DRAFT SOUTHEAST MISSOURI OZARKS REGIONAL RESTORATION PLAN AND ENVIRONMENTAL ASSESSMENT

DRAFT APPENDICES

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Appendix A:
Decision Matrix For Scoring of Restoration Proposals

PROPOSAL TITLE:

ACCEPTABILITY CRITERIA: Projects Must Pass These Four Criteria for Further Consideration:		
Is compliant and consistent with federal and state laws, policies and regulations.	Yes or No	
Demonstrates technical feasibility.	Yes or No	
Addresses injured natural resources or services targeted for restoration within the Request for Proposal or Natural Resource Damage Assessment and Restoration (NRDAR) process.	Yes or No	
Project will not be used for response actions, and will not be used to reduce or eliminate NRDAR liability by a Potentially Responsible Party (PRP).	Yes or No	

PROJECT RANKING CRITERIA: Scored Criteria	**Scoring:**	**Points Assigned:**
1. <u>Location of project (20 points possible):</u>		
a) Project occurs in an identified priority geographic area. When applicable, score according to the tiered geographic priorities identified in the RFP. *0 = outside of the Southeast Missouri Ozarks, 5 = within the Tier 1 area nearest the injured resource, etc.*	(Score 0-5) x 3	
b) Project occurs within or adjacent to a park, national forest, natural area, or conservation area within the geographic area identified. *0 = project is not near a protected area, 5 = project is within or completely surrounded by a protected area.*	(Score 0-5)	
2. <u>Preferred resources and services, identified in the RFP (50 points possible):</u>		
a) Restores or replaces lost (or depressed) ecological services and/or resources. *0 = does not restore or replace lost ecological services, 5 = substantially restores and replaces lost ecological services for the injured natural resources.*	(Score 0-5) x 2	
b) Project fits within one or more of the restoration project categories identified as appropriate for restoring the injured resources. When appropriate, score according to the prioritization of projects identified in the RFP. *0 = outside of the restoration categories identified in the RFP, 5 = proposed restoration falls within the top priority restoration category.*	(Score 0-5)	

c) Benefits federal- and state-listed species, or Missouri Species of Concern. *0 = does not benefit any listed species, 5 = directly benefits listed species.*	(Score 0-5) x 2
d) Restores lost human uses (e.g., drinking water, recreational opportunities). *0 = does not restore or replace lost human uses, 5 = fully restores or replaces a lost human uses.*	(Score 0-5)
e) Restores or enhances native diversity and abundance. *0 = does not restore or enhance native species, 5 = increases both the abundance and diversity of native species.*	(Score 0-5) x 2
f) Creates greater connectivity between existing natural areas. *0 = project fails to connect protected natural areas, 5 = project connects two previously separate protected areas.*	(Score 0-5)
g) Ecosystem improvements are self-sustaining. *0 = ecosystem improvements are not self-sustaining, 5 = ecosystem improvements require no human inputs after implementation.*	(Score 0-5)

3. Scope of Benefits (20 points possible):	
a) Provides specific benefits or enhancements not provided by other restoration projects. *0 = project does not provide any unique benefits, 5 = provides benefits entirely unique to the project.*	(Score 0-5)
b) Complements planned response actions. Does not provide benefits already provided by response actions. *0 = does not complement response action, overlaps with clean-up actions, 5 = project complements but is not redundant to the response action.*	(Score 0-5)
c) Provides the greatest scope of benefits to the largest area or natural resource population. *0 = benefits accrue only to a small, localized area, 5 = benefits a large geographical area or population.*	(Score 0-5) x 2
4. Time required for restoration (5 points possible):	
a) Time required to return resources to baseline condition is minimized. Proposal identifies expected timeline to return to baseline. *0 = no timeline is indicated and project may take a long time to return resources to baseline condition, 5 = a timeline is included and baseline conditions will be achieved in the short term.*	(Score 0-5)
5. Adverse environmental effects from actions (5 points possible):	
a) Minimal adverse impact to natural resources will occur from the proposed actions over the long term. *0 = the project results in lasting adverse environmental effects, 5 = project results in no adverse environmental effects.*	(Score 0-5)
6. Cost-effectiveness (20 points possible):	
a) Utilizes cost-effective means. *0 = project uses inflated or overly expensive means, 5 = project creatively and efficiently maximizes the use of restoration funds.*	(Score 0-5)
b) Additional funds (matching or scaled) are provided by proposal source (submitter) or to be pooled with other funding sources.	(Score 0-5) x 2

0 = no additional matching funds or in kind services are provided, 5 = more than half of project funds are provided or matched by sources other than Trustees' restoration funds.	
c) Project involves partnerships between multiple entities *0 = no additional partnerships are identified in the project proposal, 5 = proposal submitted by multiple cooperating entities.*	(Score 0-5)
7. Evaluation component (15 points possible):	
a) Project includes a monitoring component. *0 = no monitoring component, 5 = includes a detailed, funded plan for monitoring restoration success*	(Score 0-5)
b) Project identifies performance measures for successful restoration. *0 =performance measures for success are not included, 5 = workable and applicable performance criteria are directly specified in the proposal.*	(Score 0-5)
c) If goals of restoration are not being achieved, the project identifies the "next steps" to achieve restoration. *0 = proposal fails to identify any contingency steps or plans, 5 = detailed contingencies are provided for a variety of scenarios.*	(Score 0-5)
8. Technical Feasibility (5 points possible):	
a) Uses methods that are known to be technically practicable or has research to support the feasibility of the project. *0= completely novel technology, 5= internationally, peer-reviewed, and recognized methods*	(Score 0-5)

140 Possible **Total=** 0

Appendix B—Evaluation and Selection Process for Compensatory Restoration Projects

Southeast Missouri Ozarks Regional Restoration Plan

1. There are two ways that a compensatory restoration project can be proposed:

    a. The Trustee Council will publish a notice of a Request for Proposal (RFP) in local newspapers and the Trustee Council websites with at least sixty (60) days for the proposal application process. The Trustee Council will hold at least one public meeting to discuss the particular RFP.

    b. An agency member of the Trustee Council will submit to the Trustee Council a restoration proposal based on the goals of the Southeast Missouri Ozarks Regional Restoration Plan within the same period.

2. Following the proposal submission deadline, the Trustee Council representatives will convene to review the project proposals. The Trustee Council representatives will identify projects that do not meet the acceptability criteria (See Appendix A. *Decision Matrix*) and inform the submitter. At the same time, the Trustee Council representatives will conduct a joint review of the Decision Matrix criteria, to identify any potential common concerns with the projects that meet the acceptability criteria. The Trustees reserve the right to reject proposals even if they meet the acceptability criteria.

3. The representatives for each Trustee Council agency will then separately evaluate and score the project proposals using the Decision Matrix ranking criteria, consulting internal and external experts relevant to the proposals.

4. The Trustee Council representatives will reconvene to discuss their Decision Matrix criteria evaluation of the projects. The objective of this discussion is to prioritize and reach consensus on the scoring of the submitted projects based on the Decision Matrix. In the case of disagreement among the Trustee Council for a particular Decision Matrix criterion, a mean score will be generated from the individual scores generated by each Trustee.

5. The projects will be ranked by the consensus-based Decision Matrix scores and the Trustee Council representatives will adopt a resolution recommending the highest-ranked project proposals to the federal and state Trustees for funding. The number of projects recommended will be dependent upon the funds available and on the requested funds of the priority projects.

6. In the event that the Trustee Council representatives are in disagreement over the recommendation of potential restoration projects, the matter shall be elevated to the state and federal Trustees pursuant to the Memorandum of Understanding between the Missouri Department of Natural Resources, the United States Department of Agriculture, and the United States Department of the Interior.

7. Once the state and federal Trustees reach unanimous approval of the projects to be funded, the Trustee Council representatives will notify all submitters of the decision of the Trustee Council, and will identify next steps to the submitters of funded project proposals.

Appendix C—List of Other Relevant Statutes, Regulations, or Guidance

Southeast Missouri Ozarks Regional Restoration Plan

Note: This list is not exhaustive.

The Trustees have or will comply with all applicable laws, Executive Orders, policies, and regulations for each restoration project relating to

- *Clean Water Act of 1972, as amended***.** The Clean Water Act (CWA) is the first federal statute to comprehensively authorize recovery of Natural Resource Damages (NRD). The CWA imposes strict liability on owner/operators for oil spills. The CWA mandates that any NRD recoveries are used to restore, replace or acquire the equivalent of the injured natural resources.

- *Endangered Species Act of 1973, as amended.* The Endangered Species Act (ESA) requires federal agencies to determine whether their actions may adversely affect any federally listed or proposed threatened or endangered species. If so, formal consultation pursuant to Section 7 of the ESA is initiated. As part of the public review and comment process, a copy of the draft SEMORRP is provided to the FWS' Ecological Services Field Office in Columbia, Missouri to begin the consultation process.

- *Migratory Bird Treaty Act of 1918, as amended.* The Trustees will make every effort to insure that migratory bird species are protected and their habitats enhanced, as appropriate, as a result of restoration activities selected under this plan.

- *National Environmental Policy Act of 1969*. The National Environmental Policy Act (NEPA) requires federal agencies to consider the environmental effects of proposed federal agency actions. While the SEMORRP includes an Environmental Assessment for restoration planning, the federal Trustees may be required to conduct additional NEPA analysis for subsequent restoration planning and implementation that falls under the SEMORRP.

- *National Historic Preservation Act of 1966, as amended.* The FWS will provide the State of Missouri Historic Preservation Officer with the draft SEMORRP as part of the public review and comment process, requesting their input to ensure project compliance with Section 106 of the National Historic Preservation Act.

- *National Wildlife Refuge (NWR) System Administration Act of 1966, as amended.* The Pilot Knob National Wildlife Refuge is located in the SEMO. The project alternatives in this SEMORRP will not have any significant adverse effects on the

refuge. Projects proposed under the SEMORRP could positively contribute to the management of Pilot Knob NWR.

- *Executive Order 11990, Protection of Wetlands.* Implementation of any project alternative in this SEMORRP is not anticipated to have or cause any significant adverse effects on wetlands.

- *Executive Order 11988, Floodplain Management***,** directs all federal agencies to take action to avoid, to the extent possible, the long- and short-term impacts associated with the occupancy and modification of floodplains. The project alternatives in this SEMORRP will not have any significant adverse effects associated with modification and occupancy of floodplains.

- *Executive Order 12962, Aquatic Systems and Recreational Fisheries.* Executive Order 12962 directs federal agencies to add additional public access to fisheries nationwide by conserving, restoring, and enhancing aquatic systems. Implementation of some project alternatives in this SEMORRP may cause short-term adverse effects to aquatic systems but will be designed to minimize these effects and to maximize long-term benefits to aquatic systems.

- *Executive Order 13112, Invasive Species.* Implementation of any alternative in this SEMORRP will use existing integrated pest management strategies to prevent the introduction of invasive species, such as noxious weeds, and will not authorize or carry out actions that are likely to cause the introduction or spread of invasive species.

- *Executive Order 13186, Protection of Migratory Birds.* Implementation of any alternative in this SEMORRP is not anticipated to cause measurable negative effects on migratory bird populations.

- *Department of the Interior Departmental Manual, Parts 517 and 609, Pesticides and Weed Control.*
  Consistent with DOI policy, implementation of any alternative in this SEMORRP will use integrated pest management strategies. Pesticides will be used only after a full consideration of alternatives, and if used, the least hazardous material that will meet restoration objectives will be chosen.

- *DOI Departmental Manual Part 602: Land Acquisition, Exchange and Disposal.*
  Consistent with DOI policy, any selected alternative that involves land acquisition will comply with appropriate pre-acquisition standards, particularly American Society for Testing and Materials (ASTM) Standards on Environmental Site Assessments for Commercial Real Estate in effect at the time. Pre-acquisition assessments will be done by qualified individual(s) and will be done within 12

months of the date of acquisition. Any required approvals will be obtained, and acquisition conditions set out in Part 602 will be met.

- *341 FW 3. Pre-Acquisition Environmental Site Assessments.* All conditions set forth in FW3, including environmental site assessment requirements, including pre- and post-acquisition requirements, Level I, II, or III assessment, assessment standards and conditions, retention of records, and time limits will be met.

APPENDIX D--Detailed Explanation of Potentially Affected Resources in the Southeast Missouri Ozarks

Southeast Missouri Ozarks Regional Restoration Plan

For purposes of the Southeast Missouri Ozarks Regional Restoration Plan (SEMORRP), the Southeast Missouri Ozarks (SEMO) is defined by the following seven watersheds: the Big River, the Black River, the Bourbeuse River, the Current River (includes the Jacks Fork River), the Eleven Point River, the Meramec River, and the upper portion of the St. Francis River (Figure 1). Each watershed will have a Physical Resources section that will describe the topography, bedrock, soil, surface water, and ground water that can be associated with that watershed. Biological resources for the entire SEMO region are listed in the second portion of this appendix.

Differences in landform, lithology, soils, and vegetation produce a grouping of sixteen ecological subsections collectively known as the Ozarks as defined by Nigh and Schroeder's 2002 Atlas of Missouri Ecoregions. Seven of these 16 ecological subsections are identified in the SEMO border and will be briefly described in their respective watersheds (Figure 2). The following ecological subsections are located in the SEMO: Central Plateau (CP), Meramec River Hills (MRH), St. Francois Knobs and Basins (SKB), Current River Hills (CRH), Black River Ozark Border (BRO), and Inner Ozark Border (IOB).

Big River Watershed

The Big River Watershed is composed of the following three Missouri ecological subsections: Meramec River Hills (MRH), St. Francois Knobs and Basins (SKB), and Inner Ozark Border (IOB) (Nigh and Schroeder, 2002). Almost half of the Big River Watershed is composed of the MRH. The SKB is located in the upper watershed with a small portion of IOB defining all the northeast boundary of the Big River Watershed.

Physical Resources

Topography

Land elevations throughout the Big River Watershed range from 435 feet above mean sea level (msl) at the mouth of the Big River to 1,740 feet above msl in the headwaters at Buford Mountain (MDC, 1997). Almost half of the Big River Watershed is found to be located within the MRH subsection which consists of hilly to rugged lands with steep slopes and narrow valley bottoms. Local karst, losing streams, and large springs are characteristic (Nigh and Schroeder, 2002). The MRH lies within the Ozark uplift, an asymmetrical dome-shaped landform lying in southern Missouri and portions of Arkansas, Kansas, and Oklahoma. Strata dip gently northwestward and relief throughout this area is moderately high 200-350 feet or more (Nigh and Schroeder, 2002).

The SKB subsection is prevalent throughout the southeast section of the Big River Watershed and is distinctive for the presence of bedrock of Precambrian age and bedrock of Cambrian age

that fills in spaces among and around the Precambrian areas (Nigh and Schroeder, 2002). The subsection has three different topographic features: the igneous knobs and hills, the smooth floored basins and valleys on dolomites and sandstones, and the dolomite, sandstone, and cherty hills (Nigh and Schroeder, 2002). The southeastern portion of the watershed drains the northern edge of the unaltered rugged, igneous peaks of the St. Francois Mountains (MDC, 1997). Since these formations are highly-resistant to erosion, streams tend to be high gradient and form very narrow river valleys through thin residuum (MDC, 1997). Relief is generally high with local elevation changes of 300 – 1,000 feet (Nigh and Schroeder, 2002). Pre-settlement vegetation was a mixture of forest, open woodlands, glades, and small prairies in the basins (Nigh and Schroeder, 2002). Exceptionally large areas of igneous glade and woodland complexes remain, pastures and grazed woodlands occupy the basins, and lead mining has scarified the land (Nigh and Schroeder, 2002).

Bedrock

The Big River Watershed contains diverse representation of various geologic formations ranging in age from Mississippian to Precambrian which includes the Cambrian age cherty dolomites and sandstones, Ordovician cherty dolomites and the Precambrian igneous rock. The dolomites are soluble and create impressive local karst, including some very large springs, extensive caverns and numerous dry valleys (Nigh and Schroeder, 2002). The dolomites and sandstones have eroded away from the hills and are found mainly in the basins (Nigh and Schroeder, 2002). A majority of these watershed streams flow through the Salem Plateau, a dissected plateau of sedimentary rock topped by a thin layer of glacial loess (MDC, 1997). This plateau commonly forms rolling to narrowly-cut river valleys. As the Big River flows northward, it cuts through progressively younger limestone and dolomite (MDC, 1997). Sandstone is common in Jefferson County and shale becomes prominent in the lower basin (MDC, 1997).

According to the Missouri Department of Natural Resources (MDNR), substantial deposits of lead, zinc, copper, magnesium, and barite have attracted mining operations to Jefferson, St. Francois, and Washington Counties beginning over 200 years ago (as cited in MDC, 1997). Historic iron and lead surface mining disturbed numerous scattered tracts of land and caused the denudation of thousands of acres of timber for fuel for smelting (Nigh and Schroeder, 2002). Subterranean iron and lead mining continues and causes environmental concern (Nigh and Schroeder, 2002).

Soil

Soil type and quantity varies among the three subsections within the Big River Watershed. The MRH soils are closely related to bedrock lithology and landscape position, while the SKB soils in igneous bedrock areas are moderately deep and the diverse IOB soils vary with parent material and landscape position (Nigh and Schroeder, 2002).

USDA lists the primary soil series in the upper Watershed which include: Crider, Fourche, and Hildebrecht on ridge tops; Gasconade, Goss, and Irondale on slopes; and Haymond and Midco in the bottoms (as cited by MDC, 1997). Soils on ridge tops and slopes are highly erodible, while

upland soils are moderately shallow and consist of a combination of loess and residuum derived from in-place weathering of dolomite (MDC, 1997).

The lower elevations of these soils tend to be clayey with high chert content, thin, droughty, infertile, and stony, and are best suited for grasslands and forest according to USDA (as cited by MDC, 1997). In the river bottoms, very fertile silt-loam, developed from alluvium, has been deposited over cherty gravel and is suitable for row crops, bottomland forest, and pasture (MDC, 1997). These basins have very deep, reddish, silty clay loam subsoils, such as the Crider, Fourche, and Courtois series (Nigh and Schroeder, 2002).

MRH soils formed in the Roubidoux Formation are low in soluble bases such as calcium and magnesium, and include the Viburnum and Tonti series (Nigh and Schroeder, 2002). Backslope soils include the very deep Coulstone and moderately deep Bender series, both of which are very cherty (Nigh and Schroeder, 2002). Soils formed in the Gasconade and Eminence-Potosi Formations are higher in soluble bases and include the Rueter and Hildebrecht soils (Nigh and Schroeder, 2002). Throughout the MRH, backslope soils can be very deep and cherty, while the basins have deep, reddish, silty clay loam subsoils (Nigh and Schroeder, 2002).

Within the igneous bedrock areas of the SKB, soils are moderately deep and acidic (Nigh and Schroeder, 2002). Knobtop soils are on the summits, with very cobbly Irondale soils on the shoulders, and the loamy, boulder Syenite soils on the backslopes (Nigh and Schroeder, 2002).

Surface Water

The Big River Watershed encompasses 955 square miles and can be found in the following counties: Franklin, Jefferson, Washington, Saint Francois, Sainte Genevieve, and Iron. Main sub-basins throughout the watershed range from 26 to 189 square miles, with the largest being Mineral Fork. Big River becomes a sixth order stream at the confluence of Cedar Creek at river mile (RM) 118 in Washington County. According to Funk, there are 129 miles of permanent streams and 220 miles of intermittent streams in the basin (as cited by MDC, 1997).

Within the watershed, springs, some of them very large, are numerous and provide significant amounts of base flow to the streams. No natural lakes or ponds are present, except for sinkhole ponds, but numerous small lakes and ponds have been constructed for water supplies, stock watering, and to trap mining tailings (Nigh and Schroeder, 2002). Water quality is high, except where affected by lead mining or urbanization (Nigh and Schroeder, 2002).

Ground Water

The Big River Watershed lies within the Ozark Plateau's aquifer system, located throughout southern Missouri, southwestern Kansas, eastern Oklahoma and northwestern Arkansas. The Big River Watershed is comprised of two aquifers, the Ozark aquifer and the deeper St. Francois aquifer.

The aquifers are composed of limestones, dolomites, and sandstones, separated by a shale confining unit of minimal permeability (Miller and Appel, 1997). Recharge of aquifers occurs

primarily through precipitation at outcrop areas, but also minimally across the confining unit (comprised of minimally permeable shale and permeable limestone) (Miller and Appel, 1997). Water primarily passes through the aquifers via fractures and bedding planes, resulting in the dissolution of carbonate rocks, enlarged byways, and additional karstic features (Miller and Appel, 1997).Water discharges from the aquifers as base flow into streams or springs and seeps (Miller and Appel, 1997).

The Ozark aquifer is the primary water source for the Ozark Plateau Physiographic Province, the geographic area comprising most of southern Missouri, exclusive of the Missouri bootheel(Miller and Appel, 1997). It is the thickest aquifer within the Ozark Plateau aquifer system, averaging 1,000 feet in depth in south-central Missouri, and providing more than 1,000 gallons per minute (Miller and Appel, 1997). Water from this aquifer is considered "suitable for most uses" with dissolved-solid concentrations less than 1,000 milligrams per liter (except in the most westernmost parts of the aquifer) (Miller and Appel, 1997). Water from the Ozark aquifer is used for municipal, industrial, and domestic supplies (Miller and Appel, 1997).

The St. Francois aquifer subtends the Ozark aquifer and is 300-400 feet thick in south-central Missouri. Water is withdrawn from the aquifer principally in the St. Francois Mountains, where the aquifer crops out or is close to the surface (Miller and Appel, 1997). The aquifer is at the surface at that location due to uplift and subsequent erosion. Where water is withdrawn, it is considered "suitable for most uses" with dissolved-solid concentrations between 200 and 450 milligrams per liter (Miller and Appel 1997). Depending on location, yields of from 70 to more than 125 gallons per minute are possible from the St. Francois aquifer (MDNR, 2012a).

Black River Watershed

The boundary of the Southeast Missouri Ozarks Regional Restoration Plan restricts the Black River Watershed to the extent of the Ozark physiographic province, limiting coverage of this Watershed to the upper section. Due to the differences in topography, bedrock, soil, surface water, and groundwater, the Missouri portion of the Black River Watershed will be separated into two subbasins throughout this section: the upper subbasin is the area above Clearwater Dam and the lower subbasin is the area downstream of Clearwater Dam to approximately Poplar Bluff and the southeast Missouri lowlands.

The following four of Nigh & Schroeder's ecological subsections can be found throughout the Upper Black River Watershed: Current River Hills (CRH), Black River Ozark Border (BRO), and St. Francois Knobs and Basins (SKB). The CRH make up more than half of this Watershed and can be found predominantly along the western section and up to most of the northern border of the Watershed.
The SKB cross over into the Watershed in two small sections located at the Watershed's northeast border and a smaller section in the middle of the eastern border of the Watershed.

Physical Resources

Topography

The upper subbasin of the Black River Watershed in Missouri lies in the Ozark Plateau within two subdivisions, St. Francois Mountain and the Salem Plateau, according to MDNR (as cited in MDC, 2004). Land elevations in this upper subbasin range from 1,772 feet above msl at Taum Sauk Mountain, the highest point in Missouri, to 494 feet above msl at Clearwater Dam (MDC, 2004).

The overall topographic features vary greatly throughout both subbasins. Much of the upper subsection of the Watershed has topographic features the SKB and CRH subsection which include igneous knobs and hills, cherty hills, gently rolling hills giving way to steep slopes, narrow ridges, and narrow valley bottoms. The lower subbasin, consisting of the subsection can be made up of moderately dissected hills and local flatwoods, and the relief in this area is considerably lower than that found in the upper subbasin.

Upper subbasin pre-settlement vegetation was a mixture of forest, mostly forests of oak and shortleaf pine, open woodlands, glade, and small prairies. Pre-settlement vegetation for the lower subbasin consisted of oak and pine-oak woodland and forest, with post oak flatwoods on high, flat areas with the bottomland forests of scattered flatwoods, swamps, marshes, and sand prairies.

Bedrock

The eastern part of the upper subbasin of the Black River Watershed drains the St. Francois Mountains, which are formed on Precambrian igneous and Cambrian sedimentary rocks as reported by MDNR (as cited in MDC, 2004). Much of this Precambrian rock is weather-resistant rhyolite, and consequently, stream valleys are formed in the easily erodible Cambrian dolomite (MDC, 2004). The area contains mineral deposits of lead, iron, manganese, silver, and cobalt (Nigh and Schroeder, 2002). Deep subsurface lead mining occurs in the upper Black River basin and the potential for more lead mining is present (Nigh and Schroeder, 2002).

MDNR defines the western and northern part of the lower subbasin as lying in the Salem Plateau, which is formed on Cambrian and Ordovician carbonate rocks and topped by a thin layer of glacial loess (as cited by MDC, 2004).

Soil

Located in the upper subbasin of the Black River Watershed, in the Salem Plateau, Goss-Viburnum and Clarksville-Wilderness associations dominate in the uplands while Delassus-Syenite associations dominate in the river valleys (USDA as cited by MDC, 2004). Goss and Clarksville soils are found on the sides of ridges and are well drained and Viburnum and Wilderness soils are located on the ridge tops (MDC, 2004). While Wilderness soils are well drained, Viburnum soils are poorly drained. The Goss-Viburnum soils are suited for either pasture or trees, while the remaining soils are best suited for trees. Both the Delassus and Syenite

series are moderately well drained and best suited for northern red, white, and black oaks (MDC, 2004).

Throughout the upper subbasin, in the St. Francois Mountains, Irondale-Killarney-Knobtop associations dominate with Irondale and Killarney soils found on side slopes and Knobtop soils on ridge tops (USDA as cited by MDC, 2004). Due to the high potential for erosion, stony surfaces, and drought, all of these moderately well drained, highly erodible soils are unsuitable for row crops or pasture (MDC, 2004). The soil types in northern and western sides of the lower subbasin are Loring-Captina-Clarksville and Clarksville-Captina associations (USDA as cited in MDC, 2004).

Surface Water

The Black River Watershed drains a total area of 1,756 square miles in Missouri. The Black River originates in Iron and Reynolds Counties, Missouri and flows south through Reynolds, Wayne, and Butler Counties to the state line and then southwesterly in Arkansas to empty into the White River in Arkansas (MDC, 2004).

Two reservoirs exist in the watershed and both of these are located in the upper subbasin of the Black River. The Black River flows through Clearwater Reservoir in Wayne County and Lower Taum Sauk Lake is located on the East Fork of the Black River (MDC, 2004). These two reservoirs in the upper subbasin affect stream flows and fish movement and the flow in the lower Black River is primarily regulated by water released through Clearwater Dam (MDC, 2004). The watershed streams generally exhibit good water quality throughout the Ozark portion of both subbasins (MDC, 2004).

Springs are common within this watershed. Ponds have been constructed for stock watering and there are no flood control structures, except Clearwater Dam on the middle Black River basin (Nigh and Schroeder, 2002).

Ground Water

The Black River Watershed is comprised of two aquifers, the Ozark aquifer and the St. Francois aquifer. The Ozark aquifer is the major aquifer of the Watershed with a minor portion of the St. Francois aquifer found at the surface near the northeast boundary and subtending the Ozark aquifer elsewhere.

The Ozark aquifer is the primary water source for the Ozark Plateau Physiographic Province (Miller and Appel, 1997). It is the thickest aquifer within the Ozark Plateau aquifer system, averaging 1,000 feet in depth in south-central Missouri, and providing more than 1,000 gallons per minute (Miller and Appel, 1997). Water from the Ozark aquifer is used for municipal, industrial, and domestic supplies (Miller and Appel, 1997).

The St. Francois aquifer subtends the Ozark aquifer and is 300-400 feet thick in south-central Missouri. Water is withdrawn from the aquifer principally in the St. Francois Mountains, where the aquifer crops out or is close to the surface (Miller and Appel, 1997). The aquifer is at the

surface at that location due to uplift and subsequent erosion. Where water is withdrawn, it is considered "suitable for most uses," and has typical yields of 60 to 150 gallons per minute (Miller and Vandyke, 1997).

Bourbeuse River Watershed

The ecological subsection Central Plateau (CP) can be found throughout the Bourbeuse River Watershed almost in its entirety, with the exception of the boundary of the upper Watershed where minimal portions of the Outer Ozark Border, the Meramec River Hills, and the Inner Ozark Border subsections can be found. The CP will be the only ecological subsection addressed in this watershed description due to negligible extent of other subsections.

Physical Resources

Topography

The Bourbeuse River Watershed lies within the Salem Plateau subdivision of the Ozark Plateau and is defined as a region composed of steep-sided hills and deep valleys, separated by gently rolling uplands (MDC, 1999). Located within the northeastern quarter of the Ozark Plateau, the Bourbeuse River Watershed's main channel gradient is low compared to the other streams of this area, with gradients of the tributaries slightly higher in the lower watershed compared to the upper watershed (MDC, 1999). Within the headwaters of the river near Rolla, MO, elevation starts at 1,140 feet above msl and ends near Union at approximately 500 feet above msl (MDC, 1999).

The CP subsection consists of some of the least dissected portions of the Ozark Highlands and therefore a portion that retains the semblance of a true plateau surface (Nigh and Schroeder, 2002). For the majority of the plateau margin there is a more gradual transition to greater dissection of the land surface with the exception being the break with the river hills which is very sharp and unmistakable in the landscape (Nigh and Schroeder, 2002). Pre-settlement vegetation was mostly savanna or grassy woodland, and prairie (Nigh and Schroeder, 2002).

Bedrock

The geology of the Bourbeuse River valley is similar to the upper Meramec River watershed (MDC, 1999). However, MDNR further clarifies that the Bourbeuse River Watershed possesses a range of surface rocks varying in age from the younger Pennsylvanian to the older Ordovician Period (as cited by MDC, 1999). Therefore, the Bourbeuse River Watershed has younger rocks than the Pre-Cambrian Age rock formations of the Meramec River Watershed (MDC, 1999). Periodic uplift has locally elevated older Ordovician rock above younger Pennsylvanian (MDC, 1999).

There are two north trending faults that "sandwich" the newer Pennsylvanian Age formations between the older Ordovician Age formations in the Bourbeuse River Watershed (MDC, 1999). The interior contains, from greater to lesser extent, the Pennsylvanian undifferentiated, the Roubidoux Formation, and a collection of Ordovician Formation rock types containing

Smithville, Powell Cotter, and Jefferson City Dolomite formations (MDC, 1999). On either side of this interior are the Roubidoux Formation and Gasconade Dolomite (MDC, 1999). It is possible that along with the various rock types, the fault contributes to formation of the springs within the Watershed.

Soil

Ozark region soil types can be variable, most often having infertile, stony clay soils in some areas and fertile, loess-capped soils in others (MDNR as cited by MDC, 1999). Stony cherty soils characterize much of the Ozarks (MDC, 1999). Clarksville is excessively drained and formed in cherty dolomite and limestone residuum (MDC, 1999). Allgood and Persinger describe the surface soil as a very cherty silt loam underlain by a very cherty, silty clay loam (as cited by MDC, 1999). Lastly, Coulstone is a deep, somewhat excessively drained soil formed in sandstone and cherty dolomite on side slopes of ridges (MDC, 1999). In the extreme north of the Bourbeuse River Watershed a boundary is drawn where loess becomes a significant characteristic of the upland surface (Nigh and Schroeder, 2002).

Ridge-tops in the Bourbeuse River Watershed have a thin mantle of loess caps and subsoils formed in fragipans which appear cemented and restrict roots (Allgood and Persinger as cited in MDC, 1999). Within the Ozark Border region, soil types are unlike the soils of the Ozark region, having the classifications Union, Gasconade, Goss, and Peridge (MDC, 1999). Union, Hobson, Goss, and Peridge are found on uplands and four soil types are found in the river bottom areas along the Bourbeuse River: Nolin, Hartville, Cedargap, and Ashton (MDC, 1999).

Cropland and pasture, found primarily within the floodplain areas, are the land uses for 45% of the Bourbeuse River Watershed (MDC, 1999). Fifty-one percent of the total land area within the watershed is deciduous forest (MDC, 1999). Other forest types are evergreen and mixed forest land (MDC, 1999).

Surface Water

The Bourbeuse River Watershed, excluding the Meramec River and the Big River Watersheds, drains 842.9 square miles (MDC, 1999). The main channel of the Bourbeuse River flows northeasterly through Phelps, Gasconade, and Franklin Counties to join the Meramec River with its watershed encompassing portions of Maries, Osage, and Crawford Counties (MDC, 1999). The Bourbeuse River is 147 miles from mouth to headwaters (MDC, 1999).

The Bourbeuse River Watershed has fewer springs with smaller discharges than the Meramec River Watershed (MDC, 1999). Stream water quality varies according to agricultural runoff and runoff from urbanized areas (Nigh and Schroeder, 2002).

Ground Water

The Bourbeuse River Watershed is underlain entirely by the Ozark aquifer. It is the thickest aquifer within the Ozark Plateau aquifer system, averaging 1,000 feet in depth in south-central Missouri, and providing yields of more than 1,000 gallons per minute (Miller and Appel, 1997).

Water from this aquifer is considered "suitable for most uses" with dissolved-solid concentrations less than 1,000 milligrams per liter (except in the most westernmost parts of the aquifer) (Miller and Appel, 1997). Water from the Ozark aquifer is used for municipal, industrial, and domestic supplies (Miller and Appel, 1997).

The surface karst of the CP is one of the chief sources for groundwater that resurfaces in the numerous large springs of the surrounding entrenched-river subsections (Nigh and Schroeder, 2002). The CP is a major source area for groundwater that emerges in springs in the entrenched stream valleys on its sides (Nigh and Schroeder, 2002). Throughout these areas, decomposed bedrock has formed an unconsolidated residual material, allowing high rates of groundwater discharge according to Vandike (as cited in MDC, 1999). Subsurface water is abundant and of high quality, except for "hardness" (Nigh and Schroeder, 2002).

Current River Watershed (including the Jacks Fork River Watershed)

The boundary of the Southeast Missouri Ozarks Regional Restoration Plan restricts the Current River Watershed to the extent of the Arkansas/Missouri state boundary, therefore limiting this watershed discussion to focus on Missouri's physical resources. The SEMORRP boundary includes the Jacks Fork River, a tributary of the Current River, which is sectioned off in the Current River Watershed (Figure 1). Therefore, this section will address both the Current River Watershed and the Jacks Fork Watershed.

A majority of the middle section of the Current River Watershed consists of the Current River Hills (CRH). The Central Plateau (CP) subsection is found in four small fragments to the north, west, and south of the watershed. The Black River Ozark Border (BRO) has a small segment located to the very southeast of the Watershed boundary.

Physical Resources

Topography

Both the Current River and Jacks Fork River Watersheds lie within the Salem Plateau Subdivision of the Ozark Plateau Physiographic Region (MDC, 2003 and MDC, 2001a). MDNR describes the Salem Plateau Subdivision as a highly dissected plateau with upland elevations ranging from 1,000 to 1,400 feet above msl and local relief ranging from 100 - 200 feet in the uplands to 200 - 500 feet elsewhere (as cited by MDC, 2001a).

Elevations within the Current River Watershed range from a maximum of approximately 1500 feet above msl in the uplands to approximately 280 feet above msl in the lower portions (MDC, 2003). The Jacks Fork Watershed elevations range from a maximum of approximately 1,600 feet above msl in the uplands to approximately 580 feet at the confluence of the Jacks Fork and Current Rivers (MDC, 2001a). Local relief data from the MDC Fisheries Research Fish Collection Database indicate a minimum local relief of 316 feet and a maximum of 468 feet within the watershed (as cited by MDC, 2003).

The historical land cover of the Current River Watershed uplands primarily consisted of pine and mixed pine/oak woodland with an open understory of grasses and shrubs (MDC, 2003 and Nigh and Schroeder, 2002). Prairie and savanna openings were also occasionally common in some areas (MDC, 2003 and Nigh and Schroeder, 2002).

The CRH subsection consists of gently rolling hills which give way to steep slopes, narrow ridges, and narrow valley bottoms whereas the CP subsection consists of some of the least dissected portions in this area and therefore a portion that retains the semblance of a true plateau surface (Nigh and Schroeder, 2002). In most places in the CP, there is a more gradual transition to greater dissection of the land surface with the break of the river hills being very sharp and unmistakable in the landscape (Nigh and Schroeder, 2002). The BRO subsection consists of moderately dissected hills with a local relief up to 300 feet, and the local flatwoods of much less relief (Nigh and Schroeder, 2002). The western boundary of the BRO subsection with the CRH Subsection is drawn where the lower local relief of this subsection increases to more than 250 feet (Nigh and Schroeder, 2002).

Bedrock

The geology of the Current River and Jacks Forks Watersheds consists primarily of dolomites and sandstone/dolomites of Ordovician age (MDC, 2003 and MDC, 2001a). Significant exposures of Cambrian Dolomite and Precambrian Igneous Rock associated with the St. Francois Uplift are present in the middle portion of the Current River Watershed (MDC, 2003). This same dolomite is present in the lower portion of the Jacks Fork Watershed along with small exposures of Mississippian limestone and Precambrian igneous rock (MDC, 2001a). Quaternary Alluvium, associated with the Bootheel area of Missouri, exists in the southeastern portion of the Current River Watershed (MDC, 2003). In addition, a few small areas of Mississippian limestone and limestone/sandstone occur on the Current River Watershed's eastern boundary.

As is the case in most watersheds of the Ozarks, the geology of the Current River and the Jacks Fork River Watersheds in combination with the climate has created a karst landscape within the watersheds (MDC, 2003 and MDC, 2001a). This karst landscape is characterized, in part, by a close relationship between the surface water and groundwater systems and these points or areas of surface water/ground water interaction include losing streams, sinkholes, and springs (MDC, 2003 and MDC, 2001a).

Soil

The Current River and Jacks Fork Watersheds occur primarily within the Ozarks Soil Region, which Allgood and Persinger describe as "cherty limestone ridges that break sharply to steep side slopes of narrow valleys" (as cited in, MDC, 2003). Loess occurs in a thin mantle or is absent throughout this region. Soils formed in the residuum from cherty limestone or dolomite range from deep to shallow and contain a high percentage of chert in most places. Some of the soils formed in a thin mantle of loess are on the ridges and have fragipans, which restrict root penetration (MDC, 2001). Soil mostly formed under forest vegetation with native, mid-tall and tall grasses common in open or glade area.

Both of these watersheds occur within the Ozark Soil Region. The following ten soil associations occur within the Current River Watershed: Captina-Clarksville-Doniphan, Captina-Macedonia-Clarksville, Captina-Macedonia-Doniphan-Poynor, Hartville-Ashton-Cedar Gap-Nolin, Hobson-Coulstone-Clarksville, Lebanon-Hobson-Clarksville, Loring-Union-Doniphan, Wilderness-Clarksville-Coulstone, Calhoun-Amagon, and Bosket-Tuckerman (Allgood and Persinger as cited by MDC, 2003). Allgood and Persinger provide the following list of five soil associations found in the Jacks Fork Watershed: Captina-Clarksville-Doniphan, Captina-Macedonia-Doniphan-Poynor, Hobson-Coulstone-Clarksville, Lebanon-Hobson-Clarksville, and Wilderness-Clarksville-Coulstone (as cited by MDC, 2001a).

Surface Water

Total drainage area of the Current River Watershed, including the Jacks Fork River Watershed, is approximately 2,621 square miles (MDC, 2003). The Jacks Fork River is formed by the confluence of the North Prong and South Prong of the Jacks Fork (MDC, 2003). From this confluence, the Jacks Fork River flows in an easterly direction for approximately 49 miles before joining the Current River (MDC, 2001a). Approximately 18% of the Current River Watershed is drained by the Jacks Fork River (MDC, 2003). The Current River flows approximately 184 miles in a southeasterly to south direction through portions of 9 counties in Missouri and 2 counties in Arkansas (MDC, 2003).

Missouri counties that the Current River Watershed occupies include Texas, Dent, Reynolds, Shannon, Howell, Oregon, Carter, Butler, and Ripley. The Jacks Fork Watershed occupies a land area of 445 square miles in portions of Howell, Shannon, and Texas Counties (MDC, 2001a).

Springs, some of them exhibiting huge discharge (Big Spring has an average discharge of 440 cubic feet per second), are numerous and provide significant amounts of base flow and reduce seasonal fluctuations (Nigh and Schroeder, 2002). Spring flow accounts, to a large extent, for the higher sustained flows of many Ozark streams relative to streams in other regions of Missouri (MDC, 2003). Likewise, stream flow within the Jacks Fork Watershed is also enhanced by springs (MDC, 2003). Natural ponds or lakes are absent, except for sinkhole ponds (Nigh and Schroeder, 2002). Overall water quality within the watershed appears to be relatively good based on the limited scope of analysis provided in this document (MDC, 2003).

Ground Water

The Current River and Jacks Fork Watersheds are comprised of one aquifer, the Ozark aquifer. The St. Francois aquifer subtends each of these areas and is not often used for supplying drinking water.

The Ozark aquifer is the primary water source for the Ozark Plateau Physiographic Province (Miller and Appel, 1997). It is the thickest aquifer within the Ozark Plateau aquifer system, averaging 1,000 feet in depth in south-central Missouri, and providing well yields of more than 1,000 gallons per minute (Miller and Appel 1997). Water from the Ozark aquifer is used for municipal, industrial, and domestic supplies (Miller and Appel 1997).

Eleven Point River Watershed

Two ecological subsections, the Current River Hills (CRH) and the Central Plateau (CP) are found in the Eleven Point River Watershed. The CRH is located in the northeast corner of the Eleven Point River watershed boundary while the CP encompasses the western, southwestern, and southern sections of the Watershed.

Physical Resources

Topography

The Eleven Point Watershed lies within the Salem Plateau Subdivision of the Ozark Plateau and is defined by MDNR as a heavily dissected plateau with upland elevations of between 1,000 and 1,400 feet (as cited in MDC, 2001b). Local relief on the uplands is between 50 to 200 feet and in the deeply entrenched valleys between 200 to 600 feet (MDC, 2001b and Nigh and Schroeder, 2001). Elevations within the Watershed range between 1,500 feet above msl in the uplands to less than 340 feet above msl in the lower portions of the watershed within Missouri, specifically the Eleven Point River near the Missouri-Arkansas state line (MDC, 2001b).

Long gentle slopes are separated by broad, rounded ridges and wide, flat valleys, while drainages north of the Eleven Point River, in the CRH subsection, are characterized by highly dissected hills with narrow ridges and steep side slopes (MDC, 2001b). Areas in the CRH can be locally identified as gently rolling hills giving way to steep slopes, narrow ridges, and narrow valley bottoms while the CP occupies the higher, minimally dissected parts of the Ozark Highlands. (Nigh and Schroeder, 2002). Local karst, losing steams, and large springs are characteristic (Nigh and Schroeder, 2002).

Pre-settlement vegetation throughout the CRH was mainly woodlands and forests of oak and shortleaf pine (Nigh and Schroeder, 2002). Second-growth forests now dominate the landscape, with cleared land in valley bottoms (Nigh and Schroeder, 2002). CP pre-settlement vegetation was mostly savanna or grassy woodland, and prairie (Nigh and Schroeder, 2002).

Bedrock

A majority of the Eleven Point Watershed is underlain by Ordovician age dolomites and sandstone/dolomites as defined by the Missouri Spatial Data Information Service (as cited in MDC, 2001b). Isolated areas of Mississippian age limestone and limestone/sandstone are also present. According to Nigh, the light brownish-gray, cherty dolomite of the Gasconade Formation form the prominent bluffs and steep rugged hillsides along the Eleven Point River (as cited by MDC, 2001b). The bluff and hillsides are capped by a thick layer of Roubidoux Sandstone on the ridges and upper slopes (MDC, 2001b). The Jefferson City-Cotter Formation, a cherty dolomite occurring along ridge tops, is a common Ordovician age formation in the uplands of the Watershed (from Nigh, 1988 and MDC, 1997 as cited in MDC, 2001b).

Bedrock in the CRH consists of Cambrian age cherty dolomites and Ordovician cherty dolomites and sandstones (Nigh and Schroeder, 2002). The dolomites are soluble and create karst topography, including some very large springs and caverns, sinkholes, box valleys, and dry valleys (Nigh and Schroeder, 2002).

In the CP subsection, large, well-developed karst tracts are found around Howell and Oregon Counties (Nigh and Schroeder, 2002). Throughout the CP, most of the uplands shows the effects of severe, pervasive, and long-enduring dissolution of the carbonate bedrock and the surficial materials are characteristically naturally rocky and have been made more so by human-induced erosion of fines following clearing of the land (Nigh and Schroeder, 2002).

Soil

The Eleven Point Watershed occurs within the Ozark Soils Region, which Allgood and Persinger describe as "cherty limestone ridges that break sharply to steep side slopes of narrow valleys" (as cited in MDC, 2001b). Soils are rocky and formed mainly from carbonate and sandstone bedrock (Nigh and Schroeder, 2002). The following are soil associations found in the Eleven Point Watershed: Captina-Macedonia-Clarksville, Captina-Clarksville-Doniphan, Wilderness-Clarksville-Coulstone, and Hartville-Ashton-Cedargap-Nolin (alluvial). Soils formed in the residuum from cherty limestone or dolomite range from deep to shallow and contain a high percentage of chert in most places (MDC, 2001b). Loess occurs in a thin mantle or is absent and some of the soils formed in a thin mantle of loess are on the ridges and have fragipans, which restrict root penetration (MDC, 2001b).

Surface Water

The drainage area of the Eleven Point Watershed in Missouri is 1024.7 square miles (MDC, 2001b). MDNR reports that the Eleven Point Watershed is exceptional for the number and length of losing streams in the upper and middle portions of the watershed (as cited in MDC, 2001b). Much of the water produced by the Eleven Point Watershed emerges from springs originating within other watersheds and it is likely that springs within the Watershed contain ground water from other watersheds (MDC, 2001b). These springs assist in maintaining base flows in the middle and lower portions of the Eleven Point River, while streams in the headwaters of the watershed are frequently dry due to decreased significant spring input (MDNR as cited by MDC, 2001b).

Stream gradients in the CRH subsection are moderately steep to steep and typical streams in this area carry large bedloads of sand and gravel, and their channels have gravel and sandbars with pools, and riffles and little suspended sediment (Nigh and Schroeder, 2002). The CP section of the Watershed, is where widespread karst conditions inhibit the development of surface streams (Nigh and Schroeder, 2002).

Ground Water

The Eleven Point River Watershed lies within the Ozark Plateau's aquifer system, located throughout southern Missouri, southwestern Kansas, eastern Oklahoma and northwestern

Arkansas. The Watershed is underlain entirely by the shallow Ozark aquifer (Nigh & Schroeder, 2002).

The Ozark aquifer is the primary water source for the Ozark Plateau Physiographic Province (Miller and Appel, 1997). It is the thickest aquifer within the Ozark Plateau aquifer system, averaging 1,000 feet in depth in south-central Missouri, and providing more than 1,000 gallons per minute (Miller and Appel, 1997). Water from this aquifer is considered "suitable for most uses" with dissolved-solid concentrations less than 1,000 milligrams per liter (except in the most westernmost parts of the aquifer) (Miller and Appel, 1997). Water from the Ozark aquifer is used for municipal, industrial, and domestic supplies (Miller and Appel, 1997).

Subsurface water is abundant and of high quality, except for "hardness" in the CP and this subsection is a major source area for groundwater that emerges in springs in the entrenched stream valleys on its sides (Nigh and Schroeder, 2002).

The St. Francois aquifer subtends the Ozark aquifer and is 300-400 feet thick in south-central Missouri. Water is withdrawn from the aquifer only principally in the St. Francois Mountains, where the aquifer crops out or is close to the surface (Miller and Appel, 1997). The aquifer is at the surface at that location due to uplift and subsequent erosion. Where water is withdrawn, it is considered "suitable for most uses" with dissolved-solid concentrations between 200 and 450 milligrams per liter (Miller and Appel, 1997). Depending on location, yields of from 70 to more than 125 gallons per minute are possible from the St. Francois (MDNR, 2012a).

Meramec River Watershed

Physical Resources

As one of the ecological subsections identified by Nigh and Schroeder in their 2002 Atlas of Missouri Ecoregions, the Meramec River Hills (MRH) comprises a majority of the Meramec River Watershed. The lower Watershed can be found in a small section of the Inner Ozark Border (IOB) before draining into the Mississippi River while the upper Watershed, located on the west to southwestern border is defined by the ecological subsection, Central Plateau (CP).

The Bourbeuse and Big Rivers are technically classified in the Meramec River Watershed, since they are tributaries of the Meramec River. In this Southeast Missouri Ozarks Regional Restoration Plan the Big, Bourbeuse and Meramec Rivers are treated in separate watershed sections.

Topography

Most of the Meramec River Watershed lies within the Salem Plateau subdivision of the Ozark Plateau. The lower Meramec River lies within the Central Lowland Region (MDC, 1998). The Watershed is located in the northeastern quarter of the Ozark Highlands and excluding the Bourbeuse and the Big Rivers, drains 2,149 square miles into the upper Mississippi River Watershed according to the MDC Fisheries Research Section (as cited by MDC, 1998). The

lower Watershed flows through urbanized areas of St. Louis and Jefferson Counties, while the upper Watershed meanders through forested and agricultural areas (MDC, 1998).

The Meramec River Watershed is one of the most rugged regions of the Midwest, especially throughout the MRH subsection where it consists of hilly to rugged lands with steep slopes and narrow valley bottoms (Nigh and Schroeder, 2002). Topography varies from wide ridges and gentle slopes to narrow ridges, steep slopes and bluffs (MDC, 1998). USDA defines the north and west portions of this area as gently rolling topography while steep rolling topography is found in the south-central portions (as cited by MDC, 1998). Land elevations range from 400 feet to 1,400 feet above msl (MDC, 1998). Local karst, losing streams, and large springs are characteristic (Nigh and Schroeder, 2002). Pre-settlement vegetation was a pine-oak and mixed-oak woodland and forest (Nigh and Schroeder, 2002).

Bedrock

The Meramec River Watershed contains a range of surface rocks varying in age from the Pennsylvanian to the Precambrian period (MDNR as cited by MDC, 1998). The majority of these surface rock types consists of Cambrian age cherty dolomites and Ordovician cherty dolomites and sandstones (Nigh and Schroeder, 2002). The dolomites are soluble and create impressive local karst, including some very large springs, extensive caverns and numerous dry valleys and are locally prominent in the Salem Plateau (Nigh and Schroeder, 2002 and MDC, 1998).

On a smaller scale, MDNR classifies bedrock found in the lower portions of the Watershed near the Mississippi River as rock of the Mississippian Age, which includes the St. Louis Limestone, Salem Formation, Keukok Limestone, and Burlington Limestone (as cited by MDC, 1998). Between Gray Summit and Valley Park, the river meanders through the geologically older Ordovician Age rocks are stratified from oldest to youngest by the St. Peter Sandstone, Joachim Dolomite, and Plattin Formation (limestone, shale, and chert) (MDC, 1998). Potosi Dolomite is found primarily along the bottomlands of the upper and middle Meramec River (MDC, 1998).

Soil

The Natural Resources Conservation Service (NRCS) Soil Survey characterizes the area within the northern most parts of the Meramec River Watershed in an aggregate of soils known as the Deep Loess Hills, shifting to the Ozark Border and the Ozark Plateau to the southwestern extent (NRCS, as cited by MDNR, 1986 in MDC, 1998). A variety of separate soil types can be found in this area due to the local variations in climate and parent material, landforms, and vegetation (MDC, 1998). The Hartville-Ashton-Cedargap-Nolin Association parallels the Meramec River channel (MDC, 1998).

As defined by Allgood and Persinger, within the Deep Loess Hills area, the Menfro-Winfield Association comprises part of the Meramec River Watershed (as cited by MDC, 1998). Menfro is a deep, well-drained soil, formed in loess ridge tops and side slopes. Winfield is moderately well drained soil (MDC, 1998). The surface is silt loam underlain by moderately permeable, silty clay loam subsoil (MDC, 1998).

The Ozark Border is a transitional area between the Deep Loess Hills area and the Ozark Plateau, and within this Border, there are two major soil associations: the Union-Goss-Gasconade-Peridge Association and the Hobson-Clarksville-Gasconade Association (MDC, 1998). Allgood and Persinger characterize ridge tops as having a thin mantle of loess caps and soils formed in fragipans (as cited in MDC, 1998). Soil associations are also similar to the Ozark Plateau with the exclusion of the Union and the Gasconade (MDC, 1998). Deep, cherty clayey soils are red in color, due to the high iron content that oxidizes on exposure (MDC, 1998).

Forests, scattered glades, and prairie areas are found in the Ozark Plateau and the stony, cherty soil types in this area are variable, generally having infertile, stony clay soils in some areas and fertile, loess-capped soils in others (MDC, 1998). Soil formation is slow from the result of the weathering limestones, an important soil forming rock, and it leaves little behind except chert (Pflieger as cited by MDC, 1998). Within the Ozark Plateau four soil associations predominate: the Lebanon-Hobson-Clarksville Association, Hobson-Coulstone-Clarkville Association, the Captina-Clarksville-Doniphan Association, and the Hartville-Ashton-Cedargap-Nolin Association (Allgood & Persinger as cited by MDC, 1998).

Surface Water

The Meramec River Watershed is located in Crawford, Dent, Franklin, Iron, Jefferson, Phelps, Reynolds, St. Louis, Texas, and Washington Counties. The main channel of the Meramec River flows through 218 miles carrying water from the scarcely populated, forested, and agricultural upper watershed north easterly to the heavily populated and urbanized lower watershed to enter the Mississippi River below St. Louis (MDC, 1998). The Meramec River and its tributaries drain 2,149 square miles (MDC, 1998).

Springs in the Meramec River Watershed are numerous and provide significant amounts of base flow, reducing seasonal fluctuations (Nigh and Schroeder, 2002). Meramec River base flows are well sustained by these springs and by drainage from the two large major tributaries, the Big and Bourbeuse Rivers (MDC, 1998). This Watershed has many moderately mineralized springs with calcium, magnesium, and bicarbonate as the predominant dissolved components, but sulfate and chloride comprise a significant portion of the dissolved solids in the water (MDC, 1998).

Overall, water quality within the Meramec River Watershed is good. In the upper Watershed (Dent, Phelps, and parts of Crawford Counties), impoundments containing mining tailings pose a potential threat to stream water quality (MDC, 1998). In the upper and middle Watershed, cattle grazing on bottomland pasture is very common. The lower Watershed is an urbanized zone that poses other threats to water quality from sediment, land disturbance, and pollution-laden runoff entering into the lower Meramec system rapidly because of impervious surfaces from development and the channelization of tributaries (MDC, 1998).

Ground Water

The Meramec River Watershed is underlain entirely by the Ozark aquifer. The St. Francois aquifer underlays the Ozark aquifer in this region. It is the thickest aquifer within the Ozark Plateau aquifer system, averaging 1,000 feet in depth in south-central Missouri, and providing

more than 1,000 gallons per minute (Miller and Appel, 1997). Water from this aquifer is considered "suitable for most uses" with dissolved-solid concentrations less than 1,000 milligrams per liter (except in the most westernmost parts of the aquifer) (Miller and Appel, 1997). Water from the Ozark aquifer is used for municipal, industrial, and domestic supplies (Miller and Appel, 1997).

The surface karst of the CP is one of the chief sources for groundwater that resurfaces in the numerous large springs of the surrounding entrenched-river subsections (Nigh and Schroeder, 2002). The CP is a major source area for groundwater that emerges in springs in the entrenched stream valleys on its sides (Nigh and Schroeder, 2002). Throughout these areas, decomposed bedrock has formed an unconsolidated residual material, allowing high rates of groundwater discharge according to Vandike (as cited in MDC, 1999). Subsurface water is abundant and of high quality, except for "hardness" (Nigh and Schroeder, 2002).

Upper St. Francis River Watershed

The boundary of the Southeast Missouri Ozarks Regional Restoration Plan, as well as the Missouri/Arkansas state boundary limits the St. Francis River Watershed to the upper section of the watershed. The Upper St. Francis River Watershed is composed of the following three Missouri ecological subsections as defined by Nigh and Schroeder's 2002 Atlas of Missouri Ecoregions: St. Francois Knobs and Basins (SKB), Black River Ozark Border (BRO), and Inner Ozark Border (IOB).

Approximately two thirds of the Watershed is composed of the SKB with the lower section of the Upper St. Francis Watershed basin located in the BRO subsection. A sliver of the IOB can be found at the northern border of the Upper St. Francis River Watershed. Because this IOB area is so minute within this Watershed it will receive minimum treatment relative to the other two ecological subsections in this Watershed description.

Physical Resources

Topography

The Upper St. Francis River Watershed is found in Missouri and is equally divided, north and south, between the high-relief Ozark Plateau and the low-relief Mississippi Alluvial Plain. The SKB subsection has three different topographic features: the igneous knobs and hills, the smooth floored basins and valleys on dolomites and sandstones, and the dolomite, sandstone, and cherty hills (Nigh and Schroeder, 2002). Relief is generally high with local relief of 300 – 1,000 feet (Nigh and Schroeder, 2002). Pre-settlement vegetation was a mixture of forest, open woodlands, glades, and small prairies in the basins (Nigh and Schroeder, 2002). Exceptionally large areas of igneous glade and woodland complexes remain, pastures and grazed woodlands occupy the basins, and lead mining has scarified the land especially in the far upper part of the Watershed in the SKB (Nigh and Schroeder, 2002).

The BRO lies on the southern border of the Ozark uplift. Impeded drainage occurs in the soil and residuum where stream dissection is weak. Elsewhere, slopes are relatively steep and rocky

(Nigh and Schroeder, 2002). Within the BRO, local relief in the dissected parts is up to 200 feet, significantly less than the hillier north and west subsections (Nigh and Schroeder, 2002).

The absence of a deep cherty residuum in the igneous Ozark uplift and the formation of erosion resistant upland soils results in little gravel accumulation in the alluvial floodplain soils (MDC, 2001c). Channel substrates found in the St. Francis contain a significant proportion of stable cobble, stone, and boulders, and streambank soils are more cohesive than in most Ozark streams because of lower densities of gravel (MDC, 2001c).

Bedrock

The headwater area of the St. Francis River is dominated by the Ozark uplift which has exposed outcrops of Precambrian igneous rock on as much as 50 percent of the surface on some slopes as reported by MDNR (as sited in MDC, 2001c). These hard igneous rocks have no overburden, and shut-ins, cascades, and waterfalls produce ancient rigid boundaries that control the course, gradient, and floodplain features of the first 80 miles of the St. Francis River channel (MDC, 2001c). The predominance of impervious rock in this area limits infiltration and subsurface flows causing rapid runoff, flashy hydrographs, frequent flooding, and a poor aquifer that provides low, unstable base flows (MDC, 2001c).

Downstream, igneous rock is replaced by bedrock consisting of hard Cambrian dolomites and sandstone in the SKB. In the hills, the dolomites and sandstones have eroded and are found mainly in the basins (Nigh and Schroeder, 2002). Eventually, cherty Ordovician dolomite becomes the primary underlayment adjacent to the Wappapello Lake basin (MDC, 2001c).

The BRO is underlain by thick cherty dolomites and sandstones of the Ordovician Gasconade and Roubidoux Formations (Nigh and Schroeder, 2002). Throughout the BRO, dolomites are soluble and create karst conditions while signature sinkholes and caverns that are found in the Ozarks are occurs less frequently (Nigh and Schroeder, 2002).

Soil

According to NRCS, soils formed in the hard, igneous rock of the upland ridge tops lack an overburden of chert or loess and are typically described as extremely bouldery, cobbly, or stony with outcrops sometimes occupying 50 percent of the surface area (as cited by MDC, 2001c). Within these igneous bedrock areas, soils are moderately deep and acidic (Nigh and Schroeder, 2002). The combination of low soil fertility, acidic reactions, rapid runoff, and low water capacity, contributes to produce extremely droughty conditions that are most suitable for woodlands and limited grass production (MDC, 2001c). Soil series most frequently associated with the uplands are Irondale, Syenite, Delassus, and Clarksville (MDC, 2001c).

A large proportion of stones and boulders can be found in the finer silt-loam soils formed on the slopes, and a chert overburden appears on some of the foot slopes (MDC, 2001c). A fragipan is usually present which creates a root restriction depth of less than three feet (MDC, 2001c). Soils on interfluve positions include the moderately well-drained Captina series, with a root-restricting fragipan in the very gravelly residuum below the silty clay loam loess subsoil (Nigh and

Schroeder, 2002). Soil series most frequently associated with the slopes are Auxvasse, Killarney, Courtois, Fourche, and Wilber (MDC, 2001c).

The sand-silt-clay loams formed in St. Francis River floodplains are highly fertile, but fertility tends to decrease to moderate in a downstream direction (MDC, 2001c). Soils range from neutral to only slightly acidic, runoff is moderate, and water capacity is high (MDC, 2001c). Soil series most frequently associated with the floodplains are Wakeland, Haymond, and Pope (MDC, 2001c).

Surface Water

The St. Francis River drains the south-central portion of the SKB, with much of the BRO containing the section of the St. Francis River that creates Wappapello Lake. The St. Francis River originates in northeast Iron County, on a divide that separates the Black, Big, and St. Francis River drainages. The St. Francis River flows to the northeast around the St. Francois Mountains uplift (St. Francois County), then turns south and flows through Madison and Wayne Counties before flowing through Wappapello Lake to the Missouri/Arkansas border, and then continues through Arkansas and into the Mississippi River (MDC, 2001c).

The St. Francis River, from its headwaters to the Arkansas/Missouri border, is 225 miles long and its basin drains 1,839 square miles in Missouri (MDC, 2001c). In the upper basin, six dams are located which can affect flows and fish movement (MDC, 2001c). These include Wappapello Dam and Lake and the dam at DiSalvo Lake on the mainstem and four dams located on mainstem tributaries (MDC, 2001c). The upper basin is drier than most Ozark drainages on the Salem Plateau because of poor groundwater recharge associated with the predominance of impervious, igneous rock (MDC, 2001c).

Ground Water

The Upper St. Francis River Watershed lies within the Ozark Plateau's aquifer system, located throughout southern Missouri, southwestern Kansas, eastern Oklahoma and northwestern Arkansas. The aquifer within the upper section of the St. Francis Watershed is comprised of two aquifers, the Ozark aquifer and the deeper St. Francois aquifer.

The aquifers are composed of limestones, dolomites, and sandstones, separated by a shale confining unit of minimal permeability (Miller and Appel, 1997). The predominance of impervious rock in this area limits infiltration and subsurface flows causing rapid runoff, flashy hydrographs, frequent flooding, therefore, creating a poor aquifer for this area that provides low, unstable base flows (MDC, 2001c). Recharge of aquifers occurs primarily through precipitation at outcrop areas, but also minimally across the confining unit (comprised of minimally permeable shale and permeable limestone) (Miller and Appel, 1997). Water primarily passes through the aquifers via fractures and bedding planes, resulting in the dissolution of carbonate rocks, enlarged byways, and additional karstic features (Miller and Appel, 1997).Water discharges from the aquifers as base flow into streams or springs (Miller and Appel, 1997).

The Ozark aquifer is the primary water source for the Ozark Plateau Physiographic Province (Miller and Appel, 1997). It is the thickest aquifer within the Ozark Plateau aquifer system, averaging 1,000 feet in depth in south-central Missouri, and providing more than 1,000 gallons per minute (Miller and Appel, 1997). Water from this aquifer is considered "suitable for most uses" with dissolved-solid concentrations less than 1,000 milligrams per liter (except in the most westernmost parts of the aquifer) (Miller and Appel, 1997). Water from the Ozark aquifer is used for municipal, industrial, and domestic supplies (Miller and Appel, 1997). MDNR indicates that no irrigation occurs in the upper watershed (as cited in MDC, 2001c).

The St. Francois aquifer subtends the Ozark aquifer and is 300-400 feet thick in south-central Missouri. Water is withdrawn from the aquifer principally in the St. Francois Mountains, where the aquifer crops out or is close to the surface (Miller and Appel, 1997). The aquifer is at the surface at that location due to uplift and subsequent erosion. Where water is withdrawn, it is considered "suitable for most uses" with dissolved-solid concentrations between 200 and 450 milligrams per liter (Miller and Appel, 1997). Depending on location, yields of from 70 to more than 125 gallons per minute are possible from the St. Francois (MDNR, 2012a).

Biological Resources

Terrestrial Habitat

Before settlement, the Ozarks were mainly timbered with oak and oak-pine forests and woodlands (Nigh and Schroeder, 2002). Open oak and pine woodlands with bluestem grass occupied higher, gentler ground and steep exposed slopes (Nigh and Schroeder, 2002). Closed forest of oak, shortleaf pine, and mixed deciduous species were best developed on the roughest, most dissected lands (Nigh and Schroeder, 2002). Glades, fens, and sinkhole ponds added to the diversity (Nigh and Schroeder, 2002). Bottoms were mainly forested with mixed hardwood and riverfront sycamore-cottonwood types (Nigh and Schroeder, 2002).

At present, the Southeast Missouri Ozarks (SEMO) are still mainly timbered, except for cleared bottomlands and some ridges (Nigh and Schroeder, 2002). The forests and woodlands have been altered by past management practices and have become much more dense, shortleaf pine is less abundant, and much of the forest is dominated by oak of nearly even age (Nigh and Schroeder, 2002). Remnants for the lowland forest that once covered the region occur in small, managed tracts (Nigh and Schroeder, 2002).

Major natural community types found throughout the SEMO include (Nigh and Schroeder, 2002).

- Central Post Oak Dry Barrens (Savanna)
- Central Post Oak Flatwoods
- Chinquapin Oak-Ash (Eastern Red Cedar)/Little Bluestem Dry Limestone Dolomite Woodland
- Midwest Dry-Mesic Chert Prairie
- Midwest Mixed Emergent Marsh
- Mixed Oak-Hickory/Dogwood Dry-Mesic Chert Forest

- Mixed Oak-Hickory/Dogwood Dry Mesic Igneous and Chert Forest
- Ozark Dolomite Glade
- Ozark Igneous Glades
- Pin Oak-Willow Oak/Deciduous Holly Wet Bottomland Forest
- Post Oak, Black Oak, Scarlet Oak Dry Chert of Sandstone Woodland
- Post Oak, Black Oak, Scarlet Oak Dry Chert Woodland
- Post Oak, Black Oak, Scarlet Oak Dry Igneous and Chert Woodland
- Post Oak-Blackjack Oak/Bluestem Dry Chert or Sandstone Woodland
- Post Oak-Blackjack Oak/Bluestem Dry Igneous and Chert Woodland
- Post Oak Flatwoods
- Red Oak-White Oak-Sugar Maple Mesic Dolomite and Bottomland Forest
- Shortleaf Pine/Bluestem Dry Chert and Igneous Woodland
- Shortleaf Pine/Bluestem Dry Chert Woodland
- Shortleaf Pine-Oak/Vaccinium Dry Chert and Igneous Woodland
- Shortleaf Pine-Oak/Vaccinium Dry Chert Woodland
- Shortleaf Pine-Oak/Vaccinium Dry Sandstone Woodland
- Swamp Chestnut Oak-Sweetgum Wet-Mesic Bottomland Forest
- White Oak-Black Oak Dry-Mesic Chert Woodland
- White Oak/Dogwood Dry Mesic Chert Forest
- White Oak/Dogwood Dry Mesic Igneous and Chert Forest
- White Oak-Mixed Oak/Redbud Dry-Mesic Limestone/Dolomite Forest
- White Oak, Red Oak, Sugar Maple Mesic Dolomite Forest

Rare natural communities in this region include dolomite cliff communities, caves, springs, fens, and sinkhole ponds (Nigh and Schroeder, 2002). Most glade/woodland complexes have been overgrown with cedar, except in the St. Francois Mountains, where numerous high quality igneous glades still exist (Nigh and Schroeder, 2002).

Aquatic Habitat

Streams in the SEMO are clear with gravel or bedrock substrate (Nigh and Schroeder, 2002). Shut-ins, where streams flow through a narrow part of the valley of highly resistant igneous rock, are found in the St. Francois, Castor, and Black Rivers (Nigh and Schroeder, 2002). Springs are numerous with several being large (Nigh and Schroeder, 2002). Many endemic and state- and federally-listed aquatic and semi-aquatic species and species of concern are found in the SEMO (Nigh and Schroeder, 2002).

Conservation Opportunity Areas

Conservation Opportunity Areas (COAs) represent areas with unique species and habitats that are prioritized for conservation. The Missouri Department of Conservation has identified five COAs in the SEMO: the Middle Meramec, St. Francois Knobs, Current River Hills, LaBarque Creek Watershed, and Eleven Point Hills (CCM, 2012).

The Middle Meramec COA is located within the middle reaches of the Meramec River (CCM, 2012). The Middle Meramec landscape supports a variety of plants and animals, including the federally endangered Indiana bat, Gray bat, and Hine's Emerald dragonfly (CCM, 2012). Cerulean warblers and other high priority interior forest birds are relatively abundant in this area (CCM, 2012).

The St. Francois Knobs COA is the primary igneous rock landscape in Missouri (CCM, 2012). It is where Missouri's highest mountain, Taum Sauk Mountain, at 1,772 feet, and the tallest waterfall are located (CCM, 2012). The landscape features igneous glades, cliffs, fens, caves, shut-ins, and small springs (CCM, 2012).

The Current River Hills COA includes one of the largest tracts of forests and woodlands in the lower Midwest (CCM, 2012). The region is best known for extensive shortleaf pine-forests and woodlands that supported an exceptional timber boom at the turn of the twentieth century (CCM, 2012). The landscape features glades, cliffs, fens, sinkhole ponds, caves, and springs (CCM, 2012). The Current River is the most significant mid-sized river in mid-continent North America (CCM, 2012).

The LaBarque Creek Watershed COA features a high quality stream and rugged sandstone terrain, creating an area rich in diversity, surprisingly close to St. Louis in northwestern Jefferson County (CCM, 2012). Ecological values and development patterns make the watershed an excellent candidate for conservation efforts (CCM, 2012). LaBarque Creek provides over six miles of permanently flowing stream that supports 42 species of fish (CCM, 2012). The COA's underlying sandstone geology produces a dramatic landscape where flowing water carves cliffs, waterfalls, bowls and overhangs into the soft sandstone (CCM, 2012). The resulting deep, sheltered, moist canyons and ravines contain several state-listed plants found on only a few other sites in Missouri (CCM, 2012).

The Eleven Point River meanders through the picturesque Ozark hills of southern Missouri flowing through the shadows of steep bluffs, through sloping forested valleys and low-lying riparian ecosystems (CCM, 2012). Springs pouring from dolomite bluffs or rushing up from a vast network of underground flow systems provide a continuous source of water (CCM, 2012). The Eleven Point Hills COA lies in some of the most rugged and least developed portions of the Missouri Ozarks (CCM, 2012). The deeply dissected hills adjacent to the Eleven Point and Current Rivers contain relict populations of plants associated with steep bluffs, cave entrances, fens, springs and sinkholes (CCM, 2012). Through the years, woody groundcover has flourished – a byproduct of overgrazing and fire suppression (CCM, 2012). The Eleven Point Hills COA contains excellent opportunities for restoring rare natural communities and associated plants and animals (CCM, 2012).

Federally- and State-listed Species and Candidate Species

Federally listed species include any plant or animal species listed as *endangered* or *threatened* in the Endangered Species Act of 1973 as Amended. *Endangered* species include any species that is in danger of becoming extinct. *Threatened* species include any species that is likely to become endangered in the foreseeable future. *Candidate* species include any species that is being

reviewed by the Service for possible addition to the list of endangered and threatened species. Missouri state listed species include any species listed as *endangered* in the Wildlife Code of Missouri (Rule 3 CSR10-4, 111 Endangered Species).

Thirty-four species in the SEMO are state or federally listed, or are candidates for listing, including 19 species with federal status and 15 species with state status (Table 3 of the SEMORRP). When issuing a request for restoration proposals, the trustees will identify the current list of state and federal species associated with the injury caused by the release of hazardous substances.

All known federal or state threatened or endangered species, or federal candidate species in the SEMO, are described here. The list of species provided in Table 3 was compiled from county-specific information available online from the MDC Heritage Program (MDC, 2011a) and the Service (USFWS, 2012a). This list is current for the year 2012. More species may be added to this list as a result of newly discovered information.

Birds

American bittern (*Botaurus lentignosus*) is a solitary medium-sized heron with a stocky build and stripes of brown, tan, and white. American bitterns prefer wetland marshes or extensive meadows, mixed with areas of dense vegetation and open waters (MDC, 2009). It is a statewide summer resident in Missouri, listed as state endangered due to loss of wetland habitat (MDC, 2009). Preservation of wetland areas is essential for the protection of this species.

Northern harrier (*Circus cyaneus*) is a medium-sized raptor with a long barred tail, distinctive white rump, and owl-like facial disk. This species relies upon open grasslands and marshes that are densely vegetated (MDC, 2011b). The northern harrier is a rare summer resident and uncommon winter resident, listed as state endangered (MDC, 2011b). It benefits from the preservation and development of marsh lands, human use restrictions, and crop rotation (MDC, 2011b).

Peregrine falcon (*Falco peregrinus*) is a small to medium sized raptor with a black crown and nape, and a black wedge extending below the eye (MDC, 2011c). They are white with narrow dark bars in front, with a gray-blue back (MDC, 2011c). They historically nested in the bluffs along the Mississippi, Missouri, and Gasconade Rivers, but only a few pairs remained by the late 1800s (MDC, 2011c). It is state endangered due to the previous use of certain pesticides. Peregrine falcons have been reintroduced in the major urban areas where they use tall buildings as a substitute for cliffs (MDC, 2011c). Continued reintroductions will help to increase the population (MDC, 2011c).

Swainson's warbler (*Limnothlypis swainsonii*) is a large heavy bodied warbler with a long, spike-like bill and is brown on top with white to yellowish undersides, and white eyebrow (CLO, 2011). Swainson's warbler is a rare summer resident and can be found in bottomland forests with a dense overstory (MDC, 2011d). It benefits from maintaining riparian habitats, human use restrictions, control grazing of livestock, and to develop and maintain wetlands (MDC, 2011d).

Bachman's sparrow (*Peucaea aestivalis*) is a medium-sized sparrow with a long brown tail, flat forehead, and pleasant song. This species occupies glade habitats, characterized by open pine or oak-hickory woods with a well-developed understory of grass and shrubs (MDC, 2011e). Bachman's sparrow resides in southern Missouri in the summer, where it is on the northern edge of its range (MDC, 2011e). It is state endangered due to declining glade habitats and invading cedar trees (MDC, 2011e). This species benefits from the protection of mature pine forests, managed for open grassy areas (MDC, 2011e).

Mammals

Gray bat (*Myotis grisescens*) is 3-4 inches in length and is distinguished from other bat species by wing membranes that attach at the ankle (rather than the toe) (MDC, 2011f). Gray bats hibernate and roost in caves undisturbed by humans, and forage over streams, rivers, and reservoirs (MDC, 2011f). They require a corridor of mature trees between cave and foraging sites (MDC, 2011f). This species is primarily found in the Ozark highlands, but also occurs throughout Missouri where there are caves (MDC, 2011f). It is both federally and state endangered due to deforestation around caves and foraging areas, alteration of riparian habitats, human disturbance of caves, and flooding of caves from the development of reservoirs (MDC, 2011f). Management efforts to protect the gray bat include the acquisition of caves and the maintenance of foraging habitats, such as riparian corridors and old growth forests (MDC, 2011f).

Indiana bat (*Myotis sodalis*) is a medium-sized bat with brownish-gray fur with cinnamon overtones and is distinguished from other bat species by a distinct keel on its heel (MDC, 2011g). They need cool caves with stable temperatures of around 50 degrees Fahrenheit and high humidity (MDC, 2011g). Of Missouri's 6,500 known caves, only 27 have ever had sizeable Indiana bat populations (MDC, 2011g). More than 85 percent of Missouri's total population of Indiana bats hibernate in only eight specific locations, three of which are located in Shannon, Washington, and Iron Counties (MDC, 2011g). It is both federally and state endangered due to alteration of riparian habitats, human disturbance of caves in winter, and climate change (MDC, 2011g). Management efforts to protect the Indiana bat include avoiding disturbing hibernating bats, maintaining cave habitats, improving streamside habitats, and reducing use of pesticides (MDC, 2011g).

Plains spotted skunk (*Spilogale putorius interrupta*) is black with distinct white facial spots and four to six broken white stripes along the sides and back (MDC, 2011h). This species is a habitat generalist, occupying fencerows, vegetated gullies and brushy borders, brush piles, snags, rocky outcrops, open prairies, and riparian woodlands (MDC, 2011h). The plains spotted skunk occurs rarely in northern Missouri and in small sections of the Ozarks. It is state endangered in Missouri, primarily due to changing agricultural practices, such as the removal of hedgerows, "cleaner" harvest practices, and loss of habitat with a shift from small to large-scale farms (MDC, 2011h). This species benefits from the preservation of small glades and rocky outcroppings, the maintenance and development of edges, hedgerows, brush piles, and reduction in the use of pesticides on farms (MDC, 2011h).

Mollusks

Spectaclecase (*Cumberlandia monodonta*) is a large, elongated and sometimes inflated mussel that can grow to at least 9 inches (USFWS, 2011a). It is found in sheltered areas, away from the current in large rivers (USFWS, 2011a). Historically, this species was found throughout the Midwest, but is now found in only 19 streams in 11 states (USFWS, 2011a). In Missouri the spectaclecase is found in the Big, Big Piney, Bourbeuse, Gasconade, Meramec, and Mississippi Rivers (USFWS, 2011a). It is federally endangered due to alteration or degradation of its habitat, deterioration of water quality, and decline in the fish hosts' populations. The spectaclecase benefits from erosion control, improving habitat, and controlling pollution (USFWS, 2011a).

Elephant-ear (*Elliptio crassidens)* is a triangular shaped mussel with a thick dark brown to black shell (MDC, 2011i). The elephant-ear is found in swift creeks to large rivers in mud, sand, or fine gravel (MDC, 2011i). It is widespread in distribution but is considered rare. The elephant-ear has been found in the Mississippi, Meramec, Osage, Little Black, and Castor River drainages (MDC, 2011i). It is state endangered and is a candidate for federal listing due to alteration or degradation of its habitat, deterioration of water quality, and decline in the fish hosts' populations (MDC, 2011i). The elephant-ear benefits from the control of erosion and water pollution and improving the habitat for its host fish (MDC, 2011i).

Curtis' pearlymussel (*Epioblasma florentina curtisii)* is a small freshwater mussel with a dark brown shell (USFWS, 2012b). This mussel is typically found in small creeks and shallow, flowing rivers that have stable substrates (MDC, 2012a). It prefers to bury in clean, silt-free substrates of sand and gravel to gravel, cobble, and boulder in riffles and runs that are transitional areas between headwaters and lowlands (MDC, 2012a). It is both federally and state endangered as a result of rural and urban development that have adversely reduced available habitat, increased stagnation of bottom waters, increased siltation, and possibly eliminated or reduced numbers of fish hosts (MDC, 2012a). In Missouri, practices such as gravel mining, removal of trees and undergrowth along the streambank, and non-point source pollution from agriculture and urban areas have likely contributed to the decline of this species (MDC, 2012a).

Snuffbox (*Epioblasma truquetra)* is a small, triangular mussel in males and somewhat elongate in females, with a yellow, green, or brown shell. This species was historically widespread in the Midwestern states, but is steadily declining (MDC, 2011j). In Missouri, the snuffbox is found in the Meramec, Bourbeuse, Castor, St. Francis, and Current Rivers (MDC, 2011j). It is state endangered and is a candidate for federal listing due to alteration or degradation of its habitat, deterioration of water quality, and decline in the fish hosts' populations (MDC, 2011j). The snuffbox benefits from control of erosion and water pollution and improving the habitat for its host fish (MDC, 2011j).

Ebonyshell *(Fusconaia ebena*) is a heavy, rounded or oval mussel with a smooth dark brown to black shell in adults; young mussels have a light brown shell. The ebonyshell is found in swift rivers with a fine gravel to cobble substrate (MDC, 2011k). In Missouri, the ebonyshell has been found in the Mississippi, Meramec, Osage, and Little Black rivers (MDC, 2011k). It is state endangered and is a candidate for federal listing due to alteration or degradation of its habitat,

deterioration of water quality, and decline in the fish hosts' populations (MDC, 2011k). The ebonyshell benefits from control of erosion and water pollution and improving the habitat for its host fish (MDC, 2011k).

Pink mucket (*Lampsilis abrupta)* is a rounded to slightly elongate mussel with a thick, smooth yellowish-brown shell. The pink mucket burrows into beds of gravel, cobble, and sand in large streams (MDC, 2009h). This species is uncommon throughout its range (MDC, 2011h). In Missouri, the pink mucket is present in the Meramec, Gasconade, Black, and Osage Rivers (MDC, 2009h). It is state and federally endangered due to habitat loss, siltation, and deterioration of water quality (MDC, 2011h). The pink mucket benefits from control of erosion and water pollution (MDC, 2009h).

Scaleshell (*Leptodea leptodon)* is a relatively small, elongate mussel with a thin, compressed, and smooth light brown shell (MDC 2011i). The scaleshell is found in clear, non-polluted riffles with moderate current and firm gravel, cobble, or sand bottoms (MDC 2011i). This species was found throughout the river systems of the Midwestern states, and is currently found in only a few rivers in Missouri, Arkansas, and Oklahoma (MDC 2011i). In Missouri, the scaleshell is present in the Gasconade and Meramec River basins (MDC 2011i). It is state and federally endangered due to alteration or degradation of its habitat, deterioration of water quality, and decline in the fish hosts' populations (MDC, 2011i). The scaleshell benefits from control of erosion and water pollution and improving the habitat for its host fish (MDC, 2011i).

Sheepnose (*Plethobasus cyphyus)* is an oval or oblong mussel with a thick, smooth chestnut to dark brown shell (MDC 2011j). The sheepnose is found in medium to large rivers with gravel or mixed sand and gravel bottoms (MDC 2011j). This species was found throughout the river systems of the Midwestern states, but is steadily declining (MDC 2011j). In Missouri, the sheepnose is found in the Mississippi River north of the Missouri River, and the Meramec, Bourbeuse, Big, and Gasconade Rivers (MDC 2011j). It is state endangered and is a candidate for federal listing due to alteration or degradation of its habitat, deterioration of water quality, and decline in the fish hosts' populations (MDC, 2011j). The sheepnose benefits from control of erosion and water pollution and improving the habitat for its host fish (MDC, 2011j).

Rabbitsfoot (*Quadrula cylindrica cylindrica*) is a rectangular shaped mussel with a green or light brown shell containing numerous tubercles, pustules, and chevron-shaped markings (INHS, 2011). It is found in medium to large rivers in mixed sand and gravel substrates (INHS, 2011). In smaller streams it can be found on gravel bars close to fast currents, and often at the top of the substrate (MDC, 2009). This species occupies streams in southwestern and southeastern Missouri, such as the St. Francis River and Spring River basins (MDC, 2009). This species is rare throughout its range and is a candidate for federal listing as a result of lost habitat and declining water quality (MDC 2009). The rabbitsfoot benefits from the control of erosion and water pollution.

Winged mapleleaf (*Quadrula fragosa*) is an irregularly circular mussel with a rough, thick greenish brown to dark brown shell (USFWS, 2009). It is found in riffles with clean gravel, sand or rubble bottoms in clear, high quality water (USFWS, 2009). Historically the winged mapleleaf was found in scattered tributaries of the Mississippi River (USFWS, 2009). It is both

state and federally listed due to alteration or degradation of its habitat, deterioration of water quality, and decline in the fish hosts' populations (USFWS, 2009). The winged mapleleaf benefits from erosion control, improving habitat, and controlling pollution (USFWS, 2009).

Fish

Lake sturgeon (*Acipenser fulvescens*) is a large fish, up to eight feet in length, with a shark-like body, a long bony snout, and armored plates (MDC, 2012b). They have a sucker-type mouth under the snout with four smooth barbels (MDC, 2012b). Young lake sturgeon are mottled light and dark brown and turn to solid dark brown or slate colored with a white belly as adults (MDC, 2012b). Lake sturgeon inhabit rivers with firm, silt free bottoms of sand, gravel and rock and is found in the Missouri and Mississippi rivers and their larger tributaries (MDC, 2012b). It is state endangered due to overharvest and alterations of river channels (MDC, 2012b). Management should include protection from fishing, reestablishing self-sustaining populations, habitat improvement, river management, and artificial propagation (MDC, 2012b).

Crystal darter (*Crystallaria asprella*) is a large darter (5-6 inches) that is extremely slender with the back and upper sides a yellowish green, three or four broad saddle marks over the back, and 10 to 12 dark, oblong blotches along the sides (WIDNR, 2011). They inhabit open channels of large, clear streams with low to moderate gradients and long stretches of silt-free sand and small gravel substrate (MDC, 2011l). Populations have been found in the Meramec, St. Francis, Black, and Big Rivers in Missouri (MDC, 2011m). It is state endangered due to channelization, dredging, and impoundments (MDC, 2011l). Management should include the prohibition of dams and other impoundments in streams throughout the crystal darters range; avoid removing and altering the riparian corridor along streams; and, erosion and sediment controls (MDC, 2011l).

Swamp darter (*Etheostoma fusiforme*) is a slender darter that has a brownish back and upper sides, with indistinct dark saddles on the back and indistinct dark blotches along the sides; lateral line stands out as a pale line (MDC, 2012c). Lower sides and belly are cream-colored with scattered brownish spots and fins are banded with brownish lines (MDC, 2012c). These darters have been known to occupy sloughs, cypress swamps, and abandoned stream channels in Missouri (MDC, 2012c). It is almost always associated with dense aquatic vegetation in areas of water without current over the bottom of mud and detritus (MDC, 2012c). It is listed as a state endangered species in Missouri because of its limited habitat and small numbers within Missouri (MDC, 2012c). It has probably never been common or widespread in Missouri, but draining the southeastern wetlands and converting them to agricultural and urban areas has decreased the habitat for this fish (MDC, 2012c).

Goldstripe darter (*Etheostoma parvipinne*) is a rather stout, mottled-brown darter without definite crossbars on the back (MDC, 2012e). This darter habitat requirements are small, shallow, spring-fed streams with low to moderate gradient, with a sandy bottom and rooted aquatic plants due to the shade from trees above (MDC, 2012e). Within these kind of streams, this fish hides among twigs, leaves and other detritus in sandy areas with lighter current (MDC, 2012e). In Missouri, the goldstripe has only been found in locations in southeastern section of the state (MDC, 2012e). It is considered state endangered with its presence jeopardized by

excessive siltation, restriction of channel flow, water impoundment and removal of the tree canopy that helps keep the water cool and clear of algae. Agricultural and urban development have lowered the water table and added pollutants to the water.

Sabine shiner (*Notropis sabine*) is a slender, silvery minnow with a pale olive-yellow back without a definite streak along midline or dark edgings on scales (MDC, 2012g). A lowland species, this minnow species is known to inhabit a 25-mile stretch of the Black River in Missouri. It has been collected near sandbars in slight to moderate current, and it lives on or near the bottom (MDC, 2012g). It is state endangered due to its small amount of current and potential habitat (MDC, 2012g).

Mountain madtom (*Noturus eleutherus*) is a small, moderately chubby catfish that is profusely mottled with brownish blotches and bars and a square shaped tail fin (MDC, 2012h). In Missouri it is known only from only a few locations in large, moderately clear rivers in or near the transition between Ozark and Lowland regions, in gravelly riffles, sometimes where there are thick growths of aquatic vegetation (MDC, 2012h). It is state endangered due to habitat degradation (siltation, sedimentation and pollutants) resulting from human land use near streams (MDC, 2012h).

Longnose darter (*Percina nasuta*) is a two to three inch long darter with a slightly elongate head and snout and is a dull yellowish color with 10-14 dark vertical blotches on each side (OKDWC, 2011). They occur in medium to large rivers with rocky bottoms in the riffles and quiet backwaters near thick growths of aquatic vegetation (MDC, 2011n). It is state endangered due to the construction of impoundments, increase in sedimentation, and non-point source pollution (MDC, 2011o). Management should include avoidance of dam construction; avoidance of sand and gravel removal, and erosion and sediment controls (MDC, 2011o).

Pallid sturgeon (*Scaphirhynchus albus*) is a three to six foot long fish with a long pointed snout with barbels at the base of the mouth (MDC, 2012j). The back is grayish white with a lighter belly (MDC, 2012j). It is found in the main channels of the Mississippi and Missouri rivers and their larger tributaries in areas with strong currents and firm sand bottoms (MDC 2012j). It is state and federally endangered due to overfishing, dam construction and habitat loss. Management should include habitat protection and restoration (MDC, 2012j).

Insects

Hine's emerald dragonfly (*Somatochlora hineana*) is an extremely rare dragonfly that has brilliant emerald-green eyes and a dark brown and metallic green body, with yellow stripes on its sides (USFWS, 2006). They are found in spring-fed marshes (fens) and sedge meadows overlaying dolomite (USFWS, 2006). The Hine's emerald dragonfly was not known to reside in Missouri until 1999, when they were discovered in a fen in Reynolds County (MDC, 2009). It is state and federally endangered due to being found in only a few locations in four states (MDC, 2009). Management should include control of pollution, protect springs and the wetlands around them, and keep livestock and vehicular traffic out of streams, springs, seeps, and wetlands (USFWS, 2006).

Amphibians

Eastern hellbender (*Cryptobranchus a. alleganiensis*) is a large, aquatic salamander that grows to over 20 inches in length (MDC, 2011p). They have a wide, flat head with tiny eyes and a broad and vertically compressed tail (MDC, 2011p). The body and legs are covered with prominent folds to provide more surface area for respiration (MDC, 2011p). The eastern hellbender is brown to grayish-brown with a number of dark blotches and a yellowish-brown belly (MDC, 2011p). They need cool, clear streams and rivers with many large rocks (MDC, 2011p). The eastern hellbender is state endangered and has experienced a 77 percent drop in populations in the last 30 years (MDC, 2011p). Management efforts to protect the eastern hellbender include continued research into the reasons for the rapid decline in populations, control of sedimentation and pollution, and propagation and reintroduction.

Ozark hellbender (*Cryptobranchus a. bishopi*) is a large, aquatic salamander that grows to 24 inches in length (USFWS, 2011b). The Ozark hellbender is brownish in color with numerous dark blotches and has a flat body, which enables them to move in fast flowing streams by crawling on the bottom (USFWS, 2011b). They have numerous folds along the sides of the body for respiration (USFWS, 2011b). The Ozark hellbender requires clear cool streams with large flat rocks and are found only in southern Missouri and northern Arkansas (USFWS, 2011b). It is state endangered and was recently listed as federally endangered due to a dramatic decrease in their populations caused by several factors, including habitat degradation (impoundments, ore and gravel mining, sedimentation, and pollution) (USFWS, 2011b). The "chytrid fungus" is an increasing threat to amphibians here and around the world and has been found in all Ozark hellbender populations in Missouri (USFWS 2011b). Management efforts to protect the Ozark hellbender include continued research into the reasons for the rapid decline in populations, control of sedimentation and pollution, and captive propagation and reintroduction.

Plants

Mead's milkweed (*Asclepias meadii*) is a long-lived perennial herb belonging to the milkweed family (USFWS, 2005). It has a tall single slender stem; milky sap; and opposite, narrow tapered leaves (USFWS, 2005). Mead's milkweed blooms from May through mid-June, displaying yellowy/creamy-green flowers, contained in clusters of 5 to 14 flowers (MDC, 2011q). It occurs in moderately dry to dry upland tallgrass prairies, or in glades (MDC, 2011q; USFWS, 2005). Within Missouri, Mead's milkweed is primarily found in the western and southwestern counties, but is also found in a few locations in southeast and northern Missouri (MDC, 2011r). It is a state endangered species and a federally threatened species, primarily as a result of lost tallgrass prairie habitat, habitat fragmentation, and early haying (which removes immature fruits from the plant) (USFWS, 2005). Management for this species should include delaying haying until September (after the fruits mature), periodic prescribed prairie burning, and rotational grazing (USFWS, 2005).

Decurrent false aster (*Boltonia decurrens*) is a perennial that grows from 1 to 5 feet, occasionally reaching over 6 feet (MDC, 2012l). This plant blooms from July to October with quarter sized flowers with composite heads of yellow disk flowers and white to pinkish to purplish ray flowers (MDC, 2012l). This plant bears seeds from August to October (MDC, 2012l). It is known or believed to occur in the following SEMORRP counties: Howell, St. Louis, and Franklin

(USFWS, 2012c). It is listed as a state endangered species and a federally threatened species, due to the loss of historic river floodplains and wetland habitat, caused by the construction of levees and locks along the rivers, which have prevented flooding in many areas (MDC, 2012l). Management of this species should include periodic flooding or disturbance to eliminate competing vegetation and to provide high light and moist soil that the seeds require to germinate (MDC, 2012l).

Virginia sneezeweed (*Helenium virginicum*) is a golden-flowered fibrous rooted perennial, belonging to the aster family (USFWS, 2000). This plant stands at 1 to 5.5 feet tall with a simple stem (MDC, 2011s). Flowering occurs from July through November, revealing a nearly ball-shaped central disk with golden wedge-shaped petals (USFWS, 2000). The Virginia sneezeweed occurs near seasonally wet sinkhole ponds with acidic clayey soils overlain with limestone bedrock (MDC, 2011s). At the time of its listing (in 1998) the Virginia sneezeweed was thought to occur only in sinkhole ponds in Virginia. Populations of the Virginia sneezeweed have since been discovered in the Missouri Ozarks in the south-central and southwestern counties (MDC, 2011s). The Virginia sneezeweed is a state endangered and federally threatened species, primarily as a result of lost habitat (due to urbanization) and incompatible agricultural practices (MDC, 2011s).

Pondberry (*Lindera melissifolia*) is a deciduous shrub that grows to approximately 6 feet tall belonging to the Laurel family (USFWS, 2011c). Pale yellow, dioecious flowers appear in the spring before the leaves emerge and the green oval-shaped fruits are 0.5 inch long, and turn bright red in the fall (USFWS, 2011c). Reproduction is primarily vegetative by means of stolons which the plants grow in clones of numerous stems which flower when little more than 2 to 3 years of age, but appear to live for only a few years (USFWS, 2011c). Pondberry is found in wetland habitats such as bottomland and hardwoods in the margins of sinks, ponds and other depressions (USFWS, 2011c). The plants generally grow in shaded areas but may also be found in full sun. Pondberry is a state endangered and federally endangered species, as a result of habitat alteration from drainage ditching and subsequent conversion of its habitat to other uses (USFWS, 2011c). Domestic hogs, cattle grazing, and timber harvesting have also impacted the plants at some sites (USFWS, 2011c).

Running buffalo clover (*Trifolium stoloniferum*) is a perennial that grows 4 to 20 inches tall (MDC, 2011t). The leaves have three leaflets and the flowers are white (MDC, 2011t). It sends out creeping runners, which grow along the ground and take root (MDC, 2011t). It is found in open woodlands, savannas, grasslands, stream-banks, floodplains and shoals (MDC, 2011t). Running buffalo clover was thought to be extirpated in Missouri until some plants were found in St. Louis in 1989 (MDC, 2011t). Two additional sites have been found, one in Madison County and one in Maries County, and is being reintroduced on MDC lands and U.S. Forest Service lands (MDC, 2011t). It is state and federally endangered due to competition from exotic clovers (MDC 2011t). Management should include continuing to reintroduce running buffalo clover on protected lands and controlling exotic clovers on those lands.

Missouri Species of Concern

In addition to the “listed’ species, the Missouri Department of Conservation maintains a database of rare plant and animals – the “Missouri Species of Concern.” Plants and animals are given a

numeric rank (S1 through S5) based upon number of occurrences within Missouri. Missouri's species of concern are classified as *critically imperiled* (S1), *imperiled* (S2), *vulnerable* (S3), *apparently secure* (S4), and *secure* (S5). The number of critically imperiled (S1) or imperiled (S2) species that occupy the SEMO totals 337 species (Appendix E) (MDC, 2012m). *Critically imperiled* species typically have 5 or fewer occurrences or very few remaining individuals (<1,000), and *imperiled* species typically have 6 to 20 occurrences or few remaining individuals (1,000 to 3,000).

Extirpated Species

Extirpated species are species that previously existed in Missouri, but are no longer found in Missouri (MDC, 2012m). The extirpation of a species is of concern because all species have a unique role (or "niche") that they fulfill in an ecosystem. Extirpated species in the Ozarks include elk (*Cervus canadensis*), bison (*Bison bison*), gray wolf (*Canis lupus*), red wolf (*Canis lupus rupus*), and American burying beetle (*Nicrophorus americanus*). Some extirpated species are being reintroduced into Missouri. The desired endpoint of species reintroductions is to both reestablish populations of the extirpated species and also to benefit the ecosystem by replacing the lost functionality. Examples of reintroduction plans currently underway in Missouri include plans for the American burying beetle, bison, and elk. When appropriate, the restoration of injured resources may include the reintroduction of previously extirpated species.

The iconic bison is one of the largest animals in North America. They are native to Missouri's prairies where they played key ecological roles. Where they exist, bison increase native plant diversity and help control dominant prairie plants as they graze on dominant sedges and grasses and provide healthy disturbances in a prairie ecosystem (i.e., through wallowing, tree horning, and roaming) (TNC, 2011). Unfortunately, due to the overhunting of bison and changes in prairie management (e.g. competition from cattle grazing, plowing, and fire suppression), bison were extirpated from Missouri shortly after the 1840s (MDC, 2011u). Bison have since been reintroduced to some of Missouri's prairies. For example, a herd of 100 bison live at Prairie State Park in Barton County, and plans are underway to reintroduce more bison herds in Missouri.

Elk were historically found throughout Missouri, but were likely extirpated from Missouri by 1865 (MDC, 2010). The MDC developed a restoration plan for elk in the state of Missouri, and is reintroducing elk in areas where suitable habitat was found and where other management considerations were met (MDC, 2010). Elk reintroduction programs in other states have been successful and provided natural resource management, recreational, and economic benefits to the public (MDC, 2010). Areas suitable for elk reintroductions include areas with forest openings, glades, and open woodland habitats that provide an understory of herbaceous vegetation (MDC, 2010). Other important factors used to select areas for elk reintroductions include high public land ownership and access; low public road density; low density of row crops and livestock; and landowner support (MDC, 2010).

Migratory Bird Species

The SEMO is located within the Mississippi Flyway, one of the major migration routes in the United States. The Missouri portion of the flyway is narrower than portions north of it, resulting in increased numbers of migratory bird species in Missouri. The number of bird species identified in the SEMO totals more than 350 species (MAS, 2011).

Game Animals

Commonly hunted game mammals in the SEMO include white-tailed deer (*Odocoileus virginianus*), gray squirrel (*Sciurus carolinensis carolinensis*), and eastern cottontail rabbit (*Sylvilvagus floridanus*). Other game or furbearing mammals include, but are not limited to, beaver (*Castor canadensis carolinensis*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), red fox (*Vulpes fulva*), mink (*Mustela vison letifera*), muskrat (*Ondatra zibethicus*), opossum (*Didelphis v. virginiana*), raccoon (*Procyon lotor hirtus*), and striped skunk (*Mephitis mephitis avia*). Beaver, gray and red fox, mink, and muskrat are also listed as commercial species.

Popular sportfish in the SEMO's reservoirs and streams include, but are not limited to, a variety of bass species, such as largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), white bass (*Morone chrysops*), and spotted bass *(Micropterus punctulatus)*; black crappie *(Pomoxis nigromaculatus)*, white crappie (*Pomoxis annularis*), bluegill *(Lepomis macrochirus)*, redear sunfish (*Lepomis microlophus*), rock bass (*Ambloplites rupestris*), flathead catfish (*Pylodictis olivaris*), channel catfish (*Ictalurus punctatus*), chain pickerel (*Esox niger*), and walleye (*Sander vitreus*). Coolwater fish, such as rainbow trout *(Oncorhynchus mykiss)* and brown trout *(Salmo trutta)*, are also present in the Current and Meramec River basins. Commercial fish include freshwater drum (*Aplodinotus grunniens*), bigmouth buffalo (*Ictiobus cyprinellus*), common carp (*Cyprinus carpio*), river carpsucker (*Carpiodes carpio*), channel catfish (*I. punctatus*), and flathead catfish (*P. olivaris*).

Commonly hunted game birds in the SEMO include wild turkey (*Meleagris gallopavo silvestris*) and mourning dove (*Zenaida macroura carolinensis*).

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APPENDIX E - 2012 Missouri Species of Concern in the Southeast Missouri Ozarks

Southeast Missouri Ozarks Regional Restoration Plan

Common Name	Scientific Name	State Rank
Amphibians		
Mole salamander	*Ambystoma talpoideum*	S2
Three-toed amphiuma	*Amphiuma tridactylum*	S2
Eastern hellbender	*Cryptobranchus a. alleganiensis*	S1
Ozark hellbender	*Cryptobranchus a. bishopi*	S1
Grotto salamander	*Eurycea spelaea*	S2S3
Eastern spadefoot	*Scaphiopus holbrookii*	S2
Reptiles		
Western chicken turtle	*Deirochelys reticularia miaria*	S1
Western mudsnake	*Farancia abacura reinwardtii*	S2
Alligator snapping turtle	*Macrochelys temminckii*	S2
Birds		
Sharp-shinned hawk	*Accipiter striatus*	S2
American bittern	*Botarus lentiginosus*	S1
Northern harrier	*Circus cyaneus*	S2
Cerulean warbler	*Dendroica cerulea*	S2S3
Peregrine falcon	*Falco peregrinus*	S1
Common moorhen	*Gallinula chloropus*	S2
Swainson's warbler	*Limnothlypis swainsonii*	S2
Bachman's sparrow	*Peucaea aestivalis*	S1
Crustaceans		
Fustis cave isopod	*Caecidotea fustis*	S2
Salem cave isopod	*Caecidotea salemensis*	S2
Serrated cave isopod	*Caecidotea serrata*	S1
Stygian cave isopod	*Caecidotea stygia*	S1
Digger crayfish	*Fallicambarus fodiens*	S2S3
Shield crayfish	*Faxonella clypeta*	S2S3
Coldwater crayfish	*Orconectes eupunctus*	S2
Mammoth spring crayfish	*Orconectes marchandi*	S1S2
Big Creek crayfish	*Orconectes peruncus*	S2
St. Francis River crayfish	*Orconectes quadruncus*	S2
Fish		
Lake sturgeon	*Acipenser fulvescens*	S1
Alabama shad	*Alosa albame*	S2

Common Name	Scientific Name	State Rank
Western sand darter	*Ammocrypta clara*	S2S3
Highfin carpsucker	*Carpiodes velifer*	S2
Crystal darter	*Crystallaria asprella*	S1
Lake chubsucker	*Erimyzon sucetta*	S2
Swamp darter	*Etheostoma fusiforme*	S1
Harlequin darter	*Etheostoma histrio*	S2
Least darter	*Etheostoma microperca*	S2
Niangua darter	*Etheostoma nianguae*	S2
Goldstripe darter	*Etheostoma parvipinne*	S1
Starhead topminnow	*Fundulus dispar*	S2
Western silvery minnow	*Hybognathus argyritis*	S2
Plains minnow	*Hybognathus placitus*	S2
Southern brook lamprey	*Ichthyomyzon gagei*	S2S3
American brook lamprey	*Lampetra appendix*	S2
Dollar sunfish	*Lepomis marginatus*	S2
Bantam sunfish	*Lepomis symmetricus*	S2
Ghost shiner	*Notropis buchanani*	S2
Blacknose shiner	*Notropis heterolepis*	S2
Taillight shiner	*Notropis maculatus*	S1
Ozark shiner	*Notropis ozarcanus*	S2
Sabine shiner	*Notropis sabinae*	S1
Mountain madtom	*Noturus eleutherus*	S1S2
Bluestripe darter	*Percina cymatotaenia*	S2
Longnose darter	*Percina nasuta*	S1
Stargazing darter	*Percina uranidea*	S2
Eastern slim minnow	*Pimephales tenellus parviceps*	S2S3
Flathead chub	*Platygobio gracillis*	S1
Pallid sturgeon	*Scaphirhynchus albus*	S1
Southern cavefish	*Typhlichthys subterraneus*	S2S3
Insects		
Ozark stone	*Acroneuria ozarkensis*	S2
Duke's skipper	*Euphyes dukesi*	S1
Missouri glyphopsyche caddisfly	*Glyphopsyche missouri*	S1
Bald cypress katydid	*Inscudderia taxodii*	S1
Hoosier grasshopper	*Paroxya hoosieri*	S1
Applachian eyed brown	*Satyrodes appalachia leeuwi*	S1
Frison's seratellan mayfly	*Serratella frisoni*	S2
Hine’s emerald	*Somatochlora hineana*	S2
Ozark emerald	*Somatochlora ozarkiensis*	S2S3
Spined grouse locust	*Tettigidea armata*	S2S3
Millipedes		

Common Name	Scientific Name	State Rank
Causeyella cave millipede	*Causeyella dendropus*	S2
Mammals		
Southeastern bat	*Myotis austroriparius*	S1
Indiana bat	*Myotis sodalist*	S1
Plains spotted skunk	*Spilogale putorius interrupta*	S1
Swamp rabbit	*Sylvilagus aquaticus*	S2
Mollusks		
Elktoe	*Alasmidonta marginata*	S2
Slippershell mussel	*Alasmidonta viridis*	S2
Flat floater	*Anodonta suborbiculata*	S2
Cylindrical papershell	*Anodontoides ferussacianus*	S1
Western fanshell	*Cyprogenia aberti*	S2
Elephantear	*Elliptio crassidens*	S1
Curtis' pearlymussel	*Epioblasma florentina curtisii*	S1
Snuffbox	*Epioblasma triquetra*	S1
Enigmatic cavesnail	*Fontigens antroectes*	S2
Proserpine cavesnail	*Fontigens proserpina*	S1
Ebonyshell	*Fusconaia ebena*	S1
Pink mucket	*Lampsillis arupta*	S2
Scaleshell	*Leptodea leptodon*	S1
Black sandshell	*Ligumia recta*	S2
Southern hickorynut	*Obovaria jacksoniana*	S1
Sheepnose	*Plethobasus cyphyus*	S2
Rabbitsfoot	*Quadrula cylindrica cylindrica*	S1
Winged mapleleaf	*Quadrula fragosa*	S1
Salamander mussel	*Simpsonaias ambigua*	S1
Purple lilliput	*Toxolasma lividus*	S2
Capital vertigo	*Vertigo oscariana*	S1
Plants		
Large seeded mercury	*Acalypha deamii*	S1
Purple false foxglove	*Agalinis purpurea*	S2
Green false foxglove	*Agalinis viridis*	S1
Wild leek	*Allium burdickii*	S2
Floating foxtail grass	*Alopecurus aequalis*	S2
A moss	*Amblystegium polygamum*	S1
Ciliate blue star	*Amsonia ciliata var. filifolia*	S2S3
Wood anemone	*Anemone quinquefolia*	S1
Wild sarsaparilla	*Aralia nudcaulis*	S2
Mead's milkweed	*Asclepias meadii*	S2
Yellow bartonia	*Bartonia virginica*	S1

Common Name	Scientific Name	State Rank
American barberry	*Berberis canadensis*	S2
Bergia	*Bergia texana*	S2
A beggar's tick	*Bidens laevis*	S1
Decurrent false aster	*Boltonia decurrens*	S1
Few-lobbed grape fern	*Botrychium biternatum*	S1
Blue grama	*Bouteloua gracilis*	S1
A moss	*Brachelyma subulatum*	S1
Sword moss	*Bryoxiphium norvegicum*	S1
A moss	*Bryum miniatum*	S1
Northern reedgrass	*Calamagrostis stricta ssp. inexpansa*	S2S3
French mulberry	*Callicarpa americana*	S1
Grass pink orchid	*Calopogon tuberosus*	S2
Marsh bellflower	*Campanula aparinoides*	S1
Harebell	*Campanula rotundifolia*	S1
A moss	*Campylopus tallulensis*	S1
A sedge	*Carex abscondita*	S1
Broadwing sedge	*Carex alata*	S2S3
Bellow beaked sedge	*Carex albicans var. australis*	S1
Greenish-white sedge	*Carex albolutescens*	S1S2
A sedge	*Carex aquatilis var. substricta*	S1
A sedge	*Carex atlantica ssp. atlantica*	S1
A sedge	*Carex bromoides ssp. Bromoides*	S2
Brown bog sedge	*Carex buxbaumii*	S2
Cherokee sedge	*Carex cherokeensis*	S2
Fibrous-root sedge	*Carex communis var. communis*	S2
Bristly sedge	*Carex comosa*	S2
White-edge sedge	*Carex debilis var. debilis*	S1
A sedge	*Carex fissa var. fissa*	S1
A sedge	*Carex flaccosperma*	S2
Giant sedge	*Carex gigantea*	S1S2
Graceful sedge	*Carex gracillima*	S1
A sedge	*Carex microdonta*	S1
A sedge	*Carex molestiformis*	S2
A sedge	*Carex nigromarginata var. floridana*	S1
Sharp-scale sedge	*Carex oxylepis*	S2
A sedge	*Carex reznicekii*	S2
A sedge	*Carex socialis*	S2
A sedge	*Carex sterilis*	S2
Straw sedge	*Carex straminea*	S1
Shaved sedge	*Carex tonsa var. rugosperma*	S1
Triangular sedge	*Carex triangularis*	S2
Hairy-fruited sedge	*Carex trichocarpa*	S1
A sedge	*Carex vesicaria var. monile*	S2

Common Name	Scientific Name	State Rank
Willdenow's sedge	*Carex willdenowii*	S1
Ozark chinquapin	*Castanea pumila var. ozarkensis*	S2
A gourd	*Cayaponia quinqueloba*	S1
Coontail	*Ceratophyllum echinatum*	S1
Slender spike grass	*Chasmanthium laxum ssp. laxum*	S1
Rose turtlehead	*Chelone oblique*	S2
A leatherflower	*Clematis viorna*	S1
Joint grass	*Coelorachis cylindrica*	S1
Fleabane	*Conyza canadensis var. pusilla*	S1S2
A Corydalis	*Corydalis micrantha ssp. australis*	S2
Parsley haw	*Crataegus marshallii*	S1
A hawthorn	*Crataegus spathulata*	S1
A marsh elder	*Cyclachaena xanthifolia*	S1
Finger Dog-shade	*Cynosciadium digitatum*	S2
Umbrella flatsedge	*Cyperus diandrus*	S1
An umbrella sedge	*Cyperus flavicomus*	S1
Umbrella sedge	*Cyperus retroflexus*	S1
Teasel-like cyperus	*Cyperus retrofractus*	S1S2
Small white lady-slipper	*Cypripedium candidum*	S1
Showy lady-slipper	*Cypripedium reginae*	S2S3
A bladderfern	*Cystopteris tenuis*	S1
Gattinger prairie-clover	*Dalea gattingeri*	S1
Swamp loosestrife	*Decodon verticillatus*	S1
Tall larkspur	*Delphinium exaltatum*	S2
Hay-scented fern	*Dennstardtia punctilobula*	S2
Tansy mustard	*Descurainia pinnata ssp. pinnata*	S2S3
American beakgrain	*Diarrhena americana*	S1
A lichen	*Dibaeis absoluta*	S1
A moss	*Dichelyma capillaceum*	S1
Pony-foot grass	*Dichondra carolinensis*	S1
A moss	*Dicranum polysetum*	S1
A moss	*Didymodon rigidulus var. rigidulus*	S1
Amethyst shooting star	*Dodecatheon amethystinum*	S2
French's shooting star	*Dodecatheon frenchii*	S1
Spinulose shield fern	*Dryopteris carthusiana*	S2
Log fern	*Dryopteris celsa*	S1
Goldie's fern	*Dryopteris goldiana*	S2
Evergreen woodfern	*Dryopteris intermedia*	S1
Dwarf burhead	*Echinodorus tenellus var. parvulus*	S1
Lance-like spike rush	*Eleocharis laceolata*	S1
A love grass	*Eragrostis glomerata*	S1
Plume grass	*Erianthus giganteus*	S1
Umbrella plant	*Eriogonum longifolium var. longifolium*	S2

Common Name	Scientific Name	State Rank
Strawberry bush	*Euonymus americanus*	S2
A thoroughwort	*Eupatorium rotundifolium var. scabridum*	S1
A thoroughwort	*Eupatorium semiserratum*	S1S2
Forked aster	*Eurybia furcata*	S2
Big-leaved aster	*Eurybia macrophylla*	S2
Queen of the prairie	*Filipendula rubra*	S2
A moss	*Forsstroemia producta*	S1
Northern bedstraw	*Galium boreale ssp. septentriolnale*	S2
Black huckleberry	*Gaylussacia baccata*	S1
Closed gentian	*Gentiana andrewsii*	S1
Pale avens	*Geum virginianum*	S1
Hedge hyssop	*Gratiola viscidula ssp. Viscidula*	S1
A bluet	*Hedyotis boscii*	S1
Swamp sunflower	*Helianthus angustifolius*	S2
Little leaved alum root	*Heuchera parviflora var parviflora*	S1
Sharp's homaliadelphus	*Homaliadelphus sharpii*	S1
Featherfoil	*Hottonia inflata*	S2
Fir clubmoss	*Huperzia porophila*	S2
Floating pennywort	*Hydrocotyle ranunculoides*	S1S2
Ovate fiddleleaf	*Hydrolea ovata*	S2
A St. John's wort	*Hypericum lobocarpum*	S1
A moss	*Hypnum cupressiforme var. filiforme*	S1
A moss	*Hypnum pallescens*	S1
Engelmann's quillwort	*Isoetes engelmannii var. engelmannii*	S1
A moss	*Isopterygiopsis muelleriana*	S1
Large whorled pogonia	*Isotria verticillata*	S1S2
Toad rush	*Juncus bufonius var. bufonius*	S1
Cananda rush	*Juncus canadensis var. canadensis*	S1
Weak rush	*Juncus debilis*	S1
A rush	*Juncus validus*	S1
A water willow	*Justicia ovata var. lanceolata*	S2
A liverwort	*Kurzia sylvatica*	S1
Corkwood	*Leitneria floridana*	S2
Star duckweed	*Lemna trisulca*	S2
A blazing star	*Liatris scaiosa var. nieuwlandii*	S2
Turk’s cap lily	*Lilium superbum*	S1
American frogbit	*Limnobium spongia ssp. spongia*	S2
Pondberry	*Lindera melissifolia*	S1
Loesel’s twayblade	*Liparis loeselii*	S2
Primrose willow	*Ludwigia leptocarpa*	S2
A false loosestrife	*Ludwigia microcarpa*	S2
Round-branched ground pine	*Lycopodium dendroideum*	S1
A clubmoss	*Lycopodium digitatum*	S2

Common Name	Scientific Name	State Rank
Ground cedar	*Lycopodium tristachyum*	S1
A liverwort	*Marsupella sphacelata*	S1
Ostrich fern	*Matteuccia struthiopteris var. pensylvanica*	S2
Water hyssop	*Mecardonia acuminata*	S1
Two-flowered melic grass	*Melica mutica*	S1
Bogbean	*Menyanthes trifoliate*	S1
A liverwort	*Metzgeria conjugate*	S1S2
A moss	*Micromitrium megalosporum*	S1S2
Miterwort	*Mitreola petiolata*	S1
Thread-like naiad	*Najas gracillima*	S2
Sphagnum sprite	*Nehalennia gracilis*	S1
Prairie iris	*Nemastylis geminiflora*	S2
Shrubby sundrops	*Oenothera fruticosa ssp. fruticosa*	S1
Small sundrops	*Oenothera perennis*	S1
Stemless evening primrose	*Oenothera triloba*	S2
A bromerape	*Orobanche ludoviciana*	S1
A panic grass	*Panicum dichotomum var. nitidum*	S1
A panic grass	*Panicum dichotomum var. yadkinense*	S1
A panic grass	*Panicum portoricense*	S1
A lichen	*Pannaria rubiginosa*	S1
A lichen	*Parmotrema hypoleucinum*	S1
A lichen	*Parmotrema tinctorum*	S2
Slender paspalum	*Paspalum setaceum var. setaceum*	S1
Missouri cliffbrake	*Pellaea glabella missouriensis*	S1S2
Arrow arum	*Peltandra virginica ssp. virginia*	S2
A hornwort	*Phaeoceros oreganus*	S1
Mock orange	*Philadelphus pubescens var. verrucosus*	S1
Carolina phlox	*Phlox carolina ssp. carolina*	S1
Wild sweet william	*Phlox maculate pyramidalis*	S2
A moss	*Physcomitrium collenchymatum*	S1
A false dragonhead	*Physostegia intermedia*	S1
A moss	*Plagiothecium dinticulatum*	S1
Woolly plantain	*Plantago patagonica*	S2
Yellow-fringed orchid	*Platanthera ciliaris*	S1
Green wood orchid	*Platanthera clavellata*	S2
Pale green orchid	*Platanthera flava var. flava*	S2
Northern rein orchid	*Platanthera flava var. herbiola*	S2
Snake-mouth orchid	*Pogonia ophioglossoides*	S1
Water smartweed	*Polygonum amphibium var. stipulaceum*	S1
Halberd-leaved tear thumb	*Polygonum arifolium*	S1
Juniper-leaf	*Polypremum procumbens*	S2
Big-toothed aspen	*Populus grandidentata*	S1
Spotted pondweed	*Potamogeton pulcher*	S2S3

Common Name	Scientific Name	State Rank
Slender pondweed	*Potamogeton pusillus var. pusillus*	S1
A lichen	*Pseudocyphellaria aurata*	S1
A liverwort	*Ptilidium pulcherrimum*	S1
A moss	*Ptychomitrium sinense*	S1
Blunt Mountain Mint	*Pycanthemum muticum*	S2
A lichen	*Pycnothelia papillaria*	S1
Water oak	*Quercus nigra*	S2
Nuttall's oak	*Quercus texana*	S2
A lichen	*Ramalina intermedia*	S1
A moss	*Rhabdoweisia crispata*	S1
Horned rush	*Rhynchospora macrostachya var. macrostac*	S1
Golden glade-moss	*Rhytidium rugosum*	S1
A liverwort	*Riccardia multifida*	S1
A lichen	*Rimelia subisidiosa*	S1
Lake cress	*Rorippa aquatica*	S2
Rough coneflower	*Rudbeckia grandiflora var. grandiflora*	S1
Marsh pink	*Sabatia brachiata*	S1
American cupscale	*Sacciolepis striata*	S1
Giant bulrush	*Schoenoplectus californicus*	S1
Canby's Bulrush	*Schoenoplectus etuberculatus*	S1
Hall's bulrush	*Schoenoplectus hallii*	S2
Weakstalk bulrush	*Schoenoplectus purshianus*	S1
Muhlenberg's nut-rush	*Scleria reticularis var. pubescens*	S1
A moss	*Seligeria donniana*	S1
A moss	*Sematophylium marylandicum*	S1
Elliot sida	*Sida elliottii*	S1
Eastern blue-eyed grass	*Sisyrinchium atlanticum*	S2
Narrowleaf peatmoss	*Sphagnum angustifolium*	S1
Northern peatmoss	*Sphagnum capillifolium*	S1
Sphagnum	*Sphagnum inundatum*	S1
Hardhack	*Spiraea tomentosa*	S1
Sullivantia	*Sullivantia sullivantii*	S2
Tradescant aster	*Symphyotrichum dumosum var. strictior*	S2
Small white aster	*Symphyotrichum racemosum var. subdumosum*	S2
Saltmarsh aster	*Symphyotrichum subulatum var. ligulatum*	S2
A moss	*Syrrhopodon texanus*	S1
Water canna	*Thalia dealbata*	S2
A moss	*Thamnobryum alleghaniense*	S1
Cranefly orchid	*Tipularia discolor*	S2
Pale manna grass	*Torreyochloa pallida var. pallida*	S1
Ozark spiderwort	*Tradescantia ozarkana*	S2
A noseburn	*Tragia ramose*	S2
False bugbance	*Trautvetteria caroliniensis*	S2

Common Name	Scientific Name	State Rank
Trepocarpus	*Trepocarpus aethusae*	S1
Marsh St. John's wort	*Triadenum tubulosum*	S1
Running buffalo clover	*Trifolium stoloniferum*	S1
Ozark wake robin	*Trillium pusillum var. ozarkanum*	S2
Cedar elm	*Ulmus crassifolia*	S1
Rock elm	*Ulmus thomasii*	S2
Slender bladderwort	*Utricularia subulata*	S1
Ozark arrow wood	*Viburnum ozarkense*	S2S3
Northern arrow-wood	*Viburnum recognitum*	S1
Smooth white violet	*Viola macloskeyi ssp.pallens*	S2
Barren strawberry	*Waldsteinia fragarioides ssp. fragarioid*	S2
Wolffiella	*Wolffiella gladiata*	S1
Netted chain fern	*Woodwardia areolata*	S2
Yellow-eyed grass	*Xyris torta*	S1
Arkansas yucca	*Yucca arkansana*	S2
White camas	*Zigadenus elegans ssp. glaucus*	S2
Death camas	*Zigadenus nuttallii*	S1

Appendix F—List of Public Lands in the Southeast Missouri Ozarks
Southeast Missouri Ozarks Regional Restoration Plan

County	Public Land	Ownership
Butler	Allred Lake Natural Area	MO Department of Conservation
	Big Cane Conservation Area	MO Department of Conservation
	Carmichael State Forest	MO Department of Conservation
	Coon Island Conservation Area	MO Department of Conservation
	Corkwood Conservation Area	MO Department of Conservation
	Dan River Access	MO Department of Conservation
	Fisk Access	*MO Department of Conservation
	Harviell Access	MO Department of Conservation
	Hendrickson Access	**U.S. Forest Service
	Hilliard Access	*MO Department of Conservation
	Mark Twain National Forest	U.S. Forest Service
	Poplar Bluff Commercial Historic District	National Register of Historic Places
	Poplar Bluff Conservation Area	*MO Department of Conservation
	Ringo Ford Access	*MO Department of Conservation
	South Sixth Street Historic District	National Register of Historic Places
	Sportsman's Park Access	**City of Poplar Bluff
	Sun Conservation Area	MO Department of Conservation
	University Forest Conservation Area	*MO Department of Conservation
Carter	Big Spring Historic District	National Register of Historic Places
	Carter Creek Conservation Area	MO Department of Conservation
	Chilton Creek	The Nature Conservancy
	Current River Conservation Area	MO Department of Conservation
	Hunter Towersite	MO Department of Conservation
	Mark Twain National Forest	U.S. Forest Service
	Miller Community Lake	MO Department of Conservation
	MO Lumber and Mining Company District	National Register of Historic Places
	Ozark National Scenic Riverways	U.S. National Park Service
	Peck Ranch Conservation Area	MO Department of Conservation
	Rocky Creek Conservation Area	MO Department of Conservation
	Van Buren Riverfront Park	**City of Van Buren
Crawford	Anderson Memorial Conservation Area	MO Department of Conservation
	Bird's Nest Access	**Crawford County
	Blue Springs Creek Conservation Area	*MO Department of Conservation
	Campbell Bridge Access	*MO Department of Conservation
	Crooked Creek Conservation Area	MO Department of Conservation
	Dillard Mill State Historic Site	*LAD Foundation
	Huzzah Conservation Area	*MO Department of Conservation
	Keysville Towersite	MO Department of Conservation
	Maramec Spring Fish Hatchery	**The James Foundation
	Maramec Spring Park	**The James Foundation
	Mark Twain National Forest	U.S. Forest Service
	Meramec State Park	MO Department of Natural Resources

*Leased
**MO Department of Conservation Agreement Land

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County	Public Land	Ownership
	Mint Spring Access	MO Department of Conservation
	Onondaga Cave State Park	MO Department of Natural Resources
	Onyx Cave Conservation Area	*MO Department of Conservation
	Riverview Access	MO Department of Conservation
	Sappington Bridge Access	*MO Department of Conservation
	Scotia Iron Furnace Stack	National Register of Historic Places
	Scotts Ford Access	MO Department of Conservation
	Sizemore Memorial Conservation Area	MO Department of Conservation
	Snelson-Brinker House	National Register of Historic Places
	Wagon Wheel Motel Historic District	National Register of Historic Places
	Woods Memorial Conservation Area	MO Department of Conservation
Dent	Brown Conservation Area	MO Department of Conservation
	Cedar Grove Conservation Area	MO Department of Conservation
	Hyer Woods Conservation Area	MO Department of Conservation
	Indian Trail Conservation Area	MO Department of Conservation
	Lenox Towersite	MO Department of Conservation
	Lower Parker School	National Register of Historic Places
	Mark Twain National Forest	U.S. Forest Service
	Montauk Fish Hatchery	*MO Department of Conservation
	Montauk State Park	MO Department of Natural Resources
	Montauk Towersite	MO Department of Conservation
	Nichols Farm District	National Register of Historic Places
	Nova Scotia Ironworks Historic District	National Register of Historic Places
	Ozark National Scenic Riverways	U.S. National Park Service
	Shawnee Mac Lakes Conservation Area	MO Department of Conservation
	Short Bend Access	MO Department of Conservation
	White River Trace Conservation Area	MO Department of Conservation
Franklin	Catawissa Conservation Area	MO Department of Conservation
	Chouteau Claim Access	MO Department of Conservation
	East Central Regional Office	MO Department of Conservation
	Little Indian Creek Conservation Area	MO Department of Conservation
	Long Ridge Conservation Area	MO Department of Conservation
	Mayers Landing Access	MO Department of Conservation
	Meramec Conservation Area	MO Department of Conservation
	Meramec State Park	MO Department of Natural Resources
	Meramec State Park Beach Area Historic District	National Register of Historic Places
	Mill Rock Access	MO Department of Conservation
	Redhorse Access	MO Department of Conservation
	Reiker Ford Access	MO Department of Conservation
	River ‘Round Conservation Access	MO Department of Conservation
	Robertsville State Park	MO Department of Natural Resources
	Sand Ford Access	*MO Department of Conservation

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County	Public Land	Ownership
	Uhlemeyer Access	MO Department of Conservation
	Union Access	*MO Department of Conservation
	Wenkel Ford Access	MO Department of Conservation
Gasconade	Mint Spring Access	MO Department of Conservation
	Mint Spring Conservation Area	MO Department of Conservation
	Tea Access	MO Department of Conservation
Howell	Davidson-Paris Wildlife Area	MO Department of Conservation
	Davis Conservation Area	MO Department of Conservation
	Mark Twain National Forest	U.S. Forest Service
	Mountain View Towersite	MO Department of Conservation
	Ozark National Scenic Riverways	U.S. National Park Service
	Sims Valley Community Lake	MO Department of Conservation
Iron	Bismarck Conservation Area	MO Department of Conservation
	Buford Mountain Conservation Area	MO Department of Conservation
	Elephant Rocks State Park	MO Department of Natural Resources
	Fort Davidson State Historic Site	MO Department of Natural Resources
	Funk Memorial State Forest and Wildlife Area	MO Department of Conservation
	Graves Mountain Conservation Area	MO Department of Conservation
	Ketcherside Mountain Conservation Area	MO Department of Conservation
	Johnson's Shut-Ins State Park	MO Department of Natural Resources
	Mark Twain National Forest	U.S. Forest Service
	Pilot Knob National Wildlife Refuge	U.S. Fish & Wildlife Service
	Riverside Conservation Area	MO Department of Conservation
	Sam A. Baker State Park	MO Department of Natural Resources
	Taum Sauk Mountain State Park	MO Department of Natural Resources
	Ursuline Academy-Arcadia College Historic District	National Register of Historic Places
Jefferson	Brown's Ford Access	MO Department of Conservation
	Flamm City Access	*MO Department of Conservation
	LaBarque Creek Conservation Access	MO Department of Conservation
	Mammoth Access	MO Department of Conservation
	Merrill Horse Access	MO Department of Conservation
	Pacific Palisades Conservation Area	MO Department of Conservation
	Teszars Woods Conservation Area	MO Department of Conservation
	Valley View Glades Natural Area	MO Department of Conservation
	Washington State Park	MO Department of Natural Resources
	Washington State Park CCC Historic District	National Register of Historic Places
	Young Conservation Area	MO Department of Conservation
Madison	Fredricktown City Lake	**City of Fredericktown

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County	Public Land	Ownership
	Mark Twain National Forest	U.S. Forest Service
	Millstream Gardens Conservation Area	MO Department of Conservation
	Roselle Access	MO Department of Conservation
	Thompson Ford Access	MO Department of Conservation
Maries	Spring Creek Gap Conservation Area	MO Department of Conservation
Oregon	Alton Forestry Sub-Office	*MO Department of Conservation
	Cover Memorial Wildlife Area	MO Department of Conservation
	Mark Twain National Forest	U.S. Forest Service
	Myrtle Access	MO Department of Conservation
	Rose Hill Towersite	MO Department of Conservation
Phelps	Little Prairie Conservation Area	MO Department of Conservation
	Maramec Iron Works District	National Register of Historic Places
	Maramec Spring Fish Hatchery	**The James Foundation
	Maramec Springs Park	**The James Foundation
	Mark Twain National Forest	U.S. Forest Service
	Rolla Ranger Station Historic District	National Register of Historic Places
	Rosati Towersite	MO Department of Conservation
	Schuman Park Lake	**City of Rolla-Parks Department
	Scioto Lake	**The James Foundation
	Woods Memorial Conservation Area	MO Department of Conservation
Reynolds	Buford-Carty Farmstead	National Register of Historic Places
	Centerville Access	MO Department of Conservation
	Clearwater Conservation Area	MO Department of Conservation
	Clearwater Lake Management Lands	*MO Department of Conservation
	Current River Conservation Area	MO Department of Conservation
	Grasshopper Hollow	The Nature Conservancy
	Johnson’s Shut-ins State Park	MO Department of Natural Resources
	Ketcherside Mountain Conservation Area	MO Department of Conservation
	Lesterville Access	MO Department of Conservation
	Logan Creek Conservation Area	MO Department of Conservation
	Mark Twain National Forest	U.S. Forest Service
	Nova Scotia Ironworks Historic District	National Register of Historic Places
	Riverside Conservation Area	MO Department of Conservation
	Rocky Creek Conservation Area	MO Department of Conservation
	Taum Sauk Mountain State Park	MO Department of Natural Resources
Ripley	T.L. Wright Memorial Access	**T.L. Wright Lumber Co. & City of Doniphan
	Doniphan Towersite	MO Department of Conservation
	Fourche Creek Conservation Area	MO Department of Conservation

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**MO Department of Conservation Agreement Land

Appendix F—List of Public Lands in the Southeast Missouri Ozarks
Southeast Missouri Ozarks Regional Restoration Plan

County	Public Land	Ownership
	Greenville Ford Access	MO Department of Conservation
	Hemenway Conservation Area	MO Department of Conservation
	Little Black Conservation Area	MO Department of Conservation
	Mudpuppy Conservation Area	MO Department of Conservation
	Mark Twain National Forest	U.S. Forest Service
	Ozark National Scenic Riverways	U.S. National Park Service
	Sand Pond Conservation Area	MO Department of Conservation
St. Francois	Bismarck Conservation Area	MO Department of Conservation
	Bonne Terre City Lake	**City of Bonne Terre
	East Columbia Historic District	National Register of Historic Places
	Farmington Court House Square	National Register of Historic Places
	Giessing Lake	**City of Farmington
	Gruner Ford Access	MO Department of Conservation
	Hager Lake	**City of Farmington
	Iron Mountain Lake	**City of Iron Mountain
	Knob Lick Towersite	MO Department of Conservation
	Leadwood Access	MO Department of Conservation
	Mark Twain National Forest	U.S. Forest Service
	Mineral Area College Range	**Mineral Area College
	Missouri Mines State Historic Site	MO Department of Natural Resources
	Presbyterian Orphanage of Missouri	National Register of Historic Places
	Quarry Pond	**Mineral Area College
	St. Francois State Park	MO Department of Natural Resources
	St. Joe State Park	MO Department of Natural Resources
	St. Joseph Lead Mine at Bonne Terre	National Register of Historic Places
	Syenite Access	MO Department of Conservation
	Thomas Lake	**City of Farmington
	Washington State Park	MO Department of Natural Resources
St. Louis	Allenton Access	MO Department of Conservation
	Alswel-William Lemp Estate	National Register of Historic Places
	Aselman Memorial Addition to Forest 44 CA	MO Department of Conservation
	Barretts Tunnels	National Register of Historic Places
	Bee Tree Park Lake	**St. Louis County Parks
	Carp Lake	**St. Louis County Parks
	Castlewood State Park	MO Department of Natural Resources
	Emmenegger Nature Park	*MO Department of Conservation
	Forest 44 Conservation Area	MO Department of Conservation
	Goodson Conservation Area	MO Department of Conservation
	Greentree Park Access	**City of Kirkwood
	Henry Avenue Historic District	National Register of Historic Places
	Island Lake	**St. Louis County Parks
	Klamberg Woods Conservation Area	*MO Department of Conservation

*Leased
**MO Department of Conservation Agreement Land

Appendix F—List of Public Lands in the Southeast Missouri Ozarks
Southeast Missouri Ozarks Regional Restoration Plan

County	Public Land	Ownership
	Kraus, Russel & Ruth Goetz House	National Register of Historic Places
	New Ballwin Park Lake	**City of Ballwin
	Pacific Palisades Conservation Area	MO Department of Conservation
	Phantom Forest Conservation Area	MO Department of Conservation
	Possum Woods Conservation Area	MO Department of Conservation
	Powder Valley Nature Center	MO Department of Conservation
	Rockwoods Range	MO Department of Conservation
	Rockwoods Reservation	MO Department of Conservation
	Route 66 State Park	MO Department of Natural Resources
	Route 66 State Park Access	**MO Department of Natural Resources
	Saint Stanislaus Conservation Area	*MO Department of Conservation
	Simpson Park Lake	**St. Louis County Parks
	Valley Park Access	MO Department of Conservation
	Vlasis Park Lake	**City of Ballwin
Ste. Genevieve	Hawn State Park	MO Department of Natural Resources
	Hickory Canyons Natural Area	LAD Foundation
	Mark Twain National Forest	U.S. Forest Service
Shannon	Alton Club	National Register of Historic Places
	Angeline Conservation Area	MO Department of Conservation
	Birch Creek Conservation Area	MO Department of Conservation
	Buttin Rock Access	MO Department of Conservation
	Buttin Rock School	National Register of Historic Places
	Chilton Creek	The Nature Conservancy
	Chilton-Williams Farm Complex	National Register of Historic Places
	Current River Conservation Area	MO Department of Conservation
	Current River State Park	MO Department of Natural Resources
	Mark Twain National Forest	U.S. Forest Service
	Ozark National Scenic Riverways	U.S. National Park Service
	Peck Ranch Conservation Area	MO Department of Conservation
	Reed Log House	National Register of Historic Places
	Rocky Creek Conservation Area	MO Department of Conservation
	Roger Pryor Pioneer Backcountry	LAD Foundation
	Shut-In Mountain Fens	The Nature Conservancy
	Sunklands Conservation Area	MO Department of Conservation
	Thomasville Towersite	MO Department of Conservation
	Thorny Mountain	The Nature Conservancy
	Twin Pines Conservation Education Center	MO Department of Conservation
	Two Rivers Access	**Ozark National Scenic Riverways
	Winona Ranger Station Historic District	National Register of Historic Places
Texas	Barn Hollow Natural Area	MO Department of Conservation
	Gist Ranch Conservation Area	MO Department of Conservation

*Leased
**MO Department of Conservation Agreement Land

Appendix F—List of Public Lands in the Southeast Missouri Ozarks
Southeast Missouri Ozarks Regional Restoration Plan

County	Public Land	Ownership
	Mark Twain National Forest	U.S. Forest Service
	Midvale Conservation Area	MO Department of Conservation
	Ozark National Scenic Riverways	U.S. National Park Service
	South Prong Access	MO Department of Conservation
	Summersville Towersite	MO Department of Conservation
Washington	Bismarck Conservation Area	MO Department of Conservation
	Bootleg Access	MO Department of Conservation
	Buford Mountain Conservation Area	MO Department of Conservation
	Caledonia Historic District	National Register of Historic Places
	Hughes Mountain Natural Area	MO Department of Conservation
	Kingston Access	MO Department of Conservation
	Little Indian Creek Conservation Area	MO Department of Conservation
	Mark Twain National Forest	U.S. Forest Service
	Meramec State Park	MO Department of Natural Resources
	Pea Ridge Conservation Area	MO Department of Conservation
	Roger Bilderback Lake	**City of Potosi
	Washington State Park	MO Department of Natural Resources
	Washington State Park Access	**MO Department of Natural Resources
	Washington State Park CCC Historic District	National Register of Historic Places
Wayne	Clearwater District Headquarters	MO Department of Conservation
	Clearwater Lake Management Lands	*MO Department of Conservation
	Coldwater Access	MO Department of Conservation
	Coldwater Conservation Area	MO Department of Conservation
	Flatwoods Conservation Area	MO Department of Conservation
	Graves Mountain Conservation Area	MO Department of Conservation
	Hammer Memorial Conservation Area	MO Department of Conservation
	Lake Wappapello State Park	MO Department of Natural Resources
	Lon Sanders Canyon Conservation Area	MO Department of Conservation
	Mark Twain National Forest	U.S. Forest Service
	Mingo National Wildlife Refuge	U.S. Fish & Wildlife Service
	Riverside Conservation Area	MO Department of Conservation
	Sam A. Baker State Park	MO Department of Natural Resources
	Sam A. Baker State Park Historic District	National Register of Historic Places
	University Forest Conservation Area	*MO Department of Conservation
	Wappapello Lake Management Lands	*MO Department of Conservation
	Yokum School Conservation Area	MO Department of Conservation

*Leased
**MO Department of Conservation Agreement Land

Appendix G—Exemplar Request for Proposals
Southeast Missouri Ozarks Regional Restoration Plan

Request for Proposals
Natural Resource Damage Restoration Projects for the
[Company Name] Settlement

I. Introduction

This Request for Proposal (RFP) for compensatory restoration projects relates to the **[**Company**]**. Monies recovered from a Natural Resource Damage Assessment and Restoration (NRDAR) settlement are being made available for public proposals by the Missouri Trustee Council in accordance with the Southeast Missouri Ozarks Regional Restoration Plan (SEMORRP). The Missouri Trustee Council (hereafter referred to as "Trustees") is comprised of the Missouri Department of Natural Resources, the U.S. Department of Agriculture represented by the U.S. Forest Service and U.S. Department of the Interior represented by the U.S. Fish & Wildlife Service. The SEMORRP provides a process framework that governs the approach for restoration project identification, evaluation, selection and implementation presented within this RFP.

The purpose of this exemplar RFP is to identify the categories of information that will likely be included in future RFPs issued under the SEMORRP. Each RFP will be different, tailored to the specific circumstances of the type of the release and potential injury sustained and the related compensatory restoration goals of the Trustees.

A. Southeast Missouri Ozarks Regional Restoration Plan

The SEMORRP was developed under the NRDAR regulations implementing the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, commonly known as the federal "Superfund" law) to describe the process that will be used by the Trustees to identify appropriate actions to restore, rehabilitate, replace, and/or acquire natural resources equivalent to those injured by hazardous substance releases. The SEMORRP fulfills requirements under the National Environmental Policy Act of 1969 (NEPA) by taking a "hard look" at the environmental consequences of proposed federal actions, to disclose pertinent information about the actions to the public and provide public review and comment on federal actions that affect environmental resources. This exemplar RFP is part of the public review process. Once specific projects are selected, the Trustees may need to conduct additional NEPA analysis to review the specific proposed federal action as described in the selected RFP.

The development of the SEMORRP is a joint effort among state and federal natural resource Trustees and is coordinated with the public. The SEMORRP is jointly administered by the Trustees to assist in carrying out their natural resource trust mandates under CERCLA, the Oil Pollution Act, and the Clean Water Act. Natural resource damages received, either through negotiated or adjudicated settlements, must be used to restore, rehabilitate, replace and/or acquire the equivalent of those natural resources injured and services lost. The goals of the restoration plan are to:

1) Identify the natural resources and services potentially injured by the release of hazardous substances in the Southeast Missouri Ozarks;

2) Develop a request for proposal (RFP) process to evaluate and select compensatory restoration projects to achieve restoration strategies (specific restoration goals identified as part of the RFP process);

3) Identify types and examples of primary restoration projects that will be implemented by the Trustees and/or their contractors;

4) Gain efficiencies in the NRDAR process; provide for consistency and predictability by detailing the NRDAR process, thereby minimizing uncertainty to the public; and,

5) Expedite restoration of potentially injured natural resources and lost services with existing restoration funds.

This exemplar RFP is compliant with the preferred alternative selected in the SEMORRP. The preferred alternative (SEMORRP, Section 5, Alternative D) is a combination of primary and compensatory restoration. As identified in the SEMORRP, priority is given to primary restoration, whenever feasible. However, the Trustees will implement compensatory, off-site restoration when distinct advantages in cost-effectiveness or unique opportunities in protecting or enhancing important natural resources arise.

For purposes of this restoration plan the term "Compensatory Restoration" will be used to refer to the following restorations types:

- *Acquisition of Equivalent Resources or Replacement*: the substitution of an injured resource with one that provides the same or substantially similar services. 43 C.F.R. §§ 14(a) and (ii). An example is the purchase of a property containing high-quality natural resources that is threatened with development or destruction; and

- *Compensatory Restoration*: any action taken to offset the interim losses of natural resources from the date of the event until recovery (USBLM, 2008). An example of compensatory restoration is the removal of undesirable eastern red cedar trees from a glade habitat to compensate for injuries to substantially similar natural resources that occurred elsewhere.

This exemplar RFP identifies information that will be requested in a compensatory restoration RFP including:

- site-specific information as to the type of natural resources potentially injured and/or services lost;
- location of the potentially injured natural resources and/or lost services;
- restoration goals associated with the NRDAR claim and settlement for the [Company Name]; and
- restoration funds available.

Specifications and requirements for restoration projects and proposal submissions will be provided in individual RFPs.

B. Site, Claim and Settlement Information:

This section will contain a description of operations and other activities of [the Company] and any relevant history of the operation. This description will include specific locations of operations as well as the nature, type, and duration of the release of hazardous substances**.**

This section will also contain a description of the nature of the injury, identifying the type of resources which were injured as a result of the release of hazardous substances

This section will also contain a description of the settlement when final and the total amount of restoration funds available for the RFP.

This section will also contain a description of remedial actions, if any, along with a schedule of remediation and coordination of restoration projects with the proposed and/or ongoing remedial actions in the geographic area and/or other restoration actions.

C. Geographic Priority Areas for Restoration

The Trustees will prioritize areas for restoration in a tiered approach as a means of complying with the SEMORRP preferred alternative and to provide restoration specific options for the resources injured by releases of hazardous substances from [Company's] operations. The RFP will specify the criteria used to identify tiered priority areas. This tiered approach is intended to be flexible, allowing the Trustees to designate the number of tiered priority areas as is appropriate for the specific site.

An example of criteria used to establish tiered priority restoration areas is as follows:

1. Tier 1 areas are the highest priority areas. They are the very nearest to the site of injury but are not impacted by contamination.

2. Tier 2 areas are the second highest priority areas for compensatory restoration. They represent areas close to site of injury but not necessarily directly adjacent or adjoining contaminated sites.

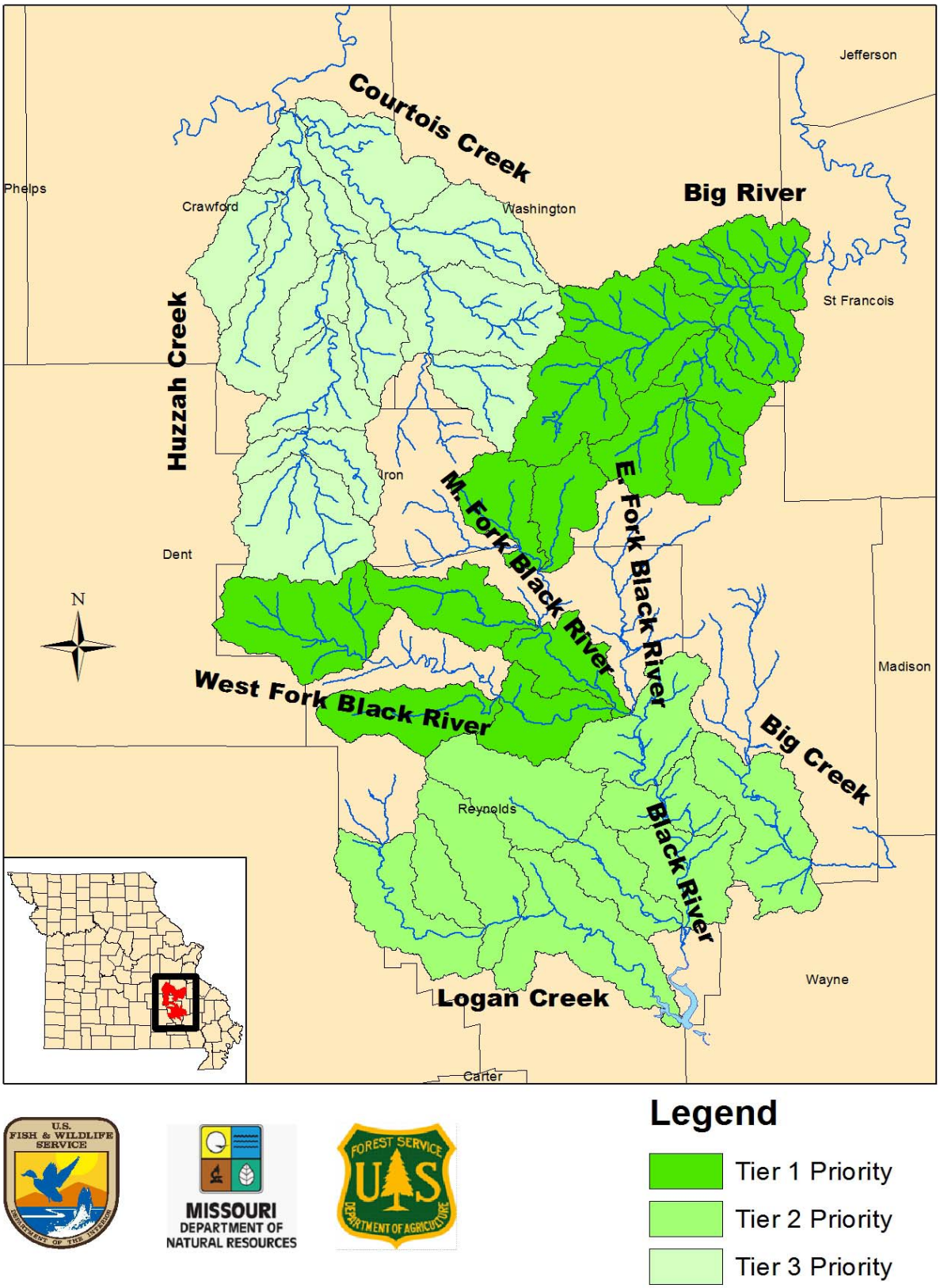
3. Tier 3 priority areas are even farther removed from the site of injury but still represent a priority area for compensatory restoration for the Trustees.

4. Tier 4 priority areas are the lowest priority areas. These sites do not fall within designated priority areas for the Trustees but may represent substantially similar resources to those at the site of injury.

This prioritization scheme will be a factor in the Trustee Decision Matrix included in Appendix A. Projects outside of these priority areas will still be eligible for funding under this RFP but will not receive prioritization**.**

Please note that each RFP will provide a new, updated map of priority restoration areas; Figure 1 is merely an example of how the Trustees may conduct geographic prioritization.

Figure 1. Example Map of Geographic Priority Areas for Restoration



D. Restoration Goals for [Company Name] RFP

NRDAR projects must have a connection to the injured resources. The trust resources within the identified geographic areas include certain injured resources, such as migratory birds and endangered species, other terrestrial and aquatic resources and supporting habitats, and groundwater resources. The restoration goals of [the Company] settlement funds in priority order are to:

1. improve or protect riparian corridor habitat;
2. protect federally threatened, endangered, and candidate aquatic species and their habitat;
3. improve or protect upland migratory bird habitat; and
4. enhance and protect groundwater recharge areas.

Please note: This list of restoration priorities is not inclusive and serves as an example for illustrative purposes only.

II. Restoration Project Types

This example RFP is not being used to solicit actual restoration proposals.

These Restoration Projects types will vary for each RFP; however, the following descriptions are included to improve the understanding of the type of information which will be provided on which a project proposal may be developed.

A. Riparian Corridor, Floodplain, and Wetland Restoration

This restoration category is a high priority for the Trustees because it meets multiple restoration goals. Restored riparian corridor improves migratory bird habitat and protects downstream habitat for federally-listed aquatic species.

B. Acquisition/Legal Protection of High Quality Natural Areas

In some cases, existing high quality habitat can be protected through acquisition or through conservation easements. These areas may be in such a high quality condition that they require little to no enhancement or physical restoration. Property purchase or conservation easements/agreements could be the primary mechanism to ensure high quality habitats are protected from development or other degradation over the long-term. The Trustees desired habitats for protection in priority order include riparian corridors, wetlands, savannas, and other woodlands or forest.

C. Enhancement of Un-contaminated Uplands

A high priority upland enhancement project is woodland restoration. Upland restoration could include burning and/or other methods to control invasive species, re-vegetating to restore native flora, erosion controls, and some type of financial and/or legal assurance of long-term maintenance and protection.

D. Enhancement and Protection of Groundwater Recharge Areas

This restoration category is a high priority for the Trustees because it meets multiple restoration goals. Enhancing and protecting groundwater recharge areas improves human and ecological uses. Therefore, enhancement of existing groundwater recharge areas, or protection of high quality groundwater recharge areas will maximize the value of existing groundwater resources.

E. Natural Resource Restoration-Based Human Use Enhancement Projects

This project category includes construction of some type of enhancement that would increase access, enjoyment, understanding, and/or use of natural resources. Examples of these types of projects include trail construction, constructing boat ramps, educational kiosks, signs, or environmental-based education programs or materials.

III. R e s t o r a t i o n Project Specifications

These Restoration Project Specification descriptions will vary for each RFP, however, for illustrative purposes only, the following descriptions are included to improve the understanding of the type of information which will be provided on which a project may be developed.

Restoration project specifications required within each proposal are included below:

A. Riparian Corridor, Floodplain, and Wetland Restoration

In general, forested canopy is the most beneficial watershed land cover for stream health. A healthy wooded watershed provides for the interception and infiltration of rainfall, leaf litter filters and slows runoff, and the extensive interlocking root systems of forests provide resistance to erosion. The structure of the forested canopy provides shelter for a variety of wildlife, food for insects and other wildlife while growing, and the base of the food chain for stream systems after leaf-fall. The roots of trees near stream channels provide resistance to erosion and downed wood supplies habitat within the stream. In addition, stream health is enhanced by easy (low gradient) transitions between the stream channel and floodplains. Riparian corridor restoration may include lowering banks to provide flood storage and riparian wetland habitat where appropriate. Riparian corridor restoration proposals will include:

<u>Site Preparation and Grading</u>
The proposal will identify the degree of site preparation and grading needed prior to re- vegetation. The proposal will identify any bank re-grading, height, slope details, re- vegetation, and maintenance components. Low angles and low height banks are preferred over high banks and steep angles. Species of conservation interest may exist and should not be disturbed.

<u>Re-vegetation</u>
The proposal will identify the native Missouri tree species to be planted, using the Terrestrial Natural Communities of Missouri (riverfront forest, mesic bottomland forest or appropriate wetland chapters) as a guide. The proposal will identify the season and density of tree planting. For example, the Trustees recommend three gallon RPM (Root Production Method) trees to be planted on 30’ centers in rows that can accommodate future mowing to control competing vegetation. Alternatively, tree planting at a minimum rate of 302 trees per acre on 12' centers for bare root trees. In addition, 50-100 native shrubs (e.g., gray dogwood, *Cornus obliqua*) per acre are recommended, and a native cover crop (e.g., Virginia wild rye, *Elymus virginicus*) seeded. The Trustees recommend planting in fall or early spring.

<u>Conservation Easements, Access, Engineering Controls, and/or Property Purchase</u>
The proposal will identify land in private ownership that requires access agreements necessary to

achieve riparian corridor restoration. The proposal will identify other potential engineered or institutional controls to ensure long-term protection of stream and riparian corridor restoration areas such as fencing, alternative water supplies for livestock, temporary or permanent conservation easements including land-owner payment, including fee-title purchasing, if necessary. The proposal will identify who will hold the easement or title of the property, and will provide information on the time period of the easements or other protective mechanism. Conservation easements or other administrative mechanisms that protect land over longer time periods will be preferred over short-term protections, as reflected in the Appendix A Decision Matrix.

Site Maintenance and Monitoring
The proposal will identify the maintenance and monitoring needed after re-vegetation. The proposal will describe the frequency and type of herbicide treatments, fire, and frequency of mowing or other cultural practices used to facilitate the success of tree planting or other vegetation.

B. Acquisition/Legal Protection of High Quality Natural Areas

Site Description
A description of the size, location, natural features, and habitat value of the property proposed for acquisition or other conservation easement should be included. Describe ownership and management of the land. Address what types of activities will take place on the property, if any.

Conservation Easements, Engineering Controls, and/or Property Purchase
The proposal will identify potential engineered or institutional controls to ensure long- term protection of restoration areas such as temporary or permanent conservation easements including land-owner payment, up to fee title purchasing, if necessary. The proposal will identify who will hold the easement or title of the property, and will provide information on the time period of the easements or other protective mechanism.

Site Maintenance and Monitoring
Acquisition projects that are selected will require a management plan. The management plan will detail methods for permanent protection and enhancement of injured resources. The proposal will identify the maintenance, if any, and monitoring needed for the long- term conservation of the site. The proposal will describe the frequency and type of herbicide treatments, fire, and frequency of mowing and/or other practices used to facilitate long-term habitat stability.

C. Enhancement of Uncontaminated Uplands

Pre-settlement natural community land cover in the SEMO area is estimated to be composed of a complex mosaic of savannahs, glades, woodlands and forests. Today native savannahs, glades, and woodlands are rare in the SEMO area. Therefore, savannah, glade, and woodland restoration will be prioritized first and other restorations will be prioritized second.

Site Preparation and Grading
The proposal will identify the degree of site preparation (burning, herbicide application, and/or grading) needed prior to re-vegetation. Species of conservation interest may exist and site preparation practices should be selected to promote these species.

Re-vegetation

The proposal will identify the native species to be planted, using the *Terrestrial Natural Communities of Missouri* (Nelson, 2005) as appropriate for the area as a guide. The proposal will also identify the season and density of planting.

Conservation Easements, Access, Engineering Controls, and/or Property Purchase
The proposal will identify land in private ownership that requires access agreements necessary to achieve restoration. The proposal will identify other potential engineered or institutional controls to ensure long-term protection of restoration areas such as temporary or permanent conservation easements including land-owner payment, up to fee title purchasing, if necessary. The proposal will identify who will hold the easement or title of the property, and will provide information on the time period of the easements or other protective mechanism.
\
Site Maintenance and Monitoring
The proposal will identify the maintenance and monitoring needed after re-vegetation. The proposal will describe the frequency and type of herbicide treatments, fire, and frequency of mowing or other cultural practices used to facilitate the success of re- vegetation.

D. Enhancement and Protection of Groundwater Recharge Areas

Groundwater provides many types of services such as human consumptive use and non-consumptive use services. Consumptive use services includes such services as providing drinking water supplies; groundwater contributing to lake water levels, yielding recreational benefits to the public, or irrigation for crops. Non-consumptive use services include such services as the value of groundwater for future generations; reserve stock against droughts, or support of land surfaces to avoid subsidence.. In addition, groundwater provides ecological services such as habitat, waters supplies for vegetation and wildlife, or maintenance of hydrologic flows.

Site Description
A description of the size, location, natural features, and value of the property proposed for acquisition or other conservation easement should be included. Describe ownership and management of the land.

Site Preparation and Enhancements
The proposal will identify the current condition of the property prior to any site preparation for enhancements. Species of conservation interest may exist and site preparation should be selected to promote these species. Native species, using the *Terrestrial Natural Communities of Missouri* (Nelson, 2005), will be identified and planted as appropriate. The proposal will identify the season and density of planting, following recommendations from the Trustees. An appropriate annual native or sterile grass cover crop should be planted in the first growing season.

Conservation Easements, Engineering Controls and/or Property Purchase
The proposal will identify potential engineered or institutional controls to ensure long- term protection of restoration areas such as temporary or permanent conservation easements including land-owner payment, up to fee title purchasing, if necessary. The proposal will identify who will hold the easement or title of the property, and will provide information on the time period of the easements or other protective mechanism.

Site Maintenance and Monitoring

Acquisition projects that are selected will require a management plan. The management plan will detail methods for permanent protection and enhancement of injured resources. The proposal will identify the maintenance, if any, and monitoring needed for the long- term conservation of the site. The proposal will describe the frequency and type of herbicide treatments, fire, and frequency of mowing and/or other cultural practices used to facilitate long-term habitat stability.

E. Natural Resource Restoration-Based Human Use Enhancement Projects

Enhancement Description
A description of the enhancement, location, and how it will directly or indirectly benefit natural resources should be included in the proposal.

Facility Maintenance and Monitoring
The proposal will identify the maintenance, if any, and monitoring needed for the long- term stability or operation of the human-use aspect.

F. General Proposal Requirements

In addition to the specifications listed above, all proposals must include the information provided below in the attached "**Restoration Project Information**" sheet.

IV. Proposal Evaluation

Proposals will be evaluated by the Trustee Council. The Trustee Council will evaluate each proposal in accordance with the Decision Matrix included in Appendix A of the SEMORRP and the Proposal Evaluation Process included in Appendix B. The Trustee Council will review the Decision Matrix and make recommendations to their respective Authorized Official and designated Trustee, who will make the final selection for funding.

V. Proposal Schedule

Proposals will be due no sooner than 60 days after issuance of the RFP. The Trustees may extend this due date, if insufficient proposals are received or other circumstances arise that warrant granting more time.

A pre-proposal conference hosted by the Trustees may be held within 60 days after release of the RFP. Additional on-site, pre-proposal conferences may be held at the discretion of the Trustees.

The Trustees will request additional information as necessary from proposal applicants within 30 days after the proposal due date. The Trustees will provide notification of selection to the Project Coordinator identified on the application within 90 days after the proposal submission.

VI. Other Legal Contracting Requirements

Successful projects will enter into a contractual or cooperative agreement with agency releasing the RFP. Additional contracting requirements may be applicable for successful projects. For example professional services or certain construction activities may require proof of insurance or bonding coverage. Successful applicants will be notified of contracting and cooperative agreement needs upon selection of proposals. Final

approval of a project will occur at the completion of any necessary contracts or formalization of cooperative agreements.

VIII. Contacts

RFP submittals should be mailed or submitted electronically to: Fish and

Wildlife Biologist
U.S. Fish & Wildlife Service
101 Park DeVille Dr. Suite A Columbia,
Missouri 65203
Fake_Email@fws.gov or

NRDAR Coordinator
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, Missouri 65102-0176
Fake.Email@dnr.mo.gov

If you have questions pertaining to this RFP, please contact the FWS by phone or email at (573) 234-2132 or Fake_Email@fws.gov .

Restoration Project Information Sheet

General Information

Organization:

Date Submitted:

Contact Name: Title:

Street Address:

City: State:

ZIP:

Phone Number:

Email:

Organization Website:

Project Information

Type of Project:

Project Name:

Location:

Latitude (decimal degrees): Longitude (decimal degrees):

County:

Watershed/Basin:

Project Size (Choose One)

Feet Miles Acres Tons

Project Description: Describe the project, including goals, and objectives. Describe how the restoration project will restore, rehabilitate, replace and/or acquire the equivalent of the natural resources injured by the release of hazardous substances into the environment. Describe the specific habitats, wetland types, or vegetation types and quantities to be protected, reestablished or enhanced, if applicable. Include a site map showing the habitats before and after completion of the project, a draft restoration design, pre-restoration site pictures, detailed maps, if possible, monitoring, and maintenance plans, and any relevant available project specifications.

Describe the surrounding land use. Adjacent property uses (either current or future planned uses) should not detract from the effectiveness of the restoration site. Include a description of the size of the project. The size of a habitat area is a major influence on fish and wildlife species diversity and population density. Other things equal, larger areas support more species and higher numbers of individuals per unit area than smaller habitat areas. Ranking will reflect an advantage to those sites which can demonstrate larger areas of permanently protected habitat for natural resources. If the restoration project is contiguous with currently protected habitat, provide details on this habitat.

Project Benefit(s): Describe how the restoration project benefits natural resources or the uses of those resources injured by the release of hazardous substances into the environment. Projects will be evaluated in terms of whether the benefits can be quantified and the success of the project determined.

Proposed Budget: Provide a detailed budget for the funding requested in descriptive summary categories such as personnel, materials, realty costs, monitoring etc. Proposals stating only a total cost with no budget breakdown will not be considered. Include information pertaining to any types of cost sharing, such as other funding sources or in-kind services that will add to the restoration project. Restoration projects supported, in part, from sources other than the settlement funds made available through this RFP will receive more points during the evaluation process than projects supported solely by these restoration funds. Cooperative projects, with matching dollars and/or in-kind services tied to activities that are compatible with the goals of the SEMORRP, have a higher potential to meet community needs while restoring natural resources. Although settlement funds will not be expended on projects more appropriately funded from other sources, where compatible projects adjoin, funding from several sources could provide much greater benefits to impacted resources than many small, scattered projects. Projects should not duplicate or substitute for traditional funding sources.

The goal of the Trustees is to achieve the maximum amount of restoration (in terms of acres, habitat units, or fish and wildlife restored) with the least expenditure. Cost effective restoration is desirable. Cost overruns will be evaluated on a case-by-case basis and may not be covered by settlement funds if insufficient justification is provided. This addresses the Technical Feasibility criteria listed under CERCLA and the NRDAR regulations. Those projects which demonstrate ability to achieve larger amounts of restoration will rank higher during the evaluation process.

Project Partners

Please provide the name, contact, and involvement (equipment, matching funds, design, etc.) of other organizations or agencies with the project activities.

Maintenance Requirements: The proposal should identify the frequency and costs of long-term maintenance (include costs under Proposed Budget section). Proposals should thoroughly take into account long-term maintenance needs.

Compliance with Applicable Laws and Regulations: Implementation of the restoration project must be consistent with applicable Federal, State, and local laws, ordinances and policies. Address what laws, ordinances, zoning restrictions, policies or regulations are applicable to the project. Example: Will a 404 permit be required under the Clean Water Act? Describe what measures would be taken to secure required permits, who will obtain them and what obstacles may delay the attainment of the permits, if any. It is the project applicant's responsibility to comply with all applicable laws and ordinances.

Timeline: Outline the estimated time and steps or phases needed to complete the project, including an estimated completion date. Estimate how long the project will take to reach its full potential. Relative timeliness of the resource recovery action will be evaluated. The restoration project should make a significant contribution to restoration of natural resources injured without a protracted implementation or resource recovery period. Implementation times of less than three years are preferred. Projects with implementation times greater than three years will need to identify why a greater time period is required and the benefits to restoration of the injured resources with the longer restoration period.

Permanence: Address the longevity of the restoration project. Projects that provide restoration in perpetuity are a higher priority and will receive more points during the evaluation process than projects that expire within a defined time period, or require annual or periodic renewal. Explain the longevity of the project and how the project will ensure the longevity through the use of such instruments as conservation easements, cooperative agreements, or other legal means to guarantee management of the trust resources on behalf of the public.

Measures of Success: Develop a plan that measures or evaluates the success and the effectiveness of the restoration project. The measures of success should be related to the goals and objectives of the proposed project. The plan should include performance standards for all phases of the restoration project and describe how the project will be certified as complete and successful. The success, viability and sustainability of the restoration project should be documented at completion.

For example, in section I.-G ("Restoration Goals"), one of the identified restoration goals for this RFP include restoring riparian corridors. Therefore, restoration projects attempting to restore riparian corridor resources will need to document a long term, quantitative increase in riparian corridor and, potentially, increases in migratory bird usage of the restored area. The Trustees will work directly with selected recipients of restoration funding to develop useful and effective restoration monitoring plans on a site specific basis if the recipient lacks the specific expertise to develop monitoring plans. An example of how to successfully conduct monitoring on riparian corridor restoration projects may be found at: http://ucanr.org/freepubs/docs/8363.pdf

Disclaimer: The submission of project information does **not** guarantee project funding. Projects will be evaluated using criteria identified in CERCLA, NEPA implementing regulations, and related laws. Selection and funding determinations will be made by the Trustee Council.