Chapter II: Methods

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Phase I NCCP/HCP Planning Area Watersheds and Ecosystems

Watershed Boundaries

The 38 terrestrial watersheds comprising the Phase I Planning Area were defined according to a slightly modified version of the California Watershed Map (CALWATER 2.0) (Figure XI-Index) distributed by the California Department of Fish and Game (DFG). The map's boundary data content was dated March 9, 1998. Jones & Stokes obtained this map coverage from the State of California Stephen P. Teale Data Center GIS Lab (Teale). Teale is under contract to the California Department of Water Resources (DWR) for this project; DFG is an in-kind cooperator.

A draft Memorandum of Understanding (MOU) has been prepared for the purpose of promoting the use, management, and maintenance of a common watershed map of California. The following state and federal agencies, with responsibilities for water resources, water quality, soils, forest, watershed, fish, and wildlife habitat, are signatories to the MOU: DFG, DWR, California Department of Forestry and Fire Protection (CDF), State Water Resources Control Board (SWRCB), USDA Forest Service (USFS) Pacific Southwest Region (R5), USDA Natural Resources Conservation Service (NRCS), U.S. Geological Survey (USGS), USDI Bureau of Reclamation (USBR), USDI Bureau of Land Management (BLM), U.S. Environmental Protection Agency (EPA) Region IX, and Teale.

Ecosystem Classification Systems

Several systems have been developed in recent years for classifying the diverse natural vegetation of California; these include the Holland system (Holland 1986), the Sawyer and Keeler-Wolf system (Sawyer and Keeler-Wolf 1995), and the California Wildlife Habitat Relationships (CWHR) system (Mayer and Laudenslayer 1988; Zeiner et al. 1990). After reviewing these classification systems, the Interagency Working Group (IAWG) for the Placer County HCP/NCCP program selected the CWHR system to classify the major ecosystems and developed land-cover types of western Placer County (Table 1).

A "cross-walk," comparing the Placer County Wildlife Habitat Relationships (PCWHR) large- and small-patch ecosystems with the CWHR (Mayer and Laudenslayer 1988), Holland (1986), and Sawyer and Keeler-Wolf (1995) systems, is provided in Table 2. The CWHR system provides a relatively simple method for classifying large patches of vegetation, and this system is widely used by professional foresters and wildlife biologists throughout California. It is also the most easily understood of the published vegetation classification systems for use by decision makers and the public.

The CWHR system was developed for statewide use; accordingly, it was revised to describe more accurately the major ecosystems and other land-cover types that currently exist in western Placer County. This revised PCWHR system is similar to the CHWR system except that some land-cover types were expanded for mapping purposes. For example, the CWHR Urban land-cover type was divided into eight subtypes in order to distinguish among areas that are surrounded by native ecosystems and areas that are entirely developed.

Large-Patch Ecosystems

Large-patch ecosystems were defined in this report as the dominant PCWHR vegetation and land-cover types that could be mapped and field-verified at a watershed scale (i.e., continuous patches larger than 0.2 hectare [0.5 acre]). The PCWHR classification system recognizes 34 large-patch ecosystems in western Placer County (Table 1). In addition to natural vegetation types, PCWHR large-patch ecosystems include subdivisions of agriculture and urban/suburban land-cover types that are not recognized in the CWHR system.

Small-Patch Ecosystems

Small-patch ecosystems were defined in this report as isolated or unique aquatic or soil communities. These include rare habitats with highly restricted ranges that may have unusual qualities and support rare species of plants or animals, and that are generally small in size (less than 0.2 hectare [0.5 acre] per occurrence). The PCWHR system recognizes the following five small-patch ecosystems in the Phase I Planning Area: landscape and golf course ponds, stock ponds, springs and seeps, Mehrten Formation soils, and serpentine soils (Table 1). Stock Ponds and Landscape and Golf Course Ponds were mapped in accordance with the process

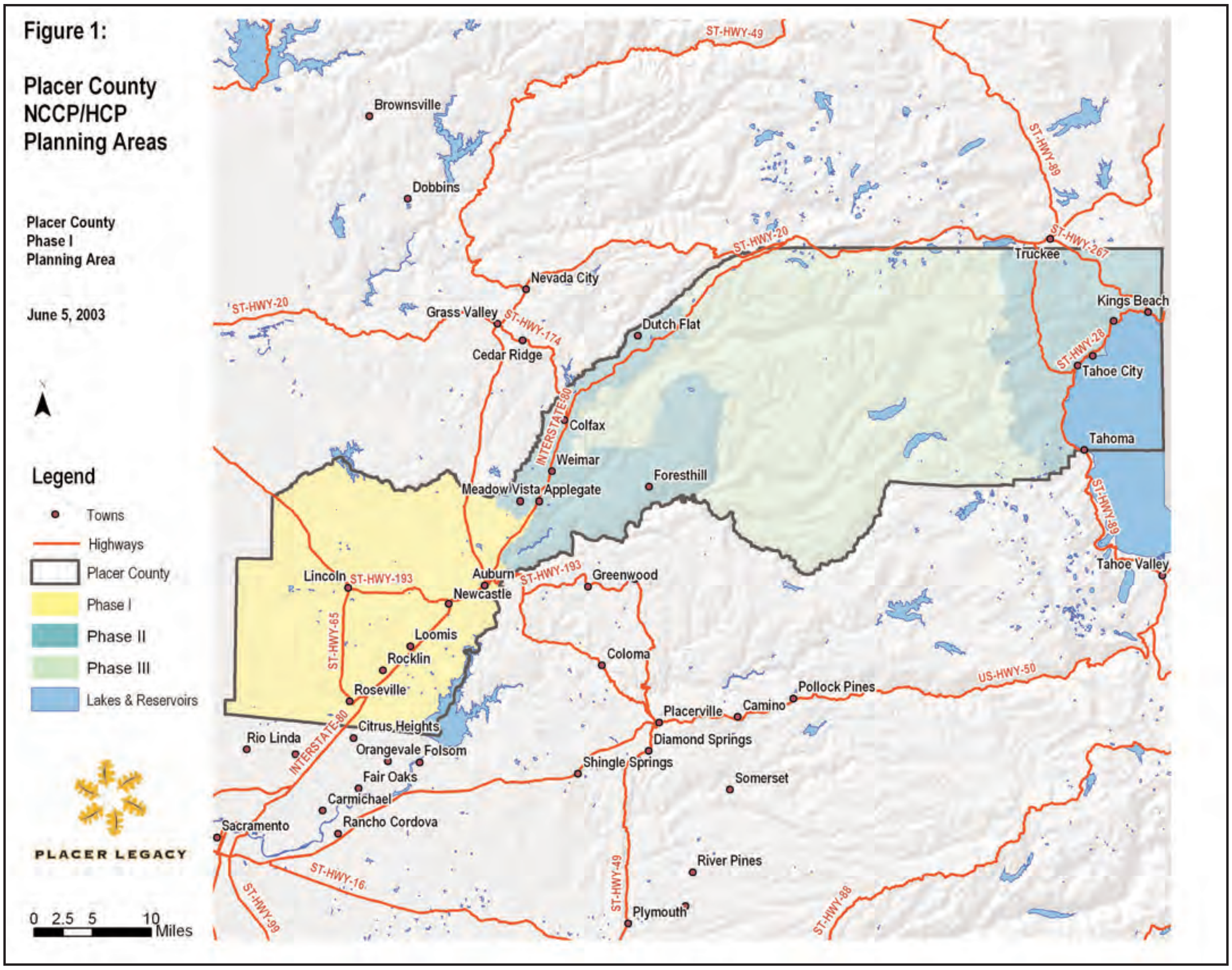

Figure 1: Placer County NCCP/HCP Planning Areas

described below. Soils derived from Serpentinite and the Mehrten Formation were mapped using NRCS soil maps (Rogers 1980). Individual layers were created showing polygons of each soil type, and the maps were sent out for field review (see Field Verification of Watershed Data Themes and Appendix I).

Plant Diversity

Plant Species Lists

Jones & Stokes botanists compiled a list of the vascular plants of Placer County from university and agency databases, published literature on the flora of Placer County, information from the local chapter of the California Native Plant Society (CNPS), voucher specimens in university herbaria, and consultation with local botanists (Appendix II). This list includes all vascular plant species known to occur in Placer County, including introduced species and extremely rare species known from only a few isolated occurrences. All inclusions on this list are supported by published literature and/or voucher specimens. Appendix II does not include species presumed to occur here only from generalized distributional information contained in regional or statewide floras.

The largest collections of Placer County plant specimens are contained in the following herbaria: University of California Berkeley (UCB), University of California Davis (UCD), and the California Academy of Sciences (CAS). Data on the mosses and lichens of Placer County are not yet available through any databases or published sources, but many specimens can be found in the UCB and UCD herbaria.

Jones & Stokes botanists consulted the following published sources and electronic databases for information on documented occurrences of plant species in Placer County: the California Natural Diversity Database (CNDDB) (2003); Inventory of Rare and Endangered Plants of California (California Native Plant Society 2001); CalFlora Database (CalFlora 2002); the PLANTS Database (Natural Resources Conservation Service 2002); Tahoe National Forest Sensitive Plant Handbook (U.S. Department of Agriculture 2000); Status of Rare and Endemic Plants in the Sierra Nevada (Shevock 1996), and floristic checklists and taxonomic references. CalFlora is a collaborative project containing more than 800,000 specimen records and other information from many contributors including UCB, USFS, USGS, Harvard University, San Jose State University, UCD Information Center on the Environment (ICE), USDA National Plant Data Center, and the Santa Barbara Botanic Garden Herbarium.

Invasive Nonnative Plants

Jones & Stokes botanists prepared a list of invasive nonnative plants known to occur in Placer County (Table 3). For the purposes of this report, noxious weeds are defined as invasive nonnative species included on the weed lists of the California Department of Food and Agriculture (CDFA) (2000) and the California Exotic Pest Plant Council (CalEPPC) (1999). These agencies provide information on pest ratings, habitat preferences, and distribution of invasive nonnative plant species. Many nonnative plants found in the Placer County are not invasive or are not known to be invasive in Placer County.

In addition to the aforementioned lists, Jones & Stokes botanists reviewed the website of the Placer County Agriculture Commission; online databases of CDFA, CalEPPC, and UCD (which contain valuable information on the identification, propagation, and control of noxious weeds); the UCB Digital Library Project CalFlora Database (2003); and the UCD CalWeed database for Placer County. The CalFlora database provided a list of documented occurrences of invasive nonnative plants in Placer County. Additionally, invasive nonnative plants observed during the field surveys were noted and added to the lists for individual watersheds (see Field Verification of Watershed Data Themes below).

Special-Status Plant Lists and Habitat Matrices

A list of special-status plants (excluding nonvascular plants, bryophytes [i.e., mosses and liverworts], and lichens) was compiled after conducting a literature review of their regional status and distribution; this list, which also provides legal status, distribution, habitat preferences, and known or potential occurrence in Placer County (Appendix III). Placer County has identified a working list of plant species that may be covered in the Phase I Planning Area NCCP/HCP (Table 4). Currently, the following five plants are on the County's working covered list: Red Bluff dwarf rush, legenere, dwarf downingia, Bogg's Lake hedge hyssop, and Ahart's dwarf rush. Species were chosen for coverage based on their current state or federal listing status, their potential to be listed in the foreseeable future, or their local importance to Phase I Planning Area ecosystems. For the purposes of this document, species referred to as "covered" indicate their presence on the County's Working List of Covered Species. During the NCCP/HCP planning process species may be added to or removed from the covered list.

Special-status plants include those species and subspecies in Placer County that are included on lists of sensitive or special-concern taxa that are maintained by federal agencies (e.g., U.S. Fish and Wildlife Service (USFWS), USFS, BLM) or state agencies (e.g., DFG, CDF), as well as those taxa that are considered rare, threatened, or endangered by CNPS (2001). Primary information sources for compiling this list include the CNDDB (2003), Inventory of Rare and Endangered Plants of California (California Native Plant Society 2001), CDFA, Tahoe National Forest Sensitive Plant Handbook (U.S. Department of Agriculture 2000), Status of Rare and Endemic Plants in the Sierra Nevada (Shevock 1996), and CalFlora. Jones & Stokes botanists obtained soils information from the Soil Survey of the Tahoe National Forest (U.S. Department of Agriculture 1994) and the Soil Survey of Placer County (Rogers 1980) to determine the presence of soils that are often associated with special-status plant taxa in the region.

All these sources were reviewed to develop a matrix of the habitat associations of the covered and other special-status plant taxa that have potential to occur in the Phase I Planning Area (Appendix IV). This matrix indicates the documented occurrence of each special-status plant taxon in each of the 34 large-patch ecosystems that were mapped. Jones & Stokes botanists did not conduct any surveys for special-status plants as part of this project.

Animal Diversity

Animal Species Lists

Jones & Stokes wildlife biologists compiled a list of the vertebrate species (fish, amphibians, reptiles, birds, and mammals) with known or potential occurrence in Placer County from university and agency databases, museum records, published literature, and consultations with agency personnel and other local experts (Appendix V). This list includes all vertebrate species that are known to occur in the county, including introduced species and extremely rare species (i.e., nonbreeding species with fewer than five documented occurrences in Placer County). It also includes a few species whose occurrence in the county is uncertain—that is, they could occur in the county on the basis of their known geographic range and habitat requirements, but no documented records or voucher specimens could be found for western Placer County.

Jones & Stokes wildlife biologists consulted the following published sources for specific taxonomic groups: Moyle 1976 and Moyle et al. 1995 for fishes; Stebbins 1966, Verner and Boss 1980, Zeiner et al. 1990, and Jennings and Hayes 1994 for amphibians and reptiles; Grinnell and Miller 1944, Remsen 1978, Verner and Boss 1980, Zeiner et al. 1990, and Williams 1996 for birds; and Ingles 1965, Hall 1981, Verner and Boss 1980, Williams 1986, and Zeiner et al. 1990 for mammals.

Questionable records of unusual or rare species were researched by examining specimens and collection records at the UCB Museum of Vertebrate Zoology and the UCD Wildlife Museum. Data files maintained by the Sierra Foothills Audubon Society were also reviewed for unpublished records of birds in western Placer County.

Lists of invertebrate species were not compiled; however, a complete list of the butterflies in Placer County is available at: www.npwre.usgs.gov/resource/distr/lepid/bflyusa/ca/300.htm.

Special-Status Animal Lists

For this project, special-status animals were defined as those species that are listed as Threatened, Endangered, or Candidates under CESA or ESA (Table 4) and all other animals that appear on lists of sensitive or special-concern taxa that are maintained by federal agencies (i.e., NOAA Fisheries, USFWS, USFS, BLM) and/or state agencies (i.e., DFG, CDF).

A working list of special-status animals with known or potential occurrence in Placer County (Appendix VI) was prepared using the sources listed above. Additional primary sources were the CNDDB (2003) and DFG's Special Animals list (California Department of Fish and Game 2003). Placer County has identified a working list of animal species that may be covered in the Phase I Planning Area NCCP/HCP (Table 4). Currently, the following 28 animals are on the County's working covered list: vernal pool fairy shrimp, vernal pool tadpole shrimp, California linderiella, valley elderberry longhorn beetle, Central Valley steelhead, Central Valley fall/late fall chinook salmon, Sacramento winter-run chinook salmon, foothill yellow-legged frog, California red-legged frog, California tiger salamander, western spadefoot toad, northwestern pond turtle, giant garter snake, Swainson's hawk, ferruginous hawk, rough-legged hawk, northern harrier, bald eagle, American peregrine falcon, California black rail, bank swallow, California burrowing owl, yellow-billed cuckoo, yellow warbler, yellow-breasted chat, Modesto song sparrow, grasshopper sparrow, and tricolored blackbird.

Species were chosen for coverage based on their current state or federal listing status, their potential to be listed in the foreseeable future, or their local importance to Phase I Planning Area ecosystems. For the purposes of this document, species referred to as "covered" indicate their presence on the County's Working List of Covered Species. During the NCCP/HCP planning process, species may be added to or removed from the covered list.

Appendix VI includes information on the legal status, California distribution, habitats, and reasons for decline or concern for all covered and other special-status animals with known or potential occurrence in Placer County. Jones & Stokes wildlife biologists did not conduct surveys for special-status animals as part of this project. However, incidental observations of some of these species were made during field surveys on public lands. The draft list of special-status animals for western Placer County was peer reviewed by the qualified fisheries and wildlife biologists identified in Appendix VI. When possible, the data contained in the draft list were field-verified during the watershed surveys (see Field Verification of Watershed Data Themes below).

Wildlife Habitat Relationships Matrix

Jones & Stokes wildlife biologists compiled the PCWHR matrix to provide an overview summary of the occurrence of native fish, amphibians, reptiles, birds, and mammals in each of the county's large-patch ecosystems (Appendix VII). This matrix was based on the CWHR electronic database (Zeiner et al. 1990), which was designed for the statewide analysis of wildlife habitat relationships, and which provides a general, but incomplete, list of potential vertebrates in Placer County and their occurrence in specific large-patch ecosystems. The CWHR species list was revised with information from the peer-reviewed vertebrate Placer County species list compiled for this project (Appendix IV). This revised list was further refined on the basis of documented observations of individual species in western Placer County and in nearby counties.

Only native and nonnative animal species that are known to occur regularly in the Phase I Planning Area were included on the PCWHR matrix; extremely rare species (i.e., fewer than five occurrences in the Phase I Planning Area) were excluded. Species occurrence data for each of the large-patch ecosystems were entered into an electronic spreadsheet. Individual species were coded as V (Visitor) if they use a specific large-patch ecosystem for feeding, resting, or migration, but do not breed there. Species were coded as B (Breeder) if they are year-round residents in specific large-patch ecosystems, or if they have been documented breeding there. Key assumptions of the PCWHR matrix coding are listed below.

Wildlife species were only coded as occurring in a specific PCWHR type if they occupy it for some significant portion of their life cycle (for example, most amphibians are shown as only occurring in streams and other aquatic habitats, but not in adjacent conifer forests or upland habitats unless those habitats are used for migration, hibernation, foraging, etc.).

Wildlife and habitat relationships included in the matrix were coded at a broad scale; consequently, the matrix usually predicts a larger number of species occurring in a particular habitat patch than is actually present.

Some ecosystems, especially forested types, represent a mix of successional stages including at least some late-successional stands (e.g., at least some trees greater than 24 inches diameter at breast height [dbh]); if these habitat elements are absent, some wildlife species that were coded as occurring in an ecosystem type may not be present in a specific forest stand.

Habitat areas must be sufficiently large to accommodate the requirements of species with large home ranges; such species may be absent from small or discontinuous patches of habitat.

The draft PCWHR matrix was reviewed by wildlife biologists, including agency biologists, with many years of professional experience observing wildlife habitat relationships in the Central Valley and the Sierra Nevada foothills. Jones & Stokes wildlife biologists also extensively reviewed the PCWHR matrix in the field during the watershed surveys (see Field Verification of Watershed Data Themes below). All suggested changes from outside reviewers and field surveyors were assessed and incorporated into the matrix if supported by direct observations, or if based on other reliable sources such as published literature or museum voucher specimens.

Ecosystem and Land Cover Mapping and Verification

Aerial Photograph Interpretation and Mapping

Jones & Stokes botanists, experienced with interpretation of aerial photographs and with the vegetation of the Phase I Planning Area, mapped large- and small-patch ecosystems and other land-cover types from rectified, year 2002 aerial photographs. Rectified means that each cell was assigned precise latitudinal/longitudinal coordinates. The aerial photographs were compiled into a photo mosaic by AirPhoto USA and purchased by the Placer County Planning Department. Each cell in this true-color photo mosaic represented an area approximately 0.4 square meter (4.3 square feet). The photo mosaic was printed out as a map series at a scale of 1:9,600 (approximately 10.4 centimeters per kilometer [6.7 inches per mile]) to map the ecosystem and land-cover types. Thirty-one map sheets were created. Acetate film was overlaid on each sheet; lines were drawn on the acetates to delineate ecosystem and land-cover polygons (0.2-hectare [0.5-acre] minimum polygon size). These lines followed visible signatures—differences in color tones and textures—on the underlying photographs.

When complete, the acetates were electronically scanned and imported into a Geographic Information System (GIS) (see GIS Mapping and Analysis below). A GIS layer was created showing the boundaries between polygons and each polygon's unique numeric identifier. To check spatial precision and assign attributes to the GIS layer, a new set of acetates showing only this layer was generated. The new acetates and the original polygon boundary acetates were overlaid onto the original photo sheets. The spatial accuracy of the GIS lines was checked, and a table was created linking each identity number to the land-cover type represented by the polygon. Errors detected during this process were corrected in the GIS database. Some polygons were split and relabeled to better reflect actual field conditions. Many small polygons were added to correctly type wetlands, ponds, and other small landscape features.

All land-cover types were mapped except Vernal Pool Complexes, because North Fork Associates had mapped this type for western Placer County in 2002. Where Vernal Pool Complexes were observed on the photo mosaic, their distribution was compared to North Fork Associates' mapping. Land-cover maps only included Vernal Pool Complexes mapped previously by North Fork Associates and individual Vernal Pools mapped by Jones & Stokes.

Geographic Information System (GIS) Mapping and Analysis

Background

Jones & Stokes GIS specialists used GIS technology to compile digital map information about the Phase I Planning Area and to generate statistics summarizing the extent of the county's physical and biological resources. A GIS is a set of computerized maps that are linked to electronic databases; this set of maps is composed of individual layers, or data themes, each representing a unique kind of mapped information (Zeiler 1999). A road layer data theme, for example, contains a series of lines, each of which represents a road. For each road, an entry (row) will exist in a related database, and various database columns may describe the road's name, length, surface type, and use levels.

Many people think of GIS simply as computer-generated maps. However, the real power of GIS is its ability to summarize the large and complex databases that underlie the maps. GIS facilitated the complex calculations necessary to quantify and analyze the physical and biological resources of the Phase I Planning Area and to catalog specific attributes of its 38 surveyed watersheds. For example, the GIS can rapidly calculate the areal extent (hectares [acres]) of Foothill Hardwood Woodland occurring on public land within 46 meters (150 feet) of the streams mapped by USGS at both watershed and Phase I Planning Area scales.

GIS is capable of producing maps with an almost infinite variety of data layers. The accuracy of individual maps, however, depends on the quality of data entered into the system. In order to develop highly accurate maps and statistics to describe the Phase I Planning Area, Jones & Stokes acquired and compiled the most current databases available from county, state, and federal agencies and nongovernmental organizations. Using the initial GIS-based maps and data summaries, Jones & Stokes botanists and wildlife biologists then spent more than 660 hours in the field verifying the accuracy of these maps (see Field Verification of Watershed Data Themes below).

Data Sources and Management

Jones & Stokes assembled a set of GIS databases that were produced from extensive recent mapping conducted by state and federal agencies, the Placer County Planning Department, local agencies, universities, research biologists, and scientific nongovernmental organizations. More than 130 individual datasets were acquired and reviewed in this process (Appendix VIII). All these layers are available on the Internet or from public agencies (many, but not all, are free). The data from these many sources were available in a variety of electronic formats: digital images, digital elevation models, ArcView (a type of GIS software) shape files, global positioning system (GPS) points, and digital raster graphics (DRGs), among others. All data were converted to ARC/INFO (another GIS software program) coverages and grids to create a consistent format for summarizing and mapping data. All imported GIS data were converted to a standard projection, State Plane Zone 2, as specified by the Placer County Planning Department.

All GIS-based analyses were undertaken using data gathered for western Placer County. However, some additional GIS data were also acquired for adjacent portions of the four surrounding California counties: Nevada, Sutter, Sacramento and El Dorado. Data were gathered for this larger area to verify the accuracy of data near the Placer County line. Thus, some data from other counties were used to verify the accuracy of mapped information near the Phase I Planning Area boundary.

Screening and Selection of Data Themes

A rigorous screening process was developed to eliminate datasets that were not valid for this study, either because of inappropriate map scale at the time of digitizing, redundancy with other databases, and/or incomplete coverage in the Phase I Planning Area. Appendix VIII lists all data themes that were used to compile maps and data summaries, the GIS methods used, and the validation process for each data theme. From the original 130+ datasets that were acquired and screened, a Jones & Stokes GIS specialist selected a subset of more than 30 to be evaluated and summarized for this report (Appendix VIII). The major data themes summarized in this report are large- and small-patch ecosystems, habitat and species occurrence, and general land ownership.

Overview of GIS-Based Techniques

Data can be stored in a GIS system as either vector (i.e., points, lines, and polygons), or raster images (grids) (Zeiler 1999). Vector data include features with definite locations (e.g., Springs and Seeps), and are stored as points. Long narrow features, like streams and canals, are stored as lines. Features that cover a defined region, like a patch of forest or chaparral, can be represented as polygons (areas of irregular shape defined by vector lines) or rasters (digital graph paper where each unique feature covers a set of cells). Complex data with arbitrary boundaries, such as rainfall maps, are stored as raster data sets.

Vector (Line, Point, and Polygon) Methods

Point location information (e.g., Springs and Seeps) and linear features (e.g., rivers, canals, and roads) are summarized as vectors. Vector data are composed of points with “real world” coordinates, such as latitude/longitude, that can be connected as arcs, lines, or closed systems of arcs that create irregularly shaped polygons (Zeiler 1999).

Point features were analyzed using the point method. A vector coverage representing the watershed was intersected with a point coverage representing the occurrences of a data theme (e.g., Springs and Seeps). This concatenation produced a database in which every point in the input theme was assigned to the watershed where it occurred. A database program was used to count all the points and to create a table summarizing the total number of points where each resource type occurs in each watershed.

Linear features (e.g., creeks) were analyzed using the line method. Each line was assigned to a single watershed; using a database program, the total length of all lines in each watershed was summed and converted to units of measurement (e.g., kilometers [miles]); subsequently, a table was created summarizing the total length of each type of linear feature in each watershed.

Land-cover types were summarized by watershed using vector overlay techniques. The watershed polygons were superimposed over the land-cover layer. Where land-cover polygons crossed watersheds, they were split at the watershed boundary such that each resultant land-cover polygon was assigned to a single watershed. The resultant database listed the land-cover type and areal extent of each polygon for each watershed in the Phase I Planning Area. The database was used to summarize the extent of each land-cover type in each watershed. The vector polygon overlay process is slower, but much more precise, than the raster method describe below.

Raster Methods

Continuous surfaces (e.g., digital representations of elevation contours) and polygons with defined areas (e.g., Serpentine Soil polygons) were analyzed as rasters (Zeiler 1999). In a raster model, a digital grid (resembling a piece of graph paper) is established in a known map projection with a defined cell size. Each cell in the graph is assigned a number that represents a feature (e.g., blue oak trees) in an associated database. If the cell size is set to 1 foot, hundreds of cells may represent a single tree. If the cell size is 1 acre, a single cell may represent many trees. The larger the cell size, the faster the computer runs, and the less precise are the results. The 30-meter (100-foot) cell size used in this analysis was determined to be the optimal size to capture all the spatial precision of the available datasets without compromising processing time and accuracy.

Most data themes represented a single category of geographic information, such as the extent of Mehrten Formation soils in the Phase I Planning Area. In the area method, a single raster was created for each theme, where the value 1 indicated the presence of the theme in a cell, and 0 indicated its absence. A program was written that stepped through each watershed and counted the total number of cells with a value of one. This created a table with the watershed number and the number of cells representing each theme. Because each cell was 30.5 meters (100 feet) on a side, a single cell represented 930 square meters (10,000 square feet). To derive total acreage, the number of cells was multiplied by 10,000 (yielding square feet) and divided by 43,560 (the number of square feet per acre). Numerical values were then converted to metric units of measure.

Ecosystem Data Themes

Ecosystem data themes tracked the distribution and acreage of large-patch ecosystems (e.g., Foothill Hardwood Woodland, Ponderosa Pine Forest), and small-patch ecosystems (e.g., Serpentine Soils) in each watershed. The primary source of information on the extent of large-patch ecosystems was original land-cover/habitat type mapping conducted by Jones & Stokes for Placer County in January and February 2003.

Error Correction Processes

Accurate data are essential to produce valid GIS maps and analyses. Jones & Stokes used several error-correction processes because of the size and complexity of the original data sources. The first process was a visual inspection to search for large-scale errors in all the computerized maps and summarized databases. Coarse errors resulting from inaccurate data were easily detected and corrected by overlaying the data on some form of physical geography, such as an earth surface model or satellite image, to determine if mapped polygon boundaries were coincident. Errors identified through this process were corrected in the data tables or routines (programs) that generated the maps and statistics.

Fine-scale errors in GIS-based maps can only be detected with fieldwork or by careful examination of aerial photographs (see Field Verification of Watershed Data Themes below). Most GIS datasets are not absolutely accurate, and their relative accuracy must be weighed against their intended use. Usually the scale of the analysis determines the required level of precision. When performing analysis at a watershed (e.g., 2,000–6,000 hectares [5,000–15,000 acres]), statewide, or countywide scale, a mapping accuracy of 30.5 meters (100 feet) may be sufficient. The units of analysis in this study were aggregate watersheds that ranged from 1,395 to 5,984 hectares (3,446 to 14,787 acres) in area. Raster analysis was conducted using representations of the map data with a 30.5 meter (100-foot) cell size. Each cell equals approximately 0.09 hectare (0.23 acre). Spatial errors less than 30.5 meters (100 feet) were not corrected because they were smaller than a single analytical unit, or cell.

The GIS data used in this report are primarily derived from aerial photo interpretation and fieldwork conducted in spring 2003. A small number of themes are based on government and scientific maps and databases of varying age. These had to be validated in the Phase I Planning Area before they could be used with confidence in this analysis (Appendix IX). There will never be sufficient resources to field-verify each line, point, and polygon for every data theme. Recognizing these limitations, Jones & Stokes did not try to validate all locations of every theme in every watershed. Themes were validated as far as possible from aerial photos, public lands, and public roads (see Watershed Surveys below). All known errors were corrected.

Field Verification of Watershed Data Themes

Jones & Stokes botanists and wildlife biologists conducted field surveys of all 38 terrestrial watersheds comprising the Phase I Planning Area from February 27 through May 4, 2003. (An additional mapped watershed, number 28, represents the surface of Folsom Lake. It was not surveyed.) The survey protocols and field data forms used in the field verification process are provided in Appendix I. The overall goal of these surveys was to verify the accuracy of the GIS watershed-based maps and data themes (Appendix X). Specific survey objectives were to:

- verify the accuracy of the selected data themes on a watershed scale throughout western Placer County;
- perform reconnaissance-level field surveys of western Placer County's 38 terrestrial watersheds;
- evaluate the presence or absence of various large- and small-patch ecosystems that occur in individual watersheds, as well as the presence of sparsely vegetated habitats such as Lacustrine (standing water), Riverine (flowing water), cliff habitats, rock outcrops, talus slopes, or other rocky or barren (including artificial) habitats; and
- assess the extent and condition of the individual ecosystem types on public lands.

Each of the 38 terrestrial watersheds in the Phase I Planning Area was assigned to a survey team comprising an experienced Jones & Stokes botanist and wildlife biologist. Approximately 16 person-hours were spent per watershed. All field survey work was conducted from public roads or on public lands. Public or private road status was determined from GIS-generated road maps provided by the Placer County Planning Department and USGS 7.5-minute topographical maps. In the Phase I Planning Area, public lands comprise state or county parks, fire and sanitation districts, and city-owned lands.

As discussed in Appendix I, Jones & Stokes botanists and wildlife biologists verified the GIS data themes and other information using both prefield (office verification) and field surveys (on-the-ground verification).

Time and access limitations did not permit all watersheds to be surveyed with equal intensity or precision. Because the watershed surveys were conducted at a reconnaissance level, they were not intended to be comprehensive or site specific. This type of inventory is appropriate and adequate for the identified survey objectives. The following major data themes were verified at randomly selected polygons in each watershed: mapped vegetation and land-use polygons, land uses and impacts, characteristics of surrounding areas, types and levels of disturbance, problems with interpretation, covered and other special-status species observations and suitable habitat areas, and the presence and extent of invasive nonnative species.

Feedback and Data Correction

Data summaries and maps of each of the Phase I Planning Area's 38 terrestrial watersheds are provided in Appendix XI. These maps were carefully reviewed in the field, and suggested changes were made to the underlying GIS databases. In a few cases when data were found to be highly inaccurate, the entire databases were rejected for use in this analysis. When possible, new, more accurate databases replaced the originals (see Appendices VIII and IX). No suitable substitutes were available for some databases; these were dropped from the final analysis (e.g., Limestone Substrate layer). Replacement databases were only used in the analysis when Jones & Stokes could verify their accuracy based on published data, or when the new data came directly from the field-verification of watershed data themes.