

LBCS

Land-Based Classification Standards Project

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LBCS Discussion Issues

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by

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I. LBCS Project Introduction

The 1965 Standard Land Use Coding Manual (SLUCM) is the only national-level attempt to standardize land-use coding for local, regional, and state land-use planning applications. The land uses and categories in the manual were based on a modified version of the Standard Industrial Classification (SIC). The coding scheme used a 4-digit SIC-like hierarchical system (see Appendix 1 for excerpts). The manual also illustrated techniques to expand the system to accommodate coding of other information related to land uses with the land-use codes. Although the SIC has undergone major revisions since 1965, SLUCM has not been updated to keep up with these changes. In 1993, the Federal Highway Administration approached APA to conduct a feasibility study to determine the interest in updating the 1965 SLUCM. In 1994, APA reported to the FHWA on the findings of a survey of federal, state, regional, and local needs for an updated land-use classification standard (see Appendix 2 for excerpts). In May 1996, APA, along with the participation of six other federal agencies, initiated the Land-Based Classification Standards (LBCS) project to update the 1965 SLUCM.

A. Project Oversight and Review

The six federal agencies and APA provide oversight and review of the study through a Steering Committee that is comprised of representatives of each of the funding agencies (see Appendix 4 for committee members).

The APA is currently soliciting professionals in land-use and planning agencies for nomination to a Technical Advisory Panel (TAP) which will review and comment on all the LBCS products. TAP members will also work with project staff in writing working papers, conducting case studies, and working on special tasks that may be required during the project. The TAP will be set up as a “virtual group.” That is, it will never meet physically in one place, but will use the Internet to

communicate, review, and participate in the project. The TAP's purpose is to comment and review all LBCS products.

B. Purpose of the LBCS Workshop

The role of LBCS Workshop participants is to discuss some of the more difficult product-related conceptual issues, before any products are developed for review by the TAP. The LBCS Workshop, held in Chicago, January 19-20, 1997, was an intensive two-day brainstorming session intended to provide comments and guidance on strategic issues. The agenda was developed with input from the workshop participants. The summary of notes from the workshop appear in Appendix 13. Discussion issues and questions in this paper are highlighted in *bold text*.

C. Project Duration and Phases

The LBCS Work Program (Appendix 3) spans over a period of three years in two phases. Phase I is 24 months and involves the development of the following: an inventory of land uses including standard language for definitions and usage; a draft classification scheme that will show the relationships between uses and categories; and a draft coding scheme. Phase II is the remaining 12 months, during which, LBCS will undergo extensive "road testing" before publishing and distribution.

D. Project Products

The following items are project products. Discussion topics are designed to follow these products.

1. Primary Products

- C A Comprehensive List of Land-Based Terms
- C A List of Definitions and Usage Examples
- C A Classification System

- C A Coding Methodology
- C A Conversion System
- C A Maintenance Plan

2. Secondary Products

- C Workshop Summary
- C Working Papers
- C Case Study Papers
- C Standards Field Testing Report
- C Annotated Bibliography
- C On-line Resources

II. Problems in Current Classification Systems

We have developed ideas about the key issues by using the background material from the 1994 study, *“Toward a Standardized Land-Use Coding System,”* (Appendix 2) and from the information we gathered while preparing the LBCS work program. The problems with existing classification systems have to do with:

- C Lack of a comprehensive inventory of land uses, land cover types, and other common land-based information terms;
- C Lack of a list of definitions of land uses and land-use activities and functions;
- C Classification standards that cannot recognize the sources of land-based data other than parcel-based sources;
- C Lack flexibility in categorizing land uses in urban, suburban, and rural areas--a system that all types of planning agencies (local, regional, state, and federal levels) can use;
- C Lack of standard ways of categorizing land uses consistent with and supporting of recent legislation at the federal level and innovative growth management techniques at the local and regional levels;

- C Lack of standards for sharing land-based information and data between various land-use applications within planning departments, within jurisdictions, within regions, and within state and federal programs;
- C Lack of software tools that exploit GIS, modern databases, and other information technologies that were not easily available until recently to many users; and
- C Lack of flexibility for updating the classification standard, the definitions contained in the standard and the coding systems used by the classification to reflect current and future methods of analyses employed in the land-based applications.

Discussion Item(s):

What other fundamental issues should be included here? Do any of these concerns require further clarification? How can these concerns be conveyed better?

Notes:

Each of the above items is discussed in detail below. Since the question of problem definition is open-ended, we will review the overall summary of problem definition throughout the workshop discussions.

III. Inventory of Land Uses and Definitions

One urgent need identified in the 1994 APA report, *Toward a Standardized Land-Use Coding System*, is a comprehensive inventory of land uses. Such an inventory would include all the traditional land uses and land-use activities relevant to planning applications. The most basic of these applications is the need to describe existing and future uses in comprehensive, corridor, special area, or functional plans, and the mapping of such land uses in these documents. Certain maps (such as zoning, small area plans, and specific area plans) require more detailed categories of land uses and land-use activities. Land uses and land-use activity terms and definitions are also used in narrative and descriptive forms in such plans; in zoning ordinances to describe what uses are allowed, nor permitted, or permitted under certain conditions; and in public hearings and forums about planning and its implementation.

A. What Do We Mean By “Land-Based”?

Historically, the term “land use” in the planning profession not only meant land uses, but also implied land cover and land rights. Even in the most basic land-use categories, such as agricultural, residential, commercial, industrial, public uses, and recreational uses, land cover and land rights or ownership characteristics are implied. For example, the “agriculture” category is a type of land cover and “public uses” is a description of an ownership characteristic.

In most planning applications, “land use” implies the inclusion of at least some aspects of land cover and land rights. This implication, however, is not universal. The term land cover in remote sensing, for example, includes many other land cover categories or finer gradations of categories that serve needs beyond those of land-use applications. Also, the term “land” itself, as applied in policy discussions about land uses, is continuously being expanded to express other purposes that

reach beyond physical or functional characteristics (Guttenberg 1993, 23-25). For example, physical or control purposes (clearing forests, draining swamps, irrigating deserts) and social purposes (redevelopment, conservation, preservation, hazards mitigation, risk assessment) compel new ways of thinking about land-use information. Although no detailed discussions of such categories are in SLUCM, the manual nevertheless incorporated such ideas by providing methods to extend the coding system for residential structure types, crop types, and ownership types. For an earlier discussion on categories that are based on planning approaches see the Wilkens (1941) outline (Appendix 8).

To avoid ambiguity in terms, this project will use the term “land-based” to refer to all the concepts embodied in the discussion above. Land-based information, therefore, includes all types of land uses and land-use activities, and those aspects of land cover and land rights information used in planning applications.

B. What Sources Will We Use To Build The Inventory

A comprehensive inventory of land uses will include a survey of land uses, land cover types used in planning applications, and those land rights commonly associated with, or employed in, planning applications. Such an inventory will be built in a database format that will initially comprise all the traditional land uses. Sources will include lists from existing standards, books on standard land-use definitions, reports, plans, and zoning ordinances in the APA library.

1. Updated List of Land Uses From SIC/NAICS Categories

This step will update the database of land uses with new uses and activities corresponding to the new SIC categories added since the 1965 SLUCM. In 1987, SIC underwent major revisions when a quarter of all SIC numbers were changed.

For this reason, many 1965 SLUCM land-use categories that correspond to SIC codes will change significantly. These changes regrouped several industries and added new ones. Some manufacturing categories have been completely removed because they no longer exist. New industries are mostly in the high-tech industries, computer-related industries, and other retail uses (video stores, yogurt shops, etc.).

An even more significant change to SIC is imminent. The North American Industrial Classification System (NAICS) will soon replace the existing 1987 SIC. The NAICS (see Appendix 6) will make substantial structural improvements and identify new industries that will enable the monitoring of long-term effects of NAFTA by examining production and sales across Canada, Mexico, and the U.S. The Census Bureau, the Bureau of Economic Analysis, and the Bureau of Labor Statistics are carrying out some NAICS changes for this year. Although the transition to NAICS will not be complete until 2009, most of the changes to the classification system are slated to be completed by 1999. Many industry sectors, like those in computers, services, and publishing, have been completed and agreed upon by the three NAFTA trading countries.

Beyond adding new industries, NAICS is also reorganizing the system according to the types of production activities performed, rather than a combination of categories based on production or market activities. If the industry codes from NAICS are used to update the 1965 SLUCM land uses list, then more than 90 percent of all uses will change and some categories must be entirely revamped. On the other hand, using the codes from the 1987 SIC will probably affect no more than 25 percent of the existing SLUCM codes.

Discussion Item(s):

Does it still make sense to base the new land-based classification system primarily on SICs? Should the LBCS inventory be based on the NAICS drafts? Is it better to build a list from 1987 SIC and then transition to NAICS? What are the implications of using either version?

Notes:

Issues related to specific coding changes, regrouping of categories, and classification changes in NAICS will be discussed in further detail below.

2. Expanded List With Terms From Other Sources

Other sources for terms to encompass concepts outside SIC/NAICS would include comprehensive plans, zoning ordinances, statutes and court case definitions, and other planning-related documents. Sources for such plans and zoning ordinances will include the APA Library, TAP members, Steering Committee members, and survey material collected for this project. These terms will augment those collected from SIC/NAICS.

Discussion Item(s):

What other sources should be explored? What are the mechanisms for getting such information quickly in the database? Can such a database be useful for other purposes?

C. Standard Definitions and Usage Examples

Many traditional land-use terms are self-explanatory and fairly consistent in usage. Some newer land-use terms used for describing new businesses and new planning trends, however, may require additional descriptions or definitions to be uniformly understood. Such definitions need not be extensive but should provide enough detail to identify the context. Typically, the language used for definitions that are commonly found in zoning ordinances would suffice. Sometimes a synonym or a related term may be required to clarify the context. For some of the newer terms, especially those derived from SIC/NAICS industry descriptions, the language from SIC/NAICS is sufficiently comprehensive for use in the LBCS inventory.

For definitions of new and unique terms not included in the above sources, multiple examples may be provided. Such examples will be extracted from existing plan documents, zoning ordinances, and other related planning documents. No new terms, definitions, or descriptions of terms will be invented for this project.

Discussion Item(s):

Should the LBCS inventory integrate land-use terms and definitions? If so, what is the rational level of integration? What should be the format of the database? Should we include all the sources of every definition in the database? Are pictures of some unique land uses in the database worth having?

IV. Developing Classification Systems

The principal objective of the project is to provide a classification scheme for land-based data so that data may be shared or compared from jurisdiction to jurisdiction, both horizontally and vertically. The classification system must also be easy to understand and to use.

Although building an inventory of land-based terms and definitions would help in some respects, some issues about classification go beyond building an inventory and collecting definitions. These issues must be first identified before discussing the more specific issues about implementation and coordination. So, the basic question is What is a classification system?

A. Components of a Classification System

The notion of classification involves three components: defining categories, ordering categories, and establishing relationships between categories (Land 1991, 5). The two principal purposes of the classification system are to be able to: generalize about the subject matter that is being categorized; and identify relationships about objects contained in those categories. Therefore, a land-based classification should contain:

- C categories about land-based information;
- C enough categories to differentiate various characteristics of land-based information; and
- C the identification of relationships between those categories.

There are two other useful ways of describing the components of a classification. These approaches are described below.

1. Statistical View of Classification

From a statistical point of view, classifications are either nominal, ordinal, or proportional. Categories such as residential, commercial, and industrial are nominal entities.

STATISTICAL VIEW
Nominal
Ordinal
Proportional

Categories such as single-family residential, duplex, townhouses, and multifamily residential are ordinal since each successive category suggests an order, in this case it is density. But when density is mapped in categories, such as 1-10 du/acre, 11-20 du/acre, 21-30 du/acre and 31-higher, they are in proportional or ratio scale. For example, many ITE Trip Generation Manual's categories for estimating traffic trips are in a ratio scale. The manual's trip generation rates for office buildings are in ranges of total square footage in increments of 25,000 square feet for smaller buildings and 100,000 square feet for larger buildings.

2. Data-Model View of Classification

From a data-model point of view, classification is the first of four levels of abstraction of data. The other three are generalization, association, and aggregation. Classification in data modeling is the mapping of several objects to a common class.

DATA-MODEL VIEW
Classification
Generalization
Association
Aggregation

For example, the mapping of all single-family residential units to a class designation like "low-density residential" is classification.

Generalization is the grouping of several classes with common properties or operations. If single-family, multifamily, etc., are different classes, then grouping is putting all such classes into one "residential" category.

Association is when a relationship between similar objects is explicitly declared. For example, several houses are within a

subdivision, or a shopping mall contains multiple department stores. The words “within” and “contains” associate different types of objects. Other associations are “in,” “out,” “adjacent,” “over” and “under.” This abstraction becomes important in GIS modeling of land-based data.

Aggregation is defining those objects that consist of other objects. In other words, aggregation can be referred to as defining compound objects. A planned unit development (PUD) may consist of residential, recreational, commercial and office classes. A single county, in turn, may consist of several PUDs, and a state would contain multiple counties. An example of aggregation of land-based data is when a COG or a regional agency assembles demographic data based on land-use projections from each of the constituent jurisdictions. Aggregation, however, is not logical and should not continue if there is no consistency in the underlying classifications, generalizations, and associations.

3. Link Between Classification and Data Modeling

Land-based classification and land-based data modeling are closely linked since both are forms of data abstraction and modeling cannot occur without a classification.

Discussion Item(s):

Are the approaches adequately described for understanding the varied forms of data encountered in land-based information systems? Should other approaches to classifications be considered?

4. Link Between Classification Standards and Coding Standards

Coding is a shorthand mechanism employed for computer data files. This is done through one or more digits of numeric

or text codes. These codes are then used to look up the textual value of the land-use through a table consisting of both the codes and textual values. This is a common database technique to speed up and simplify database operations. Coding also helps in windshield surveys where the recorder may use a short code for a lengthy text description of a land use. Therefore, using the same classification system with different coding systems is possible (a four-digit numeric system and a four-character text system). Many standards, nevertheless, treat classification and coding synonymously because coding methods can be tailored to fit the classification system.

In an hierarchial classification system, for instance, each digit of the code reflects a level in the hierarchy. Therefore, if the total number of levels in the hierarchy is four or less, and the total number of different classes is less than 9999, then a four-digit scheme could be employed. (This also assumes that no one level in any of the categories will have more than 10 unique subdivisions). By using such conventions, database operations can be speeded up because aggregate land-use statistics can be provided without ever using the look-up table.

B. Categories in Other Classification Systems

The following is a brief summary of the various ways in which other classification systems have developed categories. This discussion will highlight the conceptual differences in developing categories and not delve into too many details of the classification systems themselves.

1. SIC and NAICS Categories

Since the 1930s, the SIC system integrated a mix of categories based on production- and market-oriented economic concepts (see Appendix 6). Although such a mix generated inconsistent categories for some sectors of the economy, providing a general purpose classification system that satisfied all major

data users was nevertheless useful in meeting its principal objective. This inconsistency, using production categories for some industries and market categories for others, continues to this day. Because the SIC is a general purpose system, it has also enabled different statistical agencies to adopt their own system based on the mixed SIC categories--analogous to how the 1965 SLUCM was adapted--to overcome the conceptual differences. Demand for standards to enable comparisons between different statistical data produced by different agencies, however, necessitated a rethinking of the mixed categories in the NAICS.

NAICS chose a production-oriented approach to grouping industries into categories (see Appendix 6 for further information). This approach permitted the NAICS to provide more detailed codes for the service sector of the economy than the SIC did. The production-oriented approach also provided an opportunity to reorganize some categories to reflect manufacturing sectors of the U.S. economy in the 1930s. These differences can be best seen in the broad groups or sectors in the SIC and NAICS. The NAICS groups the economy into 20 broad sectors, up from the 10 major categories of the SIC system.

The 10 major categories of the SIC system are:

- C Agriculture, forestry, and fishing;
- C Mining;
- C Construction;
- C Manufacturing;
- C Transportation, communications, electric, gas, etc.;
- C Wholesale trade;
- C Retail trade;
- C Finance, insurance, and real estate;
- C Services; and
- C Public administration

The 20 NAICS Sectors are:

- C Agriculture, Forestry, Fishing and Hunting;
- C Mining;
- C Utilities;
- C Construction;
- C Manufacturing;
- C Wholesale Trade;
- C Retail Trade;
- C Transportation, and Warehousing;
- C Information;
- C Finance and Insurance;
- C Real Estate, and Rental and Leasing;
- C Professional, Scientific, and Technical Services;
- C Management of Companies and Enterprises;
- C Administrative and Support, Waste Management, and Remediation Services;
- C Education Services;
- C Health Care, and Social Assistance;
- C Arts, Entertainment, and Recreation;
- C Accommodation and Food Services;
- C Other Services (except Public Administration); and
- C Public Administration.

As to coding conventions, the 1987 SIC uses a 4-digit numeric code. The coding scheme uses 11 divisions at the first level; 83, 2-digit major groups at the second level; 416, 3-digit industry groups at the third level; and 1,005, 4-digit industries at the fourth level. The NAICS coding scheme uses a 6-digit numeric code instead of the 4-digit SIC to hold larger numbers of sectors and flexibility in designating sectors. The NAFTA countries have agreed to standardize the NAICS codes to the 5-digit level. The sixth digit is left open for meeting any special requirements of data users in individual countries.

2. Federal Geographic Data Committee and LBCS Activities

The Federal Geographic Data Committee (FGDC) was established through the U.S. Office of Management and Budget and charged with the responsibility to coordinate various surveying, mapping, and spatial data activities of federal agencies to meet the needs of the country. It is the lead group responsible for the National Spatial Data Infrastructure (NSDI) initiatives. Major objectives of FGDC are to avoid duplication and reduce costs in mapping and spatial data activities. The FGDC's mission involves establishing standards and providing wider access to geospatial data. It also involves coordinating geospatial data-related activities with other levels of government and with public, private, and academic sectors.

The coordination function of the FGDC establishes the link to the LBCS. Adoption of the LBCS by the FGDC will have the following implications:

- C The LBCS will become mandatory for all federal information processing of data related to land-based data. For instance, the submission of land-use data by planning consultants on federal projects should conform to any adopted FGDC standard.
- C The LBCS Project will conform to the 12-step standards approval process established by the FGDC. This process involves compliance at several stages during the project development. Since we produced the LBCS work program along similar lines, we expect the LBCS project to comply with the FGDC standards approval process.

The LBCS must be consistent with the standards developed by FGDC for land cover, land rights, and database or content standards. Although FGDC has several subcommittees and working groups, this coordination relates to three of the subgroups. They are the Earth Cover Working Group, the

Vegetation Subcommittee, and the Cadastral Subcommittee. Each of these subgroups of the FGDC works on standards for specific thematic areas. Some of these standards overlap land-based classification issues. Many drafts of such standards by FGDC exist, and understanding these would help establish the critical links between LBCS and these other efforts.

3. FGDC Earth Cover & Vegetation Categories

The Earth Cover Working Group is developing an integrated approach to the identification, classification, and mapping of features that cover the surface of the United States. The objective is to maximize resources, to avoid duplicating efforts, and to use uniform earth cover standards for a wide range of applications.

The Earth Cover Working Group will identify, classify, and develop protocols for land-cover categories necessary to add up to 100 percent of the earth surface. The cover surfaces, as they would appear on aerial photographs or satellite images are:

- C Vegetation;
- C Water;
- C Snow;
- C Ice;
- C Human Constructions;
- C Bare Soil;
- C Sand; and
- C Exposed Rocks.

Because some of these cover surfaces overlap with standardization efforts of other working groups and subcommittees of the FGDC, the Earth Cover Working Group will incorporate all such cover data categories where feasible. These include vegetation, water, soils, transportation, and cultural features.

For vegetation types, the Earth Cover Working Group has adopted the standard produced by the FGDC Vegetation Subcommittee (Appendix 10). This committee has developed a draft vegetation classification system, National Vegetation Classification System (NVCS), that is hierarchial and contains the following categories at the broadest level:

- C Natural vegetation;
- C Semi-natural vegetation;
- C Planted vegetation; and
- C Cultivated vegetation.

The above categories apply to any area having more than one percent live vegetation cover in the United States. The vegetation types within these categories include both the broad ecological characteristics and specific botanical characteristics. The core of the classification system contains:

- C Dominant life form (tree, shrub, dwarf shrub, herb, and non-vascular);
- C The percent cover of the dominant vegetation on the surface of the earth;
- C Physiognomic attributes of the dominant vegetation (evergreen, deciduous, etc.); and
- C Hydrologic regimes of the vegetation site (deserts, coastal, wetlands, floodplains, etc.).

4. FGDC Cadastral Categories

The FGDC Cadastral Subcommittee developed draft cadastral standards for the FGDC. Cadastral data are defined as the geographic extent of the past, current, and future rights and interests in real property, including the spatial information necessary to describe that geographic extent. Rights and interests are the benefits or enjoyment of real property that can be conveyed, transferred, or otherwise allocated to another for economic remuneration. The cadastral data includes only those rights and interests recorded in land record

documents.

The cadastral standard defines attributes or elements that are in landownership related documents. The standard also defines common terminology and the use of such terminology. The geographic scope of the cadastral standard extends throughout the country and also includes offshore and marine cadastral elements.

The key elements of this standard that pertain to the LBCS include legal forms of land ownership, municipal and governmental units descriptions, deed restrictions, and platting and measurement standards. Many of these categories are under development, and land-rights concepts in LBCS must correspond.

C. Criteria for Defining Categories for Land-Based Data

During the scoping stage of this project, the most frequent obstacle identified to using a classification system across applications was inappropriate categories. Categories in existing classification systems are based on specific purposes or functions of the data. Consequently, categories used for economic development applications are inappropriate for transportation applications.

Some categories are meaningful only for specific geographic scales or geographic characteristics. Categories used for applications in large cities may not be useful for rural communities, or vice versa. Even when the geographic scale is appropriate, the character of the community may require categories that are unique. For example, coastal communities and resort communities need an entirely different approach to categories for tourism-related uses.

Some newer uses are classified under the categories that give the community the most control over the land use. One

recurrent example for such seemingly arbitrary treatment is housing for the elderly. What may appear in an obvious category, such as housing, is often classified under various nonresidential uses like hospitals, hotels, and commercial and institutional uses because such uses could contain on-site medical and hotel-like catering and valet facilities. Categories, therefore, should also deal with such flexibility needs.

Yet another form of distinction in categories is based on the data collection method. Categories used for parcel-based data are inappropriate if the data is from remote sensing.

Therefore, in summary, criteria for determining categories, at a minimum, should recognize the following:

- C the applications--functions of the data (what);
- C the resolution--geographic scale or extent (where); and
- C the sources--acquisition of data (how).

A detailed comparison of classification systems is in the 1994 APA report “*Toward a Standardized Land-Use Coding Standard*” (Appendix 2, 11-18).

Discussion Item(s):

Are there other criteria for determining categories?

Notes:

The details of various functions, geographic scales, and sources of data to help determine categories will be discussed below.

1. The Applications of Land-Based Data

The classic land-based data application is the comprehensive

plan map. A typical comprehensive plan map contains the following categories:

- C Agricultural;
- C Residential;
- C Commercial;
- C Industrial;
- C Recreational;
- C Institutional; and
- C Public Uses.

A typical plan map is both a reflection of existing uses and planned or projected uses. Sometimes the map also shows the intensity or density of the uses, especially if they are residential uses. Yet, in a zoning map, the designations usually include only zoning district names. The land uses or the land-use activities in a given zone are described in the regulations about that zone. These uses appear under permitted uses, conditional uses, special uses, special exceptions, etc., in the zoning ordinance. Such lists are very specific and are further differentiated based on specific characteristics of the land-use activity. These characteristics may be related to physical access, hours or service, size of development, etc. Some familiar examples are restaurants with and without drive-through window services, convenience stores with and without gas service, and laundromats with and without on-premises plants. Both the comprehensive plan map and the zoning maps may also contain additional designations, such as an airport overlay district, historic overlay districts, a downtown commercial district, and economic development district. Such special designations also require unique land-use categories.

2. Other Dimensions of Land-Based Classification System

The problem of categories, then, is the identification of all common applications of land-based data. Guttenberg, in the essay “New Directions in Land Use Classification,” provides a

method of identifying categories based on the types of applications in planning (see Appendix 7 for excerpts). First published in 1959, this article proposes a structure for planning applications based on planning goals. Because most classification systems in planning applications are developed only to “analyze” existing conditions, the author suggests that those planning applications that have to “evaluate” or “prescribe” suffer from an impaired or stunted classification tool. To overcome this limitation, the author suggests the following additional facets or dimensions of classifications:

- C **General Site Development Characteristics:** This would provide information about the site characteristics that would not otherwise be available. The suggested categories are: undeveloped land; developed land, without structure; developed land, with temporary structure; and developed land, with permanent structure.
- C **Building Type Characteristics:** This would tell whether a parcel of land has a building on it. The suggested categories are: Hospital-type building; office building; row house; warehouse; etc. Some of the residential categories, such as single-family, two-family, town houses, low-rise apartments, etc., are building type characteristics.
- C **Activity Use:** Because activities are adaptable in various building forms, identifying what activities are predominant in what types of buildings may be necessary (church in a storefront, for example). The suggested categories are: household, school, religious, parking, office, etc.
- C **Activity Characteristics:** These categories are based on the size of the activity, range of impacts of the activity, rhythm or time shape (daily peak and low periods), and material effect, such as noise, odor, and vibration.
- C **Economic Over-use:** This is similar to functional classifications of the SIC and NAICS treatment of auxiliary and primary functions. More on this appears later in the agenda.
- C **Appraisive Quality:** These categories pertain to the physical condition and technological currency. The

concept is similar to the idea of identifying substandard structures.

- C **Economic Durability:** These categories represent the entrepreneurial interest in land use. Many risk assessment ideas from hazards mitigation and other concerns may be reflected as new categories.
- C **Social Impact:** Such categories depict the public interest in land and its use. The four suggested interests are: law enforcement, protection of users who are not property owners, environmental security, and conservation of social resources.

Discussion Item(s):

Since the classification of land uses depends on the planning applications, should we first attempt to classify all planning applications? Are classifications public-policy neutral?

3. The Scales or Geographic Extents of Land-Based Data

Typical geographic extents of land-based applications are: neighborhoods or small areas; cities or counties; regions that contain several cities and counties; and states or multistate areas.

At the neighborhood or small-area scale, land-based categories are very specific to the location and, therefore, not easy to standardize. Categories at this scale are often weighted toward a major use category. For example, downtown area plans may require finer gradations in office and commercial categories than the rest of the community. Other applications at this scale are urban renewal districts, historic areas, neighborhood plans, special tax districts, etc.

A citywide or countywide scale is the most frequently used

geography for land-based data. Land-use codes are generally assigned to a parcel-based database that often contains other cultural and demographic information. Categories for applications at this scale are more adaptable, especially by cities and other urbanized counties.

At the regional scale, typical land-based data users are COGs, MPOs, and coastal management agencies, and categories are tailored to specific program requirements (regional transportation, coastal zone management, floodplains, air quality, regional fair-share housing, etc.). The increasing emphasis on regional coordination and planning is putting pressures on regional agencies to develop common data formats that will allow standardized data collection, use, analysis, and acceptance. Categories at this scale, therefore, should be flexible so that data could be aggregated and disaggregated as needed.

At the statewide scale, and scales at the national, continental, and global levels, categories are mostly land cover types. State environmental, planning, transportation, and other related agencies use these categories. Standardizing categories at this scale is the easiest when the data is collected independent of local jurisdictions (through remote sensing, for example). Standardizing categories is more difficult, however, when aggregating data from a “bottom-up” approach. (For example, transportation or housing applications that require data from constituent jurisdictions.)

Discussion Item(s):

What are the key issues that should be considered when developing categories to address application needs at the various scales? Which issues are not critical or important for determining categories?

4. The Sources of Land-Based Data

The primary source and format of data or, more appropriately, the data acquisition methods determine what categories may be usable. The resolution or the unit of mapping or coding and the accuracy of the data are dependent on the type of source. The three common methods of land-based data sources are: site surveys, aerial photography, and satellite-based remote sensing.

Site surveys and municipal land records are the primary sources of parcel-based land-use information systems. The 1965 SLUCM at the most detailed level was designed for such purposes. Land-records data are the primary source of all land-use information at the neighborhood and citywide/countywide scales. The accuracy at this resolution is extremely high. At this resolution level, 200 to 800 land-based classes are typical, and their categories vary widely.

Communities are using aerial photography to augment site-surveyed, parcel-based data. This source is also increasingly being used to automate scanning for GIS applications. The resolution varies from a census-block level to four feet. At this resolution, 12 to 100 land-use classes are typical. The categories in which these classes are grouped are typically land-cover related.

Satellite-based remote sensing methods of acquisition are undergoing rapid changes as improvements and accessibility in the satellite, imaging, and scanning technologies increase. Resolutions of the pixels range from one- to 100-acre grids. Global imaging systems use larger grids. At this resolution, typically, there are 10 to 15 types of land cover classes. The categories of these classes are typically land-cover related.

Assigning land-based classification codes to records in a database or features on a map must allow for several resolutions. The classification unit (or what each record refers

to in the database) at each of these resolutions vary. The commonly used classification units are parcels and pixels. At the parcel level, each record in the database or the map is assigned a land-use code. At the pixel level, although every pixel may be assigned a land-use code, usually the classification unit is a group of pixels.

Many local government databases that depend on real estate records, however, do not necessarily have parcels as their smallest classification units. They may be assessment units (groups of parcels), basic land units (used in rural communities), basic spatial units (developed for GIS mapping purposes), agricultural land units, and buildings or structures. With a building or structure as the classification unit, multiple codes may be needed for each record in the database for each floor of a mixed-use multistoried structure.

The number of categories that may be used in a classification standard will, therefore, vary on the type of classification unit.

Discussion Item(s):

What are the key issues that should be considered when developing categories to address resolution levels and classification units? Should LBCS include examples of how to structure databases and coding schemes for the various resolution levels and classification units? Which of the issues discussed above are not critical or important for determining categories?

D. Principles of Organizing Categories and Category Interrelationships

The other two components of a classification system are a consistent ordering of categories and establishing relationships between categories. The two common methods in existing

classifications are:

- C a simple exhaustive listing; and
- C a hierarchy of land uses.

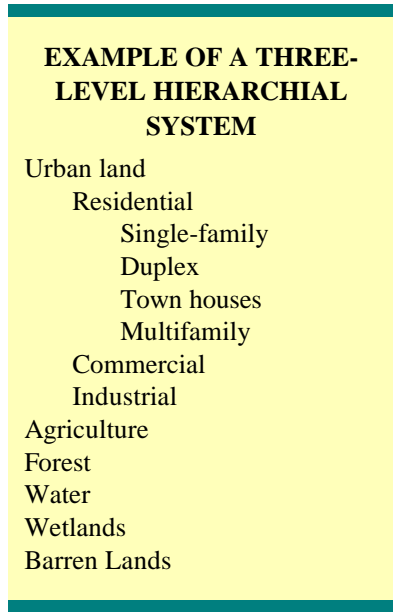
A third method that may be useful for some land-based applications is a combination of an exhaustive and hierarchial system structured like a thesaurus where a single land-use can be in multiple categories.

1. Exhaustive Listing of Categories

The exhaustive listing method uses a list of land uses with sufficient numbers of codes that balance the needs for generalization and differentiation. This is simpler of the two methods. Customizing it is easier, but harder to share or aggregate. Geographic coverages (or extents) at the neighborhood scale, typically, adopt this method. Because such a system is used for specialized areas or applications, certain types of land uses have too many or too few classes. For example, typical urban and suburban jurisdictions may have up to 50 different codes for classifying residential uses and no more than one or two codes for all water-related uses. A system for an environmental application, however, might have 50 different codes for water-related characteristics and one code for all types of residential uses.

2. Hierarchial Grouping of Categories

In a hierarchical grouping of categories, the land uses are grouped into classes that contain other groups or classes. All land uses are mutually exclusive. Both the SIC and the 1965 SLUCM are structured hierarchically. The Anderson coding system (excerpts in Appendix 9) popularized this hierarchical system to land cover applications that frequently use remote sensor data. Typically such hierarchies contain 10 or 12 broad classes for the base categories, such as urban land, agriculture, forest, water, wetlands, and barren lands. Under each of these base categories, other categories may contain more categories. Through such a structure, a classification system provides some form of an organization or conceptual consistency. For example, if the base category is urban land, it might contain residential, commercial, and industrial classes at the second level. At the third level, residential use may contain single-family, duplex, townhouses, and multifamily categories. Hierarchical systems could potentially have unlimited levels. However, in practice, land-based applications rarely employ more than six levels and most systems surveyed used no more than four levels.



3. Multidimensional Hierarchy

Conceptually, this is a flexible hierarchical system that could allow a single use or activity to appear in multiple categories. Users could freely assign such categories. For instance, in the housing for the elderly example discussed previously, it was shown how this use-type was grouped with commercial, hotel, or institutional uses instead of housing. In a multidimensional

flexible system, this use would appear under all three categories--much like a library catalog system, in which a book may appear under several subjects and the subjects can be added and deleted at will. No known land-based classification systems are using such an hierarchy although Nicholas Land (1991) proposed such a system to classify cartographic elements for maps in the United Kingdom.

The central feature of such a system would be a thesaurus-like database that contains all the land uses and each use is linked to other uses through definitions, synonyms, and homonyms. In a library classification system, this is accomplished by providing fields for narrower terms, broader terms, and related terms. The principal purpose of such a flexible system is to maximize the chances of retrieval (or finding a book in a library catalog) of a record. Such a system could be useful in economic development applications that assist in finding appropriate development sites. The more general a use class, the more categories under which it appears. Coding of terms will not be necessary in such a system since every land-use could fall under several categories. Therefore, such databases use the text description of the term as the primary key. Without a coding standard, viewing entire sets of relationships defined in the database will be difficult. Although some high-end graphical tools for such databases are available, it will be difficult for agencies using land-based classification standards to have access to such tools.

The notion of a thesaurus for a land-based classification system may overcome the problem of rigidity in categories but will undermine the ability to aggregate land-based data into broader categories uniformly. For example, if total acres for all classes are aggregated to a broader set of categories, the result will exceed 100 percent. The inability to do such acreage-based analysis defeats a basic purpose of a land-based classification standard.

Discussion Item(s):

This is a conceptual problem of defining categories; namely, do items in a category and all the categories in a system have to be mutually exclusive (the 100 percent problem)? How are attributes related to other facets of planning, such as Guttenberg's dimensions, incorporated in a land-based classification standard? Do we need multiple classification hierarchies? Is a coding scheme a necessary component of a land-based classification standard?

Notes:

Note that the conceptual dilemma described above is different from those that can be solved through layers in a GIS system. Layers are map features that are logically organized into themes of information (soils, streams, wells, parcel boundaries, etc.). One of these themes is land-use or land-based data. For Guttenberg's dimensions, see the previous section on Criteria for Defining Categories for Land-Based Data.

V. Working Papers and Case Studies

We expect that through the discussions of issues related to the development of an LBCS, we can identify all the topics that require further investigations, either through working papers or case studies.

A. Working Papers' Topics

The following topics are listed here for discussion:

- C A History of Land-Based Classifications;
- C Classification Systems in Europe & Australia;
- C Relationship of LBCS to other standards: NAICS, SIC, FGDC, FAO, ANSI, FIPS, NVCS, etc.;
- C Usage of land-based information in planning applications;

- C The language of definitions for land uses based on the inventory of land uses;
 - C Development of databases for land-based data for sharing, aggregating, and analysis;
 - C Use of land-based data in data modeling (view manipulation in GIS and CAD);
 - C Space as a new dimension in land-use classifications;
 - C Use of land-based data in data modeling (process manipulation in transportation, economic impacts, environmental impacts, etc., using GIS and non-GIS software); and
 - C Annotated bibliography & on-line resources
-
-

Discussion Item(s):

What are the key topics for working papers? Who are the best candidates to author these papers?

B. Case Studies

The following items are listed here to generate comments about case studies:

- C Objectives of the case studies
 - C Scope of the cases (data collection methodologies, usage patterns, maintenance plans, cost estimates, etc.)
-
-

Discussion Item(s):

What are the criteria for deciding which cases to study? Who are the best candidates to review and author papers about the case studies?

VI. Key Issues Affecting the Adoption of LBCS

During this study, we have identified several issues raised at the Steering Committee discussions, FGDC meetings, TAP responses, and on the net concerning the widespread use of LBCS.

A. Identification of LBCS Data

One persistent problem of data standards is developing a uniform method of identifying data sets. For example, most land-based data files do not contain information about the geography of the data set. This is largely due to the differences in the formats of the data and its information. Land-based data, which is often in a database format, cannot contain information about the name of the jurisdiction or information about the accuracy or currency of the data. Such information often accompanies the database in a descriptive text format.

The Standards Working Group has developed standards for identifying such descriptive text formats by using consistent “fill-in-the-blank” type of forms. These standards, also known as metadata standards, enable producers and users of data to exchange information about the data sets. Metadata that conform to the FGDC standard are the basic products of the National Geospatial Data Clearinghouse (Appendix 10). The clearinghouse is a distributed Internet-based on-line catalog of digital spatial data. This clearinghouse will allow users to understand and use diverse data products on the Internet by clarifying common aspects of the data. The LBCS metadata will also help publicize and support local government functions on the Internet.

The current FGDC metadata standard has more than 100 fields. Many of these fields are optional or not relevant to land-based data. As part of the standards approval process by

the FGDC, the Standards Working Group requires that the LBCS project provide guidance and samples for preparing metadata for LBCS-based data sets. The FGDC has also developed several software tools for automating publishing, searching, and retrieval of metadata on the Internet. These tools use the standard Internet protocols that are widely used and freely available.

Discussion Item(s):

Are there any items about land-based data that should be part of FGDC information about information (metadata)?

B. Implementation Design & Conversion Tools

One of the related products is a set of models for implementing the LBCS. These models will reveal other uses of current data such as further breaking down data for use by smaller jurisdictions or further aggregating data for use by larger jurisdictions. For example, one model could show how coding at the neighborhood level can be translated into broader categories at the county level and regional levels for data aggregation. Another model can be about integrating parcel-based data with remote sensing data into an environmental application using a GIS. A model to show local land-based data can be aggregated into broad SIC categories for employment and economic applications in planning.

A key component of the implementation design would be the conversion tool. The intent of such a tool is to provide a hands-on tool to convert one set of categories that may be appropriate at one scale (i.e., neighborhoods) to another scale (i.e., regional). Such a tool might offer alternatives and provide easy conversions of codes through lookup or

translation tables.

Discussion Item(s):

Are there any specific recommendations for developing models or conversion tools?

C. Need for Universal Access to Public Data

There needs to be a brief discussion of some issues related to public access to land-based data. The commonly asked questions about LBCS pertain to:

- C Freedom of Information Act provisions;
- C Legal Liability and Copyright Protections;
- C Cost Recovery Mechanisms by Public Agencies for LBCS data; and
- C The role of the Internet and Universal Access Implications.

Discussion Item(s):

***Are there any specific recommendations for dealing with these varied topics?
Do any of these warrant specific working papers?***

D. Information Technology Developments

Because of rapid technological advances (GIS, remote sensing, GPS, automated mapping, facility mapping, and land information systems in general), the project will coordinate

with major software vendors in developing standard templates for thematic mapping and other applications. Such standard templates may be incorporated as part of GIS and other mapping software.

The OpenGIS Consortium is developing universal file formats for GIS data. The LBCS project could coordinate with this effort to see that LBCS codes and categories are part of such universal formats.

Discussion Item(s):

Are there any other groups and efforts that LBCS should coordinate?

VII. National Clearinghouse & Database of LBCS

Flexibility and adaptability should be the key features of the LBCS because of the complex subject matter and the likelihood that users will modify the standards as they gain experience with the system. To support such changes, APA will be the designated repository for maintaining a consistent set of land-based definitions, categories, and coding conventions. We expect that the Internet and APA web site will play key roles in maintaining this standard.

Discussion Item(s):

What issues about the clearinghouse should we be concerned about at this stage of the project?

List of Appendices

The following references (except items 7, 8 & 9) are available on the APA web site at:

<http://www.planning.org/plnginfo/lbcs/index.html>

1. Excerpts from the 1965 Standard Land Use Coding Manual (SLUCM).
 - a. Title Page & Table of Contents
 - b. Copies of pages 1-36

2. Excerpts from the 1994 APA report "*Toward a Standardized Land-Use Coding System.*"
 - a. Executive Summary
 - b. Section I: Working Paper
 - c. Section II: Case Studies
 - d. Section III: Survey of Federal Agencies' Needs

3. LBCS Work Program.
 - a. Latest Work Program (December 13, 1996)
 - b. Management Work Plan Gantt Chart (December 13, 1996)

4. Steering Committee Members List.

5. LBCS Workshop Participants and Technical Advisory Panel (TAP).
 - a. Biographies and Addresses of Workshop Participants
 - b. TAP Responses for Working Paper Topics
 - c. List of Nominations for TAP

6. North American Industrial Classification System (NAICS) and Standard Industrial Classification (SIC).
 - a. "How NAICS Will Affect Data Users," U.S. Census Bureau, December 17, 1996.

- b. "Economic Concepts Incorporated in the Standard Industrial Classification Industries of the United States", Report 1, Economic Classification Policy Committee, August 1994.
 - c. "Aggregation Structures & Hierarchies," Issue Paper 2, Economic Classification Policy Committee, February 1993.
7. Excerpts from Al Guttenberg's *The Language of Planning: Essays on the Origins and Ends of American Planning Thought*. University of Illinois Press, 1993.
- a. Section B: Toward a Grammar of Land Use Planning, pp 21-48
 - b. Appendix A: Referential Land Use Classification
 - c. Appendix B: Prescriptive Classification
8. Edward Wilkens article "The Planning Approach to Categories" published in the *Journal of the American Institute of Planners*, 1941.
9. James Anderson, et. al. "A Land Use and Land Cover Classification System with Remote Sensor Data." USGS, 1976.
10. FGDC Standards Information including Earth Cover, Vegetation Subcommittee and Cadastral Standards.
- a. FGDC Organization
 - b. Earth Cover Working Group Charter
 - c. Earth Cover Working Group 1996-97 Work Plan
 - d. Vegetation Subcommittee Draft Vegetation Standards
 - e. Standards Working Group Reference Model
11. LBCS On-line Resources and Annotated Web

Links.

12. [Annotated Bibliography & References.](#)
13. [Summary of Notes from the LBCS Workshop, Chicago, January 19-20, 1997.](#)