US Army Corps
of Engineers
Nashville District

Environmental Assessment

Control of Attached Biofouling Mollusks (Zebra Mussels and Related Species) At Facilities Operated By USACE-Nashville District and Tennessee Valley Authority

DREISSENA POLYMORPHA (ZEBRA MUSSEL)

December 1992

FINDING OF NO SIGNIFICANT IMPACT

Control of Attached Biofouling Mollusks (Zebra Mussels and Related Species) at Facilities Operated By USACE-Nashville District and Tennessee Valley Authority

1. The introduction and spread of the zebra mussel (***Dreissena polymorpha***) and occurrence of other mollusks with similar biofouling potential poses a threat to facilities operated by the USACE-Nashville District (USACE) and Tennessee Valley Authority (TVA). Installation and activation of a variety of measures to control biofouling mollusks at facilities operated by USACE and TVA is necessary to prevent or minimize adverse economic and other consequences.

2. USACE and TVA have jointly prepared an Environmental Assessment (EA) covering the proposed action and a "no action" alternative. The proposed action would implement control measures to reduce or eliminate infestations of attached biofouling mollusks at facilities operated by USACE and TVA. This FONSI specifically addresses USACE facilities defined in the EA. The resulting environmental consequences of the proposed action would occur within or immediately adjacent to such facilities. The location and types of facilities are listed in the EA. Control methods specifically covered include chemical control, antifoulant coatings, mechanical cleaning, thermal shock, dry storage and dewatering, and oxygen deprivation. Under the "no action" alternative, no additional measures beyond those presently used to maintain facilities in an operational mode would be enacted to control attached biofouling mollusks.

3. The EA was released on December 23, 1992 for a 30 day public and agency review and comment period. Eight written responses were received (See attachments). Of those expressing reservations concerning the proposed action, two principal issues of concern surfaced. One is the potential impact of control measures on non-target aquatic species (federally listed threatened and endangered fish and shellfish and non-listed aquatic species). The second overall concern is that control strategies are not specifically listed for each facility but rather are presented as a broad package of options with little specificity about how and where each control measure covered will be applied.

4. These two issues are somewhat related and will be addressed together. The EA broadly classifies and evaluates environmental impacts of the most widely available and effective control measures for zebra mussels. The full range of control options at USACE facilities must remain available. Most control measures proposed are environmentally benign in virtually all of the major applications specified in the EA. One exception to this is the use of oxidizing chemicals or biocides, principally chlorine, in some piping systems. Chlorination is a proven treatment method with

well known environmental consequences, however, it is not selective and can impact non-target organisms. In the choices of treatment available, a strategy to minimize use of biocides has been followed. Biocides, such as chlorine, are the only practical control for vulnerable piping systems in many facilities. Several safeguards exist to limit impacts of biocides on non-target species. One built-in condition is that only the relatively small amounts of water entering critical piping systems will require treatment. This water would be discharged into much greater volumes of untreated river flows resulting in extreme dilutions. The discharge of biocides, such as chlorine, will require state issued pollution discharge permits (i.e., NPDES) for each facility. Under the conditions of such permits, the USACE must prevent concentrations of chemicals such as chlorine from exceeding permitted levels, which are intended to protect non-target aquatic life. Discharge permits will carry monitoring requirements to ensure that any biocides released into the environment are at or below levels specified by permit limits. Adherence to permit conditions and the continued coordination with appropriate resource and regulatory agencies, where there are site specific environmental concerns regarding zebra mussel control measures, will best protect sensitive biological resources from damage. In this way a minimal impact approach will be followed that still yields effective control within facilities.

5. I have reviewed the EA and, based on the above analysis, I have determined that the proposed action is a prudent commitment of resources to prevent potentially severe adverse economic consequences at facilities. I have also determined that the action does not constitute a major Federal action significantly affecting the human environment, within the meaning of the National Environmental Policy Act of 1969. I conclude that preparation of an Environmental Impact Statement is not necessary. Having weighed the potential benefits that may be accrued as a result of the proposed action against the reasonably foreseeable detrimental effects, I conclude that the implementation of control measures for biofouling mollusks is in the public interest.

15 MAR 93
Date

Stephen M. Sheppard
Lieutenant Colonel, Engineers
District Engineer

Connor/EP-E 3/9/93
Hoot/EP
for Connor/EP 3/11
Hall/CO 3/11
Miller/OC
Warren/DE-S 3/12
Caffey/E
Rapp/DDE
Sheppard/DE

DEPARTMENT OF THE ARMY
NASHVILLE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1070
NASHVILLE, TENNESSEE 37202-1070

IN REPLY REFER TO

DEC 23 1992

CEORN-EP-E

To Whom It May Concern:

The Nashville District, Corps of Engineers and Tennessee Valley Authority have jointly prepared an Environmental Assessment (EA) which addresses the control of attached biofouling mollusks (primarily zebra mussels and closely related species) in facilities operated by the two agencies. The EA was prepared pursuant to the National Environmental Policy Act (NEPA) and applicable Department of the Army and TVA rules for implementing NEPA.

The EA analyzes the consequences of pursuing a policy of "no action" and the action or preferred alternative, which is the implementation of a menu of control measures at facilities operated by the Corps and TVA. As a result of the analysis included in the EA, it has been determined that the action alternative will not significantly affect the quality of the human environment. As such, an Environmental Impact Statement is not required and a Finding of No Significant Impact (FONSI) was prepared.

Your comments on the EA are invited. All comments received within 30 calendar days of the date of this notice will be considered. All comments will be coordinated with TVA. The person to contact or submit comments to is Mr. Richard Tippit of the Nashville District at (615) 736-2020. The mailing address is, Nashville District, U.S. Army Corps of Engineers, P.O. Box 1070, Nashville, Tennessee 37202-1070, Attention: CEORN-EP-E.

R. J. Connor, P.E.
Chief, Engineering-Planning
Division

FINDING OF NO SIGNIFICANT IMPACT

CONTROL OF ATTACHED BIOFOULING MOLLUSKS (Zebra Mussels and Related Species) AT FACILITIES OPERATED BY USACE-NASHVILLE DISTRICT AND TENNESSEE VALLEY AUTHORITY

1. The introduction and spread of the zebra mussel (*Dreissena polymorpha*) and occurrence of other similar mollusks with biofouling potential poses a threat to facilities operated by the USACE-Nashville District (USACE) and Tennessee Valley Authority (TVA). Installation and activation of a variety of measures to control biofouling mollusks at facilities operated by USACE and TVA is necessary to prevent or minimize adverse economic and other consequences.

2. An Environmental Assessment (EA) covering the proposed action and a "no action" alternative has been prepared. The EA analyzed the environmental impacts of the proposed action, which is the implementation of control measures for biofouling mollusks, and the consequences of taking "no action". The analysis of the proposed action indicates that impacts of controls for biofouling mollusks would occur primarily within or immediately adjacent to facilities operated by the USACE and TVA. Control methods specifically covered include chemical control, antifoulant coatings, mechanical cleaning, thermal shock, dry storage and dewatering, and oxygen deprivation. Most of the above control methods are environmentally benign. Chemical control, which is preferred for many vulnerable piping systems, would be operated so that any releases of pollutants would comply with permit (NPDES) conditions or state water quality standards.

3. I have reviewed the EA and I have determined that the proposed action is both a prudent commitment of resources to prevent potentially severe adverse economic consequences at facilities; and that the action does not constitute a major Federal action significantly affecting the human environment, within the meaning of the National Environmental Policy Act of 1969. I conclude that preparation of an Environmental Impact Statement is not necessary. Having weighed the potential benefits that may be accrued as a result of the proposed action against the reasonably foreseeable detrimental effects, I conclude that the implementation of control measures for biofouling mollusks is in the public interest.

_____
Date

_____
Stephen M. Sheppard
Lieutenant Colonel, Engineers
District Engineer

Hoot/EP
Connor/EP
Hall/CO
Miller/OC
Caffey/EA
Boatman/DP
Rapp/DDE
Sheppard/DE

CONTENTS

CONTENTS

TABLES

FIGURES

APPENDICES

1.0 PURPOSE OF AND NEED FOR ACTION

Introduction

1.1 This environmental assessment (EA) has been jointly prepared by the U.S. Army Corps of Engineers-Nashville District (hereafter referred to as USACE) and the Tennessee Valley Authority (TVA). The purpose of the EA is to determine the environmental consequences of employing control measures to reduce or eliminate zebra mussel and other attached biofouling mollusk (ABM) infestations at facilities operated by USACE and TVA.

Background

1.2 The zebra mussel, *Dreissena polymorpha* (Pallas), is a freshwater bivalve mollusk, accidentally introduced into the North American Great Lakes during the mid-1980s (Figures 1 and 2). Native to the Caspian Sea and Ural River area of central Eurasia, zebra mussels probably came to North America in the ballast water of ocean going ships. Since their initial discovery in 1988 in Lake St. Clair, zebra mussels have colonized all five Great Lakes to varying degrees and have spread to portions of other major inland waterbodies including the Hudson, Susquehanna, Illinois, Mississippi, Ohio, Kanawha, Tennessee, and Cumberland rivers (Figure 3).

1.3 Zebra mussels are macrofouling organisms. They attach tenaciously to a wide variety of firm surfaces using tough, proteinaceous byssal threads. The larval stage of the zebra mussel differs from our native unionid mussels in that it does not require a fish host to develop into an adult. Zebra mussel larvae (veligers) are planktonic and can be drawn into raw water piping systems of facilities such as water treatment plants, hydro, fossil and nuclear generating plants, navigation locks, boat engine cooling systems, and other facilities.

1.4 Layers of zebra mussels can build up in critical piping systems as the animals settle and byssally attach (Figure 4). Partial or total blockage of piping systems can result, causing damage to or outages of equipment and facilities. Zebra mussels may also foul areas in locks such as gage wells, concrete surfaces, and untreated metal surfaces such as lock miter gates. Masses of dead zebra mussels can accumulate on beaches and shorelines, interfering with public use.

1.5 During 1991, another species of attached biofouling mollusk, for now called the quagga mussel, was identified in portions of Lake Erie, Lake Ontario, Erie Canal, and the St. Lawrence River between New York and Canada. Quagga mussels have the same general external appearance as zebra mussels. One external diagnostic feature of the quagga is a keeling or protrusion of the shell valves on the ventral side, so that if the animal is placed ventral side down on a flat surface it will usually tilt off center. The quagga's attachment and biofouling characteristics are virtually identical to those of the zebra mussel, *Dreissena polymorpha*. They have been found intermingled with zebra mussel colonies. Their existence and colonization appears to be following the course that zebra

mussels have taken, but delayed by a span of several years. Consequently, the USACE and TVA expect that control methods which are adopted for zebra mussels will apply equally to quagga mussels within a few years.

1.6 Quagga mussels apparently survive at greater depths than the zebra mussel and may tolerate more extreme water temperatures. These characteristics could widen its threat considerably, if it can both avoid and endure the higher surface water temperatures found in Tennessee and Cumberland river impoundments. Quagga mussels have yet to be found outside of the Great Lakes area, however there is no apparent reason to suspect that they will not eventually become much more widespread.

1.7 In September 1992, Dr. James Sickel of Murray State University alerted USACE and TVA biologists to the fact that some of the attached bivalves collected in the dewatered Kentucky Lock, (Tennessee River Mile 22.4), were not *Dreissena polymorpha*. Other recent zebra mussel collections were subsequently reevaluated, and some of the look-alike bivalves were confirmed at two additional Tennessee River locks, Pickwick and Guntersville. The look-alike species had shell characteristics suggesting it to be in the genus *Mytilopsis*. *Mytilopsis leucophaeata* (dark falsemussel) is the only native *Mytilopsis* found in the eastern United States. The animals from Kentucky Lock were confirmed to be *Mytilopsis leucophaeata* by an authority on this group. *Mytilopsis leucophaeata* is an estuarine species capable of surviving, but apparently not reproducing, in fresh water. The occurrence of so many individuals, at least several hundred, in Kentucky Lock raises the possiblity that this species could figure as a biofouler. At this time, the implications of finding *Mytilopsis leucophaeata* locally remain unclear. These individuals may have simply been transported to inland waters, perhaps from Atlantic or Gulf Coast ports, and ultimately deposited in area locks. Provided the animals do not reproduce the scenario may end there. During a recent (October 1992) inspection of the dewatered Cheatham Lock on the Cumberland River just downstream of Nashville, only one *Mytilopsis leucophaeata* was found during an extensive search of the chamber.

1.8 Zebra mussels, quagga mussels, and to a lesser extent dark falsemussels are all attached biofouling mollusks. Although each of these species may have slightly different tolerances to control measures, they all fall into the same pest category from the viewpoint of raw water using facility operators. They foul water systems by the same means, attaching to solid materials, and to each other, with byssal threads, and accumulating in masses. To the operators of TVA and USACE facilities, and for the purpose of this EA, control of any or all of the above animals is viewed as a single, generic problem. **Henceforth in this EA, the term "zebra mussel" is used to describe ABMs as a group, including zebra mussels, quagga mussels, dark falsemussels, and any other similar "look-alike" species with the same system-infesting behavioral characteristics commonly associated with zebra mussels.**

1.9 Passage of the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (Public Law 101-646) directed the

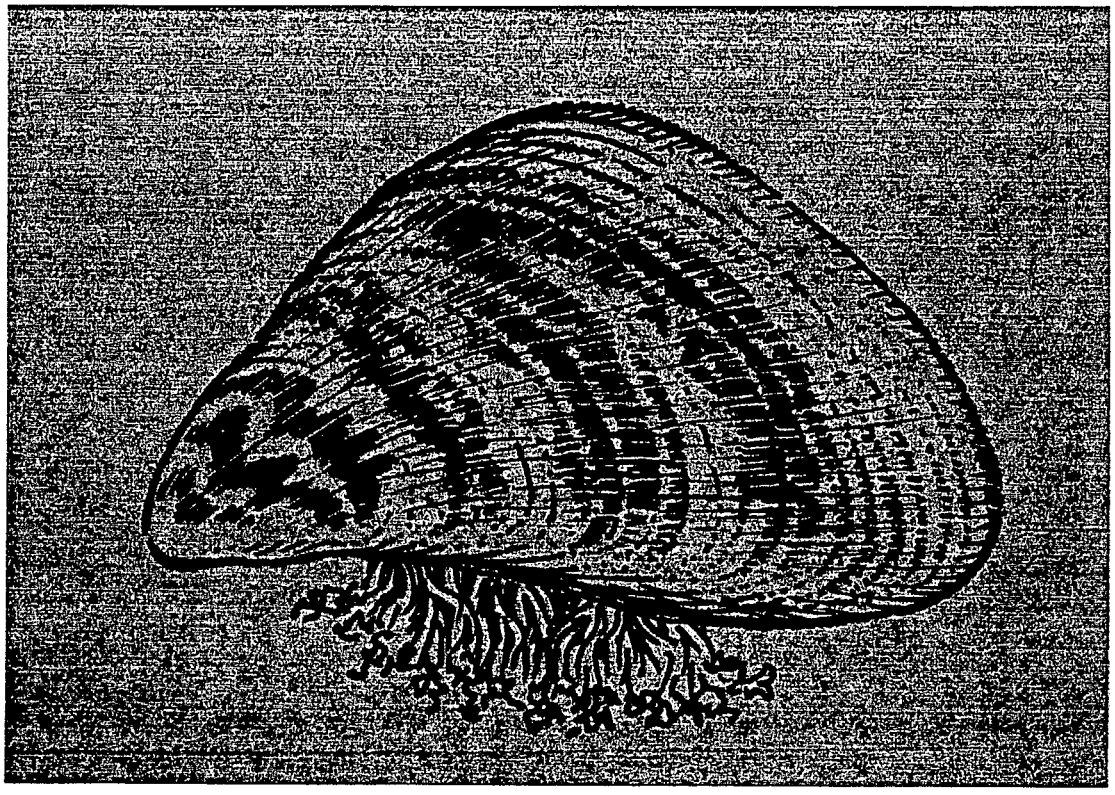

FIGURE 1
Adult Zebra Mussel (Dreissena polymorpha)
(Artist Rendering)

FIGURE 2
Adult Zebra Mussels

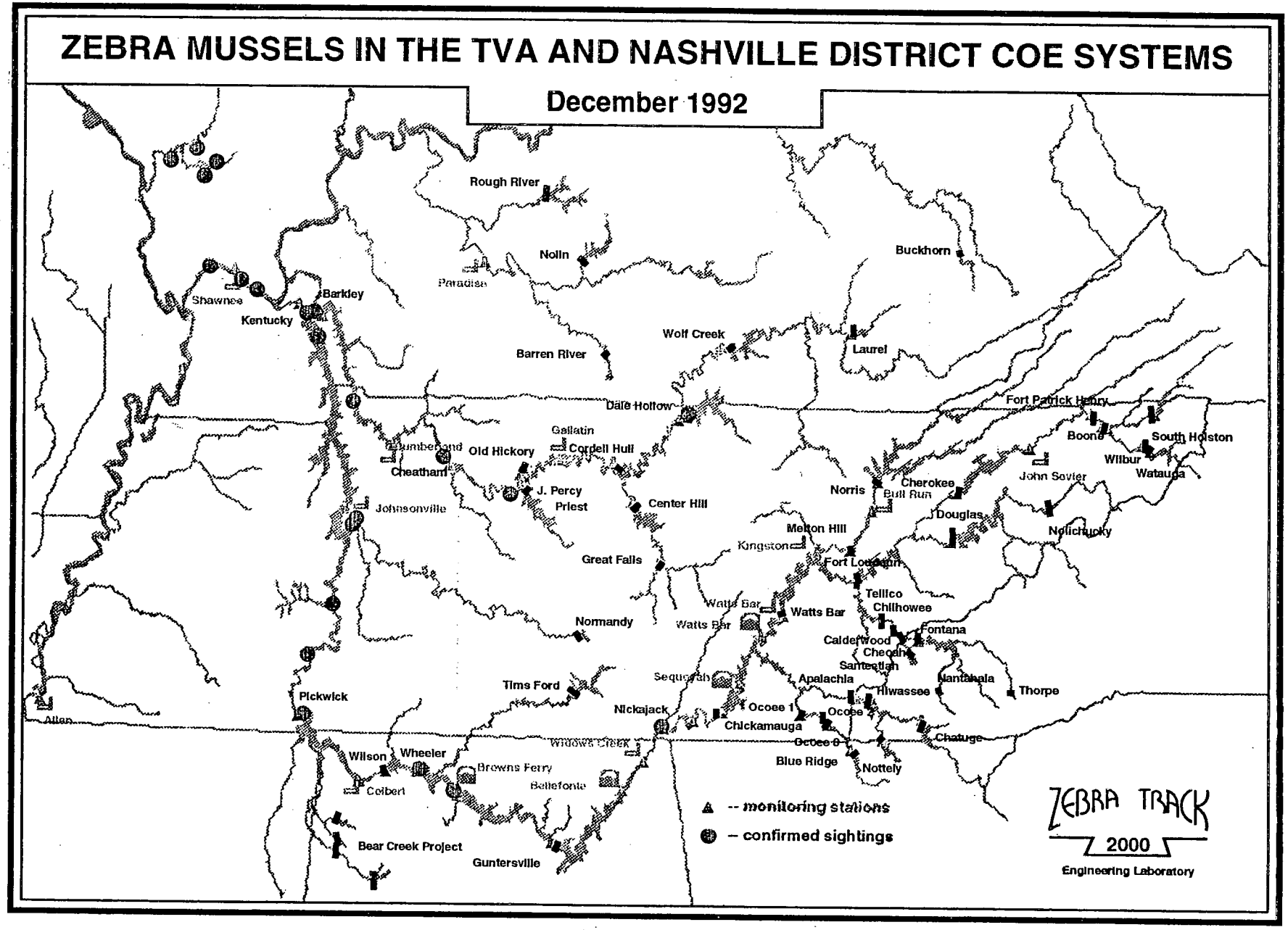
ZEBRA MUSSELS IN THE TVA AND NASHVILLE DISTRICT COE SYSTEMS
December 1992
Rough River
Nolin
Buckhorn
Paradise
Shawnee
Barkley
Kentucky
Wolf Creek
Barren River
Laurel
Dale Hollow
Fort Patrick Henry
Boone
South Holston
Wilbur
Watauga
John Sevier
Gallatin
Cumberland
Old Hickory
Cordell Hull
Cheatham
J. Percy
Priest
Center Hill
Norris
Cherokee
Bull Run
Douglas
Nolichucky
Johnsonville
Melton Hill
Kingston
Great Falls
Fort Loudoun
Tellico
Chilhowee
Watts Bar
Normandy
Fontana
Calderwood
Chepdh
Santeetlah
Sequoyah
Apalachia
Nantahala
Hiwassee
Thorpe
Tims Ford
Pickwick
Nickajack
Ocoee 1
Ocoee 2
Chickamauga
Chatuge
Ocoee 3
Blue Ridge
Nottely
Allen
Wilson
Wheeler
Browns Ferry
Colbert
Bellefonte
Bear Creek Project
Guntersville
▲ -- monitoring stations
● – confirmed sightings
ZEBRA TRACK
2000
Engineering Laboratory

Figure 3

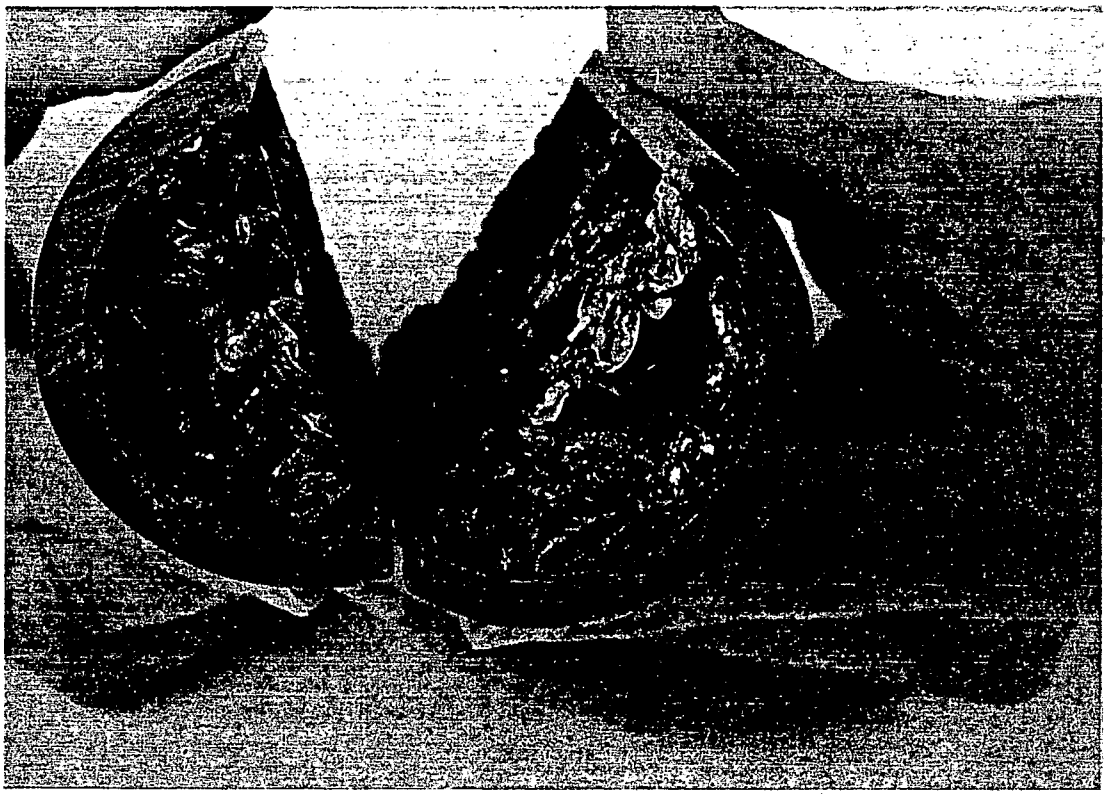

FIGURE 4
4 Inch Inside Diameter PVC Pipe
Blocked By Zebra Mussels

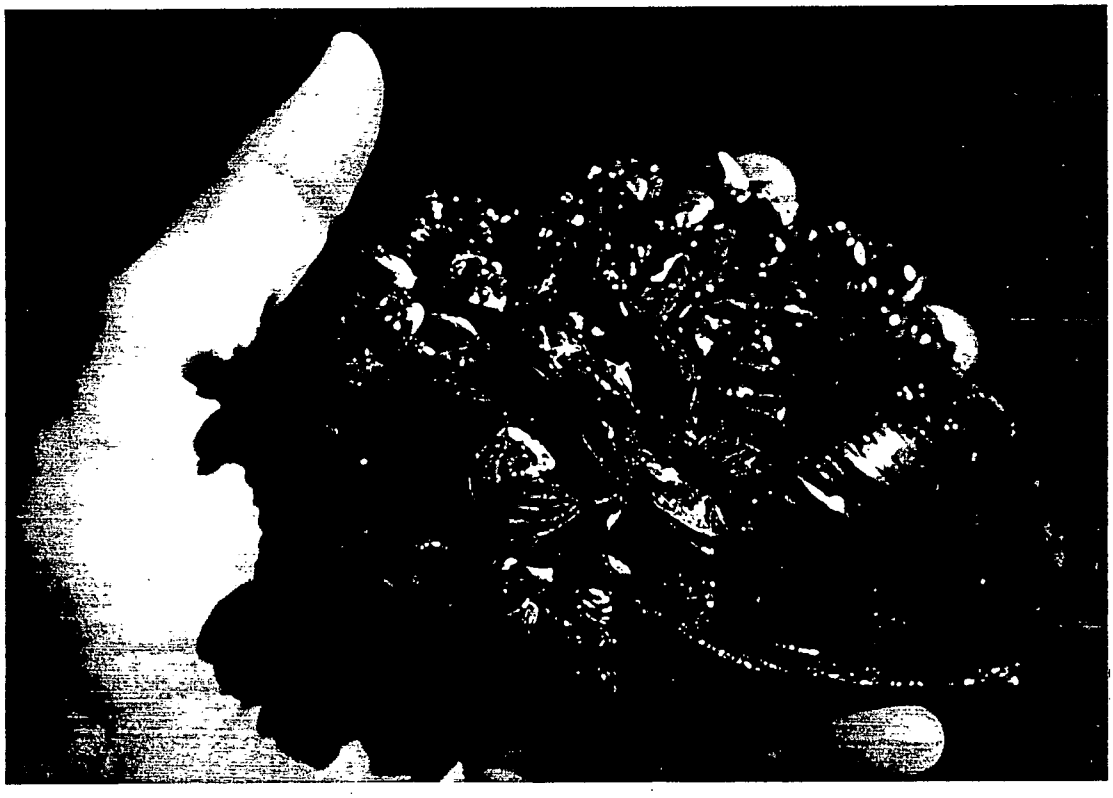

FIGURE 5
Native Unionid Fouled By
Massed Zebra Mussel Accumulation

Secretary of the Army to foster a program of research and technology development for the environmentally sound control of zebra mussels at public facilities. Public facilities are broadly defined and include locks, dams, reservoirs, water-pumping stations, water intakes, power generating stations, drainage structures, and others. The U.S. Army Corps of Engineers', Waterways Experiment Station (WES) is designated to implement a four-year program to develop environmentally sound control strategies for zebra mussels.

1.10 The presence of zebra mussels in the Tennessee and Cumberland rivers and knowledge that infestations of USACE and TVA facilities could have serious economic and other consequences has intensified the search for control measures to counter these pest organisms. The need for quick and proactive action is particularly vital. Zebra mussels reproduce prodigiously, and what are now light to moderate populations may within a few years become very heavy infestations. This rapid build up has been observed repeatedly in North America.

1.11 In this EA, the term "facilities" is used to describe a wide variety of structures and other installations operated by TVA and USACE which come into contact with water in, or withdrawn from, surface streams. Major facilities include hydropower dams, non-power dams, navigation locks, fossil-fueled electric generating plants, nuclear-fueled electric generating plants, and other installations (i.e. National Fertilizer and Environmental Research Center or NFERC) which use raw surface water. Also included in this use of "facilities" are Federal recreation areas managed by TVA or USACE (primarily the public facilities such as boat ramps, piers, and beaches they contain), remote sensing water level and water quality monitoring stations, vessels, and navigation buoys on primary and secondary channels maintained by TVA and USACE. All of these "facilities" may require the use of control measures to continue serving their intended purposes during zebra mussel infestations. However, different techniques are quite likely to be available and/or cost effective at each of the many types of facilities. Anticipated control methods which are expected to be considered for each category of "facility" are identified in Appendices B and C.

2.0 ALTERNATIVES CONSIDERED

Introduction

2.1 Two alternatives are evaluated in this EA. The action or preferred alternative would employ a variety of control technologies in Federal facilities at risk for impairment by zebra mussels. No single control technique will work in all applications, therefore a menu of different control methods is required. Each of these techniques must be as environmentally benign as possible, yet provide adequate levels of control and protection to ensure operational integrity of facilities.

2.2 The second alternative is that of "No Action". This alternative is evaluated to provide a scenario of what might be expected to occur should responsible entities take no new

actions to control zebra mussel populations in subject facilities.

No Action

2.3 Under this alternative no new initiatives would be undertaken to control zebra mussels in susceptible facilities. Routine maintenance activities currently being carried out to control Asiatic clams and other nuisance organisms (bacterial slimes, algal growths, etc.) would continue. This scenario would be expected to lead to periodic outages of hydro, fossil, and nuclear electric generating plants as a result of zebra mussels blocking or restricting essential raw water systems. Economic impacts would be profound and would be felt immediately by electric power consumers. Impairment of vital systems at navigation locks could also result from this alternative. Closure or impairment of navigation locks would have profound effects on the regional economy as well as impact the recreating public. Based upon the experiences of other utilities in the northern USA and Canada, the timeframe in which zebra mussel populations can increase from relatively low numbers to nuisance levels is short (potentially 1-3 years).

2.4 The serviceability of other Federal facilities could be threatened by pursuing a no action strategy. Important river gaging and water quality monitoring equipment could be rendered unreliable or inoperable, if zebra mussel control measures were not implemented. Heavy infestations of zebra mussels could accumulate on public boat launching ramps, and accumulations of zebra mussels on swimming beaches could impair the public's ability to use these facilities.

Implement Control Measures

2.5 Implementing the action alternative would bring into use a range of possible measures to control zebra mussel infestations at Federal facilities. Appropriate control measures would be chosen from a menu of options ranging from chemical treatments to physical barriers. The selection of a treatment method for each specific use would include an evaluation of potential environmental impacts, the level of control required, and the effectiveness of each method in that application. **Zebra mussel control would be limited to use in or on types of facilities as defined earlier; no attempt would be made to control zebra mussels away from these facilities (i.e. in the open environment). Some types of control measures are expected to be necessary at these facilities for the remainder of their productive lives.**

3.0 DESCRIPTION OF PROPOSED ACTION

Introduction

3.1 In recent years, North American facilities that use raw water in which zebra mussels are present, have come to employ a variety of different methods to control infestations. Water users in Europe, where zebra mussels have been present for many years, have designed facilities to minimize zebra mussel impacts. Most control techniques are available "off the shelf"

and have environmental consequences that are well documented. The amount and type of control to be applied by USACE and TVA will vary according to the facility, with zero tolerance of the animals in some critical raw water systems, while other facility components can function with zebra mussels present.

3.2 The effort expended on control will vary with the potential for each locality to support zebra mussels. Zebra mussel populations may not reach nuisance levels near all facilities because natural water quality or temperature conditions at some locations may not be optimal (may be limiting or semi-inhibiting). Other facilities may have constant, large infestations because they exist where habitat and water quality conditions are highly conducive to zebra mussel propagation and growth.

3.3 USACE and TVA have evaluated their facilities for risk of fouling from zebra mussels (Appendix A). Within different types of facilities, components have been evaluated for susceptibility, possible consequences if fouled, and potential control methods or strategies that could be applied (Appendices B and C).

Control Measures

3.4 The following control measure options will be considered for use in controlling zebra mussel infestations at USACE and TVA facilities:

3.4.1 Chemical Control. Chlorine, bromine, ozone, and potassium permanganate are some of the chemical biocides commonly used to disinfect water supplies (by killing bacteria, viruses, and other living organisms in the water) and to control biological pests (*Corbicula*, zebra mussels, biologic slimes) in industrial water supplies. These biocides can be classified as those which oxidize organic matter (chlorine, bromine, potassium permanganate) and those which are simply toxic to organisms (commercial molluscicides).

3.4.2 Although these biocides may not kill all organisms when applied to turbid, unfiltered water (because of absorption or reaction to organic matter), they nonetheless kill most of the organisms present in the water. For this reason, the presence of residual concentrations of biocides in the open aquatic environment is restricted by state and Federal regulatory authorities responsible for the protection of fish and other aquatic life which exist in surface water bodies.

3.4.3 Regulatory agencies typically establish in-stream surface water criteria for the protection of fish and other aquatic life and/or apply effluent limitations to point-source discharges to surface waters. In-stream criteria would typically consist of an in-stream total residual chlorine concentration of 19 micrograms/liter, (ug/l), to protect aquatic life from acute toxicity and 10 ug/l to protect against chronic toxicity (1,2). Effluent limitations applied to industrial wastewater discharges might consist of a daily maximum concentration, such as the 2.0 mg/l total residual chlorine limitation specified by Tennessee (3). States also frequently back-calculate instream criteria into point-source

discharge limitations. In some cases, more stringent EPA Effluent Limitation Guidelines may apply to specific industrial discharges (4).

(1) Kentucky Surface Water Standards at 401 KAR 5:031, Section 4(1)(h)5

(2) U.S. EPA Quality Criteria for Water 1986 states: "Freshwater aquatic organisms and their uses should not be affected unacceptably if the 4-day average concentration of total residual chlorine does not exceed 11 ug/l more than once every 3 years on the average, and if the 1-hour average concentration does not exceed 19 ug/l more than once every 3 years on the average."

(3) Tennessee Effluent Limitations and Standards at 1200-4-5-.03.

(4) Code of Federal Regulations, Title 40, Subchapter N, Part 423 - Effluent Limitation Guidelines for the Steam Electric Power Generating Point Source Category.

3.4.4 In those cases where chlorine or other biocides are selected as the preferred mechanism to control zebra mussels, TVA and USACE will limit or control discharges of chlorine or other biocides to surface waters of the United States so as not to cause any applicable in-stream, water-quality criteria to be violated, nor any effluent limitation imposed by regulatory authority to be exceeded.

3.4.5 Oxidizing chemicals, (e.g., chlorine), would mainly be used in systems where human ingress is not possible and/or where total control is desired. Typically, chlorine would be used to treat critical raw water systems of fossil, nuclear, and hydropower plants, systems that if they become infested would be extremely expensive to clean by currently available means. Metering systems would be designed with flexibility to operate intermittently or continuously and with extreme accuracy and reliability in administering correct treatment dosages. Chlorination is intended to render critical systems unsuitable for veliger settlement or to kill adult zebra mussels if they are already present. Chlorination may also be used to some degree in certain systems, like gage wells and small diameter drain lines, associated with navigation locks.

3.4.6 The second class of chemical controls, toxic chemicals include a number of commercially available molluscicides which typically could be employed on a periodic basis. Molluscicides are used in systems where some build-up of zebra mussels can be tolerated. As with any USEPA registered chemical, molluscicides must be applied according to limits specified by regulatory agency permits.

3.4.7 One naturally occurring substance which has been proven lethal to larval and adult zebra mussels is known as Endod. Endod is derived from the African soapberry plant, *Phytolacca dodecandra*, and has seen use in Africa as a molluscicide for control of snails. Endod can be removed from the water by

activated charcoal. Endod offers some promise as an acceptable molluscicide because it is noncarcinogenic, nonmutagenic, and completely biodegradable. Its availability in North America is limited at this point. The principal source country for the plant is Ethiopia.

3.4.8 Antifoulant Coatings. Coatings are available which are either toxic to zebra mussels or render surfaces very slick, resulting in poor byssal attachment. Toxic coatings include metallic coatings rich in copper, zinc, tin, or alloys of these metals. Zebra mussels usually will avoid attaching to surfaces so coated. Metallic coatings have the advantage of long service life and are a good choice for structures that are difficult to clean.

3.4.9 Coatings that render surfaces slick and thus weaken byssal attachment have some application, but generally their overall softness and tendency to degrade when cleaned limits their usefulness. Many are silicon based. These coatings are environmentally benign.

3.4.10 Mechanical Cleaning. This form of control can range from use of sophisticated pipe cleaning or "pigging" devices, to high pressure sprays, to simple scraping of surfaces and disposal of detached zebra mussels. Where large quantities of zebra mussels are removed, labor saving devices that scrape off and vacuum the animals into disposal bins have been developed. Typically mechanical cleaning is an environmentally compatible process, provided large quantities of zebra mussels are not disposed of in situations where their decaying flesh could foul the water or be drawn back into intakes. Mechanical cleaning is often employed on systems where some build-up of zebra mussels is tolerable or where it is simply not possible to economically control them through other means. Divers are usually needed where dewatering of a facility is not possible.

3.4.11 Thermal Shock. Thermal shock, the raising of water temperatures to intolerable levels, is a proven control technique. Thermal shocking can be used to kill adult zebra mussels instantly (40 degrees C or 104 Fahrenheit) or over time (5 hours at 32.5 degrees C or 90.5 Fahrenheit). Thermal backflushing has application where sources of hot water are available such as floating plant (boats, vessels, dredges) and some generating stations.

3.4.12 Dry Storage and Dewatering. Zebra mussels can be killed by exposing them to hot, dry air (desiccation). This control method is most effective if it can be conducted in an environment of low humidity and elevated temperatures. It is an effective control method provided a system can be dewatered for the amount of time necessary to achieve an effective kill. Kill times are reduced if a partial vacuum can be introduced into the closed system. The resulting dead shells would have to be removed to avoid clogging pipes. On exposed surfaces they could be manually removed. Dry storage and dewatering is an environmentally sound control technique.

3.4.13 Oxygen Deprivation. Zebra mussels must have oxygen for metabolic processes. Oxygen deprivation is an effective control method where it can be used. In some systems where

time and other conditions permit, it may be feasible to hold a volume of water and let it stagnate, creating an oxygen deficient environment in which zebra mussels cannot survive. In other situations, chemical agents such as sodium-meta-bisulfate can be added to the water. These chemicals will tie up oxygen in the water and eventually kill zebra mussels that are present. The shells of dead zebra mussels would have to be removed from these systems to prevent pipe clogging.

3.4.14 Other Control Methods. The economic havoc zebra mussels can wreak has stimulated much research into other control methods, many of which are in experimental phases. In addition, the above listed, proven, control methods are constantly being refined and made more effective in combatting zebra mussels. This is important, as experience has repeatedly demonstrated that zebra mussels often do not respond according to predictable patterns. Zebra mussels may respond in dramatically different ways in productive, warmer, southern USA waters than in waterbodies further north, where the majority of experience with effectiveness of control measures has been based.

4.0 AFFECTED ENVIRONMENT AND POTENTIAL IMPACTS

Water Quality

4.1 Introduction. The overall water quality of the operational area of the TVA and USACE is highly variable, but generally supports recognized uses such as fish and wildlife, domestic water supply, industrial water supply, livestock watering, agricultural uses, and water contact recreation. Water quality of the area covered by this EA has been extensively described in many other documents. Site specific descriptions of water quality are available through these sources.

4.2 Facilities covered by this document are generally located on the mainstem, Cumberland River, Tennessee River, Green River, lower Ohio River, Mississippi River, and larger tributaries to some of these streams. Typically mainstem impoundments are relatively shallow, run-of-the-river waterbodies that exhibit characteristics of both lentic and lotic waters. The upper portions of most pools have primarily riverine characteristics with a trend toward more lake-like characteristics nearer the impounding structure and in embayments. The substantial flows characteristic of the mainstem aid in maintaining dissolved oxygen levels. Temperature stratification does occur, generally in the deeper, more lake-like portions of many mainstem impoundments but is less persistent and more easily destabilized by the presence of flows at most times. Water quality is maintained on mainstem streams within the context of industrial development, operation of dams, watershed development, point and non-point sources of pollutants, and many other factors.

4.3 Dams on tributaries are operated for flood control, hydropower production, and augmentation of downstream water supplies. Water quality is controlled largely by the method of release from these structures. Thermal stratification

profoundly influences water quality both within the impoundment and in the tailwater stream. Hypolimnetic releases from stratified reservoirs for hydropower production are often seasonally low in dissolved oxygen, have depressed growing season temperatures, and may exhibit elevated concentrations of certain metals such as iron and manganese.

4.4 Reservoirs on tributary streams typically have a biologically productive upper layer that is relatively high in dissolved oxygen and nutrients. Actual productivity is dependent upon watershed characteristics and how the project is operated. Water quality from one location to another in any particular reservoir can be highly variable.

4.5 No Action. If no actions were taken to control zebra mussel infestations at USACE or TVA installations, this decision would not affect water quality in the vicinity of Federal facilities. Ongoing maintenance activities at the facilities would continue with no change in existing water quality conditions. If zebra mussel populations increase to high densities, those populations are likely, in and of themselves, to affect various water quality characteristics; however those effects would not occur as a result of decisions concerning zebra mussel control at the facilities.

4.6 Implement Control Measures. Most control measures would have little or no impact on water quality. Controls carried out would be on a relatively small scale in comparison to the overall size of the river systems. Operations to control zebra mussels such as deoxygenation, thermal shock, desiccation, and coatings would produce relatively little and very localized degradation of water quality that would quickly be diluted by the volume of the receiving water. Use of mechanical cleaning could impact water quality on a localized and temporary basis, if large quantities of detached zebra mussels were released into the aquatic environment.

4.7 Minimization of biocide use is the goal of USACE and TVA. Biocide residuals released into the environment would be diluted by untreated river flows many times the volume of the water treated with biocides. For example at Cheatham hydropower plant on the Cumberland River, a chlorine residual of 0.5 ppm is anticipated to be needed in the continuous treatment mode to maintain systems in a mussel free condition. Approximately 1000 gpm of water would be treated with chlorine and released into the main turbine discharge estimated at approximately 23,000 cubic feet per second (172,040 gallons per second or 10,322,400 gallons per minute). The dilution factor in this case of untreated river flows compared to chlorinated discharge is approximately 100,000 to 1. In the intermittent treatment mode, a 2 ppm chlorine residual is required at the discharge on a twice daily basis for approximately 30 minutes per treatment. In addition to the tremendous dilutions, organic material loads which are generally high in most streams, would rapidly oxidize biocide residuals.

Aquatic Biota

4.8 Introduction. Aquatic life occurring in the operational area covered by this document is quite diverse. Habitat

quality controls the abundance and variety of organisms present at any given location. Free flowing or controlled-flow stream reaches support diverse aquatic communities, including many fish species (especially catfish, bass, and trout species) sought by sports fishermen. Impounded parts of these streams support different aquatic communities, including fish species and native unionid mussels sought by both sport and commercial fishermen. The unionid fauna, even though much reduced from its preimpoundment condition, is still a very important part of the aquatic environment, perhaps serving as indicators of water quality and the profound changes that have occurred with development of the waterways. Aquatic assemblages of streams and reservoirs have been extensively studied, described and reported on in numerous general and specific sources.

4.9 No Action. Under no action there would be no significant impact on aquatic biota. Operations at facilities would continue to exert essentially the same influence on aquatic biota as occurs presently.

4.10 Implement Control Measures. Those control measures which consist of chemical treatment raise the spectre of what, if any, adverse impact will occur to the environment beyond the immediate confines of the pipe, tank, or other closed "system" targeted for protection. Chemicals which would be used to control zebra mussels would, by design be toxic to these target organisms. They also would very likely be toxic to other non-target forms of aquatic life.

4.11 Therefore, toxic concentrations of these control chemicals would not be allowed to be discharged into the general environment. Any discharges of residual control chemicals would be subject to wastewater discharge permits issued by state or Federal regulatory authorities. Discharge concentrations would have to be limited as described in Section 3.4.3. Such concentrations could be achieved by chemical or physical detoxification of treated waters before release into the environment, or by dilution of the treated water into large quantities of non-treated water.

4.12 An example of the latter case, would be where small equipment cooling water flows would be mixed with large volume, untreated cooling water flows which are orders of magnitude greater than the treated flows. This type of dilution might result in complete mixing within the pipe or system before exiting the facility, or a zone of mixing into the receiving stream may be allowed by the regulatory authority. The minute quantities of control chemicals that would find their way into the aquatic environment downstream of facilities would be diluted to such an extent that there would be no impairment to important resources such as fisheries, including spawning habitat, larval and young-of-the-year fishes, or food supplies needed to support these. Other components of the biota, such as aquatic macrophytes, aquatic invertebrates including shellfish and plankton would also suffer no impairment from control chemicals used in facilities. It is highly likely that the zebra mussel itself will be the major modifier of the aquatic environment outside of facilities, should large populations of *Dreissena polymorpha* become a reality in the region.

4.13 Control measures which involve physical removal or temporary extreme habitat changes in contained areas (thermal shock, oxygen depletion, etc. in pipes or chambers) would similarly not effect aquatic life outside of defined mixing zones, which might be totally within a given facility or adjacent to a specific Federal facility. As in the case of chemical dilution described above, the water masses in which these control activities would occur would be mixed with much larger discharges from routine activities at the facilities (lockages, turbine discharges, etc.). Habitat quality would be restored to unharmful conditions within existing mixing zones at these facilities.

Threatened and Endangered Species

4.14 Introduction. In response to the scoping letter concerning this environmental assessment (Appendix D), the U.S. Fish and Wildlife Service provided a list of federally protected endangered and threatened species reported from stream reaches adjacent to USACE and TVA facilities (Appendix E). This list, expanded to include additional species which might be found adjacent to Federal projects in this operational area, is presented in Table 1.

4.15 Many of the species included in Table 1 occur only rarely within proximity to the Federal facilities. Most of the crustaceans and fishes occur in specific habitats which no longer persist in the modified rivers. Several of the unionid mussels also occur only away from the modified rivers; however, the remainder persist only in relatively unmodified reaches of large rivers, usually not far downstream from USACE and/or TVA dams.

TABLE 1

Listed or Proposed Federally Endangered or Threatened Aquatic Species Known to Inhabit the Cumberland, Green, Ohio, Tennessee, or Middle Mississippi Rivers

Scientific Name	Common Name	Status *	Rivers **
Crustaceans			
Orconectes shoupi	Nashville crayfish	LE	(Ct)
Palaemonias ganteri	Kentucky cave shrimp	LE	(Gt)
Palaemonias alabamae	Alabama cave shrimp	LE	(Tt)
Mussels			
Cyprogenia stegaria	Fanshell	LE	C,G,T
Dromus dromas	Dromedary pearlymussel	LE	C,T
Epioblasma walkeri	Tan riffleshell	LE	(Ct,Tt)
Epioblasma o. obliquata	Catspaw	LE	C
Epioblasma torulosa gubernaculum	Green blossom	LE	(Tt)
Epioblasma t. rangiana	Northern riffleshell	PE	G
Fusconaia edgariana	Shiny pigtoe	LE	(Tt)

TABLE 1 (continued)

Listed or Proposed Federally Endangered or Threatened Aquatic Species Known to Inhabit the Cumberland, Green, Ohio, Tennessee, or Middle Mississippi Rivers

Scientific name	Common Name	Status	Rivers
Mussels			
Fusconaia cuneolus	Fine-rayed pigtoe	LE	(Tt)
Hemistena lata	Cracking pearlymussel	LE	G,T
Lampsilis orbiculata	Pink mucket	LE	C,G,O,T
Lampsilis viriscens	Alabama lampmussel	LE	(Tt)
Conradilla caelata	Birdwing pearlymussel	LE	(Tt)
Obovaria retusa	Ring pink	LE	G,T
Pegias fabula	Little-wing pearlymussel	LE	(Ct,Tt)
Plethobasus cicatricosus	White wartyback	LE	T
Plethobasus cooperianus	Orange-foot pimpleback	LE	O,T
Pleurobema clava	Clubshell	PE	(Ot)
Pleurobema gibberum	Cumberland pigtoe	LE	(Ct)
Pleurobema plenum	Rough pigtoe	LE	G,T
Potamilus capax	Fat pocketbook	LE	O
Quadrula intermedia	Cumberland monkeyface	LE	(Tt)
Quadrula sparsa	Appalachian monkeyface	LE	(Tt)
Toxolasma cylindrellus	Pale lilliput	LE	(Tt)
Villosa trabalis	Cumberland bean	LE	(Tt)
Fishes			
Cyprinella monacha	Spotfin chub	LT	(Tt)
Erimystax cahni	Slender chub	LT	(Tt)
Etheostoma boschungi	Slackwater darter	LT	(Tt)
Etheostoma (Catonotus) sp.	Duskytail darter	PE	(Ct,Tt)
Etheostoma wapiti	Boulder darter	LE	(Tt)
Notropis sp.	Palezone shiner	PE	(Ct,Tt)
Noturus baileyi	Smoky madtom	LE	(Tt)
Noturus flavipinnis	Yellowfin madtom	LT	(Tt)
Noturus stanauli	Pygmy madtom	PE	(Tt)
Percina tanasi	Snail darter	LT	T
Phoxinus cumberlandensis	Blackside dace	LT	(Ct)
Scaphirhynchus albus	Pallid sturgeon	LE	M
Speoplatyrhinus poulsoni	Alabama cavefish	LE	(Tt)

Scientific names are those used by U.S. Fish and Wildlife Service in the publication of the final listing rule

*

Status Abbreviations:
LT--Listed Threatened
LE--Listed Endangered
PE--Proposed Endangered

**

River Abbreviations:
C--Cumberland; G--Green; O--Ohio; T--Tennessee;
M--middle Mississippi
(_t)--the species occurs in tributaries of this system but not in the mainstem.

4.16 No Action. If no actions were taken to control zebra mussel infestations at USACE and TVA installations, this decision would not affect endangered and threatened aquatic species in the vicinity of the Federal facilities. Ongoing maintenance activities at the facilities would continue with no change in existing habitat conditions. If zebra mussel populations increase to high densities, those populations might, in and of themselves, have an effect, possibly profoundly negative, on various endangered and threatened species; however, those effects would proceed independently of decisions concerning zebra mussel control at the facilities. Encrusting, massed growth by zebra mussels on native unionid mussels in Lake Erie and Lake St. Clair, for example, has led to dramatic declines, in some cases virtually 100% mortality, in survival of native unionids (Figure 5). This scenario could be repeated in the Cumberland and Tennessee river basins, regardless of control options employed at Federal facilities.

4.17 Implement Control Measures. Those control measures which consist of chemical treatment raise the spectre of what, if any, adverse impact will occur to the environment beyond the immediate confines of the pipe, tank, or other "closed" system targeted for protection. Chemicals which would be used to control zebra mussels would, by design, be toxic to these target organisms. They also would very likely be toxic to other non-target forms of aquatic life, and particularly to threatened and endangered species.

4.18 Toxic concentrations of these control chemicals would not be allowed to be discharged into the general environment. Any discharges of residuals from control chemicals would be subject to facility wastewater discharge permits (NPDES) issued by state or Federal regulatory authorities, and would specifically consider potential impacts on threatened and endangered species. Discharge concentrations would have to be limited as described in Section 3.4.3. Such concentrations could be achieved by chemical or physical detoxification of treated waters before release into the environment or by dilution of the treated water into large quantities of non-treated water.

4.19 Control measures which involve physical removal or temporary extreme habitat changes in contained areas (thermal shock, oxygen depletion, etc. in pipes or chambers) would similarly not effect aquatic life outside of defined mixing zones which might be totally within a given facility, or adjacent to a specific Federal facility. Water masses in which these control activities would occur would be mixed with much larger discharges from routine activities at the facilities. Habitat quality would be restored to existing conditions within existing mixing zones at these facilities.

Water Supplies

4.20 Introduction. The Tennessee, Cumberland, Green, and lower Ohio river basins provide a dependable, generally high quality water supply for a variety of users. Users include municipalities, industry, agriculture, and many others.

4.21 No Action. If no actions were taken to control zebra mussel infestations at USACE or TVA installations, this

decision would not affect water supplies in the operating area. Ongoing maintenance activities at the facilities would continue with no change in existing water quality conditions. Zebra mussel populations are expected to affect various water supplies in the same manner and degree to which Federal facilities will be affected. However, those effects would not occur as a result of decisions concerning zebra mussel control at the Federal facilities.

4.22 Implement Control Measures. Zebra mussel control measures are unlikely to affect area water supplies significantly. Chemical control measures would release tiny quantities of residual chlorine or other biocides that would be quickly diluted by river flows or inactivated (oxidized) by organic matter in the water. Zebra mussels removed by large scale underwater, mechanical cleaning operations could temporarily degrade water quality as the dead animals decompose. Effects from this would be very localized and unlikely to impact water supplies. With massive infestations, large scale underwater removal actions could generate huge quantities of dead zebra mussels, which under certain local conditions could perhaps be drawn into a nearby water intake. Water intakes in the immediate vicinity of large scale, underwater zebra mussel cleaning operations at facilities would be identified and disposal of animals in their vicinity avoided.

Solid Wastes/Hazardous Wastes

4.23 Introduction. Experience at facilities in the Great Lakes area has shown that large quantities of zebra mussels can be a solid waste concern. As filter feeding bivalves, they may accumulate contaminants in their tissues. Depending upon concentrations of contaminants so accumulated, they could become a hazardous waste. Though no massive growths of zebra mussels have occurred in the TVA or Nashville District geographic area, the potential exists at many sites for heavy infestations to occur, causing solid waste disposal problems.

4.24 Studies by some researchers have demonstrated that zebra mussels do not appear to be major bioaccumulators of contaminants, and so far they have been disposed of by conventional means, e.g. landfilling, composting, spreading on agricultural lands as a fertilizer. Investigators continue to search for beneficial ways to use zebra mussels generated by control actions.

4.25 Solid waste regulations determine whether animals would be allowed to remain in the water as they are generated, or if they must be taken upland for disposal. The basic rule is that animals generated during underwater removal actions can, in most circumstances, remain in the water column. Animals generated in a non-aquatic situation, for example during the cleaning of a dewatered navigation lock, will not be placed back into the aquatic environment.

4.26 No Action. Zebra mussels would be generated under no action during continued routine maintenance carried out at facilities. Disposal would be handled in an environmentally acceptable manner. In some locations animals may require

testing to determine contaminant levels in their flesh. Several factors would determine whether testing for contaminants is undertaken, including proximity to sources of pollution, gross physical appearance of the animals, and the history of contaminant problems in the area. Uncontaminated animals would be disposed of in a conventional landfill or, if feasible, could be used for some beneficial purpose, perhaps by application to agricultural fields. Contaminated animals would require special handling, such as drumming and transport to a hazardous waste landfill or other approved facility handling hazardous waste. Such an action would be carried out under RCRA and other appropriate statutes.

4.27 Implement Control Measures. Under a control plan, zebra mussels would be generated, requiring disposal. With control measures in place, the amount of animals generated for disposal would be somewhat less than that under no action. Animals removed by underwater cleaning operations might be left in the aquatic environment. Large quantities of zebra mussels will not be disposed of in the immediate vicinity of a water intake, recreation area, or other environmentally sensitive site. In addition, prior to disposal, the animals may require testing, as specified under no action, to determine contaminant residue levels in their tissues. Contaminated animals would require special handling and disposal as discussed above.

4.28 Zebra mussels generated by removal from recreation areas would not be allowed to reenter the water. Disposal would be upland, with the exact method determined by their contaminant status.

Safety

4.29 Introduction. Public safety is very important. Public safety is enhanced through an extensive system of navigation aids such as buoys and markers which provide vital information about sailing routes, regulations, and hazards on primary and secondary channels. Hazardous cargoes, gasoline, chemicals, et. al., are moved in large quantities on waterways, and commercial navigators rely on the system of navigation aids for safe passage, as do recreational boaters. Visitation is very high at public use areas such as boat launch ramps and beaches, which are susceptible to fouling. The recreating public expects a reasonable degree of safety precautions to be provided for their welfare.

4.30 No Action. Public safety would be compromised by taking no action to control zebra mussels. In the event of heavy fouling, important navigation or information buoys could either sink completely or be partially submerged, no longer serving their intended use. Loss of such navigation aids could lead to groundings or collisions by commercial and recreational watercraft with the possibility of releases of hazardous materials, property damage, and personal injury. Partially sunken navigation aids, such as buoys, would themselves become a navigation hazard, particularly for small craft. The fouling of beaches and boat ramps by zebra mussel shells, which are often sharp, could result in personal injuries such as cuts.

4.31 Implement Control Measures. Public safety would be

enhanced, but not totally guaranteed by implementation of control measures. A regular maintenance program to remove mussels from susceptible navigation aids would maintain the system of channel markers and information signs. Fouling of recreation areas could still occur, but removal of most shell material would reduce the risk of personal injury to the public.

Economics

4.32 Introduction. TVA and USACE water resource and generating facilities produce a wide range of economic benefits vital to the area's economy. Benefits include electric power generation, navigation, reduction of property damage by flood control operations, and a growing recreation related industry sector. Uncontrolled populations of zebra mussels at facilities will put many of these benefits at risk. Failure to control nuisance zebra mussel populations at facilities would have major adverse consequences that would be felt immediately and profoundly by consumers and industry.

4.33 No Action. The principal economic risk incurred by TVA in adopting a no action alternative would be the cost of replacing the energy lost owing to an outage caused by zebra mussel infestation. Current estimates of replacement energy costs for hydropower plants range from $12,000 to $20,000 per 1,000 megawatt hour (MWH) to be replaced. The following estimates, for three of the four most downstream hydropower plants on the mainstem Tennessee River, (all judged to be high risk sites), are based on the assumption of a two day outage, a very conservative outage duration, of the entire plant.

TABLE 2

Estimated Economic Impact of Hydropower Plant Outage in the TVA System

Plant	# of Units	Generating Cap. MW	Replacement Energy Cost $ x 1,000
Kentucky	5	175	100-160
Pickwick Ldg.	6	236	138-230
Wheeler	11	378	218-363

4.34 The USACE operates nine hydropower plants on the Cumberland River and its tributaries. The principal economic risk incurred by the Corps in adopting the no action alternative is the cost of replacing the energy lost owing to an outage caused by zebra mussel infestations. According to the Southeastern Power Administration, the Federal marketing agency for Corps' power, the current replacement cost for the Corps' hydropower ranges from $14,000 to $22,000 per 1,000 MWH. The following estimates for the three lowermost hydropower plants on the mainstem of the Cumberland River, all high risk plants, are based on the assumption of a two day outage, again a conservative outage duration estimate, for the entire plant.

TABLE 3

Estimated Economic Impact of Hydropower Plant Outage for Selected USACE-Nashville District Plants

Plant	# of Units	Capacity MW	Replacement Energy Cost $ x 1,000
Barkley	4	149.5	100 - 158
Cheatham	3	41.4	28 - 44
Old Hickory	4	116	78 - 122

4.35 Economic losses caused by zebra mussel related powerplant outages would not be one time events. Without effective controls, zebra mussels will reinfest critical systems causing repeated outages. Experience gleaned from other utilities that have encountered zebra mussel fouling, indicates the cost to install and operate effective zebra mussel controls is just a small fraction of the cost of repeated outages and system maintenance needs incurred under no action.

4.36 Negative economic impacts would occur if navigation locks are shut down because of zebra mussel fouling problems. Delays would be especially severe at locations where auxiliary locks or alternative shipping routes are not available. The conservative estimated cost for lockage delays for a commercial tow is approximately $300/tow/hour. Zebra mussel fouling resulting in increased lock outages would also inflict a hardship on recreational boat traffic. Maintenance costs for some lock structures would increase, and the life span of certain components might be greatly reduced.

4.37 Implement Control Measures. Enacting control measures will ensure the continued normal output of services and economic benefits from facilities that could be impacted by zebra mussel fouling. As mentioned above, the cost of controlling zebra mussels is a fraction of the cost incurred in maintaining facilities without effective control for these biofouling mollusks.

Recreation

4.38 Introduction. TVA and USACE water resource developments provide a wide range of recreational opportunities and benefits. A considerable industry has grown up due to recreation associated with agency water resource projects. The experience gained from the Great Lakes has indicated significant zebra mussel populations could foul beach areas, shorelines, and boat ramps or other accesses. Impacts to navigation aids which benefit recreationists are covered under **Safety**.

4.39 No Action. In the event of significant zebra mussel fouling, public use of beaches and boat ramps would be impaired. The odor of decaying zebra mussel flesh is noxious.

Many recreationists would probably avoid such areas. Sharp shell fragments would pose a hazard to beachgoers.

4.40 If boat ramps become infested, they would remain usable, but there would be some inconvenience to the public from stepping on live and dead zebra mussel shells. Large populations could sink, weight down, or destabilize courtesy docks and sink beach area marker floats.

4.41 Implement Control Measures. Implementing control measures at recreation sites would involve removing zebra mussels from areas of high public use or areas where contact with the animals would degrade the recreational experience. Swimming beaches would be the primary site for zebra mussel removal. Since zebra mussels generally avoid soft substrates, animals entering the beach areas would most likely be swept inshore by wave action or high river flows. It is likely that many zebra mussels swept in would be dead, resulting in odor and shell fragment problems. Animals removed would be disposed of in an approved manner. Zebra mussels interfering with boat ramps, would be cleaned off. Cleaning of courtesy docks and floats might result in disposal back into the water provided this does not interfere with shoreline recreation areas.

Aesthetics

4.42 Introduction The aesthetic qualities of facilities covered by this document vary greatly. These range from massive, industrial-like complexes such as fossil fueled generating plants to the more natural setting of many recreation areas where aesthetic qualities are important. Zebra mussel fouling of some facilities would degrade the aesthetic characteristics of some locations while having no appreciable effect on others.

4.43 No Action. The aesthetic qualities of most areas under consideration would not be appreciably altered by no action. Any significant zebra mussel accumulations would occur under the water surface, and would only be revealed during dewatering of facilities or lowering of lake levels. In recreation areas affected by zebra mussels, aesthetic qualities would be lessened by windrowing of mussels on shorelines, beaches, and boat ramps. Natural processes would eventually break down the animals, but at certain times the aesthetic qualities of these areas could be significantly degraded.

4.44 Implement Control Measures. Control measures used at recreation sites would attempt to restore the aesthetic qualities of areas degraded by zebra mussels. Control measures at facilities would emphasize maintaining serviceability, with appearance as a secondary consideration in most cases. For example, if lock miter gates became severely fouled, they could be cleaned and resurfaced which would restore the appearance of that component, even though appearance is not an overriding consideration in such a facility.

Cultural Resources

4.45 Introduction. Zebra mussels have the potential to significantly infest Federal facilities located within riverine

environments of the Cumberland, Tennessee, Green, lower Ohio, and middle Mississippi river systems. Many of these facilities, particularly those associated with the early development of flood control, hydropower, and navigation meet the minimum requirements for National Register eligibility, have been determined eligible, or are listed on the National Register of Historic Places.

4.46 No Action. If no action is taken to control zebra mussel infestations at susceptible facilities, the serviceability and operation of those facilities may be threatened. Given the historic context of many of these facilities (i.e., their historic association with the development of flood control, hydropower, and navigation along affected riverways), their serviceability and continuing operation is part and parcel to their historic significance. No action may, in some cases, result in an adverse effect to potentially significant historic properties.

4.47 Implement Control Measures. Control measures, including the use of chemicals, antifoulant coatings, mechanical cleaning, thermal shock, dry storage/dewatering and oxygen deprivation at or near affected facilities will ensure their continuing operation and service. Such measures are seen as having no effect on those characteristics of the facilities which would qualify them for listing on the National Register of Historic Places.

Impact Matrix, Action Alternative or Proposed Action

TABLE 4(a)

Action Alternative or Proposed Action

Factor	Chemical Control	Mechanical Control
Water Quality	Localized minor negative impacts within mixing zone	Localized minor negative impacts within immediate aquatic disposal area
Aquatic Biota	Localized minor negative impacts within mixing zone	Localized minor negative impacts within immediate aquatic disposal area
T & E Species	Site dependent, Possible localized impacts within mixing zone	Site dependent, possible localized impacts within immediate disposal area
Water Supplies	Site dependent, possible localized impacts	Site dependent, possible localized impacts within immediate disposal area

TABLE 4(a) continued

Action Alternative or Proposed Action

Factor	Chemical Control	Mechanical Control
Solid Wastes/ Haz Wastes	No effect	Generates quantities of zebra mussels for disposal. Haz waste site dependent
Safety	No effect	Positive effect
Economics	Major positive effects	Positive effect
Recreation	Site dependent, positive effects	Site dependent, positive effects
Aesthetics	Site dependent, positive effects	Site dependent, positive effects
Cultural Resc.	Site dependent, positive effects	Site dependent, positive effects

TABLE 4(b)

Action Alternative or Proposed Action

Factor	Coatings	Thermal Shock	Dry Storage/ Dewatering	Oxygen Deprivation
Water Quality	No Impt.	No Impt.	No Impt.	No Impt.
Aquatic Biota	No Impt.	No Impt.	No Impt.	No Impt.
T & E Species	No Impt.	No Impt.	No Impt.	No Impt.
Water Supplies	No Impt.	No Impt.	No Impt.	No Impt.
Solid Wastes/ Haz Wastes	Positive Impact	No Impt.	Positive Impact	No Impt.
Safety	No Impt.	No Impt.	No Impt.	No Impt.
Economics	Positive Impact	Positive Impact	Positive Impact	Positive Impact
Recreation	No Impt.	No Impt.	No Impt.	No Impt.
Aesthetics	Positive Impact	No Impt.	No Impt.	No Impt.
Cultural Resc.	No Impt.	No Impt.	No Impt.	No Impt.

5.0 ENVIRONMENTAL COMMITMENTS

5.1 Zebra mussels, like many other non-native organisms, are an unwelcome but probably permanent part of the environment. Their unique biofouling characteristics and history in North America makes them a real threat to many facilities which provide high economic benefits. The USACE and TVA must employ controls to combat the negative impacts of these animals in facilities, while at the same time doing the utmost to protect the aquatic environment and non-target organisms. Strong commitments on the part of both agencies to environmental protection go into the planning and execution of control technologies covered in this EA.

5.2 The USACE and TVA have an ongoing dialogue with state and Federal regulatory agencies charged with protecting aquatic resources. In those cases where chlorine or other biocides are selected as the preferred control mechanism for zebra mussels, TVA and USACE will limit or control discharges of chlorine or other biocides to surface waters of the United States so as not to cause any applicable in-stream water quality criteria to be violated, nor any effluent limitation imposed by regulatory authority to be exceeded.

5.3 The TVA and USACE will minimize the use of biocides to systems that cannot otherwise be effectively treated. Biocides in general carry the highest risk to non-target aquatic species.

5.4 The TVA and USACE will continue to investigate existing and new, effective and environmentally sound control technologies that carry the lowest risks to the environment. The U.S. Army Corps of Engineers, Waterways Experiment Station is specifically charged by the 1990 Non-Indigenous Aquatic Nuisance Prevention and Control Act to design and implement a program of research and technology development that identifies environmentally sound methods and strategies to control zebra mussel infestations at public facilities. Research by WES is proceeding in four major task areas:

(1) Coordination and technology transfer
(2) Environmental testing
(3) Development and evaluation of control methods
(4) Development and testing of control strategies

Technology transfer is being accomplished through the release of a series of publications entitled **"Zebra Mussel Research Technical Notes"**. To obtain these publications or seek further information the point of contact at WES is:

Dr. Edwin Theriot
Chief, Aquatic Ecology Branch
Waterways Experiment Station
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Telephone: (601) 634-2678

5.5 The TVA and USACE will continue to investigate ways to change plant design, within limits of engineering capability and fiscal responsibility, to employ lower risk control methods such as thermal backwashing, connection to potable water systems, and closed or recirculating water systems.

5.6 The TVA and USACE will support basic investigations to determine the physiological requirements and other vital biological parameters of the zebra mussel in southeastern USA waters. To date, virtually all data and control technologies are based upon European or Great Lakes experiences with these organisms. Specific data must be developed to learn the requirements of zebra mussels in this region. Data must be converted to knowledge that can then be applied in the field to more effectively control impacts of the zebra mussel on facilities and reduce environmental impacts of control technologies.

5.7 In locations where aquatic endangered and threatened species are known to exist, or are subsequently found by future investigations to occur in proximity to facilities where chlorine or other nonselective biocides are used for zebra mussel control, the TVA and USACE will conduct more rigorous environmental review to assess possible impacts of controls on listed species. In some, but not all cases, this could involve further field investigations and preparation of additional documentation (possibly site specific EA's and or Biological Assessments), in order to fully satisfy provisions of the Endangered Species Act. Any site specific document (EA and/or BA) generated because of this circumstance, would arise under the pre-existing umbrella of coverage for zebra mussel control detailed in this EA. State and Federal regulatory agencies will be afforded the opportunity to comment on these more specific assessments prior to control measures being instituted. All applicable statutes regarding endangered and threatened species would be fully satisfied during the process.

6.0 PUBLIC INVOLVEMENT AND COORDINATION

Public Involvement Program

6.1 In June 1992 USACE and TVA mailed a scoping letter to the public and to agencies. It requested input on environmental concerns regarding zebra mussel control. Concurrently a news release, containing the same information as the scoping letter, was sent to all printed media within the Tennessee and Cumberland river basins. Appendix D contains the scoping letter and news release.

Required Coordination

6.2 USACE and TVA scientists and engineers have met with state agency officials to discuss the overall zebra mussel situation, learn about required permits for pollutant discharges from facilities, and review the NEPA process for zebra mussel control issues. This contact is ongoing as USACE and TVA seek discharge permits from individual states each of which have differing requirements for compliance with clean water statutes.

6.3 The scoping letter served as the USACE and TVA official notice to agencies to solicit input. Agency responses received are contained in Appendix E. Agency responses typically reflected issues under the purview of their regulatory

authority. A theme common to virtually all agency responses was concern that zebra mussel control methods not affect populations of non-target organisms.

6.4 The response letter received from U.S. Fish and Wildlife Service included a table of federally listed endangered and threatened species known to occur, or which historically occurred, in the Tennessee and/or Cumberland Rivers or their major tributaries that the proposed action could affect. Inadvertently the scoping letter failed to mention the Green River in Kentucky and the lower Ohio River where TVA has fossil-fueled electric generating plants. The U.S. Fish and Wildlife Service was contacted regarding this omission (Appendix E). A search of county species lists added one endangered mussel species for consideration.

Public Views and Responses

6.5 Several response letters (Appendix E) were received from the public, mainly generated by the scoping letter. Letters were received from water/wastewater utilities, conservation organizations, and one private citizen. Concerns registered included the need to avoid impacting non-target organisms and the need for the EA to be closely coordinated with the proper regulatory authorities. Responses from utilities reflected their interest in being apprised of the success of zebra mussel controls, since many of their facilities are also at risk from infestations.

7.0 LIST OF PREPARERS

7.1 The following were primary contributors to or preparers of this Environmental Assessment:

Richard Tippit
Position: Biologist
Agency: USACE-Nashville District
Education: B.S. Wildlife Management, Tennessee Tech Univ.
Experience: 17 years USACE, water quality studies, NEPA document preparation, zebra mussel point-of-contact
Responsibility: USACE environmental coordinator for EA, impact assessment

Clyde W. Voigtlander
Position: Environmental Scientist
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Education: B.S. Biology-Physical Sciences, Wisconsin State University, Eau Claire
M.S. Zoology, University of Wisconsin, Madison
Ph.D. Zoology (Limnology/Aquatic Ecology), University of Wisconsin, Madison
Experience: 30 years freshwater ecology studies, 23 years with TVA in aquatic impact assessment, natural resources and environmental policy, and T & E species matters
Responsibility: TVA environmental coordinator for EA

Roger L. Thomas
Position: Environmental Engineer
Agency: TVA-Environmental Quality Staff
Education: B.S. Civil Engineering, Bradley University
Experience: 30 years water quality and ecological investigations and assessments; industrial facility siting, monitoring, and permitting
Responsibility: TVA environmental coordinator for EA

John J. Jenkinson
Position: Biologist (Malacologist)
Agency: TVA-Aquatic Biology Department
Education: B.S. Zoology, Ohio State University
M.S. Zoology, Auburn University
Ph.d. Zoology, Ohio State University
Experience: 24 years freshwater mussel studies, 14 years with TVA in T & E mussel studies and projects
Responsibility: T & E species impact assessment

Tony Bivens
Position: Electrical Engineering Technician
Agency: USACE-Nashville District
Education: 2 years college training
Experience: 22 years hydropower operations, maintenance, and management
Responsibility: Zebra mussel controls in hydropower facilities

John Case
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Agency: USACE-Nashville District
Education: B.S. Engineering Science
Experience: 18 years USACE in regulatory program and navigation/channel maintenance
Responsibility: Zebra mussel controls in navigation related facilities

Robert Karwedsky
Position: Archeologist
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Education: B.S. Biology, Florida State University
M.S. Anthropology, Florida State University
Experience: 13 years USACE in cultural resources analysis
Responsibility: Analysis of zebra mussel control on cultural resources features

8.0 REFERENCES

8.1 The following guidance was used in developing this EA:

National Environmental Policy Act of 1969 (NEPA)

Engineering Regulation 200-2-2 Procedures for Implementing NEPA

Engineer Technical Letter No. 1110-2-33, "Engineering and Design, Sampling Methods for Zebra Mussels, USACE, Washington, DC

Zebra Mussel Research Technical Notes, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS

TVA's Procedures for Compliance with the National Environmental Policy Act

APPENDIX A

USACE--Nashville District and TVA Hydro, TVA Steam Generation, and Other Facilities Subject to Zebra Mussel Infestation

USACE-Nashville District Hydro Plants at Risk of Zebra Mussel Infestation

Level of Risk*		
High	**Moderate**	**Low**
Barkley	Center Hill	Laurel
Cheatham	Dale Hollow	
Cordell Hull	Wolf Creek	
Old Hickory		
J. Percy Priest		

*Estimates of risk are based on (1) the known distribution of zebra mussels in the Cumberland River, (2) locations of plants relative to that distribution, (3) probable routes and mechanisms of invasion by, or introduction of, the zebra mussel, (4) consideration of environmental limiting factors and known tolerances of zebra mussels for such water quality parameters as temperature, dissolved oxygen, dissolved calcium.

TVA Hydro Plants at Risk of Zebra Mussel Infestation

Level of Risk**		
High	**Moderate**	**Low**
Chickamauga	Fort Loudoun	Appalachia
Guntersville	Melton Hill	Blue Ridge
Kentucky		Boone
Nickajack		Chatuge
Pickwick		Cherokee
Raccoon Mountain		Douglas
Watts Bar		Fontana
Wheeler		Ft. Patrick Henry
Wilson		Great Falls
		Hiwassee
		Norris
		Nottely
		Ocoee 1-3
		Tims Ford
		Watauga
		Wilbur

**Estimates of risk are based on (1) the known distribution of zebra mussels in the Cumberland River and Tennessee River, (See Figure 3), (2) the locations of the plants relative to that distribution, and (3) probable routes and mechanisms of invasion by, or introduction of, the zebra mussel.

High-risk plants are mainstem Cumberland River and Tennessee River facilities, except for Raccoon Mountain, a pumped storage plant whose water source is Nickajack Reservoir. The two moderate risk Tennessee River plants are located well upstream; Fort Loudoun is the uppermost mainstem dam and Melton Hill is the lowermost dam on the Clinch River, a major tributary to the upper Tennessee River. Both of these installations have navigation locks. The low risk plants do not have navigation locks and are located on tributary streams that are not used for commercial navigation.

The primary route of invasion thus far appears to be via commercial navigation, and perhaps secondarily by recreational boat traffic, and appears to be proceeding from the foot of the Cumberland and Tennessee river systems (Barkley and Kentucky reservoirs respectively). Other routes of invasion are possible, e.g., via recreational craft transported directly from infested areas to tributary reservoirs. No estimates of relative risk within the low risk category are possible at this time.

Steam Generation and Other TVA Facilities
Subject to Zebra Mussel Infestation

Level of Risk		
High	**Moderate**	**Low**
Allen (F)	Gallatin (F)	Bull Run (F)
Bellefonte (N*)	Paradise (F)	John Sevier (F)
Browns Ferry (N)		Kingston (F)
Colbert (F)		
Cumberland (F)		
Johnsonville (F)		
NFERC (O)		
Sequoyah (N)		
Shawnee (F)		
Watts Bar (N*)		
Widows Creek (F)		

Key: F--Fossil-fueled generation plant
N--Nuclear-fueled generation plant
O--Other, non-generation industrial facility
*--Under construction, not currently operating

These facilities are located in the Tennessee River system (See Figure 3), except for Allen (Mississippi),; Cumberland (Cumberland River); Paradise (Green); and Shawnee (Ohio). The three low risk facilities are located on upstream tributaries of the Tennessee River--Bull Run and Kingston on the Clinch River, John Sevier on the Holston River. NFERC (National Fertilizer and Environmental Research Center) operates intakes and associated equipment for process and potable water.

Risk assessments were made on the same basis as for the hydro plants.

APPENDIX B

Control Plans for Facilities
(Generating Stations, Navigation Locks, Dams, Resource Facilities, Stream Gages and Monitors, Vessels)
USACE-Nashville District

ZEBRA MUSSEL INFESTATION CONTROL STRATEGIES

	Component	Potential Problem(s)	Control Methods
A.	**Navigation Locks**		
1.	Intake Trash Racks Location: All	Accretion of mussel colonies that foul or block intake screens could cause vibration of intake screens, increase filling times, and cause unbalanced filling that may cause excessive hawser stresses on tows. Increased corrosion under entrusting layers of mussels could cause increased maintenance or structural failure of the rack.	A,B,D
2.	Intake Manifolds Location: All	Accretion of mussel colonies to concrete surfaces within intake manifolds and culverts will reduce flow area and increase hydraulic roughness. Increased filling times and unbalanced filling could cause excessive hawser stresses on tows and small vessels.	B
3.	Filling and Emptying Valves Location: All	Accretion of mussels could interfere with complete closure of valves. This could cause leakage and under certain conditions cavitation. Severe accumulation of mussels to the downstream side of valves could increase weight of valve. Increased corrosion under entrusting layers of mussels could cause increased maintenance and possible failure.	A,B
4.	Wall Culverts, Side Ports, and Laterals Location: All	Reduction of flow area and increased hydraulic roughness caused by mussel accretions could cause unequal filling and emptying of lock chamber, increased turbulence in lock, and excessive hawser stresses on tows and small vessels. Increased filling and emptying times. Disposal of large volumes of mussels may require special handling.	B,J
5.	Discharge Outlets Location: All	Mussel accumulations could reduce flow area and increase hydraulic roughness causing increased emptying times, uneven flow distributions, and increased turbulence in lock.	B
6.	Miter Gates and Gate Recesses Location: All	Increased metallic corrosion under entrusting layers of mussels could lead to increased maintenance or structural failure of gate. Poor sealing could result in gates not being metered, leakage and possible vibration problems. Clearance for fully opened gates could be reduced because of accumulation of mussels within gate recesses. Gates could be scraped or damaged by moving vessels. Heavy accumulation of mussels on gates could add considerable weight to gate and strain the hinges of the gates, warp the gate leafs, and interfere with opening and closing.	B,E
7.	Bulkhead Slots and Recesses/ Bulkhead Storage Location: All	Slots and recesses could become fouled with mussels making placement of the bulkheads difficult. It is possible that a buildup of mussels along the sill (at the bottom of the recess) could prevent complete seating causing leakage.	A,B,I,K
8.	Air Vents/Internal Piping/ Equalizing Pipes/Drainage Pipes Location: All	The portion of the air vents that are submerged could become occluded resulting in blockage of air flow and cavitation.	A,B,C,E
9.	Bubbler Systems Location: All	Some locks have bubbler systems on the miter gates that are operated intermittently to disperse ice and other floating debris. Encrustation of mussels could interfere with the operation of these systems.	A,B,E

ZEBRA MUSSEL INFESTATION CONTROL STRATEGIES

	Component	Potential Problem(s)	Control Methods
10.	Emergency Closures Location: All	Encrustation of mussels on emergency closure lift gates could add excessive weight to the gates. Mussel accumulations within bulkhead slots and recesses could foul the	A,B,I
11.	Floating Mooring Bitts Location: All	Fouling of mooring bitt recesses below the water line could prevent free movement of the bitt. This would cause serious problems for tows attached to the bitts. Accumulation of mussels to the bitts could add excessive weight and impair the operation of the bitt.	A,B,E
12.	Gaging and Monitoring Equipment for Lock Operations Location: All	Encrustation of mussels at the entrances to orifices of water level indicators, or on pressure transducers could result in erroneous readings or no readings. Accumulation of mussels within wet wells could impair operation of the float causing erroneous readings.	A,C,D,E
13.	Fire Protection Systems Location: All	Mussels could foul the intakes of raw water systems used for fire protection systems, cooling water systems, and washing equipment particularly if these system are not truly stagnant water systems.	A,E,D,F,G,H,L
14.	Aids to Navigation Location: All	Accumulation of mussels on marker buoys and cables could cause sinking of the buoys and also could cause increased metallic corrosion.	A,B
15.	Cathodic Protec. Systm. Location: All	Accumulations of mussels on the anodes of these devices could impair their ability to prevent corrosion.	A,B,E
16.	Floating Guide Walls/Connect Anchor Cables Locations: KEN/L, PIC/L-AUX., WIL/L-MAIN, GUN/L-AUX	Accumulation of mussels could cause the structures to increase in weight, causing	A,B
17.	Water Heat Exchangers for Air Condit & Heat Pumps Locations: WHE/L, GUN/L, MH/L	Mussels could foul the piping, heat exchanger, and the discharged water outlets.	G,E,M
18.	Unwatering Discharge Ports Locations: All Locks	Mussel accumulation on unwatering discharge ports for valves, lockchamber unwatering pump recess/piping and upper miter seal drains could block pipes, preventing them from being used when the valves or the lock is unwatered.	F
19.	Bulkhead Recess Slot Fillers and Weights Locations: OLD/L, COR/L, CHE/L, BAR/L, KEN/L, PIC/L-MAIN & AUX, WB/L, FL/L, MH/L.	Investation by the mussels could prevent the removal of the slot fillers and weights.	A,B,C,E
20.	Emergency Dam Slot, Mounts, Piers, etc. Locations: All Locks	The mussels could coat all components relating to the installation of the emergency dam or caisson.	B

ZEBRA MUSSEL INFESTATION CONTROL STRATEGIES

	Component	Potential Problem(s)	Control Methods
B.	**Floating Plant**		
21.	Raw Water Intakes	Clogging of grating, grid at intake opening, piping stopped up, damage to engine cooling systems, reduce pumping capacity. Increase corrosion inside piping.	A,B,C,E
22.	Grid Coolers	Infestation on grid coolers could reduce effectiveness for cooling. Also increase corrosion.	A,B
23.	Hulls	Increase drag on the vessels, therefore reducing speed, increasing fuel consumption, and increase corrosion.	A,B
C.	**Hydropower Plants & Dam**		
24.	Raw Water Systems	Mussels can foul the intakes, piping and components of the generator raw cooling water, plant service water, fire suppression, transformer raw water systems, and raw water supplies to others such as fish hatcheries. This can result in partial or complete loss of cooling water flow to the generator and transformer critical components which could force the generators to reduce output or shutdown, cause loss of cooling to plant auxiliary equipment, and loss of water supply to fish hatcheries.	A,B,C,D,E, F,G,H,P
25.	Turbine Intake Trash Racks	Accertion of mussel colonies that foul or block intake screens could cause vibration of intake racks, decrease turbine capacity and efficiency, and cause unbalanced flows that could damage the turbine. Increased corrosion under encrusting layers of mussels could cause increased maintenance or structural failure of the rack.	A,B,D,O,P
26.	Main Turbine Water Passages	Accretion of mussel colonies in the main turbine water passages can cause increased resistance to water flow through the turbine water passage resulting in decreased turbine efficiency and loss of revenue from power sales.	A,B,P
27.	Filling and Emptying Valves and Piping	Turbine unwatering and fill line intakes, valves and associated piping can become fouled increasing the time required or blocking the emptying and filling of the main turbine water passages for inspection and maintenance. Infestation can cause increased corrosion of metal parts and possibly cause cavitation during use.	A,B,C,E
28.	Bulkhead Slots, Recesses, and Storage	Slots and recesses could become fouled with mussels making placement of bulkheads difficult. It is possible that a buildup of mussels along the sill (at the bottom of the recess) could prevent complete seating causing leakage.	A,B,C,I,K,M
29.	Turbine Air Vents	The portion of the air vents that are submerged could become occluded resulting in blockage of air flow into thew turbine under vaccum conditions resulting in increased cavitation to the turbine.	A,B,C,D,E,H

	Component	Potential Problem(s)	Control Methods
30.	Gaging and Monitoring Equipment	Accumulation of mussels at the openings to orifices of water level indicators, or on pressure transducers could result in erroneous readings. Accumulation of mussels within wet wells could impair operation of the float causing erroneous readings.	A,C,D,E
31.	Fire Protection Systems	Accumulation of mussels could foul the intakes, piping, and components of the fire suppression systems especially if the systems are not stagnant or share intakes with other water systems.	A,E,D,F, G,H,L
32.	Cathodic Protection Systems	Accumulations of mussels on the anodes of these devices could impair their ability to prevent corrosion.	A,B,E
33.	Water Quality Mixing Pumps	Mixing pumps which are placed in the intake area of some projects to provide improved water quality are susceptible to accumulations of mussels sufficient to cause them to sink or cause an unbalance on the pump impellers resulting in damage or destruction of the impellers.	A,B,C,M,N
34.	Turbine Packing Gland and Headcover	Turbine and wicket gate drainage areas in the turbine headcover can become fouled with mussels causing plugged drains and flooding of the headcover and turbine bearing oil reservoir.	A,B,C,E
35.	Station and Dam Drainage Sumps	Station drainage, dam drainage, and station unwatering sumps, pumps, piping, and pump/ controllers can become fouled with mussels causing pump damage or plugging of drainage lines resulting in inability to unwater turbines or flooding of the dam/powerplant.	A,B,C,D, E,N
36.	Spillway Gates and Chains, Sluice Gates	Spillway gates and chains and sluice gates can become fouled by mussel accumulations. Mussel accumulations can cause structural damage to spillway gates due to increased weight, damage protective coatings, and accelerate corrosion.	A,B,C,E,P
D.	**Natural Resources Facilities**		
37.	Beaches	Dead mussels, could foul beaches, causing public health problems through decomposing flesh, and sharp edges causing cuts. Live mussels could also foul beach delineation buoys and markers. Presence and odor of large numbers of dead mussels would limit desirability of using public swimming areas.	B
38.	Launching Ramps	Accumulation of mussels could cause health problems as 24 above. Information is not available to determine whether large accumulations would interfere with actual launching of boats.	B

ZEBRA MUSSEL INFESTATION CONTROL STRATEGIES

	Component	Potential Problem(s)	Control Methods
39.	Floating Facilitie (Courtesy Floats, Boathouses, Buoys, etc.)	Accumulation of mussels would add weight, possibly causing structures to sink. Also, increased maintenance costs would accrue to remove mussels, repaint, etc. Sinking of navigational buoys could result in public safety impacts.	A,B
40.	Boats	Many projects maintain boats at water-based facilities. Boat intakes, motors, and hulls could become infested with mussels, causing breakdowns, expensive repairs, and frequent removal of mussels.	A,B,C,M
41.	Intakes and Outfalls	Water intake and sewage outfall structures could become clogged and unserviceable, necessitating mussel removal or replacement.	A,B,C,D,F
D.	**Water Quality Facilities** & Stream Gages		
42.	Stream Gages & Water Quality Monitors	An extensive system of stream gages is operated throughout the Cumberland River Basin. Gages are operated on the mainstem and on most larger tributaries. All float type gages (20) susceptible to Zebra mussel infestation. Infestation of stilling basins, floats, and piping would result in operational failure of the gages.	A,B,C,E,N

INFESTATION CONTROL METHODS

Code	Method	Description
A	Coatings	Metallic surfaces can be coated with materials that are either toxic to zebra mussels (galvanic compounds or copper-based anti-foulant paints) or high-energy coatings that zebra mussels either cannot adhere to or attach to weakly. "Thermal Spraying is the process of applying a metallic coating by either a wire flame spray or two-wire arc process. Any material that can be made into a wire, for example, aluminum, copper, and zinc, can be applied as a thermal spray.
B	Physical Removal	Zebra mussels can be removed by scraping and brushing or by spraying water at high pressure or high pressure steam. For many systems, this may be the most efficient method to remove zebra mussels. For example, in large culverts, along walls, and gates this may be accomplished during periodic dewatering of the structure.
C	Chemical Treatment	The system can be designed to facilitate chemical treatment. The volume of water in the system can be estimated and a suitable quantity of chlorine or biocide can be injected. The system can then be sealed for an appropriate time (24-48 hours). At the end of the incubation time water could be treated to remove toxicants or if the water is no longer toxic, it could be disposed of using normal procedures. In some instances, shells of dead mussels could foul downstream components. In-line strainers can be used to protect the downstream components.
D	Removable Screens	Removable screens can be installed at the entrance to intake pipes, culverts or at other easy to access areas within the system. Spare screens can be kept on site to enable quick replacement and continued operation of the project while the primary screen is being inspected and cleaned. Screens or in-line strainers prevent adult shells from entering and fouling small-diameter downstream components such as fire protection lines.
E	Steam, Hot Water, or Hot Air Injection	Steam or hot water injection facilities could be designed and built into part or all of the system. Periodically, the hot water or steam could be injected into the system to kill zebra mussels. Zebra Mussels are only moderately tolerant of elevated water temperatures. Exposure to 32.5 degrees C for five hours has been found lethal. This temperature is low enough to be obtainable, with minor modifications. Installed emersion or strip heaters could be used to heat the piping or water. As part of this process, or as a separate control method, the system could be completely drained and exposed to the air for 7-10 days at temperatures above 15 degrees C. Each of these methods will kill adult and larval zebra mussels. When the system is reactivated, the released shells of dead mussels could be carried downstream to become lodged in nozzles or small valves, making them inoperable. In-line strainers could be used to prevent fouling of downstream components by dead shells.
F	Isolate Raw Water Intakes	Intakes for raw water systems should be isolated to prevent leakage into the system. A leaky system, drawing water from the outside, may have suitable current and velocity to supply oxygen and food thus maintaining a viable environment for growing populations of zebra mussels at inaccessible locations in the pipe. When leakage is eliminated, the water in the system is anoxic and zebra mussels will not survive.
G	Install Separate Water Supply	Using a completely separate water supply source such as storage tanks (using city or well water) will eliminate the possibility of Zebra Mussels from entering the system.
H	Use copper Piping	Copper is toxic to zebra mussels and will eliminate infestations. All or selected sections of standard iron or PVC small diameter pipe could be replaced with copper piping.
I	False Bulkheads	The use of "Dummy equipment" such as false bulkheads with wedges or water jets could be lowered to remove zebra mussels without having to dewater the facility.

INFESTATION CONTROL METHODS

Code	Method	Description
J	Disposal Facilities	The disposal of large quantities of zebra mussels removed from a lock, dam or other facility, could be difficult. Large volumes of zebra mussels should not be disposed of in a waterway. It may be necessary to hold zebra mussel waste on federal property until the odor, toxicity is reduced before taking them to a landfill. In some situations, on side disposal may be the most practical solution to the disposal problem.
K	Bulkhead/Recess Wedges	Design and fabricate a removable cutter assembly adapter to be attached to the bottom of the existing bulkheads
L	Self Drainage Systems	Modify systems to be self-draining.
M	Dry Storage	Store in dry location.
N	Change Systems	Replace system with air exchange unit.
O	Spare Replacements	Replacement component to put into service temporarily while primary component is removed for cleanup.
P	Preferential Substrates	Preferential substrates placed upstream of equipment/component to be protected. Zebras will preferentially attach to find surface, thereby decreasing the infestation on protected equipment.

APPENDIX C

Zebra Mussel Control Strategies
TVA Facilities

Zebra Mussel Control Strategies
TVA Facilities

STRATEGY DEFINITIONS

1. The following strategies are the only ones being considered by TVA for near-term application to mitigate zebra mussel infestation:

   A. Chemical treatment - primarily oxidizing biocides with the possibility of periodic, selective use of non-oxidizing biocides.

   B. Physical removal

   C. Alternative water source - e.g., potable water

   D. Thermal treatment - hot water recirculation, steam or hot air injection

2. The following strategies will be explored on a longer-term basis through coordinated, small scale field tests:

   E. Coatings - primarily non-toxic

   F. Mechanical filtration

   G. Preferential substrates

3. The following long-term changes in plant design will be investigated, but only implemented based on the economic efficacy of the change to the long-range goals of the facility. These strategies include:

   H. Raw water piping material change - e.g., to copper or galvanized material.

   I. Conversion to closed cooling water systems using air or chiller type heat removal systems.

   J. Conversion to alternative cooling source - i.e., air

   K. Addition of spare equipment - changeout to remove mussel build-up

The above strategies are being investigated for the following TVA facility raw water systems based on short-term applicability and potential long-term feasibility.

PLANT SYSTEM	STRATEGY
HYDROELECTRIC GENERATING PLANTS	
Raw Water Systems (Equipment Cooling & Fire Protection)	A,C,D,F,H,I
Turbine Intake Trash Racks	B,E,G
Main Turbine Water Passages	B,E,G
Filling & Emptying Valves & Piping	A,B,D,F,H
Bulkhead Slots, Recesses, Storage	B,E,G
Turbine Air Vents	A,B,E,H
Gauging and Monitoring Equipment	A,B,D,H
Turbine Packing Glands & Headcover	B,D,E
Station Drainage Sumps	B,D,E
Spilling Gates & Chains, Sluice Gates	B,D,E,G,K
NUCLEAR AND FOSSIL FUELED STEAM GENERATING PLANTS	
Intake Embayment Walls & Other Hard Surfaces	B,D,E,G
Stationary Trash Racks	B,D,E,G,K
Pump Intake Housing ("Bell Housing")	A,B,E,G
Traveling Screens	B,E,G,K
Intake Tunnels	A,B,E,G
Condenser Walls, Tube Sheets	A,B,D,E
Raw Water Systems (Equipment Cooling & Fire Protection)	A,B,C,D,F,H,I
Raw Water Storage Tanks	A,B,D,E,F
Station Drainage Lines & Sumps	A,B,D,E
NATIONAL FERTILIZER AND ENVIRONMENTAL RESEARCH CENTER (NFERC)	
NFERC Raw Water Intake Structure and Adjoining Potable/Process Water Treatment Plant	A,B,C,D,E,K
PDW Raw Water Intake and Pumping Station	A,B,C,D,E,K

APPENDIX D

Scoping Letter and News Release

DEPARTMENT OF THE ARMY
NASHVILLE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1070
NASHVILLE, TENNESSEE 37202-1070

IN REPLY REFER TO

CEORN-EP-E

26 June 1992

To Whom It May Concern:

The Nashville District, Corps of Engineers and Tennessee Valley Authority are considering ways to control the zebra mussel infestation that has invaded local waterways and threatens the operational integrity of our water resource development projects. We expect the zebra mussel (Dreissena polymorpha) to multiply rapidly. As required by the National Environmental Policy Act (NEPA), we will be jointly preparing an Environmental Assessment (EA). We expect to consider chemical treatment, thermal shock, dessication, oxygen deprivation, mechanical removal, coatings, and other techniques.

The purpose of this letter is to ask for your comments regarding environmental aspects of this problem and its possible solution. We want to determine what the environmental issues will be early in the NEPA process, and your comments are important.

The EA will identify, describe, and fully evaluate current environmental, recreational, and socioeconomic resources. It will explain the zebra mussel threat to facilities and structures, and evaluate the impacts of each alternative. The area of consideration includes the entire Cumberland and Tennessee River basins, with emphasis on the mainstem of these two rivers and their major tributaries having Corps or TVA projects.

Please send your written comments by July 31, 1992 to: USACE-Nashville District, P.O. Box 1070, Nashville, Tennessee 37202-1070, ATTN: Mr. Richard Tippit, CEORN-EP-E. Comments will be fully coordinated with TVA. Thank you for your help.

Sincerely,

Bradley B. Hunt

for R. J. Connor, P.E.
Chief, Engineering Division

US Army Corps of Engineers
Nashville District

NEWS RELEASE

Public Affairs Office, P.O. Box 1070, Nashville, TN 37202-1000
Telephone No.: (615) 736-7161

For Immediate Release **Release No. 92-36**

U.S. Army Corps of Engineers and TVA Preparing Environmental Assessment for Zebra Mussel Control at Projects

Nashville, Tenn. -- An environmental Assessment (EA) is being prepared to address the control of zebra mussels at facilities operated by the Nashville District of the U.S. Army Corps of Engineers and the Tennessee Valley Authority. The Corps and TVA will jointly prepare the EA.

The zebra mussel is a non-native mollusk accidentally introduced into the Great Lakes during the 1980's. They have now spread into the Cumberland and Tennessee River basins. Zebra mussels can multiply rapidly, and when they infest critical systems in locks, dams, and power plants, the operational integrity of these facilities is often threatened. Control measures being considered include chemical treatment, thermal shock, exposure to drying,

-more-

oxygen deprivation, mechanical removal, and coatings.

The EA will identify, describe, and fully evaluate current environmental, recreational, and socioeconomic resources. Facilities which may be infested will be described and the consequences of their impairment documented. The environmental impact of control measures will be assessed and fully described. The area of consideration includes the entire Cumberland and Tennessee River basins, with emphasis on the mainstem of these two rivers and their major tributaries having Corps or TVA projects and facilities.

The Corps and TVA would like to hear from the public on this matter. Please send your written comments by July 31, 1992 to:

Mr. Richard Tippit

Environmental Resources Branch

US Army Engineer District, Nashville

P.O. Box 1070

Nashville, Tennessee 37202-1070

APPENDIX E

Responses to Scoping Effort

United States Department of the Interior
FISH AND WILDLIFE SERVICE
~~Post Office Box 845~~
~~Cookeville, TN 38503~~

TAKE PRIDE IN AMERICA

August 12, 1992

NEW ADDRESS:
446 Neal Street
Cookeville, TN 38501

Mr. R.J. Connor, Chief
Engineering Division
U.S. Army Corps of Engineers
P.O. Box 1070
Nashville, Tennessee 37202-1070

(ATTN: Mr. Richard Tippit)

Dear Mr. Connor:

This is in response to your letter of June 26, 1992, regarding a proposal by the Nashville District Corps of Engineers (Corps) and the Tennessee Valley Authority (TVA) to implement measures to control infestation by zebra mussels (Dreissena polymorpha) in the Tennessee and Cumberland River basins. The Fish and Wildlife Service (Service) has reviewed the information you submitted and offers the following comments.

Since its introduction in the Great Lakes, the zebra mussel has spread rapidly and caused significant problems in water intake facilities. Individuals of D. polymorpha have recently been found in the lower Ohio River and in Kentucky Lake. Although numbers are still apparently low, the Ohio, Tennessee, and Cumberland Rivers may provide conditions suitable for rapid spread of this exotic species throughout those drainages. If zebra mussels reach population levels similar to those in the Great Lakes, they could create significant problems at numerous navigation and utilities facilities located on the rivers. In addition, because of their feeding and reproductive capabilities, zebra mussels could potentially outcompete native fish and invertebrate populations in these river basins for limited resources and eventually eliminate them. Because the Tennessee and Cumberland Rivers support some of the world's most diverse and unique aquatic communities, the Service shares your concerns and supports your efforts to attempt to control the spread of zebra mussels in the Tennessee and Cumberland Basins.

Proposed methods of control presently under consideration include chemical treatment, thermal shock, dessication, oxygen deprivation, mechanical removal, coatings, and other unspecified methods. The Service is concerned that use of chemicals, thermal shock, dessication, oxygen deprivation, and coatings may be effective controls for zebra mussels, but may also have significant adverse impacts on the native aquatic fauna. The Tennessee and Cumberland Rivers contain species of fish and freshwater mussels that could be eliminated by accidents or careless implementation

of proposed controls. Some of these species are endemic to the Tennessee and Cumberland Basins, and all of them are sensitive to alteration of habitat or degradation of water quality. A number of species are currently listed as endangered or threatened by the Service, and others are under consideration for listing in the future.

According to our records the following federally listed and proposed endangered and threatened species are known to occur, or historically occurred, in the Tennessee and/or Cumberland Rivers or major tributaries and could possibly be affected by implementation of controls.

FISH
Slender chub - Hybopsis cahni (T)
Spotfin chub - Hybopsis monacha (T)
Snail darter - Percina tanasi (T)
Boulder darter - Etheostoma wapiti (E)
Yellowfin madtom - Noturus flavipinnis (T)

MUSSELS
Alabama lamp pearly mussel - Lampsilis virescens (E)
Appalachian monkeyface pearly mussel - Quadrula sparsa (E)
Birdwing pearly mussel - Conradilla caelata (E)
Cumberland monkeyface pearly mussel - Quadrula intermedia (E)
Dromedary pearly mussel - Dromus dromas (E)
Orange-footed pearly mussel - Plethobasus cooperianus (E)
Pale lilliput pearly mussel - Toxolasma cylindrella (E)
Pink mucket pearly mussel - Lampsilis orbiculata (E)
White wartyback pearly mussel - Plethobasus cicatricosus (E)
Fine-rayed pigtoe - Fusconaia cuneolus (E)
Rough pigtoe - Pleurobema plenum (E)
Shiny pigtoe - Fusconaia edgariana (E)
Fat pocketbook pearly mussel - Potamilus capax (E)
Tan riffleshell - Epioblasma walkeri (E)
Tuberculed-blossom pearly mussel - Epioblasma torulosa torulosa (E)
Turgid-blossom pearly mussel - Epioblasma turgidula
Ring pink - Obovaria retusa (E)
Cracking pearly mussel - Hemistena lata (E)
Fanshell - Cyprogenia stegaria (E)

Section 7 of the Endangered Species Act requires all Federal agencies to ensure that actions they authorize, fund, or carry out do not jeopardize the continued existence of endangered or threatened species. Agencies must assess potential impacts to listed species and determine if a proposed action may affect them. A "may affect" finding may require initiation of formal consultation with, and issuance of a biological opinion by, the Service.

We agree that the potential for adverse impacts to native fish and mussels, as well as to navigation and other facilities along the rivers,

warrants some measures to control the spread of zebra mussels in the Tennessee and Cumberland Rivers. However, we are concerned that unless great care is taken, implementation of control measures could result in significant adverse effects to native aquatic resources, including federally listed fish and mussel species. Therefore, your environmental assessment should contain an evaluation of potential impacts of the various proposed control measures to endangered and threatened species and determinations of effect. The Service is confident that, through close coordination of this action, measures can be implemented that will control the zebra mussel and not affect the native fish and mussel communities.

Thank you for the opportunity to comment. If you have questions, please contact Jim Widlak of my staff at 615/528-6481.

Sincerely,

Lee A. Barclay, Ph.D.
Field Supervisor

CEORN-EP-E (200-1a) 03 September 1992

MEMORANDUM FOR RECORD

SUBJECT: Revision of Threatened and Endangered Species List for USACE-TVA Zebra Mussel Control Environmental Assessment

1. Reference scoping letter, CEORN-EP-E, 26 June 1992, subject as above.

2. Reference Optional Form 271, Conversation Record, of telephone conversation with Mr. Jim Widlak, US Fish and Wildlife Service, Cookeville, Tennessee Field Office.

3. Nashville District-USACE and TVA are joint lead agencies in preparation of an Environmental Assessment (EA) for implementation of controls for the zebra mussel (*Dreissena polymorpha*) at the two agencies' facilities. The above referenced scoping letter requested input regarding pertinent issues the EA should address. The area of coverage was described as the entire Cumberland and Tennessee river basins. Inadvertently the Green River in Kentucky and lower Ohio River, which should have been included in the coverage area due to TVA fossil fuel electric generating plants on these streams, were left out.

4. The USFWS scoping response letter, dated August 12, 1992, listed aquatic species which are threatened or endangered in the Tennessee and/or Cumberland rivers. In order to correct the omission of Green River and lower Ohio River, the undersigned contacted Mr. Jim Widlak on September 02, 1992. The omission was explained, and Mr. Widlak searched county species listings for the two additional locations. This produced one additional endangered freshwater mussel species, Purple Catspaw (*Epioblasma sulcata sulcata*).

5. The undersigned and Mr. Widlak agreed that documentation of this revision through a conversation record would satisfy coordination responsibilities in this matter. This record will be added to the EA.

Richard Tippit 9/3/92

Richard Tippit
Biologist

CF:
John Jenkinson-TVA Water Quality Dept
Clyde Voigtlander-TVA EQS

SANSING/EP-E RTS 9/3
~~CATHEY/EP-E~~ cj 9/4

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER POLLUTION CONTROL
150 NINTH AVENUE NORTH
NASHVILLE, TN. 37234-1534

JULY 29,1992

USACE-NASHVILLE DISTRICT
P.O. BOX 1070
NASHVILLE, TN. 37202-1070

ATTEN: MR. RICHARD TIPPIT
CEORN-EP-E

DEAR MR. TIPPIT:

THIS IS IN REPLY TO MR. CONNOR'S REQUEST OF JUNE 26, 1992 FOR WRITTEN COMMENTS REGARDING TVA'S AND THE USACE'S PLANNED ENVIRONMENTAL ASSESSMENT (EA) REPORT ON THE CONTROL OF THE ZEBRA MUSSELS IN THE TENNESSEE AND CUMBERLAND RIVER BASINS.

THE DIVISION OF WATER POLLUTION CONTROL WOULD LIKE TO OFFER THE FOLLOWING COMMENTS CONCERNING THIS REQUEST.

THE DIVISION'S PRIMARY CONCERN IS THAT ANY OF THE TREATMENT METHODS PROPOSED BY TVA AND THE USACE FOR CONTROLLING ZEBRA MUSSELS HAVE A MINIMAL IMPACT ON THE QUALITY OF THE WATERS OF THE STATE.

ANY FACILITY PLANNING TO USE CHEMICAL TREATMENT AND SUBSEQUENTLY DISCHARGE THE TREATED WATER TO THE WATERS OF THE STATE, MUST HAVE AN NPDES PERMIT AUTHORIZING SUCH DISCHARGES.

THE CHEMICAL USED MUST BE FIFRA APPROVED.

IF ANTI-FOULING COATINGS ARE USED THEY MUST BE EPA APPROVED.

ANY ZEBRA MUSSELS REMOVED ABOVE THE WATER LINE OR ON LAND SHALL NOT BE RETURNED TO THE WATERS OF THE STATE.

THE DIVISION REQUESTS THAT THE USACE AND TVA CONDUCT STATE WIDE INFORMATIONAL MEETINGS WITH INTERESTED ENVIRONMENTAL GROUPS, OUTDOOR WRITERS, AND SPORT AND COMMERCIAL FISHING GROUPS REGARDING THE FINDINGS IN THE ENVIRONMENTAL ASSESSMENT REPORT. THESE MEETINGS SHOULD BE HELD PRIOR TO THE STATE GOING ON PUBLIC NOTICE/PUBLIC HEARING FOR ANY NEW

OR REVISED NPDES PERMITS THAT RESULTED FROM THE NEED TO CONTROL ZEBRA MUSSELS.

IF YOU HAVE ANY QUESTIONS REGARDING THIS MATTER PLEASE CONTACT ME AT (615)-741-7883.

SINCERELY,

Thomas E. Roehm

THOMAS E. ROEHM
MANAGER, INDUSTRIAL FACILITIES SECTION
TENNESSEE DIVISION OF WATER POLLUTION CONTROL

C.C. PAUL E. DAVIS, DIRECTOR TDWPC.

TENNESSEE STATE PLANNING OFFICE
307 JOHN SEVIER STATE OFFICE BUILDING
500 CHARLOTTE AVENUE
NASHVILLE, TENNESSEE 37243-0001
(615) 741-1676

NED McWHERTER
Governor

JIM HALL
Executive Director

August 10, 1992

93-0028

Mr. Richard Tippit
USACE-Nashville District
Post Office Box 1070
Nashville, Tennessee 37202-1070

SUBJECT: CHTN081092-007 To control the zebra mussel infestation that has invaded local waterways & threatens the operational integrity.

Dear Mr. Tippit:

In accordance with Presidential Executive Orders 12372 and 12416 and with Gubernatorial Executive Order 58, this office serves as the designated State Clearinghouse for federal activities and grants review.

State and local government evaluation of submitted materials has indicated no conflicts with existing or planned activities. Therefore, we are recommending that this proposal be approved based on the descriptive information made available to us. However, should additional information come to the attention of this office, we may wish to comment further.

This letter should be attached to the application and become a permanent part of the project file. Any involved federal agency should respond in writing to this office if there are problems in complying with this approval. The above State Clearinghouse Identification Number should be placed in the appropriate block on the federal application form.

The appropriate funding agency will now be reviewing our recommendation. If we can be of further assistance, please do not hesitate to contact us.

Sincerely,

Charles W. Brown

Charles W. Brown
Director, State Clearinghouse

CWB:mcp

cc: Dan Sherry, Ray Gilbert, Bob Bay
Wetlands unit, Joe Richardson, Robert Baker

PHILLIP J. SHEPHERD
SECRETARY

BRERETON C. JONES
GOVERNOR

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
FRANKFORT OFFICE PARK
18 REILLY ROAD
FRANKFORT, KENTUCKY 40601

August 3, 1992

U.S. Army Corps of Engineers
Nashville District
Attn: Richard Tippit
P.O. Box 1070
Nashville, TN 37202-1070

Re: Environmental assessment on the control of Zebra Mussell Infestation in the Cumberland and Tennessee River Basins.

Dear Mr. Tippit:

The Natural Resources and Environmental Protection Cabinet's Department for Environmental Protection has coordinated the review of the above referenced notice with concerned state agencies. The following comments were submitted:

The Division of Water states the best avenue for a useful approval to this problem is to contact power companies and utilities in the Great Lakes Region. They have had the problem since 1987 and have explored the realm of treatment schemes and possible anti-fouling agents. Main areas of concern are chlorine toxicety, disolved oxygen sags below discharge temperature, thermal problems in discharge and recurring stream.

The Kentucky Department of Fish and Wildlife Resources (KDFWR) states the methods used to control the species also have the potential to cause significant impact to aquatic environmental components, including native unionids and other fishery resources. We understand that a combination of methods often provides optimal protection for water use facilities. KDFWR urges careful consideration of any control method that may release heated effluent, chemicals, significant volumes of oxygen-limited water, or molluscicides to natural systems. Zebra mussell control efforts may soon become an important water quality topic in Kentucky. We hope to serve in directing zebra mussel control strategies.

No other comments or objections to the proposed activity were received from any other concerned state agencies. If you have any questions or need additional information, please contact me at (502) 564-2150, ext. 119.

Sincerely,

Valerie Hudson

Valerie Hudson
Principal Assistant

VH/ceb

cc: Applicant
Division of Water
Department of Fish & Wildlife Resources
File

JUL 17 1992

Natural Resources and Environmental Protection Cabinet
Army Corps of Engineers Public Notice
Agency Response Request

TO:
Chester Raeuchle
Division of Design
Transportation Cabinet
6th Floor, State Office Building

DATE: 7-14-92

NOTICE: REQUEST FOR COMMENTS REGARDING THE CONTROL OF ZEBRA MUSSEL INFESTATION IN THE CUMBERLAND AND TENNESSEE RIVER BASINS

PLEASE RETURN BY: 7-28-92

INSTRUCTIONS: Please review the attached material and indicate your response below. Your response will be considered in formulating a coordinated state response. Any questions should be directed to Valerie Hudson, (502) 564-2150, ext. 119.

Return this response sheet to:
Valerie Hudson
Dept. for Env. Protection
14 Reilly Road
Frankfort, KY 40601

Please respond by the date noted above. We respectfully urge you to respond as appropriate. However, if no response is received by the date stated or you have not called to request an extension, we must assume your agency has no comment.

RESPONSE:

No Comment_____

Comment Attached_____

Comment_____

REVIEWED BY: _____ DATE: 7/22/92

STATE OF ALABAMA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
64 NORTH UNION STREET
MONTGOMERY, ALABAMA 36130

GUY HUNT
GOVERNOR

JAMES D. MARTIN
COMMISSIONER

WM. C. "BILL" GOOLSBY
ASSISTANT COMMISSIONER

DIVISION OF GAME AND FISH
CHARLES D. KELLEY
DIRECTOR

SAM L. SPENCER
ASSISTANT DIRECTOR

July 10, 1992

Mr. Richard Tippit
CEORN-EP-E
United States Corps of Engineers
Nashville District
P.O. Box 1070
Nashville, Tennessee 37202-1070

Dear Mr. Tippit:

The Fisheries Section of the Alabama Game and Fish Division has reviewed the June 26, 1992 letter concerning environmental aspects of the zebra mussel problem. Of critical concern to the fisheries resources in Alabama waters regarding chemical treatment, thermal shock, dessication, oxygen deprivation, mechanical removal, coatings and other techniques of addressing the zebra mussel problem is potential adverse effects on spawning habitat, larval fishes and food supply.

The EA should address all of the above concerns. Spawning habitat directly downstream from dams and locks should be protected. In addition, littoral spawning habitat should be addressed. The effects of any treatment on the early life stages of larval fishes should be identified and addressed. The timing of any treatment should be correlated to times of spawning and age of young-of-the-year fishes. The effects of proposed treatments should address the impacts on areas such as phytoplankton, invertebrate populations and other food organisms.

The effects of proposed treatments should address potential impacts on aquatic macrophytes. Treatments which would control zebra mussel may eradicate aquatic macrophytes.

The EA should address potential negative impacts of treatments designed to control zebra mussels on native mussel populations with an emphasis on threatened or endangered species. Methods to restock native mussels after control treatments have been tried should be addressed.

Finally, any treatments should address the negative impacts on adult fish. If the treatments will directly kill fish, the EA should address the impacts.

If I can be of further assistance, please advise.

Sincerely,

GAME AND FISH DIVISION

Fred R. Harders
Chief of Fisheries

FRH:nj

State of North Carolina
Department of Environment, Health, and Natural Resources
Division of Environmental Management
512 North Salisbury Street • Raleigh, North Carolina 27611

James G. Martin, Governor
William W. Cobey, Jr., Secretary

A. Preston Howard, Jr., P.E.
Acting Director

August 3, 1992

ATTN: Mr Richard Tippit
CEORN-EP-E
USACE-Nashville District
P.O. Box 1070
Nashville, Tennessee 37202-1070

Dear Mr. Tippit:

Your letter requesting comments regarding environmental aspects of the zebra mussel problem has been forwarded to my attention. North Carolina is in the process of trying to put together a task force from various government agencies that will be involved in the issues you are now undertaking if (or I should say, when) the zebra mussel invades North Carolina. However, except for one meeting to assess what is now being done to monitor for the presence of the zebra mussel, very little effort has been expended looking at specific control methods. It seemed to be a consensus at that one meeting that chlorination would probably be used extensively as a control method. If it is to be used extensively, and/or at high levels, then dechlorination must be addressed. It was thought that residual chlorine could do as much damage to native mollusc populations as displacement by zebra mussels. From the standpoint of a regulatory agency, our concerns will be directed toward assuring that any control methods have minimal impact on the biological integrity of surface waters.

As the zebra mussel will inevitably show up here, I would appreciate receiving a copy of your draft EA when it is completed. That kind of information will be extremely useful to our task force, when it is formalized. Please call me at 919-733-6946 if your need further information.

Sincerely,

Trish Finn MacPherson

Trish Finn MacPherson
Environmental Biology Supervisor

SIERRA CLUB - Tennessee Chapter

100 Otari Drive
Kingsport, TN
July 31, 1992

USACE-Nashville District
Mr. Richard Tippit, CEORN-EP-E
P.O. Box 1070
Nashville, TN 37202-1070

Dear Mr. Tippit:

In your Environmental Assessment considering ways to control the zebra mussel infestation, please address the following concerns of the Tennessee Chapter, Sierra Club:

1. The possibilities for unintended effects of any chemical treatment on other organisms at the treatment site and down stream.
2. The liklihood of major effects on the biota of thermal shock, dessication and oxygen deprivation. Incidental removal of key plant or animal organisms from the ecosystem is likely to have major, probably detrimental, effects on the entire ecosystem.

Sincerely,

Arthur S. Smith
By direction of Executive Committee

AS/mcff

SIERRA CLUB - Tennessee Chapter

Clark A. Buchner
975 N. Graham
Memphis, Tn 38122

July 23, 1992

Attn. Mr. Richard Tippit
CEORN-EP-E
USACE-Nashville District
P.O. Box 1070
Nashville, Tn. 37202-1070

Dear Mr. Tippit,

This letter is in response to the June 26,1992 letter by R.J. Conner concerning the Corp of Engineer proposed control of zebra mussels in the Cumberland and Tennessee Rivers. This letter was discussed in some detail at the quarterly meeting of the Sierra Club's Tennessee Chapter held this past weekend, and we send the following comments:

1. Mr. Conner's letter is not clear as to the scope of treatment that the Corp proposes. Will treatment be confined to limited areas (within power plants for example) which permit reintroduction of water into the river from a controlled point source, or will a systemwide (entire waterway) approach be carried out?

2. Since eutrophication is a major problem to fish, waterfowl and other aquatic lifeforms in both rivers, measures such as flow stoppage (which often causes die-off of other species due to oxygen deprivation) seems inappropriate.

3. Mechanical treatment can greatly impact other biota that live in sediment and water column areas of the system. This makes us question the cost effectiveness of operations such as dredging that can be very damaging to these lifeforms.

4. Methods that introduce thermal change are also questionable with respect to the damage to other aquatic life.

We trust you will take these comments into consideration as you prepare your Environmental Assessment. We understand that zebra mussels do not tend to "take-over" in clearer water that is well oxygenated. Perhaps if the Corp were to focus it's efforts on

SIERRA CLUB - Tennessee Chapter

the cleansing of these rivers, the zebra mussel "problem" would begin to correct itself.

Yours most sincerely,

Clark A. Buchner
Executive Committee/Volunteer Group

Copies: David McKinney, TWRA
Arthur Smith, SOF

Kentucky Resources Council

Post Office Box 1070
Frankfort, Kentucky 40602
(502) 875-2428
(502) 875-2845 (FAX)

July 22, 1992

Richard Tippit, CEORN-EP-E
U.S. Army Corps of Engineers
Nashville District
Post Office Box 1070
Nashville, Tennessee 37202-1070

Re: Zebra Mussel Strategy - Environmental Assessment

Dear Mr. Tippit:

The Council appreciates the invitation to comment regarding the environmental aspects of developing a control strategy for the zebra mussel infestation. The Council has two concerns.

The first concern is that both the development of environmental documentation under the National Environmental Policy Act, and the development of the substantive strategies for combating the infestation, be closely coordinated with the resources agencies in the Commonwealth of Kentucky, including the Division of Water, Department of Fish and Wildlife Resources, and Kentucky Nature Preserves Commission.

The second concern is that the environmental consequences of the infestation strategy on non-target organisms be carefully and thoroughly evaluated prior to implementation of the strategy. The direct,. indirect, interactive and cumulative effects of the strategies under consideration must be evaluated lest the "cure be worse that the illness." Thank you for your invitation to comment; please place us on the mailing list for all documents related to the Environmental Assessment.

Sincerely,

Tom FitzGerald
Director

Utility Commission
of the City of London
P.O. BOX 918
LONDON, KENTUCKY 40743-0918

July 8, 1992

Richard Tippit, P.E.
Department of the Army
Nashville District, Corp of Engineers
P.O. Box 1070
Nashville, TN 37202-1070

Dear Mr. Tippit:

This is in response to the memo of June 26, 1992 regarding zebra mussel control in the waterways of the Cumberland and Tennessee river basins. The mussel has certainly become a nuisance in the northern states and more specifically around the Great Lakes area. I hope the mussel does not become as prevalent in this part of the country but it appears it is only a matter of time. I am glad someone is looking at trying to control or possibly eliminate the creature. Since we are a water and wastewater utility we are certainly interested in the subject and aware of the potential problems with the mussel.

Also, since we are a water utility and currently withdraw water from one of your impoundments we would be concerned with the methodology utilized in the particular impoundment from which we withdraw water. The impoundment is Laurel Lake which is located in Laurel County, Kentucky. When preparing your plan I would like to request that you take into consideration the water consumers along the waterways, especially when considering chemical treatment, oxygen deprivation, and desiccation. I would hope that a suitable control technique can be developed that will be effective and still not cause a negative impact on the water quality.

Again I am glad someone is looking at a control method and I certainly wish you luck with the endeavor.

Sincerely,

Randy Bingham

Randy Bingham, Superintendent
London Utility Commission

RB/te
\MISC\MUSSEL

RIVER ROAD utility district
2245 RIVER ROAD
ASHLAND CITY, TN. 37015-5318

15 July 1992

Dear Mr. Tippet,

Thank you for your letter concerning the zebra mussel project. The only comment I can make is if the mussel is a threat to water operations, it must be dealt with. We would like to be kept up to date on activity of this project.

Thank you

Leonard Crouch
Manager,
RIVER ROAD UTILITY DISTRICT

Leonard Crouch

W. O. EP-E... 8 2/14

The City of
Clarksville

Office of the City Engineer
135 Commerce Street ■ P.O. Box 387
Clarksville, Tennessee 37041-0387
(615) 645-7418

July 8, 1992

Mr. R. J. Connor, P.E.
Chief, Engineering Division
Department of the Army
Nashville District, Corps of Engineers
P. O. Box 1070
Nashville, TN 37202-1070

Mr. Connor:

The City of Clarksville is very concerned with the potential problems associated with the zebra mussel, particularly with regard to the water treatment plant intake structure which Clarksville has in the Cumberland River.

Clarksville is presently developing plans to install chlorine defusers on the intake structure in an attempt to discourage the attachment of zebra mussels.

Respectfully,

Denzil J. Biter
City Engineer

DJB/mc

PHILIP BREDESEN, MAYOR

METROPOLITAN GOVERNMENT OF NASHVILLE AND DAVIDSON COUNTY

DEPARTMENT OF WATER AND SEWERAGE SERVICES
1600 SECOND AVENUE, NORTH
NASHVILLE, TENNESSEE 37208-2206

July 14, 1992

Mr. Richard Tippit
CEORN-EP-E
USACE-Nashville District
P.O. Box 1070
Nashville, TN 37202-1070

Dear Richard,

As you well know, it's impossible to predict how the Zebra is going to impact the Cumberland River and its users, but judging from the Great Lakes experience, Cumberland River users are going to experience severe economic liabilities due to this import.

We can assume that great bands of Zebra populations will encrust all hard substrates on Priest Reservoir. Many of these built up masses will be exposed during winter draw down and suffer mass mortalities. Such great quantities of decaying molllusc flesh could taint air and water and be carried on down the Stones River to Nashville's water intakes.

Mollusscacides and their degradation byproducts could also reach our intakes causing interferences inciuding taste/odor episodes. When large populations of bivalves die off, their shells spring open and the rotting bodies are carried downstream to clog traveling screens. This has in one instance been documented in Asian Clam mortalities.

If boat owners treat boat hulls with tin compounds, there is a real possibility that toxic tin compounds could build up in the sediment.

Should the Zebra take to the Cumberland (and there is every reason to believe that conditions are extremely ideal for the Zebra) then water clarity could be increased due to the filtering action of quantities of Zebras. This could lead to algal blooms and aquatic plants would also be favored.

Zebras may have a significant impact in accumulating toxic compounds as feces/pseudofeces and in whole body burdens. Disposal of these masses from mechanical cleaning operations must consider the possible contamination of ground and surface water.

Whiie a lot of things seem certain on the main stem of the Cumberland, who can predict what will happen to the small feeder streams? What will be the interactions between Zebra populations and native macroninvertebrates? What will determine whether they colonize the very smallest tributaries?

While the "knowns" here are very disturbing, the "unknowns" are even more disturbing! If you see a spot where you think we could help, just give us a call, but remember we are acting out of ignorance about how things are going to be sorted out. It's going to be interesting and challenging, that's for sure!

Sincerely,

Mason Sinclair
Senior Biologist

MS/dlg

Hixson, Tenn
July 14, 1992.

Dear Sir:

I read the article in the Paper Concerning the Zebra Mussel and it said Chemicals would be used if necessary, but I am wondering what is going to happen to the other mussels which is a food source for our fish and wildlife and believe it or not the Orientals use the regular Mussels for a food source and I am wondering if this Chemical would be safe for human to eat for as I said before the Children and women eat those things Sir I believe we have enough Chemical in the water already.

Aval R. Duncan
1723 Bagwell, Rd.
Hixson, Tenn
37343

ADDRESS--WT 10C-K
FAX NUMBER - 4498-K

ROOM NUMBER	NAME	PHONE
213	Bair, Judy S.	8864
433	Bates, Sharon D.	7154
411	Bryant, Carline C.	7156
210	Conner, George G., Jr.	7157
434	Davis, Jack L.	7183
407	Fisher, Thomas C., Jr.	6507
431	Fontana, Sue J.	6506
424	Goodwin, Robert J. (Jack)	8879
206	Huston, Samuel M. (Mike)	6204
409	Miller, James T.	7158
208	Minchew, Clayton J.	4199
430	Nelson, Marshall T. (Ted)	7184
212	Pilarski, Kim	3121
420	Pryor, Robert J. (Bob)	6695
414	Riberich, Ronald J.	8872
422	Shirley, A. Kathy	4567
217	Stooksbury, Teresa V.	6565

ADDRESS-WT 10D-K
FAX NUMBER 4498-K

451	Brock, W. Gary	8877
438	Brooks, Ralph H.	6770
460	Clark, Valerie L.	8174
435	Harris, Teresa D.	6770
455	Herndon, Morris G.	8153
444	Hurst, Renee G.	8503
*452	Perry, James B. (J. B.)	
457	Renfro, Paula R.	8153
462	Shipman, Samuel A.	4225
437	Stringfield, I. Kathleen	8335
248	Thomas, Linda K.	7680
440	Ungate, Christopher D.	8502
464	Williams, Erven N.	8154

* After July 10

ADDRESS-WT 10A-K
FAX NUMBER-6137-K

ROOM NUMBER	NAME	PHONE
324	Allen, Stephen C. (Steve)	6851
310	Amick, Steven F. (Steve)	6847
312	Barksdale, Susan C.	7349
309	Bird, H. Glenn	7564
112	Blackburn, James W. (Jim)	6223
246	Bowling, David L., Jr.	6262
113	Buck, Louis E.	6222
305	Burgess, Barry L.	6118
102	Dyer, Kathy C.	4166
110	Goff, Curtis W. (Curt)	4785
306	Harrington, Bruce C.	7566
244	Hubbard, Linda A.	6202
303	Hubbs, Deborah K.	7559
322	Hughes, Robert C. (Cris)	6196
242	Jones, John B.	6217
252	Kennedy, Steven (Steve)	4673
353	Limback, Steven A	6205
111	Lowe, Gregory W. (Greg)	6857
328	Miller, Barbara A.	7179
106	Milstead, Roger A.	6115
318	Nighbert, John H. (J.H.)	6837
302	Reed, Patricia W. (Pat)	4810
308	Rice, Colleen S.	7565
313	Rievley, M. Glenn	7627
300	Ruth, Deborah K.	6119
250	Sanders, Yolanda	4673
114	Shields, Edna F.	4455
329	Smith, Tamara	4675
314	Strong, Stanley A. (Stan)	7348
320	Tidwell, Karen F.	2767
304	Wilson, Bettye L.	3120
307	Wright, James M. (Jim)	4792

When the other WM Knoxville employees move to the Towers, their mailing addresses will be WT 10B-K. and will probably use fax no. 6137-K.