Appendix C – Mussel Habitat Surveys

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2007 Mussel Survey

AST Environmental Group

"A DBE Firm Specializing in Streams, Wetlands, Protected Species, Environmental Assessments, and Storm Water Compliance"

August 14, 2007
JS07-121

United States Fish and Wildlife Service
Bill Pearson
1208-B Main Street
Daphne AL 36526

Subject: 30" Water Main Pipeline
Tennessee River Crossing
Morgan and Limestone Counties, Alabama
USACE, TVA and ADEM Joint Public Notice:
07-55, application No. 2007-00977

Mr. Pearson:

AST Environmental Group (AST) has been contracted by Hethcoat & Davis, Inc. to coordinate with the United States Fish and Wildlife Service (USFWS) regarding protected species issues associated with the 30" Water Main project.

It is our understanding that the segment of pipeline to cross the main channel of the Tennessee River is to be directionally bored to a depth approximately 30 feet below the channel, and a segment of pipeline approximately 5,700 feet in length near the north shore of the Tennessee River is to be installed by using a cut-trench method (see attached Site Map). Additionally, six geotechnical bore samples will be required in the project area prior to project implementation.

We have read your letter to the USACE dated July 21, 2007 regarding the project and your concerns about effects on protected mussels that may occur with implementation of the trench-cut installation.

The USFWS lists the following aquatic species for Limestone County:

T - Slackwater darter (*Etheostoma boschungi)*
E - Boulder darter (*Etheostoma wapiti)*
E - Pink mucket pearly mussel (*Lampsilis abrupta)*
E - Rough pigtoe mussel (*Pleurobema plenum)*
E - Cumberland monkeyface mussel (*Quadrula intermedia)*
E - Cracking pearlymussel (*Hemistena lata)*
E - Ring pink mussel (*Obovaria retusa)*
E - Anthony's riversnail (*Athearnia anthonyi)*
E - Slender campeloma snail (*Campeloma decampi)*
E - Armored snail (*Marstonia pachyta)*

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Of the listed aquatic species for Limestone County, the Slackwater darter, Slender campeloma snail and the Armored snail are considered to be creek inhabiting species and would not be impacted by the implementation this project. It is believed that the Boulder darter and the Cracking pearlymussel once inhabited the Tennessee River prior to extensive damming but now do not. Anthony's riversnail occurs in several Limestone County tributaries to the Tennessee River and in one mainstem location near Chattanooga, TN; however it is not known to occur in the Tennessee River proper in the vicinity of the proposed project. The Cumberland monkeyface mussel is known from the Tennessee River but is believed to be extirpated from Alabama. The Ring pink mussel is extremely rare in the Tennessee River and has only been found below Wilson Dam in recent years.

The proposed trench-cut segment of the project lies within an overbank area of the Tennessee River and is bound on the downstream side by a constructed railroad levee. Of the listed aquatic species for Limestone County, we believe that the Pink mucket pearly mussel and the Rough pigtoe mussel may occur in the project vicinity; however given the overbank conditions along the proposed trench-cut segment, it is not highly likely that either mussel species are present within the proposed trench-cut work area.

In order to assess the project area for protected mussels, AST proposes to conduct field surveys in accordance with the following guidelines.

Geotechnical Core Sampling Locations

- AST will conduct mussel surveys at each of the six geotechnical bore locations.
- Surveys will encompass a 60 feet diameter search area centered around each proposed bore location.
- Mussels within each search area will be identified and a representative taxa list will be recorded for each location. Photographs of representative species will be taken for inclusion in the survey report.

Cut-trench Location

- AST will conduct a mussel habitat survey along the length of the proposed cut-trench alignment.
- AST divers will spot examine the substrate / habitat along the cut-trench alignment at intervals not to exceed 100 yards.
- Spot examination areas will be mapped using a hand-held GPS Unit.
- Substrate / habitat present at each spot examination location will be recorded for inclusion in the survey report.
- Mussels incidentally encountered during the habitat survey will be identified and a representative taxa list will be recorded for each location. Photographs of representative species will be taken for inclusion in the survey report.
- Areas along the cut-trench alignment with appropriate substrata for the Pink mucket or the Rough pigtoe will be examined thoroughly for the presence of the two protected species.

Buffer Location

- AST divers will examine areas along the north slope of the main river channel (extending 220 yards upstream from the proposed pipeline alignment and 450 yards downstream from the pipeline alignment) for the presence of Pink mucket or the Rough pigtoe individuals.
- Areas around Islands and additional locations where potential Pink mucket or Rough pigtoe habitat appears to be present within the buffer zone will be thoroughly examined for the presence of listed mussel species.

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- Mussels incidentally encountered during the survey will be identified and a representative taxa list will be recorded. Photographs of representative species will be taken for inclusion in the survey report.

AST is requesting written concurrence of our assessment for this project. We are also requesting your opinion regarding field survey specifications for protected species associated with the proposed project. If you need any additional information, please contact me at (256) 476-7355.

Sincerely,

Jeff Selby, M.S.
Member / Senior Biologist
AST Environmental Group

Attachments:
Site Map

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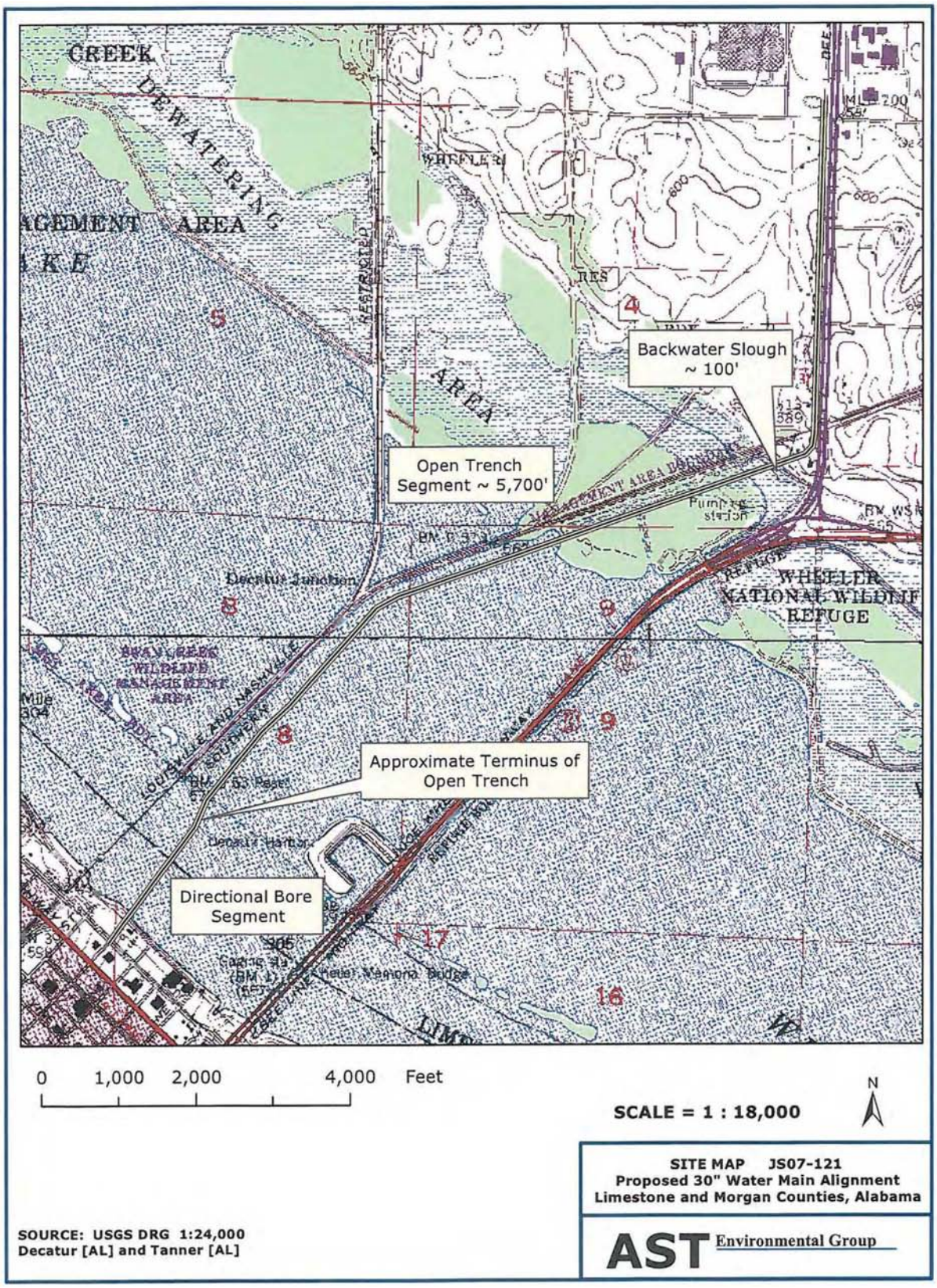
Backwater Slough
~ 100'
Open Trench
Segment ~ 5,700'
Approximate Terminus of
Open Trench
Directional Bore
Segment
WHEELER
NATIONAL WILDLIFE
REFUGE
Decatur Junction
Decatur Harbor
0 1,000 2,000 4,000 Feet
SCALE = 1 : 18,000
N
SITE MAP JS07-121
Proposed 30" Water Main Alignment
Limestone and Morgan Counties, Alabama
SOURCE: USGS DRG 1:24,000
Decatur [AL] and Tanner [AL]
AST Environmental Group

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"A DBE Firm Specializing in Streams, Wetlands, Protected Species, Environmental Assessments, and Storm Water Compliance"

October 12, 2007 JS07-121A

Mr. Jim Williams
Hethcoat and Davis, Inc.
278 Franklin Road, Ste 200
Brentwood, TN 37027

RE: Protected Species Survey
Pink Mucket Pearlymussel (*Lampsilis abrupta*) and
Rough Pigtoe (*Pleurobema plenum*)
30" water main - Tennessee River Crossing
Limestone and Morgan Counties, Alabama

Dear Mr. Williams:

This report documents the results of aquatic surveys and the potential impacts to federally protected mollusk species associated with the proposed pipeline to cross the main channel of the Tennessee River. The proposed pipeline is to be directionally bored to a depth approximately 30 feet below the channel and a segment of pipeline approximately 5,700 feet in length near the north shore of the Tennessee River is to be installed by using a cut-trench method. The site is located just east of the Tennessee River's Louisville and Nashville/Southern railroad crossing between Limestone and Morgan counties, Alabama and is in the Tennessee River Wheeler Lake reservoir.

Pursuant to consultation with the US Fish and Wildlife Service (USFWS), Alabama Department of Conservation and Natural Resources (ADCNR), and the Tennessee Valley Authority (TVA) there was concern the proposed project could cause adverse affects on aquatic communities. AST Environmental Group (AST) conducted an aquatic survey for the Federally listed endangered Pink mucket pearly mussel (*Lampsilis abrupta*) and the Rough pigtoe mussel (*Pleurobema plenum*) on October 4-7, 2007. AST personnel assessed the Tennessee River along the project corridor to determine if protected mussel were present or if suitable habitat existed for the listed species. The species identified by the USFWS and their general habitat requirements are listed below.

Pink Mucket Pearly Mussel – Federally Endangered
The Pink mucket pearly mussel (*Lampsilis abrupta*) has a very solid, somewhat inflated shell. The shell is ovate to subquadrate in outline. Males have rounded to very bluntly pointed posterior margin and females have a broad rounded to truncated posterior margin. The posterior ridge is well defined in males and lies adjacent to the dorsal margin but is indistinct in females. Umbos are inflated and raised above the hinge line with faint, scarcely looped ridges. The periostracum is yellow to dark brown and variable dark green rays may be present. The nacre varies from white to pink.

The Pink mucket pearly mussel is considered a riverine species, formerly scattered throughout the Mississippi, Tennessee, Ohio and Cumberland River systems. It has been collected from a range of riverine habitats including somewhat shallow waters with strong currents and rocky substrates usually with silt free areas. It has been collected

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from deeper waters with slower currents with sand and gravel substrates. The Nature Serve database lists the habitat for this species as: BIG RIVER, MEDIUM RIVER, RIFFLE.

Rough Pigtoe – Federally Endangered
The Rough pigtoe (*Pleurobema plenum*) has a solid inflated shell with a subtriangular outline. The anterior margin is truncated; the posterior margin is straight with a slightly convex dorsal margin and a rounded ventral margin. The posterior ridge is narrowly rounded and slightly curved, with a blunt point ventrally on the posterior margin. A shallow sulcus is often present, anteriorly to the posterior ridge, with a median ridge located centrally. Umbos are elevated above the hinge line with few irregular nodulous ridges. Periostracum has a satiny yellowish brown to reddish brown. Occasionally a series of fine dark green rays on posterior half of shell are present. The nacre is usually white but may be pink.

The Rough pigtoe historically occurred throughout the Ohio, Cumberland, and Tennessee River drainages. This species has been known to inhabit sand, gravel and cobble shoals of medium to large rivers. The Rough pigtoe has also been collected from mud and sand flats. Extant populations of this species currently inhabit tailwaters below three impoundments on the mainstem of the Tennessee River (Pickwick, Wilson, and Guntersville). The Nature Serve database lists the habitat for this species as: BIG RIVER, MEDIUM RIVER.

Mollusk Survey

Geotechnical Bore Locations. The Tennessee River was surveyed for mussel at each of 10 geotechnical bore locations by divers using SCUBA or surface-supplied air (Figure 1). The surveys encompassed a 60 feet diameter search area centered around each proposed bore location as determined using a hand-held GPS unit. Mussels within each search area were identified and a representative taxa list recorded for each location. Photographs of representative species were taken.

Cut-trench Location. A mussel/mussel habitat survey along the length of the proposed cut-trench alignment was also conducted as part of the assessment (Figure 2). AST divers spot examined the substratum/habitat along the cut-trench alignment at intervals of approximately 100-150 yards. Spot examination areas were mapped using a hand-held GPS unit. Substratum/habitat present at each spot examination location was recorded and mussels incidentally encountered during the habitat survey were identified and a representative taxa list recorded for each location. Photographs of representative species were taken. For areas along the cut-trench alignment with appropriate substrata, a 50 feet wide swath was examined for the presence of the Pink mucket or the Rough pigtoe.

Buffer Location. AST divers examined a search area along the north slope of the main river channel that extended from the proposed pipeline location 220 yards upstream and 450 yards downstream for the presence of Pink mucket or the Rough pigtoe individuals. Locations where potential Pink mucket or Rough pigtoe habitat appeared to be present within the buffer zone were thoroughly examined for the presence of the listed mussel species. Representatives of all

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mussel species incidentally encountered during the survey were identified and a representative taxa list recorded. Photographs of representative species were taken.

Species Accounts and Conclusions

The survey was lead by Jeff Selby (USFWS Federal Collection Permit TE100626-4) and assistance was provided by Terry D. Richardson, Ph.D., Ben McKenzie, and Michael McConnell. The Tennessee River at the proposed location is part of the Wheeler Reservoir. At this site it is about 1.25 miles wide and has a maximum depth of 25 feet. The substratum in the proposed search areas ranged from detritus-laden silt with some sand to silt-covered gravel and sand. The substratum at all sites was silt-covered and consisted largely of Asian clam shell. Flow ranged from minimal to unobservable. As a result of low flow and silt accumulation, habitat quality in areas assessed during this survey ranged from poor to moderate for the target species (Table 1-3). Habitat quality in the north and south overbank areas was considered to be poor. Habitat quality in the northern backwater area and portions of the northern channel slope varied from poor to moderate. Some sites in the backwater area near the channel and some sites in the river channel were mostly gravel and sand and appeared to be of marginal habitat quality for the species in question.

Tables 1-3 list the mollusk species collected during the survey. No Federally protected Pink mucket pearly mussels or Rough pigtoe mussels were observed during the survey. Live and relict shells of several mussels were found, however, many of these were species tolerant of silt and low flow conditions.

The Tennessee River at the site of the proposed pipeline had marginally suitable habitat in a few areas favorable for the federally endangered target species, however, no listed species were found during the survey. As a result, AST does not expect the proposed project would likely affect the continued existence of Pink mucket pearly mussel or Rough pigtoe mussel individuals or populations. If you should have questions or require additional information regarding this project, please feel free to contact Jeff Selby at (256) 476-7355 or Terry Richardson at (256) 443-9165.

Respectfully submitted,

AST Environmental Group

Jeff Selby, M.S.
Member / Senior Biologist

Terry D. Richardson, Ph.D
Member / Senior Ecologist

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Table 1. Representative mollusk taxa found at each of the 10 geotechnical bore locations (represented B1-B10). B10 was the northern-most bore site while B1 was the southern-most.

Common Name	Scientific Name	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
Mussels											
Three-ridge	*Amblema plicata*					2L	1L, 2R				
Yellow sandshell	*Lampsilis teres*					2R	1L		5R		
Fragile papershell	*Leptodea fragilis*								1R		
Washboard	*Megalonaias nervosa*	2L	2L	3R			8L		1L		
Three-horn	*Obliquaria reflexa*						1L, 3R				
Heel splitter	*Potamilus alata*		4L	4L	1L	1L, 1R	4L, 4R		1L, 3R		
Pistolgrip	*Quadrula (=Tritogonia) verrucosa*						1R				
Pimpleback	*Quadrula pustulosa*			1R	1R	2L, 1R	1L, 2R		1R		
Mapleleaf	*Quadrula quadrula*					1L, 1R	1L, 2R		2L, 4R		
Elephant ear	*Elliptodea crassidens*	2L	6L	2R	3L, 3R	1L					
Purple wartyback	*Cyclonaias tuberculata*			1R		1L					
Butterfly	*Elipsaria lineolata*				1R						
Pigtoe	*Pleurobema cordatum*		4R	1R	3R						
Snails											
Silty hornsnail	*Pleurocera canaliculatum*							X	X	X	X
Olive mylerysnail	*Viviparus subpurpureus*	X				X	X	X	X	X	X
Habitat											
Habitat Quality		P	M	M	M	M	P	P	P	P	P
Habitat Suitability		N	M	M	M	M	N	N	N	N	N

'L' = live; 'R' = relic shells; 'X' = species present; 'P' = poor habitat quality or suitability; 'M' = marginal habitat quality or suitability; 'N' = habitat not suitable

Table 2. Representative mollusk taxa found at each of 14 spots examined along the proposed trench alignment for habitat and mussel presence. Site 14 was the northern-most site while Site 1 was the southern-most. Counts are not presented as only representative shells were collected. No shells were encountered at Sites 6-14.

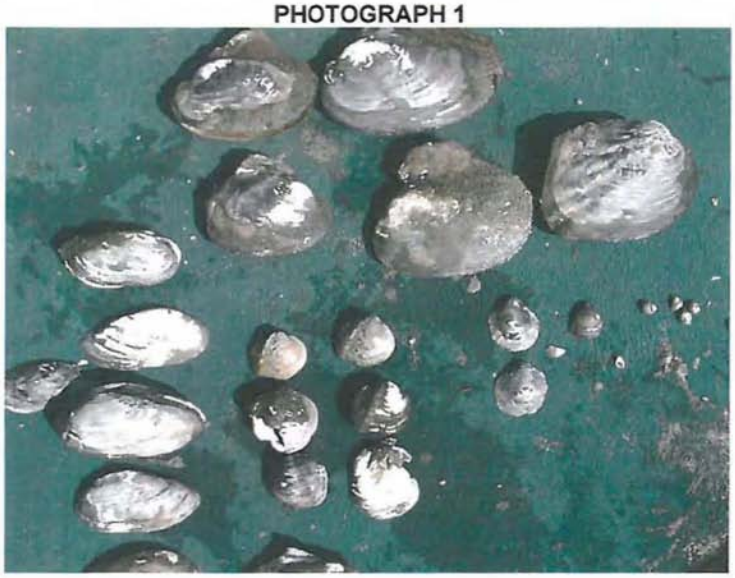
Common Name	Scientific Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14
14															
Three-ridge	*Amblema plicata*		X	X											
Yellow sandshell	*Lampsilis teres*			X											
Fragile papershell	*Leptodea fragilis*					X									
Washboard	*Megalonaias nervosa*	X	X												
Three-horn	*Obliquaria reflexa*	X	X	X											
Heel splitter	*Potamilus alata*	X	X	X	X	X									
Pistolgrip	*Quadrula (=Tritogonia) verrucosa*														
Pimpleback	*Quadrula pustulosa*		X												
Mapleleaf	*Quadrula quadrula*		X	X	X										
Elephant ear	*Eliptodea crassidens*														
Purple wartyback	*Cyclonaias tuberculata*														
Butterfly	*Elipsaria lineolata*														
Pigtoe	*Pleurobema cordatum*														
Giant floater	*Pyganodon grandis*				X										
Ebony Sandshell	*Legumia recta*		X												
Snails															
Silty hornsnail	*Pleurocera canaliculatum*														
Olive mysterysnail	*Viviparus subpurpureus*	X	X	X											
	Campeloma decisum				X										
Habitat															
Habitat Quality		M	M	P	P	P	P	P	P	P	P	P	P	P	P
Habitat Suitability		M	M	N	N	N	N	N	N	N	N	N	N	N	N

'X' = species present; 'P' = poor habitat quality or suitability; 'M' = marginal habitat quality or suitability; 'N' = habitat not suitable

Table 3. Representative mollusk taxa found during examination of the north slope of the channel. The area included the trenching alignment, and 220 yds upstream and 450 yds downstream. Counts are not presented, as only representative shells were collected.

Common Name	Scientific Name
Yellow sandshell	*Lampsilis teres*
Washboard	*Megalonaias nervosa*
Three-horn	*Obliquaria reflexa*
Heel splitter	*Potamilus alata*
Pistolgrip	*Quadrula (=Tritogonia) verrucosa*
Monkey face	*Quadrula metanevra*
Mapleleaf	*Quadrula apiculata*
Elephant ear	*Eliptodea crassidens*

PHOTOGRAPH 1

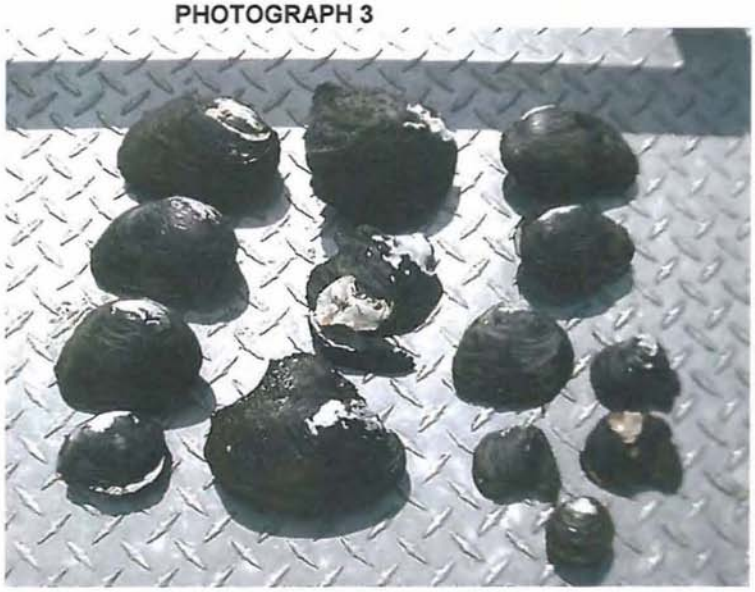


Description: Typical representative mussels from bore sites B5-B10. Taken by Terry Richardson, 10-5-07.

PHOTOGRAPH 2

Description: Typical representative mussels from bore sites B5-B10. Taken by Terry Richardson, 10-5-07.

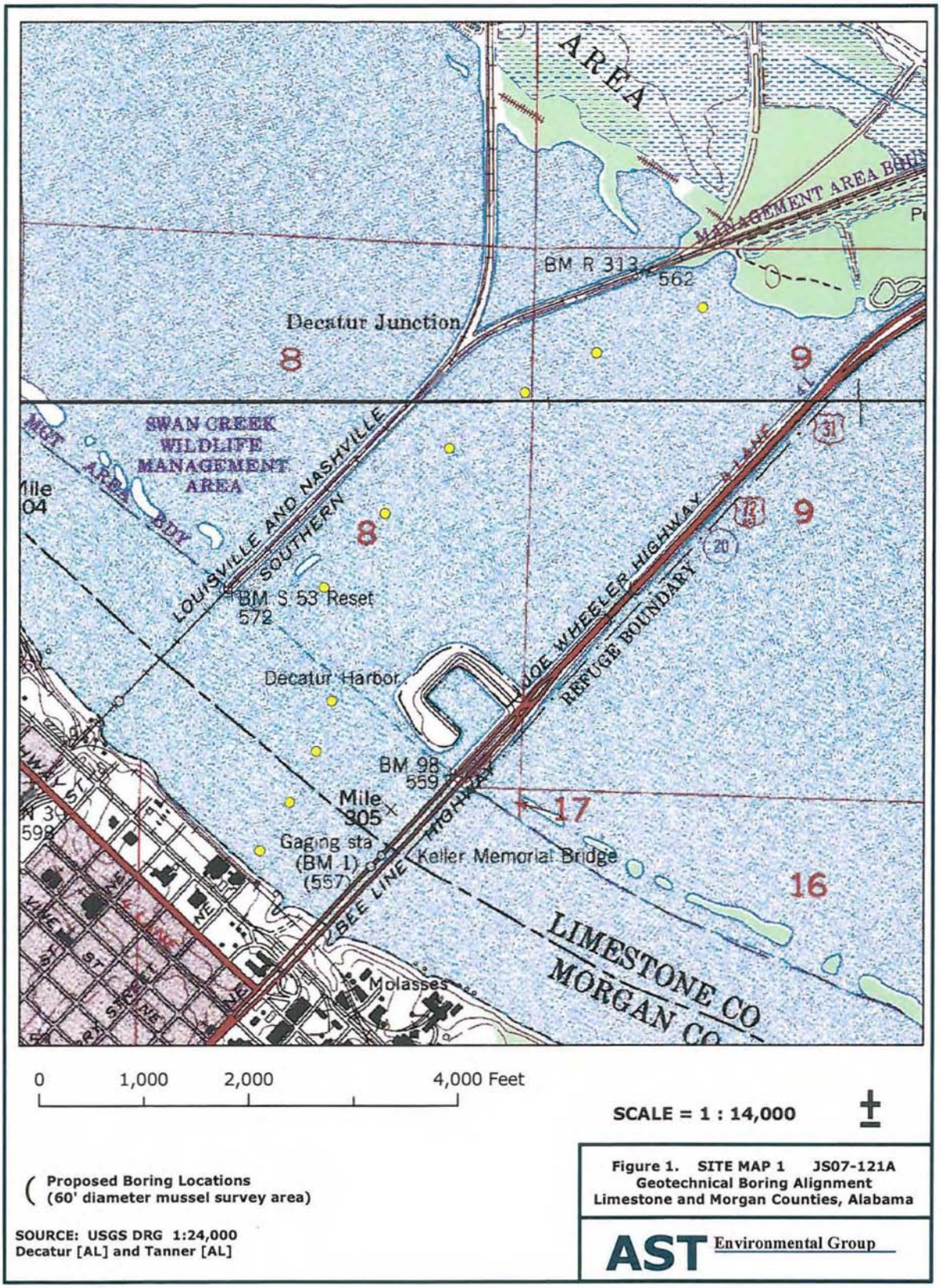
PHOTOGRAPH 3

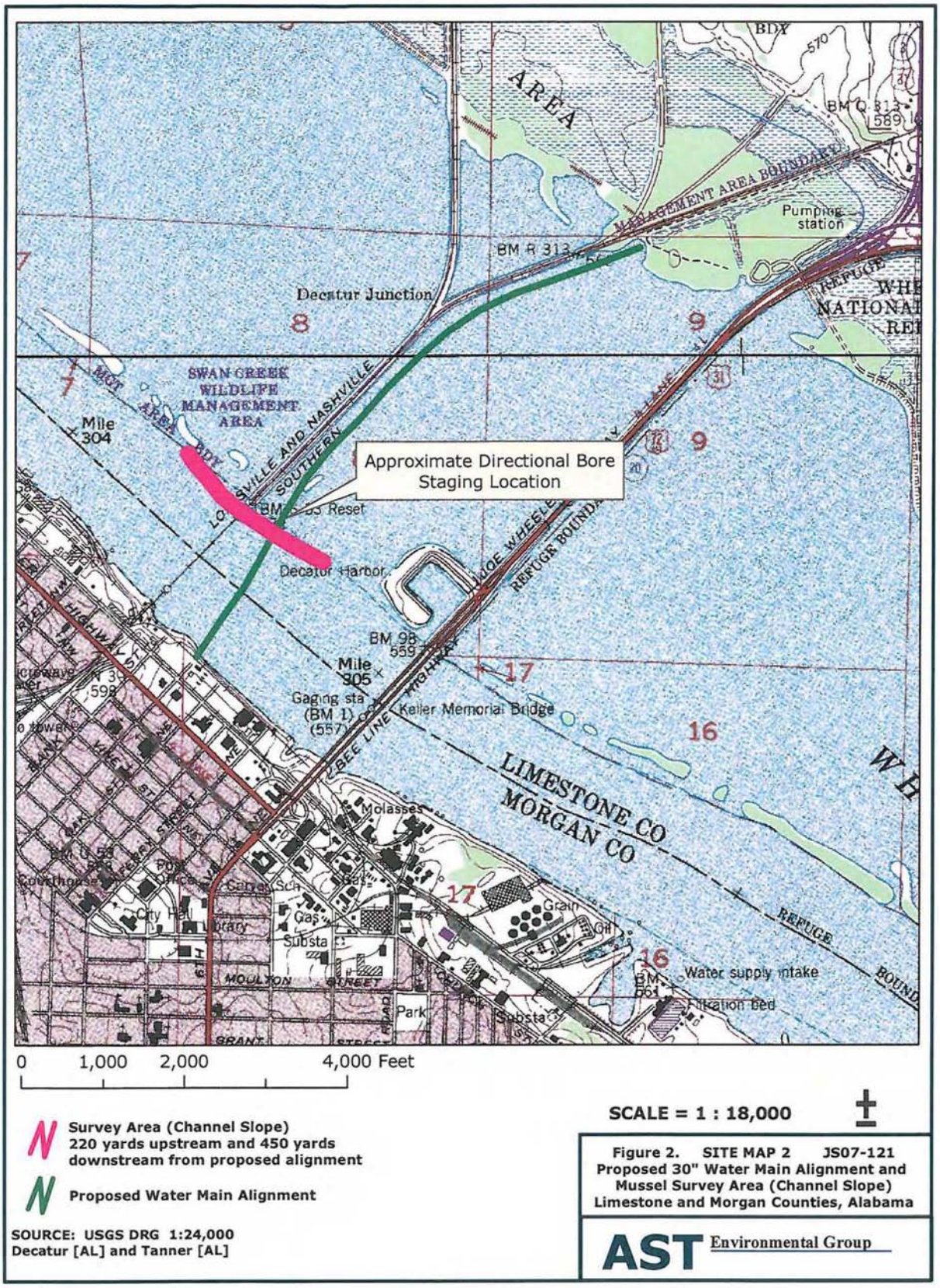


Description: Typical representative mussels from bore sites B2-B4. Taken by Terry Richardson, 10-6-07.

PHOTOGRAPH 4

Description: *Quadrula apiculata* (top row, left and middle; bottom) and *Q. metanevra* (top right). Taken by Terry Richardson, 10-6-07.


AREA
MANAGEMENT AREA BDY
BM R 313
562
Decatur Junction
8
9
SWAN CREEK
WILDLIFE
MANAGEMENT
AREA
SOUTHERN
LOUISVILLE AND NASHVILLE
8
9
BM S 53 Reset
572
Decatur Harbor
JOE WHEELER HIGHWAY
REFUGE BOUNDARY
BM 98
559
Mile
305
17
Gaging sta
(BM 1)
(557)
Keller Memorial Bridge
16
BEE LINE HIGHWAY
LIMESTONE CO
MORGAN CO
Molasses
0
1,000
2,000
4,000 Feet
SCALE = 1 : 14,000
Proposed Boring Locations
(60' diameter mussel survey area)
SOURCE: USGS DRG 1:24,000
Decatur [AL] and Tanner [AL]
Figure 1. SITE MAP 1 JS07-121A
Geotechnical Boring Alignment
Limestone and Morgan Counties, Alabama
AST Environmental Group


Approximate Directional Bore Staging Location
Decatur Junction
SWAN CREEK WILDLIFE MANAGEMENT AREA
Mile 304
Mile 305
Decatur Harbor
Keller Memorial Bridge
LIMESTONE CO
MORGAN CO
Pumping station
Water supply intake
Filtration bed
Molasses
Grain
Gas
Substa
Park
MOULTON STREET
GRANT STREET
REFUGE BOUNDARY
MANAGEMENT AREA BOUNDARY
0 1,000 2,000 4,000 Feet
SCALE = 1 : 18,000
Survey Area (Channel Slope)
220 yards upstream and 450 yards downstream from proposed alignment
Proposed Water Main Alignment
SOURCE: USGS DRG 1:24,000
Decatur [AL] and Tanner [AL]
Figure 2. SITE MAP 2 JS07-121
Proposed 30" Water Main Alignment and Mussel Survey Area (Channel Slope)
Limestone and Morgan Counties, Alabama
AST Environmental Group

2012 Mussel Survey

AQUATIC SURVEY REPORT

TENNESSEE RIVER MILE 304R

Wheeler Reservoir

LIMESTONE COUNTY, ALABAMA

Prepared for

HETHCOAT AND DAVIS, INC.

278 Franklin Road, Ste 200

Brentwood, TN 37027

Prepared by

AST Environmental

As proposed a 30-inch water pipeline is to be installed by horizontal directional drilling (HDD) to a depth approximately 30 feet below the channel and a segment of pipeline approximately 5,700 feet in length near the north shore of the Tennessee River is to be installed by using an open cut-trench method. The open cut trench site is located just east of and parallel to the CSX Railway/Norfolk Southern Railway's (formerly Louisville and Nashville/Southern Railway), Tennessee River railroad causeway crossing between Limestone and Morgan Counties, Alabama and is in the Wheeler Reservoir.

Pursuant to consultation with the US Fish and Wildlife Service (USFWS), Alabama Department of Conservation and Natural Resources (ADCNR), and the Tennessee Valley Authority (TVA) there was concern the proposed project could cause adverse affects on aquatic communities and particularly protected species. AST Environmental (AST) conducted an aquatic survey for the Federally listed endangered Pink mucket pearly mussel (*Lampsilis abrupta*), Rough pigtoe mussel (*Pleurobema plenum*), Spectaclecase *(Cumberlandia mondonta),* and the Sheepnose *(Plethobasus cyphyus)* OnJune 28, July 9, and July 10, 2012,. AST assessed the Tennessee River Wheeler Reservoir north overbank area along the project corridor to determine if protected mussels were present or if suitable habitat existed for the listed species. The species identified by the USFWS and their general habitat requirements are listed below.

Pink Mucket Pearly Mussel – Federally Endangered

The Pink mucket pearly mussel (*Lampsilis abrupta*) has a very solid, somewhat inflated shell. The shell is ovate to subquadrate in outline. Males have rounded to very bluntly pointed posterior margin and females have a broad rounded to truncated posterior margin. The posterior ridge is well defined in males and lies adjacent to the dorsal margin but is indistinct in females. Umbos are inflated and raised above the hinge line with faint, scarcely looped ridges. The periostracum is yellow to dark brown and variable dark green rays may be present. The nacre varies from white to pink.

The Pink mucket pearly mussel is considered a riverine species, formerly scattered throughout the Mississippi, Tennessee, Ohio and Cumberland River systems. It has been collected from a range of riverine habitats including somewhat shallow waters with strong currents and rocky substrates usually with silt free areas. It has been collected from deeper waters with slower currents with sand and gravel substrates. The Nature Serve database lists the habitat for this species as: BIG RIVER, MEDIUM RIVER, RIFFLE.

Rough Pigtoe – Federally Endangered

The Rough pigtoe (*Pleurobema plenum*) has a solid inflated shell with a subtriangular outline. The anterior margin is truncated; the posterior margin is straight with a slightly convex dorsal margin and a rounded ventral margin. The posterior ridge is narrowly rounded and slightly curved, with a blunt point ventrally on the posterior margin. A shallow sulcus is often present, anteriorly to the posterior ridge, with a median ridge located centrally. Umbos are elevated above the hinge line with few irregular nodulous ridges. Periostracum has a satiny yellowish brown to reddish brown. Occasionally a series of fine dark green rays on posterior half of shell are present. The nacre is usually white but may be pink.

The Rough pigtoe historically occurred throughout the Ohio, Cumberland, and Tennessee River drainages. This species has been known to inhabit sand, gravel and cobble shoals of medium to large rivers. The Rough pigtoe has also been collected from mud and sand flats. Extant populations of this species currently inhabit tailwaters below three impoundments on the mainstem of the Tennessee River (Pickwick, Wilson, and Guntersville). The Nature Serve database lists the habitat for this species as: BIG RIVER, MEDIUM RIVER.

Spectaclecase *(Cumberlandia mondonta)* Federally Endangered

The Spectaclecase *(Cumberlandia mondonta)* has an elongate, acute, compressed, relatively thin shell. The shell has rounded anterior and posterior margins with a concave ventral margin. The periostracum is greenish or brownish in younger individuals becoming blackened with age. The nacre is whitish and iridescent becoming roughened and often blotched posteriorly.

The spectaclecase occurs in large rivers typically on outside bends below bluff lines. It occurs in substrates from firm mud and sand to gravel, cobble, and boulders. It is known to inhabit submerged tree stumps and root masses and is also found under slab boulders or bedrock shelves. This species appears to require refugia from swift currents but is most often found near the interface with swift currents. Spectaclecase populations tend to be aggregated, and individuals seldom move except to burrow.

Sheepnose *(Plethobasus cyphyus)* Federally Endangered

The Sheepnose *(Plethobasus cyphyus)* has an oval or oblong shell with a smooth surface except for a single row tubercles running from the umbo to the ventral margin. The anterior

margin is rounded and the posterior end is bluntly pointed. The dorsal margin is straight and the ventral margin is curved anteriorly becoming straight posteriorly. A shallow sulcus is often present between the row of tubercles and the posterior ridge. The periostracum is yellow or light brown in juveniles, becoming chestnut to dark brown in adults. The nacre is white, and is occasionally tinged with pink or salmon.

The sheepnose is generally considered to be a large-river species but may occur in medium sized rivers. It occurs in riffles or runs with swift currents and inhabits firm mud / sand to gravel / cobble substrates. This species is typically reported from deep water runs (>2 m) with slight to swift currents and in reservoirs, immediately below dams. The Nature Serve database lists the habitat for this species as: BIG RIVER, Low gradient, MEDIUM RIVER, Moderate gradient, Riffle.

Methodology

The Mussel Survey covered an area to include the HDD Staging Area (20 meters x 20 meters) and the Open-Trench area (1,000 meters x 20 meters).

HDD Staging Area

The mussel survey included a sample area at the HDD entry location covering a 20 meter x 20 meter grid. The grid was comprised of three 20-meter long transects centered on the HDD entry coordinates. The transects were set at 10 meter increments and subdivided into 10 meter segments. Divers covered a 2-meter wide swath along each transect segment (20 m^2 / segment). Mussels collected from each segment were placed into separate mesh bags and transported to the surface for species identification and enumeration. Substrate composition and water depth was noted for each transect segment.

Transects were numbered 1 – 3 consecutively, with Transect 1 located nearest to the river channel. Each transect was subdivided into two 10-meter sample units. Subunit one was located to the north of the proposed centerline, and subunit two was located to the south of the proposed centerline for each transect sample set (Tables 5 and 6).

A series of three quarter-meter square quadrats were used to sample along each transect. The quadrat samples were collected near the center and ends of each transect line. Mussels located within each quadrat were counted and identified by species.

Quadrat samples were numbered 1 – 3 for and associated with each transect location. Quadrat 1 was located approximately 10 meters to the north of the centerline, Quadrat 2 was located near the centerline and Quadrat 3 was located approximately 10 meters south of the centerline for each sample set.

Open-Trench Area

The mussel survey included a series of samples centered along the open-trench alignment from the HDD entry location to a location identified as bore site number 8 in AST's 2007 survey (approximately 1,000 meters in length). Samples were collected at 50 meter intervals along the proposed alignment. Each sample included two 10-meter long transect segments centered on the open-trench alignment and situated perpendicular to it. Mussels collected from each segment were placed into separate mesh bags and transported to the surface for species identification and enumeration. Substrate composition and water depth was noted for each transect segment.

Transects were numbered 1 – 20 consecutively, with Transect 1 located nearest to the river channel. Each transect was subdivided into two 10-meter sample units. Subunit one was located to the north of the proposed centerline, and subunit two was located to the south of the proposed centerline for each transect sample set (Tables 1 and 2).

A series of three quarter-meter square quadrats were used to sample along each transect. The quadrat samples were collected near the center and ends of each transect line. Mussels located within each quadrat were counted and identified to species.

Quadrat samples were numbered 1 – 3 for and associated with each transect location. Quadrat 1 was located approximately 10 meters to the north of the centerline, Quadrat 2 was located near the centerline and Quadrat 3 was located approximately 10 meters south of the centerline for each sample set (Tables 3 and 4).

Based upon the criteria determined through consultation with the U. S. Fish and Wildlife Service and the TVA, that if two adjacent sampling locations along the proposed open-trench alignment exceeded a density of 0.1 mussels / m^2 , then an additional sample would be collected at the midpoint between the two adjacent locations. The initial survey results indicated that four midpoint samples were to be included in the survey. Midpoint sample locations were identified as 1A, 2A, 13A and 16A.

Species Accounts and Conclusions

The survey was lead by Jeff Selby (USFWS Federal Collection Permit TE100626-4) and assistance was provided by Terry D. Richardson, Ph.D. and Randy McCann. The Tennessee River at the proposed location is part of the Tennessee Valley Authority's integrated river management system which includes Wheeler Reservoir. At this location the original river channel is approximately 1,700-feet wide and has a maximum depth of 25 feet. The survey area in the adjacent north overbank area created by the impoundment is approximately 6,000-feet wide and has a maximum water depth of 13 feet. The substratum in the survey areas ranged from detritus-laden silty clay with some sand to silt-covered gravel and sand. The substratum at all sites was clay silt-covered and eight of the transects consisted largely of Asian clam shell. Flow ranged from minimal to unobservable except in the HDD staging area where flow was influenced by the upstream relief bridge and nearby main channel flow. As a result of low flow and silt accumulation, habitat quality for the target species in areas assessed during this survey was poor quality due to the predominately silty clay substratum. Only one transect had moderate habitat quality with sand and gravel comprising the majority of the substratum. (Table 2). The same results were observed in the quadrat samples. (Table 3).

Tables 1 and 3 list the mollusk species collected during the survey. No Federally protected Pink mucket pearly mussels, Spectaclecase, Sheepnose, or Rough pigtoe mussels were observed during the survey. Live and relict shells of several mussels were found, however, many of these were species tolerant of silt and low flow conditions.

Conclusion

The Tennessee River north overbank at the site of the proposed water pipeline had marginally suitable habitat in very few areas favorable for the federally endangered target species, however, no listed species were found during the survey. As a result, AST does not expect the proposed project would likely affect the continued existence of Pink mucket pearly mussel, Spectaclecase, Sheepnose, or Rough pigtoe mussel individuals or populations. Written concurrence with the findings of this report should be obtained from the USFWS prior to implementation of the proposed project.

AST Environmental

Jeff Selby, M.S.
Member / Senior Biologist

Terry D. Richardson, Ph.D
Member / Senior Ecologist

Table 1. Open-trench Area Transect Sample Results - Freshwater Mussel Species Identified during the Summer 2012 Survey.

Location / Transect #		1	1A	2	2A	3	4	5	6	7	8	9	10	11	12	13	13A	14	15	16	16A	17	18	19	20	sum
Anodonta suborbiculata	1														1											1
	2											1		1	1											3
Elliptio crassidens	1																									0
	2				1																					1
Megalonaias nervosa	1	2	2	2	5	3										1				2	4	3		5		29
	2	2		6	3	1		1																		13
Obliquaria reflexa	1																	1								1
	2																									0
Potamilus alatus	1	1	1		3											1										6
	2			1	2																					3
Pyganodon grandis	1				1																1	1				3
	2																	1								1
Quadrula apiculata	1		1		1						1						2									5
	2			4																						4
Quadrula pustulosa	1																									0
	2			1	1																					2
Quadrula quadrula	1	2		1													1	2	1							7
	2	1		4														3								8
total		8	4	19	17	4	0	1	0	0	1	1	0	1	2	2	3	7	1	2	5	4	0	5	0	87

Table 2. Open-trench Area Transect Sample Results - Substrate Composition. Summer 2012 Mussel Survey.

Location / Transect #		1	1A	2	2A	3	4	5	6	7	8	9	10	11	12	13	13A	14	15	16	16A	17	18	19	20	mean
Depth (feet)		11.4	11.0	9.5	11.0	7.7	12.7	12.8	10.0	8.4	8.2	8.3	8.1	7.0	6.9	6.0	6.0	6.0	6.5	6.7	7.0	7.2	6.6	6.6	6.5	8.3
Silt / Mud	1	85	80	100	20	100	100	100	100	100	100	100	100	100	100	100	100	100	100	90	100	100	100	90	100	94.4
	2	85	100	100	25	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	96.3
Sand	1	15	20	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	10	0	4.0
	2	15	0	0	75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.8
Gravel	1	0	0	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.7
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Corbicula Hash	1	x	x	x	x	x										x	x						x			
	2	x	x	x	x	x											x						x			

Table 3. Open-trench Area Quadrat Sample Results - Freshwater Mussel Species Identified during the Summer 2012 Survey.

Location / Transect #		1	1A	2	2A	3	4	5	6	7	8	9	10	11	12	13	13A	14	15	16	16A	17	18	19	20	sum
Anodonta sunorbiculata	1																									
	2																									
	3													1												1
Megalonaias nervosa	1																									
	2	1																								1
	3																									
Obliquaria reflexa	1			1																						1
	2				1																					1
	3																									
Quadrula quadrula	1																									
	2																							1		1
	3																									
total		1	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	5

Table 4. Open-trench Area Quadrat Sample Results - Substrate Composition. Summer 2012 Mussel Survey.

Location / Transect #		1	1A	2	2A	3	4	5	6	7	8	9	10	11	12	13	13A	14	15	16	16A	17	18	19	20	mean
	Quadrat																									
Depth (feet)		11.4	11.0	9.5	11.0	7.7	12.7	12.8	10.0	8.4	8.2	8.3	8.1	7.0	6.9	6.0	6.0	6.0	6.5	6.7	7.0	7.2	6.6	6.6	6.5	8.3
Silt / Mud	1	85	100	100	90	100	100	100	100	100	100	100	100	100	100	100	100	100	100	90	100	100	100	90	100	98.1
	2	85	80	100	20	100	100	100	100	100	100	100	100	100	100	100	100	100	100	90	100	100	100	100	100	94.8
	3	100	100	100	80	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99.2
Sand	1	15	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	10	0	1.9
	2	15	20	0	80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	5.2
	3	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.8
Gravel	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Corbicula Hash	1	x	x	x	x	x										x	x						x			
	2	x	x	x	x	x											x						x			
	3	x	x	x	x	x											x						x			

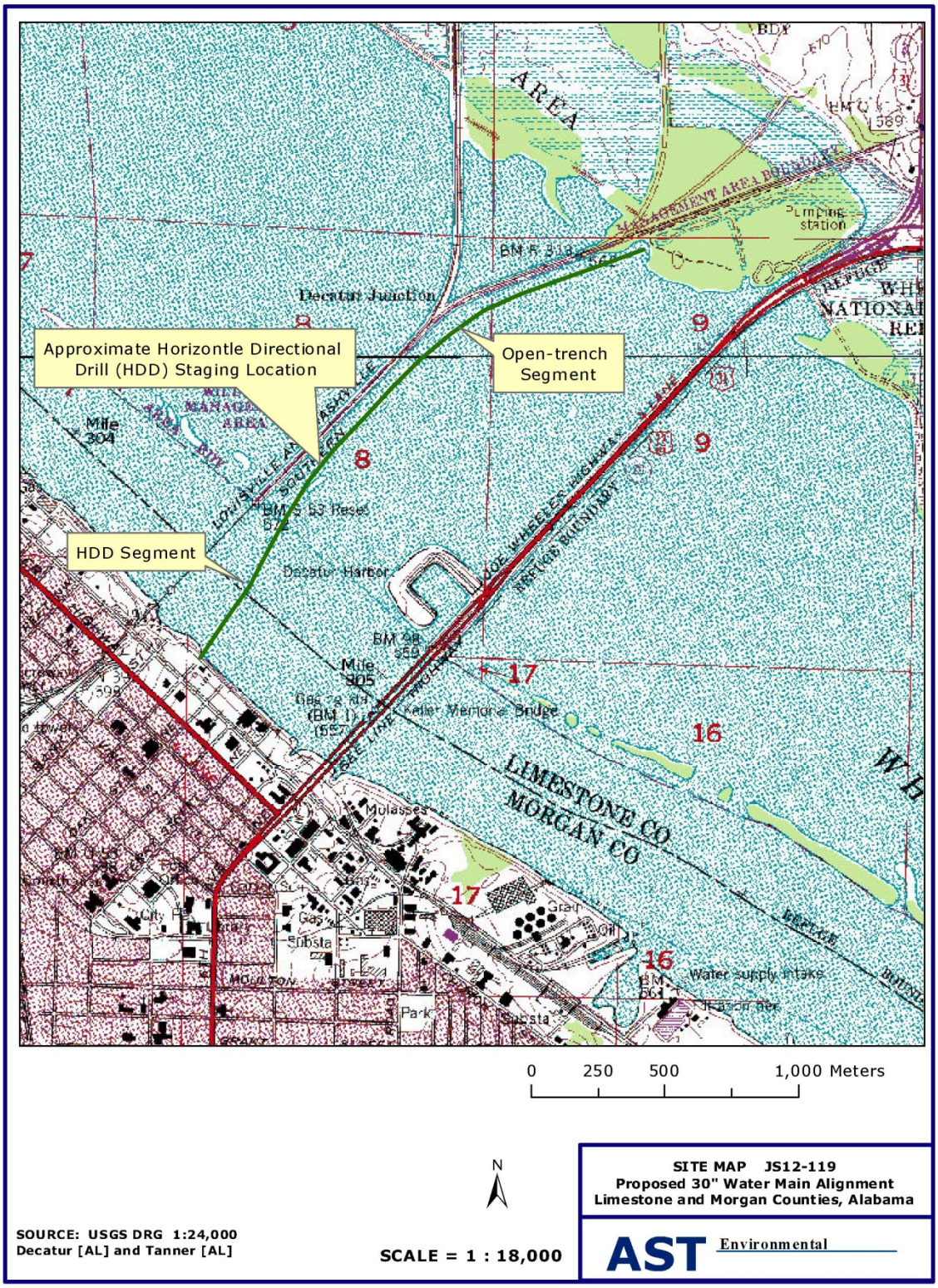
Table 5. HDD Staging Area Transect Sample Results - Freshwater Mussel Species Identified during the Summer 2012 Survey.

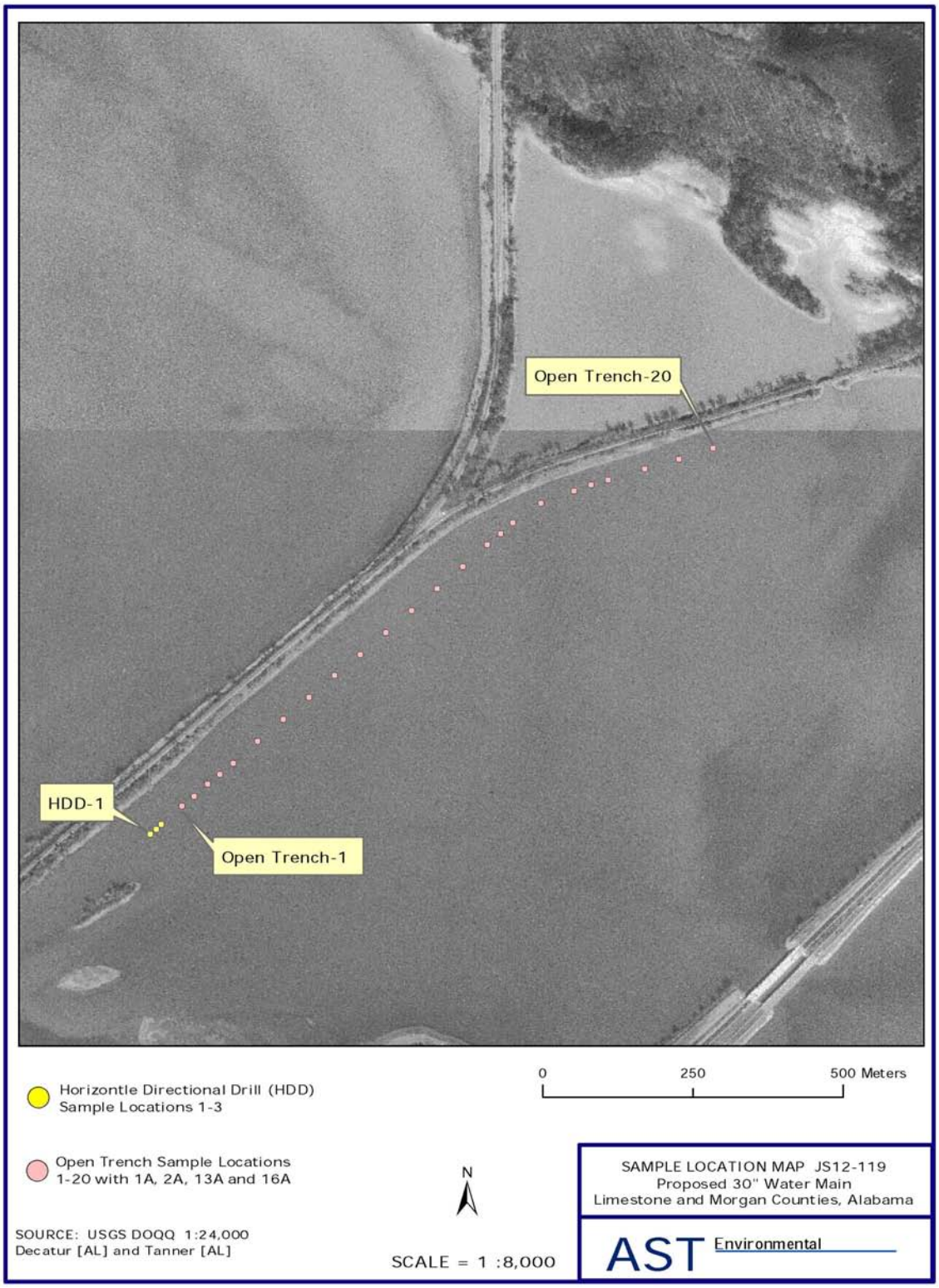
Location / Transect #		1-	2-	3-		sum
Elliptio crassidens	1		1			1
	2					
Megalonaias nervosa	1		1	2		3
	2		2	2		4
Obliquaria reflexa	1			2		2
	2			1		1
Potamilus alatus	1		1			1
	2	2	1			3
Quadrula apiculata	1			1		1
	2	1				1
Quadrula pustulosa	1	1				0
	2	1	1			1
Quadrula quadrula	1		1	2		3
	2					
total		5	8	10		21

NOTE: a single live *Q. quadrula* was the only Unionid present within the HDD quadrat samples (Q3-1)

Table 6. HDD Staging Area Transect Sample Results - Substrate Composition. Summer 2012 Mussel Survey.

Location / Transect #		1-	2-	3-		mean
Depth (feet)		10.0	10.0	10.0	10.0	10.0
Silt / Mud	1	20	30	30	20	25
	2	80	30	30	20	40
	3	-	-	-	80	80
Sand	1	80	70	70	80	75.0
	2	20	70	70	80	60.0
	3	-	-	-	20	20.0
Corbicula Hash	1	x	x	x	x	
	2	x	x	x	x	
	3	-	-	-	x	


Approximate Horizontle Directional Drill (HDD) Staging Location
Open-trench Segment
HDD Segment
Decatur Junction
Decatur Harbor
Keller Memorial Bridge
LIMESTONE CO
MORGAN CO
Mile 304
Mile 305
0 250 500 1,000 Meters
N
SITE MAP JS12-119
Proposed 30" Water Main Alignment
Limestone and Morgan Counties, Alabama
SOURCE: USGS DRG 1:24,000
Decatur [AL] and Tanner [AL]
SCALE = 1 : 18,000
AST Environmental


Open Trench-20
HDD-1
Open Trench-1
0
250
500 Meters
Horizontle Directional Drill (HDD)
Sample Locations 1-3
Open Trench Sample Locations
1-20 with 1A, 2A, 13A and 16A
N
SAMPLE LOCATION MAP JS12-119
Proposed 30" Water Main
Limestone and Morgan Counties, Alabama
SOURCE: USGS DOQQ 1:24,000
Decatur [AL] and Tanner [AL]
SCALE = 1 :8,000
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PHOTOGRAPH 1

Facing southwest near the proposed HDD Staging Location. Taken by Terry Richardson, 10-5-07.

PHOTOGRAPH 2

Facing south near the proposed open-trench area. Taken by Terry Richardson, 10-5-07.

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Tennessee River
Limestone County, AL

PHOTOGRAPH 3

Facing northeast near the proposed open-trench area.

Taken by Terry Richardson, 10-5-07.

PHOTOGRAPH 4

Potamilus alatus collected during the 2012 mussel survey. Taken by Terry Richardson, 6-29-12.

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PHOTOGRAPH 5

Anodonta suborbiculata collected during the 2012 mussel survey. Taken by Terry Richardson, 7-9-12.

PHOTOGRAPH 6

Anodonta suborbiculata collected during the 2012 mussel survey. Taken by Terry Richardson, 7-9-12.

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PHOTOGRAPH 7

Megalonaias nervosa and *Pyganodon grandis* collected during the 2012 mussel survey. Taken by Terry Richardson, 6-29-12.

PHOTOGRAPH 8

Amblema plicata collected during the 2012 mussel survey. Taken by Terry Richardson, 7-10-12.

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PHOTOGRAPH 9

Quadrula quadrula and *Quadrula apiculata* collected during the 2012 mussel survey. Taken by Terry Richardson, 6-29-12.

PHOTOGRAPH 10

Quadrula apiculata collected during the 2012 mussel survey. Taken by Terry Richardson, 6-29-12.

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PHOTOGRAPH 9

Quadrula pustulosa and *Elliptio crassidens* collected during the 2012 mussel survey. Taken by Terry Richardson, 7-10-12.

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