December 11, 2002

Colonel Thomas L. Koning
District Engineer
New England District, Corps of Engineers
696 Virginia Road
Concord, MA 01742-2751

Dear Colonel Koning:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion regarding the effects of the Surry Mountain Lake Flood Control Project located in Surry, New Hampshire, on the federally-listed endangered dwarf wedge mussel (*Alasmidonta heterodon*) in accordance with Section 7 of the Endangered Species Act of 1973 (ESA), as amended, (16 U.S.C. 1531 et seq.).

This biological opinion is based on information provided in your January 9, 2002 letter requesting initiation of formal consultation and your July 25, 2002 revised Biological Assessment (BA) describing the proposed project. It is also based on numerous telephone conversations with Army Corps of Engineers (ACOE) New England District staff, meetings with the Surry Mountain Lake Flood Control Project manager and staff, recent surveys of dwarf wedgemussels in the Ashuelot River and site visits during an experimental flow manipulation and conduit inspections. A complete administrative record of this consultation is on file at this office.

I. CONSULTATION HISTORY

The consultation history regarding this project is provided in Appendix I.

II. BIOLOGICAL OPINION

Description of Proposed Actions

The Surry Mountain Lake Flood Control Project (Surry Project) on the Ashuelot River is located within the Connecticut River watershed in the town of Surry, New Hampshire. It regulates a drainage area of approximately 100 square miles and provides flood protection to Keene, Swanzey, Winchester and other downriver communities. In conjunction with other flood control reservoirs in the Connecticut River Basin, the Surry Project also contributes to flood protection for communities along the mainstem of the Connecticut River in Massachusetts and Connecticut (U.S. Army Corps of Engineers 1981).

The Surry Project covers 1,695 acres of land acquired in fee and 86 acres in flowage easement, and has a permanent recreational reservoir of approximately 250 acres. Recreational facilities include a 600-foot swimming beach, boat ramp, picnic tables, playground, sanitary facilities and hiking and snowmobiling trails. The beach is open from mid-May into early September.

The dam for the Surry Project is an 1,800-foot rolled earth and rock-filled embankment, with a maximum height of 86 feet. Outlet works consist of an intake structure, two 4.5-foot by 10-foot stainless steel control gates, a 383-foot-long, 10-foot diameter conduit through the dam, and an outlet channel. Additional details on the Surry Project can be found in the Biological Assessment: Surry Mountain Lake Water Resource Development Project, Connecticut River Basin, Surry New Hampshire (BA), pages 4 - 6 (U.S. Army Corps of Engineers 2002).

The Surry Project is operated under the Master Water Control Manual for the Connecticut River Basin (U.S. Army Corps of Engineers 1983), Appendix 3 of the manual (U.S. Army Corps of Engineers 1972) and under unpublished, standard operating procedures developed since the last manual was revised. Surry Project outflows generally equal inflows unless adjusted during flood control or for scheduled non-flood activities. A detailed description of the reservoir operations is provided on pages 6 through 18 of the BA. Outflow guidance for flood and non-flood control activities is provided in Table 1.

Table 1. Outflow Guidance for Surry Mountain Lake Flood Control Project (BA page 6)

Event	Maximum Outflow (cfs)	Minimum Outflow (cfs)	Maximum Change in Outflow	
			Increase	Decrease
Daily Operation (non-flood control), Maintenance, and Canoe Releases	NA	75 cfs or inflow – whichever is less	100 cfs/hr above 400 cfs, 50 cfs/hr between 75 and 400 cfs	100 cfs/hr to 400 cfs, then 50 cfs/hr to 75 cfs
Emergencies	N/A	75 cfs or inflow whenever possible	100 cfs/hr above 400 cfs, 50 cfs/hr between 75 and 400 cfs	As dictated by nature of the emergency.
Flood Control – growing season[1]	850	75 cfs or inflow – whichever is less	100 cfs/hr up to 1000 cfs, then 50 cfs/hr thereafter	500 cfs/hr down to 200 cfs, then 50 cfs/hour to 75 cfs. No reductions below 75 cfs for flood control.
Flood Control – non-growing season[2]	1250			

The ACOE's standard operating procedures for scheduled non-flood and flood control activities are summarized below.

Non-Flood Control Activities
Normal reservoir operations maintain the pool-stage at approximately 14.5 feet during the summer and approximately 17 feet during the winter (to prevent gates from freezing). The pool is generally increased from 14.5 feet to 17 feet when inflows are above 75 cfs. Gate changes may be made when inflows are below 75 cfs to establish or maintain the winter pool.

Additional changes to flows and/or the pool-stage occur during non-flood scheduled activities. These activities include: 1) structural repairs and maintenance, 2) beach maintenance, 3) periodic inspections, 4) debris removal, and 5) recreational releases. Reductions in outflow below 75 cfs for maintenance or other non-flood purposes will be avoided, when possible. The ACOE will consult with the Service for unavoidable reductions in flow below 75 cfs. Ramping rates required to reduce flows to below 75 cfs will be approximately 15 cfs/day (BA page 8). Should an emergency require reducing flows below 75 cfs, the ACOE will notify the Service.

Structural repairs and maintenance: Structural repairs and maintenance include repairs to flood control gates or outlet works such as weirs or the conduit. Flow modification may be required in order to safely conduct the repair work. Modification of existing flows is coordinated with the Service and the New Hampshire Department of Fish and Wildlife to avoid adverse effects on state-
and federally-listed species. Ramping rates will follow those identified in Table 1. Maximum

[1]May 1 through August 1 (B. Williams, Army Corps of Engineers New England District, Concord, MA, pers. comm. 2002) calculated for summer pool maintenance.

[2]August 2 through April 30 (B. Williams, pers. comm. 2002) calculated for winter pool maintenance.

outflow during maintenance activities will not exceed 1,250 cfs.

Beach maintenance: All beach maintenance will be done in the "wet", *i.e.,* no draw down of the reservoir below the 14.5-foot pool stage. Previously, the reservoir pool was reduced below the 14.5-foot stage in order to conduct beach maintenance activities. This draw down occasionally occurred over a period of days. Outflow was then reduced below 10 cfs in order to reestablish the pool. The reduced flows resulted in the stranding of dwarf wedgemussels observed by the Service in September of 1998.

Periodic inspections: Periodic inspections of the outlet conduit and gates are required to maintain dam safety (BA page 12). Procedures for conducting inspections are described for three flow regimes (BA pages 7 - 8):

1. Flows ≤ 10 cfs: Inspections will occur under natural low flow conditions where flow is ≤ 10 cfs, and are most likely to occur in August or September.

2. Flows between 10 cfs and 15 cfs: If the conduit cannot be safely or adequately inspected, flows may be reduced using the following ramping procedure:
   a. Flows will be ramped down to approximately 10 cfs over a two-hour period. This would generally only occur after Labor Day weekend since it would require a draw down of the reservoir (affecting recreational use).
   b. Reduction in flows should occur in the early morning or late afternoon to minimize possible overheating of mussels.
   c. Inspections should occur under cool, overcast weather conditions, when possible.
   d. Inspections should not take longer than one hour.
   e. Flows will be ramped up as quickly as possible to current inflows.

3. Flows ≥ 15 cfs: If the inspection cannot occur under the first two conditions, ramping rates are as follows:
   Inspections will occur in October.
   A minimum of 10 cfs will be maintained
   Ramping protocol:
   outflow greater than 400 cfs - ramp rate 100 cfs/hour
   outflow less than 400 cfs - ramp rate 50 cfs/hour
   outflows between 75 cfs and 30 cfs - ramp rate approximately 15 cfs/24 hours
   outflow between 30 cfs and 15 cfs - ramp rate approximately 10 cfs/hour
   Inspection not to exceed one hour.
   Upon completion of inspection, flows will be ramped up to 75 cfs or inflow as quickly as possible.
   Inspections will occur under cool, overcast weather conditions, when possible.

Debris removal: Flows are occasionally reduced to facilitate the removal of debris that has collected on the trash racks, gates or in the conduit. Outflow may be reduced for approximately 20 minutes in order to safely remove the debris. Outflow is then returned to existing levels.

Canoe releases: One scheduled release for a canoe race in the Ashuelot River is permitted per year, generally in late April or early May. The maximum outflow during a canoe release is 350 cfs (Table 1); generally outflows are maintained at 275 cfs. During low flow conditions, it is necessary to store water prior to release. In this case, outflows will be reduced to raise the reservoir level one foot above the normal 14.5-foot stage. Raising the reservoir (thus reducing outflows) will occur over the course of one to two weeks with outflow maintained at 75 cfs or inflow (whichever is less).

Flood Control Regulation

Flood control operations are regulated according to two seasons: growing season (May 1 to August 1) and non-growing season (August 2 to April 30) (B. Williams, pers. comm. 2002). Activities occur under the following three phases (BA pages 10 - 11):

Phase 1: Reservoir discharge is generally restricted whenever rainfall in the basin exceeds 2" during a 24-hour period. In practice a minimum of approximately 75 cfs is discharged, although gates could be completely closed according to the Connecticut River Water Control Manual (U.S. Army Corps of Engineers 1983).

Phase II: Reservoir discharge continues to be restricted. Minimum discharge is generally 75 cfs, although it may be as low as 25 cfs according to the Connecticut River Water Control Manual (U.S. Army Corps of Engineers 1983).

Phase III: Once a flooding event is determined to be over, the reservoir is drawn down using ramping rates described in Table 1. In order to minimize slumping of the river banks, the maximum rate of reservoir draw down should not exceed five feet per 24 hours. Maximum outflow is not to exceed 850 cfs during the growing season and 1,250 cfs during the non-growing season (Table 1).

Additional Operation and Maintenance Activities

General maintenance of the landscape and facilities associated with the Surry Project includes landscape maintenance, vegetation control, natural resources management, maintenance of roads, bridges, parking lot, office and recreational facilities, and cultural resources management. These activities, their frequency of occurrence and consultation requirements with other agencies including the Service are summarized in Table 5 of the BA (pages 15 - 17).

Conservation Measures
The ACOE has identified specific outflow guidance that should reduce impacts to dwarf wedgemussels from changes in flow rates and water regimes. Moreover, the ACOE's guidance prohibits certain activities without prior consultation with the Service and the New Hampshire Fish and Game Department. Project-specific consultation on the following activities may avoid or minimize adverse effects on dwarf wedgemussels:

short-term drawdowns for beach maintenance and structural repairs
- reductions in discharge for periodic inspections and repairs (including conduit inspections)
- construction of new bridges and in-kind replacement of bridges
- construction of new roads and parking lots in undeveloped areas
- construction of new facilities in undeveloped areas
- construction/maintenance of wildlife viewing areas or structures
- minor habitat restoration or enhancement projects
- streambank stabilization

Background Information

The dwarf wedgemussel is the only North American freshwater mussel that has two lateral teeth on its right valve and only one lateral tooth on its left valve. The outer shell is often dark with a greenish cast, though it may be faintly rayed in younger, lighter animals. The anterior end is rounded while the posterior end is lengthened and angular, giving this mussel its characteristic "wedge-shape". The dwarf wedgemussel rarely exceeds 1.5 inches in length.

The dwarf wedgemussel is found solely in Atlantic Coast drainage streams and rivers of various sizes and moderate current. It has been found in a variety of substrates including firm sand, clay banks, muddy sand, and mixed sand, gravel and cobble. In the southern portion of its range, it is often found buried under logs or root mats in shallow water (U.S. Fish and Wildlife Service 1993). In the northern portion of its range, the dwarf wedgemussel has been found in firm substrates of mixed sand, gravel, cobble, or embedded in clay banks in water depths of a few inches to greater than 20 feet (Fichtel and Smith 1995; Gabriel 1995; Gabriel 1996; Nedeau 2002).

The reproductive cycle of freshwater mussels appears to be similar for nearly all species. During the spawning period, sperm is discharged by males into the water column, and taken in by females during siphoning. Eggs are fertilized in the gills, which serve as marsupia for larval development to mature glochidia. Upon release into the water column, mature glochidia attach to the buccal cavities, gills and fins of appropriate host fish to encyst and eventually drop off onto the substrate as juvenile mussels.

The dwarf wedgemussel is considered to be a long-term brooder. In Virginia, this species spawns in late summer, and becomes gravid in September with glochidia maturing in November (Michaelson 1993). Michaelson estimated that dwarf wedgemussels release glochidia in North Carolina in April. Wicklow (unpublished 2000) observed glochidia release beginning in March and continuing through June in one river in New Hampshire. Host fish for this species include the tesselated darter (*Etheostoma olmstedi*), Johnny darter (*E. nigrum*), mottled sculpin (*Cottus bairdi*) (Michaelson 1993), slimy sculpin (*C. congatus*) and juvenile Atlantic salmon (*Salmo salar*) (B. Wicklow, St. Anselm College, Goffstown, NH, pers. comm. 1996).

The dwarf wedgemussel was federally-listed as endangered on March 14, 1990. At one time, this species was recorded from 70 localities in 15 major drainages ranging from North Carolina to New Brunswick, Canada. Currently, there are approximately 80 documented locations for dwarf wedgemussels (Appendix B). Of these, approximately 16 are known or are believed to be reproducing populations. At least 31 of these sites are based on less than five individuals or solely on spent shells. The only known occurrence in New Brunswick, Canada (Petticodiac River) appears to be historic; no live mussels or spent shells were found during a 1997 survey (M. Hanson, Fisheries and Oceans Canada, *in litt.*,1998).

The Ashuelot River is located within the Connecticut River watershed. There are 13 known occurrences of the dwarf wedgemussel in the Connecticut River drainage, most of which are small (less than five individuals). The main stem of the Connecticut River in New Hampshire and Vermont is considered to have two of the largest remaining dwarf wedgemussel populations within its range. The upper Connecticut River population, from Northumberland to Dalton, New Hampshire, was surveyed in 1996 to determine the extent of the population. Based on preliminary surveys, it appears that the dwarf wedgemussel is scattered throughout this approximately 18-mile stretch of river. The only site that has been repeatedly surveyed and monitored is located in Lunenburg, Vermont. Surveying at this location was initiated as a result of a bank stabilization and mussel translocation project. In 1997, 536 dwarf wedgemussels were moved upriver of the bank stabilization project. In 2000, more than 5,000 dwarf wedgemussels were found in the relocation site, the stabilization site and an area immediately downstream of the bank stabilization project (Gloria and Wicklow 2001). Within a 30m x 10m plot in the translocation area, 985 dwarf wedgemussels were located. The numbers observed in the Lunenburg area indicate a population that may be in the tens of thousands.

The southern population found in the 18-mile stretch of river between Plainfield and Charlestown, New Hampshire has been surveyed and intermittently monitored from 1988 through 2001. Strayer (1994) considered this population to have one of the highest densities and the largest distribution of any of the dwarf wedgemussel populations (this was prior to the discovery of the population between Northumberland and Dalton, New Hampshire). Past monitoring efforts of this Connecticut River population were based on a catch-per-unit of effort method, although this method is not considered to be statistically valid. Nonetheless, five Connecticut River sites were monitored between 1991 and 1995, three on an annual basis. Results ranged from zero dwarf wedgemussels/hour to 24.3 dwarf wedgemussels/hour. However, the catch rate exceeded 10 mussels/hour for only 2 of 22 monitoring efforts (Gabriel 1996).

Human activity has significantly degraded dwarf wedgemussel habitat causing a general decline in populations and a reduction in distribution of the species (U.S. Fish and Wildlife Service 1993; Michaelson 1993). Primary factors responsible for the decline of the dwarf wedgemussel include: 1) impoundment of river systems, 2) pollution, 3) alteration of riverbanks, and 4) siltation (U.S. Fish and Wildlife Service 1993).

Damming and channelization of rivers throughout the dwarf wedgemussel's range have resulted in the elimination of much of its formerly-occupied habitat. In general, dams and river channelization activities result in the loss or alteration of mussel habitat (Watters 2001). Immediately upstream of a dam, conditions such as heavy silt deposition, low current and low oxygen levels are not conducive to the maintenance of dwarf wedgemussel populations. Immediately downstream of these dams, remaining habitat is subject to daily water level and temperature fluctuations and scour, conditions stressful or intolerable to sensitive dwarf wedgemussels. The mainstem Connecticut River populations are separated by a series of dams and miles of habitat that are no longer suitable for dwarf wedgemussels. There are at least five dams remaining on the Ashuelot River, with only one population of dwarf wedgemussels occurring between the Swanzey Dam and the Surry Project.

Domestic and industrial pollution was the primary cause for mussel extirpation at many historic sites. Mussels are known to be sensitive to a wide variety of heavy metals and pesticides, and to excessive nutrients and chlorine (Havlik and Marking 1987). Mussel die-offs have been attributed to chemical spills, agricultural waste run-off and low DO levels. In one instance in August of 2001, more than 20 dwarf wedgemussels and hundreds of other mussel species (including state-listed species) were killed in the Connecticut River watershed by waste run-off from a small farm (S. Jackson, University of Massachusetts, Amherst, MA, pers. comm. 2001). Some pollutants indirectly impact the mussels; for example, nitrogen and phosphorus cause organic enrichment, and in extreme cases, oxygen depletion.

Riverbank alteration includes bank erosion control measures, such as riprap, and removal of vegetation, particularly shade trees and bushes. Placement of unwashed riprap along the bank will result in increased sedimentation in the water column, while placement of stones in the river will bury mussel beds and habitat. Removal of shade trees and bushes in small stream systems may lead to significant daily water temperature fluctuations and alter light levels, potentially affecting both the mussels and host fish species. These detrimental activities have been observed on numerous occasions within the Connecticut River watershed and include riparian vegetation removal along a golf course on the Ashuelot River, river bank stabilization on the mainstem of the Connecticut River (permitted and illegal), and removal of riparian vegetation, streambank stabilization and construction of a weir on the Mill River in Massachusetts.

Siltation, generated by road construction, agriculture, forestry activities, and removal of streambank vegetation, is considered to be an important factor in the decline of many freshwater mussel species, including the dwarf wedgemussel. Sediment loads in rivers and streams during periods of high discharge may be abrasive to mollusk shells. Erosion of the outer shell allows acids to reach and corrode underlying shell layers (Harman 1974). Irritation and clogging of gills

and other feeding structures in mussels occur when suspended sediments are siphoned from the water column (Loar *et al*. 1980), severely affecting the mussel's normal activity or even causing death.

Because freshwater mussels are relatively sedentary and cannot move quickly or for long distances, they cannot easily escape when silt is deposited over their habitat. Ellis (1936) found that mussels could not survive in substrate on which silt accumulated to depths over 0.6 - 2.5 cm. He observed dying mussels with large quantities of silt in their gills and mantle cavities and attributed their deaths to interference with feeding and to suffocation. In addition, Ellis determined that siltation from soil erosion reduced light penetration, altered heat exchange in the water, and allowed organic and toxic substances to be carried to the bottom where they were retained for long periods of time. This resulted in further oxygen depletion and possible absorption of these toxicants by mussels (Harman 1974).

A further probable adverse effect on many mussel species is the impact of sedimentation or pollution on host fish species. Some fish species are vulnerable to changes in light, turbidity and pollutants. Any water quality degradation that affects host fish species may affect mussels.

Most of the dwarf wedgemussel populations are small and geographically isolated from each other (U.S. Fish and Wildlife Service 1993). This isolation restricts exchange of genetic material among populations, and reduces genetic variability within populations (U.S. Fish and Wildlife Service 1993). Strayer (1994) conducted a rangewide assessment of the dwarf wedgemussel (the assessment did not include the Lunenburg/Lancaster population in the upper Connecticut River), examining thirteen rivers and streams from New Hampshire to North Carolina. Strayer concluded that all 13 populations of the dwarf wedgemussel, including the population in the lower Connecticut River, are vulnerable to loss because of their small range, low population densities, linear ranges, or some combination of the three factors. However, for all but one of the populations studied, densities determined by Strayer were large enough so that he did not expect them to be affected by problems such as inbreeding or demographic stochasticity. Nevertheless, Strayer felt that these populations demonstrated lower fertilization rates than other freshwater mussel species, even though there was evidence of reproduction at most sites.

Effects of the Federal Action on the Dwarf Wedgemussel and its Habitat

Environmental Baseline

The environmental baseline is a summary of the status and health of the species and/or its habitat in the area affected by the proposed action. As defined in 50 CFR 402.02, “action” means all activities or programs of any kind that are authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas. The “action area” is defined as all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action. The direct and indirect effects of the actions and activities resulting from the federal action must be considered in conjunction with the effects of other past and present federal, state or private activities, as well as the cumulative effects of reasonably certain future state or private activities within the action area.

Description of the Action Area

The action area includes the Surry Project and approximately seven miles of the Ashuelot River between the Surry Project and the Colony Mill Dam in Keene (Fig. 1). Beyond the Colony Mill dam, tributaries to the Ashuelot River, including Ash Swamp Brook, Branch Brook, Otter Brook and South Branch of the Ashuelot River provide sufficient flow to buffer impacts to dwarf wedgemussels downriver of Keene under low flow conditions (see Effects of the Action Section). Dwarf wedgemussels are known to be scattered throughout the action area.

Status of the Species in the Action Area

The Ashuelot River is considered to have a large population of dwarf wedgemussels scattered throughout approximately 14 river miles. At this time, only the two Connecticut River populations are considered to be larger. The upper extent of the Ashuelot River population was periodically monitored from 1991 to 1996 (Craig 1996; Gabriel 1996) over an approximate two- to four-mile stretch of river beginning immediately below the Surry Project dam (by the USGS gauging station). Until 2001, this area was considered to have the only extant population in the Ashuelot. Total numbers found in surveys (conducted over unequal lengths of river) ranged between 38 and 103 mussels. A general comparison of survey results was made by Craig (1996) based on mussels found per person hour to compare year-to-year results; total numbers of dwarf wedgemussels for eight survey segments ranged from 2.05 mussels/hour to 5.83 mussels/hour. Smith *et al.* (2000) estimated an overall density of dwarf wedgemussels at survey segment 1 to be approximately 1.1 per m^2. He considered this to be an intermediate density compared to the Connecticut River (2.45 per m^2) and the Neversink River (0.71 per m^2).

In 2001, surveys beginning approximately nine miles downriver of the known Ashuelot River population (Fig. 1) located additional scattered dwarf wedgemussels throughout a 3.4-mile stretch of river. Thirteen individuals were found at six different locations within the survey area (Nedeau, 2001), although two sites had clusters of dwarf wedgemussels (six and four individuals respectively), indicating potential mussel concentrations.

Factors Affecting the Species Within the Action Area

The Bretwood Golf Course abuts the Surry Project and borders the Ashuelot River for approximately two river miles. The golf course has tees and holes on both sides of the river. Dwarf wedgemussels are found in smaller numbers in the portion of river abutting the golf course and immediately down river of it. A number of impacts, both physical and chemical, are believed to be associated with the golf course. Riparian vegetation, including large trees and shrubs, was removed for much of the length of the river as it winds through the golf course, most likely resulting in highly fluctuating water temperatures during low flows. Surveys indicate that higher numbers of dwarf wedgemussels occur above the golf course than below it (Craig 1996). Although the golf course was landscaped to route run-off away from the river, under high water events the course is flooded, washing pesticides and fungicides directly into the river. Grass clippings contaminated with turf management chemicals are dumped at the top of the river bank on a regular basis (S. von Oettingen pers. observation). Water is pumped out of the river at two locations for irrigation.

Single family homes, agricultural fields and a bridge crossing at Route 12A are found below the golf course. Lawn chemicals and road run-off including sediment, salt and petroleum products may further degrade water quality. However, riparian vegetation generally appears to be maintained along the riverbank. The watershed between the Surry Project and Route 12A is also a secondary well field for the Town of Keene and water quality is constantly monitored. To date, there has been no indication of water contamination at a level to threaten human consumption.

Turner (2002) investigated physical river characteristics and the potential effect of flows on the dwarf wedgemussel population in the Ashuelot River. Although she was unable to determine a single variable influencing mussel populations, she observed that water depth variability and substrate variability might influence mussel distribution in the Ashuelot River. These factors may be important in determining the level of effects from changes in flow on dwarf wedgemussel populations.

Direct Effects: Flows

Direct adverse effects to dwarf wedgemussels may occur during sudden and extreme water level fluctuations, particularly during the reproductive season of March through June (glochidial release) and during August and September low flows (spawning). A sudden increased flow during these periods may prevent glochidia from infesting host fish, wash juvenile mussels into unsuitable habitat or prevent successful spawning. Sudden flow pulses may also displace adult mussels. Turner (2002) observed that mussels nearer to Surry Dam would experience the greatest adverse effects of suddenly increased flows since they are closer to the source of release.

Conversely, rapid reductions in flow may strand mussels, making them vulnerable to dessication, high ambient temperatures and increased predation. The Service and the ACOE investigated stretches of the Ashuelot River in the action area for locations particularly affected by sudden reductions in flows. At least one location, an area by the East Surry Road Bridge, was noted to be significantly dewatered when flows suddenly dropped below 15 cfs. Surveys indicate that many dwarf wedgemussels are located in shallow water at the edge of the river bank in this location, in a band between one and two feet from the water's edge. In August 2002 during natural low flows, more than 10 dwarf wedgemussels were observed clustered in a few inches of water less than one foot from the water's edge. A rapid drop in water levels would leave these mussels stranded or in less than one inch of water. In September of 1998, flows were dropped below 10 cfs for more than three days for beach maintenance activities. Spent shells of dwarf wedgemussels and other small mussels (young *Elliption complanata*) were collected in numbers generally higher than found during previous surveys, possibly indicating selective predation of small mussels as a consequence of lower water levels. Moreover, a number of dwarf wedgemussels were found stranded above the water line in wet sand.

The Surry Project outflow guidance for non-flood control activities states that flows will not be reduced below 75 cfs or inflow *when possible*. Ramping rates to reduce flows below 75 cfs would be approximately 15 cfs/day. Direct impacts to mussels would be expected to occur during those occasions when flows are suddenly reduced below 50 cfs for an extended period of time (more

than a few hours). The severity of impacts would be dependent upon weather, time of day and longevity of the decreased flow since these factors might influence dessication and/or predation rates.

Theoretically, dwarf wedgemussels could be directly affected by high discharge rates during a flood. Flood control operations may require discharges to reduce the reservoir pool once the flooding event is over (Phase III). Ramping rates have been developed to minimize the level of impacts to downriver fauna (Table 1). Although mussels have evolved to exist in an environment with dramatic changes in flows (storm events), increased flows during low flow seasons, for example, might cause adverse effects on mussels depending upon their life stage at the time of the event (glochidia, juvenile mussels or gametes). It is unknown if the release of 500 cfs will cause juvenile mussel displacement or briefly disrupt reproduction if occurring during the reproductive season. Impacts would be dependent upon existing flow conditions and how significantly the proposed ramping schedule deviates from the current flow.

Direct Effects: Water Quality

Surry Mountain Lake is currently classified as borderline oligiotrophic/mesotrophic and does not appear to release high nutrient loads downriver (BA page 13). However, immediately below the dam, large numbers of *E. complanata* are found [these mussels were considered to be the primary "substrate" during a 1997 survey for a study of monitoring techniques (S. von Oettingen pers. observation 1997)]. *E. complanata* are considered to be very tolerant of high levels of nutrients. Their presence immediately below the dam could indicate elevated nutrient levels in the discharge water. The nutrient-rich water could be allowing *E. complanata* to outcompete dwarf wedgemussels and other species, effectively displacing them.

Indirect Effects

Indirect effects are defined as those that are caused by the proposed action and are later in time, but still reasonably certain to occur (50 CFR §402.02). No indirect effects are expected as a result of the Surry Project.

Cumulative Effects

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA. The Bretwood Golf Course has the ability to withdraw water from the Ashuelot River during periods of low flow (water withdrawal is not regulated). There may be adverse effects to dwarf wedgemussels in the immediate vicinity of the irrigation pipes, particularly during periods of low flow and high ambient temperatures. Habitat may be made unsuitable or conditions created to increase predation or physical stress to mussels inhabiting shallow and unusually warm waters. There are still available tracts of land suitable for development adjacent to the Ashuelot River within the project area. Increased development would be expected to cause increased water quality degradation from lawn and road run-off and removal of riparian vegetation.

Conclusion

After reviewing the current status of the dwarf wedgemussel, the environmental baseline for the action area, the effects of the Surry Project and the cumulative effects, it is the Service's biological opinion that the Surry Mountain Lake Flood Control Project is not likely to jeopardize the continued existence of the dwarf wedgemussel. No critical habitat has been designated for this species, therefore, none will be affected.

The non-jeopardy determination is based on the fact that dwarf wedgemussels have been monitored for almost a decade with no indication of a decline in the general population in the Ashuelot River immediately below the Surry Project. Until recently, the Surry Project was operated in a manner that did not avoid adversely affecting dwarf wedgemussels (for example, protracted discharges of 10 cfs or less during low flows occurred periodically and without consultation). Although take has been observed due to sudden reductions in flows for non-flood control events (BA pages 28 - 30), the take was not sufficient to significantly affect the population and jeopardize the species. Conservation measures included in the project proposal should also ensure that the species will not be jeopardized.

III. INCIDENTAL TAKE

Section 9 of the ESA and federal regulations pursuant to Section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is defined by the Service as an act that actually kills or injures wildlife, and is further defined as significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose

of, the carrying out of an otherwise lawful activity. Under the terms of Sections 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be a prohibited taking under the ESA, provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The ACOE has a continuing duty to regulate the activity that is covered by this incidental take statement. The measures described below are non-discretionary, and must be implemented by the ACOE in order for the exemption in Section 7(o)(2) to apply. If the ACOE fails to adhere to the terms and conditions of the incidental take statement, the protective coverage of Section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the ACOE must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR §402.14(I)(3)].

Amount or Extent of Incidental Take Anticipated

The Service anticipates that incidental take of dwarf wedgemussels throughout the action area will be difficult to detect. Current monitoring methodology generally does not give precise population counts and detecting a significant change in the population may take years or decades. A significant percent of the dwarf wedgemussel population may occur below the surface of the substrate at any given time, precluding exact mussel counts. Although spent shells may be collected, attributing the cause of mortality may be difficult. Glochidia and juvenile mussels are extremely difficult to detect, therefore it is impossible to document take of either of these life stages.

Take may occur in the form of lost productivity if sudden high flows occur during glochidia release or spawning, if juvenile mussels are washed downriver into unsuitable habitat, or if host fish species (tesselated darter) are displaced from habitat they share with the dwarf wedgemussel. This incidental take may occur during flood events and will be anticipated for the duration of the project.

We do not expect take to occur during flow manipulations for the annual recreational release, beach maintenance activities, or periodic and conduit inspections occurring under natural low flow conditions where flows are less than 15 cfs. However, the project proposal states that inspections occurring when flows are greater than 15 cfs will require flow reduction following outflow guidelines (Table 1) and should occur during cool, wet weather <u>when possible</u>. Take may occur in the form of harm or harassment if inspections are scheduled during extremely warm weather, if flows need to be significantly reduced (over 75 cfs), and if the inspections last longer than the predicted hour. Therefore, incidental take will be anticipated for inspections or maintenance occurring at flows greater than 75 cfs during high ambient temperatures and lasting more than one hour.

Effect of the Take

The Service has determined that the level of anticipated take is not likely to result in jeopardy to the dwarf wedgemussel.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to further minimize impacts of incidental take of dwarf wedgemussels in the Surry Project:

1. The ACOE shall conduct non-emergency periodic and conduit inspections only during natural low flows (15 cfs or less), removing the need to reduce flows during inspections.

2. The ACOE shall monitor dwarf wedgemussels and their host fish, tesselated darters immediately below the dam in order to determine if flood control and non-flood control operations are impacting mussels more than presently anticipated.

3. The ACOE shall conduct investigations to understand the effects of flow on dwarf wedgemussels and their habitats in order to assess impacts of the Outflow Guidance.

4. The ACOE shall educate and train Surry Project personnel in dwarf wedgemussel identification and habitat requirements in order to provide outreach to the general public, conduct surveys to determine impacts of predation during low flows and assist or conduct population monitoring.

Terms and Conditions

In order to be exempt from the prohibitions of Section 9 of the ESA, the ACOE must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary. The terms and conditions associated with the reasonable and prudent measures articulated in this biological opinion will minimize the level of incidental take identified for the dwarf wedgemussel.

Flows Management for Non-flood Control Activities

1. A conduit inspection was safely undertaken on August 1, 2002 (Fig. 2) at 14 cfs. Therefore, based on observed conditions at 15 cfs and discussions with the ACOE (J. Kedzierski, ACOE, pers. comm. 2002), non-emergency periodic and conduit inspections must occur at flows of 15 cfs or less. Future conduit inspections are scheduled to occur in 2007 or 2008 (B. Williams, pers. comm. 2002).

2. Emergencies occurring during inflows of 75 cfs or greater that require a reduction of outflow to 15 cfs or less must be coordinated with the Service immediately prior to the emergency or the ACOE must contact the Service within five days after the event for additional consultation.

3. Debris removal occurring during flows of 75 cfs or greater must be coordinated with the Service unless ramping rates are set at 15 cfs/day.

Monitoring

Dwarf wedgemussels must be monitored at two locations, the East Surry Bridge and immediately below the weir by (Fig. 3) to determine population trends. A proposal to monitor dwarf wedgemussels must be based on previous monitoring efforts (Smith *et al.* 2000) and coordinated with the Service's New England Field Office and New Hampshire Fish and Game Department. A proposal outlining the monitoring protocol must be prepared and sent to the address below no later than May 15, 2003 in order to implement monitoring by July 2003. Annual monitoring reports must also be sent to the New England Field Office and the New Hampshire Fish and Game Department (John Kanter, New Hampshire Fish and Game Department, 2 Hazen Drive, Concord, NH 03301).

Supervisor
New England Field Office
U.S. Fish and Wildlife Service
70 Commercial St., Suite 300
Concord, NH 03301

Tesselated darters must be monitored at the same locations as the dwarf wedgemussel sites (Fig. 3). Monitoring must take place after July 1 to avoid adversely affecting dwarf

wedgemussel glochidia. A proposal to monitor tesselated darters should be coordinated with the Service's New England Field Office and the New Hampshire Fish and Game Department. The proposed monitoring protocol should be submitted to the Service no later than May 15, 2003. Monitoring may be implemented in the summer of 2003 or 2004 depending if monitoring is concurrent with dwarf wedgemussel surveys or on off-years. Reports on the monitoring efforts must be provided to the New England Field Office and the New Hampshire Fish and Game Department.

Hydrologic investigations must be conducted at the two dwarf wedgemussel monitoring sites to determine effects of high flows, ramping rates and low flows on the mussels and their habitat. A proposal outlining an initial hydrologic investigation must be prepared and sent to the Service's New England Field Office no later than December 15, 2003. The study should be initiated by 2004.

Potential impacts of predation on dwarf wedgemussels during low flows must be investigated. Predation will be documented by collecting spent shells found in mussel middens between the dam and the Bretwood Golf Course during low flows (15 cfs or less). If elevated levels of predation are observed (generally clusters of spent shells), particularly at the East Surry Bridge, the ACOE must contact the Service's New England Field Office to determine whether predator control activities should be considered. Spent shells should be collected and sent to the New England Field Office.

Monitoring data will be reviewed and efforts reassessed every five years in cooperation with the Service and the New Hampshire Fish and Game Department.

All necessary permits for collecting dwarf wedgemussel shells and conducting mussel and fish monitoring must be obtained.

If freshly-killed dwarf wedgemussels are found in the project area, care must be taken in their handling to preserve biological material in the best possible condition. In conjunction with the preservation of any dead specimens, the finder has the responsibility to ensure that evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. The finding of dead specimens does not imply enforcement proceedings pursuant to the ESA. The reporting of dead specimens is required to enable the Service to determine if take is reached or exceeded and to ensure that the terms and conditions are appropriate and effective. Upon locating a dead, injured, or sick specimen of an endangered or threatened species, prompt notification must be made to the U. S. Fish and Wildlife Service's Portsmouth Law Enforcement Office telephone 603-433-0502 or the Supervisor, New England Field Office, 70 Commercial St., Suite 300, Concord, NH 03301, telephone 603-223-2541.

"Sustainable environmental design practices" for all construction and maintenance activities that could affect dwarf wedgemussel habitat must be implemented according to the Department of Defense and the ACOE's Chief of Engineers directives (DOD 2002; U.S. Army Corps of Engineers 2001).

Conservation Recommendations

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are implemented at the discretion of the action agency with the intent of minimizing or avoiding adverse effects of a proposed action on listed species or critical habitat, or to help implement recovery plans, or to develop information.

The Service recommends that the ACOE implement the following conservation measures for the benefit of the dwarf wedgemussel:

> Develop an informational program addressing freshwater mussel conservation for the general public visiting the Surry Project. Outreach materials and activities could include fact sheets, displays, and inter-active programs. The Service's New England Field Office (see contact information above) may be able to assist the ACOE in the development of this program.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendation.

IV. REINITIATION NOTICE

This concludes formal consultation on the actions outlined in the ACOE's July 25, 2002 initiation request. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law), and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals consequences of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

The Service appreciates the opportunity to work with Army Corps of Engineers New England Division in fulfilling our mutual responsibilities under the Endangered Species Act. Please contact Susi von Oettingen of this office at (603) 223-2541 if you have any questions or require additional information.

Sincerely yours,

Kenneth C. Carr
Acting Supervisor
New England Field Office

CC: Reading File
Bruce Williams, ACOE
Mike Penko, ACOE
Jim Lewis, ACOE
Gary Pelton, ACOE
Doug Bechtel, TNC New Hampshire Office
ES: SvonOettingen:12-11-02:603-223-2541

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