

CHAPTER 4

4.0 ENVIRONMENTAL CONSEQUENCES

This chapter presents the potential environmental consequences that could occur to the various resources from the adoption of each of the six alternatives (see Sections 2.1.1 through 2.1.5), including the No Action Alternative. The sections in this chapter address the same resource areas as those described in Chapter 3 (Affected Environment) and are presented in the same order. Within each section, any general discussion is followed by an evaluation of the effects of adopting each alternative and, as appropriate, a brief comparison among them. All of this information is summarized in Section 2.2 and in Table 2-1.

To facilitate the analysis of potential environmental effects of development of the MSR study area, TVA developed a range of reasonable alternatives. Under the No Action Alternative, TVA would retain the MSR, and essentially, no new development on the study area would occur. Under the Action Alternatives, TVA would dispose of the property. With the exception of Alternative F, the various Action Alternatives stipulate the types of future development and, thus, provide a framework for considering potential impacts from development.

Obviously, the type of development (e.g., residential, commercial, industrial) is a factor in predicting potential development-related effects. However, the extent and intensity of development (regardless to type) also have a bearing on the likelihood of potential effects. Additionally, the specific nature of certain types of development, especially industrial development, can affect the potential of that development to have adverse environmental effects. For example, industries with small waste streams or low energy demands would likely have less potential to generate adverse environmental effects than manufacturing facilities with large waste streams and high transportation needs.

Although the various alternatives provide a framework for postulating the types of future development on the MSR study area, the precise amount of that development and the nature of such development remain speculative. Therefore, TVA has necessarily taken a qualitative approach in determining and describing potential direct, indirect, and cumulative effects. Additionally, TVA has assumed that the eventual implementation of the Master Plan will guide development on the MSR and its implementation will tend to avoid at least some, if not most, potential adverse development-related effects. Nevertheless, TVA has identified site-specific resources on the MSR and appropriate measures to avoid or mitigate potential adverse effects to these resources.

4.1 Solid and Hazardous Waste

ERC is currently classified under RCRA as a Large Quantity Generator (LQG). This classification applies to facilities that generate 2,200 pounds (1,000 kilograms [kg]) or more of hazardous waste or more than 2.2 pounds (lb) (1.0 kilograms) of acute hazardous waste in any one month. As an LQG, ERC is assigned a unique USEPA identification (ID) number from USEPA (ID Number AL3 640 090 004). This ID number is used, in part, to help track hazardous waste generation of LQGs. Because the Power Service Shop No. 2 (PSS2) is adjacent to the ERC and is also owned by TVA, it shares the same USEPA ID number with ERC. The ERC is specified in TVA's plan for compliance with EO 13514, Federal Leadership in Environmental, Energy, and Economic Performance, which relates to reduction of waste and pollutants before they enter the waste stream (TVA 2010).

Material contained in the SWMUs is not counted toward hazardous waste generation at ERC because it is not considered newly generated. Under the LQG hazardous waste regulations, waste may be stored temporarily for up to 90 days on site before being shipped off site for disposal.

All hazardous waste generated at ERC is manifested and sent to an off-site TSD facility that is permitted by ADEM/USEPA to manage hazardous waste or sent to an approved designated facility (e.g., recycling facility). The current waste streams generated by ERC are largely the result of clean up of laboratories and chemicals no longer in use or needed and wastes from PSS2 project activities. The waste from PSS2 shop is comanaged with waste from ERC. Typical waste streams include outdated chemicals, paint, paint thinners, sandblast media, protective clothing, and oily debris. Over the previous six years, an average of 1,927 kg (or 4,248 lb) each year of hazardous waste was generated for USEPA ID Number AL3 640 090 004 (both from ERC and PSS2). The amounts ranged from 4,273 kg (or 9,420 lb) in 2005 to 1,420 kg (or 3,131 lb) in 2010. Approximately 42 percent of the hazardous waste stream generated in 2010 was due to laboratory cleanouts and closing of laboratory space. In support of EO 13514 and TVA's *Strategic Sustainability Performance Plan*, as TVA continues to close ERC laboratory facilities, the generation of hazardous waste will continue to decline.

As indicated in Section 3.1.2, the entire MSR study area plus additional lands north of Reservation Road (2,260 acres) is currently subject to ADEM HSWA Permit/USEPA ID Number AL3 640 090 004. Although this permit applies to land within the MSR study area that is not known to have contained hazardous waste, the contiguous property is nevertheless subject to the permit provisions. ADEM has provided the following guidance regarding the possible disposal and transfer of the MSR study area.

1. The footprint or permitted area cannot be reduced until TVA has a buyer for the property, and that part of the RCRA permitted area is no longer owned by TVA.
2. The RCRA HSWA Permit should not encumber the sale of any property; however, no land can be sold or transferred from within the existing permit area unless remediated to a level that would allow unrestricted use or transferred with appropriate covenants to protect human health and the environment. Such environmental covenants are outlined in ADEM Administrative Code Chapter 335-5-1 and are attached to and run with the land. Examples of covenants include groundwater development restrictions, use controls, engineering controls, and exclusion requirements. ADEM has authority through the civil court system to enforce these types of covenants.
3. A legal description of the land by survey would be required, and the covenants would be filed with the County Probate Office, pursuant to Section 12 of the Alabama Uniform Environmental Covenants Act.
4. Once a parcel of land is sold, TVA would submit a minor permit modification that indicates the land is no longer owned by the U.S. and under the custody and control of TVA. This is the mechanism for removing parcels of land from the current RCRA HSWA Permit.
5. Sites without any existing hazardous waste could be removed from the permit once a buyer is identified, and the land is removed from the permit via a permit modification. Although it is not TVA's intent, if land containing hazardous waste (i.e., the four SWMU areas included in the ongoing postclosure monitoring program) is transferred, the RCRA HSWA Permit would also be transferred to

the new owner. The new owner would then be required to meet the financial obligations and other regulatory requirements outlined in RCRA. Presently, government agencies are exempt from the financial obligation requirements.

These measures and circumstances would apply to all Action Alternatives (i.e., Alternatives B through F). As required by law, TVA would warrant in the sale deed(s) that the property has been cleaned up to the extent necessary to protect human health and the environment and that the U.S. will perform any cleanup that becomes necessary in the future.

4.1.1 Evaluation of Environmental Impacts

Two aspects of potential effects with respect to solid and hazardous wastes were considered. These included the generation of additional solid and hazardous waste from future development on the MSR study area and the potential for exposure to such wastes or remnant contamination during potential future on-site development.

In the future, once the land is privately owned, conservation, commercial, retail, residential, industrial, or a combination of these development types could occur. To the extent such development occurs, TVA expects construction and operational waste streams generated from the MSR study area property to consist largely of ordinary routine solid waste capable of being disposed of in local landfills. Operational waste streams that may be found at industrial sites could consist of wastes containing heavy metals, oily debris, lighting waste, construction debris, and petroleum-based chemicals related to transportation. This waste would be collected, managed, and disposed in accordance with applicable federal, state, and local laws and regulations. Because of the way this waste would be handled as well as the potential for unmitigated exposure to on-site contamination, TVA expects indirect and cumulative effects of MSR redevelopment, including industrial, over the 20-year plus build-out period to likely be insignificant.

Hazardous and Solid Waste Zones

To assess impacts to portions and to all of the MSR study area from disturbance of buried wastes and the likelihood of exposure of the public to these wastes, the MSR study area was divided into zones. These zones were based on the level of contamination previously detected, proximity to other areas determined contaminated, and areas not eligible for transfer due to postclosure monitoring requirements. This resulted in creation of four zones (A, B, C, and D), which were used in assessing the potential impacts of alternative future uses of the MSR study area. A brief description of each zone is included below. They are also illustrated in Figure 4-1.

Zone A – Zone A is comprised of the four postclosure monitored SWMU areas, which are not proposed for transfer by TVA, and the 31 SWMUs that were remediated to industrial standards. Although the area for the industrial remediated SWMUs (approximately 17 acres) and the area for the postclosure monitored SWMUs (approximately 64 acres that would be retained by TVA) are each relatively small, they are located near each other. Thus, potential effects of future use of this area were evaluated together. Zone A encompasses approximately 300 acres and is located in the northeast quadrant of the MSR study area. Access to Zone A is currently restricted by a fence. Exposure to soil in Zone A must not exceed that which a typical industrial worker encounters while on site at 40 hours per week for 50 weeks or 2,000 hours each year. Impacts of future industrial land uses are

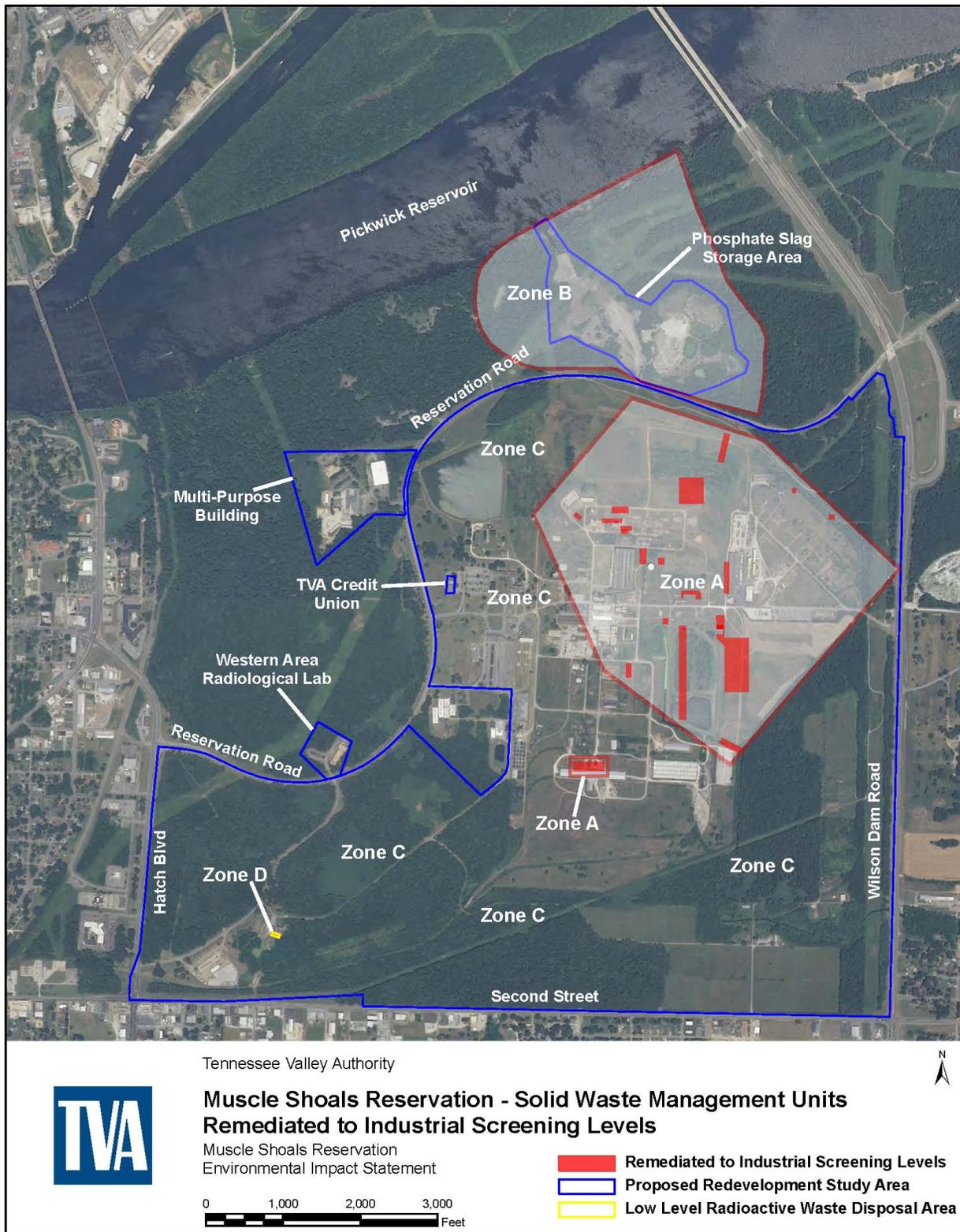


Figure 4-1. Areas of Known Contamination on the Muscle Shoals Reservation Study Area

likely to be minor but could be potentially significant if the area were used for residential purposes but not remediated for residential use standards. Therefore, without additional cleanup, land in Zone A would not be suitable for long-term occupancy such as that presented by a residential scenario.

Unless additional remediation takes place, most of the land in Zone A would remain unsuitable for residential purposes. In addition to the fenced postclosure monitoring areas, access through right-of-way easements for the purpose of conducting groundwater monitoring and visual inspections of these areas would be maintained by TVA under all Action Alternatives (see elements common to all alternatives in Section 2.1).

Zone B – Zone B consists of the phosphate slag storage area, which is located entirely north of Reservation Road. As indicated in Section 3.1.1.4, approximately 1.6 million tons of phosphate slag are stored in this 90-acre area. Because of the naturally occurring radiation from the slag, human exposure in this zone is presently limited to 500 hours per year. Currently, vehicular access to Zone B is restricted. Zone B would be considered only for use as access to the Tennessee River for potential infrastructure enhancements necessary for the development of areas south of Reservation Road under all the Action Alternatives. This area would not be sold or transferred in fee or be made available for development similar to those described in the project Action Alternatives. Without potentially substantial and costly remediation, exposure from residential development and permanent occupation of property in Zone B could result in significant health risk-related impacts.

Zone C – Zone C includes all land south of Reservation Road that is not within Zones A and D and not known to be previously contaminated. It is approximately 1,000 acres in size. The area was not used for any known fertilizer or other chemical handling, storage, or development activities conducted by TVA. This property is suitable for unrestricted use.

Zone D –As indicated in Section 3.1.1.4, the 1999 NRC decision to release the LLRWBS for unrestricted use assumed the site would remain in TVA ownership, its use would not change, and subsurface soil disturbance would not occur. TVA has three options with respect to the LLRWBS (Zone D): (1) retain ownership of the 0.23-acre LLRWBS, (2) dispose of it with deed restrictions designed to prevent future subsurface disturbance, or (3) potentially clean up (i.e., remediate) the property prior to disposing of it, thereby eliminating the need for deed restrictions.

1. Under the retention option, TVA would add this area to the approximately 64 acres of land in four monitored SWMU areas inside the MSR study area that it has decided to retain in federal ownership. This site, however, is small, surrounded by land in Zone C suitable for development, and located some distance from the other SWMUs that will be retained. This could make it difficult to maintain future access to, manage, and administer this property in the event of its retention. However, if the site remains undisturbed and undeveloped, it would not contribute to waste generation or potential human exposure risk.
2. Under the restriction of subsurface disturbance option, no subsurface development or subsurface soil disturbance would be permitted on the LLRWBS. TVA would include necessary provisions in the sale deed to prohibit such disturbance of the LLRWBS at the time of transfer of land containing this small parcel. The recorded transfer instrument with such provisions would run with the land and be available, via chain of title search, to the public and other potential future land purchasers.

TVA would assume responsibility for monitoring this mitigation strategy until proper permanent development of the property occurs. Because of the low radioactivity level of the buried material, even in the unlikely event that the material was disturbed and a pathway for exposure created, there would only be a minimal risk to human health or the environment.

3. Under the LLRWBS cleanup prior to transfer option, TVA could remove the radioactive material and responsibly dispose of it at an appropriate site designated to receive and permanently dispose of such waste. Such a cleanup, likely to residential screening levels, is presently estimated to cost about \$200,000 to \$600,000 (2010 dollars) depending upon the management of the excavated material and its ultimate disposal (James B. Colagross, radiation safety officer, TVA, personal communication, September 28, 2010). Because of these costs, the future timing of and strategy for such a cleanup is highly uncertain at this time. TVA would likely contract for such a removal and subsequent disposal through an appropriately authorized vendor that would already possess or acquire any needed NRC decommissioning license or other necessary federal, state, or local permits or authorizations. If cleaned up and given its size, use of the site would contribute very minor amounts of waste generation and would no longer have the potential to pose any future health risk.

Zone D is the small (100-foot-by-100-foot) fence-restricted area known as the LLRWBS (see Figure 3-2). This site contains low-level radioactive wastes buried from 1966 to 1981. Because these wastes were buried at least 6 feet below grade and were capped with 4 feet of clay, no surface radiation exposure is present above background levels (see Appendix D). Subsurface development and disturbance, such as excavation for building foundations, basements, or underground utilities, would expose workers to low levels of radiation from the buried wastes and would be prohibited. Surface development (e.g., parking lots, concrete slab placement to support some types of commercial, retail, or industrial development) could be permitted. Development, such as concrete or asphalt would actually enhance the shielding effect between the surface of the ground and the buried wastes.

As it relates to Zone D, under the TVA retention option discussed in item No. 1 above, the property would not be sold or developed. Therefore, there would be no potential for effects on future users of the property. Under the site cleanup (i.e., remediation) prior to transfer option as discussed in item No. 3 above, the small acreage of land in Zone D would be suitable for the variety of uses evaluated under all of the Action Alternatives. Under this scenario, no effects from exposure to workers or future users of the property would occur. Analysis under Zone D below considers the potential effects of exposure to contaminants if the site were developed with restrictions on subsurface disturbance.

In addition, the exposure to workers developing and constructing infrastructure enhancements in the phosphate slag storage area (Zone B) would be evaluated for specific proposals for land use plans. Such use of this utility corridor could more likely occur under Alternatives D, E, and F. Therefore, measures to protect worker health and safety would be incorporated into an appropriate mitigation strategy, and potential effects would be minor and insignificant.

The Master Plan, which would eventually be used to guide development, could take into account the potential availability and use of this small site under these various options recognizing the current limitation of its use, as applicable, across the range of alternatives.

4.1.1.1 Alternative A

Under the No Action Alternative, TVA would continue to manage and use the MSR study area for program purposes and economic development in accordance with the 1996 Plan. TVA would continue to receive similar amounts of hazardous waste for disposal and would maintain its classification as an LQG. Because there would be no foreseeable change from current conditions or use of the property, the potential effects of implementing Alternative A on the areas included within Zones A, B, C, and D would be negligible with no increased human health or environmental exposure risks.

4.1.1.2 Alternative B

Adoption of Alternative B would result in the requirement that the land be used in the future for conservation of natural resources and some forms of sustainable low-impact development. Use of some land for small scale, low-impact commercial or light industrial development (i.e., tertiary or quaternary), by its very nature, would not likely result in the generation of large-scale waste streams or significant amounts of solid and hazardous wastes. Thus, the likelihood of additional on-site contamination from site development under Alternative B is low with implementation of applicable measures. The likelihood of additional exposure to hazardous materials stored or remaining in Zones A through D is described below.

Zone A

As previously indicated, Zone A contains approximately 64 acres of land in postclosure monitored SWMUs, which would be retained in federal ownership, and approximately 17 acres cleaned up to industrial screening levels. Depending upon the type of development likely to occur, if any, specific areas of contamination in Zone A would be avoided, or their use would be restricted through covenants. This area could be subject to intermittent and infrequent visitation, but there would be no permanent occupancy. This would have the effect of reducing the potential for human exposure to any remaining hazardous constituents. In addition to the fenced areas, access through right-of-way easements for the purpose of conducting groundwater monitoring and visual inspections would be maintained.

Generally, implementation of Alternative B could result in some indirect beneficial effects if land in Zone A were used for certain low-impact development such as light industry. This largely brownfield area, within the immediate vicinity of the postclosure monitored SWMUs and the SWMUs remediated to industrial standards, could possibly be subject to increased visitation and the resultant opportunity for human exposure. Additional site remediation might be necessary. This additional remediation could result in beneficial effects if the existing contamination were further removed and disposed, allowing more frequent human exposure in this area.

Zone B

Zone B contains the phosphate slag storage area. Currently, exposure to an individual from access to this area is limited to no more than 500 hours per year. As stated previously, the phosphate slag storage area would only be made available for utility access to the Tennessee River, e.g., water intakes. Although the type of development anticipated under Alternative B could feasibly require a utility corridor, this need is unlikely. Thus, under Alternative B, Zone B would likely remain undeveloped and undisturbed. Nevertheless, personal exposure would remain restricted to no more than 500 hours per year. However, the exposure to workers developing and constructing infrastructure enhancements in the phosphate slag storage area would be evaluated for specific proposals for land use plans. Because Zone B is likely to remain unused for utility access

and, if so, specific proposal review and exposure rates further evaluated and mitigated, effects of any approval would be minor.

Zone C

Under Alternative B, conservation and sustainable LID could likely be accommodated on properties within Zone C, as this land is not known to be previously contaminated. No provisions would have to be made for this land, which is currently suitable for residential and other high-occupancy development. Uses such as public parks, wildlife viewing areas, hiking trails, or other recreation-oriented green spaces could easily be accommodated in suitable undeveloped areas (e.g., wetlands, forests, fields, and other naturally appearing landscapes). Because no contaminants are known to occur here, low-impact development areas such as green energy research and development, education, or ecotourism could likely be placed in Zone C with no adverse impact.

Because most property usage would likely be light to moderate and transient in nature, impacts from adoption of Alternative B from waste generation would likely be minor. Some emphasis on solid waste reduction, reuse, or recycling could be expected. These anticipated minor effects could be further reduced if existing buildings, particularly those with no potentially hazardous interior construction material, and infrastructure were adaptively reused. Because land for some low-impact development would be made available and this would result in the presence of additional people on the property, opportunity for exposure to remaining on-site contaminants would be greater compared to Alternative A but probably less than under Alternatives C, D, E, and F. The number of people on the site would probably be larger under these alternatives compared to Alternative A.

Zone D

As indicated above, Zone D is small and has fence-restricted access. Potential effects from the development of Zone D for conservation and LID under Alternative B would result in no effects if used with restrictions on subsurface development. If land in Zone D were sold but subsurface disturbance prohibited, development compatible with Alternative B could occur as long as the shielding effect of the existing cap is not compromised. No radiation exposure would result from surface use at grade, so impacts anticipated under this alternative would be minor.

4.1.1.3 Alternative C

Under Alternative C, there would be a requirement that the MSR study area be used for commercial, retail, and residential development, which would likely result in the construction of shops, theaters, stores, businesses, and homes. This development would likely result in the construction of additional areas of paved surfaces necessary for parking, the receiving and distribution of shipments of materials, and for roads. However, on-site industrial development would not occur under Alternative C. Although the commercial, retail, and residential development anticipated under Alternative C could generate a low to moderate amount of solid nonhazardous wastes, these are not the types of developments that typically generate amounts of hazardous waste requiring regulatory compliance. Types of commercial establishments that handle regulated chemicals or substances, such as gasoline, might require local, state, or federal regulation. Such developments are expected to comply with applicable regulations and, overall, result in minor environmental effects.

Therefore, the amount of hazardous wastes and effects of managing such wastes are expected to be minor. Thus, the potential for on-site contamination under Alternative C

would be low. Anticipated potential exposures to hazardous materials are described below by zone.

Zone A

Zone A property subject to sale or transfer has been remediated to industrial standards. Use of this land for commercial, retail, or residential uses would probably require additional extensive remediation, as this property is considered acceptable for a worker exposure scenario that consists of five days per week for 50 weeks per year.

Except for the postclosure-monitored SWMU areas, which will be retained in federal ownership, most of the contamination contained in such areas in Zone A is the result of chemicals in the top foot of soil. Building foundations and flooring along with the large paved surfaces would be an effective barrier to contact with surface soil. Human exposure to soil, other than by employees, would generally be occasional to infrequent. Due to the suitability of Zone A sites for industrial uses, no permanent occupancy is expected. In addition to the fenced areas, access through right-of-way easements for the purpose of TVA conducting groundwater monitoring and visual inspections would be maintained.

Initially, commercial, retail, and residential construction activities would have the potential for generation of dust and accumulation of construction debris or petroleum-related chemicals to be released to the environment (see Section 4.1). BMPs and good environmental stewardship practices would be effective in mitigating this potential effect. Temporary occupancy with exposure limits no longer than five days per week for 50 weeks per year would not result in adverse impacts to on-site workers. Additional site cleanup of construction of physical barriers between potential receptors and contaminated soil could increase exposure time and reduce the potential significance of effects. Resident development on some parts of Zone A could expose permanent occupants to the potential for significant health effects.

Zone B

Development within the 90-acre phosphate slag storage area would be restricted under Alternative C; therefore, no direct adverse effects would occur. Zone B would be considered for use as access to the Tennessee River for potential infrastructure enhancements necessary for the development of areas south of Reservation Road. Use of Zone B under Alternative C as a utility corridor would not generate significant additional exposures. However, restrictions would be required to prevent disturbance of buried contaminants during construction of any facilities located within Zone B and to limit exposures to no more than 500 hours per year. Therefore, the exposure to workers developing and constructing infrastructure enhancements in the phosphate slag storage area would be evaluated for specific land use proposals. Prior to any land use approvals, TVA would ensure worker safety from radiation exposure while temporarily on site; thus, effects would be minor.

Zone C

Because land within Zone C is not known to be contaminated, Zone C property is considered suitable for residential use and for retail and commercial development. Such development could generate minimal amounts of nonhazardous waste. Certain types of retail establishments (convenience and gasoline retail businesses) might require stringent monitoring requirements if residents were located nearby. Such developments are expected to comply with applicable state and local regulations and, overall, result in minor environmental effects. Because little or no hazardous waste would likely be generated on site, the potential for exposure and adverse effects would be minor.

Because development under Alternative C in Zone C would likely result in the presence of additional people on the MSR study area, the risk of exposure to any contaminants generated on site would be greater compared to Alternatives A and B but potentially the same or less than that likely under Alternatives D, E, and F.

Zone D

The potential effects from development of Zone D for commercial, retail, and residential use under Alternative C could generally be similar to those resulting from development within Zone C. If land in Zone D were sold but subsurface disturbance restricted, commercial, retail, and residential development under Alternative C could occur with minor effects. As long as subsurface disturbance or underground development was restricted, potential adverse health risk from radiological exposure would be minor. Under Alternative C, if development occurs on the existing soil surface (grade), the LLRWBS could be safely developed for the suitable desired uses.

4.1.1.4 Alternative D

Under Alternative D, TVA would stipulate that the MSR study area be used for industrial purposes. This development could range from heavy to light industry, involve extensive land disturbance, and intense land use. It would also likely result in the construction of additional areas of paved surfaces and potentially cause secondary effects from emissions. The amount of solid and hazardous waste that would be generated would depend on the nature of industries that could locate on the area. Nevertheless, the potential for generation of wastes, including hazardous waste resulting from the development of the MSR study area for industrial use, would likely be greater under Alternative D than under the other Action Alternatives. Industries would be required to construct and operate within regulatory standards imposed by other federal or state agencies to limit their environmental impacts. The likelihood of additional on-site contaminant generation (i.e., waste streams) would likely be highest under Alternative D compared to the other alternatives. The discussion below addresses likely exposure within Zones A through D.

Zone A

The Zone A properties subject to transfer have been remediated to screening levels that make them suitable for industrial use. Therefore, this use of Zone A would be compatible with development under Alternative D. Within the 300-acre industrial remediated area, the 64 acres allocated for postclosure-monitored SWMU areas including the phosphorus entombment area, which would be unusable for any other purpose, would be retained by TVA under all the Action Alternatives. In addition to the fenced areas, access through right-of-way easements for the purpose of conducting groundwater monitoring and visual inspections would be maintained. Thus, development of Zone A areas for industrial uses under Alternative D is not expected to result in additional disturbance of buried wastes or unsafe levels of exposure to these materials within Zone A. Because of isolating effects of ground-level development above the soil, potential effects of workers' exposure are expected to be minor.

Zone B

The phosphate slag storage area (Zone B) would be used only for a utility corridor to the Tennessee River. The potential effects of development within Zone B under Alternative D would be similar to those anticipated under Alternative C. However, the need for a utility corridor would likely be higher under Alternative D due to the possibility of additional process water intake or discharge. As a condition of future reviews, the exposure to workers developing and constructing infrastructure enhancements in the phosphate slag storage area will be evaluated for specific land use proposals. Prior to any land use

approvals, TVA would ensure worker safety from radiation exposure while temporarily on site; thus, effects would be minor.

Zone C

Land in Zone C is suitable for industrial use, and TVA would require it be used for industrial uses under Alternative D. Potential effects of industrial development would depend on the nature of the industry and the extent of development. Industrial use would require adherence to current environmental laws and regulations designed to restrict levels of land, water, and air emissions and could necessitate environmental monitoring. Because Zone C is suitable for unrestricted use and industrial-type developments would likely provide short-term employee occupancy substantially isolated from soil contact, no increased human health or environmental exposure risks are anticipated.

Although industry is largely regulated, heavy industrial development would present a potential for direct, indirect, and cumulative effects from environmental (air, land, and water) emissions, generation of hazardous waste, and accidental environmental releases. If regulatory compliance were achieved, effects would still likely be minor.

Zone D

The potential impacts of industrial development in Zone D could generally be similar to those from developing areas of Zone C. If land in Zone D were sold but subsurface disturbance restricted, industrial development under Alternative D could occur with minor effects. Because no surface-level radiation exposure would result, direct and indirect impacts from use of the LLRWBS for industrial uses associated with implementing Alternative D could be similar to those expected under Alternatives B and C. Because this site is small and, with restrictions, no other resources would be adversely affected, impacts of industrial use would be minor.

4.1.1.5 Alternative E

TVA would require that the MSR study area be used for a mixture of conservation, industrial, commercial, retail, and residential development purposes under Alternative E. Use of the site for conservation-oriented and industrial purposes would be somewhat less than that expected under Alternatives B and D. The mixture of site development under Alternative E would generate solid waste, and some hazardous wastes could be produced as a result of industrial by-products. However, because primary or heavy industry would be less likely in the mix of other uses, the generation of large quantities of hazardous waste is not likely. Such waste management would likely be regulated. Incorporating guidance for the Master Plan also suggests that land use development types considered incompatible would not likely be located adjacent to one another without adequate spacing or buffers. Therefore, the potential for additional site contamination from development under Alternative E is relatively low. The discussion below addresses likely exposure within Zones A through D.

Zone A

Under Alternative E, the portion of Zone A remediated to industrial use standards would be suitable only for industrial uses. Development of Zone A land for other uses would probably require additional remediation. Cleanup of this land for some conservation, LID, commercial, retail, or residential uses would probably require additional extensive remediation; Zone A property is only acceptable for a worker exposure scenario that consists of five days per week for 50 weeks per year. Such cleanup would likely involve the removal of a large volume of contaminated soil or other remedial technologies that would be costly. However, in light of use restrictions to minimize occupancy time on site, if used

for appropriate industrial purposes or further remediated, potential effects from radiation exposure would be minor.

Zone B

The phosphate slag storage area (Zone B) would be used only for a utility corridor to the Tennessee River. Although a utility corridor across Zone B could be required under Alternative E, the likelihood of this is somewhat less than that under Alternative D because of the reduced likelihood or extent of industrial-type development. However, as under Alternative D, potential exposure to workers in the phosphate slag storage area will be evaluated for specific land use proposals. Therefore, with restrictions or appropriate mitigation, potential for adverse impacts to worker safety from exposure are minimal.

Zone C

Property within Zone C would be suitable for the mixed use development associated with Alternative E. Because there are no known contaminants affecting this portion of the MSR study area property, such development under Alternative E would not pose undue risks of exposure to contaminants.

Zone D

The potential impacts of mixed use development in Zone D could generally be similar to those from developing areas of Zone C. If land in Zone D were sold but subsurface disturbance restricted, mixed use development under Alternative E could occur. Because no surface-level radiation exposure would result, direct and indirect impacts from use of the LLRWBS for a mixture of uses associated with implementing Alternative E could be similar to those expected under Alternatives B, C, D, and F, and impacts would be minor.

4.1.1.6 Alternative F

As described in Chapter 2, Section 2.1.6, the reasonably likely future uses of the property under Alternative F are those described in Action Alternatives B, C, D, and E and would, therefore, result in a mixture of one or more of those uses or a mixed use reflected in Alternative E. As indicated under Alternative E, use of the site for conservation-oriented and industrial purposes could be somewhat less than that expected under Alternatives B and D. The mixture of site development under Alternative F would also likely generate solid waste, and some hazardous wastes could be produced as a result of industrial by-products. However, the generation of large quantities of hazardous waste is similarly not likely. Therefore, the potential for additional site contamination from development under Alternative F is relatively low.

Because a mixture of uses under Alternative F is expected to be similar to that under Alternative E, the anticipated effects across Zones A through D would be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

4.2 Geology

Because of the underlying depth and homogeneous geology throughout the MSR study area, no disturbance of deeper deposits would likely occur. In addition, because site suitability would be taken into account prior to construction, no significant impact to geological resources from development is expected under any of the project alternatives (see Sections 3.2 and 3.3.1). Detailed site-specific studies consistent with the Master Plan would likely be performed by future landowners or developers to determine the suitability of prospective building sites for the proposed uses. Sound engineering and construction

BMPs would be applied under appropriate state or local laws and regulations to avoid building on potentially unstable sites (e.g., karst terrain). No mining, mineral extraction, or petroleum exploration, drilling, or deep excavation that could cause or contribute to bedrock subsidence are anticipated. Therefore, no indirect or cumulative geological impacts are anticipated from site development under any of the alternatives, including No Action.

4.2.1 Alternative A

Under the No Action Alternative, the MSR study area would remain in federal ownership under the control of TVA. Thus, no foreseeable additional impacts to the existing geological conditions are expected.

4.2.2 Alternative B

Implementation of Alternative B would result in the requirement that the land in the MSR study area be used in the future for conservation of natural resources. Additionally, under this alternative, some forms of sustainable low-impact development would be allowed. Under this alternative, the geological character of the area would probably be preserved, and no development would likely occur in areas where the local landforms of concern (e.g., sinkholes) could be affected.

4.2.3 Alternative C

Under Alternative C, TVA would require the new owner(s) to use the property for commercial, retail, and residential uses purposes. Under Alternative C, based on the type and extent of development, there could be less green space than developed areas compared to Alternative D and possibly Alternatives E and F. Expected loss of pervious surfaces, due to construction of buildings, roads, parking lots, and sidewalks would prevent or slow rain from filtering through the soil. This would cause additional runoff of water (and possibly pollutants) into storm drains and streams. Because the underlying strata are limestone, this could affect the natural surface drainage and flows that form dissolution openings such as sinkholes. Additional on-site development could increase the possibility of a sinkhole developing or existing sinkholes that have been filled by sediment collapsing. Assuming sufficient geological testing occurs, however, this is unlikely. BMPs could be implemented to reduce the likelihood of sediment and/or runoff entering into these karst features. This could reduce the potential for adverse impacts on human health and property damage from new or enlarged sinkholes.

4.2.4 Alternative D

Under Alternative D, use of the MSR study area would be restricted to industrial purposes. Based on the type and extent of development, there could be less green space than developed areas under this alternative compared to Alternative B and possibly compared to Alternatives E and F. This could result in the construction of additional buildings and potentially even less pervious surfaces than under Alternative C. Because of additional weight associated with larger buildings on the property, adoption of Alternative D could possibly result in greater or likely similar impacts as Alternative C to geologic features.

4.2.5 Alternative E

Under Alternative E, TVA would require that the MSR study area be used for a mixture of conservation, commercial, retail, residential, and industrial uses. Actions undertaken following the adoption of Alternative E would likely result in similar impacts to geologic features as under Alternatives C, D, and F. Furthermore, because additional acreage could remain in conservation uses and industrial development would likely be less than anticipated under Alternative D, adoption of Alternative E could result in less impact to geological resources compared to Alternatives C and D.

4.2.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses that could occur. However, as described in Chapter 2, Section 2.1.6, the reasonably likely future uses of the property under Alternative F are those described in Action Alternatives B, C, D, and E and would, therefore, result in a mixture of one or more of those uses or a mixed use reflected under Alternative E.

Because of the underlying depth and homogeneous geology throughout the MSR study area, no disturbance of deeper deposits would likely occur under Alternative F. It is expected that development would not contribute to sinkhole formation. Therefore, impacts of mixed use development under Alternative F are likely to be similar to those described under Alternative E above and the range of effects bounded by the analysis described under Action Alternatives B, C, D, and E.

4.3 Groundwater Resources

A primary concern under each of the alternatives is the potential for groundwater impacts from existing solid/hazardous waste facilities, which have indicated past evidence of local groundwater contamination. These facilities include SWMU 108 (VOCs and nitrate), SWMU 112/194 (six radionuclides), and SWMU 114 (chromium, mercury, and fluoride). Any release of contaminants from these disposal facilities could be transported by groundwater to the Tennessee River, tributary streams, and springs. Similarly, site development has the potential to affect groundwater recharge, especially if large areas of impervious surfaces (i.e., paved areas or areas occupied by buildings) are prevalent. Likewise, spills or other surface contamination can cause groundwater contamination.

The presence of VOCs in groundwater in the area downgradient of SWMU 108 could result in intrusion of VOC vapors into basements or lower levels of any future enclosed structures constructed in this area. VOC concentrations of a few mg/L observed in wells on the margins of SWMU 108 are sufficiently high to be of concern. The approximate area of VOC vapor concern extends downgradient from the northern and western boundaries of SWMU 108 to a line connecting the POC monitoring well clusters POC1A/B, POC2A/B, and POC3A/B (see Figure 3-10). The probability of vapor intrusion in this area appears low. Historical monitoring of POC wells indicates that VOCs in the area of concern are primarily found in bedrock and at low concentrations (see Appendix F). Additionally, soil cover is relatively thick in the area, ranging from approximately 70 to 80 feet, which would reduce the potential for VOCs primarily present in bedrock to reach surface structures. Nevertheless, USEPA (2008b) indicates that buildings within approximately 100 feet of a volatile contaminant source in groundwater or soil are at potential risk of vapor intrusion. Thus, there is a possibility of VOC vapor intrusion into any enclosed building constructed under any of the Action Alternatives. Therefore, under all of the Action Alternatives, TVA would advise potential buyers that, prior to construction of enclosed structures, soil gas data should be collected from above the water table in areas of historical VOC groundwater contamination to determine if a pathway for vapor intrusion is present.

Disposal of the MSR study area under any of the Action Alternatives would include the imposition of property deed covenants that would prohibit the future development of wells used for potable water supply. However, no restrictions would be placed on construction of wells for nonpotable purposes. The restriction on potable groundwater use is necessary to prevent the use of potentially contaminated groundwater beneath certain areas on the MSR study area for potable purposes, i.e., human consumption, bathing, or livestock

consumption. While groundwater beneath certain areas of the MSR study area is likely potable, some areas, such as the area beneath and downgradient of SWMU 108, exhibit contaminated groundwater. Restricting future groundwater development for potable use in all parts of the MSR study area would eliminate the possibility that groundwater withdrawals in uncontaminated areas might induce movement of groundwater from contaminated areas toward active water-supply wells. Therefore, particularly given the availability of supplies through public water systems serving the MSR region (see Section 3.3.3) and the surrounding communities' decreased reliance on well water, off-site exposure to contaminated groundwater is very unlikely.

Groundwater contamination was rigorously evaluated in the RFI Final Report (TVA 1998c) using data gathered during comprehensive hydrogeologic field investigations. Numerical models were used to evaluate the transport and fate of contaminants from existing SWMU 108 and SWMU 112/194 disposal facilities and assess the impacts to potential groundwater receptors. Preclosure conditions were assumed in simulations of both facilities. The addition of landfill covers, designed in accordance with RCRA requirements during facility closure, substantially reduced infiltration of precipitation into both facilities compared to preclosure infiltration. Therefore, preclosure simulations summarized below represent conservative, worst-case estimates of the transport and fate of contaminants from SWMU 108 and SWMU 112/194. Potential effects of SWMU 114 on groundwater and groundwater receptors (not covered in RFI) are also discussed.

SWMU 108

Past groundwater studies identified nitrate and several VOCs (primarily tetrachloroethylene) as originating from SWMU 108, and data collected were sufficient to allow a delineation of the extent of contamination at the site (TVA 1998c). Numerical flow and transport modeling was performed to assess the potential impacts of these contaminants on surface water and groundwater resources in the SWMU 108 locality. Sampling results from Pond Creek sediments upstream and adjacent to the site suggested that VOCs identified in stream sediments, although below RALs, probably originated at SWMU 108. Polyaromatic hydrocarbon contaminants in Pond Creek sediments were found at all sampling locations, and results indicated off-site and possible on-site sources related to coal and coal-combustion by-products.

A groundwater flow and contaminant transport model of the MSR site was developed in connection with the RFI to evaluate the transport and ultimate fate of nitrate and VOC contaminants associated with SWMU 108. The model was applied to three underground layers of variable thickness. The two upper layers represented overburden, and the lower layer represented the highly transmissive epikarst zone. Aquifer testing and dye tracing at MSR suggest that groundwater flow in bedrock was relatively limited. Although the Tuscumbe limestone is a significant aquifer in the region, flow meter profiles indicate very few transmissive fractures in shallow bedrock at the site; consequently, bedrock beneath the epikarst zone was not represented in the model. Details regarding the model setup, boundary conditions, hydraulic/transport parameters, and flow-model calibration were reported in the ERC RFI Final Report, Sections 2.27 and 2.30 (TVA 1998c).

Conservative transport simulations were conducted for nitrate assuming an initial condition of 250 mg/L beneath SWMU 108. This concentration is equivalent to the highest measured value at the site. The simulation period of 20,000 days (approximately 55 years) for modeling represents the life of the landfill. At the end of the 10,000-day simulation period, the limit of the 10 mg/L nitrate level (i.e., the MCL) was within 2,400 feet of SWMU 108. Model predictions after this time show reductions in nitrate concentrations. Nitrate

contamination from SWMU 108 is not expected to extend beyond the MSR study area boundaries at values in excess of the MCL (10 mg/L). The overall extent of contaminant migration is limited by hydrodynamic dispersion and dilution. In the event that nitrate contaminants from SWMU 108 reach the Tennessee River, concentrations would be reduced to immeasurable levels.

Contaminant transport simulations were conducted for tetrachloroethylene at initial concentrations of 20 mg/L, which is equal to the highest measured concentration in groundwater at the site based on November 1997 sampling results. The time interval for this simulation (4,000 days) was roughly equivalent to the period for which monitoring has been conducted at the site. According to the simulation, after 2,000 days, the predicted tetrachloroethylene plume (to the RAL of 5 µg/L) would move horizontally a maximum of about 2,000 feet in the epikarst zone. Modeling results at subsequent time intervals show significant declines in tetrachloroethylene concentrations due to biodecay. At the end of 4,000 days, only small concentrations (less than 20 µg/L) of residual tetrachloroethylene remained in the groundwater system, and RAL concentrations were exceeded only in the immediate area of SWMU 108.

Additional simulations were performed conservatively assuming a constant level of tetrachloroethylene (20 mg/L) beneath SWMU 108. The constant source transport simulation was run for a period of 8,000 days (about 22 years). The predicted tetrachloroethylene plume at 6,000 days reached a point of equilibrium where the contaminant concentrations increased no further in the downgradient direction. Contaminant migration at this point was about 3,000 feet from the center of contaminant mass to the 5 µg/L concentration boundary. Essentially no changes in plume dimensions or concentrations occurred after this time. Although conservative, the results of constant source model simulations indicate that the RAL concentration (5 µg/L) of tetrachloroethylene is expected to extend no more than 3,000 feet from SWMU 108 after 6,000 days.

Transport simulations indicated that natural attenuation processes (i.e., dilution, dispersion, and biodegradation) would prevent tetrachloroethylene from reaching potential downgradient receptors at concentrations exceeding the MCL of 5 µg/L. Furthermore, TVA can infer from the tetrachloroethylene simulations that natural attenuation processes will also reduce concentrations of the other seven VOCs to levels below their action limits before they reach potential receptors. Past monitoring shows that these VOCs occur at concentrations ranging from one to four orders of magnitude (i.e., 10 to 10,000 times) lower than that of tetrachloroethylene.

Tetrachloroethylene is the most prevalent of VOCs at SWMU 108. Although modeling did not specifically address other VOCs, the site monitoring programs assure that groundwater contamination from SWMU 108 remains at acceptable levels and near the facility. The monitored natural attenuation programs for SWMU 108 provides for routine monitoring of VOC and other constituents as described in Section 3.3.2.1. The monitoring plan was implemented in 2003, and routine monitoring is required for a period of 30 years. If POC monitoring wells indicate VOC concentrations are exceeding RALs (see Appendix F), available data will be examined collectively to determine additional investigation requirements at the site. If necessary, alternative remedial measures will be implemented.

SWMU 112/194

Groundwater monitoring results for samples collected in April 1997 from SWMU 112/194 Wells 36-37 indicated six radionuclides exceeded calculated preliminary remediation goals

(PRGs) (see Appendix H). These radionuclides included potassium-40, lead-210, polonium-210, radon-222, total radium, and total uranium. The transport and fate of these radionuclides were evaluated using the same basic groundwater flow and contaminant transport model of the MSR site used in the SWMU 108 evaluations (Julian 1999). Table 4-1 presents the half-lives and adsorption distribution coefficients (K_d) for each radionuclide used in the simulations. A constant concentration source term equal to the highest measured groundwater concentration from Table H-2 in Appendix H was applied to the model. Conservatively, the model recharge (6 inches/year) assumed preclosure conditions without the RCRA closure cap. The spatial dimensions of the source term were the same for all simulations. Source term concentrations for each nuclide were selected as the highest measured concentration for each radionuclide listed in Table H-2 in Appendix H. Simulations for all radionuclides were performed for a period of 500 years. At the time of flow and transport model development, RCRA action levels did not exist for radionuclides of concern. Model-predicted radionuclide concentrations were compared to risk-based PRGs shown in Table 4-1.

Table 4-1. Characteristics of Radionuclides

Nuclide	Atomic Number	Half-Life	Geometric Mean, K_d (g/cm ³)	Preliminary Remediation Goal ^[a] (pCi/L)
K-40	19	1.277E+09 years	75	3.81E+00
Pb-210	82	22.26 years	550	7.05E-02
Po-210	84	138.38 days	3,000	1.46E-01
Rn-222	86	3.83 days	None	NC
Ra-226	88	1600 years	9,100	1.61E-01
U-238	92	4.468E+09 years	1,600	5.87E-01

Source: TVA 1998c

Abbreviations:

g/cm³ = Grams per cubic centimeter

pCi/L = Pico-curies per liter

U-238 = Uranium-238

K_d = Distribution coefficient

Po-210 = Polonium-210

K-40 = Potassium-40

Ra-226 = Radium-226

Pb-210 = Lead - 210

Rn-222 = Radon-222

[a] Under the commercial/industrial land use scenario, risk-based PRGs for radionuclides in groundwater are based on residential exposures (USEPA 1991, Equation 10, page 35).

The downgradient movement of potassium-40 is higher than for any nuclide modeled due to its relatively low ability to be absorbed by other materials and its long half-life. Simulation results indicate potassium-40 movement is primarily downward through the overburden to the epikarst zone, after which the plume moves horizontally through the epikarst toward the Tennessee River. Potassium-40 was predicted to migrate approximately 1,000 feet downgradient of the northern boundary of SWMU 112 at a concentration of 1E-06 mg/L. This is two orders of magnitude (10 to 100 times) less than the corresponding PRG of 5.46E-04 mg/L. Uranium-238, with its relatively long half-life, reached the epikarst, but lateral movement was limited to less than 400 feet downgradient of the northern boundary of SWMU 112/194 at a concentration of 1E-07 mg/L. This is three orders of magnitude (1,000 times) less than the PRG of 8.51E-04 mg/L for uranium-238. Migration of lead-210, polonium-210, radon-222, and radium-226 after 500 years was limited to the overburden without reaching the epikarst zone, mainly due to their short half-lives and/or high capacity to be absorbed by other substances.

Conservative model simulations suggest that radionuclide transport is restricted to the immediate vicinity of SWMU 112 at concentrations that are much less than the PRGs. Simulations indicate only limited vertical and horizontal migration from SWMU 112.

Potassium-40 exhibits the most significant migration potential due to a relatively low absorption capacity and long half-life. However, soil adsorption, hydrodynamic dispersion, and dilution limit the overall extent of contaminant migration. In the likelihood that radionuclide contaminants from SWMU 112 reached the Tennessee River, concentrations would be reduced to immeasurable levels due to dilution by the river.

SWMU 114

Water samples collected from a depression on the top of the east slag pile (Sample 1W) and from a slag pile seep flowing to Pond Creek (Sample 2W) indicated concentrations of cadmium, mercury, and fluoride that exceeded MCLs (see Appendix I). A third water sample (4W) obtained from Pond Creek immediately below the east slag pile also showed a mercury concentration above the MCL. As indicated in Appendix I, groundwater gradients in the slag pile area are northwestward, indicating the Tennessee River would be the primary receptor of seepage emerging from the base of the unlined slag piles. Dilution of leachate seepage entering the river, even under low-flow river conditions, would reduce contaminant concentrations to immeasurably low levels. For example, assuming a net recharge rate of 15 inches/year (the upper end of recharge estimates) (also, see Section 3.3.1.4) over the 90-acre phosphate slag storage area, slag leachate contaminant concentrations would be reduced by a factor of about 60,000 after mixing with low flow (approximately 9,560 cfs) for the Tennessee River. Higher flows would tend to dilute the leachate further.

4.3.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Under this plan, Muscle Shoals and Wilson Dam Reservation property would continue to be used for various potential governmental and nongovernmental purposes including economic development opportunity. The property on the north side of Reservation Road would continue to be allocated for TVA programs including public recreation and open space.

Although past industrial activities have affected groundwater quality in localized areas on the MSR study area, groundwater investigations indicate no evidence of adverse impacts to potential off-site groundwater users or other receptors such as streams or springs. Postclosure monitoring at SWMU 108 indicates that application of the approved Monitored Natural Attenuation Program for SWMU 108 has been successful in assuring regulatory compliance. VOC plumes appear stable, suggesting that the rate at which contaminants are entering the groundwater system beneath SWMU 108 is approximately equal to the rate at which VOC contaminants are being naturally attenuated by biodegradation, dilution, and dispersion. In addition, long-term fate and transport simulations indicate that contaminant concentrations would never exceed RALs beyond a distance of approximately 3,000 feet downgradient of the facility boundary. Should contaminants reach the Tennessee River (the nearest potential downgradient receptor), concentrations would likely be at immeasurable levels. Likewise, postclosure groundwater monitoring of SWMUs 17-37 and 104 has not detected elemental phosphorus.

Modeling indicates that migration of radionuclides observed in groundwater samples at SWMU 112/194 would be limited to the near-field area downgradient of these facilities at concentrations exceeding their PRGs. Should contaminants reach the Tennessee River (nearest potential downgradient receptor) concentrations would be reduced to immeasurable levels. Although groundwater sampling and analysis for SWMU 114 are limited, contaminant concentrations associated with the facility are expected to be at immeasurable levels mixing with the Tennessee River.

The potential for off-site migration of contaminants from existing solid/hazardous waste landfills under Alternative A is low. Prevailing groundwater gradients indicate that any contamination from these landfills would migrate toward the Tennessee River, where contaminants would be diluted to immeasurable levels. Impacts to off-site groundwater users are not expected based on available information regarding groundwater flow in the site vicinity. The existing solid/hazardous waste landfills lie outside of the WHPA of Tuscumbia Big Spring (see Figure 3-11), the only known public groundwater supply in the vicinity of the MSR study area. Present groundwater supply well development in the Muscle Shoals-Tuscumbia-Sheffield area is limited due to the widespread availability of public water service. Furthermore, given the availability of public water, the possibility of extensive future groundwater development in the vicinity of the MSR study area that might alter groundwater-flow patterns in the area appears remote.

4.3.2 Alternative B

Under Alternative B, the MSR study area would be required to be used for conservation of natural resources and some forms of sustainable low-impact development. Because activities that could affect groundwater flow or conditions are not likely, potential groundwater quality impacts of future low-impact development associated with this alternative are expected to be negligible.

The potential long-term impacts to groundwater quality associated with existing solid/hazardous waste disposal areas described under Alternative A would also apply to Alternative B.

4.3.3 Alternative C

Development of the MSR study area under Alternative C could result in the construction of shops, stores, businesses, and residential housing. Implementation of this alternative would likely result in the construction of large areas of pavement associated with roads and parking lots. Potential impacts to local groundwater resources from future commercial, retail, and residential activities include releases of storm water containing contaminants, e.g., petroleum products, nutrients, or pesticides, to groundwater via surface infiltration. Application of measures in appropriate storm water permits and subsequent implementation of BMPs are expected to minimize the likelihood of such occurrences.

In addition to potential effects from future commercial and retail land use, implementation of Alternative C could also potentially contribute to groundwater effects associated with existing solid and hazardous waste facilities (see Section 4.3.1). However, as mentioned above, compliance with regulatory controls would make this additional contribution of pollutants unlikely.

Because a variety of development types could occur under Alternative C, there is a potential for the construction of more buildings and structures and generation of additional pollutants under Alternative C compared to Alternative A or B.

4.3.4 Alternative D

Under Alternative D, TVA would require that the MSR study area be used for industrial development. Potential impacts to groundwater resources in the MSR vicinity associated with this alternative include future soil and groundwater contamination resulting from manufacturing and industrial processes. On-site waste storage/disposal would likely take place during construction and operation of the industry. Activities necessary for industrial operation occasionally result in spills, leaks, or other unintended releases to the

environment. Common industrial contaminants include heavy metals, construction debris, and petroleum-based chemicals related to transportation.

Releases of such industrial contaminants, particularly in liquid form, to ground surface could eventually leach into groundwater beneath the MSR study area, where they would be transported downgradient to groundwater receptors. Depending on location of the release, the ultimate receptor of any contaminated groundwater might be the Tennessee River, an on-site tributary stream, or a spring located either on or off the MSR study area. The magnitude of the potential impact would depend on the nature of the contaminant(s) involved, the magnitude of the release, the ultimate groundwater receptor(s), and the effectiveness of any measures taken by the landowners to mitigate the release.

In addition to potential impacts of future industrial land use, actions resulting from the implementation of Alternative D also include potential groundwater impacts associated with existing solid/hazardous waste facilities as described in Section 4.3.1. With implementation of likely required regulatory controls, potential long-term impacts to groundwater quality would be essentially the same as those anticipated under Alternatives C but greater than those under Alternatives A and B.

4.3.5 Alternative E

Under Alternative E, the MSR study area would be used for a mixture of conservation and low-impact development, industry, commercial and retail development, and residential construction. The potential impacts to local groundwater resources associated with proposed mixed land use activities would be comparable to those expected under the other Action Alternatives. However, the extent and degree of these effects would depend in large part on the types of waste streams generated by future on-site industrial operations, the amount of wastes generated, waste-handling procedures, the amount of pervious and impervious surfaces, and the location of this development with respect to the SWMU areas. Generally, the potential for groundwater effects under Alternative E would be similar to that anticipated under Alternatives C and D, and effects could likely be greater than those expected under Alternatives A and B because industrial development would not be allowed.

4.3.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses that could occur.

Because mixed use development under Alternative F is expected to be similar to that under Alternative E, the potential environmental effects with respect to hazardous wastes generated from such development would likely be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

4.4 Historic and Archaeological Resources

Consistent with Section 106 of the NHPA, historic properties, both archaeological and architectural, can be adversely affected by federal agency undertakings that directly disturb them. Such disturbance could occur through demolition and removal, excavation, substantial site alteration, or indirect effects on their visual setting or character as a result of nearby changes. Because adverse impacts associated with the transfer of eligible historic properties on the Reservation (within the APE) are expected from this undertaking, an MOA has been finalized and executed to identify actions to be taken by TVA and others to avoid, minimize, or mitigate these effects. These eligible properties are listed in Appendix B to the MOA and locations of each shown on a topographic map in Appendix C to the MOA (see

Appendix A to this EIS). Such NRHP-eligible federally owned properties cannot be transferred to nonfederal ownership without compliance with Section 106.

In compliance with Section 106 of the NHPA, TVA evaluated potential effects of its proposed undertaking on eligible historic properties. TVA and the Alabama SHPO agreed that TVA's proposed action constituted a federal undertaking. The Alabama SHPO also concurred that the APE would be the approximately 1,400 acres proposed for transfer.

During TVA's early consultation with the Alabama SHPO, 51 historic buildings and structures within the boundary of the APE were identified as eligible for listing in the NRHP (see Figure 3-12, Section 3.4.2, and Appendix C of Appendix A to this EIS). TVA has completed consultation with the Alabama SHPO on the eligibility of these historic architectural properties (buildings and structures) on the MSR study area. Potential indirect and cumulative effects on eligible architectural resources are taken into account in the executed MOA. Adverse effects on architectural resources would also be mitigated through future implementation of design guidelines and architectural controls for new construction within a reasonable distance of these eligible properties.

In addition, historic archaeological sites 1CT495, 1CT500, and 1CT575 have been identified as part of the MSHD and, therefore, are eligible for the listing in the NRHP. Adverse effects on sites 1CT500 and 1CT575 would be mitigated as a part of an agreed-upon stipulation to collect oral histories of Wilson Village No. 2 from former residents (Appendix A). Potential adverse effects on site 1CT495 shall be dealt with through avoidance of the remaining Wilson Power Plant foundations during any construction in the utility corridor to the Tennessee River. These stipulations, along with those to address historic architectural properties, are included in the MOA.

In consultation with the Alabama SHPO, terms, conditions, commitments, and other necessary stipulations to treat or mitigate adverse effects on historic resources are memorialized in the final executed MOA. As appropriate, these stipulations would apply to all the Action Alternatives, i.e., Alternatives B, C, D, E, and F, under which the land would be transferred from federal ownership. With the application of necessary and appropriate mitigation, potential effects to historic properties across the Action Alternatives would be insignificant.

The MOA contains specific time frames within which specific actions or activities would be completed (see complete detailed description of all stipulations in the MOA in Appendix A). Following is a summary of the actions TVA would undertake:

- TVA shall inventory all original records associated with the design, construction, and operation of the USNP2 and all NFDC facilities comprised of buildings of the first and second architectural periods. Additionally, TVA shall catalog these records in a searchable electronic database and provide the original materials and the database to the Special Collections Department of Collier Library at the University of North Alabama so that these records are appropriately curated.
- TVA shall prepare an NRHP Registration Form (NPS 10-900) for USNP2/NFDC Historic District. The nomination form and supporting information shall be prepared by individuals who meet the professional qualification standards as published in the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation. Listing in the NRHP would tend to encourage and facilitate use of the Federal Tax Credits available for the rehabilitation of historic properties.

- A comprehensive Master Plan for the redevelopment of the MSR Property will be formulated and developed by TVA in partnership with the NACD and/or other appropriate local governments or development entities, with opportunities for public input and with input from the Alabama SHPO. The Master Plan shall include design guidelines for new construction located within a reasonable distance from those buildings that define architectural features of the first and second architectural periods. Additionally, the Master Plan shall incorporate architectural controls for other buildings based on the Secretary of the Interior's standards for the treatment of historic properties. These design guidelines and architectural controls will be made a part of any instrument that transfers the property out of federal ownership and will be enforceable by TVA and/or potentially by appropriate local government(s) or local historic commissions. TVA shall complete certain tasks prior to the transfer of the MSR property, in whole or in part, and submit an annual report updating the status of this stipulation to the consulting parties.
- TVA shall prepare documentation equivalent to Historic American Building Survey Level II for some properties. This level of documentation shall include:
 - Selected existing drawings of primary plans, elevations, and details in digital format and printed as ink on archival material
 - Selected photographs of each principal elevation and all significant interior spaces in digital format with large format negatives and 8-inch by 10-inch archival prints
 - Selected history and description of each building (one page) printed as ink on archival paper
- TVA shall curate any documentation produced as a result of this stipulation with the Special Collections Department of Collier Library at the University of North Alabama.
- Until such time as certain properties have been transferred from federal ownership in accordance with the terms of this agreement, TVA will provide architectural and structural condition assessments, including information on the status of the project and property disposal.
- Historic archaeological sites 1CT500 and 1CT575 have been identified as the remains of Wilson Village No. 2 and are eligible for listing in the NRHP. The proposed undertaking will have an adverse effect on sites 1CT500 and 1CT575. Both archaeological sites have had extensive survey and recordation. To augment the archaeological and documentary information on Wilson Village No. 2, TVA will collect oral histories from a sample of the remaining inhabitants of Wilson Village No. 2. These oral histories shall be transcribed and collated into a descriptive report and curated with the Special Collections Department of Collier Library at the University of North Alabama.

4.4.1 Archaeology

Archaeological resources can be affected directly from ground disturbance associated with clearing, site preparation, and construction. Adverse indirect effects to these resources can occur due to changes in the aesthetic character of the local setting. Such direct and

indirect effects to archaeological resources could occur under any of the Alternatives, including No Action.

Different degrees of site preparation could occur under the different alternatives with Alternative B likely being less extensive and less intensive. Conversely, with regard to potential land use and necessary site preparation, Alternatives C, E, and F could be greater in extent and intensity compared to Alternative B but similar or somewhat less than Alternative D. Thus, some alternatives would be inherently more likely to have greater effects than others would on archaeological resources. Regardless, adverse effects on eligible archaeological sites would be mitigated or avoided.

Alabama state laws would apply to the historic cemeteries known within the APE. These laws, along with the Master Plan, would guide potential future land uses that could affect two locally important cemeteries.

4.4.1.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development opportunities. Under this alternative, land uses, as indicated in the 1996 Plan, would not likely have an adverse effect on the three NRHP-eligible archaeological sites (i.e., 1CT495, 1CT500, and 1CT575) and the two locally important cemeteries (Cuba and Murphy-Kemper-Cockburn) described in Section 3.4. TVA would conduct any additional needed site-specific environmental reviews, including cultural resources assessment, if an action is proposed on the MSR study area that has the potential to affect archaeological resources (belowground properties) or cemeteries in the future.

4.4.1.2 Alternative B

If actions under Alternative B have little or no associated earth-disturbing characteristics, there would be little chance that development under this alternative would have an adverse effect on archaeological sites 1CT495, 1CT500, and 1CT575 and on the Cuba and Murphy-Kemper-Cockburn cemeteries. Prior to any action, including potential land transfer, TVA would assure that unavoidable adverse effects were mitigated consistent with the final executed MOA. If these archaeological sites are proposed for ecotourism, recreational activities, or other low-impact developments involving intensive or extensive earth disturbance at any of these sites, adverse effects could likely occur. Any such activities that could cause unavoidable disturbance at any of these cemetery sites could necessitate the relocation of the graves, in accordance with applicable state laws, if the cemeteries could not be avoided. Unavoidable adverse impacts on eligible archaeological sites are addressed in the final executed MOA.

4.4.1.3 Alternative C

Use of the MSR study area for commercial, retail, or residential development, as required under Alternative C, could result in adverse effects on archaeological sites 1CT500 and 1CT575 and on the Cuba Cemetery and the Murphy-Kemper-Cockburn Cemetery. The need to route utilities through site 1CT495 is unlikely under this alternative; therefore, there would be no anticipated effect on what remains of the Wilson Steam Plant foundations. Measures to mitigate for adverse effects on historic properties affected by the proposed development are documented in the final executed MOA with the Alabama SHPO (see executed MOA in Appendix A). These measures include potential data recovery at the three archaeological sites. Alabama state laws apply to the historic cemeteries. Any activities that could cause an unavoidable disturbance to any of these cemetery sites could

necessitate the relocation of the graves, in accordance with applicable state laws, if the cemeteries could not be avoided.

4.4.1.4 Alternative D

Industrial development, as required under Alternative D, could result in unavoidable adverse effects on the three NRHP-eligible archaeological sites (1CT495, 1CT500, and 1CT575) and the two locally important cemeteries (Cuba and Murphy-Kemper-Cockburn). Unavoidable adverse archaeological impacts would be mitigated through measures included in the MOA. Mitigation of adverse effects on cemeteries in accordance with Alabama state laws and historic buildings and structures as stipulated in the executed final MOA (Appendix A), as described under Alternatives B and C, would be required.

Any utilities requiring open trenching, shallow directional boring, or the placement of poles within site 1CT495 would result in an adverse effect. Avoidance by careful routing around or substantially below (through directional drilling) this site could avoid the adverse effect. If this were not possible, mitigation through data recovery and archival study would be required, as stipulated in the MOA.

4.4.1.5 Alternative E

Development of the MSR study area for mixed use following the adoption of Alternative E would likely adversely affect archaeological sites 1CT495, 1CT500, and 1CT575 and the Cuba and the Murphy-Kemper-Cockburn cemeteries. Such effects could be avoidable but, if not, would be mitigated. Alabama state laws apply to the historic cemeteries. Mitigation agreed upon for treatment of archaeological sites in the final executed MOA (Appendix A), as described under Alternatives B, C, and D, would be required to compensate for adverse effects.

4.4.1.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses that could occur.

Development of the MSR study area following the adoption of Alternative F would likely adversely affect archaeological sites 1CT495, 1CT500, and 1CT575 and the Cuba and the Murphy-Kemper-Cockburn cemeteries. Such effects could be avoidable but, if not, would be mitigated. Alabama state laws apply to the historic cemeteries. Mitigation agreed upon for treatment of archaeological sites in the final executed MOA (Appendix A), as described under Alternatives B, C, D, and E, would be required to compensate for adverse effects.

4.4.2 Architecture

The primary source of direct adverse effects to architectural resources on the MSR study area is the potential demolition of eligible buildings and structures. Over the long term, removal of historic buildings and structures, especially those that are obsolete or unsuitable for adaptive reuse, could occur under any of the alternatives, including the No Action Alternative. Indirect effects to these resources could occur if there are major changes in the visual character or the historic setting of these resources. Although reuse of existing historic buildings on the MSR would likely involve certain structural changes and alterations to the structure, reuse is preferred to demolition of the building and is encouraged by TVA.

Consultation with the Alabama SHPO has been completed and a final executed MOA is included in Appendix A. In accordance with this final MOA, impacts on historic properties are expected to be similar across the range of Action Alternatives.

4.4.2.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development opportunities. Future undertakings that have the potential to affect eligible historic architectural resources (aboveground properties) would continue to be evaluated on a case-by-case basis. TVA would consult with the Alabama SHPO and other consulting parties, as required, if new TVA undertakings are pursued. As appropriate, TVA would work with the consulting parties to address potential adverse impacts to NRHP-eligible properties.

4.4.2.2 Alternative B

Under Alternative B, TVA would require that the MSR study area be used for conservation and sustainable LID uses. Depending on the Master Plan, the objectives of the future property owner(s), and the extent of development, this could result in some stabilization, preservation, rehabilitation, or restoration (i.e., reuse) of a number of aboveground properties eligible for listing in the NRHP. If it occurs, such restoration would likely result in beneficial effects on historic architectural resources. A conservation approach would potentially result in increased exposure, use, and appreciation of the historic architectural resources within the MSR study area. If, however, development under this alternative results in adverse impacts to eligible historic buildings and structures, TVA will adhere to the stipulations in the final executed MOA to mitigate the adverse impacts.

4.4.2.3 Alternative C

Under Alternative C, TVA would require that the MSR study area be used for commercial, retail, and residential development. Depending on the extent of the proposed development, this could result in an adverse effect on historic buildings and structures eligible for listing in the NRHP. Measures to mitigate adverse effects of such historic properties are included in Section 2.3. Stipulations jointly developed with the Alabama SHPO to address adverse impacts are included in the final executed MOA. The stipulations are summarized in Section 4.4 above. TVA will adhere to these stipulations in the final executed MOA to mitigate adverse effects associated with this alternative.

4.4.2.4 Alternative D

Under Alternative D, TVA would require that the MSR study area be used for industrial development. Depending on the extent of the proposed development, this could result in an adverse effect on the properties eligible for listing in the NRHP. Through implementation of stipulations in the final executed MOA (see Appendix A), TVA would mitigate adverse impacts as described under Alternative C.

4.4.2.5 Alternative E

Under Alternative E, TVA would require that the MSR study area be used for mixed use, a combination of conservation and low-impact development and commercial, retail, residential, and industrial uses. Similar to Alternative B, C, and D, some portion of the existing aboveground historic architectural resources would likely be conserved while other NRHP-eligible resources could be adversely affected. Through implementation of stipulations in the final executed MOA (see Appendix A), TVA would mitigate adverse impacts as described under Alternatives C and D.

4.4.2.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses that could occur.

Similar to Alternative B, C, D, and E, some portion of the existing aboveground historic architectural resources would likely be conserved through adaptive reuse while other NRHP-eligible resources could be adversely affected. Through implementation of stipulations in the final executed MOA (see Appendix A), TVA would mitigate adverse impacts as described under Alternatives B, C, D and E.

4.5 Socioeconomic Resources

Several sites in the Shoals area (Colbert and Lauderdale counties) are currently available for industrial development purposes, most of which include existing buildings with relatively small acreage (see Section 3.5.3). Several large industrial sites are also available in the counties surrounding the MSR study area. In addition, there appears to be ample land and market incentives (Lord, Aeck, and Sargent Architecture 2009) to also attract and accommodate new or expanded commercial, retail, and residential development on smaller areas of vacant or undeveloped property in the Muscle Shoals community and Colbert County area. The potential for attracting new jobs and economic expansion opportunities from outside the region is a key to regional economic development and growth. The MSR study area has some potential advantages and attractions if land use is well planned in a holistic and coordinated manner.

TVA anticipates that socioeconomic effects of this development over the 20-year-plus build-out time frame could ultimately extend to the adjoining multicounty region from Limestone County, Alabama, to Tishomingo County, Mississippi. Based on the analysis below, differing levels of positive indirect and cumulative impacts are likely to occur under each of the Action Alternatives. Significant indirect and cumulative effects likely could occur under Alternatives D, E, and F.

4.5.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Existing private sites, vacant lots, and buildings on private land surrounding the MSR study area could continue to be available for development purposes (see Section 3.5). There would be no foreseeable changes in development capabilities and opportunities in the area. Therefore, if Alternative A were selected, there would be essentially no change in the current local socioeconomic conditions due to TVA actions associated with this proposal. However, under Alternative A, any beneficial economic effects that could be achieved by adopting an Action Alternative would not be recognized.

4.5.2 Alternative B

Under Alternative B, TVA would require the new owner(s) of the MSR study area to use the property for conservation and sustainable LID uses. Potential development following the selection of this alternative would have little or no effect on current economic development opportunities, including the quantity or mix of land and existing buildings available on the MSR study area or in the county and surrounding area for business and economic development purposes. However, such development would likely improve the overall quality of life in the area and increase the region's attractiveness as a place to live and to locate businesses. It could also aid in increasing visitation to the area, resulting in some increase in local income and employment. Other than the increase in quality of life, social and economic impacts would likely be relatively minor.

4.5.3 Alternative C

Potential commercial, retail, and residential development under Alternative C would result in the location of new residences and businesses on the site. Some households and businesses might be drawn to the site in lieu of locations outside the Shoals area. However, most of the development would likely be a transfer of locations within the area and would add little to the overall economy of the area. Such development would need to be well planned and attractive; otherwise, it could decrease the overall appeal of the area. It could also have noticeable impacts on quality of life in the area due to the loss of scenic and recreation opportunities in the area. Overall, the potential economic effects under Alternative C would likely be minor, but positive.

4.5.4 Alternative D

Under Alternative D, the MSR study area would be required to be used for industrial purposes. Implementation of Alternative D could have a significant positive effect on income and employment in the area if much of it were used for industrial purposes. Because investors from outside the area or region could be attracted to the site and the immediate area, implementing this alternative would likely have the greatest overall economic effects and result in additional opportunities for growth. Increases in employment and income under Alternative D are likely to be moderate to large.

However, under Alternative D, there could be some decrease in the overall aesthetics of the area, with a corresponding negative impact on the quality of life due to increased traffic, noise, and congestion and the loss of scenic and recreation opportunities in the area.

4.5.5 Alternative E

Well-planned and well-executed development of the property for the required mixed use under Alternative E could result in significant increases in employment and income in the region, along with enhanced quality of life for residents, while resulting in additional opportunities for sustainable growth. Amenities such as walking trails, natural scenery, river views, and abundant trees would continue to be major contributors to quality of life and to enjoyment of the area. Well-designed business and industrial facilities would provide increased income and job opportunities while maintaining and possibly enhancing the overall attractiveness of the area. Increases in employment and income under Alternative E are likely to be moderate.

4.5.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses that could occur.

Well-planned and well-executed development of the property for unrestricted land use under Alternative F could result in significant increases in employment and income in the region. Consistent with the Master Plan, this could occur while maintaining or possibly enhancing other quality of life attributes, similar to that described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E. Increases in employment and income under Alternative F are also likely to be moderate.

Summary

Greater positive economic impacts to the local area are likely under the Action Alternatives as compared to Alternative A. Actions subsequent to the adoption of Alternative D would likely have the greatest beneficial economic impact, although impacts anticipated under Alternative E or F could be similar and/or possibly greater than those under Alternative D. Implementation of Alternative B would have some positive economic impact due to

increased overall attractiveness of the area as a place to visit and do business. Anticipated development under Alternative C would have the smallest positive economic impact because it would most likely attract or relocate development that would have located elsewhere in the local area if the MSR study area were not available.

Development anticipated under Alternative C would have the smallest positive effect on the quality of life as a result of the anticipated attraction or relocation to the MSR of development that would have otherwise located elsewhere in the local area and could have an overall negative impact due to losses in amenities such as recreation opportunities, open space, and scenic quality. Potential effects of adopting Alternative D on quality of life likely would be mixed, with decreases in the overall attractiveness of the area in combination with potential increases in the standard of living for some residents. Negative impacts could be lessened if developments were planned and designed to minimize losses in scenic values and recreational opportunities in accordance with the anticipated Master Plan. Under Alternative A, the No Action Alternative, the current situation would continue, and therefore, there would be no directly attributable effect on quality of life. Development and land use under Alternative B would have little negative impact on quality of life and could result in an overall increase in quality of life for area residents while providing some new economic opportunities. Development of the MSR study area under Alternative E or F could result in the largest increases in quality of life in the area, both by enhancing the attractiveness of the MSR study area and by providing new employment opportunities in an attractive setting.

Potential Future Taxation

Based on TVA's current contribution to the local tax base, the impact on in-lieu-of-tax payments to the State of Alabama from the sale or transfer of the proposed approximate 1,400-acre portion of the MSR would be small (see Section 3.5). If the MSR study area land were transferred from federal ownership to private landowners, the new owners would likely pay property taxes to local governments. How and to what extent the property is ultimately developed is uncertain at this time and would be guided by the Master Plan. However, compared to the property's present contribution to the local tax base, TVA anticipates that its future contribution to the local tax base could be larger.

4.6 Environmental Justice

EO 12898 (Environmental Justice) provides that fair treatment and meaningful involvement be afforded all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. A primary goal of environmental justice is for certain federal agencies to make its achievement a part of its mission "to the greatest extent practicable and permitted by law" by identifying and addressing disproportionately high and adverse human health or environmental effects of its activities. The following analyses address the potential environmental justice effects of possible alternative types of development.

Based on the analysis below, similar to the overall anticipated socioeconomic effects, positive indirect and cumulative environmental justice impacts could likely occur under the Action Alternatives. Significant indirect and cumulative effects on minority and low-income populations could occur under Alternatives D, E, and F. Inclusion of all segments of the population in the planning (i.e., Master Plan) and MSR study area development process could help assure equitable distribution of the benefits.

4.6.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Because there would be no foreseeable change in current uses and access to the property, there would be no effects with respect to environmental justice.

4.6.2 Alternative B

Under Alternative B, the MSR study area would be used for conservation of natural resources and for sustainable LID. Selection of this alternative is likely to increase the overall quality of life in the area and improve its attractiveness as a place to visit, to live, and to locate businesses (see Section 3.5). Minority and low-income populations would receive some of the benefits of these amenities. While potential increases in employment and income resulting from development of the MSR study area under Alternative B are expected to be small, the extent to which disadvantaged populations would benefit could be enhanced by their active involvement in the planning and decision-making processes.

Implementation of Alternative B would provide enhanced recreation opportunities and scenic quality, which would be available to minority and low-income persons. However, while this would provide some new jobs, the number would be relatively small. The number of new jobs resulting from Alternative B would likely be fewer than under the other action alternatives. While this would likely result in fewer job opportunities for minority and low income workers, they would likely not be disproportionately impacted.

4.6.3 Alternative C

Implementation of Alternative C would likely result in the required land uses, location of new residences and businesses on the site. However, as discussed in Section 4.5, the total economic impact would be small over the long term under Alternative C.

Minority populations likely would share in the benefits of development, but the net effect would be minor. Most residential development likely would be in the middle price ranges, providing no direct housing benefit to low-income populations. Low-income populations might benefit directly or indirectly from any increase in construction and other employment. However, any such benefits would be minor.

Few new employment opportunities, including those for minority or low-income individuals, would result. Scenic and recreation opportunities in the area would be disproportionately lessened for these groups, especially low-income families and individuals who are likely to have less access to alternative forms of recreation. In addition, development likely under this alternative would provide few job opportunities that would not otherwise be available in the surrounding area.

4.6.4 Alternative D

Under Alternative D, the MSR study area would be used for industrial development. If much of the property were used for industrial purposes, it could have a significant positive effect on income and employment in the area (see Sections 3.5 and 4.5.4). Minority and low-income workers would also likely benefit. Benefits to these groups would depend, in part, on the type of jobs created by the industries. Access to needed training for all potential workers could greatly assist in assuring equal access and opportunities. Such training might need to involve basic skills as well as job-specific training.

Use of all the property for industrial purposes could have negative impacts on the quality of life in the area by reducing the attractiveness of recreational use of the property. These

impacts would tend to be greater for low-income populations because they are less likely to have access to alternative forms of recreation. However, adverse impacts to recreation are expected to be low to moderate (see Section 4.16.4).

Development actions likely under Alternative D have the potential to provide a relatively large number of jobs across a wide range of skill and education levels, which would benefit all segments of the local population, including minority and low-income populations. On the other hand, some recreation opportunities and scenic value are likely to be lost. Overall, disproportionate impacts to minority and low-income individuals would be less than those for Alternatives B and C, but greater than those under Alternative E or F.

4.6.5 Alternative E

Under Alternative E, well-planned and well-executed development of the property for the required mixed use could result in significant increases in employment and income in the region, along with enhanced quality of life for residents (see Section 3.5 and Section 4.5.5). Amenities such as walking trails, natural scenery, and abundant trees could continue to be major contributors to the quality of life and to enjoyment of the area. At the same time, well-designed business and industrial facilities would provide increased income and job opportunities while maintaining and possibly enhancing the overall attractiveness of the area.

All segments of the population would likely benefit from such development. Whether minority and low-income populations would benefit proportionately would depend on the type of development and uses that occur.

Minority populations likely would share in the benefits of development, but the net effect would be small. Most residential development likely would be in the middle price ranges, providing no direct housing benefit to low-income populations. Low-income populations might benefit directly or indirectly from any increase in construction and other employment. However, any such benefits would be small.

The development activities following adoption of Alternative E would provide a similar increase in employment opportunities for minority and low-income individuals as described under Alternatives C and D. Scenic values and recreation opportunities would continue to contribute to quality of life in the area. Therefore, disproportionate impacts to minority and low-income populations would be smallest under this alternative.

4.6.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses that could occur.

Well-planned and well-executed development of the property for unrestricted land use under Alternative F could result in significant increases in employment and income in the region. As under Alternative E, minority populations likely would share in the benefits of development, but the net effect would be small. Benefits to low-income populations would similarly be small. The disproportionate impacts to minority and low-income populations would similarly be small under this alternative.

4.7 Land Use

Land use and zoning laws are made up of a set of regulations and policies that implement community goals and protect community resources while attempting to guide new development. Zoning regulations affect all new construction, most alterations, commercial

occupancy changes, property line changes, and most site development activity including some tree cutting and landscaping. These regulations are enforced by various federal, state, and local laws. Land use dictates where people live, work, and recreate. Among other factors, land use affects the availability of goods and services, travel patterns, aesthetic quality, perceived levels of congestion, and how people interact with one another. Changes and conflicts in land use can occur when development is replaced or new development is built that is incompatible with current development or inconsistent with current local land use planning, zoning, or other applicable laws or ordinances. How the mix of land uses could change on the MSR study area, dictated by the demands and available supply of goods and services, is considered in the alternatives evaluated and would be taken into account in the Master Plan (also see Section 4.5).

Future land use changes generally affect the potential extent of green space loss, extent of build-out, location, and juxtaposition of new development on the landscape, likely reuse of existing buildings, acceptable noise levels, needed visual buffers, availability of recreation facilities, and other desirable environmental characteristics of the community. As indicated in Section 3.7, the adjoining communities of Sheffield and Muscle Shoals have zoning ordinances. As mentioned in Section 3.12, the local cities and counties in the Shoals area participate in the National Flood Insurance Program and, thus, regulate development of floodprone areas. Local government development and peoples' participation in the master planning process would ultimately determine the types and mix of land uses and their potential locations across the MSR study area.

4.7.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. No foreseeable changes to existing land use are likely on the MSR study area under Alternative A. Thus, any direct, indirect, and cumulative impacts from land use changes, if any, under Alternative A would be negligible. If proposals that would necessitate land use changes were proposed in the future, such requests would be subject to appropriate environmental reviews prior to any decision.

4.7.2 Alternative B

Adoption of Alternative B would require that the land be used for conservation and sustainable LID. Given that more than one-half of the current land cover of the MSR study area includes forest, scrub-shrub vegetation, or grassland, the property readily lends itself to conservation uses such as parks, hiking trails, wildlife viewing areas, and wildlife habitat management areas. Some low-impact development, including commercial uses such as education or research that can be more easily and compatibly integrated into the existing environs, would likely have minimal environmental impacts to land use. These anticipated effects could be further minimized if existing buildings and infrastructure are reused.

Green spaces, combined with some development such as that described above and in Section 2.1.2, could be allocated through the Master Plan process. Such use would be compatible with local laws and ordinances, while maintaining or potentially enhancing the current level and variety of outdoor experiences. Based upon past estimates of recreational use in the area (Section 3.16), there is probably sufficient demand for more opportunities for outdoor enthusiasts, including birders, fishers, and walkers. Based upon the presence of surrounding urbanizing areas, such use would tend to enhance the quality of life of area residents and maintain forests, wetlands, wildlife, and other valued resources.

4.7.3 Alternative C

Adoption of Alternative C would require that the land be used for commercial, retail, and residential uses. This type of development can cause a loss of pervious surfaces, which could contribute to additional surface water runoff and increase the risk of flooding. Standard engineering and construction BMPs to reduce runoff and allow groundwater recharge could include vegetation buffers and the addition of infiltration basins. Any potential for increased flood risks would also be evaluated by local regulators. Locations for certain types, styles, and prices of residential homes and supporting goods and services providers could be addressed in the Master Plan. As mentioned in Section 3.5, commercial, retail, and residential markets in the area would likely provide opportunities for growth.

Although commercial, retail, and residential development of the site along with supporting infrastructure development and needed landscaping would fairly dramatically alter the character of a large part of the area compared to its present use, these future uses would be compatible with surrounding local land use laws and regulations for Sheffield and Muscle Shoals. These types of development would not be incompatible with any known local, regional, or state plans or planning efforts presently underway.

With compliance to applicable state regulations regarding erosion control, storm water management, and BMPs, the potential impacts of implementing Alternative C on land use would likely be minimal. Given the current and projected level (Section 3.5) of similar development in the area and the surrounding Shoals community, indirect and cumulative effects would also likely be minimal. Implementation of Alternative C could likely have greater impacts on land use than Alternatives A and B and less than those expected under Alternative D. However, potentially similar impacts are expected if Alternative E or F is implemented. Both Alternatives E and F could likely involve some conservation but also some industrial development.

4.7.4 Alternative D

Adoption of Alternative D would require that the land in the MSR study area be used for industrial use, which would tend to increase the amount of impervious surfaces common in industrial areas. This could increase the need for storm water control measures to mitigate runoff and reduce the risk of localized flooding. As stated under Alternative C, implementation of standard engineering and construction BMPs could mitigate potential flood risks.

The MSR study area provides a large site (approximately 1,400 acres) and some existing infrastructure that could be used to support industrial development compared to presently known sites in the area and northwest Alabama region (Section 3.5). Other environmental factors (e.g., air quality attainment area, flat topography, nearby water-based transportation) generally make this land potentially attractive for this type of land use. However, depending on the type and extent of industrial development, greater or lesser levels of emissions and indirect or cumulative effects could be anticipated. Given the mix of similar but dispersed industries in the surrounding and adjoining area (e.g., Occidental Chemical Corporation, Monarch Tile Inc.), as well as the past industrial use of a sizeable portion of the area, future industrial use would not be an incompatible use. Evaluation of the project's compatibility, however, would be subject to state and local laws and regulations. Future land uses associated with Alternative D would not be incompatible with any presently known local, regional, or state agency plans. Similar to Alternative C, the locations and extent of certain types of industrial developments could be addressed in the Master Plan.

Because of the greater intensity of land use associated with industrial development, the potential effects of development under Alternative D on current land use could change the aesthetic character of the MSR site. Furthermore, such use, if developed extensively, could increase the potential for greater effects on wetlands, floodplains, water quality, forest (plants), and wildlife. However, given the context of surrounding land use, such change in land use would probably still be minor and similar to those expected under Alternative C. Overall, implementation of Alternative D could likely have greater impacts on land use than any of the other Action Alternatives.

4.7.5 Alternative E

Adoption of Alternative E would require that the land be used for a mixture of conservation, commercial, retail, residential, and industrial uses. The inclusion of conservation uses in a mixed use development could reduce the overall potential for adverse effects from urban runoff created by land use change. The risks of potential flooding could be similar or somewhat less than that expected under Alternative C or D. A mixed use development would likely be compatible with applicable state and local laws and regulations and would not conflict with any presently known local, regional, or state plans, programs, or activities.

The amount of change in land use on the MSR study area would depend on the extent and variety of future development on the site as influenced by the Master Plan. Because of the diversity of possible development options or types under Alternative E, implementation of this alternative would likely result in more and a greater intensity of changes in local land use than that expected under Alternative A or B. Changes in land use could be comparable to, or perhaps less, than those anticipated under Alternative C or D and likely similar to Alternative F.

4.7.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses that could occur. See Sections 2.1.6 and 4.2.6 for discussion of the rationale regarding the relationship between the alternatives and analysis undertaken.

Adoption of Alternative F would allow for unrestricted land uses consistent with the Master Plan. Similar to Alternative E, because of the diversity of possible development options or land use types under Alternative F, implementation of this alternative would likely result in more and a potentially greater intensity of changes in local land use than that expected under Alternative A or B. Changes in land use could be comparable to, or perhaps less than, those anticipated under Alternative C or D and would likely be similar to Alternative E.

4.8 Air Quality, Greenhouse Gas Emissions, and Global Climate Change

4.8.1 Air Quality

Implementation of Alternative B, C, D, E, or F would all have associated transient air pollutant emissions during the construction phase. Impacts from construction activities would be somewhat unique to each alternative. Construction-related air quality impacts are primarily related to land clearing, site preparation, and the operation of internal combustion engines.

Land clearing, site preparation, and vehicular traffic over unpaved roads and the construction site result in the emission of fugitive dust particulate matter (PM) during the site preparation and active construction periods. The largest fraction (greater than 95

percent by weight) of fugitive dust emissions would be deposited within the construction site boundaries. The remaining fraction of the dust would be subject to transport beyond the property boundary. If necessary, emissions from open construction areas and unpaved roads could be mitigated by spraying water on the roadways as needed to reduce fugitive dust emissions by as much as 95 percent (Buonicore and Davis 1992).

Combustion of gasoline and diesel fuels by internal combustion engines (vehicles, generators, construction equipment, etc.) would generate local emissions of PM, nitrogen oxides, CO, VOCs, and SO₂ during the site preparation and construction periods. The total amount of these emissions would generally be small and would result in minimal off-site impacts under all Action Alternatives.

Air quality impacts from construction activities would be temporary and would depend on both man-made factors (e.g., intensity of activity, control measures, etc.) and natural factors (e.g., wind speed, wind direction, soil moisture, etc.). However, even under unusually adverse conditions, these emissions would have, at most, a minor, transient impact on off-site air quality and would be well below the applicable ambient air quality standard. As indicated in Section 3.8, Colbert County is currently in attainment for all criteria pollutants.

Emissions from operational activities, especially industrial emissions, would be subject to regulatory requirements. TVA anticipates that future developers would acquire all necessary state and federal permits and those future on-site operations would comply with applicable air quality laws and regulations. Overall, the air quality impacts of construction-related activities under Alternative B would have the least effect on air quality compared to Alternatives C, D, E, and F.

4.8.1.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Because no foreseeable changes to existing land use would occur on the MSR study area, no additional impacts on air quality in the area are anticipated as a result of the adoption of the No Action Alternative.

4.8.1.2 Alternative B

Adoption of this alternative would require that the MSR study area be used for conservation of natural resources and sustainable LID as described in Section 2.1.2. Thus, no major sources of air pollution are likely under this alternative. Indirect and cumulative impacts on local or regional air quality during construction under this alternative would likely be minor and controlled as described above. Cumulative air quality impacts beyond the construction phase would be insignificant. Impacts of implementation of Alternative B are expected to be similar to or slightly greater than those likely under the No Action Alternative but less than those potentially associated with Alternatives C, D, E, and F.

4.8.1.3 Alternative C

Adoption of this alternative would require that the MSR study area be used for a combination of commercial, retail, and residential development purposes. Indirect and cumulative impacts on air quality during construction under this alternative are likely to have a greater impact than those anticipated under Alternative A or B.

Implementation of Alternative C would facilitate construction of commercial, retail, and residential development, which would generate additional vehicular travel. Gasoline and diesel emissions, from personal vehicles and construction vehicles and equipment, related

to this alternative would be controlled to meet current applicable regulatory requirements such as those found in USEPA 40 CFR Part 80 (USEPA 2007), which provides regulations concerning fuel and fuel additives. Due to fuel regulations and the intermittent nature of the vehicle emissions, the resulting air quality impacts would be minor.

Through its permitting and authorizations processes, the ADEM Division of Air Pollution Control Program prescribes regulations to protect and enhance the public health and welfare through the development and implementation of coordinated statewide programs for the prevention, abatement, and control of air pollution. Air emissions identified from proposed commercial or retail development associated with this alternative would be reviewed to determine if they could be mitigated by control technology, emission-reduction strategies, or avoidance. For any air quality impacts that cannot be mitigated, a full air quality analysis would be required. The nature and scope of that analysis would be defined by a protocol document. The emissions from sources associated with this alternative would be controlled to meet current applicable regulatory requirements. Thus, resulting impacts would likely be minor; however, they would likely be less than those expected under Alternative D and similar to Alternatives E and F.

4.8.1.4 Alternative D

Adoption of this alternative would require that the MSR study area be used for industrial development purposes. Indirect and cumulative impacts on air quality during construction could be greater than Alternative A, B, C, E, or F. Under Alternative D, air quality impacts during construction would be temporary and would not result in significant long-term air quality impacts.

Implementation of Alternative D would facilitate construction of industrial development, which would generate additional vehicular travel. Gasoline and diesel emissions, from personal vehicles and construction vehicles and equipment, would be controlled to meet current applicable regulatory requirements such as those found in USEPA 40 CFR Part 80 (USEPA 2007), which provides regulations concerning fuel and fuel additives. Due to fuel regulations and the intermittent nature of the vehicle emissions, the resulting air quality impacts would be minor.

ADEM regulations would be imposed through its permitting processes to protect and enhance the public health and welfare by controlling potentially hazardous air pollution. Air emissions identified from proposed industrial development associated with this alternative would be reviewed by the state to determine if they could be mitigated by control technology, emission-reduction strategies, or avoidance. Such development could be expected to meet applicable emissions standards, and thus, if compliant, environmental effects would likely be reduced.

4.8.1.5 Alternative E

Adoption of Alternative E would require that land in the MSR study area be used for a mixture of conservation, commercial, retail, residential, and industrial uses. As described under Alternatives B, C, and D, there would be some impacts to air quality during the site preparation and construction phases under any of these alternatives. Consistent with state air pollution control regulatory and enforcement authority, impacts would be mitigated to acceptable legal limits as described above. Potential impacts to air quality from proposed conservation, commercial, retail, residential, and industrial development under Alternative E could be greater than those anticipated under Alternative A or B and potentially would be similar to those under Alternative C, D, or F.

4.8.1.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses that could occur.

As described under Alternatives B, C, D, and E above, there would be some impacts to air quality during the site preparation and construction phases under any of these alternatives.

Guided by implementation of the Master Plan and consistent with state air pollution control regulatory and enforcement authority, impacts would be mitigated to acceptable legal limits as described above. Thus, impacts to air quality from the anticipated mix of land uses under Alternative F could be greater than those anticipated under Alternative A or B and would more likely be similar to those under Alternative C, D, or E.

4.8.2 Greenhouse Gas Emissions and Global Climate Change

As discussed previously in Section 3.8.2, worldwide man-made annual CO₂ emissions are estimated at 30 billion tons, with the U.S. responsible for 20 percent. U.S. electric utilities, in turn, emit 2.2 billion tons, roughly 40 percent of the U.S. total. Figure 4-2 shows how TVA's approximately 73 million tons of annual CO₂ emissions from its 2009 energy production ranks in terms of worldwide, national, and industry emissions and how the wide range of potential alternatives, from minor sources of less than 25,000 tons to a large industrial source, compare to TVA's emissions.

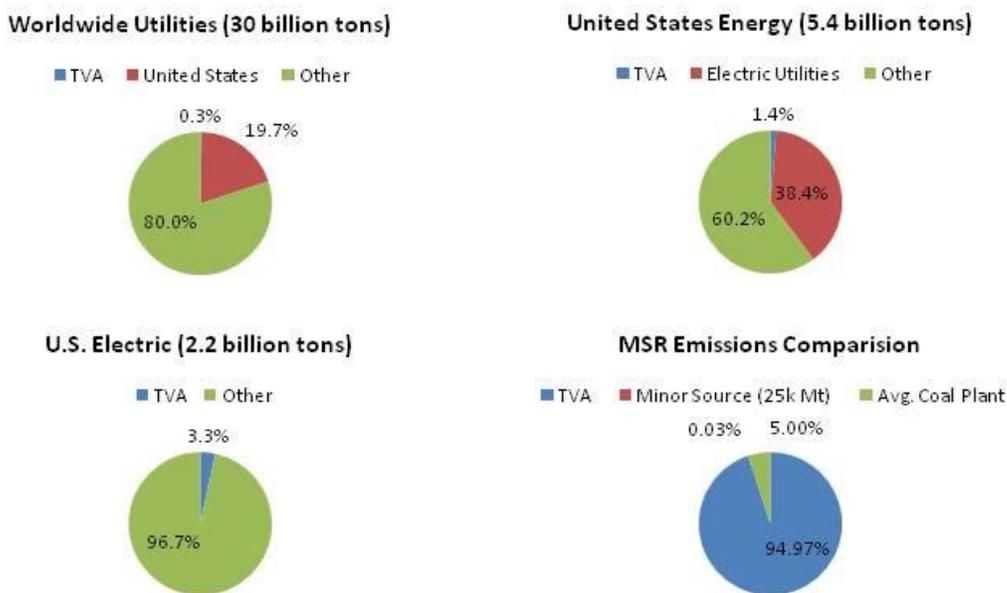


Figure 4-2. 2009 Carbon Dioxide Emission Percentages and Muscle Shoals Reservation Estimates

Amounts of GHG emissions can be estimated, but linkages to specific effects on climate change in particular geographical areas are typically speculative. There are primarily two ways in which proposals, actions, or decisions affecting land use can interact with GHGs and GCC. The first is the potential contribution to emission of GHGs, predominantly varying with the type and amount of land use change; number and size of buildings and infrastructure constructed; the energy demand associated with use of those buildings; the impact of the redevelopment on traffic patterns around and through the property; changes

in barge, rail, and truck traffic potentially influenced by activities on the property; and changes to the vegetation cover. Additional energy demand and traffic would increase CO₂ emissions. Removal of vegetation cover for buildings, parking lots, roads, and other open areas would reduce the CO₂ sink offered by any lost vegetation and would contribute an imperceptible amount globally to higher CO₂ levels in the atmosphere. On the other hand, any redevelopment such as for a park or other recreation uses could result in greater vegetation cover and an increased sink for (removal of) CO₂. Construction and operation of large industrial facilities would be subject to forthcoming GHG emission control requirements. The potential for recruiting a large heavy industry with high GHG emissions, such as a major new fossil power generation facility, and resultant land use changes on the MSR study area is remote. Global atmospheric levels of GHGs would not be changed by any detectable amount by implementation of any of the alternatives. Any new GHG emissions would, however, contribute to the cumulative total amounts of GHGs.

Depending on the nature of the proposed land use, climate change can impact specific proposals or activities that could be considered in the future under each alternative. Vulnerability is defined by the IPCC as “the propensity of human and ecological systems to suffer harm and their ability to respond to stresses imposed as a result of climate change effects” (Adger et al. 2007). For instance, higher air and water temperatures resulting from climate change can influence processes for maintaining compliance with environmental and safety standards at various industrial plants, as well as the efficiency of plant operations. Changes in the temporal distribution of precipitation across the region may require changes in water resource practices that could impact all of the alternatives. Adjustments made due to rising temperatures and water supply changes are examples of adaptation or reducing vulnerability to climate change effects. The potential for recruiting a large heavy industry with high GHG emissions, such as a major new fossil power generation facility, and resultant land use changes on the MSR study area is remote.

Implementation of any of the Action Alternatives would cause some emissions of GHGs associated with transient air pollutant emissions during the construction phase, and potential long-term emissions and changes in land surface characteristics unique to each alternative. The amounts of GHG emissions released would depend on the type and magnitude of redevelopment undertaken (Table 4-2). The range in impacts is potentially broad, with a benefit in reducing or actually possibly offsetting GHGs associated with Alternative B, to the greatest emission of GHGs associated with Alternative D. Without complete information regarding the specific type and amount of redevelopment that would occur on the MSR study area, it is highly speculative to estimate more than the potential for GHG emissions associated with each alternative and, even more so, to predict climate changes. However, TVA has evaluated reasonably foreseeable impacts related to each alternative. Depending on the type and location of future proposals for redevelopment, additional site-specific environmental review may be necessary (e.g., project requiring approval from TVA under Section 26a), and all projects would be subject to applicable federal and state regulations and permitting requirements.

Table 4-2. Emission Factor Estimates

Use	Emissions
Electricity use	7.18 x 10 ⁻⁴ metric tons CO ₂ / kilowatt-hour
Passenger vehicles	5.23 metric tons CO ₂ equivalent / vehicle / year
Home energy use	11.75 metric tons CO ₂ / home / year
Coal-fired power plant emissions	3,850,479 metric tons CO ₂ / power plant / year

Source: <http://blog.sprlaw.com/2010/03/ceq-proposes-nepa-guidance-on-climate-change/>

Emissions related to construction activities including land clearing, site preparation, demolition of certain structures, and adaptation of others and combustion of gasoline and diesel fuels by internal combustion engines would likely be less under Alternative B and similar under Alternatives C, D, E, and F. The total amount of these emissions would be relatively minor with no discernable link or effect to particular changes in global climate.

Effects on Local Climatology

In addition, climate change and GHG-related effects could be exacerbated by changes in local climate driven by other mechanisms. One potentially perceptible impact of MSR redevelopment on local climate could come directly from changes in the land surface. The impacts of land surface characteristics on local climate are well documented. The term “local” refers to areas within about half a mile of the Reservation. Increases in buildings and pavement contribute to warming of the surface due to greater absorption of solar radiation during the day, longer retention of the absorbed heat during the night, and the increase in waste heat released near the ground from building energy use (especially by heating systems, air conditioning systems, and electric lighting). Other energy use by industrial equipment also generates waste heat. These various factors contribute to the “urban heat island” effect that causes large urban centers to be consistently warmer than their rural outskirts. Therefore, any redevelopment that increases the near-surface energy balance will lead to a local warming effect and higher air temperatures by roughly 1-3°F (0.5-1.5°C) depending on weather and time of day. These increases can require greater demand for air conditioning during the warmer months of the year but lower heating requirements during winter.

The opposite effect is possible if Reservation redevelopment were to lead to greater vegetation cover, especially forest cover. Forests are naturally cooler than their surroundings during the day in summer because of the influence of moisture evaporation from trees. This phenomenon occurs to a lesser extent for surfaces covered by lower vegetation (i.e., grasses and shrubs). Increased vegetation cover is being considered by major cities in an effort to reduce cooling demand during the summer (to reduce power usage, GHG emissions, and air pollution formation). Thus, if vegetation cover were to increase from redevelopment, then it could have a small beneficial effect on both the local climate (providing a cooling effect in summer) and could be a new source of CO₂ removal.

4.8.2.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Because no foreseeable changes to existing land use would occur on the MSR study area, no incremental impacts on emission of GHGs or the potential use for climate change are anticipated as a result of the implementation of the No Action Alternative. If other land sale, transfer, or disposal actions were to be considered by TVA, additional appropriate environmental reviews would be required at that time. Climate change predictions are speculative in nature. However, scenarios considered in the EPRI study prepared for TVA (EPRI and TVA 2009) reflect the current state of knowledge and would be unlikely to result in changes to TVA management of current activities on the Reservation. See discussion in Section 3.8.2.

4.8.2.2 Alternative B

Adoption of this alternative would require that the MSR study area be used for conservation of natural resources and sustainable LID as described in Section 2.1.2. Temporary contributions of GHGs during construction of this alternative would likely be minor as described above.

Beyond the construction phase, implementing this alternative would have a negligible beneficial effect on the amount of GHGs and any contribution to cumulative global climate impacts. Conversion to conservation and LID uses could lead to a minor decrease in levels of GHG emissions by way of CO₂ storage through on-site forest restoration or regrowth at sites that are currently treeless. Global atmospheric levels of GHGs would not be changed by any detectable amount. The USEPA estimates that a medium-growth coniferous tree, planted in an urban setting, will sequester approximately 23.2 pounds of carbon over 10 years, or 0.039 metric ton of CO₂ per tree (USEPA 2009b).

4.8.2.3 Alternative C

Adoption of this alternative would require that the MSR study area be used for a combination of commercial, retail, and residential development purposes. Implementation of Alternative C would facilitate construction of commercial, retail, and residential development, which during their operational lifetime would generate additional power demand and vehicular traffic, resulting in increased CO₂ emissions. Removal of vegetation cover for buildings, parking lots, roads, and other open areas would also reduce the CO₂ sink currently afforded by the lost vegetation and would contribute an imperceptible amount globally to higher CO₂ levels in the atmosphere. With proper planning that includes retention of forests and other green space, clustered high-density housing, and nearby retail and commercial developments readily accessible to residents, the mixed use development under Alternative C could result in reduced GHG emissions compared to other developments in the surrounding area.

The proposed level of 25,000 metric tons or more CO₂ equivalent per year is a key indicator as to whether projected impacts will require further analysis (CEQ 2010). Actions under this alternative are unlikely to produce emissions greater than this guidance level.

The implementation of this alternative would likely result in generation of more GHGs than Alternative A or B, similar to Alternative E or F, and less than those generated by Alternative D. In the context of regional, national, or global emissions of GHGs, the contribution of Alternative C would still be considered minor, and a relationship to a particular impact to climate in any particular area would be speculative and unidentifiable.

4.8.2.4 Alternative D

Adoption of this alternative would require that the MSR study area be used for industrial development purposes. Generation of GHGs during construction of this alternative could be greater than the levels anticipated under Alternative A, B, C, E, or F. Alternative F could likely involve some level of conservation but also, compared to Alternative D, some reduced level of industrial development.

Similar to Alternative C, implementation of Alternative D would facilitate construction of industrial development, which during its operational lifetime would generate additional power demand and vehicular traffic, resulting in increased CO₂ emissions. Removal of vegetation cover for buildings, parking lots, roads, and other open areas will reduce the CO₂ sink offered by the lost vegetation and contribute an imperceptible amount globally to higher CO₂ levels in the atmosphere. Depending upon the types of industries developed on the MSR study area, this alternative would likely create the largest potential for generation of GHGs, whether they be in the form of CO₂ (carbon-based fuel combustion) or other gases like chlorofluorocarbons and hydrofluorocarbons, widely used as refrigerants. Industrial use would likely result in the largest increase in mobile-source emissions because residential and retail use would likely redistribute current vehicle traffic, whereas the addition of new jobs could bring additional workforce to the local area. Industrial use could

also lead to increased rail and/or barge traffic, which collectively result in increased GHG emissions.

The relative contribution to generation of GHGs associated with Alternative D has a broad range, dependent upon the type of industry that could develop. Obviously, industry such as coal-fired power plants would greatly exceed the proposed guidance level of 25,000 metric tons or more of CO₂ per year, demonstrating the need for further analysis (CEQ 2010). However, the location of a coal-fired power plant on the MSR study area is highly unlikely. Future proposed industrial development would be subject to current federal and state regulations and permitting requirements.

Depending upon the type of industry developed on the MSR study area, industrial development under Alternative D has the greatest potential not only to generate GHGs but also to be impacted by climate change. Higher air and water temperatures or changes in availability of water supply resulting from climate change can influence processes for maintaining compliance with environmental and safety standards at certain industrial plants, affect the efficiency of plant operations, influence the attractiveness of the site for certain industries, or even be a determinant as to whether certain types of industrial development could occur. Thermal effects on rivers are typically considered in association with nuclear and fossil power projects or some large secondary industries.

4.8.2.5 Alternative E

Under Alternative E, the MSR study area would be used for a mixture of conservation, commercial, retail, residential, and industrial uses. As described under Alternatives B, C, and D, there would be some impacts to levels of GHGs generated under any of these alternatives, ranging from small benefits associated with Alternative B, to generation of moderate amounts of GHGs associated with Alternative D, relative to the other alternatives. Cumulative impacts to generation of GHGs from the mix of proposed conservation, commercial, retail, residential, and industrial development under this alternative would be encompassed by and intermediate with regard to those described above for Alternatives B, C, and D.

Because the likelihood for industrial development is somewhat less under both Alternatives E and F than the potentially extensive industrial development possible under Alternative D, the potential effects of adopting Alternative E or F are likely less than those anticipated under Alternative D and likely similar to those expected under Alternative C. However, those effects would likely be greater than expected under Alternative A or B.

4.8.2.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale, and no restrictions would be placed on the types of future land uses that could occur.

As described under Alternatives B, C, D, and E above, there would be some impacts to levels of GHGs generated under any of these alternatives, ranging from small benefits associated with Alternative B, to the potential for generation of moderate amounts of GHGs associated with Alternative D, relative to the other alternatives. Cumulative impacts to generation of GHGs from the mix of proposed conservation, commercial, retail, residential, and industrial development under this alternative are likely to be similar to those under Alternative E and would be bounded by the effects described above for Alternatives B, C, D, and E.

4.9 Soils and Prime Farmland

The main mechanism by which potential effects to soils and prime farmlands can occur is the direct conversion of arable land to other uses that preclude its use for agriculture. Much of the prime farmland within the MSR study area was previously converted to nonfarm use prior to the enactment of the FPPA in 1981. The prime farmland within this study was determined to have a relative value below the threshold for warranting protection under the FPPA (see Figures 3-23 and 3-24). Therefore, conversion of the remainder of the Reservation to nonfarming uses would have minor effects.

The degree of potential impacts on soils and prime farmland depends on the amount, location, and intensity of development under the different Action Alternatives. For the purpose of analysis, the assumption was made that more intensive development would likely take place in areas that are already developed, especially within the ERC complex. Development could involve the construction of new structures or the reuse of existing structures. This assumption is based on the fact that the ERC complex is well suited for development due to the existing infrastructure. Some areas may be converted to other uses, including recreational and open space uses. The relative farming value of the soils in these areas would not necessarily be diminished by this type of conversion because these uses would not preclude their future use for agricultural purposes. Regardless, consultation with NRCS determined that conversion of prime farmland soils would not result in significant effects (see Section 3.9 and relative value of farmland discussion below).

Under the Action Alternatives, the fate of areas currently used for farming (hay production) under an agricultural use license agreement (see Section 3.9), if developed, would depend on the alternative future uses chosen by the developer and/or sanctioned in the Master Plan. Prior to the sale of any land covered by this license, however, such use would likely be terminated by TVA with a 30-day written notice. In accordance with the license, in the event of such cancellation, TVA would determine the value of any losses sustained by the licensee and provide reasonable compensation. This could include prorated refund of any unearned license payment made during the licensing period.

As indicated in Section 3.9, the *Relative Value of Farmland to Be Converted* is 55 points and the *Total Site Assessment* score was 34 points; total points for farmland conversion associated with the potential TVA land disposal and redevelopment is 89 points. This score was relatively low due to the large percentage of urbanized land around the site and the large acreage that had already been converted to industrial use. Because of this low score, the land's value for farming is not high enough to recommend that it not be converted to nonfarm use. Because only small portions of the total area have been farmed in recent years (e.g., 182 acres licensed for hay), the relative farming value of the land also is reduced. Farmland is abundant across Colbert County and the region. Therefore, direct effects on prime farmland under any of the Action Alternatives are considered minor. The indirect and cumulative effects of this conversion would generally be inconsequential.

4.9.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Under this alternative, no foreseeable changes in land use on currently arable land are likely to occur. Thus, there would be very minor (if any) impacts to the soils and farmland on the MSR study area from adoption of the No Action Alternative. Those tracts under agricultural license would likely remain available for use in the future under Alternative A.

4.9.2 Alternative B

Development actions following the adoption of Alternative B would have minimal effects on soils and prime farmland, as conservation of natural resources would be encouraged. Under this alternative, areas that are currently being used to grow hay or being maintained as turf could possibly be converted to other natural or LID areas, thus eliminating or minimizing the removal of nutrients from the soil via harvesting of hay or by other means. Under this alternative, areas currently supporting turf, hay, or forest are unlikely to be developed, as there is ample space for needed structures within the developed areas.

Under this alternative, enhancements could be made to existing natural wetlands, and areas prone to flooding adjacent to these areas could be incorporated into the wetlands. This action could result in these areas being precluded from agricultural uses and converted to nonfarming purposes; however, these poorly drained areas have limited farming value.

4.9.3 Alternative C

Implementation of Alternative C would result in some effect to soil and prime farmland, as there would likely be some development of areas that are currently supporting turf, hay, or forest. Areas where the soils have low capacity would probably be spared, as these areas tend to be less suitable for development. As occurred when the ERC complex was built, the prime farmland areas would most likely be prime sites for development due to their superior drainage and gentler slope relative to sites having nonprime farmland soils.

Potential impacts to soil and farmland under this alternative could be reduced by promoting sustainable development or development that preserves large amounts of green space within the developed areas. A large portion of the soils and prime farmland in the MSR study area is well suited for recreational purposes. Implementation of Alternative C would have a higher potential for the conversion of a greater amount of farmland to nonfarmland uses compared to Alternatives A and B.

4.9.4 Alternative D

Adoption of this alternative would likely present the greatest potential for impacts to soils and prime farmland because the prime farmland and best soils offer the best sites for industrial development. However, potential effects to soil and prime farmland could be reduced by utilizing as much as possible of the ERC complex for development or reuse of existing buildings.

4.9.5 Alternative E

The potential effects of adopting Alternative E with respect to soils and prime farmland are similar to or potentially less than those expected under Alternatives C and D depending upon the nature and extent of development (i.e., at build-out). Conservation is included among the activities for which the land would be made available under Alternative E along with a somewhat smaller amount of industrial development area (compared to Alternative D). However, the degree of potential effects would depend on the amount of green space that is preserved or left undeveloped. Therefore, adoption of this alternative would likely have less impact on soil and prime farmland than Alternative D, similar effect under Alternative C, but a greater effect than Alternative A or B.

4.9.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development without restriction as to the types of future land uses that could occur.

Adoption of Alternative F would likely have less impact on soil and prime farmland than Alternative D, greater effects than Alternative A or B, and effects similar to those expected under Alternatives C and E. Otherwise, the effects of implementing Alternative F would be the same as those bounded by the analysis under Action Alternatives B, C, D, and E.

4.10 Surface Water Quality

As indicated in Section 3.10, surface water resources on the Reservation are limited. Only the Tennessee River, Pond Creek, and an unnamed tributary to the Tennessee River are located on or adjacent to the MSR study area. The river and unnamed tributary stream are located north of Reservation Road and little or no development would occur adjacent to them. Other than Pond Creek, its floodplain, and some adjacent wetland, most of the land subject to development has vegetation and flat topography and would generally not be prone to erosion (see Figure 3-21).

Because Pond Creek is an impaired stream, particular attention would be given by developers to avoid making poor water quality conditions worse. Certain alterations or discharges into Pond Creek would require authorizations from federal, state, or local agencies, including TVA. Pond Creek and associated floodplain and wetland areas could be considered for green space or LID allocation in the development of the Master Plan. This could conserve habitat and valued resources from the potential negative effects of various land use developments. During site clearing and construction, exposed soils are more prone to erosion from rainfall and wind. If not controlled by appropriate construction BMPs, excess runoff can enter nearby surface waters, causing siltation and a degradation of water quality. As mentioned in Section 2.1, elements common to all the Action Alternatives (i.e., Alternatives B, C, D, E, and F) are generally described below:

- Any future development at the MSR study area would be subject to conditions required by state and federal permitting guidelines. Any proposals that would affect Pond Creek, the Tennessee River, or their respective 100-year floodplains in the future would be subject to additional individual environmental review and approval under Section 26a of the TVA Act. Under all the alternatives, proposals reviewed would be approved only with measures so the impacts to wetlands and floodplains (in accordance with EO 11990 and EO 11988, respectively) would be avoided, minimized, or mitigated to insignificant levels (also see Sections 4.3 and 4.12). Mitigation measures, if necessary, would be designed and implemented to avoid making poor water quality in Pond Creek worse.
- Any development on the Tennessee River would be limited to the potential utility corridor in the vicinity of the phosphate slag storage area described in this EIS (see Section 2.1). All development on the river or Pond Creek would be subject to state and federal permits, including the TVA Section 26a review process. Therefore, any future riverfront development would be subject to further environmental review and impacts analysis. Furthermore, TVA would not sell or transfer this land in fee for future development of this corridor but would make it available under specific use agreements, such as easements. Because of environmental and reservoir operations constraints along the left-descending (south bank) shoreline of the Tennessee River in the vicinity of the utility corridor, water use facilities such as a commercial dock or barge terminal, would not be approved.

4.10.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Because no foreseeable changes to existing land use would occur due to TVA actions associated with this proposal, no significant impacts to surface waters or water quality would occur under Alternative A.

4.10.2 Alternative B

Under Alternative B, conservation of natural resources would be required along with some forms of sustainable LID. Buildings, roads, parking lots, and sidewalks prevent rain from percolating through the soil, and this can result in additional runoff of water and the entry of pollutants into storm drains and streams. Increased impervious surface from future low-impact development could result in larger volumes of storm water runoff entering Pond Creek, which could increase bank erosion and potentially impact water quality. However, many of the adverse effects of buildings and pavement could be mitigated by replacing some standard surfaces with alternatives such as pervious concrete (porous pavement) and green roofs or roof gardens. Additional BMPs to reduce runoff and allow groundwater to recharge could include greenways and the addition of infiltration basins.

LID could minimize the need for construction of buildings and additional paved surfaces typically associated with implementation of commercial, retail, residential, and industrial alternatives. As a result, potential indirect and cumulative adverse impacts to surface water quality from vegetation removal, construction-related soil disturbance, and storm water runoff from impervious surfaces would be reduced compared to potential development under the other Action Alternatives. Pervious surfaces retained due to conservation measures and less development would improve water quality by filtering sediments from storm water runoff.

Adoption of Alternative B would likely result in more natural landscape conditions and retention of natural features such as forest and wetlands on the MSR study area. This could also likely have the result of reducing surface water runoff into Pond Creek and the Tennessee River and could improve aquatic conditions in Pond Creek. No significant direct, indirect, or cumulative impacts to surface water quality are expected as a result of implementing this alternative. The potential effects to water quality under Alternative B would be minor and potentially positive and similar or potentially less than those anticipated under Alternative A.

4.10.3 Alternative C

Implementation of Alternative C would likely result in more land disturbance on the MSR study area than the amount expected under Alternative A or B. The level and intensity of impacts to surface water quality would depend on the site-specific development plan. Commercial development could include use of the utility corridor.

Impervious cover in a development can range from approximately 10 percent in low-density subdivisions (fewer than two homes per acre) to more than 70 percent in high-density industrial and commercial areas (Schueler and Holland 2000). Adoption and implementation of this alternative has a greater potential for causing direct, indirect, or cumulative effects on surface water quality in Pond Creek and in the Tennessee River compared to Alternatives A and B. Implementation of appropriate BMPs (Muncy 1999) within disturbed areas would reduce the potential for these effects. As discussed above, all future development on the MSR study area would be subject to state and federal permit

conditions that would tend to reduce the potential for adverse effects to surface water and the aquatic communities in Pond Creek. Thus, resulting impacts would likely be minor.

If construction occurs consistent with applicable state and federal authorizations, no significant direct, indirect, or cumulative impacts on surface water quality are expected to result from development of the MSR study area under Alternative C.

4.10.4 Alternative D

Implementation of Alternative D would likely result in more land disturbance on the MSR study area than from implementing any of the other alternatives. Therefore, adoption of this alternative has the greatest potential to affect surface water quality. As stated above, the effect of increased impervious surfaces is also of concern in industrial development areas. The need for larger buildings and the increased demand for roads and parking areas required by a greater reliance on shipping and delivery of goods can greatly increase the need for storm water control measures to mitigate the runoff. Storm water runoff BMPs can be structural or nonstructural and range in complexity from the practice of urban forestry techniques and establishment of grassed swales to the installation of permeable concrete pavement, porous asphalt, and bioretention (rain gardens), as well as overall infrastructure planning.

Industrial development south of Reservation Road could be supported by use of the Tennessee River utility corridor area. Industrial development could also require water withdrawals from or discharges to the Tennessee River, thus potentially requiring authorization from ADEM, TVA, and USACE.

If construction occurs consistent with applicable state and federal authorizations and if BMPs are properly designed and used, no significant direct, indirect, or cumulative impacts on surface water quality are expected to result from development of the MSR study area under Alternative D. Generally, potential effects associated with Alternative D would be similar to or potentially greater than those anticipated under Alternatives C, E, and F.

4.10.5 Alternative E

Site development following the adoption of Alternative E would likely result in more land disturbance on the MSR study area compared to Alternative B. Conservation and LID; commercial, retail, residential, and industrial development would likely be accommodated in smaller areas under Alternative E compared to Alternatives B and D. However, implementation of this alternative, similar to Alternatives C and D, may create additional impervious surfaces from new buildings and parking lots. This could result in additional storm water runoff to Pond Creek and ultimately the Tennessee River.

The inclusion of conservation with commercial, retail, residential, and industrial uses in a mixed use development would introduce a natural source for mitigating some of the effects of urban runoff created by land use change. Protecting natural features such as wetlands and including conservation easements, forested buffers, and parks as part of the development's conservation use could play an important part in reducing the impacts of impervious surfaces. Innovative site designs like those discussed in Alternatives C and D, combined with the implementation of additional BMPs like open space design, well-connected and designed streets, and storm water planning would alleviate most of the potential runoff problems resulting from mixed use development.

If construction occurs consistent with applicable state and federal authorizations and if BMPs are properly designed and used, no significant direct, indirect, or cumulative impacts

to surface water quality are expected to result from development of the MSR study area under Alternative E. Generally, potential effects to surface water associated with Alternative E would likely be similar, but potentially less, compared to those described in Alternatives C and D.

4.10.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses that could occur.

The effects of implementing Alternative F with respect to surface water quality would likely be similar those attributed to Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E. Consideration in the Master Plan development and use of BMPs and other mitigative measures through the regulatory review and permitting process would minimize the potential for adverse water quality effects under Alternative F.

4.11 Wetlands

Activities in wetlands are regulated under Section 404 of the CWA and are addressed in federal EO 11990, Protection of Wetlands. Under Section 404, the USACE established a permit system to regulate activities that result in the discharge of “dredge or fill material” into the “waters of the U.S.” This requires that authorization under either a Nationwide General Permit or an Individual Permit be obtained to conduct specific activities in wetlands. The regulatory review process for jurisdictional wetlands involves a standard sequence of avoidance, minimization, and mitigation of wetland impacts. Permit applicants must avoid wetlands wherever practicable, minimize impacts, and mitigate impacts according to USACE district guidelines. Public review of Section 404 permits is a part of the regulatory review. Mitigation planning is in many cases site-specific but in most cases will consist of the purchase of credits in a USACE-approved mitigation bank. Additionally, Section 401 of the CWA requires water quality certification by the state (i.e., Alabama) for projects permitted by the federal government (Strand 1997). EO 11990 and TVA procedures implementing the EO provide that agencies, once a no practicable alternative determination is made, minimize wetland destruction, loss, or degradation and preserve and enhance natural and beneficial wetland values, while carrying out their responsibilities, including the disposal of federal land.

Under all of the Action Alternatives (i.e., Alternatives B through F), in order to assure compliance with EO 11990, TVA would include specific language in the deed, transfer, or other conveyance documents for the property describing the presence of wetlands and requiring that any proposal for future land-based improvements or water use facilities in a wetland area would be subject to TVA review and approval prior to construction. In the course of these future reviews of specific proposals, TVA would evaluate the potential impacts to the wetland(s) resulting from such proposals, including those outside the floodplain, and assure compliance with EO 11990 and its requirement for a “no practicable alternative” determination and minimization of impacts.

Approximately 39 acres of forested wetlands on the MSR study area are located in low-lying areas within the limits of the 100-year floodplain of Pond Creek and one connected unnamed stream drainage. Proposed development here would require additional environmental reviews prior to approval under Section 26a or the deed covenants. Approximately 125 acres of various types of wetlands occur at locations outside or at elevations higher than the 100-year floodplain area (see Table 4-3 and Figure 4-3). Wetlands outside the floodplain would be delineated by the new landowner. Proposed

development in these wetlands would require additional environmental reviews prior to approval under the deed covenants.

Table 4-3. Wetlands by Types and Acres Within the Limits of the 100-Year Floodplain on the Muscle Shoals Reservation Study Area

Type	Acres
Wetlands Within 100-Year Flood Zone	
Forested wetlands	38.68
Wetlands Outside 100-Year Flood Zone	
Forested wetlands	113.39
Scrub-shrub wetland	7.10
Emergent herbaceous wetlands	2.03
Man-made wetland	2.74
TOTAL	125.26
TOTAL Wetland Acres	163.94

If specific development were proposed in advance of a property sale and subsequent environmental reviews were conducted prior to the sale, TVA could require specific conditions and restrictions (see Section 4.11.3 below) in the deed, transfer, or other conveyance document so that improvements or facilities proposed to be constructed on any part of the property would avoid or minimize adverse impacts on wetlands. Potential adverse wetland impacts could also be minimized by mitigation as determined through the CWA permitting process. Wetland locations could be considered in the Master Plan development process. Because of the potential to avoid or mitigate wetlands, the overall effects of adverse alteration could be minimized or reduced to insignificance levels. TVA would work with other federal and appropriate state agencies in the course of reviews for these authorizations.

The primary source of potential direct impacts to wetlands associated with development of the MSR study area is the amount of ground-disturbing activities and vegetation removal within wetlands. The potential for adverse impacts to wetlands and to wetland functions and values increases with the amount of ground disturbance from an activity. Indirect impacts to wetlands can occur from the encroachment of adjacent development. For example, runoff from impervious surfaces and lawns can affect wetland hydrology, including recharge. Contaminants from nearby industrial, commercial, retail, or residential sources can also impact wetlands.

4.11.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Current operations on the MSR study area are not adversely affecting the existing wetlands, and no foreseeable future actions that would adversely affect wetlands are anticipated. Although changes in existing wetlands or in the functions of those wetlands are possible, the chances of such events are remote, and such changes are very unlikely to be the result of TVA actions on the MSR. Thus, no impacts to the wetlands present on the MSR study area are anticipated as a result of adoption of the No Action Alternative.

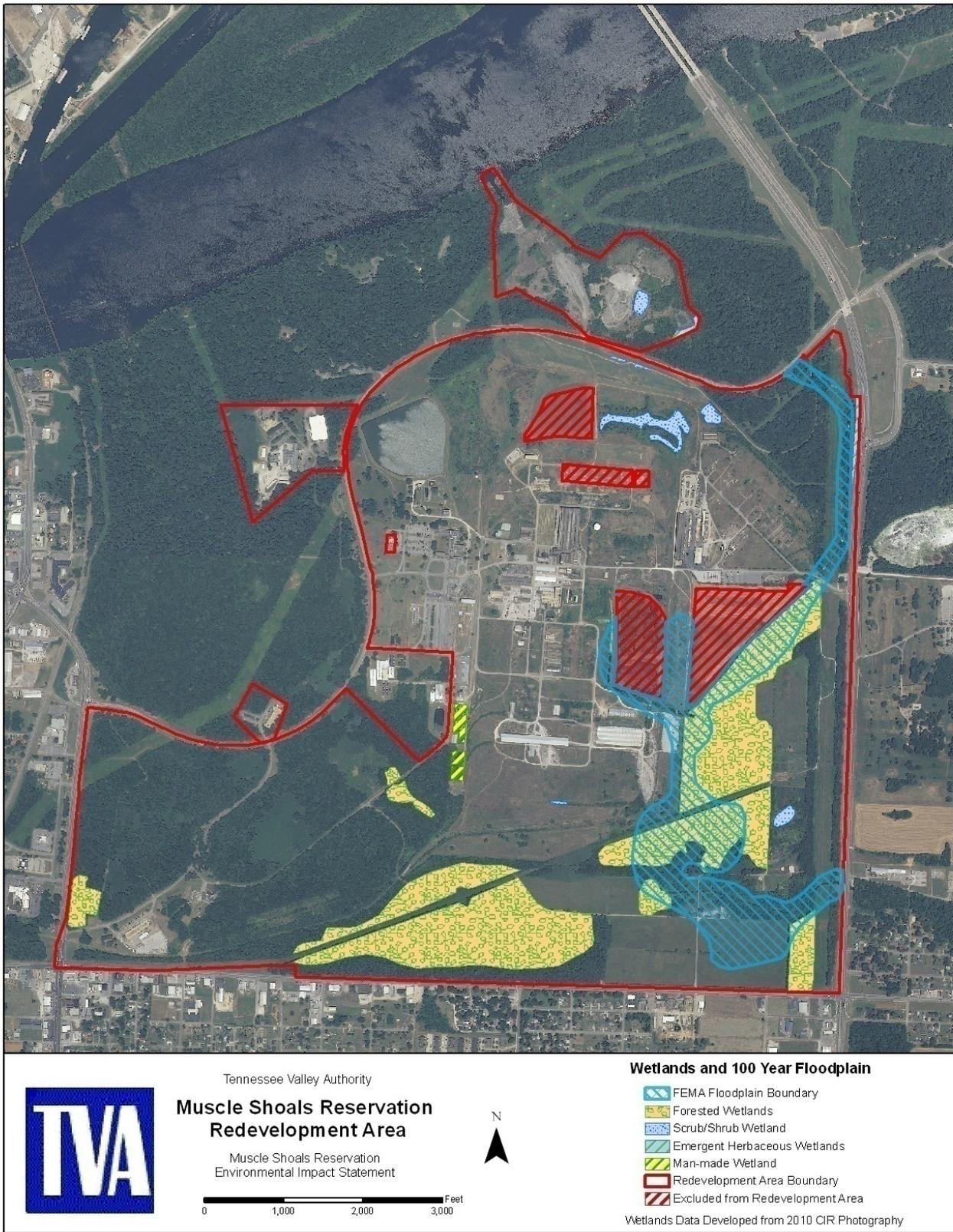


Figure 4-3. Wetlands Inside and Outside the Limits of the 100-Year Floodplain

4.11.2 Alternative B

Adoption of Alternative B would require that the MSR study area be used for conservation of natural resources and sustainable LID as described in Section 2.1.2. Development on the site would be generally compatible with existing sensitive natural resources including wetlands. In support of conservation of natural resources, wetlands present on the MSR study area could be protected or even enhanced under this alternative by limiting potential for development in these areas. Similarly, Pond Creek and associated floodplain and wetland areas could be considered for green space or LID allocation in the development of the Master Plan.

While no site-specific sustainable development plans are available at this time, adoption of Alternative B would likely have impacts similar to those expected under Alternative A and the least amount of potential impacts to wetlands compared to the other Action Alternatives.

4.11.3 Alternative C

Adoption of Alternative C would require that the MSR study area be used for a combination of commercial, retail, and residential uses. Through a requirement in the conveyance document for future reviews of any proposed construction in wetlands, impacts to wetlands would be minimized or mitigated in concert with reviews by other regulators. Some development would affect wetlands if plans show that no practicable alternative to site-specific development constraints exist. Such potential adverse wetland impacts would be offset or mitigated through project reviews for federal or state permits (i.e., Section 404 or Section 401) required for deposition of dredge or fill material or alterations of waters of the state or U.S. via some form of the following (which TVA would independently review for adequacy):

- Compensatory mitigation at an appropriate ratio including acquisition of mitigation bank credits and in-lieu-fee programs (if available)
- Off-site creation, restoration, or enhancement of wetlands
- On-site, in-kind replacement of wetlands

While mitigation would reduce the impact of wetland loss, there is the potential for a temporary loss of wetland function from the construction associated with future projects within the MSR study area. Because specific project details are unknown at this time, this loss is difficult to quantify. Because Alternative C involves a wide range of possible development activities, the potential to affect wetlands is greater under this alternative than under Alternative A or B. Due to the nature of development under Alternative C (e.g., multi-use, with individual components of varying sizes), Alternative C would allow for more avoidance than under Alternative D.

4.11.4 Alternative D

Under Alternative D, TVA would require the new owner(s) of the MSR study area to use it for industrial development. Under Alternative D, there would be impacts to wetlands if site-specific industrial development can show that there is no practicable alternative to wetland impacts. Direct impacts would be mitigated via the same mechanisms as listed under Alternative C. Wetland impacts under this alternative would likely have one or a small number of large, heavily impacted industrial sites. Because of the potential intensity of industrial development, indirect impacts to wetlands associated with potential contaminants and runoff under this alternative could be greater than those under Alternatives B, C, and E.

4.11.5 Alternative E

Under Alternative E, the MSR study area would be required to be used for a mixture of conservation, commercial, retail, residential, and industrial uses of the MSR study area. With about 12 percent (164 acres) of the MSR study area land cover being wetlands, the conservation component of Alternative E could provide a mechanism to preserve these areas and set them aside from potential development. This could be considered in the Master Plan. However, if these areas were available for commercial, retail, residential, or industrial uses, and if the developers could show that there is no practicable alternative, implementation of Alternative E would result in impacts to wetland resources on the MSR study area. Direct and indirect impacts would be mitigated via the same mechanisms as listed under Alternative C.

4.11.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale, and no restrictions would be imposed as to the types of future land uses that could occur.

Similar to Alternative E, implementation of Alternative F could result in impacts to wetland resources currently found on the MSR study area. The effects of implementing Alternative F would likely be similar to Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E. Regardless, given potential for avoidance or mitigation of direct and indirect adverse wetland effects, direct impacts would be minimized or mitigated.

Cumulative Impacts

Large-scale analysis of land cover data over time and by ecoregion indicates an overall loss of forested wetland habitat in the Interior Plateau ecoregion. This loss is associated primarily with urbanization and agriculture. Emergent and scrub-shrub wetland acreage has remained relatively stable over the last 20 years, with some gain in open water (ponds) habitats (Dahl 2006).

General trends in wetland loss in Alabama follow this same pattern. Data collected by the USFWS indicate that palustrine forested wetlands have suffered a net loss in acreage over the last 10 years, primarily due to agricultural development. Additional losses are due to transportation impacts and the growth of urban and suburban developments associated with continued population growth (Hefner et al. 1994). Prior to impoundment, the Tennessee River system had extensive areas of forested wetlands that were lost when dams were constructed and these floodplain areas were inundated.

While wetlands only occupy less than 1 percent of the total land area of the Interior Plateau ecoregion, they comprise about 12 percent of the total acreage of the MSR study area. Thus, these wetland areas are locally important within the context of regional wetland resources. Through development and implementation of the Master Plan, TVA expects that some wetlands would be avoided or adverse effects minimized or mitigated. Such avoidance could involve incorporation of wetland areas into green space, parks, or visual or noise buffers. Any net loss to function or spatial extent of these wetlands would have cumulative wetland effects.

4.12 Floodplains

Floodplains are areas that are prone to flooding. Thus, construction of permanent or temporary structures, as well as other activities, in floodplain areas can endanger life and property. Additionally, such actions in floodplains can cumulatively restrict the flow of floodwaters and worsen the effects of flooding. EO 11988 (Floodplain Management)

requires federal agencies to consider and take appropriate measures to minimize adverse effects of their actions to beneficial floodplain functions.

Under all of the Action Alternatives (i.e., Alternatives B through F), TVA would dispose of land with a requirement in the deed, transfer, or other conveyance document that any proposal for future land-based improvements or water use facilities in the floodplain would be subject to TVA review and approval prior to construction. All proposed development within the limits of the 100-year floodplains, regardless of the alternative, is subject to TVA's Section 26a jurisdiction. Therefore, TVA would evaluate the potential direct, indirect, and cumulative impacts to the floodplain resulting from such proposals and assure compliance with EO 11988 and its requirement for a "no practicable alternative" determination and minimization of impacts. Areas within the 100-year floodplain on the property occur in low-lying areas in association with the Pond Creek drainage (see Figures 3-25 and 4-3) and along the Tennessee River.

During its review, TVA would identify ways of minimizing impacts including project design features and specifications, avoidance, or offsetting cuts or flood storage volume replacements consistent with other applicable regulation. As a result of this review, TVA would fulfill the requirements of EO 11988 and ensure that adverse floodplain impacts would be minimized. Surrounding cities and counties participate in the National Flood Insurance Program and, thus, regulate development of flood-prone areas to minimize effects. Therefore, development of the area would be consistent with the requirements of the National Flood Insurance Program and the applicable local floodplain regulations.

4.12.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Case-by-case evaluations of proposed actions would be undertaken to ensure that future actions are consistent with EO 11988. Any actions requiring Section 26a approval would be subject to individual environmental review. Because no foreseeable changes in land use are anticipated under the No Action Alternative, no effects to floodplains or their functions are likely due to TVA actions associated with this proposal.

4.12.2 Alternative B

Under Alternative B, a substantial portion of the available land on the MSR study area would likely be planned and used for resource management and conservation or other LID activities. Thus, the potential for adverse impacts to natural and beneficial floodplain values would be low. For those portions of the study area property located within the limits of the 100-year floodplains of the Tennessee River and Pond Creek (Figure 3-25), TVA would review all proposed development under Section 26a of the TVA Act and complete appropriate environmental review prior to construction. Approval under Section 26a of such development would include the imposition of any necessary conditions and mitigation to minimize adverse effects to floodplain values to the extent practicable. Thus, any such approval would be consistent with the requirements of EO 11988.

4.12.3 Alternative C

Under Alternative C, the MSR study area would be used for commercial, retail, and residential uses. The level and intensity of development under this alternative could be more than that likely under Alternative B. Therefore, the potential for adverse impacts to natural and beneficial floodplain values under Alternative C would be minor but potentially greater than those expected under Alternative A or B. However, the requirement for future review under Section 26a of proposed construction in the 100-year floodplain also applies

to this alternative and would help ensure that potential impacts to floodplain values would be minor and insignificant.

4.12.4 Alternative D

The potential for adverse impacts to natural and beneficial floodplain values under Alternative D would be somewhat similar to those expected under Alternative C. The level and intensity of development under this alternative could be more and greater than under Alternatives B and C. Steps outlined under Alternative B, which would ensure that potential impacts to floodplain values would be minor and insignificant, would also apply to this alternative.

4.12.5 Alternative E

The potential for adverse impacts to natural and beneficial floodplain values under Alternative E would be greater than those expected under Alternatives A and B and likely somewhat less than that expected under Alternatives C and D. The level and intensity of development under this alternative could be similar to Alternative C but somewhat less than under Alternative D. However, the requirement for future review under Section 26a for proposed construction in the 100-year floodplain outlined under Alternative B would also apply to this alternative and would ensure that potential impacts to floodplain values would be minor and insignificant.

4.12.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale, and no restrictions or stipulations would be imposed on the types of future land uses that could occur.

Similar to Alternative E, implementation of Alternative F could result in impacts to natural and beneficial floodplain values currently found on the MSR study area. The effects of implementing Alternative F would likely be similar to Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E. Regardless, the potential for adverse impacts to natural and beneficial floodplain values under Alternative F would be minimized.

4.13 Aquatic Ecology

Fish and Aquatic Life Including Endangered and Threatened Aquatic Species

Aquatic life can be adversely affected by actions that cause degradation of water quality. Examples of such actions include runoff from construction sites and the introduction of contaminants from spills or waste streams. Additionally, the introduction of invasive species can affect local aquatic life.

Because there are few perennial streams, including the 303(d) listed as impaired Pond Creek, on the MSR study area, the diversity and abundance of common fish and aquatic life are low. The nearby Tennessee River, north of the study area, is much richer with common and rare aquatic life as described in Section 3.13.

Also, see Section 4.14.3 for discussion of terrestrial endangered and threatened species and mention of US Department of Interior, Office of Environmental Policy and Compliance concerns about aquatic species in the Tennessee River. Its letter included comments from the USFWS.

In order to minimize the effects of future development on aquatic life, the following conditions would apply to all Action Alternatives (Alternatives B, C, D, E, and F):

- Any future development on the upland portion of the MSR study area (i.e., that area south of Reservation Road) would be subject to state and federal permitting laws and regulations. Compliance with conditions authorizing disturbances associated with development in or near water bodies would reduce the potential for adverse impacts to water quality and habitats in Pond Creek.
- Development on the Tennessee River would be limited to the utility corridor. All development creating obstructions on the river would be subject to state and federal permits, including future approval from TVA under Section 26a of the TVA Act. Any future riverfront development would be subject to an independent environmental review and impacts analysis. Because of the large number of endangered and threatened species present in the Tennessee River, TVA would formally consult with the USFWS under Section 7 of the Endangered Species Act on any future project identified as having adverse effects on protected aquatic habitat or species in the Tennessee River. As a result of this consultation, any authorization to proceed with approving any facilities or structures would involve compliance with provisions of an incidental take permit and reasonable and prudent mitigation measures. Alternative A.

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Because no foreseeable changes to existing land use are expected on the MSR study area, no additional effects to surface waters or water quality are likely. No impacts to the aquatic communities in Pond Creek or the unnamed tributary of the Tennessee River are anticipated from implementing the No Action Alternative due to TVA actions associated with this proposal. In the event that a different land use is proposed at some time in the future, additional environmental review would be performed for that proposal, and impacts would be mitigated as appropriate.

4.13.1 Alternative B

Development of the MSR study area following the adoption of Alternative B would likely result in improved landscape conditions on the property from an overall ecological perspective. There are few streams on the MSR study area, but there are several man-made ponds. The type of development stipulated under Alternative B would likely have the result of reducing surface water runoff into Pond Creek and could improve aquatic conditions in Pond Creek. Thus, no direct, indirect, or cumulative adverse effects to surface water quality or to aquatic communities (including endangered and threatened species) are likely under this alternative.

4.13.2 Alternative C

Development activities resulting from the implementation of Alternative C would likely result in more land disturbance on the MSR study area than is expected under Alternative A or B. Depending on the nature and extent of uses ultimately proposed, disturbance under this alternative would likely be similar to that anticipated under Alternatives D, E, and F. Commercial development could include use of the utility corridor. As discussed above, in addition to the Master Plan, all future development on the MSR study area would be subject to authorizations from federal, state, or local agencies, including TVA. The resultant permit conditions would reduce the potential for adverse surface water impacts and impacts on aquatic communities in Pond Creek. Due to use of BMPs, topography, distance from the Tennessee River, and amount of vegetation between the study area largely south of Reservation Road, no direct, indirect, or cumulative impacts to aquatic resources (including

endangered and threatened species) are likely to result from upland development of the MSR study area.

Actions resulting from the adoption of this alternative would have a greater potential for direct, indirect, or cumulative effects on aquatic resources on Pond Creek and in the Tennessee River compared to Alternatives A and B. As with all the Action Alternatives, any construction of obstructions that would directly affect the Tennessee River or its 100-year floodplain would be subject to additional individual environmental review. As stated above, TVA would formally consult with the USFWS regarding projects having potentially adverse effects on endangered and threatened aquatic species in the Tennessee River.

4.13.3 Alternative D

Anticipated development under Alternative D would likely result in more land in industrial use and potentially greater intensity of disturbance on the MSR study area than that expected under Alternative B. Disturbance under Alternative D would likely be similar or perhaps somewhat greater than that expected under Alternatives C and E. Industrial development could include use of the utility corridor. Industrial development could also require water withdrawals from or discharges to the Tennessee River. As discussed under Alternative C above, development on the area would be subject to state and federal permit conditions that would reduce the potential for adverse impacts on surface water and aquatic life in Pond Creek or the Tennessee River.

Development of the MSR study area under Alternative D has the highest potential to affect aquatic resources in the Tennessee River (including endangered and threatened aquatic species). As part of its environmental review of proposed projects subject to Section 26a approval, TVA would formally consult with the USFWS regarding projects having potentially adverse effects on federally listed aquatic species in the Tennessee River. Therefore, similar to Alternative C, no direct, indirect, or cumulative adverse effects to these resources are likely to occur as a result of upland development of the MSR study area.

4.13.4 Alternative E

Implementation of Alternative E and the resultant mixed land use would likely result in more land disturbance on the MSR study area than adoption of Alternative B. Disturbance under this alternative would likely be similar to that associated with Alternatives C and D. As discussed above, all future development on the MSR study area would be subject to state and federal permit conditions that would tend to reduce the potential for adverse surface water impacts and impacts on aquatic communities in Pond Creek and the Tennessee River. Any construction of obstructions that would directly affect the Tennessee River (e.g., industrial water withdrawals or discharges) would be subject to individual environmental review under Section 26a of the TVA Act. Actions subsequent to the adoption of this alternative could potentially affect aquatic resources in the Tennessee River (including endangered and threatened aquatic animals) because of the potential need for industrial use of the utility corridor. TVA would formally consult with the USFWS under Section 7 of the Endangered Species Act on any future project identified as having adverse effects on protected aquatic habitat or species in the Tennessee River. Therefore, similar to Alternatives C and D, no direct, indirect, or cumulative adverse effects to these resources are likely to occur as a result of upland development of the MSR study area under Alternative E.

4.13.5 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses that could occur.

With the implementation of BMPs and other routine measures, TVA anticipates that there would be no effects on aquatic ecology, fish, and aquatic life including endangered and threatened species, under Alternative F. Because mixed use development under Alternative F is expected to be similar to that under Alternative E, the potential environmental effects with respect to aquatic life from development would likely be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

Aquatic Invasive Species

Asian freshwater clam (*Corbicula fluminea*), zebra mussel (*Dreissena polymorpha*), and invasive aquatic plants such as hydrilla (*hydrilla verticillata*) are known from the Tennessee River. Future land uses on the study area associated with any of the alternatives under consideration would likely have no potential for changes to the status of aquatic invasive species in the Tennessee River. Because no known invasive aquatic species are currently present in the MSR study area and no effects on populations in the Tennessee River are expected, the implementation of either the No Action or any of the Action Alternatives is not likely to contribute to the introduction or spread of any of these or other aquatic invasive species. Any development along the shoreline of the Tennessee River would be addressed under future permitting and additional environmental reviews.

4.14 Terrestrial Ecology

4.14.1 Plants

The primary cause of potential effects to plant communities under any of the alternatives is site disturbance. Construction of buildings and facilities, including necessary site clearing and preparation, results in the removal of existing plant cover and can change the suitability of the site for certain plant life. The extent of changes in the plant community would depend on the particular proposed land use. The 4-acre TACF Research Orchard is an interim use of that site and is not the only research orchard in the historic range of the species (see Section 3.14.1). Continued use and availability of this site for research would be addressed in the Master Plan under any of the Action Alternatives.

Under the No Action Alternative, a change in land use at the 4-acre TACF Research Orchard is not likely, and research at the site would continue. However, the loss of the orchard through transfer of ownership or change in land use of the site under any of the Action Alternatives would result in a loss of research opportunity and the loss of potential application of research results in conserving American chestnut trees in the region.

4.14.1.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. According to the 1996 Plan, the site where TACF conducts research is allocated for ERC-related uses. Because the terrestrial communities found on the MSR study area are generally common and representative of the region and the current removal plan for control of invasive species on the reservation would likely continue, no significant impacts to the terrestrial ecology of the MSR study area are anticipated as a result of implementing Alternative A.

4.14.1.2 Alternative B

Adoption of Alternative B would require that the land in the MSR study area be used for conservation of natural resources and sustainable LID. Under this alternative, through the master planning process, TACF Research Orchard could continue to occupy the same 4-

acre site, or possibly a larger area, for research to contribute to the development of blight-resistant hybrid chestnut trees.

With over 43 percent of the land cover presently in grasslands, pastures, hayfields, and early successional areas, implementation of Alternative B could potentially provide a way to transform some of these areas into more suitable habitat for scrub-shrub and forest-dwelling wildlife. Currently, the understory of the deciduous forest is predominantly covered by invasive Chinese privet. To achieve the conservation theme under Alternative B, areas of high infestation of invasive species could be controlled, which would enable native plants (e.g., spring wildflowers) that are being outcompeted by nonnative species to return to the forest floor. Much of the current invasive species removal work occurring on the Reservation is being done by volunteer groups trying to restore the Old First Quarters SWA. Based on the likelihood of some continuing terrestrial community restorations and control of invasive species inhabiting the MSR study area by these groups, adoption of Alternative B could result in beneficial effects to terrestrial life on the MSR study area.

A former Alabama Champion American chestnut tree, heavily infested with blight and presently reduced to stump sprouts, is reported (i.e., known) to occur within the MSR study area. Because Alternative B would foster conservation of natural resources as well as the potential for areas to be conserved in accordance with the Master Plan, no impacts to the former champion trees are anticipated under this alternative.

4.14.1.3 Alternative C

Adoption of Alternative C would require that the MSR study area be used for commercial, retail, and residential uses. Although the terrestrial communities found on the MSR study area are common and representative of the region, these terrestrial ecosystems provide habitat for various species of wildlife and plants. Potential impacts to native plant communities on the MSR study area would depend on the extent of ground disturbance and permanent change of land use under Alternative C. Due to their prevalence on the MSR study area, such disturbance could foster the spread of invasive plants during and after construction. Preventive measures implemented by future landowners, potentially in concert with state regulators, could include:

- Limiting the introduction of weed seeds
- Ensuring that all equipment is free of weed seeds before moving to another location
- Using weed-free riprap or rock for projects to prevent the introduction of seeds
- Early detection and eradication of small patches of weeds
- Minimizing the disturbance of desirable plants along trails, roads, and waterways
- Maintaining desired plant communities through good management
- Monitoring high-risk areas such as transportation corridors and bare ground
- Revegetating disturbed sites with native or noninvasive nonnative plants

Common plants could be impacted by development but some plants would be retained in green spaces and undeveloped areas. However, making the land available for uses under

Alternative C would result in negative impacts to the vegetative community structure currently found on the MSR study area. Such development would likely eliminate deciduous forests that have the potential to adversely affect habitat capable of supporting state-listed plants (see Section 3.14.3.1 and Table 3-18). However, opening up some areas of dense vegetation could also allow desirable plants, e.g., wildflowers, to become reestablished.

The effects of implementing Alternative C to terrestrial vegetation are likely greater than effects anticipated under Alternatives A and B. Because affected terrestrial vegetation, even rarer species habitat, is also relatively common through the species ranges, these negative effects would not be significant.

The continued availability of TACF Research Orchard would be determined in the Master Plan. Because other alternative uses of this 4-acre site could be determined in this planning process, the research opportunities provided could be discontinued under this alternative. Loss of research results from this plot could be significant to the recovery of the American chestnut within the southern portion of its range.

Because adoption of Alternative C would require that land within the MSR study area be used for commercial, retail, and residential uses, adverse impacts to the former champion American chestnut tree site could occur if not included on land set aside by the Master Plan.

4.14.1.4 Alternative D

Under Alternative D, the MSR study area would be used for industrial development. Similar to Alternative C, potential impacts to native plant communities on the MSR study area would depend on the extent of ground disturbance. As indicated in Alternative C, common plants could be similarly impacted under this alternative. However, making the land available for industrial development would result in negative impacts to the vegetative community structure and likely would eliminate deciduous forests that have the potential to adversely affect habitat capable of supporting state-listed plants (see Section 3.14.3.1 and Table 3-18). However, opening up some areas of dense vegetation could allow desirable plants to become reestablished as mentioned in Alternative C.

As indicate under Alternative C, adoption of this alternative has the potential to negatively impact the site of a former American chestnut champion tree unless it's set aside by the Master Plan. The preventive measures described under Alternative C to minimize the effects of the potential spread of a number of invasive plants on the Reservation could also be implemented under Alternative D. Implementation of Alternative D would likely have similar impacts to Alternatives C, E, and F but greater impacts than Alternatives A and B. The use of TACF Research Orchard could be discontinued under this alternative, depending on the land use allocations resulting from the Master Plan. The significance of this effect could be similar to that described under Alternative C.

4.14.1.5 Alternative E

Adoption of Alternative E would require that the MSR study area be used for a mixture of conservation, commercial, retail, residential, and industrial uses. Depending on the action taken on particular parcels of land, potential impacts to the terrestrial life of the area could have positive or negative effects. With over 43 percent of the land cover in grasslands, pastures, hayfields, and early successional areas, common plants could be impacted by development. Some common plants could be retained in conservation areas identified as a part of the Master Plan. However, making the land available for mixed use would result in

negative impacts to the vegetative community structure currently found on the MSR study area and likely would eliminate some deciduous forests that have the potential to adversely affect habitat capable of supporting state-listed plants (see Section 3.14.3.1 and Table 3-18). However, opening up some areas of dense vegetation could allow desirable plants to become reestablished as mentioned under Alternative C.

Preventive measures to minimize the effects of the potential spread of invasive plants, also described under Alternative C, could be implemented under Alternative E. Implementation of Alternative E could likely have less impacts compared to Alternative D, similar impacts to Alternatives C and F, but greater impacts than Alternatives A and B. Similar to Alternative B, C or D, adoption of Alternative E has the potential to negatively impact the site of a former American chestnut champion tree unless it's set aside by the Master Plan. The Master Plan would address the continued use of the 4-acre TACF Research Orchard. However, under this alternative, there would be a mixture of land uses, including conservation actions. Thus, although other uses could feasibly occur on the orchard site, such uses may not be likely under Alternative E. The significance of this effect could be similar to that described under Alternative C.

4.14.1.6 Alternative F

Under Alternative F, the MSR study area would be made available for sale and development with no restrictions on the types of future land uses.

With the implementation of BMPs, various buffer zones, possible efforts to discourage the spread of nonnative plants, and conservation of green space from the Master Plan, TVA anticipates that there would be minor effects on common plants under Alternative F. The potential environmental effects to terrestrial plants from development would likely be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

4.14.2 Wildlife

Wildlife is potentially affected by the same mechanisms that affect plant life (see Section 4.14.1). The disturbance or removal of vegetative cover affects habitat suitability for many animal species. This has less of an effect on more mobile species that can move to nearby areas having suitable habitat. Some less mobile animals could be lost or displaced completely by various degrees of site disturbance. Eventually, competition for available suitable habitat among and between species results in equilibrium and typically some species population reductions. Any clearing of forested habitat that occurs as a result of development within the MSR study area would contribute to further habitat fragmentation. Given the current extent of habitat fragmentation present, species present within the study area are already exposed to some degree to the effects of habitat fragmentation. Therefore, no significant impacts of additional development are expected.

To reduce potential effects on birds that visit the area, some land in the southwest portion of the MSR study area used by migratory birds could be integrated into plans for open green space (e.g., park) likely included in the Master Plan.

4.14.2.1 Alternative A

Under Alternative A, there would be no foreseeable changes in land use, land cover, or available wildlife habitats as a result of this proposal. Therefore, adoption of Alternative A would not likely result in changes to the wildlife on the MSR study area.

4.14.2.2 Alternative B

Under Alternative B, TVA would require that the MSR study area be used for conservation uses and LID. Implementation of this alternative could result in the continuation of volunteer programs in public parks or other green spaces to expand early successional fields and more intensive removal of invasive species of plants that currently degrade the overall quality of wildlife habitats in the MSR study area. The southwestern section of the MSR study area could be incorporated into additional green space maintenance under this alternative. Therefore, the mixed habitat area could remain available to benefit resident and migratory birds. Adoption of this alternative could result in minor but beneficial impacts to terrestrial wildlife resources.

Actions that could occur following the adoption of Alternative B would likely result in improved wildlife habitat conditions within the study area and the long-term availability of habitats, making it potentially somewhat more beneficial than Alternative A.

4.14.2.3 Alternative C

The MSR study area would be used for commercial, retail, and residential development under Alternative C. Potential impacts to wildlife communities on the MSR study area would depend on the extent of development. Depending on the spatial extent and nature of the potential development, adoption of this alternative would result in a reduction in the amount and change in the vegetative community structure and suitability of some wildlife habitat, the displacement of some wildlife species into adjacent forested habitats, and the direct mortality of some less mobile wildlife. Some species would continue to use portions of the MSR study area, but overall diversity of species and numbers of individuals would likely be lower. The resident wildlife species on the MSR study area are typical of the region, and the quality of habitats in the MSR study area would remain representative of those common in the region.

Adoption of Alternative C and the subsequent construction and operation of commercial, retail, and residential developments could reduce wildlife diversity, resulting in adverse impacts at a local level. In particular, the forested wetland area in the southwest portion of the MSR study area would likely be attractive for commercial or retail development because of its location adjacent to Hatch Boulevard. Some migrant birds could be forced to seek out suitable habitats at other locations in the area or region to support their needs, and some individual birds could perish. Development of this area could significantly affect important migrant bird habitat there. Compensatory mitigation for the loss of any forested wetlands, which appear to be an important component of this habitat, as a result of development would likely be required consistent with requirements of the CWA. However, because similar habitat does not occur on the remainder of the TVA land on the Muscle Shoals/Wilson Dam Reservation, compensatory mitigation for the loss of bird habitat and recreation opportunity (i.e., bird watching) would be difficult to accomplish on the MSR study area. However, potential habitat loss from the MSR study area site would not likely adversely impact these bird populations or the recreational opportunity created on a regional scale.

With respect to wildlife resources, the potential impacts of adopting Alternative C would likely be greater than those anticipated under Alternative A or B and potentially similar or less than those expected under Alternatives D, E, and F. Impacts of development under Alternative C could be reduced elsewhere in the area or region when losses of portions of the forested wetland habitats on the area are avoided or mitigated by the Master Plan.

4.14.2.4 Alternative D

Under Alternative D, use of the MSR study area would be restricted to industrial uses. The spatial extent and the intensity of potential industrial development would likely be similar to that described under Alternative C. The extent could range from sparse to dense, and intensity of development could range from light to severe, depending upon the type of industry that locates on the MSR study area. As acknowledged under Alternative C, impacts of forested wetland habitat loss in the southwest portion of the study area could significantly affect migrant birdlife and recreation opportunity at the local level. Impacts of development under Alternative D could be reduced elsewhere in the area or region when losses of portions of the forested wetland habitats on the area are mitigated. Potential effects under Alternative D could range between beneficial or minor to extensive, significant, direct, adverse impacts; given habitat loss in the context of existing surrounding development, effects would more probably be moderate. Therefore, potential impacts to terrestrial wildlife resources under Alternative D would be similar to, or perhaps greater than, those described under Alternative C.

Impacts of actions subsequent to the adoption of Alternative D could also be greater than those anticipated under Alternatives A and B and potentially similar or greater than those expected under Alternatives E and F. Similar to Alternative C, impacts of development under Alternative D could be reduced elsewhere in the area or region when losses of portions of the forested wetland habitats on the area are avoided or mitigated.

4.14.2.5 Alternative E

Under Alternative E, the spatial extent and the intensity of potential mixed use development would likely be similar to that described under Alternative C. Implementation of Alternative E could also result in a similar range of effects as those described under Alternative D. As acknowledged under Alternative C, impacts of forested wetland habitat loss in the southwest portion of the study area could significantly affect migrant birdlife and recreation opportunity at the local level. The potential impacts to wildlife from development under Alternative E could be reduced elsewhere in the area or region when losses of portions of the forested wetland habitats on the area are mitigated.

The potential effects of implementing Alternative E would likely be greater than those anticipated under Alternatives A and B. However, potential effects under Alternative E would likely be similar to those expected under Alternative C and perhaps less than those anticipated under Alternative D because this alternative has a conservation component that would tend to reduce the severity of potential adverse effects to wildlife.

4.14.2.6 Alternative F

Under Alternative F, no restrictions on the types of future land uses would be imposed.

TVA anticipates that the potential for adverse impacts to nonendangered terrestrial animals under Alternative F would likely be similar to those expected under Alternative E. As previously stated regarding common plants, some land set aside for conservation in the Master Plan could minimize effects on common terrestrial life under Alternative F. The potential environmental effects to terrestrial animals from development would likely be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

4.14.3 Terrestrial Endangered and Threatened Species

One federally listed as threatened plant is reported from Colbert County, Alabama, and no federally listed plants or habitat capable of supporting such species are known from the

MSR study area. Although several state-listed plants (see Table 3-18) are known to occur within 5 miles of the MSR study area, none are known from the site. However, habitat capable of supporting two state-listed plants could occur on the study area.

Plants considered of conservation concern are identified in Section 3.14.2.1 and Table 3-18. Animals of conservation concern, which include 2 federally endangered bats, are identified in Section 3.14.2.3 and denoted in Tables O-1, O-2, and O-3 in Appendix O. Neither plants nor animals have official protection status. Of the protected animal species listed in Section 3.14.3.2, only the gray bat occurs on the MSR study area. Several populations of gray bats occur in the region, and this species forages throughout much of the Tennessee River Valley. This species exits roost sites at sunset and forages over large areas of the Tennessee River (Best et al. 1995). Gray bats make brief foraging flights up tributary streams and creeks that branch from the Tennessee River, including creeks that cross the MSR study area. The proposed actions have minor potential for impacting this species, as gray bats readily forage along streams in forested or nonforested habitats. Because of the availability and accessible foraging habitat nearby and elsewhere within its range, the adoption of any of the proposed alternatives would not result in cumulative impacts to gray bats or other listed species of terrestrial animals.

As explained above, under all the Action Alternatives, TVA would further evaluate any future actions by others that could modify streams, their adjoining shorelines, wetland areas, and land within the limits of the 100-year floodplain and conduct any needed additional environmental reviews. This process would tend to reduce the potential for adverse effects to rare or listed wildlife species.

Under all the Action Alternatives, TVA has determined that future land uses implemented on the MSR study area would have no effect on any federally endangered or threatened terrestrial animals or plants or any designated critical habitats. As indicated in Section 4.13 Aquatic Ecology, because of the large number of aquatic endangered and threatened species present in the Tennessee River, all future development subject to approval from TVA under Section 26a of the TVA Act would be reviewed. TVA would formally consult with the USFWS under Section 7 of the Endangered Species Act on any project identified as having adverse effects on protected aquatic habitat or species in the river. As a result of this consultation, any authorization to proceed with approving any facilities or structures would involve compliance with provisions of an incidental take permit and reasonable and prudent mitigation measures. In its e-mail and attached letter of February 28, 2011, the US Department of the Interior, Office of Environmental Policy and Compliance, acknowledged that development with the highest potential to affect aquatic resources in the Tennessee River would be addressed as part of TVA's environmental review of proposed projects subject to Section 26a of the TVA Act, and as such be subject to Section 7 review under the Endangered Species Act.

4.14.3.1 Plants

4.14.3.1.1 Alternative A

Under Alternative A, there would be no foreseeable changes in land use, land cover, or rare plant habitat as a result of this proposal. Currently, the continued spread of invasive plant species, especially Chinese privet, is a major threat to habitats potentially suitable for supporting rare plant communities. Volunteers currently partner with TVA to control and remove invasive plants on the Reservation. If these practices for controlling invasive plants continue, no significant adverse impacts to rare plant communities on the MSR study area are anticipated as a result of implementing the No Action Alternative. Given the abundance

of some of these invasive plants in the area and region, effects of this work are probably of benefit locally. Such removals of competing plants allow for more desirable species, such as wild flowers, to inhabit the site.

4.14.3.1.2 Alternative B

Adoption of Alternative B would require that the MSR study area be used for conservation and LID. Based on field investigations and database queries, there are no observations or known records of federally or state-listed plant species occurring within the MSR study area. However, two state-listed plants (Dutchman's breeches and false rue-anemone) are known to occur in the Old First Quarters SWA north of Reservation Road and outside the MSR study area. Habitat capable of supporting these two plant species could be present within the MSR study area. However, no impacts on rare plants or populations are anticipated under this alternative.

4.14.3.1.3 Alternative C

Based on field investigations and database queries, there are no observations and no known records of federally or state-listed plant species occurring within the MSR study area. Because adoption of Alternative C would require that land within the MSR study area be used for commercial, retail, and residential uses, adverse impacts to rare plant habitat could occur. The nature and intensity of these effects would depend on the spatial extent and characteristics of the potential development and the effectiveness of the Master Plan in avoiding potential adverse effects to plant species. The potential effects to threatened and endangered plant habitat from implementing Alternative C could likely be greater than those anticipated under Alternatives A and B and similar or less than those anticipated under Alternative D, E, or F.

4.14.3.1.4 Alternative D

There are no observations or known records of federally or state-listed plant species occurring within the MSR study area. However, habitat capable of supporting Dutchman's breeches and false rue-anemone could be present within the MSR study area. Because much of the study area could be disturbed or converted to permanent industrial uses under Alternative D, adoption of this alternative has the potential to result in negative impacts to rare plant habitat. Depending on the amount of industrial development, potential effects under this alternative would likely be similar to or greater than those expected under Alternative C and similar or greater than those anticipated under Alternative E or F. Implementation of the Master Plan could also reduce effects of this alternative as mentioned under Alternative C.

4.14.3.1.5 Alternative E

Depending on the action taken on particular parcels of land, potential impacts to the terrestrial plant life of the area could have positive or negative effects under this alternative. Habitat capable of supporting two state-listed plants could be present within the MSR study area. The potential impacts of adopting Alternative E on sensitive plant habitat are expected to be less than those anticipated under Alternative D but similar to those associated with the implementation of Alternative C. The potential effects of adopting this alternative are expected to be greater than those anticipated under Alternative A or B. If areas recognized as potential habitat for rare plant populations are set aside for natural resource conservation or other green space in the Master Plan, then implementation of Alternative E would have no adverse effects to unique or state-listed threatened and endangered plant species.

4.14.3.1.6 Alternative F

Under Alternative F, there would be no restrictions on the types of future land uses that could occur on the MSR study area.

The potential for adverse impacts to unique or state-listed threatened and endangered plant species under Alternative F would likely be similar to those expected under Alternative E. Some land set aside for conservation in the Master Plan could minimize effects on rare plant habitat under Alternative F. The potential environmental effects to such plant communities from development would likely be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

Cumulative Impacts

Because no federally listed or state-listed endangered or threatened plants occur on the MSR study area, no direct, indirect, or cumulative effects on such species would occur under any of the alternatives. None of the Action Alternatives involve specific measures to control invasive plants such as Chinese privet and kudzu, which are both abundant throughout the area and region. Efforts to control these plants are underway by volunteers under Alternative A and would likely be encouraged under Alternative B. The absence of measures to control such invasive plants under any of the alternatives could lead to the reestablishment and spread of these species to additional sites on the MSR study area, the Reservation, and adjacent properties. Depending upon the future land uses on the nonfederal property, implementation of voluntary measures identified in Section 4.13.1.3 could minimize or reduce the direct, indirect, and cumulative effects of the spread of these plants on the area and adjoining properties.

4.14.3.2 Wildlife

4.14.3.2.1 Alternative A

Currently, there are no ongoing activities on the MSR study area that cause adverse effects to any federally or state-listed or protected wildlife species. With the exception of occasional foraging by gray bats, there are no known occurrences of terrestrial threatened or endangered wildlife species on the site. Under the No Action Alternative, there would be no additional effects to listed or protected wildlife species because no foreseeable changes to existing land use would occur on the MSR study area. Under this alternative, future proposals would be considered under a new and separate environmental review to determine their impact on gray bats and other threatened and endangered species.

4.14.3.2.2 Alternative B

Adoption of Alternative B would require that the land in the MSR study area be used for conservation of natural resources and sustainable LID. Under Alternative B, as a part of conservation efforts on the area, dense stands of invasive plants could be removed from areas adjacent to streams in the MSR study area, including Pond Creek. This could result in creating additional foraging habitat along stream corridors and more foraging opportunities for gray bats that use this area. Under Alternative B, potential effects on rare species' habitat are expected to be similar to or less than those expected under Alternative A if removal of invasive plants continues.

4.14.3.2.3 Alternative C

Under Alternative C, although unlikely with implementation of the Master Plan, habitats surrounding streams where gray bats forage could be modified at levels ranging from minor to extensive. Gray bats readily forage along streams in urban or rural settings; thus, no direct adverse impacts to gray bats are expected. Adoption of this alternative could result

in indirect impacts to gray bats, as modifications to the surrounding landscape could affect sources of food along Pond Creek and other streams in the MSR study area. However, given the low number of gray bats foraging along streams in the MSR study area, the extensive foraging range of gray bats, and the abundance of foraging habitat available locally (i.e., habitat on the Wilson Dam tailwater and associated creeks) and regionally (upper Pickwick and lower Wilson reservoirs), no effects on gray bats are expected from planned commercial, retail, and residential development of the property. As previously mentioned, to help minimize disturbance to the area along Pond Creek, a corridor of land for conservation or green space purposes could be set aside, thus potentially reducing effects of nearby development.

Under Alternative C, potential effects on rare bats or their habitat are expected to be less than those anticipated under Alternative D and the same or similar to those likely under Alternative E or F. Depending on the spatial extent and intensity of development, wetland avoidance or mitigation would likely reduce indirect and cumulative effects of any potential habitat loss. Implementation of the Master Plan could set aside this habitat in a conservation area or corridor.

4.14.3.2.4 Alternative D

The potential impacts to threatened and endangered wildlife from activities under Alternative D would likely be greater than or similar to those from implementing Alternatives C and E. Because gray bats only occasionally forage over streams on the MSR study area, no direct impacts to this species are expected. Shifts or reductions of food sources could indirectly impact gray bats. However, as indicated under Alternative C, given the low number of bats and the availability of ample foraging opportunities nearby, effects on gray bats from stream modifications in the MSR study area are not expected.

Under Alternative D, potential impacts to habitat for rare species are expected to be similar or greater than those described under Alternative C.

4.14.3.2.5 Alternative E

The potential effects to protected wildlife, including the gray bat, from implementing Alternative E would be the same or similar to those expected from implementing Alternative C or D. No direct impacts to gray bats are expected for reasons mentioned previously. Shifts or reductions of food sources could indirectly affect gray bats. However, given the low number of gray bats in the area and because there are ample opportunities to forage elsewhere nearby, no effects on this species from the development in the MSR study area are expected. Under this alternative, bat usage could approach levels afforded under Alternative B, depending upon the type, extent, and intensity of development.

Under Alternative E, potential impacts on rare species' habitat are expected to be less than those anticipated under Alternative D and the same or similar to those likely under Alternative C or F.

4.14.3.2.6 Alternative F

The potential effects to listed or protected wildlife, including the gray bat, from implementing Alternative F would be the same or similar to those expected from implementing Alternative C, D, or E. No direct impacts to gray bats are expected for reasons mentioned previously. Shifts or reductions of food sources could indirectly affect gray bats. However, given the low number of gray bats in the area and because there are ample opportunities to forage elsewhere nearby, no effects on this species from the development in the MSR study area

are expected. Under this alternative, bat usage could approach levels afforded under Alternative B, depending upon the type, extent, and the intensity of development.

Cumulative Impacts

Common resident wildlife is generally abundant both locally and regionally. The acreage of rural upland landscapes in the area, including public land, with habitats suitable to supporting these species, appears somewhat stable. This habitat is being slowly affected by agricultural and forestry operations and residential, business, and infrastructure development in northwest Alabama from west of Huntsville to Iuka, Mississippi. Some migratory bird populations, particularly Neotropical migrants and others that rely on wetland habitats, including those on the Muscle Shoals/Wilson Dam Reservation, are declining. As mentioned in Section 3.11 and although regionally there have been losses in both forested and scrub-shrub wetland habitat types, there is an overall gain in wetland resources in Alabama and nationwide (Sifneos et al. 2009). Because much of the MSR study area contains existing development and represents a small fraction of the available habitat in the surrounding counties and region, cumulative impacts on resident wildlife including birds, under any of the Action Alternatives (B, C, D, E, or F) would be insignificant.

4.15 Natural Areas

The Old First Quarters SWA, which lies north of Reservation Road, is the only designated natural area on Muscle Shoals Reservation (see Section 3.15). Because this SWA is outside the scope of this EIS, it would not be directly affected by any proposed development, regardless of the alternative selected. Although not recognized as designated natural areas by TVA, some vegetated (e.g., woodlots) and reverting (e.g., scrub-shrub) land within the MSR study area appears natural in its character and has potential value as wildlife habitat. Other nearby designated natural areas, trails (Section 4.16), and naturally appearing landscapes can be directly or indirectly affected by development. Sources of potential adverse effects range from direct elimination and replacement to changes in the aesthetic and natural character from noise, presence of nearby buildings or structures, and odors.

Nearby construction or the presence of additional impervious surfaces such as paved areas could result in runoff to the natural area or changes in surface water quality. Nearby development can also reduce use of some areas by wildlife and decrease the desirability of the site for recreational use. Additionally, some of the informal naturally appearing landscapes could be used for development sites. However, there are no designated natural areas on the MSR study area proper.

4.15.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Under this alternative, the visual buffers established along major roads and the reservation trail complex as well as a vegetative buffer established along the Pond Creek corridor would remain. This buffer also serves to reduce the effects of noise. There would be no foreseeable change in the recreational use of or status and protection of the Old First Quarters SWA in the vicinity of the MSR study area. Therefore, no formally designated or informal naturally appearing landscape would be directly or indirectly affected. No cumulative effects to these resources would result from adoption of this alternative.

4.15.2 Alternative B

Under Alternative B, the MSR study area would be used for conservation of natural resources and LID. Conservation of informal naturally appearing landscapes (i.e., native grass areas, areas of forests and wetlands, green space, and TACF Research Orchard), combined with LID within the MSR study area, would likely allow these landscapes to remain in their current relatively natural state with the potential to be used as outdoor classrooms for public use and research. Conservation efforts and LID would likely reduce the potential for aesthetic and scenic values of formal natural areas and naturally appearing landscapes from being diminished while preserving the parklike setting of the MSR study area.

Conservation or LID uses would likely have a low potential for indirect adverse impacts to nearby natural areas (i.e., the Old First Quarters SWA, Wilson Dam Tailwater Restricted Mussel Harvest Area, Tennessee River/Wilson Dam NEP, and the MSR trail complex); thus, vegetation removal and construction-related soil disturbance would be reduced. Additionally, any short-term degradation of water quality associated with storm water runoff from impervious surfaces would likely be less under this alternative than under the other Action Alternatives. Pervious surfaces retained due to conservation measures and less development would improve water quality by filtering sediments from storm water runoff. Under this alternative, a priority would be placed on protecting and enhancing the natural character of the area while allowing less intrusive forms of development. Maintaining and preserving the trail complex located within the boundaries of the MSR study area, including the corridor of native grass plantings and vegetative buffers that protect the trails' integrity, would tend to reduce any impacts to these natural areas caused by LID.

Because designated natural areas and naturally appearing landscapes adjacent to and within the MSR study area could benefit from enhanced conservation efforts and LID, the potential effects to natural areas could be beneficial under Alternative B and potentially greater than those expected under Alternative A. Because enhanced conservation efforts paired with LID would foster the preservation of plant and animal communities, the implementation of Alternative B would reduce the potential for water quality degradation and maintain aesthetic and scenic values for both naturally appearing landscapes and designated natural areas within and adjacent to the MSR study area. The potential cumulative effects to natural areas and naturally appearing landscapes would be positive under Alternative B compared to the effects expected from development under the other Action Alternatives.

4.15.3 Alternative C

Commercial, retail, and residential development required under Alternative C would likely indirectly affect the nearby designated natural area and trails due to potential increased traffic volume and higher levels of noise. These conditions would tend to decrease the overall experience of users of the adjacent SWA and MSR trail complex. Informal trails, native grass areas, and TACF Research Orchard could be directly affected by new development. Although outside boundary of the SWA, the section of the Rockpile Hiking Trail that is included in the MSR trail complex may be indirectly affected if development of the phosphate slag storage area occurs as part of implementation of a utility corridor to the Tennessee River. The level and intensity of impacts to the Rockpile Hiking Trail would depend on the site-specific plan of development. Potential effects to the trail would be long-term and moderately adverse if the trail is permanently divided or if portions of the trail become inaccessible to the public due to development. These indirect impacts would be reduced to short term and minor if implementation of the utility corridor incorporates the trail

into the plan. These indirect effects are expected to be greater than those likely to occur under Alternative A or B.

Locations of designated natural areas would also be taken into account in the development of the Master Plan.

4.15.4 Alternative D

Depending on the degree and intensity of industrial development required under Alternative D, the formally designated natural area and trails near the MSR study area could be indirectly affected due to potentially increased emissions, visual intrusion, increased traffic volume, and higher levels of noise. These would diminish the overall experience of users of the adjacent SWA and MSR trail complex. Other nearby designated natural areas, including four parks, a WMA, TVA HPA, and NWR could be impacted indirectly due to increased emissions that could decrease the aesthetic quality of these areas during peak operating times. Informal naturally appearing landscapes including trails, the native grass areas, and TACF Research Orchard would likely be directly affected by new development. These landscapes within the MSR study area may be permanently altered by industrial development. Potential loss of trails and wildlife habitat associated with informal naturally appearing landscapes within the redevelopment area may occur. These indirect effects are expected to be greater than those likely to occur under Alternatives A, B, and C.

The potential indirect effects of adopting this alternative on the Rockpile Hiking Trail and other sections of the MSR trail complex, including the portion that extends south of Reservation Road onto the MSR study area and other informal naturally appearing landscapes, would likely be the same as those described under Alternative C.

4.15.5 Alternative E

Under Alternative E, the balance between development and conservation efforts could benefit natural areas in the vicinity of the MSR study area by setting aside areas for conservation that would make available additional recreational opportunities and encourage use of the SWA and MSR trail complex. Depending on the intensity and degree, development of commercial, retail, residential, and industrial areas could also have some indirect adverse impacts on natural areas in the vicinity of the MSR study area due to an overall increase in development and associated increases in traffic, noise, and other forms of disturbance as described under Alternative D.

Indirect effects of development under Alternative E on the Rockpile Hiking Trail and other sections of the MSR trail complex and other landscapes would be the same as those described in Alternatives C and D.

4.15.6 Alternative F

The potential for direct, indirect, and cumulative adverse impacts to the designated natural area, Old First Quarters SWA, and other natural landscapes under Alternative F would likely be similar to those expected under Alternative E. Some land set aside for conservation in the Master Plan could minimize effects on natural areas and trails under Alternative F. The potential environmental effects to such areas from development would likely be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

4.16 Recreation

Recreational opportunities are affected by development in various ways, depending on the type of development (e.g., residential or mixed as opposed to industrial) and the proximity of that development to the recreational feature or resource. Potential effects of development occur primarily as the loss of facilities, lost recreational opportunity, or a reduction in the quality of the recreational experience.

A utility corridor could be constructed across the 90-acre phosphate slag storage area under any of the Action Alternatives, but it is more likely under Alternatives D, E, and F. Depending on the level and type of development that occurs, use of a utility corridor for utilities or other supporting infrastructure could adversely affect the segment of the Rockpile Hiking Trail that crosses this corridor. As noted in Section 3.16 (see Figures 3-30 and 4-4), this section of the Rockpile trail crosses the skimmer wall built as part of the Wilson Power Plant. Because there is an inlet behind (landward of) the wall, some forms of water access could possibly be accommodated without impacting the trail or fishing that commonly occurs in this area. Conversely, water access needs that would require breach or removal of the skimmer wall would sever the existing trail and also adversely impact shoreline fishing access.

Use of the utility corridor at the slag storage area could also potentially affect recreational use of the Wilson Dam tailwater (Tennessee River) shoreline along its left-descending (south) bank opposite the lock access channel and Florence port. However, because a commercial dock or a barge terminal could affect reservoir operations and navigation (see Section 4.19) and be subject to flooding or impact endangered species, such a proposal at this location would not be approved by TVA.

A 1-mile segment of the paved National Recreation Trail Complex that was extended south of Reservation Road in 2003 (and, therefore, is within the proposed redevelopment study area) could be affected by future development under any of the Action Alternatives. This trail segment, and the adjacent native vegetation planted and currently managed to provide a buffer for the trail, could be negatively affected by adjacent development and related increases in vehicular traffic and traffic noise. Furthermore, because the trail crosses Reservation Road at two locations, increased traffic along this route could increase hazards associated with trail users attempting to cross the road. As described in Section 3.16, a transportation project enhancement grant was used to partially fund construction of this portion of the trail. In the formal agreement with ALDOT and FHWA, TVA is required to obtain written approval if the land on which these improvements are made is sold or the recreational use is changed. Therefore, prior to any transfer of the affected land from federal ownership, TVA would consult with ALDOT and FHWA and obtain the needed written authorization.

The 900-foot section of the paved trail that crosses the Multipurpose Building portion of the proposed redevelopment study area could also be affected under any of the Action Alternatives. Increases in motorized traffic entering and exiting this parcel could negatively impact trail use including a decrease in user safety.

Closure of any of the trail segments outlined above would greatly reduce the integrity and usability of the TVA trails complex. Because TVA's system of trails—especially the paved trail—is an integral and vital part of a larger trail system that extends into the city of

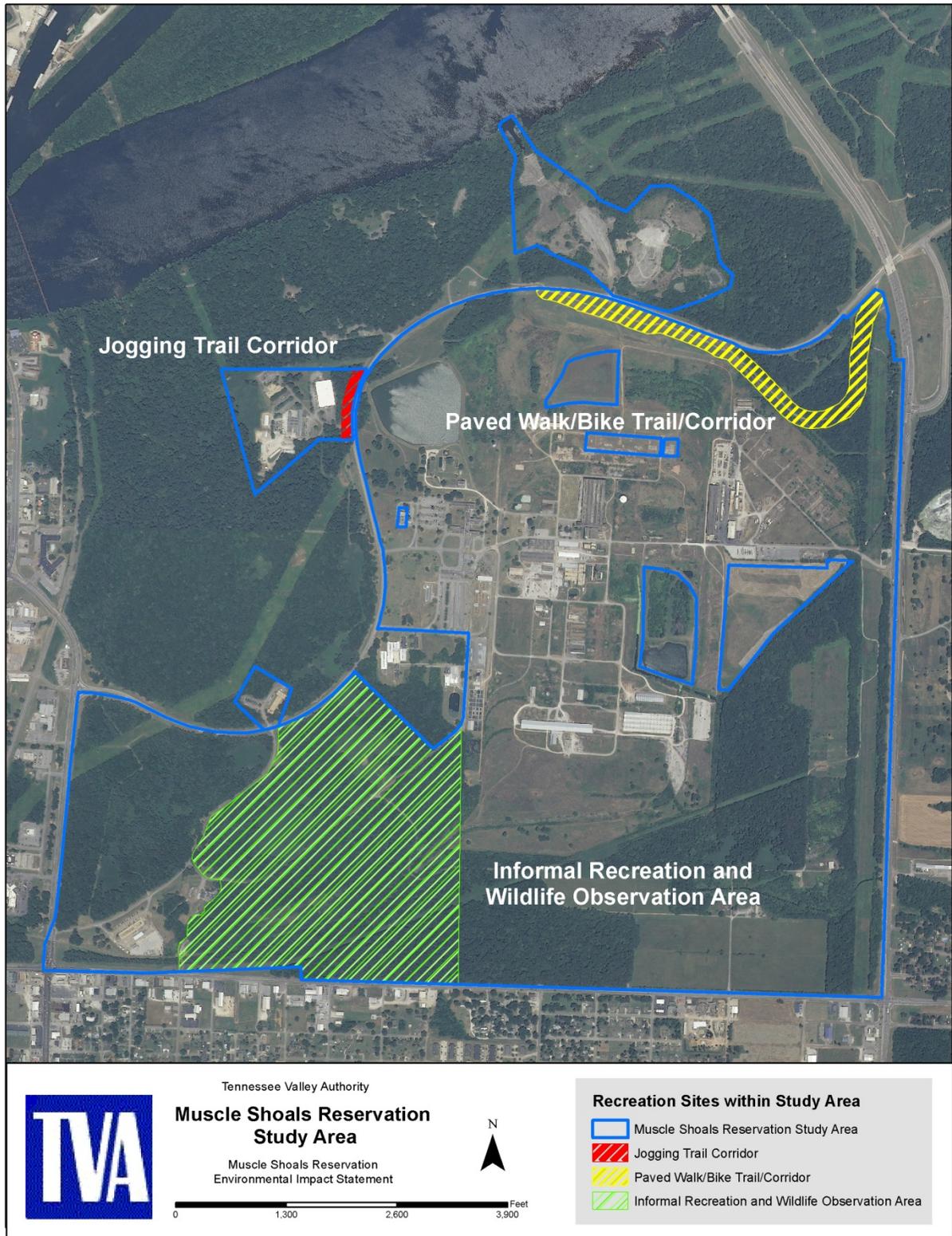


Figure 4-4. Recreation Sites Within the Muscle Shoals Reservation Study Area

Sheffield and across the river into the Florence community, such actions would also trigger cumulative negative impacts on nonmotorized recreation and transportation systems within a multicounty and multicounty area. To reduce the potential for adverse effects to recreational opportunities or facilities such as those outlined above, the following measures could be employed under any of the Action Alternatives (i.e., Alternatives B, C, D, E, and F).

1. The 1-mile segment of paved trail located on the south side of Reservation Road, including the corridor of native vegetative plantings along each side of the trail, (a) may be preserved and maintained in TVA ownership for its current recreational usage or, with the concurrence of ALDOT and FHWA, (b) could be preserved and managed for public recreation use under an agreement (e.g., easement) between TVA and the new landowner or other responsible party for the development area, or (c) upon agreement with ALDOT and FHWA, could be relocated to the north side of Reservation Road if the area on the south side is needed for other purposes under any of the Action Alternatives. Option (c) would eliminate the two existing crossings of Reservation Road by the trail and, thus, enhance public safety. However, because this alignment would require construction of a bridge over Pond Creek, this approach could involve considerable expense.
2. The 900-foot section of paved trail, including a protective corridor, on the Multipurpose Building parcel could be (a) retained by TVA, (b) preserved and managed for public recreation use under an agreement (e.g., easement) between TVA and a new landowner, or (c) relocated to skirt the boundaries of the Multipurpose Building parcel.
3. Development of the phosphate slag storage area as part of a utility corridor to the Tennessee River could also include potential impacts to the Rockpile Hiking Trail and the paved trail complex along Reservation Road. Impacts of severing these trails could be temporary, and mitigated through rerouting the trail, or permanent causing a loss of future recreational use opportunity. Depending on the nature of utility corridor facilities construction, efforts would be made to avoid trail closure or reduce effects of trail usage through planning or other design features (such as reconstruction of segments of the disrupted trail and/or revegetation of the trail corridor). This could help to maintain the integrity and character of the trail and trail environs.

The future availability of land within the MSR study area for potential recreational use could be integrated into plans for open green space (e.g., parks) depending on the land use allocations resulting from the Master Plan development process.

4.16.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Under this alternative, there would be essentially no foreseeable change in current access to recreation facilities or the availability of these facilities. Thus, recreational availability, quality, and activity patterns are not expected to change. Use opportunities on trails and other recreation facilities along with informal use of some of the MSR properties both north and south of the Reservation Road would likely continue. According to Alabama's Statewide Comprehensive Outdoor Recreation Plan, demand for access to trails to accommodate walking, hiking, and bicycling is likely to increase statewide.

4.16.2 Alternative B

Development following the implementation of Alternative B, conservation and LID, would likely have a positive effect on recreational use on the MSR study area. Implementation of this alternative would make the MSR study area available for protecting and enhancing the natural character of the area, which is a key factor in its attraction as an outdoor recreation resource. Adoption of Alternative B could also result in additional recreation enhancement to supplement recreation facilities north of Reservation Road and help meet future recreation needs in the area. This could occur in association with continuation of volunteer programs and establishment of new or expansion of existing public parks or other green spaces.

Implementation of this alternative would also likely result in preservation and/or improvement of areas of the MSR that currently receive informal recreation use such as walking, jogging, and nature observation. Likewise, the types and levels of development such as green energy research, education, and ecotourism envisioned under this alternative would be less impacting than some other types of development expected to occur under the other Action Alternatives. Thus, implementing Alternative B would likely preserve or increase the overall amount of open space and areas in a relatively natural character across the area.

Although adoption of Alternative B could enhance recreational use of the MSR overall, there is some potential for negative impacts on recreational use areas and facilities that are located within the proposed MSR study area boundaries. The recreational trail located north of Reservation Road that continues south of the road onto the northeast corner of the property as well as the trail along the river near the phosphate slag storage area could both be affected. Although the use of the phosphate slag storage area for a utility corridor is unlikely under this alternative, these potential impacts could include those described above (Section 4.16) involving the 1-mile segment of the National Recreation Trail Complex and a shore segment of the Rockpile Hiking Trail along the Tennessee River (see Figure 3-30). TVA would obtain approval from ALDOT and FHWA prior to selling land associated with the trail complex and, to the extent practicable, avoid or reduce construction and operational impacts on the Rockpile Hiking Trail and the 900-foot section of the paved trail that passes through the Multipurpose Building portion of the proposed redevelopment area.

All three of these trail segments could remain unaffected or potentially enhanced through consideration of local recreational needs and use values through the Master Plan development process. Within the context of the recreation resources protection efforts outlined above, the cumulative effect of adopting this alternative on recreation would likely be positive.

4.16.3 Alternative C

Development of the MSR study area for commercial, retail, and residential use as required under Alternative C could cause significant negative impacts on public recreational use of the area. Such effects would be greater than those anticipated under Alternative B. Potential development associated with Alternative C would likely change the character of the MSR study area from open space and areas in a relatively natural character to developed, resulting in the area being less attractive for recreation. Increases in traffic levels and associated traffic noise could also make the area less suitable for outdoor recreation and could increase the potential for conflicts between trail users and vehicular traffic, especially at the two points where the paved trail crosses Reservation Road.

The three potential recreation-related impacts outlined under the discussion of Alternative B (i.e., potential effects associated with the development of the phosphate slag storage area as a utility corridor and the two segments of the Reservation Road trail within the MSR study area) would also apply to this alternative.

A third potential effect under this alternative relates to recreation use that currently occurs within the southwestern section of the MSR (see description under Sections 3.14 and 3.16). Modifications within this area resulting in the loss of existing vegetative cover or old road networks could have a negative effect on joggers and walkers that regularly use this area and a significant adverse effect on seasonal (e.g., spring and fall) bird-watching opportunities.

Implementation of the following measure, through execution of the Master Plan, could substantially reduce the potentially most adverse impacts on recreational use of the MSR study area:

- Informal trail networks within the southwestern portion of the MSR study area that are eliminated due to implementation of Alternative C could be replaced with trails that offer similar recreation opportunities at suitable locations north of Reservation Road or at other public parks or natural areas in the vicinity.
- Some recreational activities, such as fall bird watching, may not be available on other sections of the MSR study area due to the unique character of the southwestern area of the proposed redevelopment area and the unique population of bird species that are present in this area during the fall.

4.16.4 Alternative D

The potential impacts of future development under Alternative D are expected to be greater than those under Alternative B and similar to those under Alternative C. However, some types of industrial development and operations could produce additional noise or other environmental emissions that might result in some additional adverse impacts on nearby recreational areas as compared to Alternative C. The implementation of the mitigation measures described previously could substantially reduce the potential direct and indirect impact of this alternative on recreational opportunities and the quality of the experience. However, depending on the nature and extent of potential industrial development under this alternative, there could be significant negative impacts on the open space character and public recreation use of the MSR study area under Alternative D.

The potential recreation-related impacts outlined under Alternative C and the corresponding commitments would also apply to Alternative D. These commitments would reduce the potential direct impacts of this alternative. However, the expected reduction in open space areas; potential loss of areas currently managed for and available to the public for informal recreation, including the birding area on the southwestern portion of the property; increase in motorized traffic flows on area roads as well as on additional road networks that could be constructed; and increased noise levels would result in low to moderate adverse impacts on recreation. This could increase the potential for negative cumulative effects compared to Alternatives A and B.

4.16.5 Alternative E

The potential for more balanced development and conservation efforts envisioned under Alternative E would likely result in continued maintenance and protection of existing recreation facilities and activities and could also result in maintaining areas currently used

for informal recreation and other low-impact activities available to and considered important to the public. However, development of commercial/retail, residential, and industrial areas could also likely have moderate negative impacts on recreational users due to the overall increase in development and associated increases in traffic and noise that would likely take place within the MSR study area. Depending on the intensity and location of residential, commercial, and industrial use areas, loss of open space and loss of areas currently managed to accommodate informal recreation use could also occur. Green spaces and buffer zones of vegetation, barriers, and effective use of juxtaposition and spacing of development and infrastructure could help reduce visual and noise effects.

The potential impacts of adopting and implementing Alternative E are expected to be greater than those anticipated under Alternative B and similar to those expected under Alternative C or D. The potential recreation-related impacts outlined under Alternative C and the corresponding commitments would also apply to Alternative E. As previously indicated under Alternative D, these commitments would reduce the potential direct, indirect, and cumulative impacts of this alternative.

4.16.6 Alternative F

The potential for direct, indirect, and cumulative adverse impacts to recreation resources under Alternative F would likely be similar to those expected under Alternative E. As indicated above, some land set aside for conservation in the Master Plan could minimize effects on recreation under Alternative F. The potential environmental effects from such development would likely be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

4.17 Transportation

In a letter dated August 18, 2009 (Brown 2009), ALDOT notified TVA of two projects under study its long range planning that could affect TVA land in the vicinity of the MSR study area. Only one verifiable project is noted in the study area, which is the widening of Second Street from four to five lanes (effectively constructing a center turn lane) between Hatch Boulevard and Wilson Dam Road. As this project does not add capacity (because turn lanes already exist at the major intersections on Second Street except Firestone Avenue), it has limited applicability to the transportation impact analysis. This project is referenced as Project #5 in the *Shoals Area 2030 Long Range Transportation Plan* (Skipper Consulting Inc. 2005).

ALDOT has indicated plans to widen US 72 (Hatch Boulevard) between Jackson Highway and Second Street to six lanes if warranted by traffic growth. A specific timeline has not been determined for this project. Additionally, there are long-term plans possibly to provide an interstate facility from Memphis, Tennessee, to Atlanta, Georgia, using an alignment on or similar to US 72. Implementation of this project was not assumed primarily because its timeline and likelihood are not defined. However, if such a project were to move forward, it could affect traffic flow on surface streets in the Muscle Shoals area. Some of the regional through traffic on Hatch Boulevard, Second Street, and Wilson Dam Road would likely divert to such a facility.

Future conditions were analyzed for the year 2035, a conceptual year in which the proposed MSR redevelopment would likely be complete. Future traffic volumes were estimated. To estimate the traffic that would likely occur whether the MSR study area is redeveloped or not (also known as “background traffic”), a 1.90 percent linear annual growth rate was utilized (see Section 3.17.1). To estimate the traffic volumes that would be

generated by the MSR study area redevelopment alternatives (i.e., “project traffic”), land use and certain nonbinding assumptions for each alternative were made. All trips estimated to be generated in each alternative are considered “new” project trips. The assumptions were then utilized to conduct a trip generation analysis based on the rates and equations published in the standard Institute of Transportation Engineers’ (2008) reference *Trip Generation User’s Guide*. The estimated trips under each Action Alternative are presented in Table 4-4.

Table 4-4. Trip Generation Under Alternatives B Through E

Alternative	Project Trips on External Roadway			
	A.M. Peak Hour		P.M. Peak Hour	
	Enter	Exit	Enter	Exit
Alternative B	3,626	591	876	3,779
Alternative C	2,151	1,353	2,130	2,986
Alternative D	3,054	1,596	783	3,832
Alternative E	3,526	1,089	1,677	4,367

The resulting estimated new project trips for each alternative were assigned to the local roadway network utilizing existing traffic distribution patterns to estimate the total (background + project) number of peak-hour vehicles at each intersection in the year 2035, which were then analyzed to determine future LOS.

4.17.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. The existing intersection LOS for Alternative A is shown in Table 4-5

Table 4-5. 2035 Alternative A Intersection Level of Service

Location	A.M. LOS	P.M. LOS
Hatch Boulevard at Jackson Highway	D	E
Hatch Boulevard at Reservation Road	A	B
Hatch Boulevard at Second Street	D	D
Second Street at Firestone Avenue	B	B
Second Street at Wilson Dam Road	E	E
Wilson Dam Road at MSR Access (unsignalized, eastbound approach)	F	F
Wilson Dam Road at Access Road	B	E
Access Road at River Road	B	C
Access Road at Reservation Road	B	C

Bolded letters representing LOS mean that improvements to the roadways are needed.

The results indicate that the existing roadway network, even without redevelopment of the MSR study area, cannot accommodate the estimated increases in traffic over the next 25 years at several locations. To determine whether new land uses would have an adverse impact, the estimated traffic levels under the Action Alternatives were compared to those anticipated under Alternative A. In order to compare the Action Alternatives to Alternative A in the year 2035, potential roadway improvements were identified that could improve LOS conditions under Alternative A. The potential improvements are depicted in Table 4-6. At

the intersection of Wilson Dam Road and the MSR Access Road, the LOS failure indicated by the analysis is likely due to the limitations in the analysis, and no improvements were recommended. As shown in Table 4-7, these improvements would improve conditions to LOS D or better and, to the degree feasible, should be considered in the future as necessary.

Table 4-6. Transportation Improvements Under Alternative A

Location	Improvements
Second Street at Wilson Dam Road	<ul style="list-style-type: none"> • Dedicated eastbound right-turn lane • Dedicated westbound right-turn lane • Additional westbound left-turn lane
Wilson Dam Road at Access Road	<ul style="list-style-type: none"> • Additional southbound left-turn lane
Hatch Boulevard at Jackson Highway	<ul style="list-style-type: none"> • Additional southbound left-turn lane (would require widening Hatch Boulevard southbound to three lanes south of the intersection)

Table 4-7. Intersection Level of Service Under Alternative A With Suggested Improvements*

Location	A.M. LOS	P.M. LOS
Hatch Boulevard at Jackson Highway	C	D
Hatch Boulevard at Reservation Road	A	B
Hatch Boulevard at Second Street	D	D
Second Street at Firestone Avenue	B	B
Second Street at Wilson Dam Road	D	D
Wilson Dam Road at MSR Access (unsignalized, eastbound approach)	F	F
Wilson Dam Road at Access Road	A	C
Access Road at River Road	B	C
Access Road at Reservation Road	B	C

*Expected in 2035

Bolded letters representing LOS mean that improvements to the roadways are needed.

4.17.2 Action Alternatives

Using the total trip volumes for Alternatives B through E, a LOS analysis was provided for each of the five Action Alternatives. To accommodate the new trips, three additional signalized access points to the MSR study area (one each on Wilson Dam Road, Hatch Boulevard, and at the intersection of Second Street at Firestone Avenue) were assumed for the analysis. In addition, redevelopment of the MSR study area was assumed to include upgrading the current access point to the MSR on Wilson Dam Road to include signalization. A signal warrant analysis and permit approval by ALDOT and/or any appropriate review agencies would be needed at the time of the MSR redevelopment.

In addition, to compare to the No Action Alternative with LOS D or better conditions, the improvements identified in Table 4-6 were assumed to be implemented by state or local agencies by the year 2035. The intersection LOS for Alternatives B through E is shown in Table 4-8.

Table 4-8. Intersection Level of Service Under Alternatives B, C, D, and E*

Location	Alternative B		Alternative C		Alternative D		Alternative E	
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
Hatch Boulevard at Jackson Highway	F	F	F	F	F	F	F	F
Hatch Boulevard at Reservation Road	F	F	F	F	F	F	F	F
Hatch Boulevard at Access Point	B	C	B	C	C	C	C	D
Hatch Boulevard at Second Street	E	F	E	F	F	F	E	F
Second Street at Firestone Avenue	B	C	B	C	C	C	D	C
Second Street at Wilson Dam Road	D	D	D	D	D	D	D	D
Wilson Dam Road at MSR Access	A	B	A	A	B	B	B	A
Wilson Dam Road at Access Road	A	B	A	A	B	B	A	B
Access Road at River Road	B	D	B	C	D	D	B	C
Access Road at Reservation Road	B	B	C	B	C	C	C	C

*Expected in 2035

Bolded letters representing LOS mean that improvements to the roadways are needed.

The results indicate LOS failure under all the Action Alternatives at three intersections all along Hatch Boulevard corridor. In particular, the LOS failures along Hatch Boulevard at Jackson Highway and Reservation Road are severe, based on the observed average delays of over 200 seconds, despite the assumed improvement of triple southbound left-turn lanes at Hatch Boulevard and Jackson Highway. In effect, the analysis indicates that the combination of the “background traffic” (including the large number of vehicles that have to turn left or right to stay on the US 43/72 route designation at Hatch Boulevard and Jackson Highway) and the estimated new trips associated with the MSR study area would severely impact the Hatch Boulevard corridor. Overall, the transportation impacts of redevelopment of the MSR study area from Alternatives C and E would be greater compared to Alternatives B and D because these alternatives would likely generate more trips to and from the MSR study area.

Under Alternative F, the MSR study area would be developed with no restrictions on the types of future land uses that could occur. As described in Sections 2.1.6 and 4.2.6, the reasonably likely future uses of the property under Alternative F are those described in Action Alternatives B, C, D, and E and would, therefore, result in a mixture of one or more of those uses or a mixed use reflected in Alternative E. Therefore, impacts of development under Alternative F on transportation are likely to be similar to those described under Alternative E and within the range of effects bounded by those described under Action Alternatives B, C, D, and E.

4.17.3 Potential Mitigation Strategy

Based on the results of the Alternative B, C, D, and E analysis, a determination was made that the LOS failures at Hatch Boulevard at Second Street could likely be mitigated with the strategic addition of turn lanes. However, the LOS failures on Hatch Boulevard would

require more comprehensive solutions. Two overall potential mitigation approaches were developed:

Option 1: Realign the US 43/72 designation through Hatch Boulevard and relocate Jackson Boulevard to Birmingham Road (Table 4-9).

Option 2: Incorporate an additional access point to the MSR between the Tennessee River and Hatch Boulevard and construct grade-separated flyover for southbound US 43/72 through traffic at Hatch Boulevard (Table 4-10).

Table 4-9. Mitigation Option 1 for the MSR Study Area

Location	Improvements
Hatch Boulevard at 2 nd Street	<ul style="list-style-type: none"> • Dedicated westbound left-turn lane. • Dedicated eastbound right-turn lane.
Hatch Boulevard at Jackson Highway	<ul style="list-style-type: none"> • Realign US 43/72 approaches to major north-south movement forming a new T-intersection with Hatch Boulevard on the eastbound approach. Jackson Highway would be relocated to utilize Birmingham Street to intersect with US 43. • Three through lanes for northbound and southbound approaches to US 43/72. Would require widening Hatch Boulevard to six lanes south of the intersection. • Northbound and westbound dual left-turn lanes.
Hatch Boulevard at Reservation Road	<ul style="list-style-type: none"> • Realign Jackson Highway to intersect with Hatch Boulevard on the eastbound approach (currently Birmingham Street). • Eastbound triple left-turn lanes. Would require widening Hatch Boulevard to six lanes north of the intersection. • New eastbound through lane. • Dedicated eastbound right-turn lane. • Additional westbound and southbound right-turn lanes to provide dual-turn lanes. • Dual dedicated southbound right-turn lanes with free-flow conditions (would require three receiving westbound lanes on Birmingham Street that would likely merge into two lanes).

Table 4-10. Mitigation Option 2 for the MSR Study Area

Location	Improvements
Hatch Boulevard at 2 nd Street	<ul style="list-style-type: none"> • Dedicated westbound left-turn lane. • Dedicated eastbound right-turn lane.
Hatch Boulevard at Jackson Highway	<ul style="list-style-type: none"> • Construct a two-lane flyover over the intersection for southbound US 43/72 traffic, which would merge with a single lane carrying eastbound through (from Hatch Boulevard) and northbound right (Jackson Highway) traffic south of the intersection to create three lanes on Hatch Boulevard southbound toward Reservation Road. • Widening of Hatch Boulevard to six lanes between Jackson Highway and Reservation Road. • Provide an additional westbound left-turn lane.
Hatch Boulevard at Reservation Road	<ul style="list-style-type: none"> • Reconfigure the westbound right-turn channelized movement into a free flow (which would tie into a six-lane Hatch Boulevard north toward Jackson Highway).

Location	Improvements
US 43/72 at New MSR Access	<ul style="list-style-type: none"> • New signalized access to the MSR on US 43/72 between Hatch Boulevard and the Tennessee River. • Provide dual westbound left-turn lanes. • Dedicated channelized free-flow westbound right-turn lane. • Three through lanes northbound and southbound (north of the intersection, this would need to, along with the receiving lane from the westbound right turn lane, taper into two lanes northbound and southbound to tie into the O'Neal Bridge). • Provide dual southbound left-turn lanes.

Access improvement to the MSR study area for Alternative A, as shown in Table 4-6, were assumed to occur along with the mitigation options. These two mitigation strategies were tested using transportation analysis software. The results of utilizing these improvements for Alternatives B through E are provided in Tables 4-11 and 4-12. In addition, these improvements would require diversion of traffic volumes under each of the alternatives, including Alternative F.

Table 4-11. Mitigation Option 1 Intersection Level of Service Under Alternatives B, C, D, and E*

Location	Alternative B		Alternative C		Alternative D		Alternative E	
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
Hatch Boulevard at Jackson Highway	B	B	B	B	B	B	B	B
Hatch Boulevard at Reservation Road	F	F	F	F	F	F	F	F
Hatch Boulevard at New Access Point	B	C	B	C	B	C	B	D
Hatch Boulevard at Second Street	C	C	C	D	C	D	C	D
Second Street at Firestone Avenue	B	B	B	C	C	C	B	C
Second Street at Wilson Dam Road	D	C	D	D	D	D	D	D
Wilson Dam Road at New Access Point	B	A	A	A	A	B	A	B
Wilson Dam Road at MSR Access	A	B	A	A	A	B	A	B
Wilson Dam Road at Access Road	A	C	A	C	A	C	A	C
Access Road at River Road	B	B	B	B	B	B	B	C
Access Road at Reservation Road	B	B	B	B	C	B	B	B

*Expected in 2035

Bolded letters representing LOS mean that improvements to the roadways are needed.

Table 4-12. Mitigation Option 2 Intersection Level of Service Under Alternatives B, C, D, and E*

Location	Alternative B		Alternative C		Alternative D		Alternative E	
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
US 43/72 at New Access Point	B	A	A	B	B	A	B	A
Hatch Boulevard at Jackson Highway	B	B	B	B	B	B	B	B
Hatch Boulevard at Reservation Road	C	C	B	C	C	C	C	D
Hatch Boulevard at New Access Point	A	A	A	A	A	A	A	B
Hatch Boulevard at Second Street	C	D	C	D	C	D	C	D
Second Street at Firestone Avenue	B	B	B	B	B	B	B	B
Second Street at Wilson Dam Road	D	C	C	C	D	C	D	C
Wilson Dam Road at New Access Point	A	A	A	A	A	A	A	A
Wilson Dam Road at MSR Access	B	A	A	A	A	A	A	B
Wilson Dam Road at Access Road	A	C	A	C	A	C	A	C
Access Road at River Road	B	B	B	B	B	B	B	B
Access Road at Reservation Road	B	B	B	B	B	B	B	B

*Expected in 2035

The modeling results for Option 1 indicate that these improvements would upgrade all of the intersections on US 43/72 considerably, including improving Hatch Boulevard at Jackson Highway to a LOS B. However, the intersection of Hatch Boulevard and Reservation Road would continue to operate at LOS F, despite significant reductions in average delay.

In contrast, the modeling results for Option 2 indicate that the improvements tested would mitigate all observations of LOS E or F in the vicinity of the site. Therefore, this option is recommended over the improvements in Option 1. However, given a variety of unknowns (e.g., alternative selection, the feasibility of particular improvements in terms of cost and engineering, community preferences, etc.), both options should be considered as potential mitigation strategies by transportation officials at Colbert County or ALDOT. TVA would rely on local and state authorities to consider these strategies or others ways for minimizing future development effects on traffic and would not be responsible for implementing or funding any particular strategy. Anticipated changes in traffic levels and volume would also be taken into account in the development of the Master Plan.

Indirect and Cumulative Effects

Because of the volumes of new traffic potentially generated by the year 2035 under any of the alternatives, but more so under Alternatives C, D, E or F, TVA anticipates that indirect and cumulative effects on the local transportation network within a mile or so from the MSR study area could also be significant. However, because of current improvements to Wilson

Dam Road, including its likely future widening from East Avalon south to US 72/20 (Alternate), as well as unscheduled but planned local ALDOT projects, local cumulative impacts are expected to be more moderate within a few miles from the site. At this distance along major routes, the influence of traffic associated with the redevelopment site could be assumed to return to normal volumes at those locations. If the major interstate (Memphis – Atlanta) becomes a reality, it could affect traffic flow on surface streets in the Muscle Shoals area. Thus, traffic-related congestion could be minimized and further reduce long-term cumulative effects of the potential redevelopment. Transportation impacts from this redevelopment proposal would likely cause insignificant impacts within Colbert County and the multicounty region, regardless of the adopted alternative.

4.18 Scenic Resources

Potential impacts to scenic resources were examined based on anticipated changes likely to occur on the existing landscape and the landscape character after alteration. Identifying these changes in the landscape character was based on commonly held perceptions of landscape beauty and the aesthetic sense of place.

The slope and vegetation patterns of a landscape can be determining factors in the relative ability of a particular landscape to accept human alteration with varying impacts to the scenic attractiveness and scenic integrity. For example, a landscape that is relatively level (i.e., flat) and densely forested has a much greater capacity to absorb change than does a landscape that is steeply sloping and sparsely vegetated or vegetated with lower-growing herbaceous vegetation. These characteristics are expressed in the general landscape character of the MSR study area where the topography is flat to gently sloping and vegetation types and patterns are diverse yet dense to sparse.

The 1996 Plan recommended the establishment of certain visual buffers, which continue to serve their visual management and protection purpose, along Reservation Road and the length of all transportation corridors surrounding the MSR (see Figure 2-1). Similarly, the Master Plan would likely involve the establishment of appropriate buffers to separate various land uses and to reduce potential impacts associated with scenic resources and noise. In addition, given current land use and urban landscape character over much of the interior of the site observable from Reservation Road, as well as recommended buffer zones, the extent and magnitude of visual alteration to the existing landscape from implementing any of the Action Alternatives would not change the scenic value class beyond the threshold of significance.

Creation or supplementation (i.e., additional plantings) of existing vegetative buffers would not be required. However, existing vegetation included within the buffer areas as shown in Figure 4-5, which should be considered in the Master Plan, could remain or be allowed to mature. The retention of these vegetative buffers, as identified below and in Section 2.3, in combination with limiting new roadway intersections (i.e., curb cuts) could reduce the potential for disturbance and maintain the park-like setting for viewers using TVA land and facilities along, and north of, Reservation Road. See a photograph of a segment of the maintained right-of-way along both sides of Reservation Road in Figure 3-35.

The measures described below could be used to reduce the potential for adverse effects to visual resources under the Action Alternatives and would be considered in development of the Master Plan.

- Except where maintained within the existing road right-of-way, a vegetative buffer, measured 150 feet from the edge of the pavement, shall be maintained along both sides of Reservation Road within the MSR study area from the intersection of Hatch Boulevard to the Wilson Dam Road overpass (Figure 4-5).
- Except where maintained within the existing road right-of-way, a vegetative buffer, measured 150 feet from the edge of the pavement, shall be maintained along Hatch Boulevard from the intersection of Reservation Road, southward for a distance of 500 feet (see Figure 4-5).
- Except where maintained within the existing road right-of-way, a vegetative buffer, measured 150 feet from the edge of the pavement, shall be maintained along Wilson Dam Road from the Reservation Road overpass, southward for a distance of 2,000 feet (see Figure 4-5).
- No more than four additional curb cuts (i.e., new roadway entrances onto the area) shall be made along Reservation Road.

4.18.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Potential effects to scenic resources associated with the adoption and implementation of this alternative were previously addressed in the 1996 Plan. No additional foreseeable actions that could have visual effects beyond those considered in the 1996 Plan are anticipated under the No Action Alternative.

4.18.2 Alternative B

Requiring the MSR study area land to be used for resource conservation and sustainable LID under Alternative B could result in enhanced opportunities for public use of the MSR property while maintaining or enhancing the landscape character. Any low-impact development occurring on the area under Alternative B is expected to adhere to the standards established in the Master Plan regarding visual buffers to mitigate potential adverse effects to scenic resources. Because the visual quality of the area would likely be increased, adoption of this alternative would likely result in a beneficial effect on scenic resources within the MSR study area. Although visual buffering would occur, potential development under Alternative B could result in similar or slightly greater visual impacts than those likely under Alternative A. However, actions under Alternative B would likely result in a less discernable impact to existing scenic resources and landscape character compared to development under Alternatives C, D, E, and F.

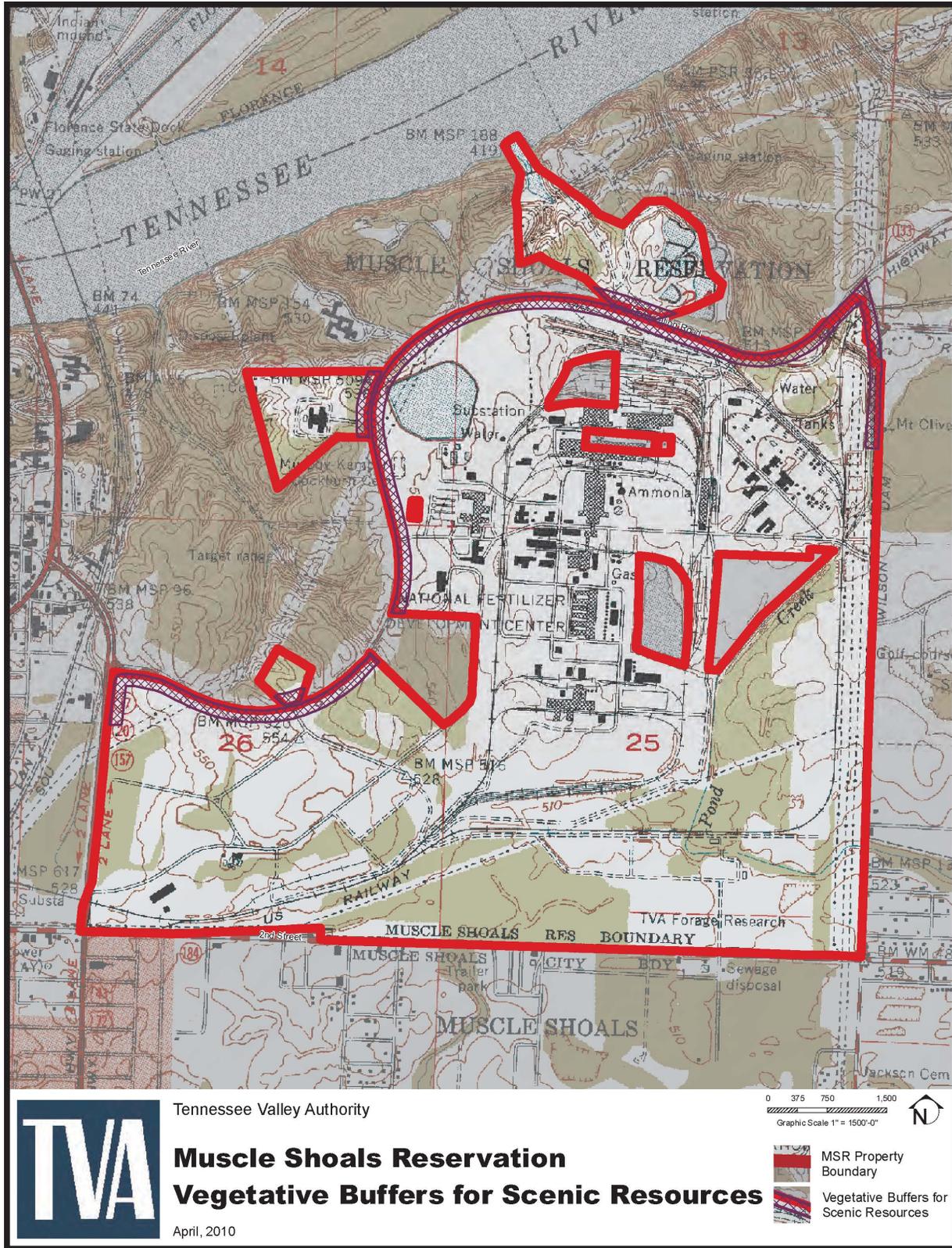


Figure 4-5. Proposed Vegetation Buffers for Scenic Resources

4.18.3 Alternative C

The MSR study area would be required to be used for commercial, retail, and residential land uses under Alternative C. This could result in a discernable change in the existing landscape character, depending on the location, density, context sensitivity, and phasing of development. Proposed development could take place over nearly the entire MSR study area. These types of development could affect areas of rural, pastoral, and naturally appearing landscape character. Vegetation would likely be removed or reduced to allow for development and the expansion of infrastructure associated with this alternative. The topography within the MSR study area could be uniformly graded to facilitate construction and expansion of utilities and services within the site. The measures identified above or in the Master Plan standards, applicable to Alternatives B, C, D, E, and F, if implemented, could mitigate impacts to scenic resources. With such mitigation, implementation of this alternative would not likely result in a significant impact to scenic resources. Eventual development activities under Alternative C would likely result in a more discernable impact to existing scenic resources and landscape character as compared to Alternatives A and B. However, with the implementation of appropriate standards, development under this alternative would result in impacts similar to those associated to Alternatives D, E, and F.

4.18.4 Alternative D

Adoption of Alternative D would require that the property be used for industrial purposes. Depending on the type of industry that could locate on site, development under this alternative could result in adverse effects to existing scenic resources within the MSR study area. Removal of existing trees and extensive site grading and surfacing could affect the scenic integrity of portions of the MSR study area having a rural, pastoral, or naturally appearing landscape character. Discharges, emissions, smoke or vapor plumes, odors, noise, and/or waste light could also be generated, depending on the size and type of industry located on the MSR study area.

The measures and potential Master Plan standards identified above, which are applicable to Alternatives B, C, D, E, and F, could mitigate impacts to scenic resources. Thus, implementation of this alternative would not necessarily result in a significant impact to scenic resources. Site development under Alternative D would likely result in greater impacts compared to those expected under Alternatives A, B, E, and F. However, with the implementation of appropriate measures, potential effects under Alternative D would be similar to those likely under Alternative C.

4.18.5 Alternative E

Under Alternative E, TVA would require that the MSR study area be used for a mixture of commercial, retail, residential, and industrial land uses. Depending on the composition of land uses as well as their size, density, and location, implementation of Alternative E could result in the partial removal of existing woody vegetation and moderate site grading. Conversely, adoption of this alternative could result in the protection or enhancement of areas expressing a rural or naturally appearing landscape character potentially associated with desirable conservation, retention of forests, parks development, or other green space initiatives.

The measures or potential Master Plan standards mentioned above could mitigate adverse impacts to scenic resources. With the appropriate implementation of these measures, development under this alternative would not result in a significant impact to scenic resources. Implementation of Alternative E would likely result in a more discernable impact to scenic resources as compared to Alternatives A and B. However, with mitigation,

proposed actions subsequent to the adoption of this alternative would result in impacts similar to those likely under Alternatives C, D, and F.

4.18.6 Alternative F

The potential for direct, indirect, and cumulative adverse impacts to scenic resources under Alternative F would likely be similar to those expected under Alternative E. As indicated above, some land set aside for conservation or vegetative buffers in the Master Plan could minimize effects on scenic resources under Alternative F. The potential environmental effects from such development would likely be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

Indirect and Cumulative Effects

Implementation of any of the Action Alternatives would result in increased development within the MSR study area. This increase would likely vary by alternative. Implementation of Alternative B or C would likely result in low- to moderate-density development, whereas development under Alternatives D, E, and F would likely result in more moderate- to high-density development. Although roadways are presently heavily traveled, these variable intensities of development could result in associated varying degrees of discernable future increases in traffic on the roadways that bound the property. The amount of on-site traffic, particularly on Reservation Road, and disturbance is expected to increase over time under all the alternatives, including the No Action Alternative (see Section 4.17.1). With mitigation, these increases could likely be absorbed into traffic densities, transportation improvements, and travel patterns over time and would not significantly cumulatively affect scenic resources.

Similar to the incremental increase in traffic associated with the Action Alternatives, increases in discernable levels of night sky brightness could occur with heavier levels of development. While this potential exists, incremental increases in night sky brightness associated with these alternatives would not significantly indirectly or cumulatively affect scenic resources due to the existing levels of night sky brightness created by the four neighboring cities.

4.19 Navigation

As indicated in Section 3.19, the Florence-Lauderdale County Port Authority's barge terminal, the major navigation channel, and Wilson Dam Lock are located on the right-descending (north) riverbank opposite the MSR study area. Potential river navigation effects could be a concern primarily along the left-descending (south) shoreline, particularly in the vicinity of the utility corridor (across the slag storage area).

The five Action Alternatives (particularly Alternatives D, E, and F) involve the potential use of land in the study area for a utility corridor to the Tennessee River. Future use of this property has the potential to interfere with commercial and recreational navigation if it involves the placement of structures in or on the Tennessee River. Such structures could likely include water or sewage outfalls, water intakes, or other types of pipelines. The likelihood of needing such water access or water use facilities would vary by the nature of potential development under each of the Action Alternatives.

Any proposed facility or shoreline alteration on the Tennessee River would be subject to state and federal authorization, including TVA review and approval under Section 26a. Because of environmental and reservoir operations constraints along the left-descending (south) shoreline of the Tennessee River in the vicinity of the utility corridor, TVA would not

approve a barge terminal, commercial dock, or other similar shoreline facility. However, the Florence-Lauderdale County Port Authority, a major multimodal port, is located at TRM 256.5 on the right-descending (north) riverbank opposite the MSR study area site. The Wilson Dam lock is also on the north riverbank. Depending on the type and extent of future development on the MSR property, materials, goods, and products shipped to or from the site would contribute to an increase in commercial barge traffic on the north bank.

The Tennessee River channel between the dam and O'Neal Bridge, in the vicinity of the south bank, is unsuitable for commercial navigation for the following reasons:

- The shoreline in this area and any potential water use facilities would be susceptible to high flows that are produced when Wilson Hydro Plant is generating or spilling during flood control operations, as well as fluctuations in water surface elevations that result from hydro units being turned on and off.
- Wave wash or prop wash from passing vessels can cause damage to shoreline facilities.
- Existing structures over the river including O'Neal Bridge at TRM 256.4 (US 72/43 or North Jackson Highway) and particularly the old Southern Railroad trestle at TRM 256.5, toward the river's south side, would pose hazards to any increased number or size of vessels motoring upstream to the area of the utility corridor site (see Figure 4-6).
- Water depths at this location may be too shallow for certain types of operations without dredging or excavation.

4.19.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Development of the utility corridor or along Tennessee River shoreline at the site of the phosphate slag storage area would not likely occur under this alternative. Thus, no additional effects to navigation are anticipated under this alternative and use of the utility corridor to the river is unlikely.

4.19.2 Alternative B

Sustainable, low-impact development as required under Alternative B is unlikely to require use of the utility corridor or to affect the Tennessee River. Thus, there are no foreseeable impacts to navigation under Alternative B. However, in the unlikely event that some water access or development on the riverfront is necessary under Alternative B, TVA would review such future requests under Section 26a on a case-by-case basis. Approval of these requests would likely be contingent on the implementation of necessary measures to reduce the potential for adverse effects to navigation.

4.19.3 Alternative C

The need for shoreline alterations or water use facilities associated with commercial, retail, and residential development under this alternative is unlikely. Thus, potential navigation-related effects are unlikely. The potential for high flows, fluctuating water surface elevations, and increased commercial or recreational boating traffic may require restrictions or limitations to be placed on the type or size of shoreline facilities allowed, if any, under this alternative. All such requests would require independent review and Section 26a approval by TVA.



Figure 4-6. Existing O'Neal Bridge and the Old Southern Railroad Trestle

4.19.4 Alternative D

Industrial use of the MSR study area under Alternative D would increase the likelihood that the utility corridor and supporting infrastructure development would be needed. The potential for adverse navigation impacts associated with shoreline alterations or water use facilities that may be requested to support the industrial uses of the property, such as a pipeline or intakes, are greatest under Alternative D compared to Alternative A, B, C, E, or F. These potential effects are related to the extent of potential industrial development that could occur south of Reservation Road given that the MSR study area would not be available for other types of land uses. All requests for such uses at this location along the

Tennessee River would require independent review and Section 26a approval by TVA as described in Alternatives B and C. As previously mentioned, TVA would not allow development of a barge terminal, commercial dock, or other similar shoreline facility along this shoreline of the Tennessee River (see Section 4.19). Under this alternative, an increase in navigation traffic could occur at nearby port facilities.

4.19.5 Alternative E

Under Alternative E, shoreline development or water use facilities such as a pipeline or intakes could be requested to support mixed use development of the MSR study area. Such water use facilities could adversely impact navigation, and the potential for effects is similar to or slightly less than those under Alternative D. All requests for shoreline alterations or water use facilities at this location would be subjected to independent review and Section 26a approval by TVA as described above. As mentioned in Alternative D, the river shoreline in the vicinity of the utility corridor would not be approved for water use facilities such as a commercial dock or barge terminal (also see Section 2.1.6). Under this alternative, an increase in navigation traffic could occur at nearby port facilities.

4.19.6 Alternative F

The potential for direct, indirect, and cumulative adverse impacts to navigation traffic under Alternative F would likely be similar to those expected under Alternative E. Even under a likely mix of alternative land uses (unrestricted), some use of the utility corridor would likely be needed to support an industrial development component on the MSR study area. Similar use as described under Alternative D would minimize effects on navigation under Alternative F. The potential environmental effects from such development would likely be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

Indirect and Cumulative Effects

In regard to potential indirect or cumulative effects on navigation, TVA expects such effects to be none or inconsequential. Because the main river channel and Wilson Lock access are on the opposite side (right-descending or north bank) of the Tennessee River, commercial navigation traffic and patterns under the action alternative (Alternatives B through F) are not expected to change. As described above, the Florence Port, located opposite the MSR study area site, would serve the needs of developers to move materials, goods, and products by barge to or from the site. Commercial barge traffic could increase and likely be accommodated with existing facilities. Therefore, no adverse indirect or cumulative effects on commercial navigation are expected. Because much of the left-descending shoreline would remain allocated to Public Recreation and Open Space and industrial development of the MSR study area would likely be less under Alternative A, no indirect or cumulative effects on commercial navigation are expected.

Construction and operation of industrial support infrastructure, such as a pipeline or intake, could adversely affect recreational navigation in the immediate area, so under any of the Action Alternatives (particularly Alternative D, E, or F), effects on recreational navigation are expected to be cumulatively minor and regionally insignificant. Such future proposals for shoreline infrastructure development would be independently reviewed under Section 26a and approved only with mitigation, as appropriate.

4.20 Noise

Generally, noise refers to unwanted sound, especially sound that creates an annoyance or disruption of normal activities. Typical noise sources include construction activities, equipment operation, and vehicular traffic. The amount of noise at a particular location can be reduced by the use of strategically placed physical barriers, vegetation screens, separation of the source and the receptor by distance, and enclosing the noise source. The noise effects on a particular receptor are a function of the location (i.e., perspective) of the noise source, both of which can be subject to change.

4.20.1 Alternative A

Under the No Action Alternative, TVA would continue to use the 1996 Plan to manage the MSR study area for program purposes and economic development. Therefore, the foreseeable level of new external noise generated is not expected to change as a result of this proposal.

4.20.2 Alternative B

Under Alternative B, TVA would require the new owner(s) of the MSR study area to use the property for conservation and sustainable LID uses. Development under both Alternatives A and B would largely retain or resemble the reservation's current environmental state and recreational opportunities without introducing substantial additional noise generation sources to the environment. Therefore, implementation of Alternative B would add little or no contribution to the noise levels currently existing on the proposed MSR redevelopment study area and would not likely negatively affect TVA employees, wildlife, or the recreational users and other visitors (i.e., receptors) to the area.

4.20.3 Alternative C

Adoption of Alternative C would require that the MSR study area be used for commercial, retail, and residential uses. Depending upon the nature, location, and intensity of these developments, implementation of Alternative C could introduce additional noise from such sources as increased traffic flow, construction noise, and increased residential population noise. These impacts could disturb internal noise receptors (i.e., TVA employees and other workers) on the property as well as recreational users nearby and wildlife and their communication and breeding habits. Recent studies on birds nesting along roads and highways found that increased traffic noise could hamper detection of songs by birds of the same species, making it more difficult for birds to establish and maintain territories, attract mates, and maintain pair bonds, and possibly leading to reduced breeding success in noisy habitats (Parris and Schneider 2008). In some less common instances, birds demonstrate a high tolerance for environmental noise that poses no threat. However, based on the current level of background noise along major roadways around the property and any likely future expansion and substantive traffic increases, these impacts on people and wildlife are not expected to be significant.

During its peak use between 1977 and 1980, the MSR property was typically occupied by approximately 950 TVA employees. Currently, the number of TVA employees commuting by vehicle to the Reservation is approximately 600 to 700. Given the drop in vehicular traffic from reduced employment, the noise impacts associated with the additional people and traffic from development under Alternative C would probably not be significant. Because of normal daytime background noise levels and the presence of existing commercial development, particularly along Hatch Boulevard and portions of Second Street, external receptors around the area would not likely be exposed to a significant increase in the overall level of new noise generated. These multiple use businesses and

dwellings represent the closest sensitive receptors bordering the MSR study area that would be exposed to noise generated from the site (i.e., external noise receptors).

Most noise caused by new commercial development would likely occur during daylight hours. Because of the distance between generators and sensitive residential receptors along other portions and south of Second Street, noise from new commercial development would not cause a significant level of annoyance. Existing daytime background noise levels around the property averaged nearly 80 dBA measured during the morning hours between May 20, 2010, and May 28, 2010 (see Section 3.20 Noise). The resulting DNL noise levels, including noise generated from new sources, would probably remain at or near the 1977 average levels of 55 dBA daytime and 45 dBA nighttime. Development under Alternative C would likely have greater potential noise effects compared to Alternatives A and B, potentially less than Alternative D and possibly similar impacts compared to those likely under Alternative E or F.

4.20.4 Alternative D

The MSR study area would be used for industrial purposes under Alternative D. Noise level increases of 5 to 20 dBA DNL are conceivable during plant construction and operations, depending on the type of industrial development ultimately locating on the site. Under Alternative D, heavier types of industry (e.g., metal factories, mills, other production facilities) that could occupy the site, along with the heavier truck or rail traffic and machinery operations associated with these industries, would pose the greatest risk of significantly increased noise impacts from the redevelopment project.

The study area already contains several potential development locations bordered by evergreen and deciduous forests. If these forested areas were left intact and if the proposed industrial developments were located with noise abatement in mind, these forests and strips of vegetation would tend to reduce the noise anticipated under Alternative D. Vegetation buffers potentially addressed in the Master Plan to reduce the effects of noise could be the same as those intended to maintain or enhance scenic values on the property (also see Section 4.18). Additionally, maintaining a noise-reduction zone between the industrial developments and the potentially impacted wildlife on the reservation would reduce the potential for disturbance or harm to these resources. A calculated noise-reduction zone (see Section 3.20) and the retention of the previously mentioned forests could reduce noise associated with Alternatives C, E, and F and, even more so, with Alternative D. Other potentially acceptable mitigation measures include strategically positioned or constructed physical sound barriers or enclosures for the heavy construction equipment and production machinery, proper interior acoustics, and the muffler sound suppression systems for trucks and other heavy equipment. Development under Alternative D would likely have greater potential noise effects compared to Alternatives C, E, and F and substantially greater impacts compared to those likely under Alternative A or B.

4.20.5 Alternative E

Mixed use development required under Alternative E would potentially introduce additional noise sources, including traffic, residential noise, and industrial noise compared to the current condition. However, because the amount of industrial use would likely be less, adoption of this alternative is less likely to introduce the same level of noise as development under Alternative D. The previously discussed mitigating factors of the forests, the use of modern technology such as enclosures or barriers, and a calculated noise-reduction zone could be implemented under Alternative E. If these measures were in place, development

under this alternative would not likely cause significant noise-related effects on interior or exterior receptors.

Development under Alternative E would likely have less noise effects compared to Alternative D, probably about the same as Alternative C, and potentially greater impacts compared to Alternative B.

4.20.6 Alternative F

The potential for direct, indirect, and cumulative adverse impacts from noise under Alternative F would likely be similar to those expected under Alternative E. Even under a likely unrestricted land uses scenario, other described land use components would also likely occur in lesser proportions on the MSR study area. Similar measures as described under Alternatives D and E would minimize effects of noise under Alternative F. The potential environmental effects from such development would likely be similar to those described under Alternative E and bounded by the analysis under Action Alternatives B, C, D, and E.

Indirect and Cumulative Effects

Likely on-site impacts from noise associated with the alternative future uses of the MSR study area are expected to be minor to moderately significant during any short-term commercial or residential construction and long-term operation of heavy industrial plants or facilities. The impacts depend on the type of sensitive interior or external noise receptors in the project development areas, such as people and wildlife, and the proximity of the new construction location(s), such as residential, on the MSR.

Noise would be a minor impact during operation under all the alternatives at the nearest receptor locations off site (external). Moderate, short-term direct impacts are expected at the proposed operating sites. Daytime background noise from existing commercial and industrial development would contribute to the overall levels experienced by nearby receptors. Potential indirect impacts or cumulative DNL noise effects over the long term, particularly under Alternatives C and D and potentially under Alternative E or F, would be minor with the incorporation of noise mitigating strategies such as distance, barriers, enclosures, and modern technological noise reducers. Such effects could have a greater effect on nearer residential communities south of Second Street but less effect on commercial areas west of the MSR study area. Use of noise-reduction measures could be taken into account during the Master Plan development process.

4.21 Unavoidable Adverse Effects

Unavoidable adverse impacts on some resources are expected to potentially occur as a result of transferring the TVA property to nonfederal ownership and implementation of the preferred development alternative. Depending upon the type, nature, and extent of development, these resources could include historic and archaeological resources, groundwater, surface water quality, wetlands, nonendangered aquatic life, terrestrial plants and wildlife, recreation, transportation, and scenic resources. These effects could result from land use changes, including vegetation clearing and related site disturbance and construction, increased surface water runoff, loss of recreation opportunities, increased concentrated human use and facility operation, increases in noise and land-based traffic, and improvements to existing and new road and utilities construction. Some of these adverse effects could be reduced through implementing mitigation measures described in Sections 2.1 and 2.3.

Adverse effects on public health from exposure to groundwater affected by regulated remnant contaminants could be unavoidable. TVA will prohibit use of groundwater for drinking water from any location on the MSR study area property. Monitored SWMU areas and the phosphate slag storage area would be retained in federal ownership. Parts of the MSR study area, i.e., zones, differentiated by potential amounts and types of remaining contaminants, if any, require restrictions on development and use based on levels of exposure determined to protect human health. For example, Zone A, an approximately 300-acre area, of which it was determined that about 17 acres were cleaned up to industrial screening levels, could be made available for appropriate industrial development without additional remediation. Zone B, the phosphate slag storage area, would be restricted from development and not sold in fee, but access to the property for certain uses, such as utility rights-of-way, could be considered under specific use agreements (e.g., easements). Zone C, about 1,000 acres not known to have been contaminated, could accommodate a variety of types of development. Zone D, a small 100-foot-by-100-foot fenced area of buried low-level radioactive waste, might also be used for a variety of types of development if the fill material (i.e., the soil cap) over the site is not disturbed by excavation or trenching. As required by law, TVA would warrant in the sale deed that the property has been cleaned up to the extent necessary to protect human health and the environment and that the U.S. will perform any cleanup that becomes necessary in the future.

Because portions of the approximately 1,400-acre MSR study area contain streams or lie within the limits of the 100-year floodplain or wetland areas, some additional future project-specific environmental reviews associated with actions requiring approval from TVA under Section 26a would be conducted prior to implementation of development plans by new property owners. The extent of the floodplain near prime development sites (e.g., Second Street and Wilson Dam Road) could be considered avoidable yet such areas are very likely to be proposed for development (with mitigation) if there is no practicable alternative. Such planned land uses would reflect the customs and values of the local people and would be guided by the local governments through a comprehensive Master Plan along with other applicable local regulations, laws, and ordinances. Such development would only occur consistent with EO 11988.

Development under any of the five Action Alternatives (B, C, D, E, or F) would also be accomplished in accordance with transfer deed restrictions or other commitments to avoid, reduce, rectify, minimize, compensate, or mitigate adverse impacts to human health or the environment. Unavoidable adverse impacts on historic properties (i.e., buildings and structures), groundwater, and transportation could likely continue under Alternative A, No Action. Some potential adverse resource impacts such as those to surface water quality, floodplains, prime farmland, aquatic and terrestrial life, prime farmland, recreation, scenic resources, and navigation would be less likely under Alternative B. Mitigation measures would be designed and implemented to avoid further degradation of water quality in Pond Creek. Overall, implementation of the Master Plan will help strategically minimize potentially unavoidable adverse effects by guiding land use away from environmental conflicts and resources that are more sensitive.

Because of the extent and intensity of existing commercial, business, recreation, and residential development among the adjoining municipalities surrounding the MSR study area, implementation of any of the five Action Alternatives is not expected to significantly cumulatively adversely affect any resources evaluated during this study.

4.22 Relationship of Short-Term Uses and Long-Term Productivity

NEPA requires consideration of the “relationship between short-term uses of man’s environment and the maintenance and enhancement of long-term productivity” (40 CFR § 1502.16). For the redevelopment of the MSR study area, short-term uses generally are those that are expected to occur within a 20-year plus build-out period, while long term refers to later decades (e.g., 30 to 50 years). Productivity is the capability of the land to provide market and amenity outputs and values for future generations. The capability of the land to sustain productivity is one factor that influences the quality of life for future generations.

Once the MSR study area is sold and transferred, it would be subject to development and changes in land use likely by private interests. In the short term, such development is anticipated to be consistent with the alternative that TVA selects. Planned development would also ultimately be implemented in accordance with a Master Plan prepared by TVA, local governments, and the Shoals communities. Such development would also be in compliance with other applicable federal, state, and local laws, regulations, and ordinances, as well as consistent with any special commitments, restrictions, or mitigation measures required by TVA to protect public health or the environment.

Sale or transfer of the land for developed uses (e.g., industrial, commercial, retail, residential, and some types of mixed use development) has the potential to decrease the productivity of land for agriculture, forestry, wildlife, some recreational activities, and management of other natural resources. The current licensing of 182 acres of agricultural land would cease prior to transfer of any of the affected property. Along with this licensed acreage, some prime farmland soils would likely be converted to nonagricultural uses. Additional potential development over the approximately 1,400-acre landscape, including access roads, parking lots, commercial, retail, and other business, as well as residential, industrial, and even certain less intensive LID, would convert and reduce the acreage of existing productive open land, fields, and forests. Although provisions to avoid, minimize, or mitigate losses of natural functions and values associated with wetlands and floodplains would be developed, some development on such land and associated losses of productivity would likely occur in the short term.

Although some, but probably a lesser amount, of land in green spaces is expected to be retained under Alternatives C, D, E, and F, development subsequent to the adoption of these alternatives would result in short- and long-term overall losses in productivity. Development under Alternatives C, E, and F would also likely have less but similar effects on long-term productivity of land not built upon (i.e., outside the direct footprint of buildings, pavement, and supporting facilities). Because of the potential from more direct intensive development as well as indirect off-site and cumulative effects, adoption of Alternative D would likely have the greatest comparative short- and long-term effects. Conversely, adoption of Alternative B would increase the likelihood of maintaining greater long-term productivity of land and sustainability of development within the MSR study area due to the anticipated conservation of natural resources including forest, fields, wetlands, and wildlife habitats. From a conservation perspective, creation or maintenance of more natural land cover would also reduce runoff, increase buffer, maintain terrestrial plants and wildlife, and protect water quality and aquatic life, thus contributing to the site’s long-term productivity. Therefore, long-term productivity of the land is expected to be greatest under Alternative B.

Continued regional development trends on private lands in the surrounding counties, particularly east toward Huntsville, Alabama, could continue to contribute to a long-term

gradual loss of some wetland types and the degradation of aquatic and terrestrial habitats regardless of the alternative selected.

4.23 Irreversible and Irretrievable Commitments of Resources

A commitment of resources is irreversible when options are lost to future generations. An irreversible commitment of resources suggests that a permanent or long-term—over 50 years—commitment of environmental resources would result from implementing the proposed action. Irreversible commitments of resources also generally occur from the use of nonrenewable resources, such as minerals, cultural resources, and fossil fuels, which have few or no alternative uses at the termination of the proposed action. Other factors are also considered such as resources like soils where productivity is renewable only over long time spans. Conversely, an irretrievable commitment of resources suggests that a short-term—less than 50-year—commitment of resources would result in the lost production or elimination of renewable resources such as timber, agricultural land, or wildlife habitat. Opportunities for use of these resources are foregone for the period of the proposed action, but these decisions are reversible. The use of opportunities foregone is irretrievable.

The disposal of land from the MSR study area under all the Action Alternatives would result in direct impacts to the environment. Once the land is transferred from federal ownership, it is expected that it would be developed. Construction and operation activities on this land would result in an irretrievable and irreversible commitment of natural, physical, and cultural resources.

Under the No Action Alternative, there would be no foreseeable changes of land use within the MSR study area. Thus, adoption of Alternative A would preclude any irreversible or irretrievable commitments of land resources resulting from the proposed disposal or transfer action. Adoption of Alternative B would result in some compatible LID and likely fewer irreversible or irretrievable commitments of resources. This would include the need for less raw and manufactured materials and conservation and maintenance of renewable natural resources on the site. Depending upon the nature and extent of development, construction of commercial, retail, and residential structures, facilities, and supporting infrastructure under Alternative C, E, or F would involve irreversible commitment of fuel, energy, and building materials. Similar amounts of irretrievable natural resources would likely be directly lost to site development under Alternative C, E, or F. The greatest loss of irreversible and irretrievable resources has the potential to occur under Alternative D, industrial land use.

4.24 Energy Resources and Conservation Potential

The potential for energy use and conservation savings would be similar under Alternative A or B. Depending on the nature and extent of development associated with Alternatives C, E, or F similar energy usage and potential resource conservation are expected. Greater energy usage and less conservation are likely under Alternative D, industrial land use. Any necessary mitigation of adverse effects would be imposed to minimize conservation losses associated with all the Action Alternatives. The strategically developed Master Plan would take into account the TVA selected alternative, consider establishing standards, and guide future development decisions, thus conserving energy resources.

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