Roads Analysis Report

Land Between The Lakes NRA

July 2003

Area Wide Analysis

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STEP 1 – SETTING UP THE ANALYSIS

INTRODUCTION

In August 1999, the Washington Office of the USDA Forest Service published Miscellaneous Report FS-643 *Roads Analysis: Informing Decisions about Managing the National Forest Transportation System.* The objective of roads analysis is to provide decision-makers with critical information to develop road systems that are safe and responsive to public needs and desires, are affordable and efficiently managed, have minimal negative ecological effects on the land and are in balance with available funding for needed management actions.

On January 12, 2001, the Forest Service issued a final road management policy consisting of the final National Forest System Road Management Rule and administrative policy. It emphasizes local, science-based decisions designed to maintain a road system that is safe, responsive to public needs, environmentally sound and affordable to manage.

WHAT IS ROADS ANALYSIS?

Roads analysis is an integrated ecological, social, and economic approach to transportation system planning based on the best available science. Analysts are expected to use relevant existing scientific literature to assess the benefits and risks of the current transportation system, to disclose assumptions made during the analysis, reveal the limitations of the information on which the analysis is based, and subject the analysis results to critical technical review.

Roads analysis is to be conducted at multiple scales, ranging from the forest or area scale to the watershed and project levels. The issues generated and the recommendations offered are intended to be commensurate with the level of detail at which the analysis is conducted. Roads analysis may be integrated as a component into forest, watershed, or project level analyses, or it may be conducted as a stand-alone process. It is important to emphasize that roads analysis in itself does not result in a decision, but provides information to line officers in support of their decisions by disclosing the important social, economic, and ecological issues and effects relevant to road management proposals. Actual road management decisions made by responsible officials must be disclosed in appropriate National Environmental Protection Act (NEPA) documents.

Finally, roads analysis is intended to be an ongoing and iterative process that is continually responsive to changing conditions, including available funding, research and monitoring results, changes in physical or environmental conditions, and new regulatory requirements. Roads analysis is an honest response to our obligation to continually seek to refine the balance between the public need for access and the capability and health of the land base that the transportation system serves.

PROCESS FOR ANALYSIS

Roads analysis is a six-step process designed to be sequential with possible feedback and iteration over time as the process matures. The process provides a set of possible issues and analysis questions for which the answers can help managers make choices about road system management. The process, including the following six steps, is detailed in Miscellaneous Report FS-643 Roads Analysis (FS 643), which is available for review at our Administrative Headquarters in Golden Pond, KY.

Step 1. Setting up the analysis

Step 2. Describing the situation

Step 3. Identifying issues

Step 4. Assessing benefits, problems, and risks

Step 5. Describing opportunities and setting priorities

Step 6. Reporting

PRODUCTS

The product of this analysis is this report that documents for decision-makers the information and analysis used to identify opportunities, and set priorities, for National Forest System Roads on the Land Between The Lakes National Recreation Area (LBL). Accompanying this report is a listing of Maintenance Level (ML) 3, 4, and 5 roads and a map showing those roads.

This analysis includes a methodology for quantifying access needs and resource impacts for project level roads analysis, including a decision framework and potential management options.

PROCESS FOR SETTING PRIORITIES

This analysis addressed the transportation system (ML 3, 4, and 5 roads) from an LBL perspective and not by individual roads (which will be done during subforest scale analyses). Criteria and a process for developing priorities at the project scale is included in this report, Step 5.

OBJECTIVES, LEVEL AND SCALE OF THE ANALYSIS

Objectives of analysis

The general objective of this roads analysis is to provide the Area Supervisor with critical information to develop road systems that are safe and responsive to public needs and desires, are affordable and efficiently managed, have minimal negative ecological effects

on the land and are in balance with available funding for needed management actions.

Scale of analysis

This is a forest scale analysis for LBL. It concentrated on Maintenance Level 3, 4, and 5 roads. Only existing data was used, and to the extent possible, spatial or Geographic Information System (GIS) data was used. This roads analysis will be used to support the LBL Area Plan since addressing road related issues will be an integral part of the planning effort.

This analysis will also support project scale roads analyses. Throughout the report during discussions on scale, project and watershed scales are treated interchangeably because projects on LBL warrant 6th level watershed scale analysis. This is due to the small geographic area included at that 6th level watershed.

INTERDISCIPLINARY TEAM MEMBERS (IDT) AND PARTICIPANTS

The core interdisciplinary team and their specialties are:

Paul Schaefer	IDT Leader
Erika Davis	Customer Service
Robert Wise	Customer Service
Tripp Scott	Law Enforcement
John Donahue	Environmental Stewardship

Other team members who participated and their specialties are:

Steve Bloemer	Wildlife Biologist
Judy Hallisey	Soils & hydrology
Gary Hawkins	Recreation
Daphne Sewing	Environmental Education
Greg Barnes	Social
Dale Wine	Fire
Jane Benson	GIS

INFORMATION NEEDS

Information needs are identified for the Key Issues in Step 3 and Step 4 – Key issues, Questions and Answers of this analysis.

RESOURCE QUESTIONS AND ANSWERS

The IDT Leader reviewed the 71 key questions and determined that 38 were appropriate to apply to the Maintenance Level 3, 4, and 5 roads at the LBL scale analysis. The questions that were selected are included in this report. (All of the questions can be viewed in FS643.) The remaining 33 questions are more appropriate for the project/watershed scale analyses.

The IDT answered the 38 resource questions to determine the associated benefits, problems and risks of the transportation system in general terms. This information was then used to develop the LBL Key Issues and Questions related to the road system. These receive further analysis in this document, and are the standard for future watershed related analysis. Resource Questions and Answers are Appendix A of this document, but are maintained in the planning record due to the size of the document.

PUBLIC INVOLVEMENT

Since public involvement has been an integral part of the Area Planning effort, and since this analysis is not a decision document, no public involvement was planned for this roads analysis.

STEP 2 – DESCRIBING THE SITUATION

IDENTIFY EXISTING DIRECTION

Forest Service Manual (FSM) 7700 includes national policy for all phases of management of the Forest Service Transportation System. FSM 7710 includes specific direction for roads analysis and record keeping. There are handbooks that provide guidelines for the management of the FS Transportation System.

Specific direction for completion of roads analysis in the FS is contained in FS Publication 643, published in August 1999. Further clarification and timeframes for completion of Forest level roads analysis is included in internal FS memos.

The Tennessee Valley Authority (TVA) Natural Resource Management Plan (NRMP) and Environmental Impact Statement (EIS) for Land Between The Lakes (LBL), published in 1994, does not provide direction or management standards or guidelines for the LBL road system. It is therefore impossible to compare current conditions to standards or baseline information. Additionally, TVA did not number roads in Forest Service maintenance classes 1 and 2. These roads were not considered part of the LBL road system. Finally, TVA's road numbering system was the opposite of the FS maintenance numbering system. TVA level 1 roads were the most developed roads, while FS level 5 roads are the most developed. TVA road numbers reflected the road level status at the time the numbering system was developed. Many roads are not in the same condition as reflected by their road numbers.

ENVIRONMENTAL

GEOLOGY, GEOMORPHOLOGY, SOILS, AND WATER

LBL lies along the eastern edge of the ancient Mississippian Embayment, within the Ohio River basin of central United States. Its current physiography results from impoundments of the Tennessee and Cumberland Rivers, the dominating physical elements of LBL. The rivers form topographic trenches roughly parallel to each other along the length of LBL. Topography is greatly dissected by numerous tributaries of each river that head against each other so as to form a narrow drainage divide. The divide between the rivers is somewhat closer to the Tennessee than to the Cumberland, and the elevation of the divide is relatively even. Original maximum relief before the lakes were formed was little more than 90 meters. Presently lake elevation reduces relief somewhat. Tributaries and their dissections are so close together that most of the area is in slope. They have steep gradients in the headwaters but their lower course has low gradient with broader valley floors. Confluences of the tributaries with the major rivers are nearly at right angles, exhibiting a landscape controlled by geologic structures such as faults and bedrock strike. LBL's mature topographic features are displayed in its narrow ridge crests, steep slopes of low relief, sediment-filled valleys, and narrow bottomlands.

Bedrock is dominantly cherty limestone of the Mississippian System and part of the stable North American continental plate or craton. LBL owes its homogeneity of bedrock and topography to the fact that the rivers parallel the strike of the bedrock throughout the entire length of LBL. Limestone is a soluble rock, while chert is resistant both to solution and abrasion. Some lithologic units contain thin shale layers and disseminated clay and silt, which together with the chert form the residual weathered product. Weathering of pure limestone would form no soil. Surface exposures of bedrock are uncommon in LBL, occurring primarily along lakeshores.

Chert is an abundant constituent of the limestone bedrock. Rock fragments of chert are a major residual product of weathering of the soluble limestone. Angular chert fragments of all sizes are present in the soil profile and loose on many hillslopes. Chert reaches waterways by mass wasting or direct scouring of stream channels.

Glaciers did not reach the Tennessee or Cumberland valleys so there are no glacial deposits in LBL. Indirect effects of glaciations just to the north to the LBL region are evident by: 1) deepening of the valleys, 2) ponding and aggradations of the valleys, and 3) deposition of windblown silty and sandy loess mantling uplands. Caves and caverns are unknown and sinkholes are uncommon within LBL compared to the Pennyrile region just to the east. This may be indicative of much less water circulating underground than places east. Another postulation is there may have been insufficient geologic uplift to expose caverns above the deeper water filled cavities.

LBL is situated just east of the New Madrid Seismic Zone, the region affected by the Reelfoot Rift System, locale of high intensity earthquakes in 1811 and 1812. LBL is outside the zones of major seismic activity though it would be within the area of potential damage. The New Madrid Seismic Zone is the junction of several major structural elements of east-central United States. The triple junction of the rift controls the location of the lower Tennessee River.

The climate is temperate continental. Average rainfall is 1,173 mm per year. Total amounts of rainfall are as great in summer as winter. However, evapo-transpiration is so great in summer that streams and most springs cease flow. Severe arctic storms have been known to penetrate the area in most winters. Most winter precipitation is in the form of rain however. Stream flow increases in winter because of low evaporation and little transpiration.

Growing season averages 186 days. There appears to be a greater amount of precipitation at weather stations near the middle of LBL than at stations north or south. Site extremes are definitely moderated by proximity to the waters of Lake Barkley and Kentucky Lake. The minimum temperatures are higher and the maximum temperatures are lower than those comparable sites away from the lakes.

Erosion processes manifest in many forms. The filling of the lakes established a shoreline where waves and currents are now very active geomorphic agents. Mass wasting is primarily in the form of soil creep and slumps. Slumping seems to have

played only a minor role, discernible today mainly in road cuts along The Trace and at lakeshores, and is the result of human action. Both are due to over steepening of the equilibrium of slope, known as the angle of repose. Landslides are rare. Soil creep is the dominant mass wasting process.

Erosion is less rapid on north facing slopes than on south facing slopes. South facing slopes are subject to greater evaporation in all seasons. Erosion is particularly severe in winter and spring because freezing and thawing cause heaving of the silty loess or clay matrix of cherty soil. Loose particles then become subject to rain impact and slope wash.

Erosion by running water has etched LBL's landscape. The retreat of discontinuous gullies (headcuts) is the most active and most obvious erosion process within LBL. The sequence of headcuts up the channels may be analogous to the scour and riffle sequence of larger stream channels and a natural process. Sediment is transported down valley in this manner of scour and fill. Active erosion against steam valley slopes and across the mouths of tributaries is deepening the tributary channels. Changing base elevation from pool levels of the lakes exacerbates the process. Coarse gravels are spread farther out into the bays at times of low water than would be true if normal pool were maintained.

Flow of water is intermittent in the stream channels. Drainage catchments are too small to retain enough water to maintain year-round flow. Many springs and seeps are present in LBL, and most appear to be seasonal. However springs and seeps in every valley offer a clue to the extensive ground water network that must exist.

Soils of LBL have developed from limestone bedrock, Cretaceous gravels or loess. Soils derived from parent materials are low in nutrients. The land is not favorable to cultivation nor intense cultural activity because of rough topography and low site quality. Bottomland soils, composed of fluvial sediments are relatively more favorable for cultivation and pasture but subject to flooding. Loess, derived from wide flood plains of the Ohio and Mississippi Rivers, has been wind deposited on the slopes of much of LBL. Loess is primarily coarse silt to very fine sand but clay has developed in the B-horizons. Loess deposits are typically thicker on the east and south sides of major streams of LBL. Loess is also thicker on the eastern side compared to the western.

There are differences in soil types between Kentucky and Tennessee Counties in part because loess and coastal plain gravels are generally absent in Stewart County. Furthermore, limestone bedrock appears at slightly higher elevations and outcrops are more common in the southern half of LBL, thus resulting in thinner, rockier soils.

There are numerous locations of severely eroded soils within LBL. These mostly occur on the steep, short relief hillslopes of silty-clay loam complexes. Other soils have high erosion hazards due to slopes, impermeable subsoil layers and fine silt or clay particles. Removal of vegetation exacerbates erosion rates and hazards. Overall there are approximately 94,825 acres of erosive soils within LBL.

Road-Stream Proximity and Interactions

Roads within floodplains, wetlands or encroaching on stream channels can intensify runoff events and increase sediment input to the streams. Many roads are located along stream channels or within their valleys to take advantage of gentle slopes and easier construction. Culverts were installed at many of the stream crossings but were never designed to pass more than a 25-year interval event. Streams entrain and transport enormous amounts of cherty fragments, adding to flow volumes that these culverts were never designed for. Washout and breaching of culverts are common after major runoff events. Other culvert installations have channelized flows, increasing velocities resulting in scour below the outlet. This exacerbates downcutting of the stream channel.

Where roads intersect with wetlands, running prisms are often turnpiked above normal surface elevation. This reduces surface hydrology flows and directs flows to culverts and other reliefs, channelizing flows and resulting in scour.

WILDLIFE

According to the NRMP, LBL provides habitat for a wide array of wildlife. LBL's documented wildlife species include 53 mammals, over 230 birds, 28 amphibians, 41 reptiles, 92 fish, and numerous terrestrial invertebrates (i.e. insects). The NRMP has also identified 5 mammals, 6 birds, 4 reptiles and amphibians, and 7 plants that are federally listed as endangered, threatened, or candidate species that occur or may occur on LBL. Federally listed species that occur or suitable habitat occurs on LBL include Red Wolf (*Canis rufus*), Gray Bat (*Myotis grisescens*), Indiana Bat (*M. sodalis*), bald eagle (*Haliaeetus leucocephalus*), and Price's Potato Bean (*Apios priceana*). LBL also provides habitat for state-listed species for Tennessee and a proposed list of threatened and endangered species for Kentucky (Kentucky does not have a legislated state list).

The NRMP provides programmatic guidance for the forest and open lands to provide habitat requirements for a broad array for wildlife habitat from early successional habitat to mature forest interiors. Roads provide access to enable the implementation of management activities in order to provide for these habitats. Roads also provide access for the public for wildlife viewing, wildlife photography, and hunting opportunities.

FOREST

The forest resource encompasses approximately 151,550 acres (89%) of all lands at LBL. The forestland is largely comprised of the oak/hickory cover type (80%). The remainder is comprised of maple/beech (8%), pine (4%), and other cover types (8%). The current forest composition and structure is a direct result of past land use practices that have occurred in LBL. These practices include but are not limited to woods burning by former landowners (and most likely by Native Americans,) timber harvesting at various intensities, charcoal production for the eight iron furnaces located within LBL, and land clearing for agriculture and then their subsequent abandonment.

The Natural Resources Management Plan for LBL has identified five objectives for the forest management program. The five objectives include: 1) Manage for a predominantly oak/hickory forest with a range of size and age classes which meet wildlife habitat needs, 2) Enhance the visual quality of LBL's landscape through forest management activities, 3) Increase environmental awareness and promote the use of environmentally responsible management practices, 4) As a biosphere reserve, research methods and techniques in ecosystem management, and to; 5) Demonstrate how sustainable forest management on a public recreation and education area can be compatible with other uses and stimulate the local economy. To achieve these stated objectives timber harvesting could occur on approximately 109,050 acres of forestland.

OPEN LAND

Open land encompasses approximately 12,050 acres (7%) of all lands at LBL. Open lands include wildlife planting areas, woods openings, cooperative farming areas, ecological restoration sites, and other areas.

The Natural Resources Management Plan for LBL has identified five objectives for the open land management program. The five objectives include 1) Provide for the orderly growth and development of desirable stages of early plant succession to meet wildlife habitat needs; 2) Improve visual diversity through open land management activities; 3) Provide sufficient distribution of grain and green forage to supplement natural food and cover for wildlife; 4) Test and demonstrate sustainable open land management through ecological restoration, maintenance of open lands, and agricultural practices and techniques; and 5) Increase environmental awareness and encourage environmental protection in the region.

The LBL landscape generally exhibits moderate to low plant species diversity, but also includes areas of high plant species diversity. Chester reported a total of 1,310 taxa that includes: native woody taxa (17.5 percent), native non-woody taxa (59.1 percent), and non-native taxa (23.4 percent).

Roads can be beneficial in achieving ecosystem management goals. Management activities (i.e. timber harvest, prescribed fire, mowing, crop planting) needed to achieve the objectives of the forest and open land management programs at LBL are feasible because roads provide both vehicular access and boundaries (i.e. fire lines for prescribed fire).

Roads can also be detrimental to ecosystem functions. In a naturally functioning ecosystem, the communities of organisms are continuously interacting among themselves and with the physical environment. The loss or reduction of any of these living or non-living components, within such a system, affects individual organisms and changes the dynamics of the system. Construction and maintenance activities of roads and subsequent usage disrupt ecosystems to various degrees. Small ecosystems may be destroyed by direct disturbance. Large ecosystems may be capable of tolerating some level of direct disturbance without a significant change in system dynamics. Indirectly,

any ecosystem, small or large, may suffer from alterations in the microclimate and increases in public access associated with road corridors. The cumulative effects of numerous roads within an area may change territorial movements of some terrestrial and aquatic wildlife.

BIOSPHERE RESERVES

LBL is designated as an International Biosphere Reserve. As part of the Biosphere Reserve Program, approximately 42,500 acres of land within LBL are to be designated as core area lands. These core area lands have a protected status that prohibits many management activities such as timber harvesting, traditional agriculture practices, and associated new road construction. This core network would provide research opportunities for investigating site dependent and configuration concerns for managing natural areas. The range of core land sizes (from sub-watersheds to stand level) should facilitate understanding of factors determining optimum size of natural reserves for various wildlife populations and plant community types (NRMP page 89).

TIMBER SALES

According to TVA records, timber sales have occurred at some level on LBL since 1966. Roads are an important aspect to the timber sale program at LBL as they provide access to forest stands scheduled for harvest. Commercial timber sale projects, offered through a competitive bidding process, are used as a method to achieve the objectives of the Forest Management Program identified in the 1994 NRMP for LBL. The NRMP developed a sale schedule that identified by year where sales could occur and also set guidelines in regards to how much acreage could be harvested annually. From 1995 – 1999 sale volume averaged 4-million board feet/year of timber harvested over an average of 2,000 acres annually.

FIRE SUPPRESSION/FUELS MANAGEMENT

The incidence and extent of wildland fires at LBL has been relatively low. Based on wildland fire data collected during the past 15 years, the average annual fire season at LBL includes four fires that consume a total of 143 acres. Wildfire points of origins are typically adjacent to roads or trails at LBL. Over the past 15 years, most fires occurring at LBL have been attributed to human causes, although nationally arson is only attributed to 25% of all wildland fires.

Currently, there is a limited fuels management program at LBL. The current NRMP for LBL allows prescribed fire to be used for various resource objectives. Prescribed fire is used primarily to reduce the buildup of hardwood leaf litter accumulated in campgrounds and to restore and maintain native plant communities in identified open lands. Fuels management treatments have averaged approximately 500 acres a year for the past three years. (Documented data prior to Forest Service management in 2000 is unavailable. Acres treated by prescribed fire during TVA management of LBL is estimated to be similar.)

SOCIO-CULTURAL AND ECONOMIC

DEMOGRAPHICS (POPULATION)

Changes in demographics are a primary factor driving changes in human uses and values. Population growth within LBL's bordering counties has grown significantly between 1990 and 2000. The Kentucky counties averaged a 16.4% increase, which is 6.8% higher than the state average. In Tennessee, the counties averaged a 21% increase, which was 4.7% higher than the state average (see Table 1). The increase is due to the increasing ages of the Baby Boomer Generation, which is now retiring. Land Between The Lakes is a prime retirement area, and is highly rated by Rand McNally as one of the best places in the U.S. to retire. Furthermore, with local universities and the low cost of living, we are seeing an increase in the younger population as well. With many factors ranging from retirement, county economic development and stimulus plans, local universities, low cost of living, and recreation opportunities, LBL and the surrounding communities will see a dramatic increase in population for the next 25 years.

Percent Change 1990-2000
Projected Change 2000-2025

	% Change 1990-2000	% Change 2000-2015	% Change 2015-2025
	Population	Population	Population
State of Kentucky	9.6	10	8
KY Counties			
Calloway	11.2	11	12
Lyon	22	18	13
Marshall	10.7	13	9
Trigg	21.6	18	25
State of Tennessee	16.7	22	15
TN Counties			
Henry County, TN	11.6	12	10
Steward County, TN	30.5	25	18

The minority population in the local area still makes up only a small portion of the total population. However, the percentage of the minority population is increasing at a substantially greater rate than the state averages (see Table 2 below).

Minority Population Change by State and County in Association with LBL			
	Minority Population		**% Change 1990-2000**
	1990	**2000**	
State of Kentucky **KY Counties**	293,473	435,014	48
Calloway	1177	1951	66
Lyon	471	690	46
Marshall	120	575	379
Trigg	1263	1500	19
State of Tennessee **TN Counties**	829,117	1,193,924	43
Henry	2933	3512	19
Stewart	185	683	269

The area's economy is growing due to the increase in manufactures and increase in higher education among individuals. Within the bordering counties and others within reasonable commuting distances, many moderate sized factories have been established and more are moving in. The LBL area is a largely an export economy ranging from commodities in agriculture, manufacturing, and other services. This is allowing the population to increase as well as the local economy.

County and State Urban/Rural Population			
	1990		
	Urban	Rural	% Rural
State of Kentucky **KY Counties**	1,910,028	1,775,268	48
Calloway	14,439	16,296	54
Lyon		6,624	100
Marshall	6,419	20,786	76
Trigg		10,361	100
State of Tennessee **TN Counties**	Unknown	Unknown	Unknown
Henry	9,440	18,448	66
Stewart		9,479	100
LBL Overall	30,928	81,994	73

Even though there has been a population increase during the last decade, the LBL area has become slightly more rural. In 1990 the current rural average was 73% for the total area (see Table 3 below). Even though the 2000 estimates are not complete, we feel that this percentage has increased slightly. People moving into the area seem to be moving here to take advantage of its rural character, forest environment, and recreational opportunities; thus, they are moving to the rural sections of the counties instead of the urban area.

In sum, the population in the forest analysis area is increasing, with a substantial increase in the minority population. The population is moving to rural areas, but it still appears that the area's economy is healthy and growing. Poverty and unemployment has decreased. All of these indicators suggest that there will be an increasing demand for leisure time activities.

HISTORIC

LBL is a 170,000-acre outdoor recreation and environmental education area in western Kentucky and Tennessee. It was established in 1963 when President John F. Kennedy charged the Tennessee Valley Authority (TVA) with a mission to demonstrate how an area (known then as "Between the Rivers" or BTR) with limited timber, agricultural, and industrial resources could be converted into a recreation asset that would stimulate economic growth in the region. The President's rationale was that a recreation area within the region would attract large numbers of visitors, which, in turn, would stimulate the regional economy through tourist spending. With the President's authorization and congressional funding for land purchase in 1964, TVA began the task of developing LBL. TVA subsequently developed LBL into a national recreation and environmental education demonstration area. In 1999, LBL was transferred from the TVA to the USDA Forest Service where the Southern Region manages it. (Additional information on visitor use can be found in Appendix A, Resource Questions SI 1 and 3.)

Indian Occupation

This area was occupied by Native Americans for at least 10,000 years. This occupation culminated in an agricultural society some 500 years before contact with European settlers. The Indian occupation undoubtedly left trails and pathways, some of which may have been co-opted by the earliest white settlers. However, there are no tangible remains of the trails and pathways left by the Indians visible on LBL today.

Earliest Settlers

The earliest settlers in LBL came with the intention of establishing homes and farms on their own land. The major transportation routes used by these early settlers were the Tennessee and Cumberland Rivers. The roads and paths created "Between the Rivers" (BTR) often led to river landings, where steamboats and other river craft could land and take on goods and passengers. Ferries were quickly established to provide transportation across the rivers. A network of small roads and paths grew up organically to serve the folks living between the rivers.

Iron Industry

When the iron industry came to western Kentucky and Tennessee, roads were developed to bring charcoal and iron ore to the furnaces. Historic records show the creation of a "tram road" to feed raw materials to Center Furnace. It is possible that similar roads were made for the other furnaces in LBL. The iron industry faded in the latter part of the nineteenth century, due to changing technology and a decreased interest in the fairly low-grade ores available here.

Development of BTR Community

Small towns grew up in BTR, including Golden Pond, Model, Birmingham, Tharpe, and others. BTR shared in the general economic downturn after the Civil War. Goods continued to move by riverboat, so river landings continued to be the most important focal points of the road system. One economic activity that flourished was where local residents would cut railroad ties from the widespread forests of BTR and take them down to the riverbank, where they would be collected by riverboats.

The Great Depression hit BTR hard. The Depression was felt in the agricultural parts of the country earlier than in the cities, and BTR was a rural agricultural area. One positive development in this time period was that the Eggner Ferry Bridge and the Henry R. Lawrence Memorial Bridge were built. This made the road between the two bridges very important, a status that continues today.

Mail routes were among the highest quality and best maintained roads in BTR. When Kentucky Lake and Lake Barkley were created, some of these mail route roads were inundated, but many of them remained above water.

Creation of LBL

When LBL was created, the existing road system had to be adapted to meet the needs of a National Recreation Area. One of the major changes was the creation of a main north-south route, called The Trace. This involved building a good quality two-lane road, which was mainly new construction especially in the northern half of LBL. A new bridge was built at the north end of LBL and the last remaining traces of the traditional isolation of the Land Between the Rivers was over.

Roads to the major campgrounds and lake access areas were upgraded and often paved. Other roads, which may once have been important paved roads, were reduced to lower maintenance levels. Hiking, biking, and horse trails were created, sometimes using old roadbeds.

ENGINEERING (ROADS)

There are approximately 733 miles of road in our GIS databases, including approximately 359 miles of Maintenance Level (ML) 3, 4, and 5 roads that are suitable for low-clearance vehicles (passenger cars). ML 2 roads are suitable for high clearance vehicles and are frequently closed for public use. These roads are single-purpose, low volume roads normally single-lane and unsurfaced. ML 1 roads are currently impassable or are blocked to all traffic. The road density at LBL is approximately 3 miles of road per square mile.

There are five maintenance levels used by the Forest Service and described in FSH 7709.58 Transportation System Maintenance Handbook. Recent efforts by the Environmental Stewardship Department have identified approximately 310 miles of unnumbered roads and assigned four-digit road numbers. These are included in the

733 mile total but they have yet to be included in the INFRA database. One hundred of those miles are ML-1, 171 miles are ML-2, 13 miles are ML-3, 7 miles are ML-4, and 19 miles are ML-5. The above totals do not include unclassified roads.

Forest Service Maintained Road Mileage by County

State: Kentucky
County: Lyon

FS ML	MATERIAL	MILEAGE
2	NATIVE	11.82
3	AGGREGATE	12.74
3	NATIVE	11.60
4	AGGREGATE	20.30
4	PAVEMENT	8.43
5	PAVEMENT	7.38

State: Kentucky
County: Trigg

FS Maintenance Level	MATERIAL	MILEAGE
2	NATIVE	31.92
3	AGGREGATE	15.96
3	NATIVE	26.46
4	AGGREGATE	32.47
4	PAVEMENT	17.36
5	PAVEMENT	1.30

State: Tennessee
County: Steward

FS Maintenance Level	MATERIAL	MILEAGE
2	NATIVE	29.79
3	AGGREGATE	8.31
3	NATIVE	18.83
4	AGGREGATE	26.35
4	PAVEMENT	8.50
5	PAVEMENT	2.49

The preliminary recommendations and cost estimates provided in the FHWA 2002 Engineering Study for Roads & Bridges detail immediate road safety needs requiring approximately $300,000 in program dollars for all roads ML 1-5. We have addressed

many of these safety concerns through Memorandums of Agreement with the Federal Highway Administration, the Tennessee Department of Transportation, and the Kentucky Transportation Cabinet for all respective hard surface roads, encompassing approximately 16.2% of the area's roads (primarily ML 5 and select ML 4 roads). The remaining road safety issues are being addressed through our maintenance contract.

RECREATION

For LBL, the approximately 359 miles of ML 3-5 roads provide for roaded recreation opportunities. These roads represent the best and most heavily used routes for scenic driving. Our studies indicate that for every market segment surveyed, Scenic Driving ranked number 1 according to information provided by a 1999 survey, see Table 4. This in conjunction with the aging population, who participate in less physical activity, would indicate an increased demand which may exceed the current supply. This effect may be accentuated if the anticipated Highway 68/80 expansion increases visitation as expected (State of Kentucky, Transportation Cabinet – Highway 68/80 Environmental Assessment, 1994.)

Rank Order of Activity Participation by Market Segment for Activities where over 20% of Respondents Indicated They Participated		
Families w/ Children	**Mature Adults**	**Young Adults**
Drive / Scenic - 49.5%	Drive / Scenic - 56.2%	Drive / Scenic - 50.6%
Wildlife Viewing - 32.8%	Wildlife Viewing - 35.2%	Wildlife Viewing 40.0%
Hike / Day - 29.7%	Info/Welcome Sta - 29.9%	Hike / Day - 30.0%
Fishing / Boat - 29.4%	Fishing / Boat - 29.8%	Fishing / Boat - 25.9%
Fishing / Shore - 28.6%	Hike / Day - 27.4%	Info/Welcome Sta - 24.1%
Info/Welcome Sta - 28.6%	History / Site - 27.0%	Beach Use - 21.8%
Camping/Developed - 27.0%	Camping/Developed - 23.5%	Picnicking - 21.8%
Picnicking - 23.9%	Fishing / Shore - 21.0%	Boating / Motor - 21.2%
Beach Use - 22.8%	Shopping / Gifts - 20.8%	Fishing / Shore - 20.6%
Boating / Motor - 20.7%	Picnicking - 20.5%	Camping/Developed - 20.0%
Swimming - 20.2%		

STEP 3 – IDENTIFYING ISSUES AND STEP 4 – ASSESSING BENEFITS, PROBLEMS AND RISKS

The process used for identifying Key Issues and Key Questions is detailed on page 6, Resource Questions and Answers. The result of this process is the identification of the following six Key Issues that were determined to be of such importance that they must be considered in any decision regarding the road system on LBL.

KEY ISSUE 1

There is a substantial but unquantified economic benefit to the surrounding region by maintaining the LBL road system for recreation visitors and LBL related commercial activities.

KEY QUESTION 1-1

Is FS maintained access economically important for products and services provided to the local economy? (Access question)

ANSWER

LBL's road system provides the surrounding region with many economic benefits. Highway 68/80, a major highway running east and west, is substantially used for the transportation of goods and services throughout Western Kentucky. Without its presence, transportation cost could hurt small companies, higher education institutions, and local businesses. Although The Trace is the major road that runs north and south, its primary purpose is to serve visitors to LBL. However, it does provide some economic benefits to the surrounding communities because it provides a quality scenic drive and access to other important LBL facilities.

Tourism is highly dependent on the Level 4 and 5 road system, which forms the backbone of the LBL system. Many of our Level 4 and 5 roads, as well as Level 3, provide suitable transportation to the many facilities throughout LBL. Without these roads maintained to use standards, visitation would drop at LBL and regionally, impacting adjacent visitor and commercial activities. The financial, community, and resource benefits of LBL providing a maintained road system contributes to local product and service economies, and more than offsets the cost of maintaining the road system.

SCALE

Forest level roads analysis supplies the context for the magnitude and extent of individual road changes. Watershed and project level analysis provides the detail.

INDICATORS

- Road status/availability (seasonal or permanent closures, upgrades, etc.)
- Change in road status/availability
- Displacement or loss of existing recreational use
- Creation or improvement of new or different recreational opportunities
- Loss of access to revenue producing resources
- Economic benefit of an activity or facility to the local area

SOURCE

- Forest road files
- Forest marketing data
- POS Data
- (NVUM) surveys/traffic counter data from Recreation files

DECISION FRAMEWORK FOR MEASURING ACCESS IMPACT (RATING GUIDE)

High Access Need – Road provides primary access to recreational facilities/sites, developed recreation sites, and developed environmental education sites identified in the 2002 LBL Legal Road Map. These may include campgrounds, picnic facilities, lake access points, overlooks, etc. Road provides access to important, heavily used dispersed recreation areas and/or special events. Road is essential for access for commodity production and/or area businesses. Road will provide access to new, reopened, or increased opportunities in the foreseeable future.

Moderate Access Need – Road provides access to known dispersed camping sites, small special events, lake access areas, special interest areas, mountain bike routes, woodcutting areas or areas used for hunting, birding routes, areas customarily used for special forest product gathering, or trailheads not shown on the LBL Legal Road Map. Tourism or local businesses benefit is limited or indirect. Alternatives or substitutes may exist.

Low Access Need - Economic dependency is either low or short term. Road provides secondary or tertiary access to an area/facility/resource.

KEY ISSUE 2

Loss of traditional access could impact dispersed recreation visitors, including long-term users and past landowners.

KEY QUESTION 2-1

What is the effect of access and/or road status changes on dispersed recreation visitors, including long-term users and past landowners? (Access question)

ANSWER

LBL is a multiple use area that encompasses a wide range of dispersed recreation activities. Dispersed recreation also includes a variety of uses and activities by former residents of the area.

Since the federal government acquired the 170,000 acres, former residents and their relatives still enjoy visiting their old home places and old community sites. The many cemeteries that exist in LBL also play a prominent role in the local social order and are extremely important to those who have family buried at LBL. Road access to the cemeteries, old home places, and former community sites are extremely important to the former residents and their descendents seeking their cultural roots. These locations are scattered throughout LBL along public and administrative roads and sometimes along overgrown roads that are no longer part of the road system.

Sense of Place

Local sense of place may be associated with areas such as spiritual or cultural sites, scenic vistas, hunting camps, and historic sites or traditional rural activities such as wood cutting and hunting. It is important to define affected communities and the expected degree of social and economic benefits and disruption from proposed changes in road infrastructure. Spiritual and aesthetic values can be distant and abstract or part of a local sense of place. Road-related activities include "passive use value." This term includes two categories: Things people appreciate without actually using them or even intending to use them (like a distant wilderness or an endangered plant or animal) are called "existence values"; and things people want to remain available for others (such as their descendants) to use and appreciate are called "bequest values."

As with other social and economic issues and values, some "sense of place" issues are associated with access needs, while others are dependent on restricted road access. Increased access can result in social impacts. Maintenance of social and cultural integrity among forest stakeholders depends in part on their ability to maintain historic uses and the quality of their experiences. For the most part, increasing access by improvement of roads is seen in a positive light by many users of LBL.

Unroaded Attributes

Road management can have either positive or negative effects on unroaded area attributes. Management of roads leading to an unroaded area can have a positive effect on the visual experience if the roads are managed in such a way as to highlight natural attributes and character of the area. This could include things such as soft curves rather than a straight road, undulating tree lines along the roadside as opposed to a fixed-width linear corridor, and native vegetation selected and managed to highlight the natural scenic beauty of the area.

Roads can have a negative effect on unroaded attributes in a number of ways. First, being man-made and artificial, they detract from the natural integrity and natural appearance of an unroaded area. Roads can detract from an unroaded experience and solitude because of traffic noise. Depending on the type of traffic (recreational vs. commercial), amount of traffic, speed of traffic, topography, wind, etc., vehicle/traffic noise can carry from a short distance up to several miles into an unroaded area detracting from the unroaded/solitude experience.

User Conflicts

Conflict between the surrounding communities and TVA occurred any time TVA attempted to change road accessibility or failed to maintain access to the cemetery sites in LBL. (As of this writing, the USDA Forest Service has improved the overall conditions of access roads to major campsites and facilities. Although mandated by law to provide the same access to cemeteries as TVA provided, the local communities have shown appreciation to the USDA Forest Service in their efforts in road maintenance. This includes the timely response to road maintenance requests.) Any change in the status of roads in LBL will be met with resistance from the local communities, hunters, fishermen, backwoods campers, etc. As the population of the former residents becomes older, they will expect at least the same amount of road access that has existed before. Their children can be expected to pick up their parents' concern for the same issues of access shown by the last generation.

Any roads damaged by conflicting users (i.e. "mudding" activities) causes resource damage and leads to inaccessibility for other activities. Roads temporarily closed to accommodate a specific activity or event causes conflicts with other visitors attempting to access the area for recreation or other purposes. There should be consideration of the effects prior to authorizing single use closures.

Seasonal or Temporary Closures

The recent closure of facilities, roads, and trails to protect roads from resource damage has caused concern with some users. These concerns stem from the fact that TVA rarely closed its facilities to protect the resource. In the last three years, the FS has found itself challenging that historic precedent and explaining why closures are necessary for

resource/visitor protection. Education on the reasons for temporary closures, and the consequences of not protecting the resources, is an ongoing necessity.

Administrative Roads

Roads not on the legal road map given out to the public are considered administrative roads. They generally serve as access points for FS maintenance or research use or are used by cooperative farming and other cooperative activities.

Roads vs. Trails

There is public (and administrative) confusion on the status of certain roads and trails on LBL. This includes the Wrangler Camp trails that allow horse drawn wagons, trails that follow old road beds formally utilized by residents, and OHV trails at Turkey Bay that are wide enough to be classified as roads (width >50") and facilitate use by 4x4 vehicles. Portions of other trail systems, including the majority of the North/South Trail south of Golden Pond, are located on old roads and still facilitate use by vehicles for administrative access. The same can be said of the Fort Henry Trail system. This has caused some conflicts over the types of use occurring on the roads and leads to illegal uses and/or excessive resource damage.

Scenic Driving

Other factors that affect road management include scenic quality objectives, location of sensitive viewpoints, and recreational experience objectives. All of these may influence road construction, reconstruction, or maintenance level options. Road management choices that change scenery can also change social and economic activities associated with that scenery. Scenery is affected by what can be seen from a given spot, as well as what can be seen from other sensitive areas back into that spot. In general, Recreation Opportunity Spectrum can be used as an objective for sustaining and achieving landscape character.

Gathering Forest Products

Native Americans and early settlers depended on the land and rivers to produce the food, fiber, and medicinal products needed to survive. In more recent times, the gathering or hunting of plants and animals has continued at LBL. Presently, the Forest Service allows gathering of fruits (e.g. blackberries), nuts (black walnuts, hickory nuts, pecans, acorns), and fungi (e.g. morels). With permits, some woody species (hardwood and softwood timber, and timber products) can be removed. Some non-native flora can be cut (above ground) and removed from old home places. Hunting and fishing continue to be very popular and result in the removal of game species. The road system provides access for all of these uses.

SCALE

Impacts to opportunities for dispersed driving-related recreational activities from road closures should be assessed at the watershed/project level. Forest level summaries can supply the context for the magnitude and extent of change.

INDICATORS

- Does it (the road) access an old home site?
- Is it a "popular" camping area?
- Does it provide access to lakeshore?
- Is it regularly used for wildlife viewing/sightseeing?
- Is it regularly used for hunting?
- Is it regularly used for fishing?

DATA SOURCES

- Local transportation plans or strategies. It is important to examine these documents for information on local concerns and plans for development. These planning documents include the transportation element of county and city general plans, community action plans, fire safety plans, and bicycle and other recreational transportation plans.
- GIS cemetery overlay
- GIS US Highway 68/80 project overlay
- GIS LBL historical buildings, communities, and roads overlay
- LBL TOPO MAP 1964 (historical sites of homes, communities, and churches)
- Kentucky Transportation Cabinet website ref US Highway 68/80 corridor dated 07/12/2001 http://www.kytc.state.ky.us/Features/Land_Between_The_Lakes.htm

DECISION FRAMEWORK FOR MEASURING ACCESS IMPACT (RATING GUIDE)

High Access Need - Road includes 5 or 6 of the indicators listed above.

Moderate Access Need - Road includes 3 or 4 of the indicators listed above.

Low Access Need - Road includes 1 or 2 of the indicators listed above.

KEY QUESTION 2-2

Do access and/or road status changes affect our legal obligation to provide cemetery access? (Access question)

ANSWER

No – despite any changes that might be proposed to LBL's road system, the FS is legally obliged to ensure access to cemeteries within the Recreation Area for purposes of visitation, maintenance, and burial. Proposed road status changes must consider the potential effect on cemetery access.

We are required by law to ensure access to cemeteries at least at the level that existed when LBL was acquired by the federal government. This requirement is not modifiable by the managing agency. Therefore, cemetery access roads are rated as High. A list of all the roads on LBL is available in Appendix B of this document. One column identifies roads that directly access cemeteries.

Planned temporary cemetery road closures should be coordinated with the cemetery contact person prior to the closure. This will meet our obligation to provide access while at the same time allowing for extensive maintenance/replacement activities. Unplanned closures (windfall, washouts, etc.) should be repaired as soon as possible.

SCALE

Impacts to cemetery access should be assessed at the watershed/project level.

INDICATORS

- Proposed change to a road used to access a cemetery, including road closure (temporary, seasonal, or permanent) or a change in maintenance level

SOURCES

- Cemetery database – GIS cemetery layer
- Deceased Person Information Records
- Cemetery Files
- Administrative Guidelines for Cemeteries on LBL
- 1998 LBL Protection Act – Section 528

DECISION FRAMEWORK FOR MEASURING ACCESS IMPACT (RATING GUIDE)

High Access Need - Cemetery access levels shall be maintained at the same level as existed when the federal government acquired the land in the mid-1960s. This level is identified for each cemetery in the folders in the filing cabinet at Golden Pond marked

"Cemetery Files." Access routes and condition of roads to all cemeteries were identified and, in many cases, photographed between 1966 and 1968. Cemetery access roads will always be rated "High."

Moderate Access Need - N/A

Low Access Need - N/A

KEY ISSUE 3

Loss of the existing road access could impact administrative activities.

KEY QUESTION 3-1

Is the existing road system adequate for research, inventory, monitoring and administration, biosphere reserves management, vegetation management, fire suppression and fuels treatment, wildlife management, view shed and recreation management? (Access question)

ANSWER

There are approximately 733 miles of road in our GIS databases including approximately 359 miles of Maintenance Level (ML) 3, 4, and 5 roads that are suitable for low-clearance vehicles (passenger cars). The remaining ML 1 and 2 roads are suitable for high clearance vehicles, used for administrative traffic only, or blocked to all traffic. ML 1 and 2 roads are single-purpose, low volume roads normally single-lane and unsurfaced.

LBL is designated as an International Biosphere Reserve. As part of the Biosphere Reserve Program, approximately 42,500 acres of land within LBL are to be designated as core area land. This core network would provide research opportunities for investigating site dependent and configuration concerns for managing natural areas. Roads can be beneficial in achieving ecosystem management goals. Management activities (i.e. timber harvest, prescribed fire, mowing, crop planting) needed to achieve the objectives of the forest and open land management programs at LBL are feasible because roads provide both vehicular access and boundaries (i.e. fire lines for prescribed fire).

Road access is critical on lands suitable for forest management, especially with regards to timber harvesting. The 109,050 acres of forestland available for timber harvest (suitable timber base) is accessible by the current road system. Lack of road access has not been a limiting factor in the past for harvest proposals or for treatments needed in response to areas damaged by insects and diseases, fire, wind, ice, or snow.

SCALE

Impacts to administrative uses of the existing road system should be assessed at the watershed and project levels. Forest level assessments would inaccurately reflect administrative access needs.

INDICATORS

- Recreational use patterns
- Historic and planned management activities
- Internal comment

SOURCE

- Forest road files
- NRUM surveys/traffic counter data from recreation files

DECISION FRAMEWORK FOR MEASURING ACCESS IMPACT (RATING GUIDE)

High Access Need - Access required on a yearly basis by five or more of the seven listed administrative uses.

1. Research
2. Inventory and Monitoring
3. Biosphere Reserves management
4. Vegetation management
5. Fire suppression and fuels treatment
6. Wildlife management
7. View shed and recreation management

Moderate Access Need - Access required on a yearly basis by three or four of the seven listed administrative uses.

Low Access Need - Access required on a yearly basis by two or fewer of the seven listed administrative uses.

KEY ISSUE 4

Road use, design, and maintenance is contributing significantly to increased sediment loads in LBL creeks, impacting water quality and potentially resulting in impacts to riparian dependent species or wetlands.

KEY QUESTION 4-1

What proportion and magnitude of the road system poses high risk, including the contribution of roads to cumulative watershed effects relative to background conditions and thresholds of concern? (Resource question)

ANSWER

Road networks in LBL are the most significant source of LBL management-accelerated delivery of sediment to streams, Kentucky Lake, and Lake Barkley. In addition to

acceleration of sedimentation, there are numerous direct and indirect impacts to aquatic systems associated with road construction and management. While some of these impacts have positive benefits, such as accessibility to recreation facilities, open lands, the general forest, or the protection of watersheds from catastrophic wildfire; roads have unavoidable effects on streams, wetlands, and riparian areas no matter how well they are located, designed, and maintained.

Roads can contribute to sedimentation through erosion of their surface, cut slope, and fill slope. The amount of fine sediment generated from road surfaces varies considerably based upon the erodibility of the surface material, slope of the exposed surfaces, and frequency, timing, and duration of use. Water, riparian, and aquatic resources are generally more vulnerable to adverse effects of sedimentation where roads are located near streams, lakes, or riparian zones or are hydrologically connected to these features. Fine sediments are readily transported long distances from their origin where ditches, pipes, or streams provide hydrologic connectivity. The chronic delivery of surface generated sediments can be of special concern to aquatic organisms during early life stages.

Roads generate sediment through the erosion of the running surface, unstable cut and fill slopes, drainage structure fills, and unvegetated drainage ditches and shoulders. The amount of sediment produced is related to surfacing type, traffic volume, maintenance levels, and erosion hazard of soils.

Burroughs, et al, 1989, found the first three years following road construction to be an acute, highly erosive period for roads impacting streams. Following three years, road conditions improve as ditches, right-of-ways and clearing widths revegetate and stabilize. However, a chronic level of sediment continues to be produced, particularly if regular maintenance on the road is not implemented.

Analysis of the forest roads for this key question relies upon three environmental indicators: *(1)* roads that encroach upon streams, *(2)* road-stream crossings, and *(3)* roads on sensitive, erosive soils.

Many roads are located along stream channels or within their valleys to take advantage of gentle slopes and easier construction. About 268 miles of road encroach upon the stream network. Most locations are distributed evenly along headwaters and main channels of watersheds across LBL. However, high miles of road encroachment are noted along headwaters of Crooked Creek and Lick Creek. Two major roads, The Trace and US Highway 68, encroach upon numerous streams along their routes.

Culverts, installed at many of the stream crossings, were never designed to pass more than a 25-year interval event. Streams entrain and transport noticeable amounts of cherty fragments, adding to flow volumes that these culverts were never designed for. This increases the risk of mass failure of the fill material. Also, fill material has been found to be a chronic sediment source to most streams under normal precipitation and runoff events. Culvert installation requires fill material across stream valleys. The amount of

surface erosion would increase accordingly by number of stream crossings within a watershed. Regular maintenance to stream crossings will reduce sediment inputs. There are 509 places where Level 3, 4, and 5 roads cross streams within LBL. A large number of crossings occur in Barrett, Bear, Crooked, Lick, Lost, Furnace, Turkey, Panther, and Pryor Creek watersheds.

Many of LBL's stream channels have downcut their longitudinal profiles through progressive headcuts in response to the fluctuating base elevations of the large lake levels. Undersized and/or improperly installed culverts and unstable outlets have accelerated the degradation of the streambed by increasing velocities of flow through constricted pipes, thereby increasing the splash erosion at outlets. If the crossing (culvert, bridge, ford) is misaligned, flow can be directed against stream banks away from the thalweg and accelerate bank erosion. Stream sediment then increases and water quality is lowered. As the streambed continues to degrade and downcut, subsurface flows (water table) continue to lower correspondingly, resulting in localized drier riparian sites and changes in vegetation.

Most roads in this analysis have paved or aggregate surfacing and are maintained. Nearly all roads have existed for more than 10 years and many for more than 30 years. Proper maintenance reduces the production of sediment and the risk of it being transported to the streams. Paved surfaces (Level 5) produce the least amount of sediment. Aggregate surfaced roads (Level 4) have reduced levels of sediment relative to native surface roadways. However, the limestone aggregate used on most of LBL's roads breaks down into fine particles after time and heavy use and can contribute to available sediment load. Proper grading techniques, drainage of the road prism, and replacement of surfacing reduces this sediment amount. Native surface roads contribute the most sediment, as they are vulnerable to rutting. There are seasonal closures on some roads for wildlife habitat protection that has beneficial indirect effects to the soil and water resources.

LBL has around 94,825 acres of erosive soils, or roughly half the NRA. Roads intersect these soil types across 4,295 acres. Areas of concern are in the Baxter Hammock Complex, Brandon Silt Loam, Bodine Cherty Silt Loam, Nixa Cherty Silt Loam, and Padon Silt Loam soil units. Slope doesn't appear to be much of a factor as these soil units are generally moderate in slope, 6-30%.
Mitigations to reduce erosion and sediment transport are critical on these soil types and may include such practices as mulching, use of geo-technical materials, seeding, directing drainage flows onto vegetated filter strips, catch basins, and routine maintenance.

The cumulative effect of management activities involves the additive magnitude, intensity and timing of human and natural impacts. Each watershed represents a unique history of disturbances as well as a unique sensitivity based upon the natural processes that control and form each landscape (geology, climate, etc.). Because of the nature of road effects on natural processes such as hydrology and sedimentation, they can account for a large proportion of the potential cumulative effects within watersheds. Ultimately, cumulative watershed effects are displayed in the channel's dynamic equilibrium.

Desired conditions for long-term maintenance of aquatic, riparian, and water resources is met by minimizing the sedimentation risks associated with roads by

- Minimizing the amount of road located on sensitive soils or highly erodible road surfaces;
- Minimizing the amount of road near streams;
- Minimizing un-armored or erodible fill at road/stream crossings;
- Minimizing hydrologic connectivity between roads and streams, lakes, or riparian zones;
- Minimizing use of roads on sensitive soils during wet-periods;
- Increase of proper road maintenance and design.

SCALE

Forest or Watershed/Project is appropriate.

INDICATORS

- Road miles that are within 100 feet of streams
- Miles of road encroaching or connected to stream channels
- Number of stream crossings within the watershed
- Miles of road on highly erodible soils

DATA SOURCES

- Forest Roads GIS Layer
- Streams GIS Layer
- Soils GIS Layer

DECISION FRAMEWORK FOR MEASURING RESOURCE IMPACT (RATING GUIDE)

High Resource Impact – Road segments that encroach on streams, are connected to streams, are on erosive soils, and have a high number of stream crossings (3 or 4 out of 4 indicators).

Moderate Resource Impact – Road segments that have 2 of the 4 indicators.

Low Resource Impact – Road segments with only one out of 4 indicators.

KEY QUESTION 4-2

What proportion and magnitude of the road system poses a high risk to wetlands? (Resource question)

ANSWER

There are approximately 6,420 acres of wetlands within LBL boundaries as classified by the National Wetlands Inventory, USFWS. The large lentic wetlands include the impoundment lakes of Honker Bay, Hematite Lake, Energy Lake, Bard Lake, and wildlife refuges of Bear Creek and Long Creek. Other major wetlands are located near the heads of all shoreline bays of Kentucky Lake and Lake Barkley. Riparian area lotic wetlands are located within riparian areas of all perennial streams. There are additional small, unclassified wetlands under one acre in size scattered across the landscape.

Honker, Hematite, Energy and Bards Lakes all have roads across the impoundment dams that create these lakes. The impoundments are necessary to maintain water levels; drainage is provided through spill gates. Indirect effects may include risk of chemical pollutants from vehicles and sediment washed from road shoulders. These effects should be looked at more closely during watershed roads analysis.

Roads that intersect with wetlands may affect aquatic species habitat. Conservation of aquatic diversity should be a consideration of local wetlands.

Large areas of riparian areas are directly and indirectly affected by road encroachment along Lost Creek, Bards Lake, Turkey Creek (southern boundary of OHV), and Furnace Creek. Additionally access roads to several bays encroach on wetlands near the head of the bays. Effects may include culverts that channelize flows, roads fill that may be chronic sediment sources, and reduction in wetland acres. Most of these areas are relatively flat in slope so increases in flow velocities and sediment transport may be minimal. Most of these roads are armored with pavement or gravel that reduce sediment production. In all, about 131 acres of wetlands may be affected by road crossings or encroachments.

During watershed/project level roads analysis, opportunities should be evaluated for relocating roads out of the wetland areas and restoring surface hydrology through use of multiple culverts and perforated fills. To sustain wetland features and reduce sediment, elbowed stand pipes at culvert inlets and low water fords should be considered.

SCALE

Forest or watershed/project is appropriate.

INDICATORS

- Acres of wetlands impacted by roads
- Location of roads to wetlands (within 100 feet)

DATA SOURCES

- Forest Roads GIS Layer
- Watersheds GIS Layer
- National Wetlands Inventory GIS Layer

DECISION FRAMEWORK FOR MEASURING RESOURCE IMPACT (RATING GUIDE)

High Resource Impact - Existing or proposed road crosses wetland. Existing road design is such that it is hydrologically connected to wetland. Cross-drainages alter subsurface flows.

Moderate Resource Impact - Existing or proposed road is adjacent to wetland or is within 100 feet of a wetland.

Low Resource Impact - Existing road or proposed new road is more than 100 feet from a wetland.

KEY ISSUE 5

Roads cause direct impacts to wildlife and plant species on LBL.

KEY QUESTION 5-1

How do roads affect the spread of undesirable exotic species? (Resource question)

ANSWER

Undesirable exotic species compete and threaten native diversity; habitat for fish, wildlife, and native plants; and soil stability. Invasion by exotic species may have significant biological and ecological effects if the species are able to disrupt the structure or functions of an ecosystem. Invasive undesirable exotic species are recognized as a major issue throughout the National Forest system. Undesirable exotic species of concern at LBL include exotic invasive plant species and the gypsy moth (*Lymantria dispar*).

Invasive exotic plant species are spreading at an alarming rate within the Southern Region. The Southern Region has compiled a list of exotic plants that pose the greatest threat to National Forest Lands in the south. Many of these exotic invasive plant species are known to occur on LBL. Examples of exotic plants that pose a severe threat on LBL include (but are not limited to) Japanese honeysuckle (*Lonicera japonica*), Kudzu (*Pueraria Montana*), autumn olive (*Elaeagnus umbellta*), Multiflora rose (*Rosa multiflora*), Johnson grass (*Sorghum halepense*), and Sericea lespedeza (*Lespedeza cuneata*).

Generally, biological invasion is promoted by disturbance. Building and/or maintaining roads into a forest represent disturbances that create and maintain new edge habitat. These roadside habitats can be invaded by a suite of exotic invasive plant species, which may disperse by natural agents such as wind and water. It appears that the level of road is not a determining factor in invasive plants, as plants colonize even on Level 1 roads. Human agents such as vehicles, riding stock, livestock food and other materials transported to LBL can also aid in the dispersion of undesirable exotic plants. Roads may be the first point of entry for exotic species into a landscape. The road can serve as a corridor along which the species moves farther into the landscape. Upon establishment, some invasive exotic plants may then be able to move away from the open roadside and into adjacent forested land. For example, Bush honeysuckles *(Lonicera spp.)* can become established and spread in the forest under-story and Kudzu can overtop forest canopies. Conversely, with road decommissioning and the subsequent forest canopy closure, some existing undesirable exotic plants populations would be reduced (i.e. Nepalgrass – *Microstegium vimineum*).

The gypsy moth has been a primary defoliator of hardwoods in the Northeastern United States since its introduction in 1869. Isolated infestations have been noted in some North Central, Southern, and Western States and are subject to eradication by the USDA Animal and Plant Health and Inspection Service. There have not been gypsy moth

infestation incidents on LBL to date. Since oaks are the preferred host species, LBL is extremely vulnerable to gypsy moth defoliation if the insect becomes established. The host range is extensive, and artificial spread of the insect has increased the already high rate of dispersion by natural means. Roads facilitate artificial spread, specifically the movement of egg masses and pupae. Vehicles serve as vectors by moving egg masses and pupae from infested areas to areas not infested.

Control of exotic species is facilitated by road access. The use of hand crews, mechanical, or herbicide application to control noxious weeds can be conducted at less cost with road access. Prescribed fire may be used to reduce populations of some exotic organisms, primarily plant species. This operation is greatly facilitated by road access and the control lines provided by the roads themselves.

SCALE

At the LBL-wide scale, this process would identify areas where known populations of undesirable exotic species exist. Overlaying maps of these areas with road density maps would indicate road management opportunities.

At the watershed/project scale, exotic species populations, host species, or susceptible habitats could be evaluated for areas where road closure, decommissioning, or road construction are appropriate. This scale should focus inventories and the assessment of the risk of new or increased movement opportunities for undesirable exotic species.

INDICATORS

- Locations of undesirable exotic species
- Species establishment and spread vectors (see Appendix D and Web Pages listed under Data Sources below)
- Susceptibility of an area to invasion and spread of exotic species (based on current and proposed road management activities)

DATA SOURCES

- Appendix D – Non-Native and Invasive Plant Species
- Noxious Weed Inventories
- Forest Roads GIS Layer
- Southern Region's Exotic Invasive Plant Species List
- Southeast Exotic Pest Plant Council
- Results from LBL's Annual Gypsy Moth Pheromone Trapping Program
- http://www.exoticpestplantcouncil.org/links.cfm
- http://plants.usda.gov/

DECISION FRAMEWORK FOR MEASURING RESOURCE IMPACT (RATING GUIDE)

(Resource measured is the establishment and spread of Undesirable Exotic Species)

High Resource Impact - Road is open to the public. Significant ground disturbance is proposed adjacent to portions of road that have existing populations of undesirable exotic species that are known as prolific invaders, or populations of these species are immediately adjacent to disturbance area.

Moderate Resource Impact - Ground disturbance is proposed along portions of road that do not have existing populations of undesirable exotic species that are known as prolific invaders and spread readily, but populations of these species are in the vicinity of the disturbance area. Road is closed to public access. Mitigation measures are in place for equipment cleaning.

Low Resource Impact - Ground disturbance is not proposed, road is closed to the public, or minor ground disturbance is proposed along portions of road that do not have existing populations of undesirable exotic species, and these species are not in the vicinity of the disturbance area. Mitigation measures are in place for equipment cleaning.

KEY QUESTION 5-2

How does the road system directly affect wildlife, including road kill and habitat fragmentation for a variety of species? (Resource question)

ANSWER

The LBL road system and human use of those roads has affected and continues to affect wildlife and wildlife habitat. Access to the forest created by the road network generates both positive and negative effects on wildlife. From a positive standpoint, roads provide access to manage and maintain wildlife habitats on LBL. Direct negative effects can include habitat loss, fragmentation, and road kills. Roads can also facilitate other negative effects on wildlife such as poaching and providing convenient access to the backcountry that can lead to litter and habitat degradation, but these impacts are believed to be small on LBL in relation to the total amount of habitat.

Roads and right-of-ways create open land habitat and edge habitat, favoring species that use these habitats. However, the habitat immediately adjacent to the road (within 6 - 15 feet of the road shoulder) is of limited value as wildlife habitat because plant species composition (e.g. fescue and sericea) has limited forage value, and roadside maintenance activities (regular mowing) and traffic provide disturbance that may injure or kill wildlife which venture onto the road. Other roadside maintenance activities that adversely affect habitat immediately adjacent to the road shoulder include grading, salting, and road repair. On the larger right-of-ways, open land habitat more than 6 - 15 feet from the road shoulder (widths of commonly used bushogs) often contains a greater mix of native plant species and is maintained at less frequent intervals to provide forage and cover for open land wildlife species.

Roads can be detrimental to species that prefer interior habitat and experience increased mortality near or along edges. Forest fragmentation can threaten native species populations by breaking up large blocks of contiguous habitat and by degrading the quality of the remaining habitat for those species sensitive to an increase in the amount of forest edge. The impacts to these species depends on a number of factors, including the size and composition of the remaining habitat blocks and the particular needs of the species. At LBL, the TVA NRMP has set aside 25 percent of LBL in Biosphere Reserve Core areas to provide minimally disturbed ecosystems, and to help address the needs of species requiring large blocks of unfragmented forest.

Roads can also act as a barrier to terrestrial species movement. The effectiveness of the barrier is a result of road width, traffic density, and the mobility of the species. Roads become a more effective barrier as road width and traffic density increase, and species mobility decreases. When populations become subdivided, there is increased risk of demographic fluctuation, local extinction of subpopulations, reduced potential for recolonization after a local extinction, and a progressive loss of local biodiversity. These problems are more significant on areas with sensitive species and where habitat fragments are smaller than the needs of the species that occur on those areas.

Many species are sensitive to harassment or human presence, which are often facilitated by road access. Harassment of wildlife may occur when people driving along the roadways approach wildlife too closely causing disturbance, or when drivers intentionally swerve off their path of travel to kill animals such as snakes. Harassment can lead to reductions in productivity, increases in energy expenditures, or displacements in population distribution or habitat use.

Wildlife road-kills are common occurrences along LBL's roadways, particularly the paved roads with higher speed limits. Deer/auto collisions commonly occur, and multiple unreported strikes occur with small mammals, reptiles, amphibians, and birds. There is a direct correlation between the drivable speed of a road and wildlife road kills. At LBL, level 5 roads have the highest incidence of wildlife road kills. Reptiles and amphibians seek roads for thermal cooling and heating. In doing so, these species can experience significant chronic mortality from motorized vehicles. Highways and other roads with moderate to high rates of motorized traffic may function as population sinks for many species of reptiles and amphibians, resulting in reduced population size and increased isolation of populations. While wildlife road kills directly affect individuals of various wildlife species, there is no data to suggest that wildlife populations are currently being threatened by the impacts of road kills on LBL.

The present road system provides access throughout LBL to help meet LBL's mission to provide access and opportunities for driving for pleasure, wildlife viewing, hunting and trapping. Access provided by the LBL's road network can facilitates habitat protection and improvement projects (forest and open lands management). Habitat improvement projects that involve the use of equipment and/or personnel can be conducted more safely and cheaper with road access. Roads can help protect wildlife habitats by providing access for initial attack on wildfires, acting as firelines, and providing safe deployment

areas for fire fighting personnel. This is minor consideration due to the rarity and small scale of wildland fires on LBL.

SCALE

The road impacts discussed above are general in nature and can be analyzed at all scales. The primary function of this information at the LBL-wide scale is to identify the adequacy of the current road system and determine if changes should be made. These changes would most likely be linked to specific land allocations, determined during the Planning Process currently underway to create a LRMP.

At watershed/project level analysis the impacts identified above can be addressed in terms of road densities, level of road use, sensitive habitat areas, and sensitive species. Analyses should examine the effects on wildlife populations and unique habitats for wildlife. Land areas could be identified where new roads would present high risk to wildlife species and species habitats, or areas where roads would be permitted due to low risk and high need.

INDICATORS

- Critical habitat
- Road maintenance level
- Level of road use (traffic counts and locations of roads)
- Road density (miles of open road per square mile)

SOURCES

- LBL NRMP and FEIS
- Wildlife records and inventories (Hunt Data, Breeding Bird Surveys, Unique Habitat Areas)
- Forest Law Enforcement records
- Forest Roads GIS Layer
- Research conducted on LBL roads pertaining to road kills
- Traffic counts

DECISION FRAMEWORK FOR MEASURING RESOURCE IMPACT (RATING GUIDE)

(Resource measured will be habitat fragmentation, road kill potential and potential impacts on wildlife populations)

Potential High Resource Impact – High road densities relative to species needs, Maintenance Level 5 roads (high speed, high traffic volumes), and road sections bisect identified critical habitat, construction of new roads that will open for public use indefinitely

Moderate Resource Impact – Moderate road densities, Maintenance Level 4 roads

(moderate speed, moderate traffic volumes), and construction of new roads that would receive moderate public use and not threaten critical habitats.

*Low Resource Impact*_– Low road densities, Maintenance Level 3 and 2 Roads (Slow speed, Low Traffic Volumes). Roads that would receive light public use, for administrative use only or used for a finite duration then decommissioned.

KEY QUESTION 5-3

Are the road edges providing habitat for threatened, endangered or sensitive species? (Resource question)

ANSWER

(Much of the discussion under wildlife is applicable to TES)

LBL's Natural Resources Management Plan has documented 5 mammals, 6 birds, 4 reptiles and amphibians, and seven plants that were federally listed as endangered, threatened, or candidate species that occur or have potential habitat on LBL. Federally listed species that occur or suitable habitat occurs on LBL include Red Wolf (*Canis rufus*), Gray Bat (*Myotis grisescens*), Indiana Bat (*M. sodalis*), bald eagle (*Haliaeetus leucocephalus*), and Price's Potato Bean (*Apios priceana*). LBL also provides habitat for state-listed species in Tennessee and Kentucky (Kentucky does not have a legislated state list).

Some TES thrive in edge habitats. One of the better populations of the Price's Potato Bean occurs along the roadside of a Level 5 LBL road. At least five sensitive plant species have been documented along various roads of LBL.

SCALE

At the LBL-wide scale, known roadside populations and habitat for TES would be identified to ensure that mitigation measures are in place for TES protection in regards to roadside maintenance activities.

At the watershed/project scale, for projects potentially impacting roadsides, inventories should be conducted to: 1. Identify any undocumented occurrences of TES, to examine the risk to localized populations or habitat, and, 2. Report on the status of existing TES habitat and populations on roadside edges. Prior to new road construction or changes in road maintenance activities, areas should be inventoried to identify where new roads would present high risk to terrestrial species and species habitat, or areas where roads would be permitted due to low risk and high need.

INDICATORS

- Location of roadside populations and habitat for TES
- Level of road use (traffic counts and locations of roads)
- Type and frequency of road maintenance activities

SOURCES

- USFWS T&E species list for LBL
- Kentucky and Tennessee Department of Natural Heritage Data Bases for TES
- TES monitoring and inventory data for LBL
- Regional Forester's Sensitive Species List
- Forest Roads GIS Layer
- Research conducted on LBL pertaining to TES
- TES Recovery Plans

DECISION FRAMEWORK FOR MEASURING RESOURCE IMPACT (RATING GUIDE)

Violations of the Endangered Species Act and/or USFW approved Species Recovery Plans result in resource impacts above the High Resource Impact category below. These types of impacts require immediate changes to come within compliance of the law or recovery plans.

High Resource Impact – Federal TES habitat exists with a significant potential for colonization, there are high public use levels (as are found on ML 4 and 5 roads,) and existing/proposed roadside maintenance activities are/would impact the TES habitat.

Moderate Resource Impact – Federal TES habitat exists with a moderate to low potential for colonization, there are moderate public use levels (as are found on ML 2 and 3 roads,) or state TES populations or potential habitat exists and there are ongoing or proposed roadside maintenance activities that could impact populations or habitat.

Low Resource Impact – TES populations or habitat do not exist, there are low public use levels (as are found on ML 2 and 1 roads,) or roadside maintenance activities will not adversely impact them or are not occurring or proposed.

KEY ISSUE 6

There is a backlog of deferred maintenance and reconstruction needs.

KEY QUESTION 6-1

Are there opportunities to reduce backlog maintenance needs? (Access question)

ANSWER

Resource damage on lower level roads during vulnerable periods increases the impact on public safety, administrative and public use, and raises the cost of maintenance for the FS. Opportunities to reduce this cost and its associated backlog can be identified by examination of historical road maintenance data, as well as INFRA road condition surveys. These examinations will highlight areas of extensive ongoing road maintenance, helping focus resources where they will do the most good. Additional data can be found in the Engineering Study for Roads and Bridges, June 2002. Management options are available to reduce backlog, and are addressed in the Decision Support Framework on Page 45.

The preliminary recommendations and cost estimates provided in the 2002 Engineering Study for Roads & Bridges detail immediate road safety needs requiring approximately $300,000 in program dollars for roads ML 1-5. This report provides an inventory of existing conditions, maintenance needs, and identifies alternative funding sources.

Maintenance costs for forest highways and public forest service roads, approximately 119 miles, are transferred to the respective states through existing Memorandum of Agreements. Provided all parties perform as agreed upon, the maintenance backlog will begin to decrease.

SCALE

Impacts to opportunities for deferred maintenance reduction should be assessed at the watershed and project levels. Forest level summaries can supply the context for the magnitude and extent of change.

INDICATORS

- ML of existing roads
- Increase in road-related special response calls
- Changes in Road Management Objectives
- Routine and backlog maintenance cost
- Public comment

SOURCE

- LBL LRMP
- INFRA Condition Surveys
- 2002 Engineering Study for Roads & Bridges

DECISION FRAMEWORK FOR MEASURING ACCESS IMPACT (RATING GUIDE)

High Access Impacts - Roads identified as ML 4 or 5 require regular and expensive "special responses," have high routine maintenance cost, do not meet the RMO's, receive

regular negative public comment, and the overall maintenance budget is declining, or CIP funding is not made available for reconstruction.

Moderate Access Impacts - Roads identified as ML 2 or 3 require regular and expensive "special responses," have moderate or average routine maintenance cost, do not meet the RMO's, receive regular negative public comment, and the overall maintenance budget is declining.

Low Access Impacts – Does not meet the impact definitions above.

DETERMINING THE ACCESS AND RESOURCE RATINGS FOR USE IN THE DECISION SUPPORT FRAMEWORK

Each Key Question contains criteria for determining if the Access Needs or Resource Impacts related to Key Issues are High, Moderate, or Low. Ratings for all questions are; High = 3 Points, Moderate = 2 Points, and Low = 1 Point. There are a total of 5 access and 5 resource questions, so a point total for access can range from 5 to 15. The tables below shows the composite scores and ratings for access and resources.

COMPOSITE ACCESS RATING	TOTAL SCORE
High (H)	11-15
Moderate (M)	6-10
Low (L)	1-5

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COMPOSITE RESOURCE RATING	TOTAL SCORE
High (H)	11-15
Moderate (M)	6-10
Low (L)	1-5

For example, if the access questions rate as follows, the composite score would be 12, or overall high access is required for road x.

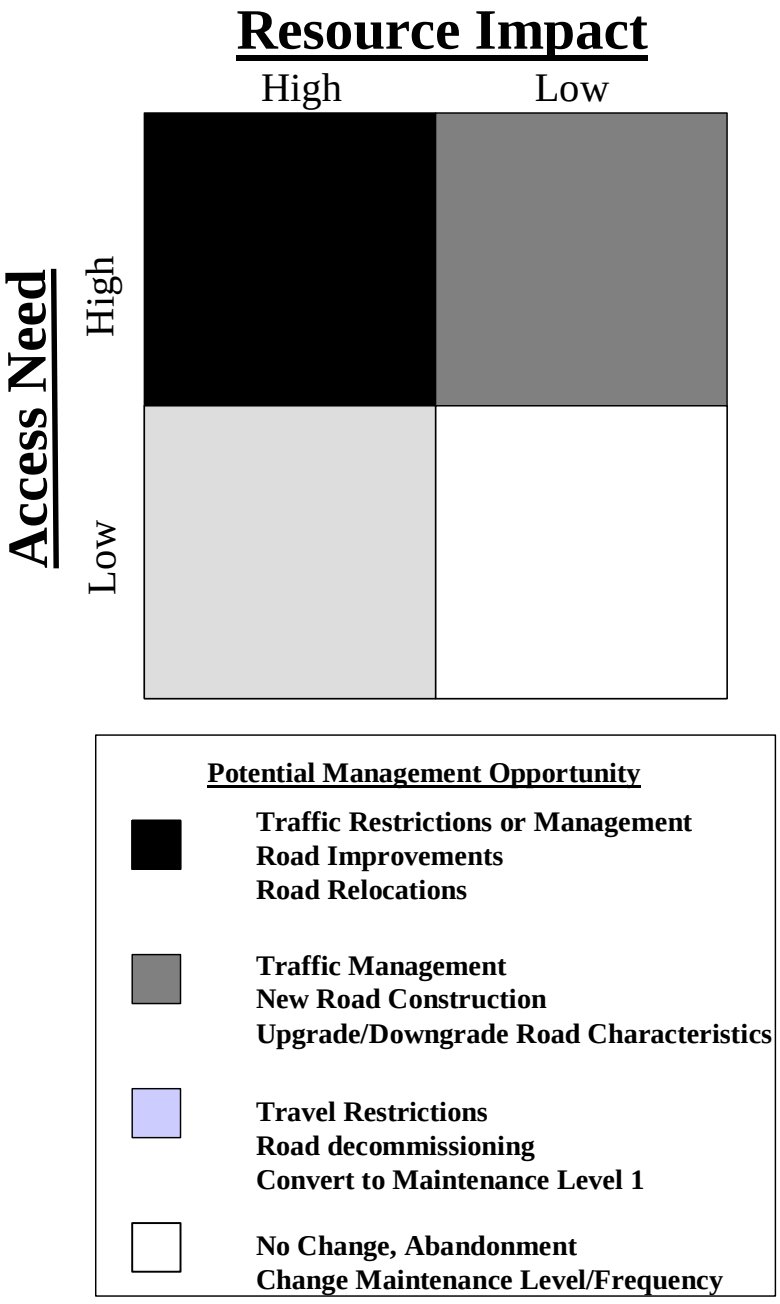
Key Question 1-1 rates 2
Key Question 2-1 rates 2
Key Question 2-2 rates 2
Key Question 3-1 rates 3
Key Question 6-1 rates 3
Total = 12 points, or High Access Need.

Certain uses may affect the overall access need rating. Some roads may have a higher access need rating than indicated by the simple composite of their scores. An example would be roads that access LBL cemeteries or roads that access primary recreation sites. Likewise, some resource impacts may have a higher rating than indicated. An example would be roads that directly impact endangered species.

DECISION SUPPORT FRAMEWORK

The following Decision Support Framework assist the IDT in identifying management options based on composite scores for Access Needs and Resource impacts.

The following Figure is the *Decision Support Framework* for addressing road related opportunities through the roads analysis process.



STEP 5 - OPPORTUNITIES & PRIORITIES

ROAD RECOMMENDATIONS

Typically, a roads assessment spreadsheet is the management tool for summarizing, documenting, and displaying the interdisciplinary team's consideration of the key questions on a road-by-road basis. Road management recommendations are developed by comparing the need for access with the potential resource impacts generated by the access. On LBL, this will occur at the watershed or project level roads analysis.

The Key Issues and Questions developed for this Roads Analysis are appropriate for all watershed level analysis. There may be a need for some changes in issues at lower level analysis, but changes should be limited. Lower level Roads Analysis based on (a) Key Issues and Questions, (b) utilizing the Decision Support Framework (displayed in Figure on page 44,) and (c) focusing on watersheds which are most at risk, should result in quality analysis requiring less time and resources.

It is important to remember that roads analysis is a dynamic, iterative and ongoing process that is sensitive to new and more detailed information that may emerge at different scales of analysis and through time. Funding resources and constraints are key components of decision-making and priority-setting and are often subject to change. Each iteration of roads analysis, over time and at varying scales, will need to evaluate the road system in the current ecological, social, and fiscal context to arrive at road management options appropriate to the time and place.

The NRMP 1994 (and associated EIS) does not include analysis of the existing road system, nor does it include any Standards and Guidelines for forest roads on LBL. Also, the LBL road system inherited from TVA was not fully numbered or attributed. This lack of direction and detail makes it difficult to compare the current road system with what is desirable or acceptable on LBL. Due to the lack of direction, this document will not make road by road recommendations for Level 3 through 5 roads. Instead, this roads analysis will

1. Identify and map LBL roads and prepare basic roads data (attributes;)
2. Identify 6th level watersheds, develop criteria, and rate road impacts to soil and aquatic resources;
3. Identify wetlands, develop criteria, and rate road impacts to wetlands;
4. Identify 6th level watershed overall road densities;
5. Identify 6th level watershed ML 4 and 5 high road densities;
6. Identify roads that provide direct access to cemeteries.

STEP 6 - REPORTING

KEY FINDINGS OF THE LBL-WIDE ROADS ANALYSIS

DOES THE EXISTING SYSTEM OF ROADS CREATE A RISK TO ECOSYSTEM SUSTAINABILITY?

Evaluation of the classified road system in a Forest-wide context suggests that roads do not pose a serious risk to LBL ecosystem capability as a whole. However, there are locations where increased risks to aquatic and wetland resources are sufficient to warrant modification to road administration or infrastructure (see maps beginning on page 53.) Following is a summary of these locations:

- Two 6th level watersheds (Crooked and Lick) have increased risk due to sediment and cumulative watershed effects on ecosystem processes and/or habitat.

- Five wetlands (Davenport Bay, Willow, Honker, Crooked, and Devil's Elbow) have increased (high) risk due to roads directly crossing wetlands, impacting the hydrology and ecosystem process and/or habitat.

- Four wetlands (Turkey, Barnett, Lost, and Laura Furnace) have increased (moderate) risk due to roads being with 100 feet of a wetland and potentially impacting the hydrology and ecosystem process and/or habitat.

- There are several watersheds with higher levels of total road density, and higher levels of Level 4 and 5 road densities. Although road density here is not interpreted to mean "good" or "bad", road density in general, and the effect of linear land uses specifically, needs further discussion in forest planning. For now, roads affect resources primarily in the following manner:

    - Human management and use of resources;
    - Habitat connectivity;
    - Favoring a species of wildlife and disfavoring others;
    - Dispersal routes for wildlife;
    - Road mortality;
    - Recreation and social access;
    - Spread of exotic plants and animals.

CAN MAINTENANCE REQUIREMENTS OF THE EXISTING SYSTEM BE MET WITH CURRENT AND PROJECTED BUDGETS?

The cost to maintain the existing Forest transportation system is greater than the current budget. Savings from implementing recommendations from the 2002 Engineering

Study (ES) for Roads and Bridges, prepared by the Federal Highway Administration Eastern Federal Lands Highway Division, at the watershed/project level would help alleviate this situation, but there would still be a discrepancy.

In 2000, LBL transferred from TVA to the USDA Forest Service with $25 million in facility and road backlog maintenance costs, as assessed by TVA. The 2002 ES study identifies $39.7 million in capital improvement road needs. This backlog is partially due to the designed intent of the majority of the roads on LBL being different from the current use by the FS. Many of the roads were intended to function primarily as private drives, cemetery, and agriculture access.

The current total roads budget is approximately $500,000/year plus an additional $300,000 for the States.. Per the 2002 ES the annual maintenance cost for paved roads is approximately $1.4 million. It is unlikely that future budgets will rise sufficiently to overcome such a backlog or to hinder its increase. It is more likely that LBL will fall further behind in its road maintenance program each year. Capital funds have, and will continue to be, potential funding opportunities.

ARE SOME ROADS NOT NEEDED TO MEET PROJECTED ACCESS NEEDS?

The Level 3 through 5 roads identified in this document are considered to be adequate for current and foreseeable future access needs. It is very unlikely that any Level 3, 4, or 5 roads will be closed, however, great opportunity exists to lower their maintenance cost and reduce impacts. It is expected that watershed roads analyses will identify some Maintenance Level 1 and 2 roads as surplus to forest needs, and many Level 1 and 2 roads where costs and impacts may be reduced.

IF NEW ACCESS IS PROPOSED, WHAT ARE THE EXPECTED BENEFITS AND RISKS?

No new road access is proposed or evaluated in this forest-scale assessment. However, should new access be required, road construction will need to be evaluated at the watershed and/or project scale. Any future new road(s) would be constructed with modern design and layout techniques that will minimize adverse ecological risks while providing safe and efficient transportation. Any decision to add road mileage to the system should consider the constrained road maintenance budget and the potential conflicts that additional maintenance needs will engender.

WHAT OPPORTUNITIES EXIST TO CHANGE THE ROAD SYSTEM TO REDUCE THE PROBLEMS AND RISKS, OR TO BE MORE CONSISTENT WITH FOREST PLAN DIRECTION AND STRATEGIC INTENT OF THE ROAD SYSTEM?

There are a number of options available to reduce costs and minimize road-related risks on the LBL road system. Operational or administrative actions are displayed below in Figure 2 – Decision Support Framework (see page 45) for addressing road related opportunities. Some specific examples include the following:

Reducing Maintenance Levels: Reducing a Maintenance Level 2 to a Maintenance Level 1

This can reduce maintenance requirements as well as address water quality risks. Since Level 1 roads are not maintained for access, it is important they are in a condition where they can be essentially self-maintaining. They should not have ditches and cross drains that require maintenance, nor should they have drainage structures that require regular maintenance. When considering reductions in maintenance levels from Level 2 to Level 1, consideration must be given to the work needed to place the road in such a condition that it can be self-maintaining and the associated costs. Work required may include reshaping to an outsloped configuration, removing culverts and fills, or replacing culverts with rock-armored dips or rock fills. If the costs of such work exceed the long term maintenance cost savings, then other sources of funding may be appropriate on the basis of benefits to resources at risk. All of the considerations discussed above require site-specific and detailed analysis on a road-by-road basis.

Reconstruction

Annual maintenance costs may be reduced by reconstructing or relocating roads/road segments that are currently maintained in an inslope-ditch-crossdrain configuration to an outsloped or crowned template where road surface drainage is dispersed over the full length of the road prism rather than being concentrated into ditches and discharged via cross drains. An outsloped template not only reduces maintenance needs, but also typically minimizes the adverse impacts often associated with the concentration of surface runoff. The costs associated with reconstruction are substantial and often cannot be justified on an economic basis alone. Some relocations can also assist by utilizing designs that lay gently on the land and avoid steep slopes, erosive soils, and hydrologic connectivity.

Decommissioning

Maintenance costs may be reduced through the elimination of unneeded roads. The identification of unneeded roads and of feasible maintenance levels is best accomplished on a road-by-road basis at the project or watershed scale of analysis. When evaluating candidate roads for decommissioning, careful consideration must be given to public and administrative use needs. Opportunities for the Forest road system will be addressed at the watershed scales. Some analyses have already been completed and are incorporated here by reference: Long Creek Watershed and Highway 68/80 Watersheds.

KEY POINTS BY RESOURCE

ECONOMIC BENEFIT

- LBL's road system provides the surrounding region with many economic benefits.

- Tourism is highly dependent on the Level 4 and 5 road system, which forms the backbone of the LBL system.

HISTORIC ACCESS AND DISPERSED RECREATION

- Road access to the cemeteries, old home places, and former community sites are extremely important to the former residents and their children seeking their cultural roots.

- Conflict between the surrounding communities and TVA occurred any time TVA attempted to change road accessibility or failed to maintain access to the cemetery sites in LBL.

- Despite any changes that might be proposed to LBL's road system, the FS is legally obliged to ensure access to cemeteries within the Recreation Area for purposes of visitation, maintenance, and burial.

- Any change in the status of roads in LBL will be met with resistance from the local communities, hunters, fishermen, backwoods campers, etc.

- Roads temporarily closed to accommodate specific activities or events create conflicts with other visitors attempting to access the area for recreation or other purposes. There should be consideration of the effects on other users prior to authorizing single use closures.

- The recent closure of facilities, roads, and trails to protect roads from resource damage has caused conflicts with some users. Education on the reasons for temporary closures, and the consequences of not protecting the resources, is an ongoing necessity.

ADMINISTRATIVE ACCESS

- Management activities (i.e. timber harvest, prescribed fire, mowing, and crop planting) needed to achieve the objectives of the forest and open land management programs at LBL are feasible because roads provide both vehicular access and boundaries (i.e. fire lines for prescribed fire).

- Lack of road access has not been a limiting factor in the past for harvest proposals or for treatments needed in response to areas damaged by insects and diseases, fire, wind, ice, or snow.

RIPARIAN AND AQUATIC RESOURCES

- Road networks in LBL are the most significant source of management-accelerated delivery of sediment to streams, Kentucky Lake, and Lake Barkley. Road related sedimentation impacts were not included in the TVA NRMP/EIS.

- Water, riparian, and aquatic resources are generally more vulnerable to adverse effects of sedimentation where roads are located near streams, lakes, or riparian zones or are hydrologically connected to these features.

- LBL has around 94,825 acres of erosive soils, or roughly half the NRA. Roads intersect these soil types across 4,295 acres.

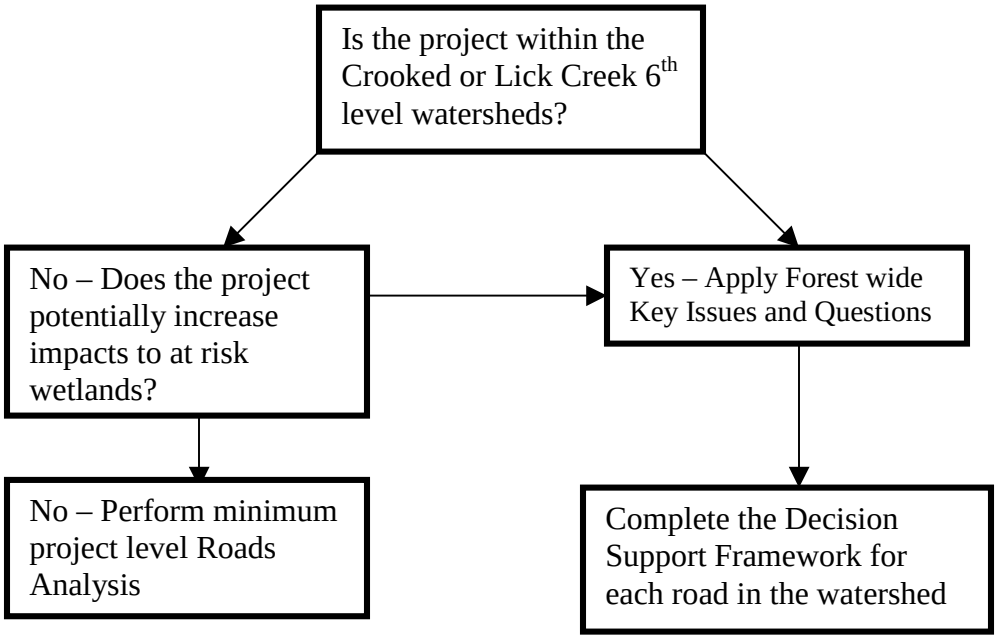
- There are 268 miles of road encroachment along streams and 509 stream crossings within LBL on Level 3, 4, and 5 roads on LBL.

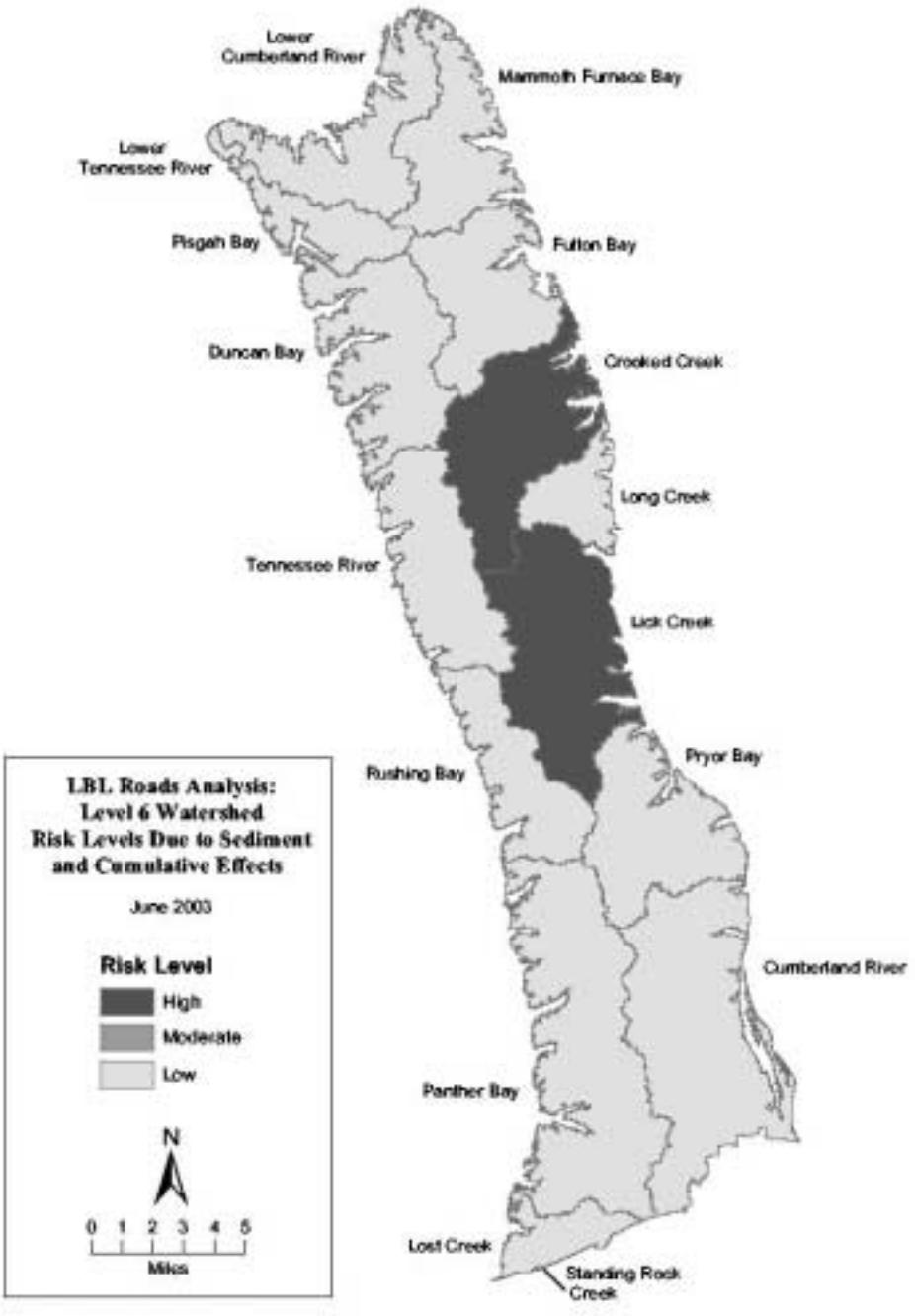
- Desired conditions for long-term maintenance of aquatic, riparian, and water resources are met by minimizing the cumulative effects associated with roads by
    - minimizing the amount of road located on highly erodible soils;
    - reducing connectivity between roads and streams, lakes, or riparian zones;
    - increasing proper road maintenance and cross drainage;
    - minimizing use of roads on sensitive soils during wet periods.

- Roads are affecting wetlands directly and indirectly through sedimentation, channelization of water flow, encroachment, and changes in surface and subsurface hydrology.

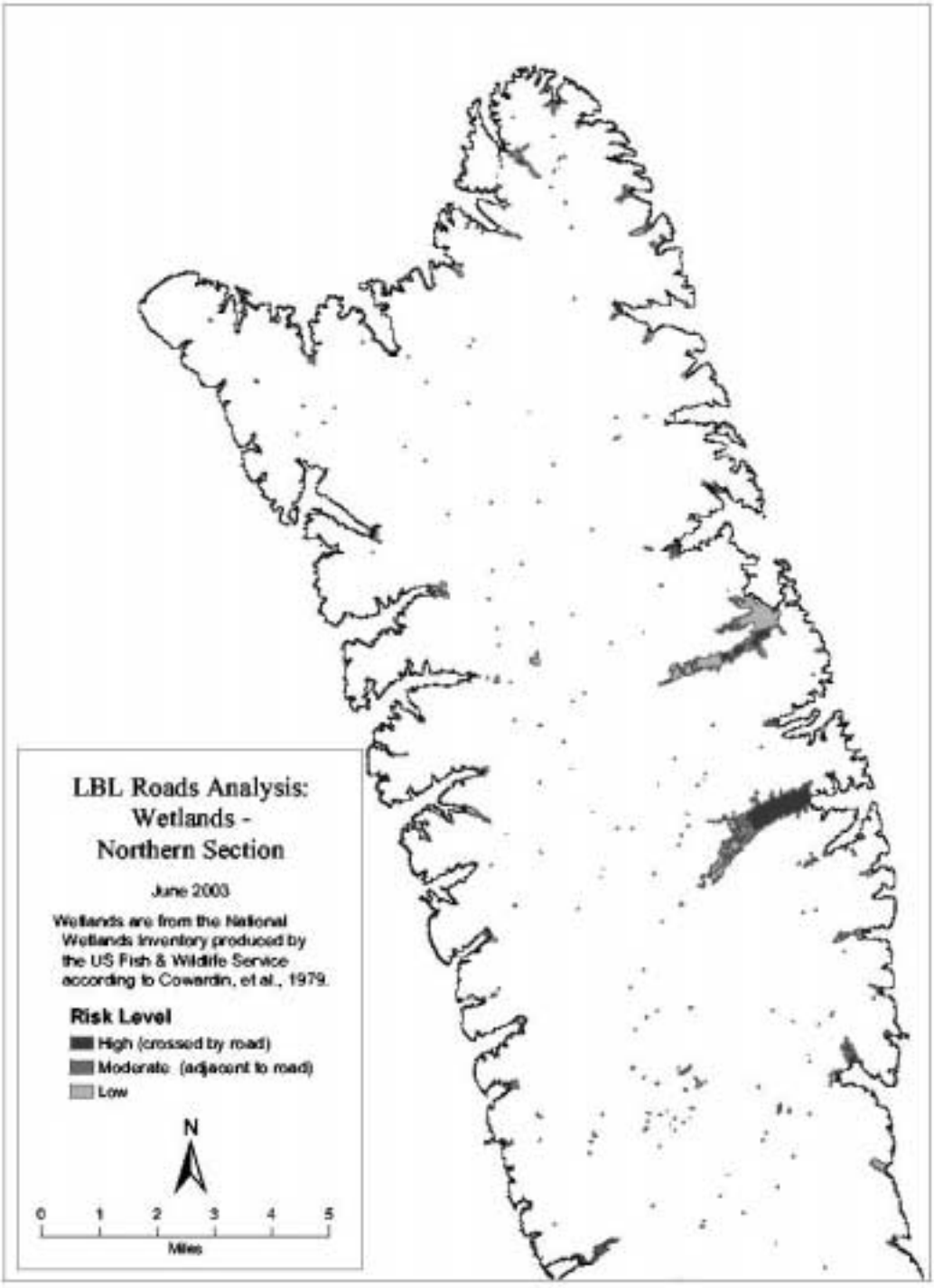
- There are approximately 6,420 acres of wetlands within the LBL boundaries. There are 131 acres directly affected by road encroachment.

The following Figure is the Project Level Decision Tree for Aquatic resources and Roads Analysis.





The above map displays the risk level for watersheds based on soil types and how closely the roads are connected to the streams (i.e. crossings, location in riparian corridor, hydrological connections, etc.).


LBL Roads Analysis:
Wetlands -
Northern Section
June 2003
Wetlands are from the National Wetlands Inventory produced by the US Fish & Wildlife Service according to Cowardin, et al., 1979.
Risk Level
High (crossed by road)
Moderate (adjacent to road)
Low
N
0 1 2 3 4 5
Miles

The north and south wetlands maps display the risk level for wetlands based on the direct or indirect impacts on roads to wetlands. Direct impacts include roads located within wetlands, and indirect impacts include roads located within 100 feet of wetlands. (More detailed maps are located in the roads analysis planning record.)

WILDLIFE AND PLANTS

- Generally, biological invasion is promoted by disturbance. Building and/or maintaining roads into a forest represent disturbances that create and maintain new edge habitat. These roadside habitats can be invaded by a suite of exotic invasive plant species, which may disperse by natural agents such as wind and water. It appears that the level of road is not a determining factor in invasive plants, as plants colonize on even Level 1 roads. (Southern Forest Resource Assessment – Effects of Linear Land Use on Forest Wildlife, October 2002)

- Undesirable exotic species of concern at LBL include exotic invasive plant species and the gypsy moth.

- The gypsy moth has been a primary defoliator of hardwoods in the Northeastern United States since its introduction in 1869. Since oaks are the preferred host species, LBL is extremely vulnerable to gypsy moth defoliation if the insect becomes established. Roads facilitate artificial spread, specifically the movement of egg masses and pupae. Vehicles serve as vectors by moving egg masses and pupae from infested areas to areas not infested.

- Control of exotic species is facilitated by road access.

- Road impacts on wildlife include habitat loss, fragmentation and road kills.

- Roads and right-of-ways create open land and edge habitat, favoring species that use these habitats.

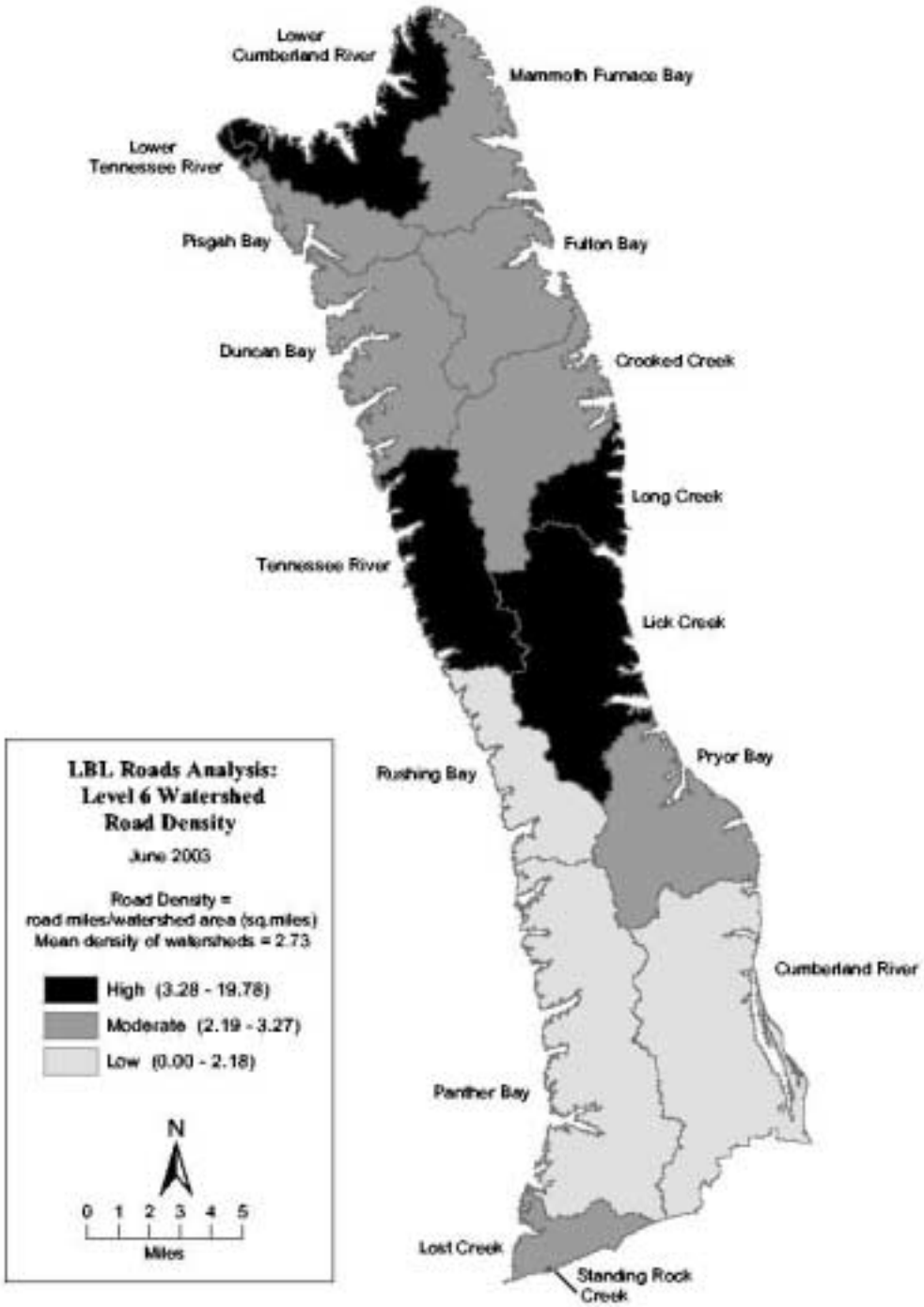
- LBL level 4 and 5 roads directly contribute to wildlife mortality. Reptiles and amphibians are most effected.

- Roads provide access for management and recreation activities related to wildlife.

DEFERRED MAINTENANCE

- The preliminary recommendations and cost estimates provided in the 2002 Engineering Study for Roads & Bridges detail immediate road safety needs requiring approximately $300,000 for roads ML 1-5.

- Maintenance costs for forest highways and public forest service roads, approximately 119 miles, are transferred to the respective States through existing Memorandum of Agreements.


Lower
Cumberland River
Mammoth Furnace Bay
Lower
Tennessee River
Pisgah Bay
Fulton Bay
Duncan Bay
Crooked Creek
Long Creek
Tennessee River
Lick Creek
Pryor Bay
Rushing Bay
Cumberland River
Panther Bay
Lost Creek
Standing Rock
Creek
LBL Roads Analysis:
Level 6 Watershed
Road Density
June 2003
Road Density =
road miles/watershed area (sq.miles)
Mean density of watersheds = 2.73
High (3.28 - 19.78)
Moderate (2.19 - 3.27)
Low (0.00 - 2.18)
N
0 1 2 3 4 5
Miles

ROAD DENSITY BY LEVEL 6 WATERSHED

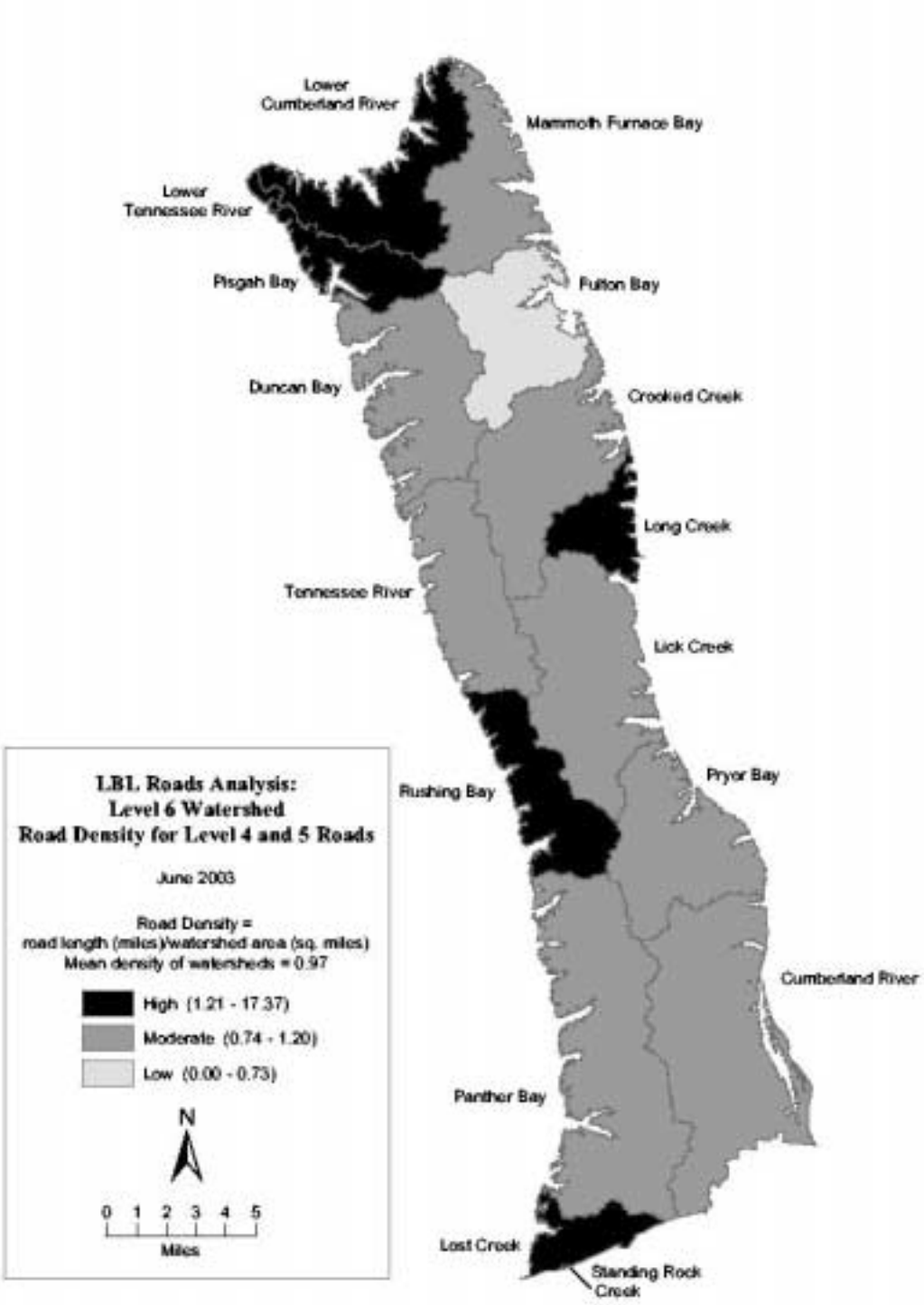
Watershed	Area (miles^2)	Roads (miles)	Road Density
Lick Creek	26.89	90.66	3.37
Long Creek	7.12	25.69	3.61
Crooked Creek	22.25	62.42	2.81
Fulton Bay	17.70	48.27	2.73
Mammoth Furnace Bay	15.24	36.63	2.40
Lower Cumberland River	17.33	57.69	3.33
Pryor Bay	20.14	58.86	2.92
Cumberland River	35.60	70.75	1.99
Tennessee River	18.49	63.03	3.41
Duncan Bay	21.01	61.92	2.95
Pisgah Bay	8.30	26.64	3.21
Lower Tennessee River	0.69	2.76	3.99
Rushing Bay	14.13	29.81	2.11
Panther Bay	38.14	79.75	2.09
Standing Rock Creek	0.03	0.55	19.78
Lost Creek	6.21	19.62	3.16
TOTAL	**269.27**	**735.06**	**2.73**

The above Map and Table display the 6th level watershed road densities on LBL. The current average density on 6th level watersheds is 2.73 miles of road per square mile, with a range of 1.99 to 3.99 mi/mi sq. (There is a partial watershed with a density of 19.78 which is an anomaly due to the arbitrary LBL boundary.) The map displays High, Moderate and Low road densities based on an arbitrary +/- 25% of the mean density. For the purposes of this analysis, the map displays watersheds more and less likely to show effects of road density on aquatics, plants, recreation, or wildlife. There are no current road density standards in the TVA NRMP for any resources on LBL.

- The implication of wildlife habitat fragmentation by roads within LBL depends on habitat requirements for individual species. Therefore, habitat fragmentation within the forest is not a factor considered to be good or bad, but rather an element of species specific habitat requirements. Land management planning may develop standards based on species needs. (See the discussion of impacts of roads under Key Issue 5 in this analysis.)

- Aquatics are affected by road density primarily through the general connection where increased roads result in increased erosion and sedimentation. A comparison of the above map with map ????, which displays watershed risk levels, suggest that the connection is not direct.

- Plants are primarily affected by road density through human manipulation of the environment (access for other reasons) and the introduction of noxious weeds.
- Recreation is affected by road density in several ways, including access for dispersed and developed recreation, and roadless/wilderness opportunities.


Lower Cumberland River
Mammoth Furnace Bay
Lower Tennessee River
Pisgah Bay
Fulton Bay
Duncan Bay
Crooked Creek
Long Creek
Tennessee River
Lick Creek
Pryor Bay
Rushing Bay
Cumberland River
Panther Bay
Lost Creek
Standing Rock Creek
LBL Roads Analysis:
Level 6 Watershed
Road Density for Level 4 and 5 Roads
June 2003
Road Density =
road length (miles)/watershed area (sq. miles)
Mean density of watersheds = 0.97
High (1.21 - 17.37)
Moderate (0.74 - 1.20)
Low (0.00 - 0.73)
N
0 1 2 3 4 5
Miles

ROAD DENSITY OF LEVEL 4 AND 5 ROADS BY LEVEL 6 WATERSHED

Watershed	Area (miles^2)	Roads (miles)	Road Density
Lick Creek	26.89	25.37	0.94
Long Creek	7.12	9.70	1.36
Crooked Creek	22.25	23.53	1.06
Fulton Bay	17.70	11.46	0.65
Mammoth Furnace Bay	15.24	12.23	0.80
Lower Cumberland River	17.33	28.42	1.64
Pryor Bay	20.14	18.75	0.93
Cumberland River	35.60	26.68	0.75
Tennessee River	18.49	14.89	0.81
Duncan Bay	21.01	16.55	0.79
Pisgah Bay	8.30	15.47	1.86
Lower Tennessee River	0.69	2.26	3.26
Rushing Bay	14.13	17.28	1.22
Panther Bay	38.14	28.34	0.74
Standing Rock Creek	0.03	0.49	17.37
Lost Creek	6.21	8.78	1.41
TOTAL	**269.27**	**260.19**	**0.97**

The above Map and Table display the 6th level watershed ML 4 and 5 road densities on LBL. The current average density on 6th level watersheds is 0.97 miles of road per square mile, with a range of 0.74 to 3.26 mi/mi sq. (There is a partial watershed with a density of 17.37 which is an anomaly due to the arbitrary LBL boundary.) The map displays High, Moderate and Low road densities based on an arbitrary +/- 25% of the mean density. For the purposes of this analysis, this displays watersheds more and less likely to show effects of ML 4 and 5 road density on aquatics, recreation, plants, and/or wildlife. There are no current road density standards for any resources on LBL.

- The implications of wildlife habitat fragmentation within LBL depend on habitat requirement for individual species. Larger and wider roads are more effective dispersal barriers for wildlife, particularly small mammals and reptiles/amphibians. (Forest Service - Southern Research Station, *Southern Forest Resource Assessment, Effects of Linear Land Use on Forest Wildlife*, October 2002) Wide roads also increase road related mortality rates for medium sizes mammals. High speed roads increase road related mortality rates for medium and large size mammals, reptiles and amphibians.

- Effects of Level 4 and 5 roads on aquatic resources are mixed. Paved (Level 5) roads have lower levels of surface erosion and contribute less to sedimentation. Graveled (Level 4) roads are usually well designed and maintained but can provide substantial sediment due to frequent grading and from large storm events. Also, there is a connection between wide road density and their effects on surface and subsurface hydrology.

- Plants are primarily affected by wide road/density on LBL because wide roads (ML 4 and 5) often contain wide maintained shoulders. These shoulders serve as open land habitat and are a refuge for uncommon or listed plant species. Shoulders and disturbed areas adjacent to these roads are also prime habitat for invasive or noxious weed species.

- Level 4 and 5 road density is an indicator of substantial developed recreation in the area.

GLOSSARY

* Indicates definition is from FSM 7705 (1/12/01).

Arterial Road: Primary travel route that provides service to a large land area usually connecting with public highways or other Forest Service arterial roads.

Community Capacity: The community's ability to sustain itself over time based primarily on the economic health and quality of social interactions and institutions.

Collector Road: Road that serves small land areas and usually connects with Forest Service arterials or public highways. They collect traffic from local roads and terminal facilities.

Deferred Maintenance: Maintenance that can be deferred without a loss of road serviceability until such a time as the work can be economically or efficiently performed.

Demographics: The statistical data of a population, especially those showing average age, income, and education, etc.

Forest Roads*: As defined in Title 23, Section 101 of the United States Code (23 U.S.C. 101), any road wholly or partially within, or adjacent to, and serving the National Forest System and which is necessary for the protection, administration, and utilization of the National Forest System and the use and development of its resources.

Forest Transportation Facility*: A classified road, designated trail, or designated airfield, including bridges, culverts, parking lots, log transfer facilities, safety devices, and other transportation network appurtenances, under Forest Service jurisdiction that is wholly or partially within or adjacent to National Forest System lands.

Lentic – ponded water.

Local Road: Single purpose road, connecting terminal facilities to collectors or arterials.

Lotic – flowing water.

Maintenance Levels: The level of service provided by a specific road and the maintenance required for that road consistent with road management objectives and maintenance criteria.

a) **Maintenance Level 5:** Roads that provide a high degree of user comfort and convenience. Normally are double lane, paved facilities, or aggregate surface with dust abatement. This is the highest standard of maintenance.

b) **Maintenance Level 4:** Roads that provide a moderate degree of user comfort and convenience at moderate speeds. Most are double lane and aggregate surfaced. Some may be single lane. Some may be dust abated.

c) **Maintenance Level 3:** Roads open and maintained for travel by a prudent driver in a standard passenger car. User comfort and convenience are not considered priorities. Typically low speed, single lane with turnouts and native or aggregate surfacing.

d) **Maintenance Level 2:** Roads open for use by high-clearance vehicles. Passenger car traffic is discouraged. Traffic is minor administrative, permitted, or dispersed recreation. Non-traffic generated maintenance is minimal.

e) **Maintenance Level 1:** These roads are closed. Some intermittent use may be authorized. When closed, they must be physically closed with barricades, berms, gates, or other closure devices. Closures must exceed one year. When open, it may be maintained at any other level. When closed to vehicular traffic, they may be suitable and used for non-motorized uses, with custodial maintenance.

f) **Objective Maintenance Level:** The maintenance level to be assigned at a future date considering future road management objectives, traffic needs, budget constraints, and environmental concerns. The objective maintenance level may be the same as, or higher or lower than, the operational maintenance level.

g) **Operational Maintenance Level:** The maintenance level currently assigned to a road considering today's needs, road conditions, budget constraints, and environmental concerns. It defines the level to which the road is currently being maintained.

National Forest System Road*: A classified forest road under the jurisdiction of the Forest Service. The term "National Forest System Roads" is synonymous with the term "forest development roads" as used in 23 U.S.C. 205.

New Road Construction*: Activity that results in the addition of forest classified or temporary road miles (36 CFR 212.1).

Passive Use Value: This term includes the following two categories:

- **Existence Values**: Things people appreciate without actually using them or even intending to use them.
- **Bequest Values**: Things people want to remain available for others, such as their descendents, to use and appreciate.

Public Roads*: Any road or street under the jurisdiction of and maintained by a public authority and open to public travel (23 USC 101(a)).

Private Road: A road under private ownership authorized by an easement to a private party, or a road that provides access pursuant to a reserved or private right.

Public Lands Highways, Forest Highways: A coordinated Federal Lands Highway Program includes Forest Highways, Public Lands Highways, Park Roads, Parkways, and Indian Reservation Roads. These are roads under the jurisdiction of, and maintained by, a public road authority or the Forest Service and open to public travel (23 USC 101).

Road*: A motor vehicle travelway over 50 inches wide unless classified and managed as a trail. A road may be classified, unclassified, or temporary (36 CFR 212.1).

a) **Classified Roads*:** Roads wholly or partially within or adjacent to National Forest System lands that are determined to be needed for long-term motor vehicle access, including State roads, county roads, privately owned roads, National Forest System roads, and other roads authorized by the Forest Service (36 CFR 212.1).

b) **Temporary Roads*:** Roads authorized by contract, permit, lease, other written authorization, or emergency operation, not intended to be a part of the forest transportation system and not necessary for long-term resource management (36 CFR 212.1).

c) **Unclassified Roads*:** Roads on National Forest System lands that are not managed as part of the forest transportation system, such as unplanned roads, abandoned travelways, and off-road vehicle tracks that have not been designated and managed as a trail; and those roads that were once under permit or other authorization and were not decommissioned upon the termination of the authorization (36 CFR 212.1). The regulations at 36 CFR 223.37 require revegetation within 10 years.

d) **Unnumbered road (local term):** existing, mapped TVA roads, generally Maintenance Level 1 and 2, that were not assigned numbers by TVA but have been subsequently numbered by the FS.

Road Decommissioning*: Activities that result in the stabilization and restoration of unneeded roads to a more natural state (35 CFR212.1)(FSM 7703).

Road Maintenance*: The ongoing upkeep of a road necessary to retain or restore the road to the approved road management objective.

Road Management Objective (RMO): The purpose, use, operational, and maintenance level of the road based on resource management objectives and access and travel management objectives.

Road Reconstruction*: Activity that results in improvement or realignment of an existing classified road as defined below:

a) **Road Improvement*:** Activity that results in an increase of an existing road's traffic service level, expansion of capacity, or a change in its original design function.

b) **Road Realignment*:** Activity that results in a new location of an existing road or portions of an existing road and treatment of the old roadway (36 CFR 212.1).

Roads Subject to the Highway Safety Act *: National Forest System roads that are open to use by the public for standard passenger cars. This includes roads with access restricted on a seasonal basis and roads closed during extreme weather conditions or for emergencies, but which are otherwise open for general public use.

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