MARK TWAIN LAKE MASTER PLAN

CLARENCE CANNON DAM AND MARK TWAIN LAKE MONROE CITY, MISSOURI

CHAPTER 2 SETTING AND FACTORS INFLUENCING MANAGEMENT AND DEVELOPMENT

2.1 DESCRIPTION OF RESERVOIR

Mark Twain Lake is a civil works project consisting of a lake/reservoir impounded by an earthen and concrete dam structure, power generation plant, outlet works, spillway, re-regulation dam, and public use lands and facilities. Clarence Cannon Dam, and its associated features, became operational in 1984. Approximately 54,762 acres of land were acquired in fee title for the reservoir, downstream operational areas, and recreation areas. An additional 9,740 acres of flowage easement was acquired to accommodate a flood elevation of 642.0 feet NGVD¹. The operational facilities at Mark Twain Lake are described as follows:

Location. Clarence Cannon Dam and Mark Twain Lake are located on the Salt River in northeastern Missouri, generally in Monroe and Ralls Counties. The main dam site is located in Ralls County at mile 63.0 on the Salt River, approximately 12 miles southeast of Monroe City, Missouri. A re-regulation dam is located approximately 9.5 miles downstream from the main dam site. The project area is served on the north by U.S. Highway 24, and on the south by State Highway 154. State Highway 107 bisects the project area from north to south, and provides a major reservoir crossing near Florida, Missouri. State Highway J crosses the main dam, and is the primary north-south transportation corridor on the eastern side of the lake.

Clarence Cannon Dam. Clarence Cannon Dam consists of a compacted earth embankment, a gated concrete spillway, a concrete hydroelectric power plant and a water temperature control weir. State Highway J crosses the top of the dam. The total length of the dam is 1,940 feet with the centerline of the dam running in a near north-south direction. The concrete portion of the dam is 845.75 feet in length, and abuts the southern rim of the valley.

- **Earth Embankment.** The compacted earth embankment has a crest elevation of 653.0 feet NGVD. The embankment is about 1,094 feet in length.
- **Spillway.** The spillway is part of the concrete portion of the dam, and is 230 feet in length. It begins 360 feet from the southern rim of the valley. The spillway is topped by

¹ Note: All elevations cited are in terms of the National Geodetic Vertical Datum (NGVD)

four 50-foot wide by 39-foot high tainter gates separated by 10-foot wide piers. The spillway crest elevation is 600.0 feet NGVD. A 230-foot wide by 198.86-foot long stilling basin, with two rows of baffle piers and an end sill is provided for the purpose of energy dissipation. The stilling basin floor is at elevation 508 feet NGVD.

- **Power Plant**. The power plant is part of the concrete portion of the dam, and is located immediately north of the spillway. The power plant is 222.75 feet in length. The power plant contains a Kaplan 27,000-KW turbine generator and a Francis 31,000-KW pump turbine generator. The invert elevation of the intake structure is 520.0 feet NGVD. The invert elevation of the outlet structure is 483.0 feet NGVD.
- Water Temperature Control Weir. A water temperature control weir, constructed of rolled earth, is located 400 feet upstream of the centerline of the concrete portion of the dam. The crest elevation of the weir is 580.0 feet NGVD, and is approximately 780 feet in length.

Re-Regulation Dam. The re-regulation dam is located 9.5 miles downstream from the main dam, and consists of a compacted earth embankment, a gated concrete spillway, a sluice and an operating house. The total length of the dam is 1,550 feet.

- **Earth Embankment.** The crest elevation of the compacted earth embankment is 537.0 feet NGVD. The embankment is 1430 feet in length.
- **Spillway.**The concrete spillway is 119.5 feet in length. The spillway is topped by two 32 by 31 foot-high tainter gates separated by an 8 foot wide pier. The spillway crest elevation is 499.0 feet NGVD. A 68 foot by 40 foot stilling basin with an end wall is provided for the purpose of energy dissipation. The stilling basin floor is at elevation 494.0 feet NGVD. The operating house is located at the west end of the spillway.

Saddle Dams. Two small saddle dams are located just north of the entrance to the Frank Russell Recreation Area.

Lake Shoreline, Length, and General Character. The reservoir covers approximately 18,600 acres and has a shoreline of approximately 285 miles at the pool level of 606 feet NGVD. The average depth of the pool at 606 feet NGVD is 29 feet.

Park and Recreation Facilities. Several areas have been developed at Mark Twain Lake for the visiting public to enjoy a variety of outdoor recreational experiences. The most common activities engaged in are fishing, boating, water-skiing, sailing, camping, picnicking, swimming and hunting. Developed facilities available at the lake include a visitor center, four campgrounds, three group camping areas, five picnic areas, 21 boat launching areas, five nature trails, two marinas, and three beaches. Hunting and fishing opportunities are available on all Corps of Engineers lands and waters except where restricted and posted due to recreational development or safety. (Chapter 5 presents a complete description of all recreational facilities.)

2.2 HYDROLOGY

The Mark Twain Lake watershed is comprised of 2,318 square miles with an additional 29 square miles draining into the re-regulation pool. The North Fork of the Salt River is the major drainage channel, draining 626 square miles (27% of the drainage area). The North Fork is 88.0 miles in length, has an average gradient of 4.5 feet per mile and has a maximum elevation of approximately 1,000 feet. The Middle Fork, Elk Fork and South Fork of the Salt River are the other major tributaries to Mark Twain Lake. The Middle Fork drains 356 square miles (15%), is 65.4 miles in length, has an average gradient of 5.1 feet per mile and has a maximum elevation of approximately 940 feet. The Elk Fork drains 262 square miles (11%), is 34.8 miles in length, has an average gradient of 7.9 feet per mile and has a maximum elevation of approximately 880 feet. The South Fork drains 298 square miles (13%), is 38.0 miles in length, has an average gradient of 7.2 feet per mile and has a maximum elevation of 880 feet. Combined, the North Fork, Middle Fork, Elk Fork and South Fork drain a total of 1,542 square miles, which is 66% of the Mark Twain Lake watershed.

The Mark Twain Lake watershed is a gently undulating plain in the upstream portion and it becomes more rolling and hilly in the downstream reaches. High rock bluffs border the streams at various locations. The river valleys are characterized by fairly narrow, tortuous courses interspersed by areas of widened bottomlands. Hickory and oak groves are scattered among crop and grazing lands. Strip mining in the South Fork watershed may produce acid runoff. Several clay pits in the southwestern portion of the Mark Twain Lake watershed account for some colloidal suspension, which increases the turbidity of the lake.

Mark Twain Lake is a flood control reservoir with multiple purposes. There are also incidental benefits to Mississippi River navigation. The pool at elevation 606.0 feet NGVD retains 100 percent of available flood control storage and 100 percent of the joint-use storage for the other project purposes, namely hydroelectric power generation, water supply, fish and wildlife and recreation.

2.3 SEDIMENTATION AND SHORELINE EROSION

The rate of sedimentation within the reservoir is influenced by regional and site specific conditions, including annual and seasonal precipitation patterns and associated storm water runoff, as well as river bank erosion and agricultural runoff. Sedimentation is unavoidable for reservoirs like Mark Twain Lake due to tributary sedimentation contribution, high water events, and wind and wave action. Accounting for sedimentation was included in the design and management of the reservoir. According to the last re-survey in May 2010, 26,318 ac-ft of storage had been depleted of the 457,000 ac-ft of original storage in the joint-use pool, a reduction of 5.8 percent. It was the opinion at that time that the existing water supply contract allocation of 20,000 ac-ft not be modified due to the small amount of storage depleted. Overall, the May 2010 re-survey found a deposition rate of 2,061 ac-ft/yr since the beginning of the project, close to the anticipated rate of 1,740 ac-ft/yr.

2.4 WATER QUALITY

Water quality sampling is conducted with a watershed approach to establish trend analysis and maintain water quality at or above state and federal regulations. Water quality monitoring is conducted to assure safe conditions for human recreation, wildlife, and aquatic life as maintained and managed within the lake system. The water quality management program for the lake includes monitoring of baseline parameters, ecological trends, swimming beach E. coli, and investigation of problem areas to keep the lake within state and federal standards. The sampling and analysis which are conducted at the Mark Twain Lake sites reflect the minimal set of parameters needed to analyze the current status of water quality for the Mark Twain Lake system. Excellent coordination and cooperation exists between the Corps of Engineers, Missouri Department of Conservation, Missouri Department of Natural Resources, and the Southwestern Power Administration concerning lake levels and water quality affecting aquatic life and fish spawning.

2.5 PROJECT ACCESS

Major Highways. Primary transportation corridors providing regional access to Mark Twain Lake are U. S. Highway 36, an east-west four-lane accessible highway located north of the lake, and U. S. Highway 61, a north-south four-lane accessible highway located east of the lake. The immediate Project Area is served on the north by U.S. Highway 24, and on the south by State Highway 154. State Highway 107 bisects the project area from north to south, and provides a major reservoir crossing near Florida, Missouri. State Highway J crosses the main dam, and is the primary north-south transportation corridor on the eastern end of the lake. These highways provide the public with safe and adequate access to all areas of the Project.

Local/County Roads. Local authorities are responsible for the maintenance of several offproject roads that provide the public with access from major highways to recreation areas. The condition of these roads varies, however, most can be considered as adequately maintained. The following roads with access descriptions are the primary routes of travel used by the visiting public.

- State Route J from Highway 154. This road provides access to the Ray Behrens, South Spillway, John C. "Jack" Briscoe, North Spillway, Frank Russell, and John Spalding Recreation Areas, as well as the Mark Twain Lake Project Office. Ralls County.
- State Route EE from Highway 19. This road leads from Highway 19 west to Route J. Ralls County.
- State Route BB from Route J. This road leads to the Route BB boat ramp and Hunter Fisherman Access 60. Ralls County.
- John F. Spalding Access Road (Old State Route J) from Route J. This road provides access to the John F. Spalding Recreation Area. Ralls County.
- State Route N from Highway 24. This road leads to Route N Boat Ramp and Hunter Fisherman Access 11. Monroe County.
- State Route HH from Highway 24. Leads to Indian Creek Access Road, Shell Branch Recreation Area and Hunter Fisherman Access 15. Monroe County.
- Indian Creek Access Road (County) from State Route HH. Leads to Indian Creek Recreation Area. Monroe County.

- State Route U from Highway 107. Leads to Mark Twain State Park and Historic Area. Monroe County.
- Robert C. Allen Access Road (County) from Highway 154. Leads to Robert E. Allen Recreation Area. Monroe County.

2.6 CLIMATE

The climate of the Mark Twain Lake region is considered moderate. The following is representative of the weather conditions that are encountered.

Temperature. Summers are generally mild with occasional temperatures slightly in excess of 100 degrees Fahrenheit. Periods of extreme heat are usually short, if accompanied by sufficient rainfall. Winters are usually moderate, although periods of extremely cold weather are experienced. Weather changes and temperature fluctuations are frequent throughout the year with the extremes varying from 116 to -31 degrees Fahrenheit. Average temperatures by months during the recreation season in counties contiguous to the reservoir in degrees Fahrenheit are as follows: April 54°, May 64°, June 74°, July 78°, August 76°, and September 68°.

Wind. The maximum wind movement occurs in March and the minimum in August. The average wind velocity is about 10.3 miles per hour. The prevailing winds over the basin are generally from the south.

Humidity. The relative humidity varies from about 59 percent to 86 percent in the winter and from 51 percent to 89 percent during the remainder of the year.

Precipitation. The annual average precipitation over the drainage area above the dam site is about 37.1 inches. Two-thirds of the annual rainfall normally occurs during the spring and summer, with local cellular storms occurring generally in July and August. Average annual snowfall amounts to about 21 inches and is usually limited to the period from November to March. The snow cover seldom lasts for more than a few days at a time.

2.7 TOPOGRAPHY, GEOLOGY, AND SOILS

Topography. The topography at Mark Twain Lake reaches a maximum elevation of about 780 feet NGVD in the southwestern portion of the project to a minimum of approximately 520 feet NGVD along the main stream of the Salt River. The North Fork, Middle Fork, Elk Fork and South Fork are the main tributaries of the Salt River within the project boundaries and have a maximum elevation of 675 feet NGVD in the western part of the project. The sides of the major valleys are dissected by short tributaries whose gradients extend from the flat uplands to the valley bottoms. The divides between these tributaries form a continuous belt of hills along either side of the major valleys. The land adjoining the project is relatively flat farmland.

Geology. The predominant geologic structure controlling the local dip of rock strata at the project is the Lincoln Fold, a complex plunging asymmetrical anticline located in northeast Missouri. The project area is located in the Dissected Till Plains Section of the Central Lowlands Physiographic Province. The geologic formations occurring at the surface within the

project area include Paleozoic sedimentary rocks (primarily limestone and shale) Pleistocene glacial drift, and recent alluvium. The area is characterized by low to moderate relief in the uplands with locally high relief (up to 200 feet) occurring in the bluffs along the Salt River and its tributaries. Some karst features are present in the project area, most notably, solution cavities in the limestone bluffs.

The geologic formations' stratigraphy in the area consists essentially of nearly flat-lying sedimentary strata of Mississippian and Pennsylvanian formations on the uplands. These in turn, are overlain by Pleistocene deposits of glacial till, residuum, or on the floodplains, by recent alluvium. Frequently observed formations found in differing regions of the project include the Hannibal Formation, Chouteau Formation, Burlington-Keokuk formation, Warsaw Formation, Pennsylvanian Age Strata, and Pleistocene and Recent Deposits.

The nature of significant economic mineral deposits within the project area makes any protective measures beyond slope or erosion protection unnecessary. Sufficient reserves of fire clay, coal, and other geologic resources are present outside the project area to preclude the exploitation of any deposits within Government property lines. Geologic items of a collectible nature such as the geodes present in the Keokuk Limestone and its weathered residuum, and the rather unique pyritized fossils of the Hannibal Shale may be deemed significant enough to consider them a resource that warrants management.

Soils. Soil surveys have been prepared by the United States Department of Agriculture – Natural Resources Conservation Service (NRCS) for the counties encompassing Mark Twain Lake (Ralls and Monroe, MO Counties). Engineering as well as other land use interpretations for each soil unit encountered in the respective counties are included in these soil surveys. The predominant soil units within the project area are the Armstrong-Leonard Association and the Goss-Gorin-Lindley Association. The soils of the area present several problems. They are erosive particularly when the shoreline of the lake is subjected to periods of high water combined with windy conditions; bank erosion and caving can occur. Many of the soil deposits are in an area of glacial origin, and include rocks and boulders of large to moderate size at or immediately beneath the ground surface. These conditions can complicate foundation and utility trench design and placement.

2.8 RESOURCE ANALYSIS (Level 1 Inventory Data)

Wildlife Resources. The wildlife species known or expected to occur on the Mark Twain Lake area are those common to the region in general. The land and its plant association support an upland game population, predators and a variety of non-game mammals and birds. Although the project is located in the Mississippi Flyway, the major flights of waterfowl normally pass down the Mississippi to the east and the Grand River to the west. There are; however, sufficient numbers of waterfowl using the lake to have a huntable population. Some "threatened" or "rare and endangered" species do occur in the area; these are discussed in Section 2.8.3 and Table 2-1.

Land management procedures on public lands benefit many of the species present and attract other species to the area. Such procedures are beneficial to songbirds, game birds, and mammals. Trees and shrubs have been and will continue to be planted to provide nesting cover and food for all wildlife species. Wildlife food plots varying in shape, size and species composition are planted in areas to increase available foods for wildlife. Succession control in the form of mowing, disking, and prescribed fire eliminates woody plants while providing diversity among herbaceous plants, in contrast to adjacent untreated areas. Nest boxes provide additional nesting spaces for wood ducks, purple martins, house wrens, tree swallows, bluebirds, bats, and squirrels. Together, the private farms and the public wildlife areas provide a proper balance of food and cover for wildlife over much of the project. Areas that are in the agricultural lease program provide additional food and cover for wildlife species. Civic and private organizations in partnership with the Corps of Engineers assist in the development of structures beneficial to all wildlife on public lands.

Project management practices will be used to maximize the support value of the project for fish and wildlife production, while at the same time maximizing recreational opportunities for hunters and fishermen. Waterfowl management objectives will be fully coordinated with other agencies and should be consistent with the North American Waterfowl Management Plan. The lake's future potential for commercial fishing activity should not be over-looked. The Corps needs to continually monitor the lake's water quality, and to alert regulatory authorities of identified sources of contamination and of the need for implementing rectifying measures to control such pollution.

Fish Resources. The impoundment of Mark Twain Lake has caused a decrease in fast-water adapted fish species, and an increase in slow-water adapted fish species. Species found in the lake pool include the following: black bass, white bass, black crappie, white crappie, bluegill, green sunfish, channel catfish, blue catfish, flathead catfish, walleye, and several species of minnows including common carp, several species of suckers, gars, freshwater drum, and gizzard shad. The tailwater downstream of the re-regulation dam yields sizable concentrations of crappie, white bass, channel catfish, flathead catfish and walleye.

The Mark Twain Lake Project Office coordinates with the MDC on the management of the fisheries resource at the project area. Water regulation aspects at the project having a potential effect on fish include (1) water level fluctuations governed by annual precipitation patterns and power generation demands (2) a weir at the front of the dam that keeps the water released through the turbines close to the natural river temperatures, (3) tainter gates used during high water periods and a concrete apron with force diffusers, and (4) a re-regulation dam that impounds a 9.5 mile pool downstream from the main dam to provide storage for pump-back power generation and dampen fluctuations downstream. The re-regulation pool normally can fluctuate up to eight feet.

To support fisheries habitat, standing timber was left in coves, along some shorelines, and portions of the main lake basin. The lake's fish population is periodically sampled and evaluated by MDC, with age and growth rates of key species determined annually. Periodic checks of reproductive success are made with a comprehensive sample being taken in the fall. In the future, if large numbers of commercial fish species reach a marketable size, a limited commercial fishing program may be considered. Such a program would utilize that portion of the fisheries not highly desirable or susceptible to sport fishing. Predator species not showing adequate

survival or contribution to the creel will not be considered for future supplemental stockings. Sport fish species may be stocked periodically if natural reproduction is insufficient to maintain fishable populations and if such stockings are supported by scientific evaluation and research. The MDC has completed several studies in the lake that increase our understanding of biotic and abiotic variables that influence Gizzard Shad, Crappies, and Largemouth Bass population dynamics in the lake. Current studies are being conducted on Blue Catfish in the lake.

The Corps of Engineers developed and operates a brood pond in the Sandy Creek Area of Mark Twain Lake. It is a 3.5 acre nursery pond, supported by two minnow ponds. The purpose of the pond is to raise sport fish such as Channel Catfish and hybrid Blue Gill to support nine recreational pond and youth fishing programs on project lands.

Vegetative Resources. Prior to construction of the lake, about half of the present fee-owned project land was forested. The majority of this land was located above the lake pool elevation. The white oak-black oak-northern red oak (Forest Cover Type No. 52) is the most common association on upland sites. The white oak association (Forest Cover Type No. 53) also occurs frequently. Shagbark hickory comprises a substantial stocking on most upland sites. Dominant trees include White Oak, Northern Red Oak, and Black Oak. Hickory (Carya spp.), and Ash (Fraxinus spp.) usually occupy the co-dominant or intermediate class. Sugar Maple, Elm, Black Cherry, Red Bud, Flowering Dogwood, and Serviceberry are the predominant understory species. Understory shrub species include Fragrant Sumac, Corralberry, Greenbriar, and various forms of shade tolerant grasses.

Floodplain forests of the Salt River basin are predominately Silver Maple and American Elm (Forest Cover Type No. 62); however, local variations do occur in the area with such species as Eastern Cottonwood, Sycamore, River Birch, Pin Oak, Green Ash, Persimmon, Hackberry and Black Willow being common.

Openlands are comprised of cool season/forb grasslands, warm season native prairies, agricultural lands, and early to mid-successional fields. Openlands are managed through various means to provide diverse wildlife habitat. Mechanical manipulations (mowing, successional disking, and supplemental food resource development), agricultural lease, and prescribed burning are employed to manage and maintain open lands. Even with these practices, portions of open land have reverted to natural succession with the invasion of such species as Hawthorn, Blackberry, Elm, Oaks and Sassafras.

Threatened and Endangered Species. Specific management practices formulated for the project's operations and maintenance will take into account the need to protect and enhance conditions for federally listed and state listed endangered species provided in Table 2-1. Additional observations and field study are needed to determine the presence or absence of endangered species. Management practices will also take into account carrying capacities for developed recreation areas. Management and maintenance practices will include regulating visitor numbers and erosion/site deterioration repairs.

Table 2-1 - Federal and/or State Threatened and Endangered Plants, Animal Species, and Ecological Communities Known to Occur, or That May Potentially Occur Within The Mark Twain Lake Area*

Common Name	Scientific Name	State Rank	State Status	Federal Status
Dry –Mesic Loess/Glacial Till Forest		Vulnerable		
Dry Limestone/Dolomite Woodland		Vulnerable		
Dry Sandstone Woodland		Vulnerable		
Dry-Mesic Limestone/Dolomite Forest		Vulnerable		
Mesic Bottomland Forest		Imperiled		
American Badger	Taxidea taxus	Vulnerable		
Bald Eagle	Haliaeetus leucocephalus	Vulnerable		Protected
Barn Owl	Tylo alba	Vulnerable		
Indiana Bat	Myotis sodalis	Critically Imperiled	Endangered	Endangered
Gray Bat	Myotis grisescens	Critically Imperiled	Endangered	Endangered
Northern Long-Eared Bat	Myotis septentrionalis			Threatened
Eastern Foxsnake	Pantherophis vulpinus	Critically Imperiled		
Black Sandshell	Ligumia recta	Imperiled		
Ghost Shiner	Notropis buchanani	Imperiled		
Silver Chub	Macrhybopsis storeiana	Vulnerable	Species of Concern	
Mississippi Silvery Minnow	Hybognathus nuchalis	Vulnerable		
River Darter	Percina shumardi	Vulnerable		
Western Sand Darter	Ammocryta clara	Imperiled		
Regal Fritillary	Speyeria idalia	Vulnerable		
Sheepnose mussel	Plethobasus cyphyus	Imperiled	Endangered	Endangered
Spectaclecase	Cuberlandia monodonta	Vulnerable		Endangered
Fat Pocketbook	Potamilus capax	Critically Imperiled	Endangered	Endangered
Ebonyshell	Fusconaia ebena	Critically Imperied	Endangered	
Rock Pocketbook	Arcidens	Vulnerable		

	confagosus			
Elusive Clubtail	Stylurus notatus	Imperiled		
Large Seeded Mercury	Acalypha Deamii	Critically imperiled	Species of Concern	
Hickorynut	Obovaria olivaria	Vulnerable		
Wartyback	Quadrula nodulata	Vulnerable		
Western Wall Flower	Erysimum capitatum	Vulnerable		
Prairie Dandelion	Microseris cuspidate	Imperiled		
Ditch Grass	Ruppia maritime var rostrata	Critically Imperiled		
Wild Sarsaparilla	Aralia nudicaulis	Vulnerable		
Running Buffalo clover	Trifolium stoloniferum		Endangered	Endangered
Eastern Prairie Fringed Orchids	Platanthera leucophaea		Endangered	Threatened
Western Prairie Fringed Orchids	Platanthera praeclara		Endangered	Threatened
Decurrent False Aster	Boltonia decurrens		Endangered	Threatened

*Information provided by the Missouri Heritage Database

Invasive Species. Invasive species continue to pose significant threats to project resources. Infestations of invasive plants, diseases, animals, and insects are fast becoming one of the greatest threats to the earth's biological diversity, as well as human health. Invasive species are defined as species that do not naturally occur in a specific area and whose introduction causes or is likely to cause economic or environmental harm, or harm to human health. Many species pose relatively minor risk to altering native systems, while others have the potential for great impact. There are a number of invasive plant species that suppress regeneration whether they are exotic or native in origin. They do this by out-competing the native vegetation for water, sunlight, nutrients, and space. While the overall number of invasive plant species is very large and continues to grow, managers have identified a select number of invasive and/or weedy species of special concern. Some plant species include Reed Canary Grass, various species of Honeysuckle, Black Locust, Crown Vetch, Eastern Red Cedar, Elm, Sassafras, Shingle Oak, Autumn Olive, Honey Locust, Sericea Lespedeza, Blackberry, Multi-flora Rose, various species of Sumac, Purple Loose Strife, and Trumpet Creeper. This is not an all inclusive invasive species list for the Project, but instead a handful of the hundreds of invasive species that has already infested and continues to arrive. Another invasive species of concern noted by MDC biologists is the Asian Carp in the reregulation pool and the re-regulation dam's tail water.

This list will likely grow in the future and managers must remain vigilant and act quickly as new threats arise. Exotic species did not evolve with the ecosystem they invade and their introduction usually irreversibly degrades the native ecosystem, and may ultimately affect the survival of native species. Zebra Mussels, Feral Hogs, Gypsy Moth, Asian Long-horned Beetle and Emerald Ash Borer are not yet within the Project area, but are expected to be in the future and will have tremendous consequences both in actual cost to manage and overall dynamic change to the ecosystem they invade. The Operational Management Plan contains additional information on the invasive species. Invasive species control programs are closely coordinated with appropriate-agencies to insure that the environmental effects are adequately considered.

Ecological Setting. Mark Twain Lake and the re-regulation pool provide a significant fish and wildlife resource for northeast Missouri. Constructed on the three main forks to the Salt River, the lake provides habitat for many species of plants and animals some of which are threatened, endangered, or concerned. Lands around the lake have four designated environmentally sensitive areas.

Wildlife population limiting factors at Mark Twain Lake appear to be minimal. Although about half of the fee lands are forested, there is a significant portion in grassland or open lands. The ratio of open land to forest creates the desirable edge effect. Food and cover are both abundant and well-interspersed. Woodlots, lake shore, timber, and brushy field borders furnish all the requirements necessary to support viable wildlife populations. Large habitat complexes allow for the introduction of species such as Osprey, Barn Owl, and River Otter.

The Corps has designated and manages 14,536 acres of land exclusively for fish and wildlife purposes at Clarence Cannon Dam and Mark Twain Lake, Missouri. In 1978, the MDC notified the St. Louis District that they could not accept a license at the project for fish and wildlife management. Accordingly, the St. Louis District accepted the responsibility to implement and manage the program with its personnel and resources.

The development of recreational facilities and associated accesses has provided visitors with quality outdoor recreational opportunities with minimal effect on the environment. Campgrounds, picnic areas, boat ramps, etc. have been designed and developed in order to retain the outstanding esthetic quality on the lake and surrounding area. Waste collection and treatment is stringently regulated in compliance with state and local regulations. Recreation management including regulating visitor use has kept site deterioration to a minimum. Vegetative and landscape management practices have controlled erosion and prevented potential environmental degradation. Developed roads and hunter fisherman parking areas have controlled off-road

vehicle use while providing visitors with access to trails and underdeveloped wooded areas with minimal environmental impact.

Wetlands. Nine wetland sub-impoundments have also been developed to provide for waterfowl management. These areas are managed by periodically manipulating water levels to provide resting and feeding areas for migratory waterfowl.

2.9 DISPOSAL AREAS

The project has four major disposal areas within its boundaries. One of the areas is inundated by the lake. Two of the sites are immediately downstream of the dam along the exit channel. These sites are now recreation areas with roads, parking and boat launching facilities. Two other sites have been re-vegetated. One of these sites is located near a water tower just off County Road J where it crosses the lake and the other location is downstream of the exit channel. These sites can be developed, however, subsurface conditions can have extreme variations (boulders, rocks, debris, etc.) and cause additional design and construction costs. Any development such as parking lots, roads and buildings should consider the past use of the land, loads, potential settlements, and excavation techniques required (boulders, rocks, etc.). Disposal areas should be investigated thoroughly before development.

2.10 MINERAL AND TIMBER RESOURCES

The pre-project exploitation of mineral and timber resources near the project area was not considered detrimental to public use and enjoyment of the resource base, nor does it constrain or influence resource development and management.

Mineral Resources. No economically viable deposits of metallic minerals occur within the project area. However, there are other deposits of economic or potentially economic grade resources within the reservoir area. These include fire-clay, limestone, sand and gravel, and coal.

- **Fire-Clay**. The Cheltenham Clay is the chief source of high-grade ceramic clay in the region, and is known to occur within the project area, and adjacent uplands. At present, clay is only being produced locally in the Goss area, approximately 14 miles west of the dam site. These deposits generally occur at elevations above maximum flood pool; however, it is possible that some of the clay pits may be deep enough to be impacted by prolonged periods of high pool. Sump pits in some of the excavations are below maximum flood pool, but it is believed that seepage into these pits from the reservoir will be minimal due to the short periods of high water and natural topographic boundaries between the pits and the reservoir.
- Limestone. Limestone is suitable for use as flagstone. Crushed stone is common in the reservoir area and outcrops are numerous. To be commercially useful, limestone should be chert free with relatively shallow overburden, accessible to transportation, and relatively free of impurities. The potential economic limestone units within the project area are the Chouteau and the lowest portion of the Burlington Formations. There are a

few limestone quarries in the area, but no known active quarry will be impacted by even extended periods of maximum pool. The quarry previously operated by the State of Missouri for resurfacing Highway J is now inundated by the reservoir.

- Sand and Gravel. There were, at the time the dam was under construction, several producers of sand and gravel operating in the project area. Production of sand and gravel is generally accomplished by locating a suitable bar or deposit in the riverbed, and removing the material by dragline or similar procedure. After depletion of the deposit, or location of more economically exploitable deposits elsewhere, the operation is moved. The worked sites are sometimes replenished during seasonal periods of high water, and may be reworked following sufficient re-deposition. The completion of the dam and reservoir has virtually eliminated this cycle of replenishment, to the extent that production will be limited to existing deposits downstream of the dam without significant renewal. Because of the method of operation, all of the areas upstream of the dam have been impacted by the reservoir. Those areas inundated by the pool are no longer accessible to exploitation.
- **Coal.** There are no economically viable coal deposits known to exist within the reservoir area; however, there have been small coal strip mining operations on lands near the project area southeast of the reservoir. The mining has been of low sulfur coals in the discontinuous Pennsylvanian Cabannis Subgroup. Minor discontinuous coal seams exist within the reservoir area in the Tebo, Scammon, and Weir cyclothems of the Cabannis Subgroup. These deposits outcrop along some of the tributaries of the Salt River in the southern and western portions of the reservoir area west of Highway 107, along Highway 154. These deposits are found at elevations from 640 to 690 feet NGVD, generally above the maximum flood pool.

Timber Resources. Major forest types of commercial value found within the project area are oak-hickory, and bottomland hardwoods. At present the timber resources can be classified as pole timber or immature saw timber. The existing timber quality is a direct result of past land management practices prior to purchase. There is, however, the potential to support local mills with limited intermediate cutting practices, establishing a solid timber base for future planning.

- Oak-Hickory Forest Type. The white oak-black oak-northern red oak (Forest Cover Type No. 52) is the most common association on upland sites. The white oak association (Forest Cover Type No. 53) also occurs frequently. Shagbark Hickory comprises a substantial stocking on most upland sites. Dominant trees include White Oak, Northern Red Oak, and Black Oak. Hickory (Carya spp.). and Ash (Fraxinus spp.). usually occupy the co-dominant or intermediate class. Sugar Maple, Elm, Black Cherry, Red Bud, Flowering Dogwood, and Serviceberry are the predominant understory species. Understory shrub species include Fragrant Sumac, Corralberry, Greenbriar, and various forms of shade tolerant grasses.
- **Bottomland Hardwoods Forest Type.** Flood plain forests of the Salt River Basin are predominately Silver Maple and American Elm (Forest Cover Type No. 62); however, local variations do occur in the area with such species as Eastern Cottonwood, Sycamore,

River Birch, Pin Oak, Green Ash, Persimmon, Hackberry, and Black Willow being common.

2.11 CULTURAL RESOURCES

The St. Louis District Historic Properties Management Report No. 47, Historic Properties Data Synthesis, Mark Twain Lake, Missouri, September 1995 provides site information to project personnel on the subject of identified archaeological sites, material and remains. The Historic Properties Management Report documents archaeological investigations in the Mark Twain Lake region, prior to impoundment. The pre-impoundment archaeological research in the project region is divided into four phases:

- Phase 1, 1959-64, the University of Missouri surveyed and excavated archaeological sites under a cooperative agreement with the National Park Service.
- Phase 2, 1967-68, University of Missouri, under contract with the National Park Service, excavated nine archaeological sites.
- Phase 3, 1974-May 1977, University of Nebraska, under contract with the U.S. Army Corps of Engineers, St. Louis District, conducted further survey and testing.
- Phase 4, May 1977 August 1980, the Cannon Reservoir Human Ecology Project (CRHEP) was executed.

The combined archaeological research efforts performed in the Mark Twain Lake Project area identified over 1500 prehistoric sites and 300 historic sites ranging in age from 12,500 to 100+ years old.

In addition to the subsurface remains, a total of 225 historic buildings were evaluated prior to impoundment. Of these, a total of 25, were recorded to standards established by the Historic American Building Survey (H.A.B.S.) standards. Prior to impoundment, and following completion of the H.A.B.S. documentation, all historic structures were razed and removed from the project area.

It is the policy of the St. Louis District to manage historic properties at the same level as other programs (i.e. recreation, wildlife, flood control, etc.). The *St. Louis District Historic Properties Management Plan, Mark Twain Lake, September 1994*, serves as a reference to assist lake personnel in managing identified cultural resources and meeting federal regulations concerning cultural resource management.

2.12 INTERPRETATION/VISUAL QUALITIES

The Interpretive Services and Outreach Program (ISOP) is an essential part of the Corps Civil Works program. Through this program the project can communicate Corps missions and accomplishments, achieve management objectives, and foster environmental stewardship. Reaching diverse audiences and partners, it can improve visitor and employee safety, help with team cohesiveness, and enhance visitor's experiences by providing interpretive resources to meet their needs. It is one of the most effective tools to connect with the general public, user groups, and stakeholders. The Corps' Interpretive Services and Outreach Program (ISOP) regulations are found in ER 1130-2-550 and EP1130-2-550. The Corps defines interpretation as "communication and education processes provided to internal and external audiences, which

support the accomplishments of the agency's missions, tell the agency's story and reveal the meanings of and the relationships between natural, cultural, and created environments and their features." The key is to help people connect to and relate to project sites, leading to their involvement and support. This can be done through displays, brochures, visitor center exhibits, and interpersonal contacts, among other ways.

Interpretive services are provided by highly trained and motivated Park Rangers, many of who are professionally certified interpreters. They have the skills to help visitors relate to project sites, promote safety, encourage stewardship, and understand the role of the Corps. Mark Twain Lake's ISOP communicates to the public through various resources including but not limited to guided tours, self-guided trails, Visitor Center exhibits, virtual tours on the website, on and off-site educational programs, campfire programs, safety fairs, special events and through the M.W. Boudreaux Memorial Visitor Center. The program also uses news releases and billboards to communicate mission and safety messages in addition to social media such as Facebook and email. Water Safety continues to be a top priority.

Geologic Qualities. The site of the Clarence Cannon Dam is on the Salt River in northeastern Missouri, 63 river miles west of the Mississippi River. Mark Twain Lake is principally located in Ralls and Monroe Counties, and at normal pool extends 34 miles upstream on the North Fork of the Salt River, which is the main stem. The highest altitudes in the project area are on the flat upland divides, which reach a maximum altitude of about 780 feet. The local relief is about 100 feet along the major tributaries and increases to about 200 feet along the main stem. The sides of the walley bottoms; and the divides between these tributaries form a continuous belt of hills along either side of the major valleys. The Salt River and its major tributaries flow through meandering valleys bordered by steep rocky walls. Nearly all the valley meanders occur where the valleys are incised into limestone strata of the Mississippian age, or, near the Clarence Cannon Dam, into limestone above and below shale. An unusual feature of the valley bottoms along the Salt River is their great variability in width that is now reflected in the variable width of Mark Twain Lake.

Vegetative Qualities. The vegetative types are discussed in paragraph Chapter 2.8 entitled "Vegetative Resources." These different vegetative types combine to form moderate scenic qualities.

Land-Uses. Land management on project lands is, for the most part, complementary to scenic qualities. The majority of the adjacent lands are forested, but there is also a significant portion in open land.

Visual Qualities. The combination of features listed in the above paragraphs form the overall visual qualities of the lake area. For Mark Twain Lake, the overall esthetic qualities are moderate. The primary reasons for this are the moderate relief topography, exposed rock, the interspersion of forest and open land constituting the majority of adjacent land, and moderately turbid waters.

2.13 DEMOGRAPHICS

The following is a brief demographic analysis of Monroe and Ralls Counties, Missouri. Table 2-2 below reveals a 5.1% decrease in population for Monroe County and a 5.6% increase for Ralls County from 2000 to 2010. The study area as a whole experienced an increase in population of less than 1.0% for this period. According to the Missouri SCORP (Statewide Comprehensive Outdoor Recreation Plan 2013-2017), Missouri is home to nearly 6 million people and growing steadily at 6% per decade, yet lagging behind the National growth projection of 10% per decade.

	2010	2000	1990	1980	1970
Monroe County	8,840	9,311	9,104	9,716	9,499
Ralls County	10,167	9,626	8,476	8,911	7,846
TOTAL	19,007	18,937	17,580	18,627	17,345

Table 2-2 -	County	Populations	By	Decade
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Both Monroe and Ralls County follow the State of Missouri's racially and ethnically diverse population trends with 83% of Missourians identifying as white, nearly 12% as black, and 3.5% as Hispanic. According to the 2010 U.S. Census, Missouri's total minority population increased from 16% in 2000 to 19% in 2010.

According to the Missouri SCORP, Missouri's population is also aging. The number of children under 20 will remain steady over the next decade, but those 65 and older will increase from less than 14% to nearly 17%. By 2030, more than one in five Missourians, 1.4 million people, will be over the age of 65, an 87% increase over 2000. The dramatic change in the elderly population is due to increased longevity and aging of the baby-boomer generation. This trend causes recreation professionals to rank the age group 55+ second (after teens) in unmet needs. This trend will continue to grow, as baby-boomers age, unless additional efforts are made to serve seniors. The Monroe and Ralls County median age in 2010 was 43-44 years of age while the median age for Missouri is 38 years of age.

2.14 REGIONAL ECONOMICS

Manufacturing, food and medical services, retail trade, construction and agriculture comprise the major employment sectors in northeast Missouri. The unemployment rate for the northeast Missouri region at is 5.5%, slightly lower than the statewide rate of 5.8%.

2.15 RECREATION FACILITIES, ACTIVITIES AND NEEDS

Visitation Profile. Mark Twain Lake is one of the most popular water based recreation locations in northeast Missouri. On average, Mark Twain Lake entertains approximately two million visits per year. Peak visitation at Mark Twain Lake occurs April through September and accounts for 80% of the total visitation. Visitors at Mark Twain Lake recreate through boating, fishing, swimming, camping, hiking, walking, biking, hunting, geo-caching, picnicking, and horse-back riding.



Table 2-3 - Visitation At Clarence Cannon Dam And Mark Twain Lake

Visitation Data presented in OMBIL for Clarence Cannon Dam and Mark Twain Lake.

Zone of Influence. The Zone of Influence is the surrounding geographic area that the site impacts in terms of origins for visitors. The camping zone of influence is composed of a 200 mile radius from the Clarence Cannon Dam; this radius accounts for 95% of the total camping and day-use visitation. This area includes parts of Iowa, Illinois, and most of northeastern and central Missouri. Major cities in this zone include Columbia, Osage Beach and St. Louis in Missouri and Springfield in Illinois. The local zone of influence primarily includes Audrain, Boone, Clark, Marion, Monroe, Pike, Ralls, Randolph and Shelby Counties in Missouri and Adams and Pike Counties in Illinois. It also includes portions of Davis, Lee and Van Buren Counties in Iowa.



Table 2-4 – Zone of Influence Mapping

Visitor zip codes collected from the ORMS reservation program and annual Customer Comment Card Surveys.

Recreation Analysis

The Statewide Comprehensive Outdoor Recreation Plan (SCORP) is an integral part of capturing the history and popular activities to enhance recreation opportunities in Missouri. The SCORP ties together voices from the users of recreation sites, planners and developers, government officials, agency managers and elected officials. This collaboration effort is in place to lay out a plan to guide recreation development in a useful, beneficial, and sustainable manner.

Missouri SCORP Data (2013-2017). A telephone survey of Missouri residents was conducted in July 2011. A total of 768 surveys were completed, half in urban and half in rural regions of the state, providing a 95% (+/- 5%) confidence interval for each. Results were combined and weighted based on the urban/rural ratio (70/30) of the state's population. The survey focused on residents who had participated in outdoor recreation at a public facility at least once in the past year; those who had not participated in the past year were screened out of the survey.

Availability of Outdoor Recreation

Available Activities. According to Missouri SCORP data, residents are satisfied with the availability of outdoor recreation activities in Missouri overall and more than a third are very satisfied. They are less satisfied, however, with the availability of organized and supervised outdoor recreation programs and only one in five residents are very satisfied. In particular, residents who are not satisfied with programs want more opportunities for walking, biking and youth related activities.

Available Facilities. Most Missourians are satisfied with the number and availability of outdoor recreation facilities in the state, but those who are not satisfied want more walking trails, water parks/pools and parks. One in ten Missourians has limited access to sidewalks, and more than half of those residents would use sidewalks if they were available in their neighborhoods. Young Americans nationwide expressed similar desires for sidewalks during President Obama's America's Great Outdoors (AGO) Initiative, suggesting that communities use sidewalks and pathways to link neighborhoods to parks and green spaces. Missouri residents who visit certain types of facilities at least once a year say more of these facilities are needed -- gardens, trails, outdoor swimming pools, camping sites, outdoor aquatic complexes, target shooting sites, ATV/ORV riding areas, outdoor basketball courts, tennis courts and disc golf courses.

Popularity of Outdoor Recreation

Popular Activities. The most popular outdoor recreation activity among Missourians is walking – more than a third of residents walk daily. More than one in five Missourians enjoy daily gardening, wildlife observation/birding and dog walking. Most Missouri residents walk for recreation, join in outdoor family gatherings, drive for sightseeing, visit local parks and garden at least once a year. More than half enjoy picnicking, outdoor swimming, visiting historic/education sites, wildlife observation/birding, fishing and boating at least annually. Walking, bicycling, playing baseball and playing golf are more popular among urban residents while rural Missourians are more likely to be fishing, boating, target shooting, hunting and ATV riding. Table 2-5 lists the most popular activities from the Missouri SCORP Data.

Popular Facilities. Walk-able streets/sidewalks, local parks, gardens, fishing sites and outdoor swimming pools are the most popular facilities used by Missourians monthly. More than one in five residents visit playgrounds, lakes, trails, boat access sites, rivers, picnic areas and historic/education sites at least once a month. Three out of four Missourians use local parks and walk-able streets/ sidewalks at least once a year. More than half of Missourians visit historic/education sites, lakes, gardens, picnic areas, and/or state parks once or more annually. A recent national study showed that people place a greater priority on having sidewalks and places to take walks than on living within walking distance of specific places in a community, such as stores and restaurants. Not surprisingly, urban residents are more likely to use walk-able streets/ sidewalks and local parks while rural residents are more likely to use fishing sites, lakes and rivers.





How often does your household participate in this activity?

Recreational Carrying Capacity. Utilization rates of camping and day use areas at Mark Twain Lake vary and are impacted by environmental, geographic, and facility development factors. During the main recreation season (May-August) on holiday weekends most of the campgrounds and developed day use areas are utilized at or beyond the physical carrying capacity of the current infrastructure. Additionally, when environmental factors such as the weather or prevalence of fish and game are favorable, several areas experience heavy use similar to that of a holiday weekend. However, on week days not leading into or following a holiday, for camp-loops with reservations, utilization numbers tend to be lower. Campsites with full service hook-ups and/or 50 Amp electrical service tend to have higher utilization rates than standard campsites. According to utilization data and customer comment card survey results, additional full service

hook-up campsites and 50 Amp service campsites are needed, desired by the customer, and would improve carrying capacity.

Resource managers continually balance area usage to sustain high quality recreation opportunities and respond to the increasing and fluid demand for water-based resources to minimize negative impacts to environmental resources, safety, or visitor experiences.

2.16 RELATED RECREATIONAL, HISTORICAL, AND CULTURAL AREAS

The Mark Twain Lake Project is the primary source of outdoor recreational activities for the area. Hunnewell Lake administered by the Missouri Department of Conservation and the Route J Reservoir run by Monroe City are the two closest lakes to Mark Twain Lake and both lakes are very small. Although these lakes have camping, picnicking and boating opportunities, they do not compete nor compare to the opportunities offered at Mark Twain Lake. The Mississippi River is approximately 30 miles from Clarence Cannon Dam and provides the public with numerous outdoor recreational opportunities on a large river environment. Hannibal, Missouri, located 28 miles northeast of Clarence Cannon Dam, is the site of Mark Twain's Boyhood Home. A shrine commemorating the birthplace of Mark Twain is located on Mark Twain State Park lands near Florida, Missouri. The Union Covered Bridge State Historic Site is home to one of the four remaining covered bridges in Missouri that represents the Burr-arch truss design. These three historical areas provide visitors to the lake with supplementary points of interest.

2.17 REAL ESTATE

Acquisition Policy. The acquisition policy for the Clarence Cannon Dam and Mark Twain Lake Project was the purchasing of a fee area encompassing the majority of lands at or below 642.0 feet NGVD, which is four feet above the top of the flood pool elevation. Additional lands were purchased above this elevation to support project missions and/or operations including recreation, and mitigation. The total fee title real estate interest at the Clarence Cannon Dam and Mark Twain Lake Project is 54,742 acres. The total flowage easement interest at Mark Twain Lake is 9,740 acres.

The majority of fee title land is managed by the U.S. Army Corps of Engineers in accordance with its authorized purposes and regulatory requirements. The Missouri Department of Natural Resources leases 1,559 acres for use as a State park. Other lessees include the Clarence Cannon Wholesale Water Commission, Blackjack Marina, and the Indian Creek Marina.

2.18 PERTINENT PUBLIC LAWS

Development and management of Federal reservoirs for various purposes is provided under several statutes. These laws cover development of recreation facilities, licensing of project lands for fish and wildlife purposes, protection of natural resources, and leasing of project lands for incidental uses other than recreation. In addition, applicable legislation for cultural resource protection at this project is listed.

Recreation. Development and management of recreation facilities by the Corps, other governmental agencies, local groups, or individuals is authorized under the following public laws:

- Section 4 of the Flood Control Act, approved 22 December 1944 (PL 78-534), authorizes providing facilities for public use, including recreation, and conservation of fish and wildlife.
- The River and Harbors Act, approved 2 March 1945 (PL 79-14), specifies the rights and interests of the states in watershed development and water utilization and control, and the requirements for cooperation with state agencies in planning for flood control and navigation improvements.
- Section 209 of the Flood Control Act of 1954 (PL 83-780), approved 3 September 1954, amended the Flood Control Act of 1944. It authorized the Secretary of the Army to grant leases to federal, state or governmental agencies without monetary considerations for use and occupation of land and water areas under the jurisdiction of the Department of the Army for park and recreation purposes when in the public interest.
- The Land and Water Conservation Fund Act of 1965 (PL 88-578), approved 1 September 1964, contains provisions by which the Corps may charge for admission and use of its recreation areas under prescribed conditions.
- The Federal Water Project Recreation Act (PL 89-72), approved 9 July 1965, contains cost sharing provisions for acquisition of lands and development of recreation facilities for water resource projects authorized after 1965. It also provides for cost sharing development of new areas that were not part of initial project construction.
- The Architectural Barriers Act of 1968 (PL 90-480), together with the acts and amendments listed in 7, 8, and 9 below, provides information and guidance regarding universal accessibility for persons with disabilities to Corps recreation facilities and programs.
- The Rehabilitation Act of 1973 (PL 93-112) and the Rehabilitation Act Amendments of 1974 (PL 93-516) (see Architectural Barriers Act above).
- The Rehabilitation, Comprehensive Services, and Developmental Disabilities Amendments of 1978 (PL 95-602) (see Architectural Barriers Act above).
- The Americans with Disabilities Act of 1990 (PL 101-336) (see Architectural Barriers Act above).
- Architectural Barriers Act (ABA) standards and guidelines for accessible design, 2004.
- Accessibility Guidelines for Outdoor Developed Areas, 26 September 2013.

- The Water Resources Development Act of 1992 (PL 102-580), approved 31 October 1992, authorized the Challenge Cost Sharing Program (Section 225) that permits the Corps to develop and implement a program to accept contributions of funds, materials and services from non-Federal public and private entities to be used in managing recreation facilities and natural resources. This is now known as the Challenge Partnerships programs.
- The Omnibus Budget Reconciliation Act Day Use Fees, approved 10 August 1993 (PL 103-66), contains provisions by which the Corps may collect fees for the use of developed recreation sites and facilities, including campsites, swimming beaches, and boat launching ramps but excluding boat launching ramps in undeveloped or lightly developed areas with minimum security and illumination.
- The Water Resources Development Act of 1996 was approved 12 October 1996. Section 208 (Recreation Policy and User Fees) directed the Corps to put increased emphasis on recreation opportunities at Corps projects and specifies that a portion of recreation fees collected at Corps projects remain for use at the project where they are collected. Section 519 (Recreation Partnership Initiative) directed that, in general, the Corps is to promote federal, non-federal, and private sector cooperation in creating public recreation opportunities at Corps projects.

Fish and Wildlife. Fish and wildlife resources are maintained and protected in compliance with the following public laws:

- The Fish and Wildlife Coordination Act, enacted 10 March 1934, as amended, 14 August 1946 (PL 79-732), 1958 (PL 85-624), provides authority for making project lands of value for wildlife purposes available for management by interested federal and state wildlife agencies. It further provides for more effective integration of a fish and wildlife conservation program with federal water resources developments.
- The National Environmental Policy Act of 1969, as amended (42 USC 4321 et seq), declares a national environmental policy and requires that all federal agencies shall, to the fullest extent possible, use a systematic, interdisciplinary approach which integrates natural and social sciences and environmental design arts in planning and decision making.
- The Endangered Species Act of 1973 as amended (16 USC 1531 and 1536) requires that federal agencies shall, in consultation with the U.S. Fish and Wildlife Service (USFWS) (or the National Marine Fisheries Service), use their authorities in furtherance of conserving endangered and threatened species and take such action as necessary to assure that their actions are not likely to jeopardize such species or destroy or modify their critical habitat.
- The Water Resource Development Act of 1986, Section 1135, provides for modifications in the structures or operations of a project, consistent with authorized project purposes to improve the quality of the environment, i.e. restoration of fish and wildlife habitat.

WRDA 1996 amended Section 103 of WRDA 1986 by specifying that the non-federal share of environmental restoration and protection projects shall be 35 percent.

• Executive Order 12962, 7 June 1995, entitled Recreational Fisheries directs Federal agencies to improve the quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased recreational fishing opportunities by means of a number of duties. In addition, it establishes a National Recreational Fisheries Coordination Council consisting of seven members (including one designated by the Secretary of Defense). The "Coordination Council" is charged with developing a comprehensive Recreational Fishery Resources Conservation Plan. This EO also directs all Federal agencies to identify and minimize conflicts between recreational fisheries and their responsibilities under the Endangered Species Act of 1973 and expands the role of the Sport Fishing and Boating Partnership Council.

Forest Resources - Protection and Improvement of Natural Resources.

- The Forest Conservation Act (PL 86-717) approved 6 September 1960, provides for the • protection of forest cover in reservoir areas, and specifies that reservoir areas of projects for flood control, navigation, hydroelectric power development, and other related purposes, owned in fee and under the jurisdiction of the Secretary of the Army and the Chief of Engineers, shall be developed and maintained so as to encourage, promote and assure fully adequate and dependable future resources of readily available timber through sustained yield programs, reforestation, and accepted conservation practices, and to increase the value of such areas for conservation, recreation and other beneficial uses; provided, that such development and management shall be accomplished to the extent practicable and compatible with other uses of the project. The law further provides that in order to carry out the national policy declared in the first section of this Act, the Chief of Engineers, under the supervision of the Secretary of the Army, shall provide for the protection and development of forest or other vegetative cover and the establishment and maintenance of other conservation measures on reservoir areas under his jurisdiction, so as to yield the maximum benefit and otherwise improve such areas. Programs and policies developed pursuant to the preceding sentence shall be coordinated with the Secretary of Agriculture, and with appropriate state conservation agencies.
- Other Incidental Uses. Title 10, United States Code, Section 2667, authorizes the lease of land at water resource projects for any commercial or private purpose not inconsistent with other authorized purposes, subject to specific restrictions thereupon, as set out in regulations, policy, and Delegations of Authority. Title 16, United States Code, Section 460d, authorizes use of public lands for any public purpose, including fish and wildlife, if it is in the public interest. Such uses are also subject to regulations, policy and Delegations of Authority. The use of project lands for easements and licenses is authorized in various Congressional Acts and codified in Titles 10, 16, 30, 32 and 43 of the United States Code. Lands and rights-of-way will be acquired pursuant to provisions of the Uniform Real Property Acquisition and Relocation Assistance Act of 1970, PL 91-646, as amended.

- Cultural and Historical Considerations. A number of laws mandating the protection of cultural resources on public lands have been passed during the past 95 years. These laws and Executive Orders are summarized in Appendix A of the St. Louis District Cultural Resource Management Policy (April 1982). The following laws subsume, clarify or supersede all previous cultural resource law:
- The National Historic Preservation Act of 1966 (PL 89-665) approved 15 October 1966, as amended through 2000 (PL 91-243, PL 93-54, PL 94-422, PL 94-458, PL96-1999, PL 96-244, PL 96-515, PL98-483, PL 99-514, PL 100-127, PL 102-575, PL 103-437, PL 104-333, PL 106-113, PL 106-176, PL 106-208, and PL 106-355), states a policy of preserving, restoring, and maintaining cultural resources and requires that federal agencies take into account the effect any undertaking may have on sites that may be eligible for inclusion on the National Register of Historic Places.
- The Archaeological and Historic Preservation Act of 1974 [as amended (16 USC 469-469c)], amended the 1960 Reservoir Salvage Act (PL 86-523), and provides for the preservation of historical and archaeological data that might otherwise be lost or destroyed as the result of flooding or any alteration of the terrain caused as a result of any federal construction projects.
- American Indian Religious Freedom Act of 1978 (PL 95-341) enacted on 11 August 1978, protects the rights of Native Americans to exercise their traditional religions by ensuring access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites.
- The Archeological Resources Protection Act of 1979 (16 USC 470 et seq.), PL 96-95, 96th Congress Revision and update of 1906 Antiquities Act protects archaeological resources and sites that are on public lands and Indian land, and fosters increased cooperation and exchange of information between governmental authorities, the professional community, and private individuals.
- The Native American Graves Protection and Repatriation Act (PL 101-601) was enacted on 16 November 1990 and requires federal agencies and museums to inventory and summarize human remains, funerary objects, sacred objects, and objects of cultural patrimony and to provide this information to potentially affiliated Native American Tribes. The Act requires repatriation of these items, upon request and following the guidelines in 43 CFR Part 10, to the cultural affiliated tribe(s) and establishes a grant program within the Department of the Interior to assist tribes with repatriation and museums in preparing the inventories and collection summaries. The act also outlines the procedures that Federal agencies must follow in the event of an inadvertent discovery or intentional excavation of human remains and funerary objects from federal or tribal lands.
- Indian Sacred Site, Executive Order 13007, signed on 24 May 1996, directs federal landmanaging agencies to accommodate Native American use of sacred sites for religious purposes and to avoid adversely affecting the physical integrity of sacred sites. Agencies

are required to develop procedures for reasonable notice to tribes of a proposed action or land management policy that may restrict access to, or ceremonial use of, a sacred site or adversely affect its physical integrity.

• The Water Resources Development Act of 2000, Section 208, authorizes the army to rebury Native American human remains that were discovered on Civil Works project lands and have been rightfully claimed by a tribe on those lands.