Section VI – Impacts of Final Alternative Plans

1. System Economic Effects

a. General. Since the navigation system modeling was confined to a two-lock system consisting of Chickamauga and Watts Bar, navigation impacts are confined to the localized effects at those two projects. Because of excess capacity at downstream projects on the Tennessee River and the fact that Chickamauga traffic constitutes only a very small share of traffic on the mainstem Ohio River, a full navigation system analysis was considered unnecessary. Since justification and timing of a replacement lock has been established in the without-project condition, the with-project analysis focuses on which lock size is most appropriate.

b. Period of Analysis. Similar to the treatment of the without-project alternatives, the alternative with-project conditions were tested for implementation in different years to identify the optimal timing. Optimum timing for completing an alternative is the timing that maximizes net benefits for that alternative. The optimum timing for the plan that could be implemented first, given existing logistical limitations, defines the period of analysis for all plans. For each of the lock replacement plans, the analysis indicated that net benefits would be maximized with implementation in 2010. For that reason, the period of analysis selected was 2010-2060.

c. Capacity Considerations. One change from the screening level evaluation of alternatives pertains to the capacity of the 75'x400' lock alternative. Since this is a non-standard lock size with no existing data on tow processing practices and times available, considerable effort was devoted to development of this data. Locking procedures and processing times for various tow sizes were developed with input from Corps navigation operations staff with considerable commercial towing experience. The major emphasis of effort was to develop the process for locking a tow that arrives three barges wide at a lock that is only two barges wide. Standard towing practice is for tows in excess of eight barges to be configured three barges wide. This requires significant effort and time for the crew to break and remake the tow and to shuttle barges between the mooring cells and the lock. Insufficient room is available to break and make the tows along the lock approach walls. Therefore, the tows must utilize the upper and lower mooring cells for this process.

Table VI-1 compares estimated capacities at both Chickamauga and Watts Bar under the without-project condition and the improved condition. Without the implementation of helper boat operations, the capacities of Chickamauga and Watts Bar in the WOPC are 7.9 and 8.3 million tons, respectively. Implementation of helper boat operations at Chickamauga and Watts Bar increases the locks' capacities to 11.0 and 11.5 million tons. A 75'x400' lock at Chickamauga would have a capacity of 12.8 million tons without helper boats. Helper boat operations add an additional 4 million tons to project capacity, for a total of 16.8 million tons. Increasing the lock size to 110'x600' increases the lock capacity to 41.0 million tons.

Table VI-1 Physical Capacities of Chickamauga and Watts Bar Under Alternative Improvement Plans (Million Tons)

Alternative	Chickamauga		Watts Bar	
	w/o HB	w/HB	w/o HB	w/HB
WOPC	7.9	11.0	8.3	11.5
Congestion fee	7.9	11.0	8.3	11.5
75'x400'	12.8	16.8	8.3	11.5
110'x600'	41.0	NA	NA	11.5

A principal operational advantage of a larger lock at Chickamauga is the capability to process more barges per lockage, which is conducive to the formation of larger, more efficient, tows. The average size of tows transiting the Chickamauga lock is currently about 6.6 barges, because of the small size of the lock; jumbo barges (1,500 tons) are forced to lock through one at a time. This causes lengthy tow processing times, and accounts in part, for the reluctance of some towing companies to operate above Chickamauga. Construction of a lock measuring 75'x400' would permit the lockage of four jumbo barges at a time

(6,000 tons). A lock measuring 110'x600' would accommodate nine jumbo barges at a time (13,500 tons).

d. Traffic Accommodated. Traffic accommodated is that portion of the traffic demand that is predicted by modeling to move on the waterway system under each alternative plan. The volume of traffic that system studies indicate could move on the Upper Tennessee segment at a rate savings over the 2010-2060 period is presented in Table VI-2 for each alternative. Estimated without-project traffic levels are also presented for comparison purposes.

Table VI-2 Expected Waterway Traffic Accommodated Under Alternative Chickamauga Improvement Plans (Thousands of Tons)

Year/ Project	Traffic Demand	WOPC[1]	Congestion Fee[1]	Alternative Lock Sizes[2]	
				75'x400'	110'x600'
2000					
Chickamauga	7,586	-	-	-	-
Watts Bar	6,530	-	-	-	-
2010					
Chickamauga	8,283	7,485	7,288	7,485	7,556
Watts Bar	7,116	6,390	6,193	6,390	6,390
2020					
Chickamauga	8,777	7,917	7,917	7,917	7,994
Watts Bar	7,522	6,741	6,741	6,741	6,741
2030					
Chickamauga	9,400	8,461	8,338	8,462	8,548
Watts Bar	8,039	7,187	7,064	7,188	7,188
2040					
Chickamauga	10,209	9,168	8,911	9,170	9,266
Watts Bar	8,710	7,768	7,511	7,769	7,769
2050					
Chickamauga	10,874	9,746	9,003	9,751	9,856
Watts Bar	9,261	8,241	7,499	8,245	8,245
2060					
Chickamauga	11,322	10,133	9,020	10,250	10,251
Watts Bar	9,628	8,553	7,441	8,559	8,559

[1] Includes helper boats at Chickamauga and Watts Bar.
[2] Includes helper boats at Watts Bar.

Each of the alternative plans except the congestion fee alternative would increase the amount of traffic that could move on the waterway at a rate savings. In 2010, the alternative plan calling for construction of the 110’x600’ lock at Chickamauga produces an incremental increase (over the without-project condition) of 71,000 tons at Chickamauga, but no incremental increases at Watts Bar. Construction of a 75’x400’ lock at Chickamauga produces no incremental increases in tonnage at either Chickamauga or Watts Bar in the year 2010. With implementation of the congestion fee (ranging from $0 to $2.34 per ton), traffic at Chickamauga and Watts Bar decreases by 197,000 tons at both projects. In year 2060, the analysis indicates that each of the plans would increase the traffic accommodated by 118,000 tons at Chickamauga and 6,000 tons at Watts Bar. Note that even though the two locks have significantly different capacities, they accommodate the same amount of traffic. This is due to the low amount of traffic demand. The Congestion fee plan would produce reductions in traffic accommodated of about 1.1 million tons at both Chickamauga and Watts Bar.

e. Traffic Diverted. Table VI-3 compares Chickamauga traffic diversions under the without-project condition with those that occur under the with-project condition. The traffic diversions to overland modes form the basis for benefits associated with reductions in emissions, highway damages, and highway congestion that result from implementation of any of the alternative with-project conditions. Levels of diversions are related to the fee (ranging from $0 to $2.34 per ton) under the congestion fee alternative, and to capacity constraints at the Chickamauga facility. Throughout the period of analysis, the highest levels of diversions occur under the congestion fee alternative. In 2010, diversions at Chickamauga and Watts Bar amount to 995,000 tons and 923,000 tons, respectively. By 2060, these diversions amount to 2.3 and 2.2 million tons. For a lock measuring 75’x400’, traffic diversions amount to about 798,000 tons at Chickamauga and 726,000 tons at Watts Bar in 2010. By year 2060, the diversions related to this alternative reach about 1.1 million tons at both facilities. The levels of traffic diversions that occur with construction of the 110’x600’ lock are 727,000 and 726,000 tons at Chickamauga and Watts Bar, respectively, in year 2010. By 2060, the tonnages diverted amount to about 1.1 million tons.

Table VI-3 Expected Waterway Traffic Diverted Under Alternative Chickamauga Improvement Plans (Thousands of Tons)					
Year/ Project	**Traffic Demand**	**WOPC[1]**	**Congestion Fee[1]**	**Alternative Lock Sizes[2]**	
				75'x400'	**110'x600'**
2000					
Chickamauga	7,586	-	-	-	-
Watts Bar	6,530	-	-	-	-
2010					
Chickamauga	8,283	798	995	798	727
Watts Bar	7,116	726	923	726	726
2020					
Chickamauga	8,777	860	860	860	783
Watts Bar	7,522	781	781	781	781
2030					
Chickamauga	9,400	939	1,062	938	852
Watts Bar	8,039	852	975	851	851
2040					
Chickamauga	10,209	1,041	1,298	1,039	1,039
Watts Bar	8,710	942	1,199	941	941
2050					
Chickamauga	10,874	1,128	1,871	1,123	1,123
Watts Bar	9,261	1,020	1,762	1,016	1,016
2060					
Chickamauga	11,322	1,189	2,302	1,072	1,071
Watts Bar	9,628	1,075	2,187	1,069	1,069

[1] Includes helper boats at Chickamauga and Watts Bar
[2] Includes helper boats at Watts Bar

f. Transit Times. The average transit times per tow for each of the alternative plans relative to the without-project condition are listed in Table VI-4. Not included in these averages are increases in lock delays during closures. The processing times for the 75'x400' were revised from that used in the screening level analysis to more accurately represent anticipated processing procedures. Since there are no existing 75'x400' locks with substantial traffic data, this information was developed based on existing Chickamauga lock processing times and Corps of Engineers lock operations staff. All of the with-project alternatives at Chickamauga produce reductions in the average processing times at Chickamauga, relative to the without-project condition. This effect

Table VI-4 Expected Average Transit Times Under Alternative Chickamauga Improvement Plans (Hours Per Tow)

Year/Project	WOPC[1]	Congestion Fee[1]	Alternative Lock Sizes[2]	
			75'x400'	110'x600'
2010				
Chickamauga	13.7	13.0	8.2	2.1
Watts Bar	24.6	22.4	24.6	24.6
2020				
Chickamauga	15.6	15.6	8.9	2.1
Watts Bar	11.3	11.3	11.3	11.3
2030				
Chickamauga	18.7	17.9	9.9	2.2
Watts Bar	12.5	12.1	12.5	12.5
2040				
Chickamauga	25.7	22.6	11.8	2.3
Watts Bar	14.4	13.4	14.4	14.4
2050				
Chickamauga	37.2	23.6	13.9	2.4
Watts Bar	16.4	13.4	16.4	16.4
2060				
Chickamauga	53.5	23.8	6.0	2.4
Watts Bar	18.1	13.2	18.2	18.2

[1] Includes helper boats at Chickamauga and Watts Bar.
[2] Includes helper boats at Watts Bar.

extends to Watts Bar because of tonnages diverted from the system. The most effective alternative for reducing transit time is the 110'x600' lock, which would accommodate up to nine jumbo barges in a single lockage. The 75'x400' lock would be somewhat less effective in reducing average transit times at Chickamauga, since this lock size would accommodate only four barges in a single lockage. The congestion fee alternative produces reductions in lockage times at Chickamauga that are quite small or nonexistent in the early years of the period of analysis, but become quite substantial in later years. With navigation improvements at Chickamauga, the major source of delays on the Upper Tennessee segment is relieved. At Watts Bar, an early drop in the average transit time occurs because of the implementation of helper boat operations around 2012. Additionally, the increase in transit times at the Watts Bar facility is only seven hours over the 40-year period, 2020 to 2060. Since a sizeable portion of the projected traffic demand never reaches the Watts Bar facility, only a relatively small amount of delay is transferred upstream to that facility.

g. Transportation Savings. Table VI-5 compares the incremental transportation savings associated with the alternative navigation improvement plans under ordinary operations, over and above those generated in the without-project condition. These numbers are confined to the transportation savings that would be realized under the alternative plans, and in the case of the congestion fee alternative revenues collected are not included. These numbers exclude the recreation benefits and external cost reductions cited previously. Since there is relatively little difference in traffic accommodated by the alternative lock sizes, the savings that materialize are the result of more efficient operations, especially the larger average number of barges per lockage.

Table VI-5 Incremental Transportation Savings Attributable to Alternative Improvement Plans, 2010-2060 (Thousands of FY 2001 Dollars)

Year	Congestion Fee[1]	Alternative Chickamauga Lock Sizes[2]	
		75'x400'	110'x600'
2010	107	724	1,547
2020	0	930	1,889
2030	39	1,317	2,487
2040	305	2,263	3,810
2050	1,328	4,020	6,021
2060	3,743	8,511	9,169

[1] Includes helper boats at Chickamauga and Watts Bar.
[2] Includes helper boats at Watts Bar.

The biggest difference among the alternative plans displayed in Table VI-5 is between the congestion fee alternative and the larger lock alternatives. The data show a relatively narrow distinction among the alternative lock sizes. In 2010, transportation savings range from between $107,000 for the congestion fee alternative and about $1.6 million dollars with a lock measuring 110’x600’ lock. The difference between the 75’x400’ and the 110’x600’ is $823,000. By 2060, transportation savings range between $3.7 million for the congestion fee alternative and $9.2 million for the 110’x600’ lock size. The difference between the 75’x400’ and 110’x600’ is only $658,000.

2. Environmental, Cultural, and Social Impacts

a. General. Certain unavoidable environmental, cultural, and social impacts are associated with construction of a new lock at Chickamauga. Most adverse impacts, however, can be limited to relatively small geographic areas. Since the alternatives are constructed at the same location and have the same major features, the environmental, cultural and social impacts are essentially the same with a few minor exceptions. Negative short-term impacts are construction related. Potential fish kills and loss of riparian habitat from blasting would be realized for all of the new lock alternatives.

b. Water Quality. Construction activities performed outside the cofferdam would be similar for all lock sizes. Within the cofferdam itself, although the size of area would vary, no additional significant impacts are expected. Dredging activity along the right descending bank would be the same for both lock alternatives.

Sediment disturbance during blasting and removal of portions of the riverbed for construction and channel widening would suspend some soil and rock material in the water. Bank construction activity may also cause erosion during heavy rainfall, which could wash excavated material into the reservoir. Use of best management practices including silt fences and other barriers constructed downstream of exposed material would prevent or minimize such problems. Water quality sampling would be performed downstream of any construction activities to ensure compliance with water quality standards.

c. Air Quality. The air quality in the vicinity of Chickamauga Lock and Dam is generally good. The dam is located in an area that is in attainment or unclassifiable for all state and national ambient air quality standards (NAAQS).

Short-term air quality impacts could result from burning debris, dust, and equipment exhaust; however, these impacts would tend to be localized. Long-term impacts will be more regional in scope.

Long locking times increase transportation costs and can force a shift to the alternative modes. The alternative modes, i.e., truck and rail, may be less expensive for shipping costs in the short run, but they also add considerably to fuel consumption and air pollution.

Regulatory programs set standards to protect air quality criteria. Although the Chattanooga area has been a non-attainment area in the past, it is now, as is all of Tennessee, an attainment area. The entire system of navigation locks on the Tennessee and Cumberland Rivers has contributed to this by reducing the number of trucks and trains, and thereby the amount of fuel, necessary to ship goods from one area to another.

d. Aquatic Resources. The Tennessee River is one of the richest rivers in the world with regard to aquatic biodiversity. These native resources have been severely impacted over the years by changes in land use, the introduction of a variety of point and non-point source pollutants, and changes in the river's hydrology. The present system of dams and locks has changed much of the length of the river from a free-flowing stream into a slower, deeper, series of reservoirs.

The four miles immediately downstream from Chickamauga Dam have been designated a State mussel sanctuary. Results of surveys conducted 11 years apart indicate that mussels are surviving in this area; however, most of the animals are old and there is little evidence of recent recruitment. In general, mussels once inhabited most of the length of the river but, now, populations survive only in suitable river-like habitats that typically occur in dam tailwaters. These populations are now separated by habitats changed from a riverine to a lacustrine environment. The mussels resources in the Chickamauga Dam tailwater are significant from both a regional (population) and national standpoint (from the presence of Federal listed species).

The construction of dams has altered the sediment bed transport that affects many aquatic resources such as mussels and fish spawning beds. The dams cause sediment and nutrients to accrete in the impounded sections and downstream areas to be swept clean of sediments. Bottom dwelling organisms above the dams suffer from an overabundance of sediment and nutrients, while animals living immediately downstream from the dams are deprived of these elements.

Large tows must make several cuts or breaks in the barges to process them through the lock. The towboats must constantly maneuver from side to side as well as in line with the channel. Although the wash from the tows is fairly insignificant when aligned with the channel, when the tows must move from side to side the wash can disturb adjacent mussel beds. The more cuts required, the greater the disturbance. Other tows that wait their turn often toe into the bank. This disturbs or physically disrupts the mussel beds they pass over (or in some cases grind over) and also damages the terrestrial vegetation at the point of impact. For these reasons, larger locks are preferable to smaller ones.

Although the mussels would be minimally disturbed by the construction of a new lock, after the entire project is complete, the impacts to the mussels could be beneficial over present conditions. Minimizing or preventing the need to breakup barge configurations would significantly reduce prop wash and the need for bank toe in by waiting barges.

Fisheries in the area support both a commercial and a recreational fishery. Both are described in the 1996 FEIS as among the most productive in Tennessee and appear to be relatively stable. Nevertheless, fisheries and fish habitat conditions have been stressed over the years by the change from a free-flowing riverine system to a regulated water release program. Although the present resources appear to have adjusted somewhat to modified habitat conditions, migratory fish species appear to find it more difficult, though not impossible, to reproduce in the series of reservoirs. Migratory fish are generally blocked from passage to potential spawning sites upstream by the dam. Presently, the only upstream passage available for the migratory fish is through Chickamauga Lock. If the lock were closed, fish populations would be limited to those presently in the reservoir pools and those that survive the downstream transit over the spillway or through the generators. Closure of Chickamauga Lock would further strain an already artificial ecology. Fish and other organisms that can transit the dams to different pools have a more diverse gene pool and consequently they are usually healthier than isolated populations. Properly designed, however, a new lock could actually enhance the fish's present ability to migrate both upstream and downstream.

e. Wetlands and Wetland Wildlife. The only wetlands identified in the vicinity of Chickamauga Dam project are on the left bank shoreline (TRMs 468.8L to 469.4L on Nickajack Reservoir). These wetlands were identified during preliminary field inspections and classified and mapped using the classification system of Cowardin, et al. (1979). No project related activities would occur within this river reach. Therefore, no direct or indirect impact to wetlands is expected from construction. Nor are there any anticipated impacts to wetlands from the operation of a new lock.

f. Upland Vegetation and Wildlife. Most of the vegetation in the construction and laydown area would be disturbed or removed during construction of the proposed facility. The various plant species occurring on the site and the vegetative communities they comprise (lawns, pine plantations, hardwood forests, riparian zone, and brushy areas) are well represented in the local area. No unusual community types or areas of critical habitat would be affected because of construction and operation of the proposed facility.

Riverbank excavation in the lock approach modification area (between TRMs 470.0R and 470.6R) will eliminate approximately 11.2 acres of wooded shoreline (riparian) habitat. Adverse modification of this area would be offset, i.e., mitigated, by replanting native riparian tree species along the top of the new cut bank, as site conditions and adjacent land uses allow. Additionally, the latest natural landscape techniques would be applied, as appropriate, to protect the recontoured shoreline from erosion, provide habitat for riparian wildlife species, and enhance shoreline aesthetic values.

g. Threatened and Endangered Species. The Tennessee River is one of the richest rivers in the world with regard to aquatic biodiversity. These native resources have been severely impacted over the years by changes in land use, the introduction of a variety of point and non-point source pollutants, and changes in the river's hydrology. The present system of dams and locks has changed much of the length of the river from a free-flowing stream into a slower, deeper, series of reservoirs. Many of the native aquatic organisms were not able to adapt to these changes and have been largely or completely replaced by substantially fewer species capable of living in the modified habitats.

One Federally listed endangered mussel species has been found in the project area. The pink mucket (Lampsilis abrupta) is a mussel found in low numbers at a number of locations throughout its range and a few individuals of this species have been found in the mussel bed along the right shore of the river where the approach channel is proposed to be widened. Other endangered mussel species might still occur in the project area; however, none have been found during any recent survey in the area. These endangered mussel species are significant from both a regional (population) and national standpoint (from the presence of Federal listed species).

The river systems were much different prior to the construction of the dam. Riverine habitats were converted to lacustrine habitats throughout the length of the mainstem Tennessee River. In addition, the aquatic habitat conditions have been stressed over the years by the change from a free-flowing riverine system to a regulated flow system. The construction of dams has altered the sediment bed transport that affects many aquatic resources such as the endangered mussels. Mussel populations are particularly vulnerable because of their sedentary life style. Many mussel species require specific flow conditions and are adapted to a riverine environment. Some river-dwelling species now survive only in the tailwaters. In addition, the dams allow sediment and nutrients to accrete in the impounded sections. Bottom dwelling organisms living upstream from the dams must contend with an overabundance of sediment and nutrients while organisms living just downstream from the dams must contend with extremely low levels of these elements. This can be detrimental both to the benthic organisms that are inundated and smothered by the accretions, and to the organisms downstream that are deprived of their benefit. Both point-source and nonpointsource contaminants, particularly large amounts of sediment from construction, agriculture, and poor land management techniques, contribute to the accretion and to the nutrient loading.

Under Section 7 of the 1973 Endangered Species Act, the Corps and TVA have initiated formal consultation with the FWS. All of the mussels in areas that would be disturbed by the construction would be collected by divers and relocated. Other mitigation measures might be included in the Biological Opinion to be issued by the FWS.

Many factors have impacted the endangered mussels and together they have brought some of these species to the verge of extinction. Chickamauga Lock and Dam, when it was built more than 60 years ago, undoubtedly contributed to these negative impacts. Construction of a new lock, however, would have an insignificant impact overall, and when complete may provide some positive benefits that would help offset past negative effects. Minimizing or preventing the need to breakup barge configurations would significantly reduce prop wash and the need for bank toe in by waiting barges.

Mountain skullcap (*Scutellaria montana*), is a federally threatened member of the mint family. It occupies areas of suitable habitat on the Big Ridge Habitat Protection Area located immediately adjacent to the TVA site designated for disposal of excavated material generated by lock construction. This herb requires shade provided by an intact forest canopy and is especially sensitive to encroachment from weed species when the forest canopy is removed. Individuals of this species are known to occur within 150 feet of the proposed spoil disposal site.

The Mountain skullcap, although Federally listed as threatened, is known at several other sites besides the one adjacent to the lock. This population is, in fact, one of the smaller known communities. Nevertheless, as a part of the construction process, not only would the entire site be preserved intact, but also an additional protective buffer would be provided to ensure it remains undisturbed. The species would be completely avoided and therefore, no other mitigation would be required.

h. Cultural Resources Impacts. The Chickamauga Lock and Dam complex is an eligible historic property under the National Register of Historic Places. The Norfolk Southern Railroad Bridge is a potentially eligible National Register property. Both would either be significantly altered, or have its visual context changed, by project implementation of any of the alternatives.

The existing lock would eventually be closed under any of the alternatives. Construction of a new lock would obviously change the appearance of the dam. The new lock guide walls would extend under and beyond the bridge, thereby altering the surrounding view of the bridge. In addition, at least one of the support piers of the bridge would be surrounded or wrapped by metal sheet pilings to protect it from inadvertent collisions by barges, further altering the historic appearance of the bridge.

Resulting work will adversely affect properties that are eligible for listing in the National Register of Historic Places. The Advisory Council on Historic Preservation is being notified and the Tennessee State Historic Preservation Officer (SHPO) is being consulted to determine how such adverse effects can be taken into account by avoidance, minimization, or mitigation. The adverse effects will be taken into account by stipulation within a Memorandum of Agreement.

i. Environmental Justice. Executive Order 12898 requires that extensive outreach and opportunity for involvement will address concerns of all communities and that minority residents and low-income residents receive fair and equitable consideration for any potential adverse health and environmental effects from proposed actions. All of the work would take place on TVA property or on property leased for the purpose. This was discussed in Section 5.4 of the 1996 FEIS. The TVA analysis concluded that there were no disproportionate effects on minority or low-income populations. No substantial change in this information is known to have occurred during the last six years.

j. Land Use. The SR 153 Bridge across the lock would remain open during construction and Lake Resort Drive would be relocated. As part of the relocation of Lake Resort Drive, two new bridges would be built, one over North Chickamauga Creek and one for grade separation between Lake Resort Drive and the permanent access road to the North

Chickamauga Creek Greenway. Improvements would be made to the intersection of Access Road and Lake Resort Drive that would facilitate safer access to SR 153.

No direct land use impacts would occur at nearby industries or the community college near Chickamauga from the operation of a new lock. However, marginal secondary impacts from development of industrial and transportation facilities could be expected over time on the reservoir upstream of the new lock. In the larger region around the reservoir, there could be impacts associated with increased shipping of commodities through the lock resulting mainly from intermodal shifts.

k. Cumulative Impacts. Cumulative impacts are defined as “the impact on the environment which results from the incremental impact of the (proposed) action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions (40 CFR 1508.7)”. Council for Environmental Quality (CEQ) guidance identifies an 11-step process for evaluating cumulative effects.

The assessment can be defined as “what resource goals is the proposed action going to affect”. Effects can result from either direct-project related, indirect-project related, and independent indirect causes. Based on the public and agency scoping and review performed for the previous NEPA documents conducted for this project, the following resources have been identified as target resources within the assessment goals: socioeconomics, recreation/tourism, river navigation, aquatic resources, air quality, threatened and endangered species, and cultural and historic resources.

Chickamauga Lock has contributed significantly to the socioeconomics of the region. Cumulatively it plays an important role in the economics of the region and directly and indirectly impacts such diverse factors as job and population distribution, recreation, housing, industry and more. Although the lock is important for maintaining the status quo, it could play a larger role if it was rebuilt as either a 75 x 400 or 110 x 600 foot size. Economic models do not predict any runaway growth or development from this lock, although it is expected to contribute to the overall growth of the region.

Recreation and tourism are closely tied to socioeconomics. The cumulative impacts of the lock and dam system have had an impact on recreation and tourism in Tennessee. Although the lock is not as important to recreation as it is to navigation, closure would curtail some events. As recreation dollars are spent they have a large ripple or cumulative effect in the local economy.

The cumulative impacts of the lock and dam system have had a tremendous impact on the transportation industry. The lock at Chickamauga Lock and Dam plays a significant role in the overall system. Without the lock roughly a third of the Tennessee River system would be severed from the whole. Although the lock is important for maintaining the system at current levels, it could play a larger role if it was rebuilt as either a 75 x 400 or 110 x 600 foot size.

Individually many factors listed above may not play a very significant role on aquatic resources, but when added together they have had a profound cumulative effect. Chickamauga Lock and Dam has contributed significantly to these impacts over the years. The impact of replacing the lock, however, would have only a minor effect on the overall system, and could actually provide minor improvements.

Man has had a significant cumulative impact on air quality in the region. The lock and dam system has made shipping large quantities of materials much more effective and has therefore contributed to the overall reduction of the cumulative negative impacts to air quality.

Many factors have impacted the mussels and together they have brought many of these species to the verge of extinction. Chickamauga Lock and Dam, when it was built more than 60 years ago, undoubtedly contributed to the negative impacts. Construction of a new lock, however, would have an insignificant impact overall. Minimizing or preventing the need to breakup barge configurations would significantly reduce prop wash and the need for bank toe in by waiting barges.

Mountain skullcap (*Scutellaria montana*), is a federally threatened member of the mint family. It occupies areas of suitable habitat on the Big Ridge Habitat Protection Area located immediately adjacent to the TVA site designated for disposal of excavated material generated by lock construction. This herb requires shade provided by an intact forest canopy and is especially sensitive to encroachment from weed species when the forest canopy is removed. Individuals of this species are known to occur within 150 feet of the proposed spoil disposal site. The Mountain skullcap is known at several other sites besides the one adjacent to the lock. As a part of the construction process, not only would the entire site be preserved intact, but also an additional protective buffer would be provided to ensure it remains undisturbed. The species would be completely avoided and therefore, no other mitigation would be required.

Resulting work will adversely affect properties that are eligible for listing in the National Register of Historic Places. The Advisory Council on Historic Preservation is being notified and the Tennessee State Historic Preservation Officer (SHPO) is being consulted to determine how such adverse effects can be taken into account by avoidance, minimization, or mitigation. The adverse effects will be taken into account by stipulation within a Memorandum of Agreement.

l. Mitigation Measures. When designing a project, negative environmental impacts are to be avoided wherever and whenever possible. Where negative impacts cannot be avoided, they must be minimized. Compensation must be made for impacts that can be neither avoided nor minimized.

Several environmental design features have been built into the three construct new lock designs. These features would allow significant foreseeable impacts to be either avoided completely or to be minimized. In fact, some features may, in the long run, actually enhance the environment over present project conditions. These environmental design features include:

- All mussels within the temporary lock approach channel that must be dredged would be collected and relocated to unaffected areas within the state-designated mollusk sanctuary. This probably would include individuals of at least one endangered species.
- The terrestrial areas that are disturbed during the construction process will be replanted or reforested, and so, long-term losses will be minimized.

- To the extent practicable, the riverbank will be bioengineered to restore the riverine habitat. Due to fast current conditions, lower portions may be riprapped to prevent erosion.
- Studies since the original lock was constructed have shown that different valve designs may improve opportunities for migratory fish to move upstream. These improved designs would be incorporated into the new lock design as an environmental design feature. This would be an improvement over the existing lock.
- One threatened species of plant, the mountain skullcap, has been found at a site adjacent to the proposed project area. This area would be completely avoided including a 250-foot surrounding buffer.

Construction Best Management Plans (BMPs) and using cofferdams or other means to work in the dry to prevent stirring the substrate and contributing to the sediment load would be incorporated in the construction specifications. Through these environmental design features all foreseeable negative impacts would be either avoided or minimized. In some cases the environment may be improved over the long term. No compensatory mitigation, therefore, would be necessary.