

ASSESSMENT OF THE IMPACTS
OF THE
CLINCH RIVER BREEDER REACTOR PLANT
ON THREATENED OR ENDANGERED SPECIES

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TABLE OF CONTENTS

	<u>Page No.</u>
1. PURPOSE	1
2. THE SITE.	2
2.1 Terrestrial Environment.	2
2.2 Aquatic Environment.	3
3. THE PLANT	5
4. THE SAMPLING PROGRAM.	8
4.1 Terrestrial.	8
4.2 Aquatic.	9
5. THREATENED OR ENDANGERED SPECIES.	12
5.1 Grey Bat - <u>Myotis grisescens</u>	12
5.2 Slender Chub - <u>Hybopsis cahnii</u>	14
5.3 White Warty-Back Pearly Mussel - <u>Plethobasis cicatricosus</u>	15
5.4 Dromedary Pearly Mussel - <u>Dromus dromas</u>	17
5.5 Yellow-Blossom Pearly Mussel - <u>Epioblasma florentina florentina</u>	19
5.6 Fine-Rayed Pigtoe Pearly Mussel - <u>Fusconaia Cuneolus</u>	20
5.7 Shiny Pigtoe Pearly Mussel - <u>Fusconaia edgariana</u>	21
5.8 Pink Mucket Pearly Mussel - <u>Lampsilis orbiculata orbiculata</u>	23
5.9 Orange-Footed Pearly Mussel - <u>Plethobasis cooperianus</u>	26
5.10 Rough Pigtoe Pearly Mussel - <u>Pleurobema plenum</u>	27
5.11 Birdwing Pearly Mussel - <u>Conradilla caelata</u>	29
5.12 Green-Blossom Pearly Mussel - <u>Epioblasma torulosa gubernaculum</u>	30
5.13 Alabama Lamp Pearly Mussel - <u>Lampsilis virescens</u>	31
5.14 Species Under Status Review.	33
6. THE ASSESSMENT OF POTENTIAL IMPACT.	33
6.1 Impacts due to Plant Construction.	34
6.2 Impacts due to Plant Operation	36
7. CONCLUSION.	39
8. REFERENCES.	41

1. PURPOSE

This assessment is submitted to the U.S. Fish and Wildlife Service (FWS) by the U.S. Nuclear Regulatory Commission (NRC) to comply with Section 7 of the 1978 Amendments to the Endangered Species Act. In a letter (Check, 1981) dated October 26, 1981, the NRC requested information concerning Federally recognized threatened and endangered species, both listed and proposed to be listed, and designated or proposed critical habitat which might be affected by the construction and subsequent operation of the proposed Clinch River Breeder Reactor (CRBR) located in Roane County, Tennessee. The utilities pursuing the NRC construction permit for the CRBR plant are the U.S. Department of Energy, Tennessee Valley Authority and Project Management Corporation. The FWS responded to this request on November 5, 1981 (Hickling, 1981) informing the NRC that the plant site is within the known range of thirteen threatened or endangered species (Table 1). The current status of the list of species was verified by the NRC staff in a phone conversation with FWS on August 11, 1982. The plant site or the nearby surrounding area has not been designated or proposed as critical habitat for any threatened or endangered species. Three additional species not now listed or officially proposed for listing are under status review (SR) by the FWS and may be listed at some time in the future (Table 1). The FWS requested that efforts be taken if possible to avoid adversely impacting any of these three species.

Under provisions of the Act the FWS requires the NRC to perform a biological assessment for the listed species.

This report provides the result of the NRC's biological assessment which predicts the impact on the species listed in Table 1 from the construction and operation of the Clinch River Breeder Reactor. This assessment is based on a site visit by Dr. M. Masnik and Mr. Gerry Gears made to the proposed CRBR site in October 1981, discussions with individuals with knowledge of the species (Table 2), the CRBR docket, the results of the freshwater mussel study conducted by TVA personnel in the vicinity of the site and a review of the published literature.

2. THE SITE

The proposed Clinch River Breeder Reactor (CRBR) Plant site is located on a 1364-acre site on the north bank of the Clinch River in Roane County, TN about 25 miles west of Knoxville, TN. The site is approximately surrounded on three sides by water and occupying a broad bend in the river between Clinch River miles (CRM) 16 and 18. A map of the site and surrounding area is provided in Figure 1.

2.1 Terrestrial Environment

The site supports moderately diverse plant and animal populations. A mosaic of forest types covers nearly all of the 1364 acres, with 37% in hardwoods, 47% in conifers, 11% in mixed forest, and 5% in nonforested land. The mosaic reflects previous land use and present forest management practices on the site. Extensive farming prior to 1942 resulted in erosion and loss of soil fertility on steep slopes. Most of the existing deciduous forests were present as early as 1924, but

acreages of conifers doubled from 1940 to 1972 because of natural old field succession and because of recent plantings of pine. Two of the plant communities, so-called "natural areas", on the site are of ecological interest because of their stages of succession and relatively undisturbed condition. These are 1) approximately 28 acres on the east boundary of the site dominated by northern red oak, tulip poplar, and white oak, and 2) about 15 acres of mixed deciduous (beech-mixed oak) forest in the northern part of the site. Plant and animal populations on the site are similar to those of much of the surrounding land (USNRC, 1982).

2.2 Aquatic Environment

The stretch of the Clinch River in the vicinity of the site forms the north leg of Watts Bar Reservoir. Its water elevation is controlled by Watts Bar Dam 55 miles downstream of the proposed plant site. Pool level is generally maintained between 735 and 741 feet above msl. The Clinch River in the vicinity of the site is characterized as wide (360ft) and deep (15-20 ft) with highly variable river velocities. During normal pool elevation there are no riffle areas or exposed gravel bars.

Based on records from 1963 to 1979, the average flow of the Clinch River is about 5380 cfs at the site. The maximum hourly average release was 54,960 cfs and the maximum daily average flow was 34,966 cfs (NRC, 1982). Flow in the Clinch River at the site is regulated by the upstream Melton Hill Dam. Flow reversal at the site may periodically occur due to the action of Melton

Hill Dam and the peculiarities of the reservoir system hydrodynamics. No extended periods of zero flow are anticipated (NRC, 1982).

Water temperatures measured at CRM 21.6 between 1963 and 1979 varied between a maximum of 78°F and a minimum of 33°F.

Jenkinson (1982) reported that a study of the dominant substrate components of the Clinch River in the vicinity of CRBR (CRM 14-17) revealed that the bottom is predominately (38.1%) fines (muck, silt, and clay) followed by sand (23.1%), rock (boulders, rip-rap, and bedrock - 14.4%) gravel (13.5%) and cobble (11.1%). Upstream of the CRBR site (CRM 18.2-21.0) the bottom is of similar composition with fines predominating (31.1%) followed by sand (25.2%), gravel (22.3%), cobble (14.5%) and rock (7.0%).

A number of comprehensive studies on the aquatic biota inhabiting the stretch of the Clinch River in the vicinity of the proposed CRBR site have been conducted in the last few years. Sampling by the applicants was conducted in 1974-75 (ER, 1975), by Exxon Nuclear Corporation in the middle and late 1970's (Exxon, 1976; Morton, 1978) and by Oak Ridge National Laboratory in the late 1970's (Loar, 1981; Loar et al., 1981). An extensive summary of this information is presented in the Draft Supplement to the Final Environmental Statement for the Clinch River Breeder Reactor Plant (USNRC, 1982). The aquatic biota were found to be typical for the middle to upper Tennessee River system. Because of the site's placement along a stretch of the Clinch River at the

upstream end of Watts Bar Reservoir the aquatic flora and fauna contain representatives of both lentic and lotic environments. None of the studies conducted during the 1970's conclusively demonstrated the presence of any federally protected aquatic species in the vicinity of the site.

3. THE PLANT

The Clinch River Breeder Reactor (CRBR) will be constructed by the Project Management Corporation (PMC), the Tennessee Valley Authority (TVA), and the U.S. Department of Energy (DOE). The single unit plant is designed to use a liquid-sodium-cooled fast breeder reactor to produce 975 megawatts of thermal energy (MWt). A map of the site and general plant layout is presented in Figure 2.

The plant would employ two mechanical draft cooling towers and a circulating water system (CWS) to cool the exhaust steam from the turbine generators. Makeup water for the nuclear plant would be obtained from a perforated pipe intake (Figure 3) located in the Clinch River at CRM 17.9. The intake makeup flow rate would be about 6145 gpm.

The maximum rate of water loss from CWS due to evaporation and drift from each of the cooling towers is estimated to be 3623 gpm and 106 gpm, respectively.

A submerged single-port discharge structure (Figure 4) at CRM 16.0 would be constructed to discharge the cooling tower blowdown and other plant effluent

into the Clinch River. The total station discharge rate would be about 2412 gpm. Effluents will be regulated by NPDES Permit Number TN0028801.

The daily maximum cooling tower blowdown temperature would be limited to 91°F by the NPDES permit. The minimum expected temperature is 60.5°F. Hypochlorite would be injected periodically into the CWS for biofouling control. The NPDES permit would limit the instantaneous maximum concentration of total residual chlorine to 0.14 mg/l.

During construction two extended aeration activated sludge sewage treatment plants with a combined capacity of 65,000 gpd would be in operation. A 13,000 gpd unit would remain after plant construction is completed to treat wastes generated during normal plant operation. The discharge of the plant sanitary waste system effluents would also be governed by the NPDES permit. Other minor effluent waste streams would include discharges from the water treatment system, steam generator system, and chemical cleaning wastes.

The estimated total yearly release of radioactive materials in gaseous effluents at 389 Ci for noble gases and 1 Ci for tritium (NRC, 1982). The estimated yearly release of radioactive liquid waste in the effluent stream that is discharged to the Clinch River is approximately 0.016 Ci, excluding tritium and dissolved gases (NRC, 1982).

The following from NRC (1982) provides a discussion of plant construction activities that have the potential for impacting aquatic biota through sedimentation, in-river activities and loss of habitat.

An Erosion and Sediment Control Plan has been developed by the applicants for the planned construction activities at the site. The NPDES permit requires the approval of such a plan by EPA. The objective of the plan is to control the erosion and sedimentation resulting from construction activities by minimizing soil exposure, collecting and controlling rainfall runoff in the construction area, and by shielding and/or binding soil on cut slopes where stabilization is required. Discharge of silt to the Clinch River would be further controlled by placing runoff treatment ponds and sand filters to collect and treat rainfall runoff. The plan incorporates the EPA and State of Tennessee standards of performance for new sources, best management practices, and other applicable guidance documents to control the potential pollution resulting from the construction activity.

In-river activity would be confined to construction of the barge unloading facility, the intake, and the discharge. Improvement of the access road and construction of a railroad spur would involve some dredging and placement of granular fill and riprap. Construction of these facilities or improvements will be scheduled separately to minimize impact to the river.

Construction of the barge unloading facility at CRM 14.8 would disturb about 600 linear feet of shoreline and about 11,000 yds³ of sandy silt material would be dredged from the river. The bottom of the dredged area would be covered with 700 yds³ of sand to cushion barges during unloading. Only about 1700 ft² of river bottom below the 741 ft normal pool elevation of Watts Bar Lake (Clinch River) would be disturbed by construction of the barge unloading facility.

Approximately 9400 ft² of river and shoreline area would be excavated or dredged for installation of the pumphouse and intake pipes.

Installation of the discharge structure would require excavation of approximately 2600 ft² of river bottom.

Limited dredging and placement of granular fill and riprap would be associated with improvement of the site access road and construction of the railroad spur. These activities would affect about 34,000 ft² of existing river bottom below the 741 ft pool elevation.

4. THE SAMPLING PROGRAM

4.1 Terrestrial

Seasonal on-site trapping surveys were completed for winter, spring, summer and fall of 1974 (ER-OL, 1975; NRC, 1982). The results of these surveys were presented in NRC (1982). No endangered or threatened faunal species were found on the site. However, a cave search in August, 1974 did indicate the presence many years ago of 500-1000 gray bats in a cave on Chestnut Ridge. Mist-netting also in August 1974 indicated the absence of feeding individuals from the site.

A reconnaissance survey of the site was conducted in August 1980 (Energy Impact Associates, 1980). The survey placed emphasis on examining existing populations of the status review plant species Cimicifuga rubifolia and Saxifraga careyana.

4.2 Aquatic

Benthic macroinvertebrates (benthos) were collected approximately monthly by the applicants between March 1974 and May 1975 using a Ponar dredge and artificial substrates. Benthic sampling was conducted at four locations in the river including the approximate location of the proposed intake and discharge structures. No specimens of any species of freshwater mussels designated as threatened or endangered were collected (ER, 1975).

Juvenile and adult fish were sampled approximately monthly by the applicants between March 1974 and May 1975 using electroshockers and gill nets. Fish eggs and larvae were sampled monthly in the spring and summer of 1974 using a $\frac{1}{2}$ meter ichthyoplankton net. No specimens of any species of freshwater fish designated as threatened or endangered were collected.

In May and June of 1982 TVA conducted a freshwater mussel survey in the vicinity of the CRBRP site. Initially the survey was to examine the bottom between CRM 14.0 and 18.0. Later it was determined to expand the survey to include the stretch of river between CRM 18.2 and 21.0. The freshwater mussel survey consisted of a scuba assisted transect and areal examination of the river bottom. The transect portion of the study consisted of divers swimming along cables laid on the bottom across the full width of the river gathering all live freshwater mussels they could see or feel. The cross river transects of the first survey began at CPM

14.0 and ended at CRM 18.0 and were located 0.2 river miles apart giving a total of 21 transects.

Each transect was divided into 20-foot intervals. Data on the number of live mussels found and the two dominant substrate types were recorded for each interval for each transect.

The following, taken from Jenkinson (1982), describes the diving and collection procedure:

For each transect, two scuba divers entered the water along the left (descending) bank and one diver swam along each side of the transect cable. Both divers maintained hand contact with the cable while they swam across the river looking and feeling for mussels. Live mussels found within the visibility range (up to five feet on either side of the cable) were placed in a nylon collection bag. At the flag-marked end of each 20-foot interval, the bag of mussels (if any) was attached to a nylon loop tied to the cable and a substrate composition entry was made on the slate one of the divers was carrying. When the divers had completed the transect, the cable was raised, each bag of mussels was sorted, the animals were identified to species, appropriate mussel and substrate entries were made on the field sheet, and the mussels were returned to the river. (Some representative voucher specimens were retained for documentation purposes).

Areal examinations were conducted in the immediate vicinity of the proposed intake (CRM 17.9), discharge (16.0) and barge unloading facility (14.8). These qualitative dive searches were conducted by divers swimming at random over the bottom in these areas for approximately one hour. They collected all live mussels they encountered. All mussels found at each site were sorted, identified, counted by species, recorded on a field sheet, and returned to the river.

The sampling program was designed to allow for a more intensive investigation in the event that 5 or more mussel species were found in two adjacent 20-ft intervals or if one or more specimens of any federally protected species was found in a 20-ft interval. This more intensive survey would have involved a series of 15 minute dives in the same substrate type at the site of the initial find. Neither criteria was met during the entire mussel survey so the more intensive survey was not conducted.

On April 21, 1982, prior to the start of the mussel survey, a specimen of Lampsilis o. orbiculata the federally designated pink mucket pearly mussel, was found at CRM 19.1 by a TVA dive crew looking for sauger eggs. When the mussel survey of CRM 14.0 - 18.0 was completed and no specimens of any species of endangered mussel were found, TVA became concerned about the possible existence of populations of endangered species just upstream of the proposed site.

Once the preliminary results of the CRM 14.0 - 18.0 mussel survey were available, the decision was made to extend the survey three miles further upstream the Clinch River from CRM 18.2 to 21.0. The survey of CRM 18.2 to 21.0 was conducted in same manner as the previous survey. Cross-river quantitative transects 0.2 mile apart were used. All steps of the earlier survey procedure were followed without modification. A complication arose in sampling around two island complexes located in this stretch of the river. The two channels around Jones Island were of different lengths. TVA was unable to maintain consistent spacing of all the transects. The difference in channel

length was accommodated by deleting one transect from the shorter channel (CRM 20.6) and equalizing the spacing between the remaining transects in that channel.

Figure 5 provides the location of the quantitative transects and qualitative sites included in both TVA mussel surveys conducted in May and June 1982.

Table 3 provides a summary of the results of the transect and area searches (summed by river mile). Included is the record of the Lampsilis orbiculata orbiculata taken in April 1982 at CRM 19.1. A total of 11 species of freshwater mussels and 190 specimens were identified from the Clinch River between CRM 14.0 and 20.0 (includes the single specimen of L. o. orbiculata).

5. THREATENED OR ENDANGERED SPECIES

A short discussion follows for each of the federally recognized threatened or endangered species identified by the FWS (Hickling, 1981) whose known range includes the CRBR site. The amount of detail presented for each species is commensurate with its actual or probable occurrence in the vicinity of the site.

5.1 Grey Bat - Myotis grisescens

Critical habitat for this endangered species has not been designated in the near vicinity of the CRBR site (Title 50 CFR 17.11).

Grey bats are almost exclusively cave dwelling and are narrowly restricted to certain special cave habitats (Tuttle, 1976). Summer roosts of the grey bat are nearly always located adjacent to a river or reservoir over which the bats feed.

Since grey bats are highly specialized for certain ecological cave conditions that are in limited supply, colonies often must migrate long distances between summer and winter caves. Delayed reproduction, small litter size, and high juvenile mortality also preclude rapid population growth (Humphry and Tuttle, 1978). Since gray bats aggregate in large numbers at their winter caves and favor particular caves, repeated disturbance or destruction of such caves is specially serious. Since grey bats cannot reproduce if not in colonies, primary attention to their endangered status must be concerned with the number and vulnerability of existing colonies (Humphry and Tuttle, 1978). The survival of grey bats is dependent upon protection of their cave roosts from disturbance. Even protection of formerly occupied grey bats caves can be helpful, as these caves are suitable for hibernation and may become reoccupied.

Currently, a large maternity cave for the grey bat occurs 40 miles southwest of the site near the Tennessee River; several other maternity caves occur near the Tennessee River from 20 to 60 miles southwest of the site. Hibernating caves for grey bats occur 70 and 130 miles southwest and 90 miles northeast of the site, all within about one week's travel time of the site (Tuttle, 1976).

An on-site mist netting survey demonstrated the absence of individuals from the site (DOE, 1982). A site cave search provided evidence of a previous occupation of 500-100 grey bats in a cave located in the northern portion of the site along Chestnut Ridge. (DOE, 1982). The formerly occupied cave will not be affected by any construction or operational activities and, therefore, would be available for reoccupation. Environmental construction controls (NRC, 1982) will protect the Clinch River and the Erosion and Sediment Control Plan will require a minimum of a 25 foot wide vegetation border along the river so that any favorable grey bat foraging habitat provided by the river itself will not be affected by construction or operation activities.

Based on the results of the onsite mist netting survey and site cave search it is concluded that the possible occurrence of this species on the proposed CRBR site is unlikely. Construction and operation of the CRBR site will not affect foraging habitat, if present, in the vicinity of the site. Since this species is not known from the site, and no significant impact to habitat critical to the existence of this species will occur no further consideration as to the potential for impact to this species due to the construction or operation of the CRBR plant is provided.

5.2 Slender Chub - Hybopsis cahni

Critical habitat for this species has not been designated (Title 50 CFR 17.11).

The slender chub is a rare endemic species reported from the Clinch and Holston systems in Tennessee. Masnik (1974) reported H. cahni from the main channel Clinch and Powell Rivers at elevations of less than 1200 ft. H. cahni is not known from Norris Reservoir, however, one collection was taken in 1936 from below Norris Dam and represents the downstream record of this species.

H. cahni is restricted in habitat to medium to fairly large warm rivers with swift deep runs over uniform loose pea-sized gravel covered with little silt (Masnik, 1974).

Extensive sampling by the applicants (see Section 4.2), Exxon Nuclear Corporation (Exxon, 1976) and Oak Ridge National Laboratory (Loar, 1981; Loar et al., 1981) did not reveal the presence of this species in the proposed site vicinity.

Based on the results of the above studies and the known habitat requirements of this species and the habitat present at the proposed site (see Section 2.2), it is concluded that the possibility of occurrence of this species in the vicinity of the CRBR site is highly unlikely. Since this species is not known from the site, no further consideration as to the potential for impact to this species due to the construction or operation of the CRBR Plant is provided.

5.3 White Warty-Back Pearly Mussel - Plethobasis cicatricosus

Critical habitat for this endangered species has not been designated (Title 50 CFR 17.11).

The white warty-back pearly mussel was not known (Ortmann, 1918) to inhabit the Clinch River within 40 RM of the CRBR site prior to construction of the Tennessee Reservoir system. J. Jenkinson, TVA biologist, (Longenecker, 1982), reported only one recent record of this species from the Tennessee River near Savannah, TN near RM 190.

Extensive sampling by the applicants (see Section 4.2), Exxon Nuclear Corporation (Exxon, 1976) and Oak Ridge National Laboratory (Loar, 1981; Loar et al., 1981) failed to reveal the presence of this species in the vicinity of the proposed site. The extensive mussel survey (see Section 4.2) conducted by the applicants in May and June of 1982 also failed to collect any specimens of this species.

D. Wade, TVA biologist, indicated that this species is typically found on stable gravel or cobble substrates and marginally on sand or clay substrates if the bottom material was current-swept, stable and penetrable enough to allow the mussels to dig in (Longenecker, 1981).

Although favorable or marginally favorable substrate conditions may exist in the vicinity of the CRBR site, the information on the historic and present distribution of this species and the results of earlier benthic surveys and the recent freshwater mussel survey suggest that the species is probably not present in the stretch of the Clinch River in the vicinity of the proposed

CRBR site. Since this species is not known from the site no further species specific considerations as to the potential for impact due to construction or operation of the CRBR plant is provided.

5.4 Dromedary Pearly Mussel - Dromus dromas

Critical habitat for this endangered species has not been designated (Title 50 CFR 17.11).

The dromedary pearly mussel was known from the Clinch River (Ortman, 1918) prior to construction of the Tennessee Reservoir system. Historical records within 40 river miles of the CRBR site, summarized by Longenecker (1981) taken from Ortman (1918), were from the Clinch River at Solway, TN in 1914 (RM 44) and Edgemoor, TN (RM 48) in 1915.

Jenkinson (Longenecker, 1982) reported that the current range (records from 1975 to the present) of this species in the Tennessee system includes the middle reaches of the Clinch (RM 170-190) and Powell Rivers (RM 67-136), a short reach of the Tennessee River below the Watts Bar Dam (RM 520-521) and one site on the Cumberland River below Cordell Hull Dam (RM 296).

On July 25, 1974 a single specimen of a freshwater mussel was collected at CRM 17.9 by Westinghouse Environmental Sciences Division and tentatively identified by their consultant as Dromus sp. The specimen was reexamined

by B. G. Isom, and G. Gooch of TVA and found to be a specimen of Quadrula puslulosa. The reidentification was confirmed by P. Yokley (1975).

Extensive sampling by the applicants (see Section 4.2), Exxon Nuclear Corporation (Exxon, 1976) and Oak Ridge National Laboratory (Loar, 1981; Loar et al., 1981), failed to reveal the presence of this species in the vicinity of the proposed site. The extensive mussel survey (see Section 4.2) conducted by the applicants in May and June of 1982 also failed to collect any specimens of this species.

Wade indicated that this species is typically found on stable gravel or cobble substrates and marginally on sand or clay substrates if the bottom material was current-swept, stable and penetrable enough to allow the mussels to dig in (Longenecker, 1982).

Although favorable or marginally favorable substrate conditions may exist in the vicinity of the CRBR site, the information on the present distribution of this species and the results of earlier benthic surveys and the recent freshwater mussel survey suggest that this species is probably not present in the stretch of the Clinch River in the vicinity of the proposed CRBR site. Since this species is not known from the site, no further species specific consideration as to the potential for impact due to the construction or operation of the CRBR Plant is provided.

5.5 Yellow-Blossom Pearly Mussel - Epioblasma florentina florentina

Critical habitat for this endangered species has not been designated (Title 50 CFR 17.11).

The yellow-blossom pearly mussel was not known (Ortmann, 1918) to inhabit the Clinch River within 40 river miles of the CRBR site prior to construction of the Tennessee Reservoir system. Jenkinson (Longenecker, 1982) reported that there are no recent records for this species and it is presumed to be extinct.

Extensive sampling by the applicants (see Section 4.2), Exxon Nuclear Corporation (Exxon, 1976) and Oak Ridge National Laboratory (Loar, 1981; Loar et al., 1981) failed to reveal the presence of this species in the vicinity of the proposed site. The extensive mussel survey (see Section 4.2) conducted by the applicants in May and June of 1982 also failed to collect any specimens of this species.

Wade indicated that this species probably was found on stable gravel or cobble substrates (Longenecker, 1982).

Although some gravel and cobble substrates may exist in the vicinity of the CRBR site, the lack of occurrence of this species in the Clinch River in the vicinity of the site both in recent and historic times as well as the present possibility that it is extinct suggest that it is highly unlikely that the species would be impacted by CRBR construction or operation. Since this

species is not known from the site, no further species specific consideration as to the potential for impact due to the construction or operation of the CRBR Plant is provided.

5.6 Fine-Rayed Pigtoe Pearly Mussel - Fusconaia cuneolus

Critical habitat for this endangered species has not been designated (Title 50 CFR 17.11).

The fine-rayed pigtoe pearly mussel was known from the Clinch River (Ortmann, 1918) prior to construction of the Tennessee Reservoir system. Historical records within 40 river miles of the CRBR site summarized by Longenecker (1981), taken from Ortmann (1918), were from the Clinch River and Solway, TN (RM 44) in 1914, at the mouth of Poplar Creek near Clinch RM 12.0 prior to 1918 and from the Emory River near Harriman, TN (RM 11) in 1915.

Jenkinson (Longenecker, 1982) reported the current range (records from 1975 to the present) of this species in the Tennessee System as the middle reach of the Powell River (specific sites not available), the Clinch River (RM 156 to 226, and 268-322), and one site on the Paint Rock River (RM 48).

Morton (1978) reported a single specimen of freshwater mussel from the genus Fusconaia. The specimen was collected just downstream of the proposed CRBR site. The specimen was not identified to species and is not available for reidentification. E. Morgan (person. comm., 1981) stated that he was present during the collection of the specimen. He recalled that the specimen was

collected along the north shoreline of the Clinch River on a mud flat formed during reservoir drawdown just upstream of the Gallaher Bridge (CRM 14). Most of the specimens collected at the site, including the specimen identified as Fusconaia, were relict shells. Morgan (person. comm., 1981) stated that the subject specimen could have conceivably predated Watts Bar Reservoir.

Extensive sampling by the applicants (see Section 4.2), Exxon Nuclear Corporation (Exxon, 1976) and Oak Ridge National Laboratory (Loar, 1981; Loar et al., 1981), failed to reveal the presence of this species in the vicinity of the proposed site. The extensive mussel survey (see Section 4.2) conducted by the applicants in May and June of 1982 also failed to collect any specimens of this species.

Wade indicated that this species is typically found on gravel or cobble substrates (Longenecker, 1982).

Although some gravel and cobble substrate exists in the vicinity of the CRBR site the lack of occurrence of live specimens in the Clinch River in the vicinity of the site suggest that it is unlikely that the species would be impacted by CRBR construction or operation. Since this species is not known from the site, no further species specific consideration as to the potential for impact due to the construction or operation of the CRBR Plant is provided.

5.7 Shiny Pigtoe Pearly Mussel - Fusconaia edgariana

Critical habitat for this endangered species has not been designated (Title 50 CFR 17.11).

The shiny pigtoe pearly mussel was known from the Clinch River (Ortmann, 1918) prior to construction of the Tennessee Reservoir system. Historical records within 40 river miles of the CRBR site, summarized by Longenecker (1981), taken from Ortmann (1918), were from the Clinch River at Pattons Ferry (RM 14) prior to 1918, at the mouth of Poplar Creek near Clinch RM 12.0 prior to 1918, and the Clinch River at Edgemoor, TN (RM 48) in 1915.

Jenkinson (Longenecker, 1982) reported the current range (records from 1975 to the present) of this species in the Tennessee System as the middle reach of the Powell River (RM 67-136), an extended reach of the Clinch River (RM 184-279), the upper portion of the North Fork Holston River (RM 84-92), an upper reach of the Paint Rock River (RM 44-59) and the middle reach of the Elk River (RM 70-118).

Morton (1978) reported a single specimen of freshwater mussel identified as from the genus Fusconaia just downstream of the proposed CRBR site. An explanation of the identification and disposition of this specimen is contained in Section 5.6.

Extensive sampling by the applicants (see Section 4.2), Exxon Nuclear Corporation (Exxon, 1976) and Oak Ridge National Laboratory (Loar, 1918; Loar et al., 1981), failed to reveal the presence of this species in the vicinity of the proposed site. The extensive mussel survey (see Section 4.2) conducted by the applicants in May and June of 1982 also failed to collect any specimens of this species.

Wade indicated that this species is typically found on gravel or cobble substrates (Longenecker, 1982).

Although some gravel and cobble substrate exists in the vicinity of the CRBR site, the lack of occurrence of live specimens in the Clinch River in the vicinity of the site suggest that it is unlikely that the species would be impacted by CRBR construction or operation. Since this species is not known from the site, no further species specific consideration as to the potential for impact due to the construction or operation of the CRBR Plant is provided.

5.8 Pink Mucket Pearly Mussel - Lampsilis orbiculata orbiculata

Critical habitat for this endangered species has not been designated (Title 50 CFR 17.11).

The pink mucket pearly mussel was known from the Clinch River (Ortmann, 1918) prior to construction of the Tennessee Reservoir system. The only historic record within 40 river miles of the CRBR site in Longenecker (1981) and taken from Ortmann (1918) was from the Clinch River at Solway, TN (RM 44) in 1914.

Jenkinson (Longenecker, 1982) reported the current range (records from 1975 to the present) of this species in the Tennessee System as one site on the Clinch River (RM 185), and a number of separated sites on the Tennessee River. Additionally, it is known from the Ohio River near Paducah, Kentucky (near RM 940), several sites in the Cumberland River (RM 275-305), nine sites in the

lower 55 miles of the Merawec River, Missouri and from the Little Black River, St. Francis River, Sac River, Gasconade River and Osage River - all in Missouri. Table 4 provides a listing of Lampsilia orbiculata orbiculata collected by TVA personnel during 1976 and 1978 (Jenkinson, pers. comm. 1982).

Based on the "site location" and "indication of abundance" columns in Table 4, it can be concluded that the species has relatively widespread distribution in the Tennessee System; however, it does not appear to occur in any one locality in abundance. It appears that it consistently forms a relatively insignificant component of the mussel faunal at a particular site and occurs singly or almost so and it is not known to form large populations. This species is typically a large water species found most often in the tailraces of many of the mainstream Tennessee River dams.

On April 21, 1982, a single specimen of L. o. orbiculata was collected at CRM 19.1, approximately 1.2 miles upstream of the proposed CRBR intake structure, by a TVA dive crew looking for sauger eggs. Extensive sampling by the applicants (see Section 4.2), Exxon Nuclear Corporation (Exxon, 1976) and Oak Ridge National Laboratory (Loar, 1981; Loar et al., 1981), failed to reveal the presence of this species in the vicinity of the proposed site. The extensive mussel survey (see Section 4.2) conducted by the applicants in May and June of 1982 also failed to collect any specimens of this species.

Wade indicated that this species is typically found on stable gravel or cobble substrates occurring marginally on sand or clay substrates if the bottom material is current-swept, stable and penetrable enough to allow the mussels to

dig in (Longenecker, 1982). Jenkinson (person. comm., 1982) stated that this species prefers gravelly substrates and is often found in firm sand and infrequently in silt and clay.

Based on the single specimen collected at CRM 19.1 in April 1982 and the presence of some suitable substrate in the vicinity of CRBR site, it is concluded that this species is present in the immediate vicinity of the site. However, based on its abundance at other locations and the fact that no additional specimens were collected during the mussel survey, it is likely to exist in extremely low numbers in this reach of the Clinch River. Furthermore, its preferred habitat of tailraces of mainstream Tennessee River Dams and a substrate of gravel suggest that the Clinch River in the vicinity of the CRBR site is less than optimal habitat. Even if a large number of these organisms could occur at a single site, the marginal habitat at the CRBR site would probably result in low population densities.

The fact that Lampsilis o. orbiculata was not collected along any of the 36 mussel survey transects suggests that, if more than one specimen of L. o. orbiculata exists in this 7 mile river reach, the population size must be quite small, most likely smaller than that of the species found most infrequently during the survey (e.g., Elliptio crassidens one specimen taken). If it is assumed that the divers examined conservatively a 5-foot aggregate width across each transect the survey would have covered approximately .473% of the bottom in the 7 mile length of river (Jenkinson, 1982). Using this value to expand the observed number of E. crassidens encountered in the transects and not discounting unfavorable

habitat, the survey data would lead to an estimate of 211 specimens of E. crassidens present in the 7 miles of river (Jenkinson, 1982). The best approximation that can be made concerning the population size of Lampsilis orbiculata in CRM 14.0 - 21.0 is that the number lies between 1 (the specimen found at CRM 19.1 and returned to the river) and 211 (the estimate for the rarest species encountered during the quantitative survey). Based on the data presented in Table 4 on observed past abundance of this species at a single collecting site, it is probable that the actual population size in this reach of river is much closer to 1 than to 211.

Since this species is present in the vicinity of the proposed site an analysis of potential for impact due to construction and operation of the CRBR Plant is presented in Section 6 of this report.

5.9 Orange-Footed Pearly Mussel - Plethobasis cooperianus

Critical habitat for this endangered species has not been designated (Title 50 CFR 17.11).

The orange-footed pearly mussel was known from the Clinch River (Ortmann, 1918) prior to construction of the Tennessee Reservoir System. Historical records within 40 rivermiles of the CRBR site, summarized by Longenecker (1981), and taken from Ortmann (1918) were from the Clinch River at Pattons Ferry (RM 14) before 1918, and the Clinch River at Edgemoor, TN (RM 48) in 1915).

Jenkinson (Longenecker, 1982), reported the current range (records from 1975 to the present) of this species in the Tennessee System as a few widely scattered sites on the Tennessee River (RM 253, 170, 183, 197, 205, 345 and 595).

Extensive sampling by the applicants (see Section 4.2), Exxon Nuclear Corporation (Exxon, 1976) and Oak Ridge National Laboratory (Loar, 1981, Loar et al., 1981), failed to reveal the presence of this species in the vicinity of the proposed site. The extensive mussel survey (see Section 4.2) conducted by the applicants in May and June of 1981 also failed to collect any specimens of this species.

Wade indicated that this species is typically found on stable gravel or cobble substrates (Longenecker, 1982).

Although some gravel and/or cobble substrate exists in the vicinity of the CRBR site the lack of occurrence of this species in the Clinch River near the site suggests that it is unlikely that this species would be impacted by CRBR construction or operation. Since this species is not known from the site, no further species specific consideration as to the potential for impact due to the construction or operation of the CRBR Plant is provided.

5.10 Rough Pigtoe Pearly Mussel - Pleurobema plenum

Critical habitat for this endangered species has not been designated (Title 50 CFR 17.11).

The rough, pigtoe, pearly, mussel was not known (Ortmann, 1918) to inhabit the Clinch River within 40 river miles of the CRBR site prior to construction of the Tennessee Reservoir system.

Jenkinson (Longenecker, 1982) reported the current range (records from 1975 to the present) of this species in the Tennessee System as two sites on the middle reach of the Clinch River (RM 179 and 185), and at least one record from the Tennessee River near Savannah, TN (near RM 190).

Extensive sampling by the applicants (see Section 4.2), Exxon Nuclear Corporation (Exxon, 1976) and Oak Ridge National Laboratory (Loar, 1981; Loar et al., 1981), failed to reveal the presence of this species in the vicinity of the proposed site. The extensive mussel survey (see Section 4.2) conducted by the applicants in May and June of 1982 also failed to collect any specimens of this species.

Wade indicated that this species is typically found in stable gravel or cobble substrates and marginally in sand and clay substrates if the bottom material was current-swept, stable and penetrable enough to allow the mussels to dig in (Longenecker, 1982).

Although favorable or marginally favorable substrate conditions may exist in the vicinity of the CRBR site, the information on the historic and present distribution of this species and the results of earlier benthic surveys and the recent freshwater mussel survey suggest that the species is probably not present in the stretch of the Clinch River in the vicinity of the proposed

CRBR site. Since this species is not known from the site, no further species specific considerations as to the potential for impact due to construction or operation of the CRBR Plant is provided.

5.11 Birdwing Pearly Mussel - Conradilla caelata

Critical habitat for this endangered species has not been designated (Title 50 CFR 17.11).

The birdwing pearly mussel was not known (Ortmann, 1918) to inhabit the Clinch River within 40 rivermiles of the CRBR site prior to construction of the Tennessee Reservoir system.

Jenkinson (Longenecker, 1982) reported the current range (records from 1975 to the present) of this species in the Tennessee River System as the middle reach of the Clinch River (RM 170-190), the middle reach of the Powell River (RM 67-136), one short reach of the Tennessee River below Watts Bar Dam (RM 520-521) and one site on the Cumberland River below Cordell Hull Dam (RM 296).

Extensive sampling by the applicants (see Section 4.2), Exxon Nuclear Corporation (Exxon, 1975) and Oak Ridge National Laboratory (Loar, 1981; Loar et al, 1981), failed to reveal the presence of this species in the vicinity of the proposed site. The extensive mussel survey (see Section 4.2) conducted by the applicants in May and June of 1982 also failed to collect any specimens of this species.

Wade indicated that this species is typically found on stable gravel or cobble substrates (Longenecker, 1981).

Although favorable substrate conditions may exist in the vicinity of the CRBR site the information on the historic and present distribution of this species and the results of earlier benthic surveys and the recent freshwater mussel survey suggest that the species is probably not present in the stretch of the Clinch River in the vicinity of the proposed CRBR site. Since this species is not known from the site, no further species specific considerations as to the potential for impact due to construction or operation of the CRBR Plant is provided.

5.12 Green-Blossom Pearly Mussel - Epioblasma torulosa gubernaculum

Critical habitat for this endangered species has not been designated (Title 50 CFR 17.11).

The Green-blossom pearly mussel was not know (Ortmann, 1918) to inhabit the Clinch River within 40 rivermiles of the CRBR site prior to construction of the Tennessee Reservoir system.

Jenkinson (Longenecker, 1982) reported the current range (records from 1975 to the present) of this species in the Tennessee System as the middle reach of the Clinch River (RM 187).

Extensive sampling by the applicants (see Section 4.2), Exxon Nuclear Corporation (Exxon, 1976) and Oak Ridge National Laboratory (Loar, 1981; Loar et al, 1981), failed to reveal the presence of this species in the vicinity of the proposed site. The extensive mussel survey (see Section 4.2) conducted by the applicants in May and June of 1982 also failed to collect any specimens of this species.

Wade indicated that this species is typically found on stable gravel or cobble substrates (Longenecker, 1981).

Although favorable substrate conditions may exist in the vicinity of the CRBR site, the information on the historic and present distribution of this species and the results of earlier benthic surveys and the recent freshwater mussel survey suggest that the species is probably not present in the stretch of the Clinch River in the vicinity of the proposed CRBR site. Since this species is not known from the site, no further species specific consideration as to the potential for impact due to construction or operation of the CRBR Plant is provided.

5.13 Alabama Lamp Pearly Mussel - Lampsilis virescens

Critical habitat for this endangered species has not been designated (Title 50 CFR 17.11).

The Alabama lamp pearly mussel was known from the Clinch River (Ortmann, 1978) prior to construction of the Tennessee Reservoir System. The

only historic record within 40 rivermiles of the CRBR site, given by Longenecker (1981), and taken from Ortmann (1918) was from the Emory River at Harriman, TN, in 1915.

Jenkinson (Longenecker, 1982) reported the current range (records from 1975 to the present) of this species in the Tennessee System is the upper Paint Rock River system (RM 59-60 and Hurricane [sic.] Crock).

Extensive sampling by the applicants (see Section 4.2), Exxon Nuclear Corporation (Exxon, 1976) and Oak Ridge National Laboratory (Loar, 1981; Loar et al., 1981), failed to reveal the presence of this species in the vicinity of the proposed site. The extensive mussel survey (see Section 4.2) conducted by the applicants in May and June of 1982 also failed to collect any specimens of this species.

Wade indicated that this species is typically found on stable gravel or cobble substrates (Longenecker, 1981).

Although favorable substrate conditions may exist in the vicinity of the CRBR site the information on the historic and present distribution of this species and the results of earlier benthic surveys and the recent freshwater mussel survey suggest that the species is probably not present in the stretch of the Clinch River in the vicinity of the proposed CRBR site. Since this species is not known from the site, no further species specific consideration as to the potential for impact due to construction or operation of the CRBR Plant is provided.

5.14 Species Under Status Review

Cimicifuga rubifolia and Saxitraga careyana populations known from the site were examined by Energy Impact Associates (1980) personnel in August, 1980. The populations were found to be undisturbed. These populations will be protected from all construction and operation activities. The staff presented an analysis of these two status review species in NRC, 1982.

Io fluvialis, the spiny river snail, was not known to inhabit the Clinch River near the CRBR site prior to the construction of the Tennessee Reservoir system. The recent extensive biotic surveys on the Clinch River (Exxon, 1976; Loar, 1981; Loar et al. 1981; ER, 1975; and Jenkinson, 1982) failed to collect any specimens of this species. Suitable habitat for this species (small rivers, fast water, cobble boulder substrate) is not present at the site. It is concluded that the species is not currently present at the site and probably will not occur at the site in the future.

No further species specific considerations as to the potential for impact to any of these three species due to construction or generation of the CRBR Plant is provided.

6. THE ASSESSMENT OF POTENTIAL IMPACT

Based on the staff's foregoing evaluation on the presence of the species on site the only species that could potentially be impacted by the construction and operation of the CRBR Plant is Lampsilis o. orbiculata. The following assessment is confined to this species.

6.1 Impacts Due to Plant Construction

Construction activities associated with the CRBR Plant have been evaluated for their potential for impact to Lampsilis o. orbiculata.

Construction activities are of concern because of the potential to affect the pink mucket pearly mussel through excessive river bottom siltation downstream of the site and through loss of habitat due to in-river construction. Project related siltation of the river bottom could result from site preparation activities with poor site stabilization and runoff control as well as from in-river construction activities

The erosion and sediment control plan for the CRBR Plant (see Section 3) requires the applicants to minimize soil exposure, control and collect rainfall runoff in the construction site, and shield or bind soil in cut slopes where required. Generally sediment discharge to the Clinch River will be controlled by impounding runoff from the construction area and by filtering the runoff prior to discharge. Five rainfall runoff ponds are to be constructed prior to any other excavation in the watershed.

The runoff from these ponds will be managed to maintain a pH in the range of 6.0 to 9.0 and a total suspended solids of 50 mg/l or less.

Major in-river activities will be confined to the construction of the barge unloading facility, the intake and discharge structures and placement of granular

fill material. Construction of these facilities will be scheduled separately to minimize the impact on the river. Dredging may be performed behind steel sheet piling barriers or cofferdams to minimize downstream siltation.

Based on the above requirements of the erosion and sediment control plan the staff concludes that siltation of the river bottom due to construction activities on the CRBR site and in the Clinch River will be minimal. No adverse impact to Lampsilis o. orbiculata population due to siltation is expected.

In-river structures and improvement of the access road and construction of the railroad spur (see Section 3) would result in the disturbing or loss of a total of about 1.1 acres of riverbottom.

Based on the small area of riverbottom habitat that will be disturbed or lost and the results of the freshwater mussel area surveys (see Section 4.2) which did not reveal the presence of any L. o. orbiculata at the proposed sites of the intake, discharge, or barge unloading facility, the staff concludes that few, if any, specimens of this species would be detrimentally impacted.

The staff concludes that construction related activities associated with the CRBR Plant will not detrimentally affect the L. o. orbiculata population, if indeed a population exists, in the Clinch River in the vicinity of the site. The minimal amount of in-river habitat loss and the requirements of the erosion and sediment control plan will insure that no adverse effects to this species will occur.

6.2 Impacts Due to Plant Operation

Operation of the CRBR Plant may potentially affect the pink mucket pearly mussel through entrainment of glochidia, loss of host fish due to plant operation, bottom scour downstream of the discharge, the discharge of chemicals, acute and long term low level thermal effects on gametogenesis and reproduction, and radioactive releases.

Those glochidia that are entrained through the plant CWS would probably experience 100% mortality. Therefore if a significant number of glochidia are lost due to entrainment the potential for impact on the population of Lampsilis o. orbiculata exists. Because of flow manipulation at the Melton Hill Dam, the Clinch River in the vicinity of the site has experienced periods of no flow. The number of glochidia available for entrainment under lotic conditions is greater than in a lentic environment because the flowing of water would allow a larger number of glochidia to become available for entrainment. The staff, therefore, performed its analysis of impact for the more conservative lotic conditions. Based on the fraction of total river flow withdrawn by the plant using the lowest average monthly flow of 3716 cfs for May and the maximum water makeup of 22.3 cfs, the average loss would be 0.6% of the organisms assuming a uniform distribution of glochidia. Even under low flow condition of 1000 cfs, the loss would be only 2.2%. The staff, therefore, concludes that this loss is insignificant and the loss of glochidia of L. o. orbiculata will not detrimentally affect the population in the vicinity of the station.

The loss of a host species of a freshwater mussel could result in its extirpation from a reach of river. Lampsilis o. orbiculata is known to utilize Stizostedion canadense and Aplodinotus grunniens as host species. Neither of these species are expected to detrimentally impacted by plant operation (NRC, 1982). The use of the perforated pipe intake and the amount of water that will be withdrawn will result in negligible impingement and entrainment to all species of fish inhabiting the Clinch River. Therefore the staff concludes that the loss of significant numbers of the host species of fish will not occur and there will be no detrimental effect on L. o. orbiculata.

Scour of the bottom in the immediate downstream vicinity of the discharge structure could potentially affect or exclude adult L. o. orbiculata.

A thermal-hydraulic model conducted for the applicants (ER, 1975) indicated that scouring by the discharge plume would be limited to a small area of the bottom, about 100 square feet. The staff concludes that this is an insignificant loss of available bottom habitat and will not result in an adverse effect on the species.

Nonradioactive chemical discharges from CRBR are described in Section 3. Nonradioactive chemical discharges associated with CRBR operation are regulated by the NPDES permit TN0028801. The NPDES permit limits discharges to levels that will not result in any acute or chronic effect on freshwater mussels inhabiting the bottom downstream of the discharge. Furthermore, the discharge design will result in a dilution of 14 to 1 within 66 ft of the discharge point.

Thermal discharges may result in acute or long term effects on freshwater mussels. Section 3 describes the thermal discharge limits imposed by the NPDES permit. The applicants' thermal-hydraulic modeling study found that typical bottom temperatures are predicted to be 1.2°F above ambient over less than 425 ft² of river bottom. The worst case condition of extended no flow still increased the temperature of only a small area of bottom. No acute thermal effects on Lampsilis o. orbiculata is expected. Long term gonadal or reproductive effects may occur on any individuals inhabiting the area influenced by the plume however this area is almost insignificant in relation to the total area available to the species in the river. Therefore, it is concluded that no detrimental effect on this species due to the thermal plume is anticipated.

Depending on the pathway and radiation source, aquatic biota will receive doses approximately the same or somewhat higher than man receives. Although guidelines have not been established for acceptable limits for radiation exposure to species other than man, it is generally agreed that the limits established for humans are also conservative for other species. While the existence of extremely radiosensitive biota is possible, and whereas increased radiosensitivity in organisms may result from environmental interactions with other stresses (e.g., heat, biocides, etc.), no biota have yet been discovered that show a sensitivity (in terms of increased morbidity or mortality) to radiation exposures as low as those expected in the aquatic environment downstream of the CRBR site.

Furthermore, in all the plants for which an analysis of radiation exposures to biota other than man has been made, there have been no cases of exposures that can be considered significant in terms of harm to the species, or that approach the exposure limits to members of the public permitted by 10 CFR Part 20 (Blaylock and Witherspoon, 1976). Since the BEIR Report (NAS, 1972) concluded that the evidence to date indicates that no other living organisms are very much more radiosensitive than man, no measurable radiological impact on populations of Lampsilis o. orbiculata is expected as a result of routine operation of this plant.

Based on the above analysis, the staff concludes that CRBR Plant operation will not result in a detrimental effect on L. o. orbiculata inhabiting the Clinch River in the vicinity of the site. Design and placement of plant structures, the restrictions imposed by the NPDES permit on the water quality of the discharge and the restrictions of 10 CFR Part 20 on radiological releases insure that minimal impact to all biota including L. o. orbiculata will occur.

7. CONCLUSION

It is concluded that construction and operation of the CRBR Plant will not have an adverse impact on any of the federally protected endangered or threatened species known or suspected to inhabit or utilize the site, nor will any impact occur to any designated critical habitat. The NRC staff does not recommend any additional studies or monitoring programs for endangered or threatened species.

Based on the foregoing biological impact assessment, it is the opinion of the NRC staff that initiation of consultation in this action is not necessary.

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TABLE 1. List of Endangered and Threatened Species Which May Occur in the Clinch River Breeder Reactor Site*

Gray bat (Myotis grisescens) - E
 White warty-back pearly mussel (Plethobasis cicatricosus) - E
 Dromedary pearly mussel (Dromus dromas) - E
 Yellow-blossom pearly mussel (Epioblasma florentina florentina) - E
 Fine-rayed pigtoe pearly mussel (Fusconaia cuneolus) - E
 Shiny pigtoe pearly mussel (Fusconaia edgariana) - E
 Pink mucket pearly mussel (Lampsilis orbiculata orbiculata) - E
 Organge-footed pearly mussel (Plethobasis cooperianus) - E
 Rough pigtoe pearly mussel (Pleurobema plenum) - E
 Birdwing pearly mussel (Conradilla caelata) - E
 Green-blossom pearly mussel (Epioblasma torulosa gubernaculum) - E
 Alabama lamp pearly mussel (Lampsilis virescens) - E
 Slender chub (Hybopsis cahnii) - T

In addition to listed and proposed Endangered and Threatened species, there are species which, although not now listed or officially proposed for listing as Endangered or Threatened, are under status review (SR) by the Service and may be listed at some time in the future. Status review species are not legally protected under the Endangered Species Act and the biological assessment requirements do not apply to them. However, we would appreciate any efforts you might make to avoid adversely impacting them. The following species under status review may occur within the project area:

Cimicifuga rubifolia
Saxifraga careyana
 Spiny River snail (Io fluvialis)

* Source: Letter to P. S. Check (NRC) from W. C. Hickling, FWS Area Manager, Asheville, North Carolina. November 5, 1981.

TABLE 2. List of Knowledgeable Individuals Contacted During Preparation of this Biological Assessment

<u>Individual</u>	<u>Affiliation</u>
Robert Currie	U.S. Fish and Wildlife Service
Gabe Marciante	Oak Ridge National Laboratory
John J. Jenkinson	Tennessee Valley Authority
David A. Tomljanovich	Tennessee Valley Authority
Donald C. Wade	Tennessee Valley Authority
Billy G. Isom	Tennessee Valley Authority
Eric L. Morgan	Tennessee Technological University
Robert E. Jenkins	Salem College

TABLE 3. Summary of Freshwater Mussels Collected from the Clinch River in the Vicinity of the CRBR Site During the Spring of 1982.¹

Species	Transect Searches (summed by River Mile)								Random Searches			
	14	15	16	17	18	19	20 ²	Totals	14.8R ⁴	16.0R ⁵	17.9R ⁶	19.1 ⁷
<u>Amblema costata</u>	10	1	1	2				14		2		
<u>Anodonta grandis</u>	3	1	2	2	9	4	9	30	1	4	2	
<u>Anodonta suborbiculata</u>			1		2			3		1		
<u>Cyclonaias tuberculata</u>	5	3	3	2	2			15	1			
<u>Elliptio crassidens</u>							1	1				
<u>Lampsilis orbiculata</u> ³								0				1
<u>Lasmigona complanata</u>		3		1		1	1	6		1		
<u>Pleurobema cordatum</u>	1		1					2				
<u>Proptera alata</u>			1	1	3			5			1	
<u>Quadrula metanevra</u>	1						1	2				
<u>Quadrula pustulosa</u>	25	24	34	10	12	4	2	111	13	14	15	
Total Specimens	45	32	43	18	28	11	12	189	15	22	19	
Species Present	6	5	7	5	5	5	3	10	3	5	4	
Average Per Transect	9.0	6.4	8.6	3.6	5.6	2.2	2.0	5.2				

1. From Jenkinson, 1982
2. Includes data from river mile 21.0
3. Endangered species
4. Location of the proposed barge unloading facility
5. Location of the proposed discharge
6. Location of the proposed intake
7. Collection location of L. orbiculata

Table 4. Record of Lampsilis orbiculata orbiculata from the Tennessee System collected during 1976 and 1978 by TVA.*

River and Reach	Site Location	Source of Information	Indication of Abundance	
<u>Tennessee River</u>				
TRM 5.3-22.0	TRM 22.0	TVA 1978a	Not Available	
TRM 105.5, 125.9-206.7	164.5	"	1 of 523	
	170.4	"	2 of 1,808 specimens examined	
	174.5-175.5	"	1 of 1,003 specimens examined	
	197.0	"	2 of 1,498 specimens examined	
	201.0-205.0	"	2 of 870 specimens examined	
	TRM 249.8-257.8	251.0	TVA 1978b	1 collected
TRM 334.5-346.5	252.8	"	4 collected	
	334.5	"	1 collected	
	336.5	"	2 collected	
	336.6	"	5 collected	
	344.0	"	1 collected	
	345.6	"	1 collected	
	346.5	"	1 collected	
TRM 422.3	Not found			
TRM 514.2-528.9	518.4	TVA 1978b	Not Available	
	520.2	"	"	
	520.3	"	"	
	520.4	"	"	
	520.7	"	"	
	521.0	"	"	
	521.0	"	"	
	521.3	"	"	
	525.0	"	"	
	527.4	"	"	
	528.0	"	"	
	528.1	"	"	
	TRM 576.4-600.8	588.4	TVA 1978b	Not Available
		592.5	"	"
<u>Cumberland River</u>				
CRM 273-305.3	CRM 275.4	TVA 1976	1 of 252	
	279.5	"	Not Available	
	281.2	"	"	
	283.0	"	2 of 371	
	283.0	"	1 of 171	
	284.3	"	3 of 80	
	291.1	"	1 of 500	
	293.1	"	2 of 140	
	296.8	"	3 of 181	
	297.0	"	3 of 26	
	302.8	"	2 of 14	
	305.3	"	2 of 8	

* From Jenkinson (person. comm., 1982).

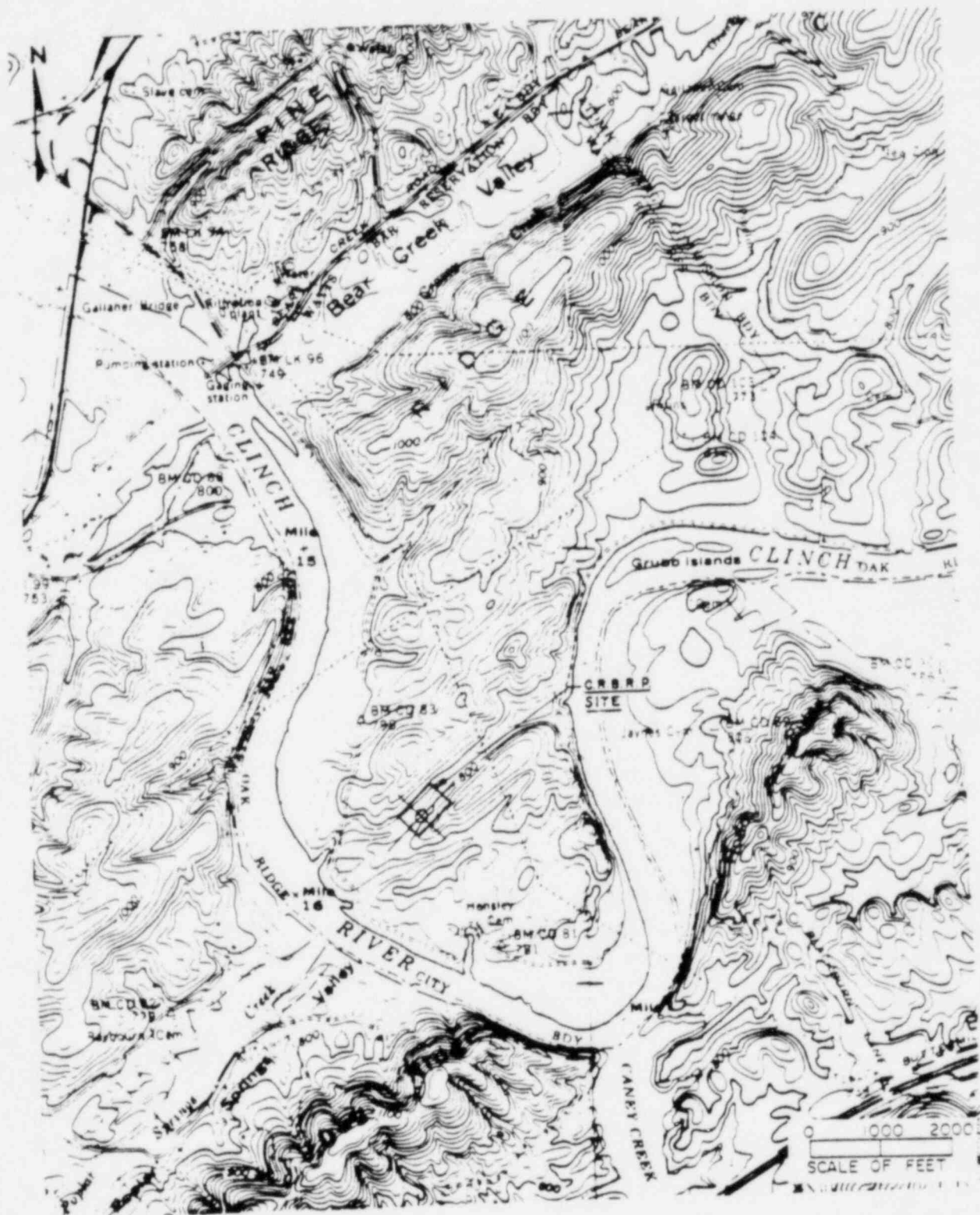


Figure 1. Map of Site and Surrounding Area*

*From ER (1975), Fig. 2.1-5

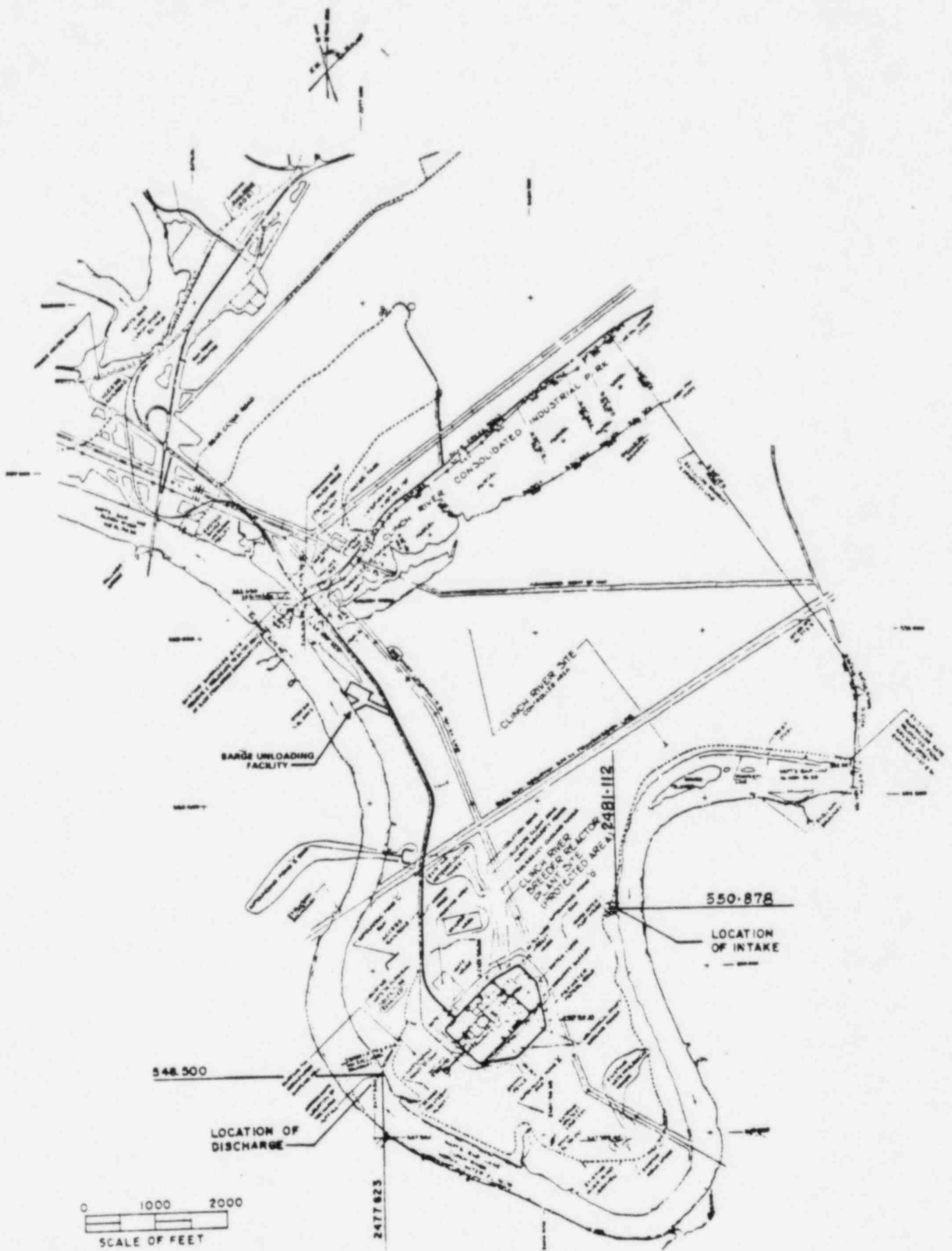


Figure 2. Map of Site and General Plant Area*

*From EP (1975) Figs. 4.1-1 and 3.4-9

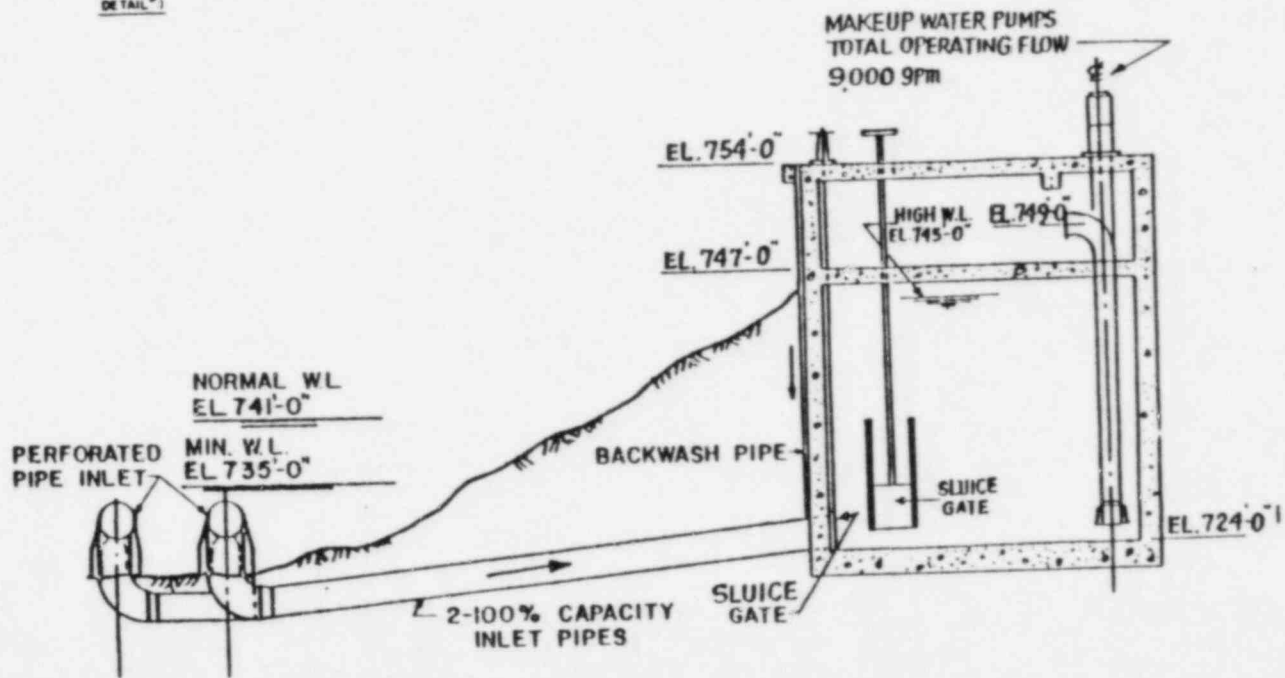
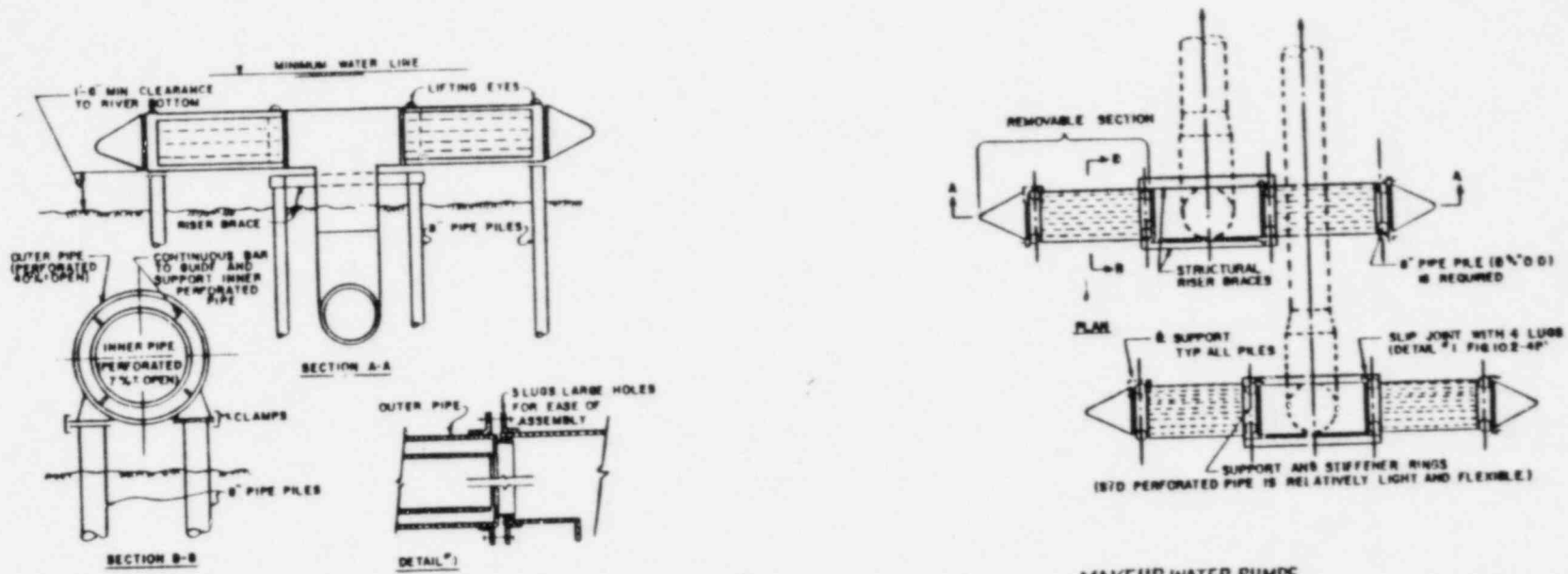


Figure 3. Perforated Pipe Intake Structure*

*From NRC (1977), Figs. 3.8, 3.10, 3.11

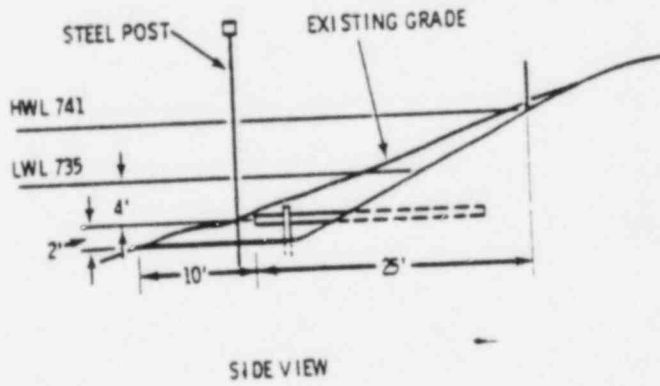
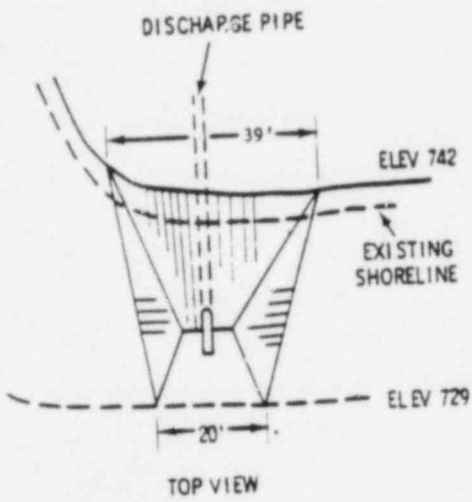


Figure 4. Submerged Single Port Discharge Structure*

*From NRC (1977), Fig. 3.12

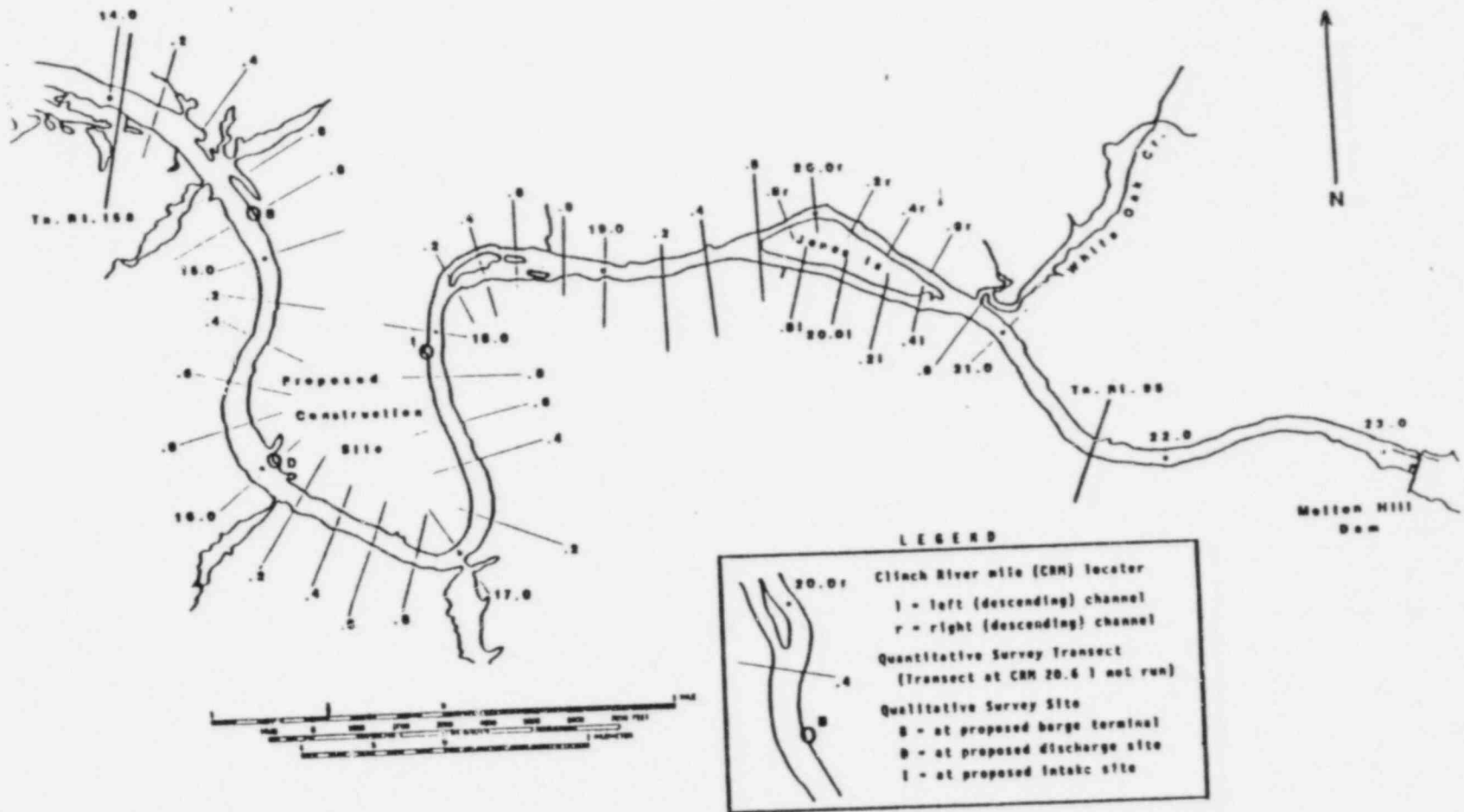


Figure 5 Location of the Mussel Survey Transects and Areal Survey Sites Examined in the 1982 TVA Study*

*From Jenkinson (1982), Fig. 1.