data Management Form, Figure 15. Figure 27 shows the options available for this module.

![NED LCTA Extension Export - LCTAJUS](image)

Select the tables to export by ensuring a check mark appears to the left of the table name. To select all tables select the All Listed Tables option. Choose a path to receive the files by single clicking the Select Path button. After choosing the tables and providing a path single click the Export Selected Tables button to export the data.

5.13 Load Handheld Data
The load handheld module automatically imports data into the database from the handheld data logger files. These files are created using the inventory or monitoring collection program written for LCTA data collection. Figure 28 shows the handheld data loading screen.

![Handheld Data File Import Form](image)

**Figure 28: Handheld Data File Import Form**

When the Handheld Data File Form first opens, the program will check in the /HHFiles directory, below the directory containing LCTA.MDB, for any valid handheld files. If this directory or any valid files are not found a message will appear stating so. Handheld files can exist in any directory. To change the location of the handheld files, select the **Select New Path** button and navigate to the correct directory. All valid handheld files will appear in the **Files** list box. Valid handheld files will be of the form,

```
??-*.*
```

where ?? are the first two letters of the LCTA database.

For example, if the LCTA application is connected to the LCTAJUS database then all valid handheld file names are JU-*.*. Note that an LCTA database must be connected to the LCTA application before importing files.

To import one specific file, double click the file name from the **Files** list box. To import all files, select the **Import All** button. Before selecting either option, set the year in the **Year of Data** list. The program will compare this value to the year of the date read from the handheld data file. If the two do not match, a dialog prompts the user to correct the date or accept the date read from the file. This option was added to catch problems that might occur with the date set on the handheld.
data logger. Progress of the loading process is reported in the information bar at the lower left portion of the Access LCTA window.

Any error messages are reported in the Error section of the form and saved to the file /Files/HHLoad.err. After the loading process is finished, the errors can be viewed by selecting the printer button. If a large number of files are loaded and many errors were written, the limitation of the error text box may be reached. A dialog will report such an occurrence.

Once a file is successfully loaded, the file name is changed. The program will replace the first letter of the file name with an exclamation mark (!). This will avoid loading the program again at a later time. After all files have been processed, the file list is updated.

Before data are imported, the program will check the database for the plot and date read from the handheld data file. If it is found, a dialog will prompt for an action. The existing data can be deleted and the handheld data loaded or the file can be skipped. Be aware that if changes were made to the database and the handheld data are reloaded, all changes are lost.

The import module was built around the assumption that most errors will be from either blank data fields (where information is required, such as the date the plot was measured or the name of the installation) or from data missing in a long sequence of recorded plot data. In the first situation, all required fields are checked to ensure they contain valid data. In the latter, missing data tend to show up during the field format checks, as sequences of plot data generally contain alternating formats. For example, the program might expect a species code (text field) followed by the number of individuals of that species (an integer field), followed by height information (an integer field). If the height field is missing from the import file, the program will find the species code for the next record. It will expect an integer field but will detect a text field and report an error. At this point, the import process is stopped for the current file. No data from that file will appear in the database. The program will also check integer and real values for valid numbers. Text strings are only checked for missing values for those data requiring data.

If data that are read from the handheld data file pass all error checks, an SQL insert statement is written to the LOAD.TMP file. Once all lines have been read from the data file and all error checks passed, the statements in the LOAD.TMP file are processed to insert the data into the database. To view the LOAD.TMP file for the last file processed, select the View LOAD.TMP in Default Editor button. The default editor is set using the utilities form.

If a particular file fails to load and the reason is not immediately obvious, place a check next to the Write Debug Info option. This will instruct the program to write information about the data read from the handheld data file to /Files/Loaderr.txt. Selecting this option will cause the program to run much slower.

Because of additional error checking performed by Access LCTA and the nature of loading data into Access, this program will perform slower than the original LCTA Program Manager during the data loading process. However, with the increased error checking and debugging, correcting faulty files is easier.
6 Utilities

Access the program utilities by selecting *Utilities* from the Main Navigation Form (Figure 1). Figure 29 shows the available options. Each tabbed area of the form contains specific options.

![LCTA Options Form](image)

**Figure 29** LCTA Options Form.

6.1 Toolbars and Menus

By default, Access LCTA will start with the application toolbar and menu bar shown in Figure 30. To use the built-in tools and features of Microsoft Access, use the default toolbars and Access menu bars. Select the desired settings on Figure 29. Alternatively, the Access LCTA application toolbar and menu bar have options to set this.

![Access LCTA Toolbar and Menu](image)

**Figure 30** Access LCTA Toolbar and Menu.

6.2 Default Text Editor

The default text editor is used for viewing files saved by the Access LCTA program, such as error files. To change this option, enter the path and file name of the desired program and select the *Change Text Editor* button. To view a file, select the *File Manager* tab on the LCTA options.
form (Figure 29). Select a file name from the list, then select the **Open** button to open a file using the default text editor. You may also double click a file name.

### 6.3 Data Dictionary

The form shown in Figure 31 is the LCTA data dictionary. Access this form by selecting **Data Dictionary** from the LCTA Options Form under the Dictionaries tab (Figure 29). The Data Dictionary Form displays information about all tables found in the database.

Select a table from the **Tables** list to see the table description, number of records in the table, fields, field information, tables controlling the selected table, and tables controlled by the selected table. Controlling and controlled tables refer to referential integrity constraints. Select a field from the **Fields** list to see information for the selected field.

Controlling table and controlled tables are defined as part of the database structure and ensure data integrity. The selected table controls data entry into those tables listed in the **Controls** list. For example, a plot and date combination must be entered in PlotSurv before data can be entered in AerCover. PlotSurv is referred to as the primary table and AerCover is the foreign table. These designations are noted in the upper right hand portion of the form if valid. Data entry into the selected table is controlled by the tables listed in the **Controlled By** list. To see the specific data fields that are defined in the referential integrity constraint select the table in either the **Controls** list or the **Controlled By** list.

If the table resides in a database other than the application database the **Attached** field will have "yes" as the value. The location of the attached table is shown in the connection string.

In the example shown in Figure 31, PlotSurv is the selected table. PlotSurv controls data entry into AerCover by InstalID, PlotID, and RecDate. This means that an InstalID, PlotID, and RecDate combination must first exist in PlotSurv before data can be entered in AerCover for the
same combination. PlotMast controls PlotSurv by InstallID and PlotID (not shown). An InstallID and PlotID combination must appear in PlotMast before data can be entered in PlotSurv for the same combination. PlotSurv is both a primary table and foreign table, as noted at the top of the form. The AerCover table is also an attached table.

Select the *Park* button to reduce this form to a button (Figure 32), which is placed at the top of the Access window. This leaves the data dictionary readily available. Select the button (Figure 32) to restore the form. Select the *Update Information* button to rebuild the table containing all the information shown. This is useful when the form has been left open (parked) and new tables have been created. To print the data dictionary for the entire database, select the printer button.

![Figure 32: Parked Data Dictionary.](image)

### 6.4 Query Dictionary

The form shown in Figure 33 is the LCTA query dictionary. Access this form by selecting *Query Dictionary* from the LCTA Options Form under the Dictionaries (Figure 29). The Query Dictionary Form displays information about all queries found in the database.

![Figure 33: LCTA Query Dictionary.](image)

Select the *Park* button to reduce this form to a button, which is placed at the top of the Access window (Figure 34). This leaves the query dictionary readily available. Select the button (Figure 34) to restore the form. Select the *Update Information* button to rebuild the table containing all the information shown. This is useful when the form has been left open (parked) and new queries
have been created or existing ones have been updated. To print the data dictionary for the entire
database, select the printer button.

![View Query Dictionary](image)

**Figure 34: Parked Query Dictionary.**

### 6.5 Attachment Manager

Access LCTA is divided into two separate databases. One database, LCTA.MDB, contains the
Access LCTA application code, queries, tables, forms, and reports. The second database contains
the LCTA data and must be named LCTAXXX.MDB where XXX is the three-letter installation
code. The LCTA data are connected with the Access LCTA application by using a built-in feature
of Microsoft Access allowing attached tables. When tables are attached to a database, they are
accessible but physically reside in the database originally containing the table. All LCTA data
tables are attached to LCTA.MDB. This allows for easy updates of the application and can
improve overall performance.

The attachment manager facilitates the attachment and removal of tables attached to the
application database, LCTA.MDB (Figure 35). Select **Attachment Manager** from the Managers
section of the LCTA Options Form (Figure 29). To attach tables, change the path in the database
path field by selecting the **Select New Path** button. Select a database from the list and either
select a table from the **Remote Tables** list or select the **Attach All Tables** check box then select the
**Attach Table(s)** button. If an LCTA database is selected from the database list, all LCTA tables
attached to the application database are removed before attaching any new ones. This avoids the
possibility of mixing tables from two different LCTA databases. All other attached tables remain attached.

To remove an attached table, select the table from the Local Tables list and select Remove Selected Tables. To remove all attached tables, select the Remove All Attached Tables. Note that when an attached table is removed, only the connection between the application database and the data database is removed. The table and its data are still available in the remote database.

Select the Attached Tables Report button to create a file listing all attached tables and the name of the database where the tables reside. The file ATTACH.TXT is saved in the /Files directory below the directory containing the application database.

6.6 Update Manager

The update manager will facilitate updating the current version of Access LCTA to the newest version. Select Update Manager from the Managers section of the LCTA Options Form (Figure 29).

Before downloading the most recent version, all user-defined tables and queries must be moved to another database. Permanent local tables and queries not created by the developers of the program are listed in the list boxes in the upper left-hand portion of the form. Some of the listed tables and queries will have been created by the program, during execution, and do not need to be moved. Try to name user-defined tables and queries with a prefix to make them easier to find. For example, prefix names with "MY_". Select the table to copy from the table list. Select the desired database to receive the tables from the Database list, changing the path as needed, then select the Copy Selected Table button. Repeat as necessary.

Any user-created forms and reports must be moved manually. To move these objects manually, move the application database to a new location. Open the database you want to receive these
objects, for example, the new updated application. Select <File> from the main menu, then select <Get External Data>, then <Import>. Select the database containing the objects to copy and then select the objects. Select the OK button to import the selected objects.

All user-created tables, queries, reports, forms, and modules should be placed in the database containing the LCTA data. This will facilitate the update procedure and reduce the risk of losing any of these objects.

Once all of the tables have been moved, select the Download button. Your web browser will open and connect to the Access LCTA program download page on the CEMML web site. Compare the version information displayed on the Access LCTA Updates Form with that on the web site. Only download the file if the version on the web site is newer. The web site will contain instructions for installation. Place the update in the same location as the currently running version. This will ensure all the icon links to the program work.

6.7 Open Database

The Open Database button, found under the Managers section of the LCTA Options Form (Figure 29), is used to open the LCTA data database. This allows the user to work in the LCTA data database outside of the Access LCTA program. After selecting this button the Access LCTA application database is closed and the LCTA data database (i.e. LCTAJUS.MDB) is opened. This is beneficial when the user wishes to create new tables and queries that are to be saved in the data database and not the Access LCTA application database. This will prevent the loss of such tables and queries in the event the Access LCTA application database is updated. Please note, an LCTA data database must be attached to the Access LCTA application before this option will work.

6.8 Scaling

Access LCTA is designed to adjust forms, and their elements, to a scale that will allow the user to see the complete form on their screen. The program will check the resolution of the computer and make appropriate adjustments to forms and form elements.

At some resolutions, mainly low resolutions (640 x 480), the program can select inappropriate values. This causes the forms to display incorrectly or center incorrectly on the screen. To turn off automatic scaling and centering of forms remove the checks from the two options shown on the Scaling section of the LCTA Options Form (Figure 29).

6.9 Backups

Access LCTA can automatically check for the date of the last backup performed on the LCTA data database. The frequency of this check is set under the Backups tab of the LCTA Options Form (Figure 29). The frequency can be set to daily, weekly, monthly, or turned off completely.

To perform a backup, click the Backup Database button on the Backups portion of the LCTA Options Form. A dialog box will show the currently attached database and the name and location of the backup file. Selecting the Select New Output Path button changes the location of the backup. Only the location of the backup is changed, the file name is generated automatically.

When Access LCTA is first started, the program will check the last date of a backup and compare that to the backup frequency option. If the date of the last backup is older then the frequency option, the user is prompted and given the option to backup the data database. In the event the
data database becomes corrupted, the backup file can be renamed and used in place of the original file. To rename the file to a proper name, remove the "backup" portion of the file name. For example, LCTAJUSBackup.MDB would become LCTAJUS.MDB. It is also important to keep copies of the databases in a location other than the current computer.

### 6.10 Compile

The compile section of the LCTA Option Form (Figure 29) contains settings and utilities for compiling the database. Access applications are compiled internally to make the program more efficient when accessing internal code. The compilation process does not create an executable program. Applications need to be compiled when the file name is changed, code is changed/added, or the decompile process is executed. Access LCTA will check the compiled status of the program each time it is started. If the program is found to be in an uncompiled state, it will be automatically compiled. To turn this option off remove the check from the automatically compile option. To manually compile the database, click the **Compile Database Now** button.
7 Program Registry

Access the program registry by selecting *Program Registry* from the Main Navigation Form (Figure 1). Select the topic from the *Topic* list to view the information. Information is available for program version, technical support points of contact, and the default text editor defined. Other topics may be added in the future. An example of the program version is shown in (Figure 37).

To access the CEMML home pages, select the *CEMML Web Site* button. A web browser must be installed and working and access to the Internet enabled before selecting this option. The *Program Support* button opens the Access LCTA support pages.

![Figure 37: About LCTA Form.](image)

Figure 37: About LCTA Form.
8 Appendix: Analyses Reference

This appendix contains a list of input tables, working tables, working queries, assumptions and result queries for the analyses listed in sections 4.2 through 4.10. An explanation of the items in this appendix follows.

<table>
<thead>
<tr>
<th>Input Tables</th>
<th>LCTA data tables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working Tables</td>
<td>tables used by the analysis containing initial summaries of LCTA data</td>
</tr>
<tr>
<td>Working Queries</td>
<td>queries summarizing data that are referenced by the final result query</td>
</tr>
<tr>
<td>Assumptions</td>
<td>any assumptions or rules used during analysis</td>
</tr>
<tr>
<td>Result Queries</td>
<td>final query containing the analysis or summary results</td>
</tr>
</tbody>
</table>

8.1 Land Use Analysis

8.1.1 Land Use Analysis Input Tables
- LandUse: LCTA military and non-military land use
- MaintAct: LCTA maintenance activities
- ErosEvid: LCTA observed wind/water erosion
- PlotSurv: LCTA plot survey information
- PlotMast: LCTA master plot information

8.1.2 Land Use Analysis Working Tables
None

8.1.3 Land Use Analysis Errors Checked
- Missing Plots in LandUse, MaintAct, and ErosEvid
- Null Values in LandUse, MaintAct, and ErosEvid
- Duplicate Values in LandUse, MaintAct, and ErosEvid

8.1.4 Land Use Analysis Working Queries
- tmp_PlotsByGroup
  Number of plots by year and group from LandUse, MaintAct or ErosEvid (depending on options selected, may include all plots or core plots only)
- tmp_PlotsByYear
  Number of plots by year from LandUse, MaintAct or ErosEvid (depending on options selected, may include all plots or core plots only)

8.1.5 Land Use Analysis Assumptions
None

8.1.6 Land Use Analysis Result Queries
- tmp_Analysis_Landuse
  Results for all years from LandUse, MaintAct or ErosEvid (depending on options selected, may include all plots or core plots only)
- tmp_Analysis_Landuse_Group
  Results for all years by user defined grouping element from LandUse, MaintAct or ErosEvid (depending on options selected, may include all plots or core plots only)
8.2 **Ground Disturbance Analysis**

8.2.1 **Ground Disturbance Analysis Input Tables**

- **GndCover**: LCTA initial inventory and long-term monitoring basal data
- **LineMon**: LCTA short-term monitoring basal data
- **PlotSurv**: LCTA plot survey information
- **PlotMast**: LCTA master plot information

8.2.2 **Ground Disturbance Analysis Working Tables**

- **tmp_Disturbance**: Disturbance summaries by plot and year for all years and plots from GndCover and LineMon

8.2.3 **Ground Disturbance Analysis Errors Checked**

- Missing plots in GndCover
- Missing plots in LineMon
- Null disturbance value in GndCover
- Null disturbance value in LineMon

8.2.4 **Ground Disturbance Analysis Working Queries**

- **Disturbance_SummaryGndCover**: Disturbance summaries by plot and year for all years and plots from GndCover
- **Disturbance_SummaryLineMon**: Disturbance summaries by plot and year for all years and plots from LineMon
- **Disturbance_GndCover**: Count of ground disturbance by plot, year, and Disturb

Minor underlying queries exist for the above-mentioned that are not listed here.

8.2.5 **Ground Disturbance Analysis Assumptions**

None

8.2.6 **Ground Disturbance Analysis Result Queries**

- **tmp_Analysis_Disturbance**: Results by year(s) (depending on options selected, may include all plots or core plots only and all years or a single year)
- **tmp_Analysis_Disturbance_Group**: Results by year(s) and user defined grouping element (depending on options selected, may include all plots or core plots only and all years or a single year)
- **tmp_Analysis_Disturbance_Plot**: Results by year(s) and plot (depending on options selected, may include all plots or core plots only and all years or a single year)
8.3 Ground Cover Analysis

8.3.1 Ground Cover Analysis Input Tables

- **GndCover**: LCTA initial inventory and long-term monitoring basal data
- **LineMon**: LCTA short-term monitoring aerial/basal data
- **PlotSurv**: LCTA plot survey information
- **PlotMast**: LCTA master plot information

8.3.2 Ground Cover Analysis Working Tables

- **tmp_GroundCover**: Basal cover summaries by plot and year for all years and plots from GndCover and LineMon. The original basal cover and converted basal cover (short-term monitoring terminology) are shown.

8.3.3 Ground Cover Analysis Errors Checked

- Missing plots in GndCover
- Missing plots in LineMon
- Null VegID in GndCover
- Null GndCov in LineMon

8.3.4 Ground Cover Analysis Working Queries

- **Veg_SummaryGndCover**: Basal cover summaries by plot and year for all years and plots from GndCover. The original basal cover and converted basal cover (short-term monitoring terminology) are shown.
- **Veg_SummaryLineMon**: Basal cover summaries by plot and year for all years and plots from LineMon.
- **VegidSummary_GndCover**: Basal cover summaries by plot and year for all years and plots from GndCover. For those VegID that have matching entries in the PlntList table, the scientific name is shown.
- **VegidSummary_LineMon**: Percent of basal cover hits from LineMon

Minor underlying queries exist for the above-mentioned that are not listed here.

8.3.5 Ground Cover Analysis Assumptions

None

8.3.6 Ground Cover Analysis Result Queries

- **tmp_Analysis_GroundCover**: Results by year(s) (depending on options selected may include all plots or core plots only, all years or a single year, recorded basal cover or converted basal cover, and basal cover by type or percent cover)
- **tmp_Analysis_GroundCover_Group**
Results by year(s) and user defined grouping element (depending on options selected may include all plots or core plots only, all years or a single year, recorded basal cover or converted basal cover, and basal cover by type or percent cover)

tmp_Analysis_GroundCover_Plot
Results by year(s) and plot (depending on options selected may include all plots or core plots only, all years or a single year, recorded basal cover or converted basal cover, and basal cover by type or percent cover)

8.4 Aerial Cover Analysis

8.4.1 Aerial Cover Analysis Input Tables
AerCover  LCTA initial inventory and long-term monitoring aerial vegetation data
LineMon   LCTA short-term monitoring aerial/basal data
PlotSurv  LCTA plot survey information
PlotMast  LCTA master plot information
PlntList  Installation LCTA species list

8.4.2 Aerial Cover Analysis Working Tables
\begin{itemize}
  \item \textbf{tmp\_AerCover}
    \begin{itemize}
    \item Aerial cover summaries by plot and year for all years and plots from AerCover.
    \end{itemize}
  \item \textbf{tmp\_AerCoverConvert}
    \begin{itemize}
    \item Aerial cover summaries by plot and year for all years and plots from AerCover and LineMon. The original aerial cover is converted from AerCover and combined with LineMon data (short-term monitoring terminology).
    \end{itemize}
\end{itemize}

8.4.3 Aerial Cover Analysis Errors Checked
Missing plots in AerCover
Missing plots in LineMon
Null VegID in AerCover
Null AerCov in LineMon
Missing genus, life, form, or origin in PlntList

8.4.4 Aerial Cover Analysis Working Queries
AerCover\_VegAerCoverConvertSummary1
\begin{itemize}
  \item Aerial cover summaries by plot and year for all years and plots from AerCover. The original aerial cover is converted from AerCover to short-term monitoring terminology.
\end{itemize}
AerCover\_VegAerCoverConvertSummary2
\begin{itemize}
  \item Summary of no aerial cover by plot and year for all years and plots from AerCover.
\end{itemize}
AerCover\_SummaryLineMon
\begin{itemize}
  \item Aerial cover summaries by plot and year for all years and plots from LineMon.
\end{itemize}
AerCover\_VegAerCoverTotalSummary
\begin{itemize}
  \item Aerial cover summaries for total hits by plot and year for all years and plots from AerCover.
\end{itemize}
AerCover\_VegAerCoverPASummary
\begin{itemize}
  \item Aerial cover summaries for presence/absence by plot and year for all years and plots from AerCover.
\end{itemize}
VegidSummary\_AerCover
Aerial cover summaries by plot and year for all years and plots from AerCover. For those VegID having matching entries in the PlntList table, scientific name is shown.

Minor underlying queries exist for the above-mentioned that are not listed here.

8.4.5 Aerial Cover Analysis Assumptions
Only known VegID listed in the PlntList table are included.

8.4.6 Aerial Cover Analysis Result Queries
- tmp_Analysis_AerCover
  Results by year(s) (depending on options selected, may include all plots or core plots only, all years or a single year, recorded aerial cover or converted aerial cover, and aerial cover by type or percent cover)
- tmp_Analysis_AerCover_Group
  Results by year(s) and user defined grouping element (depending on options selected, may include all plots or core plots only, all years or a single year, recorded aerial cover or converted aerial cover, and aerial cover by type or percent cover)
- tmp_Analysis_AerCover_Plot
  Results by year(s) and plot (depending on options selected, may include all plots or core plots only, all years or a single year, recorded aerial cover or converted aerial cover, and aerial cover by type or percent cover)

8.5 Woody Vegetation Analysis

8.5.1 Woody Vegetation Analysis Input Tables
- BeltTran LCTA initial inventory and long-term monitoring belt transect data
- BeltMon LCTA short-term monitoring belt transect data
- BeltSurv LCTA belt transect exceptions species (belt restrictions)
- PlotSurv LCTA plot survey information
- PlotMast LCTA master plot information

8.5.2 Woody Vegetation Analysis Working Tables
- tmp_Belt
  Belt transect summaries by plot and year for all years and plots from BeltTran and BeltMon.
- tmp_Belt_HtCats
  User-defined height categories

8.5.3 Woody Vegetation Analysis Errors Checked
- Missing plots from BeltTran
- Missing plots from BeltMon
- Null VegID in BeltTran
- Null VegID in BeltMon
- Unknown Genus for VegID in BeltTran
- Unknown Genus for VegID in BeltMon
- Missing BeltSurv entries (belt restriction information)
8.5.4 Woody Vegetation Analysis Working Queries

VegidSummary_BeltTran
Summary of belt transect data by plot and year for all years and plots from BeltTran. Includes plant name information.

VegidSummary_BeltMon
Summary of belt transect data by plot and year for all years and plots from BeltMon. Includes plant name information.

VegidSummary_BeltSurv
Summary of belt transect exception species by plot and year for all years and plots from BeltSurv. Includes plant name information.

Minor underlying queries exist for the above-mentioned that are not listed here.

8.5.5 Woody Vegetation Analysis Assumptions
BeltSurv data are assumed to be correct.

8.5.6 Woody Vegetation Analysis Result Queries

tmp_Analysis_Belt
Results by year(s) (depending on options selected, may include all plots or core plots only, all years or a single year, and predefined or user defined height categories)

tmp_Analysis_Belt_Group
Results by year(s) and user defined grouping element (depending on options selected, may include all plots or core plots only, all years or a single year, and predefined or user defined height categories)

tmp_Analysis_Belt_Plot
Results by year(s) and plot (depending on options selected, may include all plots or core plots only, all years or a single year, and predefined or user defined height categories)

8.6 Universal Soil Loss Equation (USLE) Calculations

8.6.1 Universal Soil Loss Equation (USLE) Calculations Input Tables

GndCover LCTA basal vegetation data
AerCover LCTA aerial vegetation data
SoilMast Master soil series table
SoilLS LCTA plot slope data
SoilSmpl LCTA plot soil sample data
PlotSurv LCTA plot survey information
PlotMast LCTA master plot information

8.6.2 Universal Soil Loss Equation (USLE) Calculations Working Tables

tmp_Erosion
USLE summaries by plot and year for all years and plots. All subfactors of the USLE are shown. LS (topographic factor) is calculated for three points along the transect in addition to a mean LS for the overall plot. Erosion status and erosion index values are calculated for these three points and the mean.
8.6.3 Universal Soil Loss Equation (USLE) Calculations Errors Checked

Missing aerial cover information for all plots
Missing ground cover information for all plots
Missing aerial cover height information for all plots
Missing aerial cover data
Missing ground cover data
Multiple R values in PlotMast
Missing soil series in PlotMast
Missing soil sample data
No soil sample data found in the SoilSmpl table
No matching soil series in PlotMast and SoilMast
Missing published K value in SoilMast
Missing calculated K value in SoilMast
Missing T value in SoilMast
Missing slope in SoilLS
Missing slope length in SoilLS
Missing plots in SoilLS

8.6.4 Universal Soil Loss Equation (USLE) Calculations Working Queries

Minor underlying queries exist that are not listed here.

8.6.5 Universal Soil Loss Equation (USLE) Calculations Assumptions

Any type of ground cover, other than bare ground, is used to calculate percent ground cover.
During short-term monitoring, average minimum drip height is from previous inventory year.
If slope information is missing, LS is used from the most recent year containing LS.
When calculating a K value, structure code = 2 and permeability class = 3 when not provided.

8.6.6 Universal Soil Loss Equation (USLE) Calculations Result Queries

`tmp_Analysis_USLE`

Results by year(s) (depending on options selected, may include all plots or core plots only, all years or a single year, published K value or calculated K value)

`tmp_Analysis_USLE_Group`

Results by year(s) and user defined grouping element (depending on options selected, may include all plots or core plots only, all years or a single year, published K value or calculated K value)

8.7 Diversity Indexes

8.7.1 Diversity Indexes Input Tables

AerCover LCTA aerial vegetation data
PlntList Local LCTA species list
PlotSurv LCTA plot survey information
8.7.2 Diversity Indexes Working Tables

tmp_Diversity

*Diversity indexes by plot, year, and guild for all years and plots. S (the number of species recorded), N (the total number of individuals summed over all species), and diversity indexes are shown.*

8.7.3 Diversity Indexes Errors Checked

Missing plots in AerCover
Missing plots in LineMon
Null VegID in AerCover
Null AerCov in LineMon
Missing genus, life, form, or origin in PlntList

8.7.4 Diversity Indexes Working Queries

Minor underlying queries exist that are not listed here.

8.7.5 Diversity Indexes Assumptions

None

8.7.6 Diversity Indexes Result Queries

tmp_Analysis_Diversity_Group

*Results by year(s), user defined grouping element, and guild (depending on options selected, may include all plots or core plots only, and all years or a single year)*

8.8 Power Analysis

8.8.1 Power Analysis Input Tables

AerCover: LCTA aerial vegetation data
GndCover: LCTA basal and disturbance data
PlntList: Local LCTA species list
PlotSurv: LCTA plot survey information

8.8.2 Power Analysis Working Tables

tmp_Disturbance

*Disturbance summaries by plot and year for all years and plots from GndCover and LineMon*

tmp_GroundCover

*Basal cover summaries by plot and year for all years and plots from GndCover and LineMon. The original basal cover and converted basal cover (short-term monitoring terminology) are shown.*

tmp_AerCoverConvert

*Aerial cover summaries by plot and year for all years and plots from AerCover and LineMon. The original aerial cover is converted from AerCover and combined with LineMon data (short-term monitoring terminology).*
8.8.3 Power Analysis Errors Checked

Note that no error checking is done during this analysis. The assumption is made that all errors have been checked and corrected before proceeding with this analysis. Use the data management utilities to check errors. In addition, running the ground disturbance, ground cover, and aerial cover analysis will check and report any invalid entries.

8.8.4 Power Analysis Working Queries

- tmp_Analysis_PowerAnalysis_Plots1
  List of core plots for first year from one of the working tables (depends on test variable selected).
- tmp_Analysis_PowerAnalysis_Plots2
  List of core plots for second year from one of the working tables (depends on test variable selected).
- tmp_Analysis_PowerAnalysis_Plots3
  List of plots in common between first and second years.

Minor queries exist that are not listed here.

8.8.5 Power Analysis Assumptions
All errors have been corrected.

8.8.6 Power Analysis Result Queries
None

8.9 Plot Summary

8.9.1 Plot Summary Input Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LandUse</td>
<td>LCTA military and non-military land use data</td>
</tr>
<tr>
<td>MaintAct</td>
<td>LCTA maintenance activities data</td>
</tr>
<tr>
<td>ErosEvid</td>
<td>LCTA observed wind/water erosion data</td>
</tr>
<tr>
<td>AerCover</td>
<td>LCTA aerial cover data</td>
</tr>
<tr>
<td>GndCover</td>
<td>LCTA basal cover data</td>
</tr>
<tr>
<td>BeltTran</td>
<td>LCTA initial inventory and long-term inventory belt transect data</td>
</tr>
<tr>
<td>BeltMon</td>
<td>LCTA short-term monitoring belt transect data</td>
</tr>
<tr>
<td>SoilLS</td>
<td>LCTA slope data</td>
</tr>
<tr>
<td>SoilMast</td>
<td>Master soil series information</td>
</tr>
<tr>
<td>PlotSurv</td>
<td>LCTA plot survey information</td>
</tr>
<tr>
<td>PlotMast</td>
<td>LCTA master plot information</td>
</tr>
</tbody>
</table>
8.9.2 Plot Summary Working Tables
None

8.9.3 Plot Summary Errors Checked
None

8.9.4 Plot Summary Working Queries
VegidSummary_Aercover
Aerial cover summaries by plot and year for all years and plots from AerCover. For those VegID having matching entries in the PlntList table scientific name information is shown.

VegidSummary_GndCover
Basal cover summaries by plot and year for all years and plots from GndCover. For those VegID having matching entries in the PlntList table scientific name information is shown.

VegidSummary_BeltTran
Woody vegetation summaries by plot and year for all years and plots from BeltTran. For those VegID having matching entries in the PlntList table scientific name information is shown.

VegidSummary_BeltMon
Woody vegetation summaries by plot and year for all years and plots from BeltMon. For those VegID having matching entries in the PlntList table scientific name information is shown.

8.9.5 Plot Summary Result Queries
None
9 References


