

Section 11 Environmental Effects Associated with the Breach of the Upper Reservoir at the Taum Sauk Project

This review examines the environmental impacts resulting from the breach of the upper reservoir rim dike at the Taum Sauk Pumped-Storage Hydroelectric Project (FERC Project No. 2277), operated by AmerenUE (licensee). At approximately 5:20 a.m. on December 14, 2005, the northwest corner of the upper reservoir failed, releasing approximately 4,300 acre-feet of water in approximately one half hour. The water flowed down Proffit Mountain into the East Fork Black River, through a State Park and campground and into the lower reservoir. The flows overtopped the project's lower reservoir dam and traveled downstream in the Black River through the town of Lesterville, Missouri located approximately six miles downstream. The incremental rise in the river level at Lesterville was estimated at two feet which remained within the banks of the river.

The following assessment is general in nature and the result of site visits, field interviews, public data filed with the Commission, internet available information and published accounts of the events. When available, quantifiable data of the impacts associated with the breach are presented, otherwise, a qualitative analysis is provided to describe the effects of the event. It is recognized that the environmental impacts of flooding are varied and wide ranging. This report outlines the major environmental and socio-economic effects of the flooding immediately following the event. The breach of the upper reservoir dike is described in detail in the preceding sections of this report.

11.1 General Description of the Hydro Project and Project Area

The Taum Sauk Project is located in Reynolds County, Missouri approximately 100 miles south of St. Louis and six miles north of Lesterville, MO. It is a pumped storage facility with a 55-acre upper reservoir on Proffit Mountain and a 370-acre lower reservoir located on the East Fork Black River at its confluence with Taum Sauk Creek. The lower reservoir is operated as a run-of-river reservoir and provides storage for water to be pumped to the upper reservoir at night or during periods of low power demand. During the day, or periods of high energy demand, the two reversible pump/generators are used to generate electricity.

The project is located in the heavily forested St. François Mountains with two large portions of the Mark Twain National Forest lying to the east and west of the project area. The project is near Taum Sauk Mountain Tower and Trail, Bell Mountain Wilderness and Elephant Rocks State Park and abuts the Johnson Shut-

Ins State Park. Some outstanding natural features of these mountains include igneous rock glaciers, igneous glades, extensive gravel washes, fens, and forests of oak, hickory and pine.

The Taum Sauk Project is near the upper end of the Black River drainage basin with approximately 88 square miles of drainage upstream from the lower reservoir. The project is located on the East Fork Black River which originates in the Mark Twain National Forest near Graniteville, MO. The East Fork Black River generally flows south through Johnson Shut-Ins State Park and then into the project's lower reservoir. The three mile stretch of the East Fork Black River that flows through the State Park is on Missouri's Clean Water Commission list of Outstanding State Resource Waters.

Below the project's lower reservoir, the river continues to flow south for approximately six miles to the town of Lesterville, MO where it joins the West Fork Black River to form the Black River. The Black River continues to flow south through Clearwater Lake before leaving the state in a southwest direction. There it flows into the White River in northeast Arkansas.

11.2 Environmental Effects Resulting from the Dam Breach

The breach of the upper reservoir rim dike resulted in the release of approximately 4,300 acre-feet of water. The torrent water flowed in a northwest direction down Proffit Mountain to the valley floor where it met the East Fork Black River and began flowing south in the East Fork Black River. Because of the path the water followed, the most extensive damage was outside the project boundaries. In addition to the human impacts, the dam breach affected various land and water resources which are discussed in more detail below.

11.2.1 Immediate Health and Human Impacts

The upper reservoir, atop Proffit Mountain, breached at approximately at 5:15 a.m., releasing a wall of water that rushed down the mountain to the valley floor. There it crashed into the state park superintendent's home shattering it from its foundation while the superintendent and his family were still inside (Figure 11.1). Reports of the event indicate that first responders quickly found the superintendent clinging to a tree; however, it took another hour and half to locate his wife and three small children (ages 5, 3 and 7 months) who were swept up to quarter mile for their home. The family members suffered various contusions and abrasions and were covered in mud. The children were hospitalized in St. Louis, MO and listed in critical condition with hypothermia and breathing problems

(Compiled from news sources, Dec. 14 2005). Eventually, after varying weeks of hospitalization for the children, they were all released from the hospital in good health.



Figure 11.1 - State park superintendent's former home. (Source: Staff)

Search and rescue teams were dispatched within the State Park and vicinity. No other casualties were reported owing in large part to the time of year and time of day when attendance at the park is/was minimal. However, it was reported by the Associated Press that the flood waters slammed into a truck hauling a load of zinc on Route N near the reservoir. The driver climbed onto the roof of the truck and saw that another truck and a car were also submerged, with the drivers also on the roofs of their cars. It was also reported that a mobile home, several cars and a tractor-trailer were washed away.

Early during the event, not knowing whether the lower dam would be able to sustain the sudden impact of flood waters, emergency personnel called for a voluntary evacuation of parts of Lesterville. However, the lower reservoir was nearly empty as a result of previously pumping water to the upper reservoir and

was therefore able to absorb the flood flows. River levels in Lesterville rose to an estimated level of 2 feet above the normal river level but still within its banks.

One home approximately 200 hundred yards from the Superintendent's residence (located off Route N) was surrounded by flood waters but, because it is located on a small hill, the flood waters encircled the residence but did not flood it. The surrounding farmland however, was flooded and debris and sediment was deposited in the fields. Additionally, some of the farmland fencing was destroyed (Figure 11.2).



Figure 11.2 - Farmland with debris on north side of Route N. Note home on small hill. (Source: U.S. Geological Survey)

11.3 Geology and Soils

As discussed in more detail in Section 2.2, Proffit Mountain was created 1.4 billion years ago from volcanic ash and lava and when cooled formed hard rhyolite porphyry. Later, seas extending up from the Gulf of Mexico covered the area and deposited sedimentary rock. As the land rose, the sea retreated exposing the area to weathering conditions. Soil in the project area is shallow and generally consists of stone and gravel. In the valleys and floodplains of the area, soils are alluvial in nature.

To keep river-borne sediment from reducing the Lower Reservoir storage capacity or blocking the canal between the power plant and the lake, a bin wall dam was constructed to trap gravel in the East Fork of the Black River just upstream of the reservoir. In the past 30 years, this gravel trap has been cleaned out five times. Each time approximately 30,000 cubic yards of material were removed (MDOC, 2005a).

11.3.1 Environmental Impacts to Geology and Soils

Approximately 317 acres, between the upper and lower reservoir, were directly impacted by the release of water immediately following the dam breach. A map and description of the land uses and soils of this impacted area can be found in Appendix E in the back of this report. The erosive force of the water from the breach removed all topsoil to bedrock in an approximate 200-yard swath, down the face of the Proffit Mountain (Figure 11.3) along the course of an intermittent unnamed tributary. Also, seen in Figure 11.3 is the shallowness of the topsoil along the tree line.



Figure 11.3– Downstream view from breach (Source: Staff, 12/22/05)

A break in the slope of the terrain is located where the unnamed tributary joins the East Fork Black River at the lower portion of the mountain. Most of the deposition of eroded sediments and rock fill from the dam embankment occurred at this point, forming a debris dam (Figure 11.4) and pond at the approximate location of U.S. Geological Survey gage station (No. 070661270) which was severely damaged during the event. The material deposited at this point ranged from boulders several feet in diameter to sand and fine silts. Concrete, rebar, and

sections of the geomembrane lining from the Upper reservoir were also present in the debris field.



Figure 11.4 – Looking upstream from debris dam (Source: Staff, 12/22/05)

It is expected that there will be continued soil erosion and transport of material of varying sizes from the slope of Proffit Mountain and the associated debris field. The licensee has proposed a series of temporary sediment retention structures along the affected area to prevent further transport of the sediments, until they can be stabilized.

A large amount of sediment was also captured by the existing bin wall dam, upstream of the lower reservoir. The bin wall is approximately 400 feet long and constructed of two rows of sheet piles driven into the river bed with rock fill between the sheet piles. It serves as a trap for gravel in the stream and is located just upstream of the pump/ generating plant. The licensee maintains a dredging permit with the Army Corps of Engineers. Additional land has been acquired on the west side of the East Fork Black River to dispose of dredge spoils.

11.4 Water Quality

The East Fork Black River is located in the Upper Saint Francis watershed, and is not listed on the Missouri or U.S. EPA list of impaired streams. An impaired stream is a stream that has had a Total Maximum Daily Load study completed and is believed to be affected by point-source or non-point source pollution. The basin has some of the lowest erosion potential in the state of Missouri, which results in particularly low sediment yields, bed loads, and turbidities. The annual erosion rate for all land types in the upper basin totals only 2.9 tons/acre. Sheet erosion on tilled land is the most serious threat in the area at 13-18 tons/acre, which is considered moderate. Gully erosion and sheet erosion on permanent pasture and non-grazed forest is considered slight. Sediment yield to streams, typically low in the Ozark region, is extremely low at only 0.6 tons/acre/year (MDOC, 2005a).

Municipal waste discharges throughout the sparsely populated East Fork Black River subbasin, are mostly small, adequately designed, and pose few serious threats to the water quality of receiving streams. Eight National Pollution Discharge Elimination System permitted wastewater discharges are located in the upper subbasin. Upgraded facilities and improved operation and maintenance of the municipal sewage systems have reduced the frequency of untreated effluent releases, which most often resulted in only minor aesthetic impacts on six miles of permanent streams (MDNR, 2005a). Filamentous algal blooms often occur during the summer in the main stem below Farmington, MO, which indicates nutrient enrichment and the potential for periods of low dissolved oxygen. The planned upgrade in the Farmington Treatment Plant should alleviate this problem. (MDOC, 2005a)

11.4.1 Environmental Impacts to Water Quality

Data collected to date suggest that the impact to water quality is a large increase in turbidity. The initial breach removed all of the overburden on the slope of Proffit Mountain. The larger sediments, and the material from the embankment, were mostly deposited upstream of the “shut-ins” area in the state park. Smaller clay particles suspended during the event stayed in suspension, and did not show any signs of settling two weeks after the event. Small particles, such as clays, can have an electrostatic charge that repels other particles and allows clay to stay in suspension in the water column indefinitely.

In order to reduce turbidity in the lower reservoir, AmerenUE, with the approval of the Missouri DNR and Commission, used common alum based flocculants (used primarily for drinking water treatment) to remove the charge on

the particles and allow them to settle. Flocculation is a process by which the electrostatic charge of suspended particles is neutralized by a flocculent, allowing the particles to stick to one another and form flocs. Once the flocs are large enough they fall from suspension. After receiving state approval of the plan on January 20, 2006, and Commission approval on January 25, 2006, the licensee applied the flocculent to the lower reservoir on January 25-27, 2006. Without use of a flocculent the particles would have stayed in suspension, and the water in the lower reservoir would have cleared much more slowly. In addition, turbidity caused by suspended clay particles would have remained in the river downstream over a longer period and likely extended further downstream.



Figure 11.5 – Turbidity at Johnson’s Shut-ins (Source: Staff, 12/22/05)

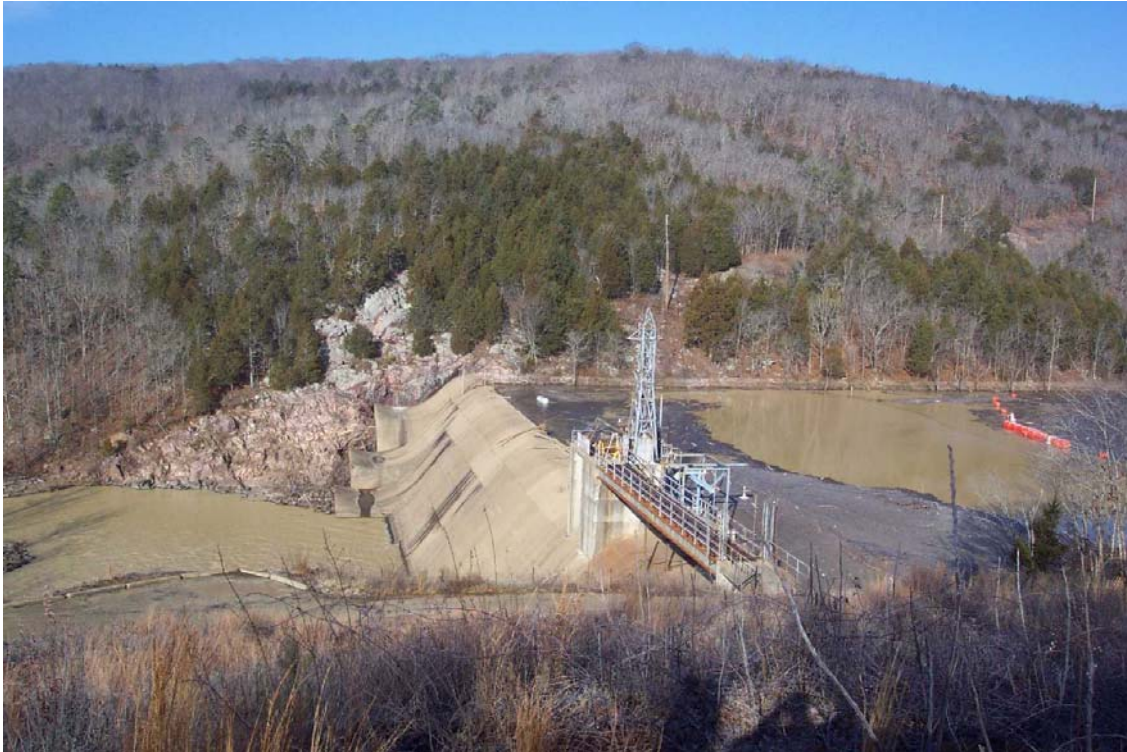


Figure 11.6 – Turbidity at Lower Dam (Source: Staff, 12/22/05)

11.5 Biological Resources

11.5.1 Aquatic Resources

11.5.1.1 Fisheries Resources

The state classifies the fishery of the East Fork Black River as a warm water fishery. AmerenUE, in its initial consultation document for relicensing the Taum Sauk Project, indicated that from the Missouri Department of Natural Resources (DNR) literature, 42 fish species occur in the East Fork Black River (in Johnson’s Shut-Ins State Park and below the lower project reservoir) (Table 1).

Table 11-1 - Fish species in the East Fork Black River. Those listed below the lower dam identified from one sample collection. (Source: Cieslewicz 2004 cited in Initial Consultation Document, AmerenUE, 2004)

Common Name	Species	Present Down-stream of Project	Present Upstream of Lower Dam
Longear sunfish	<i>Lepomis megalotis</i>	X	X
Bluegill	<i>L. macrochirus</i>	X	X

Redear sunfish	<i>L. microlophus</i>	X	
Green sunfish	<i>L. cyanellus</i>	X	X
Redspotted sunfish	<i>L. miniatus</i>	X	
Shadow bass	<i>Ambloplites ariommus</i>	X	
Rock bass	<i>A. rupestris</i>		X
Largemouth bass	<i>Micropterus salmoides</i>	X	X
Smallmouth bass	<i>M. dolomieu</i>	X	X
Spotted bass	<i>M. punctulatus</i>		X
Grass pickerel	<i>Esox americanus</i>		X
Greenside darter	<i>Etheostoma blennioides</i>		X
Rainbow darter	<i>E. caeruleum</i>		X
Fantail darter	<i>E. flabellare</i>		X
Orangethroat darter	<i>E. spectabile</i>		X
Banded darter	<i>E. zonale</i>		X
Logperch	<i>Percina caprodes</i>		X
Channel catfish	<i>Ictalurus punctatus</i>	X	
Yellow bullhead	<i>Ameiurus natalis</i>	X	X
Ozark madtom	<i>Noturus albater</i>		X
Northern hogsucker	<i>Hypentelium nigricans</i>	X	X
Creek chubsucker	<i>Erimyzon oblongus</i>		X
Golden redhorse	<i>Moxostoma erythrurum</i>	X	
Black redhorse	<i>M. duquesnei</i>	X	
Central stoneroller	<i>Campostoma anomalum</i>		X
Largescale stoneroller	<i>C. oligolepis</i>		X
Whitetail shiner	<i>Cyprinella galacturus</i>		X
Hornyhead chub	<i>Nocomis biguttatus</i>		X
Bigeye shiner	<i>Notropis amblops</i>		X
Wedgespot shiner	<i>N. greenei</i>		X
Rosyface shiner	<i>N. rubellus</i>		X
Telescope shiner	<i>N. telescopus</i>		X
Ozark minnow	<i>N. nubilus</i>		X
Bleeding shiner	<i>Luxilus zonatus</i>		X
Southern redbelly dace	<i>Phoxinus erythrogaster</i>		X
Bluntnose minnow	<i>Pimephales notatus</i>		X
Creek chub	<i>Semotilus atromaculatus</i>		X
Common carp	<i>Cyprinus carpio</i>	X	
Gizzard shad	<i>Dorosoma cepedianum</i>	X	
Blackspotted topminnow	<i>Fundulus olivaceus</i>		X
Northern studfish	<i>F. catenatus</i>		X
Mottled sculpin	<i>Cottus bairdi</i>		X

The East Fork Black River exhibits good aquatic biodiversity. The majority of the fish species above occur in rivers and streams where the preferred habitat is clear moving water with gravel-cobble-boulder bottoms (Pflieger, 1991). The East Fork Black River substrates are typically diverse and stable, and bank erosion is generally not a problem in this area since the riparian corridors are mostly forested.

Many of the game fish species in the list above inhabit lakes, reservoirs, or pools in rivers. This type of habitat has little or no current, generally clear water, and continuous cover such as submerged timber or aquatic vegetation.

11.5.1.2 Environmental Impacts to Fisheries

From where the flood water initially entered the East Fork Black River (near the entrance to the state park) to the lower reservoir is approximately 3 miles. Water from the upper reservoir flooded the banks of the East Fork Black River between the entry point and the lower reservoir. Given the volume of the flood waters and the rock debris it carried, it is highly likely that many fish were killed and most of the remaining fish were washed downstream and into the flood plain. Following the event and reconnaissance of the area, neither the licensee nor resource agencies reported to the Commission any dead or stranded fish in pools. This seems to indicate that most fish in the reach were washed downstream into the lower reservoir which was at a low elevation after water was pumped to the upper reservoir. During the event, it is likely many surviving fishes were washed into areas for which they were not adapted and were subjected to additional environmental stressors. For example, the ability of riverine species to survive in a highly turbid lentic environment for an uncertain length of time is unknown. Some generalist species, which can naturally utilize a variety of habitats, may have survived while others did not due to poor water quality, lack of food sources, and cover. As water quality conditions improve in the river, fish will gradually recolonize the impacted reach of river provided suitable habitat and food sources are available. The species rich diversity of the Shut-Ins State Park will be slow to recover, possibly taking several years.

The high flows immediately following the rim dike breach, carried a tremendous amount of sediment and boulders into the river from the upper dam's embankment, in addition to the scour created down the side of the mountain. Vegetative debris and earthen sediment was deposited on the valley floor and in the East Fork Black River (Figure 11.7). The volume of the debris and sediment altered the configuration of the river from the point of entry to the Shut-Ins area of the park and destroyed riparian habitat (Figure 11.8). It also reduced aquatic habitat and adversely affected the river channel by creating pools, barrier dams and disjoining habitats.



Figure 11.7 - Modified channel of the East Fork Black River (Source: Staff)



Figure 11.8 - East Fork Black River within State Park. (Source: Missouri Department of Conservation)

The channel modification was most extensive upstream from the Shut-Ins at the entrance to the State Park. The natural boulder and bedrock area of the Shut-Ins helped prevent excessive scour and the reconfiguration of the channel in that area; however, below the Shut-Ins area and upstream of the lower reservoir, significant loss of riparian habitat, flooding, scour, and turbidity were sustained (Figure 11.9).

For natural fish reproduction in streams, the channel generally consists of a series of pools, chutes and riffles. Inspection of the stream channel within the state park to the Shut-Ins area indicated substantial alteration of the natural stream channel thereby creating the loss of habitat as well as food sources.



Figure 11.9 - Scour and loss of riparian habitat below the Shut-Ins. (Source: Missouri Department of Conservation)

At the time of staff's inspection on December 22, the river and reservoir were still extremely turbid from the event. The river upstream from the lower reservoir was showing signs of clearing as continuous clear water from the headwaters above where the event occurred continued to flow into the East Fork Black River at the state park. The reservoir, however, remained very turbid as a

result of the event. Further, discharge flows spilling from the lower reservoir were also turbid creating a muddy appearance in the Black River below the dam. Verbal accounts from the DNR indicated that the turbidity extended for over 20 miles to Clearwater Lake. Similarly, the turbidity in this stretch of the Black River would also adversely impact aquatic resources.

Excess turbidity reduces aquatic photosynthesis and oxygen levels in the water and can cause stress or death to fish as well as other organisms. Different species are more susceptible to turbid conditions. Prolonged exposure may adversely affect fishes' gills and respiration. Additionally, large quantities of suspended materials can kill or bury fish eggs; however, in a warm water fishery, little to no reproduction occurs in December. Nevertheless, excessive turbidity or prolonged turbidity may prevent fish from spawning later in the spring. Further, habitat degradation caused by sediment reduces or eliminates essential habitat. For instance, the hornyhead chub requires clear streams with clean gravel or rubble bottoms to construct its nest from stones (Pflieger, 1991). Many riverine species require sediment-free substrate for reproduction. In addition to the direct impact on reproductive life history, excessive turbidity also adversely impacts food sources such as macroinvertebrate populations which are discussed more below. Careful design will be required to mitigate terrestrial impacts and to restore essential fluvial geomorphic and aquatic habitats.

11.5.2 Aquatic Macroinvertebrate Resources

Aquatic macroinvertebrates are good overall indicators of stream quality because they are affected by water chemistry and the physical and biological conditions of a stream. They are also a critical part of the stream's food web; an adverse impact to smaller macroinvertebrates quickly affects the many species of fishes that feed upon them. Some macroinvertebrate species are intolerant of pollution and can not easily escape adverse conditions. Thus, when environmental changes occur, the species must endure the disturbance, adapt quickly, or die.

The MDC lists four mussel species and one clam species collected in the Black River water basin above Clearwater dam. They are the giant floater (*Anodonta grandis*), fatmucket (*Lampsilis siliquoidea*), northern broken-ray (*L. reeviana brittsi*), squawfoot (*Strophitus undulatus*), and the non-native invasive Asiatic clam (*Corbicula fluminea*) (MDC, 2002). Mussels are filter feeders. Good water quality and low siltation are general characteristics of suitable habitat for a diverse mussel community. Substrate characteristics such as gravel or sandy bottoms are also necessary for many mussel species. The licensee indicated in its relicensing document that only one species, broken-ray, was found below the

project's lower reservoir dam. The licensee added that the invasive Asiatic clam is found throughout the lower reservoir.

The MDC states that three crayfish species have been collected in the upper Black River basin. They are the woodland crayfish (*Orconectes hylas*), the spothanded crayfish (*O. punctimanus*), and the Hubbs crayfish (*Cambarus hubbsi*) (MDC, 2002). These crayfish species generally inhabit streams with low turbidity, free flowing water with gravel and large rubble substrates.

Concerning aquatic insects, the Missouri DNR has recently conducted surveys in Johnson Shut-Ins and Taum Sauk State Parks in 2004. The results of those surveys have not been published to date. However, given the good water quality of the East Fork Black River prior to the event, it is expected that a diverse and species-rich community of aquatic insects existed before the December 14 event.

11.5.2.1 Environmental Impacts to Macroinvertebrates

Given the massive amount of debris and sediment that entered the river, it is highly probable that the flooding event likely killed the vast majority of macroinvertebrate species in the State Park area by grinding or smothering. Some transport of invertebrates downstream also likely occurred. Further down the river, as the larger boulders and cobble settled out, the high flows flushed organisms downstream, and even further down river (in areas where fine sediment and turbidity remained) voluntary drift most likely occurred. Consequently, long reaches of the East Fork Black River below the impact site are likely to have been significantly depleted of macroinvertebrate populations.

The ecological relationship between macroinvertebrate populations and fish productivity is well known. Habitat reduction caused by the breach event decreased invertebrate populations and adversely impacted fish by reducing food availability. Natural recolonization of the affected areas will be a lengthy process dependent on clear water and the flushing of the sediments from the substrate.

11.5.3 *Land Resources*

11.5.3.1 Flora Resources

Proffit Mountain is a heavily forested area lying on the western edge of the Central hardwood Region (Figure 11.10). The MDC (2001) states that the forests of this region contain more than 70 deciduous tree species, several evergreens, and many shrubs and forest plants. Oak and hickory species make up the majority of trees

found in this area; however in the southern and southeastern Ozarks, shortleaf pine may comprise 25 to 50 percent of the stand. The MDC adds that the remaining trees in this upland area are dominated primarily by oaks such as white, black, scarlet, and northern red oak and the less common species include southern red, chinkapin, burr, and pin oak. Hickory makes up a small percentage, but is a consistent part of the forest. Other important large tree species include blackgum, red and sugar maple, ash, elm, black walnut, and red cedar. Also, there are many small tree species associated with oak-hickory forests. These include dogwood, sassafras, redbud, serviceberry, eastern hop hornbeam, and American hornbeam (MDC, 2001).



Figure 11.10 - Forested area surrounding Proffit Mountain (opposite side of breach) with upper reservoir in the background. December 2005. (Source: Missouri Department of Conservation)

The forest resources continue to the valley floor and along the reaches of the East Fork Black River and through Johnson's Shut-Ins State Park. In addition to the park's geologic and hydraulic formations that draw many visitors, Johnson's Shut-Ins State Park is also known for two fen areas. A "fen" is a wetland environment where soils are saturated from the upwelling of mineral-rich groundwater that can create a spring. A fen, or bog-like area, is usually hydraulically connected to a creek or stream. The fen areas at Johnson's Shut-Ins State Park occupy approximately 8 acres. (MDC, 1999).

The wetland areas at the state park consist of a seep forest and calcareous fen located within the floodplain of the East Fork Black River (MDC, 1999). According to the MDC, seep forests are rare in Missouri and are comprised of red maple, green ash, slippery elm and honey locust. Additionally, two rare plants are also found in the fens along with other notable wetland species including closed gentian, silky willow (Figure 11.11 and Figure 11.12) and an uncommon variety of southern blue flag (MDC, 1999).



Figure 11.11 - Silky Willow (*Salix sericea*) (Source: MDC, 1999)



Figure 11.12 - Closed Gentian (*Gentiana andrewsii*) (Source: MDC, 1999)

11.5.3.2 Flora Environmental Impacts

Prior to the December 14 event, Proffit Mountain was heavily forested as seen in the satellite photograph (Figure 11.13). From the base of the upper reservoir in the northwest corner, where the breach occurred, to the valley floor and state park, over 250 acres of forest vegetation was denuded. Compounding the problem of deforestation is the fact that all soil in a 200 yard swath down Proffit Mountain was removed down to bedrock. Therefore, the ability to reforest this area is highly

problematic. It is expected that due to the absence of topsoil, this area will remain deforested.



Figure 11.13 - Pre-event satellite photograph of the forested area surrounding Proffit Mountain. (Source: Google Earth, 2005)

In addition to the deforested mountain areas, the fen areas within the state park were submerged in layers of sediment. In some areas of the state park, several feet of sediment were observed. Cleanup and recovery of the fen area began in January 2006, however, the extent of the damage to the sensitive and rare plants in the fen areas will not be known until the spring and summer, after emergence. Since many of the plants within the fen areas are on the state's species of concern list, the loss of any listed plants would be highly significant.



Figure 11.14 - Deforested riparian vegetation below Shut-Ins area of state park. (Source: MDC)

The riparian vegetation along the East Fork Black River was another area that suffered substantial deforestation (Figures 11.1-11.5). The extent of the damage is severe and extends from the entrance to the state park through the Shut-Ins area and below the Shut-Ins area to the lower reservoir. In some areas over one hundred yards of riparian vegetation was washed out due to the breach. In other areas ground-covering riparian vegetation was buried in silt and sand limiting recruitment. Natural recovery of the riparian areas will be hampered by poor soil quality and lack of soil (bedrock exposure) due to the flood.

11.5.3.3 Wildlife Resources

The hardwood forest of Proffit Mountain provide habitat for a variety of wildlife species. The more common mammals found in the upland wood areas include: whitetail deer, coyote, bobcat, red and gray foxes, raccoons, mice, rabbits, skunks, and gray, flying and fox squirrels (MDC, 2005).

The MDC lists over 125 species of birds found in Reynolds County with approximately 29 species associated with upland habitat. The more common species include: the great-horned owl; wild turkey; Cooper's, red tailed and sharp-

shinned hawks; grouse; blackbird; crow; grackle; and song birds such as bunting, blue jay, cardinal, finch, mockingbird, robin, sparrow and warbler species.

In the forested bottomland areas and the riverine and reservoir areas of the project (Figure 11.15) there are a number of additional bird species that occur in these habitats. Common species include the wood duck, mallard, Canada goose, heron, flycatcher, pileated woodpecker, various warblers, gnatcatcher, wren, wood thrush and barred owl (MDC, 2005).

According to the MDC, there are approximately 15 amphibian species and 18 reptilian species in the forested and aquatic areas of the project. The species include: seven frog and one toad species; six salamander species and the red-river mudpuppy; 12 snake species such as the copperhead, black rat, eastern garter, kingsnake, and timber rattlesnake; four turtle species; and two skink species (MDC, 2005).



Figure 11.15 - East Fork Black River leading into Taum Sauk lower reservoir. December 2005. (Source: MDC)

11.5.3.4 Environmental Impacts to Wildlife

At the time of staff's environmental inspection following the event, the DNR indicated that one turtle was found dead as a result of the flood. No other report or

recovery of terrestrial animals was filed; however, any slow moving forest species unable to escape the flood waters were most likely swept away or killed by the torrent flows. A substantial amount of forested habitat (approximately 270 acres) has been lost to both terrestrial and avian species. In addition to the habitat loss, the forest provides a valuable food source for many species. The loss of the trees and undergrowth reduces food availability.

Further, the torrent flows created a vertical corridor down Proffit Mountain, up to 200 yards wide, extending from the valley floor to the base of the upper reservoir. The corridor prevents normal behavioral movement for many species located in the area. For instance, the movement of raccoons, squirrels or mice from one edge of the deforested area to the other edge (over the open bedrock area) exposes these small mammals to predation, therefore, the open bedrock area acts as a barrier to movement.

11.6 Threatened and Endangered Species

For plant and terrestrial animals potentially occurring in the project area, the U.S. Fish and Wildlife Service (FWS) lists two species as threatened or endangered: the gray bat (*Myotis grisescens*) as endangered and Mead's milkweed (*Asclepias meadii*) as threatened (FWS, 2002). Further, in a letter dated June 8, 2005, filed with the Commission regarding the licensee's initial consultation document, the FWS stated that in addition to the two species above, it believes that the bald eagle (*Haliaeetus leucocephalus*), Indiana bat (*Myotis sodalists*), and Hine's emerald dragonfly (*Somatochlora hineana*) could potentially occur within the project area.

For the various habitats in the project vicinity, the MDC lists 11 plant, seven bird, two amphibian, two insect, two mammal, and two fish species as species of concern (MDC, 2005). The state status of these species varies from widespread and apparently secure (but of long term concern), to critically imperiled.

11.6.1 Environmental Impacts to Threatened and Endangered Species

Gray bats require undisturbed caves as their preferred habitat and forage over streams, rivers and reservoirs. Although some caves do occur in Reynolds County, no caves are believed to exist in the project area or the area affected by the breach.

The MDC states that Mead's milkweed occurs primarily in western and southwestern portions of the state, but can also be found in scattered locations of southeastern and northern Missouri. The preferred habitat for Mead's milkweed is tall grass prairies and igneous glades. This species has not been identified to occur in the project area.

If bald eagles occur in the area, the loss of forested habitat reduces nesting opportunities for the species. Further, the reduction in riverine and reservoir fisheries could adversely impact an important food source of any bald eagles in the area.

In addition to the two listed federally threatened and endangered species, the state lists 26 species of concern for the project area. Within the forested area of Proffit Mountain, the black bear is state listed as rare. If black bears occur or migrate in the project area, the swath of deforestation down Proffit Mountain may have eliminated some feeding areas as well as disrupted corridors between feeding areas. Additionally, the exposed mountainside no longer provides protective cover for movement in that area.

Of the six state listed bird species, two have the preferred habitat of forested uplands. Cooper's hawk and the sharp-shinned hawk prefer dense shortleaf pine or oak-hickory stands for nesting habitat. The deforested area of Proffit Mountain reduced the available nesting habitat for these species if they occur in the area. Similarly, two amphibians, the wood frog and four-toed salamander, inhabit forested upland environs. Both occur in leaf litter in deciduous forests. The wood frog breeds in ephemeral pools and intermittent streams such as the one the flood waters followed down the side of Proffit Mountain. The deforested area of Proffit Mountain potentially reduced the available breeding habitat. Further, unlike the avian species, the slower moving amphibians in the pathway of the initial surge of water after the breach could have been killed, injured or swept away.

The remaining state listed species in Reynolds County are plants of which several species occur within Johnson's Shut-Ins State Park. Again, as mentioned in the Flora section, the extent of the destruction of these sensitive and rare plants will not be known until a survey is completed in the spring and summer.

11.7 Cultural Resources

It is generally known that prehistoric communities in this area resided near rivers and in lowland areas. Prehistoric and indigenous Indian tribes are known to have lived in the project area. Prior to the event, the licensee was planning to

conduct a comprehensive survey of historic, archaeological and cultural properties in the project area as a part of the relicensing process.

The impacts associated with the December 14 event may have exposed previously undiscovered remnant artifacts or washed artifacts downstream. The impact of the event as it relates to cultural resources on Proffit Mountain are not known, however, they will be more fully understood after completion of the licensee's cultural resource study that would occur in consultation with Indian tribes and the State Historical Preservation Office.

11.8 Recreational Resources

The Taum Sauk Project is rurally located and surrounded by three state parks: Johnson's Shut-Ins, Elephant Rocks and Taum Sauk Mountain. Each of these parks provide a variety of recreational opportunities such as camping, hiking and swimming at Johnson's Shut-Ins, hiking and viewing geologic wonders at Elephant Rocks, and hiking and wilderness exploration in the rugged and scenic Taum Sauk Mountain State Park.

Recreational opportunities within the project boundary include fishing in the lower reservoir, picnicking, camping, viewing the upper reservoir and visiting an interpretive center and museum. On March 27, 2003, the licensee filed, with the Commission, its Form 80 Recreational Report (FERC, 2003). The report indicated that for year 2002, the annual, daytime recreation days were approximately 30,000 and about 800 days of nighttime recreational use (utilizing the project's 25 campsites). The licensee stated that the primary activity at the project is fishing for warm water game fish in the lower reservoir; however, a large percentage of the recreational day users are visitors to the project's museum and visitor center which often include school children on field trips. Hunting is prohibited on project land as well as swimming and water skiing in the lower reservoir.

Approximately six miles downstream from the lower reservoir is the town of Lesterville, MO. There are several commercial outfitters in the area that attract considerable numbers of tourist. The outfitters provide float trips, kayaking, and canoeing on the Black River and camping facilities for both recreational vehicles (RV) and tents. Below the Taum Sauk Project's lower reservoir, the Black River flows from river mile 8.4, or the junction with the Middle Fork near Lesterville, to river mile 25.0 (Highway K Bridge), or the last take-out above Clearwater Lake at full reservoir. Clearwater Lake is a 1630 acre reservoir operated primarily for flood control by the U.S. Army Corps of Engineers.

11.8.1 Recreational Impacts

As a result of the December 14 event, and at the time of this report, Johnson's Shut-Ins State Park is closed until further notice. The park is one of the state's most popular state parks which draw nearly 250,000 visitors yearly (DNR, 2006). In addition to the reconfiguration of the river and sediment and debris deposited in it, the majority of the physical damage to the park was in the area adjacent to the East Fork of the Black River. Extensive damage was reported to the superintendent's residence, the campground, the fen areas (which are the park's signature natural feature), and to the park store and office which were flooded but, are still standing. The boardwalk to the shut-ins area was also slightly damaged.

Restoration of the park is currently underway. If the cleanup of the park cannot be completed by the beginning of the summer of 2006, recreational opportunities associated with the park will be adversely affected limiting (and perhaps eliminating) the public's use of the park for the summer.

Similarly, the licensee has indefinitely closed public access to the upper reservoir, the visitors' center and the museum while it continues restoration work at the project. The lower reservoir also remains closed while the licensee continues to monitor water quality and control sediments. During the winter months, fishing and camping usage is minimal, however, in late spring and summer, recreational angling and camping normally increases. If the lower reservoir remains closed at that time, recreation at the project will also be adversely affected.

Since the event, the Missouri DNR has been holding monthly meetings at the Lesterville High School to keep the public informed of cleanup and recovery activities at the Johnson's Shut-Ins State Park. At those meetings, it was reported that several of the recreational outfitters speculated that if the river remains turbid through the spring and early summer, their businesses (and recreational opportunities) would be adversely affected because fewer people would want to float a muddy river when the public is use to the Black River being a clear river.

On January 25, 2006, the licensee, in consultation with the state resource agencies, undertook measures, to use flocculates to restore water clarity to the reservoir and river. Reports indicate that there has been a noticeable improvement in water clarity in the lower reservoir and river below the dam following the treatment. It is expected that water quality and clarity would improve through the spring; therefore, the extent of any decrease in recreational river-based businesses can not be calculated at this time.

The impacts of the event with respect to the other nearby state parks should be negligible. None of those facilities were directly affected by the event.

11.9 Transportation

As the flood waters reached the bottom of the mountain and the East Fork Black River, flows carrying mud, rocks and many trees were deposited on Route N. The Missouri Department of Transportation (MoDOT) stated that maintenance crews were dispatched immediately to the scene and worked to clear the roadways of the debris. MoDOT bridge crews were also dispatched to monitor bridges in the effected area. No damage was reported in the MoDOT's December 14, 2005 press release (modot.mo.gov).

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