CONSERVATION PLAN

APPLICATION FOR AN INCIDENTAL TAKE AUTHORIZATION

INGRAM BARGE FLEETING FACILITY PROJECT

MASSAC COUNTY, ILLINOIS
AND
McCRACKEN COUNTY, KENTUCKY

Prepared for:

INGRAM BARGE COMPANY

September 2020

REDWING
ECOLOGICAL SERVICES, INC.
1139 South Fourth Street • Louisville, KY 40203 • Phone 502.625.3009 • Fax 502.625.3077

VIA EMAIL

September 16, 2020

Ms. Heather Osborn
Illinois Department of Natural Resources
Office of Resource Conservation
Division of Natural Heritage
One Natural Resources Way
Springfield, Illinois 62702
Heather.Osborn@Illinois.gov

Subject: **Conservation Plan – Application for an Incidental Take Authorization**
Ingram Barge Fleeting Facility Project
Massac County, Illinois and McCracken County, Kentucky
USACE Project: LRL-2019-288
USFWS Project: FWS 2019-B-0449
EcoCAT Review: 2000330
Redwing Project: 19-146

Dear Ms. Osborn:

On behalf of Ingram Barge Company, Redwing Ecological Services, Inc. is pleased to submit this Conservation Plan to the Illinois Department of Natural Resources, Division of Natural Heritage in support of a proposed fleeting facility on the Ohio River in Massac County, Illinois and McCracken County, Kentucky. This plan evaluates potential impacts to 12 federal and/or Illinois state listed mussel species as a result of the project, including the purple wartyback (*Cyclonaias tuberculata*), butterfly (*Ellipsaria lineolata*), elephant-ear (*Elliptio crassidens*), spike (Elliptio dilatata), ebonyshell (*Fusconaia ebena*), pink mucket (*Lampsilis abrupta*), orangefoot pimpleback (*Plethobasus cooperianus*), sheepnose (*Plethobasus cyphyus*), Ohio pigtoe (*Pleurobema cordatum*), fat pocketbook (*Potamilus capax*), rabbitsfoot (*Quadrula cylindrica cylindrica*), and monkeyface (*Quadrula metanevra*). Adverse effects are anticipated to these 12 mussel species as a result of the proposed project. Therefore, the project will require an Incidental Take Authorization from the Illinois Department of Natural Resources.

We respectfully request your concurrence with the findings of this report. Please contact Seth Bishop or Richard Clausen at (502) 625-3009 with any questions you have during your review of the attached report.

Sincerely,

Seth R. Bishop
Seth R. Bishop (Sep 16, 2020 14:48 EDT)
Seth R. Bishop
Senior Ecologist

Richard Clausen byKAV
Richard S. Clausen
Principal
Senior Ecologist

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cc: Mr. Jeff Schaefer – HDR Engineering, Inc.

CONSERVATION PLAN

APPLICATION FOR AN INCIDENTAL TAKE AUTHORIZATION

INGRAM BARGE FLEETING FACILITY PROJECT
MASSAC COUNTY, ILLINOIS AND
McCRACKEN COUNTY, KENTUCKY

Submitted to:

ILLINOIS DEPARTMENT OF NATURAL RESOURCES
DIVISION OF NATURAL HERITAGE

Prepared for:

INGRAM BARGE COMPANY

Prepared by:

REDWING ECOLOGICAL SERVICES, INC.

Seth R. Bishop
Seth R. Bishop (Sep 16, 2020 14:49 EDT)

Seth R. Bishop
Senior Ecologist

Richard Clausen

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Principal
Senior Ecologist

September 16, 2020

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INTRODUCTION

Ingram Barge Company (Ingram) is pleased to submit this Conservation Plan as application for an Incidental Take Authorization from the Illinois Department of Natural Resources in support of a proposed barge fleeting facility on the Ohio River in Massac County, Illinois and McCracken County, Kentucky. The fleeting facility will be constructed and operated along the right descending bank of the Ohio River between River Mile (RM) 935 and 937.4 near Brookport, Illinois. The facility will consist of six barge fleeting areas, with each fleeting area capable of holding up to 72 barges. A mooring structure consisting of two spud barges and two spar barges will also be located in each fleeting area. The spud barges will be secured to the river bottom using spud piles and a ship anchor. The purpose of the project is to provide a designated offshore location for the temporary fleeting of barges during assembly and disassembly of barge tows.

Ingram is seeking a Section 10 (Rivers and Harbors Act) permit for the proposed project from the U.S. Army Corps of Engineers (USACE), which requires an evaluation of potential impacts to species listed under the Endangered Species Act (ESA). A review of the U.S. Fish and Wildlife Service's (USFWS) Information for Planning and Consultation (IPaC) website (USFWS IPaC 2020) resulted in the identification of 16 federally listed species that have the potential to occur in the project area, including 12 mussel species (Appendix A). Due to the location of the project in the Ohio River and the presence of suitable habitat in the project area, a mussel survey of the Ohio River was performed by Mainstream Commercial Divers, Inc. (MCDI) to determine the presence/probable absence of the mussel species. During the survey, the federal and Illinois state endangered fat pocketbook (*Potamilus capax*), state threatened butterfly (*Ellipsaria lineolata*), state endangered elephant-ear (*Elliptio crassidens*), state endangered ebonyshell (*Fusconaia ebena*), and state threatened black sandshell (*Ligumia recta*) were encountered in the project area.

Under the Section 10 permit process, the USACE initiated consultation with the USFWS Kentucky Field Office (KFO) regarding the federally listed mussel species. The USFWS KFO concurred with the USACE's proposed effects determination of "may affect, not likely to adversely affect" for seven of the 12 mussel species, but determined that the project is likely to adversely affect the fat pocketbook, pink mucket (*Lampsilis abrupta*), orangefoot pimpleback (*Plethobasus cooperianus*), sheepnose (*Plethobasus cyphyus*), and rabbitsfoot (*Quadrula cylindrica cylindrica*). Based on this determination, the USACE initiated formal consultation with the USFWS KFO for the five mussel species. The formal consultation process was completed on August 17, 2020 through issuance of the Final Biological Opinion by the USFWS KFO. Correspondence between the USACE and USFWS is included in Appendix A. The Final Biological Opinion was submitted to the Illinois Department of Natural Resources (IDNR) on August 19, 2020.

The USACE sent a request for comments for Public Notice to the IDNR regarding potential effects to Illinois state listed species from the proposed project. In a letter dated July 11, 2019, the IDNR determined that

unlawful take of the butterfly, elephant-ear, ebonyshell, black sandshell, and fat pocketbook is likely from the project and recommended that Ingram seek an Incidental Take Authorization (ITA). As a result, this Conservation Plan was prepared to apply for an ITA from the IDNR.

Since the initial IDNR correspondence, the black sandshell has been delisted from the List of Endangered and Threatened Species in Illinois; therefore, this species is not addressed in the Conservation Plan. During the same review, the monkeyface (*Quadrula metanevra*) was added as a threatened species to the List of Endangered and Threatened Species in Illinois. Two monkeyface individuals were captured during the mussel survey for the project; therefore, unlawful take of this species is likely as a result of the project, and the species is addressed under the plan.

Based on the USFWS KFO's determination that the proposed project is likely to adversely affect the pink mucket, orangefoot pimpleback, sheepnose, and rabbitsfoot, all of which are Illinois state listed species, these four species are also addressed under the Conservation Plan. The plan also addresses three additional state listed species that are known to occur in the project vicinity based on a 2007 survey of a mussel bed approximately 0.8 mile downstream of the proposed project. These three species include the state threatened purple wartyback (*Cyclonaias tuberculata*), state threatened spike (*Elliptio dilatata*), and state endangered Ohio pigtoe (*Pleurobema cordatum*) mussels.

Based on coordination with the USFWS KFO and IDNR and previous mussel survey results, adverse effects to five federal and state listed species and seven state listed species are anticipated as a result of the proposed project. These 12 species are summarized in the following table and discussed further in the Conservation Plan.

Scientific Name	Common Name	Federal Status	IL State Status
Cyclonaias tuberculata	purple wartyback	Not Listed	Threatened
Ellipsaria lineolata	butterfly	Not Listed	Threatened
Elliptio crassidens	elephant-ear	Not Listed	Endangered
Elliptio dilatata	spike	Not Listed	Threatened
Fusconaia ebena	ebonyshell	Not Listed	Endangered
Lampsilis abrupta	pink mucket	Endangered	Threatened
Plethobasus cooperianus	orangefoot pimpleback	Endangered	Endangered
Plethobasus cyphyus	sheepnose	Endangered	Endangered
Pleurobema cordatum	Ohio pigtoe	Not Listed	Endangered
Potamilus capax	fat pocketbook	Endangered	Endangered
Quadrula cylindrica cylindrica	rabbitsfoot	Threatened	Endangered
Quadrula metanevra	monkeyface	Not Listed	Threatened

1.0 DESCRIPTION OF THE PROJECT IMPACT

Potential impacts from the proposed project are described below in terms of a description of the affected area, a biological description of each affected species, a description of project activities, and potential adverse effects to state listed species.

1.A AFFECTED AREA

Ingram proposes to construct and operate a barge fleeting facility along the right descending bank of the Ohio River between RM 935 and 937.4 near Brookport, Illinois (Figure 1). The proposed facility will consist of six barge fleeting areas along approximately 11,300 linear feet of the river. Each fleeting area will encompass an area of approximately 1,600 linear feet by 315 linear feet (11.57 acres). The six fleeting areas combined will cover a total area of approximately 69.42 acres.

The area affected by the proposed project, hereinafter referred to as the “project area”, will include the six fleeting areas and additional areas between and around the fleeting areas where barge tows and tow boats will be operating (Figure 2). The additional areas encompass approximately 400 feet between each fleeting area, 370 feet upstream of the fleeting areas, 400 feet downstream of the fleeting areas, and 100 feet towards the river from the fleeting areas. The six fleeting areas (69.42 acres) and additional areas (83.36 acres) will result in a total project area of 152.78 acres. The portion of the Ohio River in the project area is under the jurisdiction of the USACE.

1.B BIOLOGICAL DESCRIPTION OF AFFECTED SPECIES

Background information for the 12 mussel species is presented below, including species description, habitat, distribution, and threats.

1.B.1 Purple Wartyback

The purple wartyback is a medium sized mussel up to 127 mm in length. The shell is round and moderately thick, with a square posterior end and round anterior end. The dorsal margin is straight, and the central margin is curved. The shell surface is covered with tubercles, with the exception of the anterior fourth of the shell. Shell color ranges from yellowish brown to greenish brown in young individuals and becomes dark brown in older individuals (Cummings and Mayer 1992).

Habitat for this species ranges from small to medium-sized streams to the main channel of large rivers. Individuals are typically found in the current at depths of one to seven meters in gravel or mud substrate

(Parmalee and Bogan 1998). This species occurs in the Mississippi River drainage from southern Minnesota south to Arkansas and from the Ohio River drainage in western Pennsylvania west to eastern Oklahoma (Williams et al. 2008). The purple wartyback also extends into the Grand and Thames Rivers in Ontario, Canada (Metcalfe-Smith and Cudmore-Vokey 2004). The species is widespread in the Cumberland and Tennessee River drainages in Kentucky, Virginia, Tennessee, and Alabama (Parmalee and Bogan 1998, Williams et al. 2008). Declines in this species have occurred in certain parts of the northern and outer limits of its range, but the species is still common in the southern parts of the range (NatureServe 2020). In Illinois, it is found sporadically in the Kankakee (Sietman et al. 2001), Vermillion, Ohio (Cummings and Mayer 1997), and Rock Rivers (Schanzle et al. 2004), but is present in only three of the 12 drainages where it formally occurred (Cummings and Mayer 1997).

The purple wartyback was listed as threatened by the State of Illinois on April 26, 1999. The species was previously widespread in Illinois but is nearly extirpated due to habitat destruction, over collecting, and other development pressures (Mankowski 2012). Threats to this species in the lower Ohio River include impoundments, channelization and dredging, sedimentation, chemical contaminants, mining, and pollution. The zebra mussel (*Dreissena polymorpha*), an exotic species that colonizes the shells of native mussels, has also invaded the Ohio River and represents a threat to the purple wartyback (USFWS 2018a).

1.B.2 Butterfly

The butterfly is a medium-sized mussel that has a thick, triangular shell with a rounded anterior and pointed posterior. The shell is up to 127 mm long, with a sharply defined posterior ridge and flattened lateral surfaces. The shells of males are compressed, while females have more inflated shells. The outside of the shell is smooth and generally yellow or yellowish-green with numerous interrupted V-shaped or rectangular brown rays. The pseudocardinal and lateral teeth are well developed, and the inside of the shell is white (Cummings and Mayer 1992, MDNR 2020a).

This species generally inhabits large rivers with swift currents and sand or gravel substrates. The butterfly has also adapted to impoundment areas in the Cumberland and Tennessee Rivers, where it has been found in water depths up to six meters (Parmalee and Bogan 1998). The species' range includes the Mississippi River drainage from Minnesota to western Pennsylvania and south to Louisiana, Alabama, Mississippi, and Georgia. Most populations are stable, with minor declines evident in Minnesota and expansion of the species in the Tennessee and Cumberland Rivers (Murray and Leonard 1962, Vidrine 1993, Parmalee and Bogan 1998, Williams et al. 2008).

The butterfly was listed as threatened by the State of Illinois on January 18, 1994. The species was previously widespread in Illinois but is nearly extirpated due to habitat destruction, over collecting, and other

development pressures (Mankowski 2012). Threats to the butterfly in the lower Ohio River include impoundments, channelization and dredging, sedimentation, chemical contaminants, mining, pollution and zebra mussels (USFWS 2018a).

1.B.3 Elephant-ear

The elephant-ear is a medium to large mussel up to 150 mm long with a thick, triangular-shaped shell. The shell is generally smooth and has a distinct posterior ridge. Shell color is dark brown to black, with younger individuals having yellowish-green shells with green rays. The nacre may be purple, pink, or white. The pseudocardinal and lateral teeth are well developed (Klocek et al. 2008, MDNR 2020b).

This species inhabits large streams to rivers, as well as channels. Individuals are typically found in mud, sand, gravel, and rocky substrates in moderate to swift currents (Heard 1979, UM 2020). The elephant-ear has a wide range in the eastern U.S., including the Mississippi and Alabama River drainages in Alabama, Florida, Georgia, Illinois, Indiana, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, Ohio, Tennessee, Virginia, West Virginia, and Wisconsin (Parmalee and Bogan 1998, UM 2020). In Illinois, this species is found sporadically in the Wabash and Ohio Rivers (Cummings and Mayer 1997).

The elephant-ear was listed as endangered by the State of Illinois on March 17, 1989. The species was previously widespread in Illinois but is nearly extirpated due to habitat destruction, over collecting, and other development pressures (Mankowski 2012). Threats to the elephant-ear in the lower Ohio River include impoundments, channelization and dredging, sedimentation, chemical contaminants, mining, pollution and zebra mussels (USFWS 2018a).

1.B.4 Spike

The spike is a medium sized mussel up to 127 mm long. The shell is solid, elongate, and elliptical in shape, with a rounded anterior end and rounded to slightly pointed posterior end. The dorsal margin is straight to slightly curved, and the ventral margin is straight to curved in young individuals, with older individuals becoming more arched. The outside of the shell is smooth and ranges in color from greenish brown with faint green rays in small individuals to dark brown in larger individuals (Cummings and Mayer 1992).

The spike primarily inhabits shoal habitat in medium streams to large rivers in water four to eight meters deep. The species may also occasionally be found in the tailwaters of dams and in lakes under some conditions (Williams et al. 2008). Distribution is widespread in the eastern U.S., including the entire Mississippi River drainage from the St. Lawrence River south to northern Louisiana and west to Oklahoma (Parmalee and Bogan 1998). The species is also common in portions of the Great Lakes drainage (Mirarchi

et al. 2004a). The species was previously found in 20 of 25 drainages in Illinois but is now confined to just the Fox River, Kankakee-Iroquois River, Vermillion and Maxon River, Sangamon River, Kaskaskia River, and Little Wabash and Bonpas Creek drainages (Schanzle and Cummings 1991, Cummings and Mayer 1997, Sietman et al. 2001).

This species was listed as threatened by the State of Illinois on January 18, 1994. The species was previously widespread in Illinois but is nearly extirpated due to habitat destruction, over collecting, and other development pressures (Mankowski 2012). Threats to the spike in the lower Ohio River include impoundments, channelization and dredging, sedimentation, chemical contaminants, mining, pollution and zebra mussels (USFWS 2018a).

1.B.5 Ebonyshell

The ebonyshell is a medium-sized mussel reaching a size of up to 102 mm in length. The shell is heavy and inflated, with a rounded anterior end and a posterior end that is rounded or bluntly pointed. The dorsal margin is slightly rounded, and the ventral margin is curved or straight. The shell color ranges from light brown in young individuals to dark brown or black in older individuals. Slightly elevated ridges are present on the shell that indicate periods of growth (Cummings and Mayer 1992).

This species inhabits large rivers at depths of three meters or more. Individuals are typically found in swift currents over stable sand or gravel substrates, but may also be found in sand, silt, or mud (Cummings and Mayer 1992, Parmalee and Bogan 1998). The species' range extends from Wisconsin and Minnesota west to Oklahoma and east Texas and south through northern Louisiana, Alabama, and Mississippi (Parmalee and Bogan 1998). The ebonyshell is known to inhabit the Mississippi River basin, including the Mississippi River, Minnesota River, St. Croix River, Illinois River, Ohio River, and other bodies of water in the basin that provide suitable habitat (UM 2020). In Illinois, this species is generally found in the Ohio River and sporadically in the Mississippi and Wabash Rivers (Cummings and Mayer 1997).

The ebonyshell was originally listed as threatened by the State of Illinois on January 18, 1994 and was later listed as endangered on February 21, 2014. The species was previously widespread in Illinois but is nearly extirpated due to habitat destruction, over collecting, and other development pressures (Mankowski 2012). Threats to the ebonyshell in the lower Ohio River include impoundments, channelization and dredging, sedimentation, chemical contaminants, mining, pollution and zebra mussels (USFWS 2018a).

1.B.6 Pink Mucket

The pink mucket is a medium-sized mussel characterized by an elliptical, subovate, subquadrate shell attaining a size of approximately 105 mm in length. Valves are inflated, thick, heavy, unsculptured, and gaping at the anterior-ventral base (USFWS 1985a). The species is sexually dimorphic, with females having a rounded anterior margin with the posterior-ventral area expanded, broad, and somewhat truncated to accommodate the marsupium. In males, the anterior margin of the shell is curved or rounded, and the posterior end is somewhat pointed (Hildreth 1828, Simpson 1914, Johnson 1980).

This species inhabits large rivers in moderate to fast-flowing water and is found at depths of 0.5 to nine meters in mixed sand, gravel, and cobble substrate. The pink mucket is benthic and usually remains buried in the substrate, with only the posterior extent of the shell and siphons exposed to the water column. This species also appears to have adapted to reservoir-type conditions in the upper reaches of some impoundments and prefers mud and sand substrates in these slower waters (USFWS 2018a).

The pink mucket generally occurs in large streams throughout the Ohio River drainage; however, at least 20 streams are considered to have lost their populations based on the lack of recent live individuals. These losses are primarily due to the construction of dams and general habitat degradation from pollution and other sources. Currently, only 16 extant populations of pink mucket are known, occurring in the Meramec, Big, Osage, Gasconade, Ohio, Kanawha, Green, Cumberland, Tennessee, Clinch, Little Tennessee, Paint Rock, Black, Current, Little Black, and Spring Rivers (USFWS 2018a). Populations are distributed sporadically and are small where they occur, and this species is particularly susceptible to local extirpations (USFWS 1985a). All habitat in the lower river reach in Tennessee is now inundated or adversely affected by cold tailwaters, likely rendering the species extirpated. The pink mucket is also considered extirpated from Little Black River in Missouri, having not been found live or fresh dead since 1980 (Bruenderman et al. 2001a).

This species was listed as federally endangered under the Endangered Species Act (ESA) on June 14, 1976 (USFWS 1976) and state threatened by the State of Illinois on April 26, 1999 (Mankowski 2012). Pink mucket populations appear to be suffering from ongoing habitat degradation due to continuing impacts from historical land use practices, such as mining and fossil fuel extraction (Roberts and Bruenderman 2000). Channel and bank degradation and pollution also threaten this species (Roberts and Bruenderman 2000, Bruenderman et al. 2001b), as well as the zebra mussel (USFWS 2018a).

1.B.7 Orangefoot Pimpleback

The orangefoot pimpleback is a medium-sized mussel that reaches a size up to 95 mm in length. The shell is large, heavy, and nearly circular or sub round in outline. The posterior ridge is low and rounded, sometimes with a wing. The shell is marked by dark, concentric, irregular growth rests, with the posterior two-thirds covered with numerous raised tubercles. Faint, green rays are found in younger specimens. Hinge teeth are well developed, with the left valve having two, divergent, ragged teeth (USFWS 1985b).

This species is endemic to the Ohio River system, inhabiting medium to large rivers with stable, clean substrates comprised of silt, sand, and gravel (USFWS 2018b). Individuals have been found in riffles and shoals, as well as deeper areas up to 10 meters (USFWS 1985b). In the lower Ohio River, specimens have been collected in sand and gravel habitats at depths ranging from five to 10 meters. Recent records of live individuals have been reported within the portion of the Ohio River downstream from the Tennessee River confluence. The species is rare, even in areas of known populations, and is often difficult to detect due to portions of the population occurring below the surface of the substrate (USFWS 2018b).

The orangefoot pimpleback was listed as federally endangered under the ESA on June 14, 1976 (USFWS 1976) and state endangered by the State of Illinois on July 25, 1984 (Mankowski 2012). Ongoing threats to the orangefoot pimpleback include water quality degradation from point and non-point sources, agricultural runoff, and other pollutants. In addition, the species is affected by hydrologic and water quality alterations resulting from the operation of impoundments. A variety of instream activities (e.g., sand and gravel dredging, navigation, fleeting, etc.) also threaten orangefoot pimpleback populations (USFWS 2018b).

1.B.8 Sheepnose

The sheepnose is a medium-sized mussel up to 140 mm in length with an elongate ovate, moderately inflated shell with thick, solid valves. The anterior end of the shell is rounded, and the posterior end is truncate to bluntly pointed. The posterior ridge is gently rounded and flattened ventrally, with a row of tubercular swellings on the center of the shell from the beak to the ventral margin. A shallow sulcus lies between the posterior ridge and central swellings. Beaks are high and located near the anterior margin. In young individuals, the periostracum is often light yellow to yellowish brown, becoming darker with age. The right valve contains a large triangular pseudocardinal tooth, and the lateral teeth are heavy, long, and slightly curved (Parmalee and Bogan 1998).

The sheepnose primarily inhabits large streams in shallow shoal habitats with moderate to swift currents, as well as deep runs. The species is typically found in coarse sand and gravel substrates but may also be

found in mud, cobble, and boulder substrates (Oesch 1984, Parmalee and Bogan 1998). The range of the sheepnose includes the Mississippi, Ohio, Cumberland, and Tennessee Rivers and their tributaries. The sheepnose historically occurred in at least 77 streams in 15 states; however, the current distribution includes 26 streams in 14 states. The species has been eliminated from approximately two-thirds of its former streams, as well as long reaches in streams where it still occurs. Surveys conducted within the past five to 10 years in the lower Ohio River have resulted in recent records, and the species may be more common in this area than previously estimated. However, the low numbers typically encountered during mussel surveys only indicate species presence and provide little information on distribution and population size (USFWS 2012a).

The sheepnose was listed as federally endangered under the ESA on April 12, 2012 (USFWS 2012a). The State of Illinois listed this species as threatened on March 17, 1989 and changed the listing status to endangered on January 18, 1994 (Mankowski 2012). This species has experienced a significant reduction in range, and most of the populations are disjunct, isolated, and appear to be declining. The decline of the sheepnose is primarily the result of habitat loss and degradation from impoundments, channelization and dredging activities, gravel mining, chemical contamination, sedimentation, pollution, and zebra mussels (USFWS 2012a).

1.B.9 Ohio Pigtoe

The Ohio pigtoe is a small to medium mussel up to 102 mm in length with a heavy triangular shell. The anterior end is rounded, with a bluntly pointed posterior end. A sulcus is present from the anterior end to the posterior ridge. The dorsal margin is straight, and the ventral margin is curved anteriorly and straight posteriorly. Shell color is typically brown or chestnut, with green rays present on juveniles (Cummings and Mayer 1992, Roe 2002).

This species primarily occurs in large rivers but may also be found in medium sized rivers. Individuals are generally found in or immediately above riffles with strong currents and substrates of sand, gravel, cobble, and boulders (Gordon and Layzer 1989, Roe 2002). Some studies suggest the Ohio pigtoe is tolerant of reservoirs (Gordon and Layzer 1989); however, Parmalee and Bogan (1998) noted that the species has not adapted well to reservoirs in Tennessee. The range of the species once included the upper Mississippi River drainage from the St. Lawrence River in western New York west to Wisconsin, Iowa, and Kansas and south to Arkansas and Alabama (Burch 1975). The Ohio pigtoe was also common throughout the Ohio River drainage but is now sporadic in the Ohio and Muskingum Rivers (Watters 1995) and potentially extirpated from the Wabash River and other tributaries. The species is more common in the Green, Tennessee, and Cumberland River reservoirs and a few Tennessee River tributaries. Distribution in Illinois is limited to the Ohio River, where it is generally distributed (Cummings and Mayer 1997).

This species was listed as endangered by the State of Illinois on January 18, 1994 due to restricted habitats or low populations within the state (Mankowski 2012). Threats to the Ohio pigtoe in the lower Ohio River include impoundments, channelization and dredging, sedimentation, chemical contaminants, mining, pollution and zebra mussels (USFWS 2018a).

1.B.10 Fat Pocketbook

The fat pocketbook is known to grow to a length of 127 mm and has a round to oblong shell that is greatly inflated and has a deep beak cavity (Cummings and Mayer 1992). The shell is thin to moderately thick, and both the anterior and posterior ends are rounded. The shell is typically rayless, smooth, and very shiny, and the periostracum can be light brown, yellow, or olive, often becoming dark brown in older individuals. Young fat pocketbooks may have a few faint ridges on the umbo and a small posterior wing; however, these characteristics are not always present in older individuals. The umbos are greatly inflated, elevated above the hinge line, and turned inward. The nacre is bluish white and often iridescent; however, it may include some pink or salmon color in some specimens (Cummings and Mayer 1992).

The fat pocketbook is a large-river species that is typically found in slow-flowing water with a mud (silt/clay), sand, or gravel substrate (USFWS 1989). Although the fat pocketbook was historically widespread within much of its original range, populations of this species and its range have declined in the last 50 years. Relatively dense populations are known from portions of the St. Francis River drainage in Arkansas and Missouri and sporadically elsewhere. Surveys and records from commercial mussel fisherman within the last five to 10 years in the lower Ohio River have recorded this species near Paducah, Kentucky and Metropolis, Illinois. Based on these records, the fat pocketbook may be more common in the lower Ohio River than previously thought. Many of these records are from young individuals (i.e., <5 years old), indicating that the species has been able to successfully reproduce in recent years (USFWS 2019).

The fat pocketbook was listed as federally endangered under the ESA on June 14, 1976 (USFWS 1976) and state endangered by the State of Illinois on July 25, 1984 (Mankowski 2012). The primary causes for the decline of this species in its historic range are from navigation (e.g., maintenance dredging) and flood control activities (USFWS 1989). Reductions in water quality (metals, pesticides, and other pollutants) from point source discharges have also likely affected populations of this species. Competition with the zebra mussel has also caused declines of this species in some portions of their range (NPS 2006, Hunter et al. 1996).

1.B.11 Rabbitsfoot

The rabbitsfoot is a medium to large mussel with an elongate, rectangular shell reaching 120 mm in length. The beaks are moderately elevated and slightly above the hinge line, and beak sculpture consists of a few strong ridges or folds continuing onto the newer growth of the umbo as small tubercles. The shell includes a few large, rounded, low tubercles on the posterior slope, although some individuals will have numerous small, elongated pustules, particularly on the anterior. The periostracum is generally smooth and yellowish, greenish, or olive in color, becoming darker and yellowish-brown in older individuals. Dark green or nearly black chevrons and triangles pointed ventrally may also be present; however, these patterns are absent in some individuals (Parmalee and Bogan 1998).

This species primarily occurs in small to medium-sized streams and some large rivers. Individuals are typically found in shallow water along the bank and adjacent runs and shoals with reduced water velocities. Specimens also may occupy deep water runs, having been found in three to four meters of water. Preferred substrates generally include gravel and sand (Parmalee and Bogan 1998). The rabbitsfoot seldom burrows, and typically lies on its side on the surface of the substrate. Historically, rabbitsfoot populations were found in 66 streams within the Ohio River basin; however, the species is currently extant in only 20 streams, representing a 70 percent decline from historical occurrences. Several extant populations are represented by only a single living or fresh dead specimen (USFWS 2013). Currently, two extant rabbitsfoot populations are known in the Ohio River, including one population located near Spencer County, Indiana and another population near Hancock County, Kentucky (Clarke 1995). The largest population is located downstream of Lock and Dam 52 and 53. Numerous live and fresh dead specimens have been reported from this area over the past 25 years, with the majority occurring downstream of Lock and Dam 52 near Paducah, Kentucky. This population includes multiple age and size classes (Butler 2005). Critical habitat has also been designated for this species, including 1,437 miles of stream in 12 states (USFWS 2012b).

The rabbitsfoot was listed as federally threatened under the ESA on October 17, 2013 (USFWS 2013) and state endangered by the State of Illinois on March 17, 1989 (Mankowski 2012). Threats to this species include impoundments, channelization and dredging, sedimentation, chemical contaminants, mining, and oil and natural gas development (USFWS 2012b).

1.B.12 Monkeyface

The monkeyface is a medium sized mussel that can reach up to 127 mm in length. The shell is squarish in shape with thick valves and a prominent posterior ridge. The posterior slope of the shell is flattened and

appears winged, often with a series of small ridges that curve upward. The outside of the shell is yellowish, greenish, or brown and usually marked with green V-shaped markings (MDNR 2020c).

The monkeyface primarily inhabits shoal habitat in medium to large rivers (Williams et al. 2017). Distribution is widespread in the eastern U.S., extending from the Upper Mississippi and Ohio River drainages south to the Tennessee and Arkansas Rivers. The species is also found in the Cumberland River (Tennessee and Kentucky) and Tombigbee River (Alabama and Mississippi) (Parmalee and Bogan 1998). The species was previously found in 10 drainages in Illinois, but healthy populations can presently be found in only the Kankakee and Mississippi Rivers (Cummings and Mayer 1997).

This species was listed as threatened by the State of Illinois on May 28, 2020. The species was previously widespread in Illinois but is nearly extirpated due to habitat destruction, over collecting, and other development pressures.

1.B.13 Species Occurrences

Data provided by the Illinois Natural Heritage Database shows records for the elephant-ear, ebonyshell, and orangefoot pimpleback within the downstream portion of the project area. These occurrences also extend downstream of the project area for approximately 0.7 mile. Occurrences of the butterfly and ebonyshell are also known approximately 4.7 miles upstream of the project area.

Occurrences of all 12 mussel species are known from a mussel bed called the Brookport Bed located approximately 0.8 mile downstream of the project area. A survey by Williams and Schuster (1983) reported 14 species of mussels from this bed in 1983, and a 1995 survey by Clarke resulted in the identification of nine mussel species. In the mid-2000s, a commercial brailer working with the USFWS and Kentucky Department of Fish and Wildlife Resources discovered the presence of the orangefoot pimpleback and pink mucket within the Brookport Bed. Based on these results, a formal mussel survey was performed in the bed in 2007. Survey methods included semi-quantitative and qualitative searches by MCDI, as well as brailing. Survey sites were selected based on information provided by the commercial brailer, with the intent of identifying additional species in the mussel bed. The survey area was located in the right descending portion of the river between RM 938.2 and 938.8, approximately 0.8 mile downstream of the proposed project. Multiple surveys were performed during July, August, September, and October, resulting in a total of 8,227 live mussels from 32 unionid species. Federal and Illinois state listed individuals included 6,046 ebonyshells, 721 monkeyfaces, 124 butterflies, 68 elephant-ears, 23 orangefoot pimplebacks, 20 Ohio pigtoes, 12 purple wartybacks, 10 fat pocketbooks, five spikes, one pink mucket, one sheepnose, and one rabbitsfoot. Of the 10 fat pocketbooks, six were considered juveniles (i.e., $\leq$5 years old), indicating recruitment of this species in the Brookport Bed.

A mussel survey was also conducted approximately six miles upstream of the proposed project in Livingston County, Kentucky in 2015. The survey was performed for a proposed fleeting area along the left descending bank of the Ohio River between RM 928.3 and 928.9. The survey consisted of 10 100-meter long transects and six qualitative search areas located between transects with high mussel concentrations. During the survey, a total of 203 live mussels from 15 unionid species were encountered, including multiple butterfly and ebonyshell individuals. One fat pocketbook individual was found in the upstream portion of the survey area between 40 and 50 meters from shore. No other federal or Illinois state listed mussels were found.

1.B.14 Mussel Survey

A mussel survey was performed for the proposed project by Mainstream Commercial Divers, Inc. (MCDI) between October 15 and November 2, 2018. Prior to the survey, a survey plan was submitted and approved by the USFWS. The survey area extended along the right descending bank from approximately 300 meters upstream of the fleeting facility to 400 meters downstream of the facility (Figure 4). The survey included both semi-quantitative and qualitative survey methods. The semi-quantitative survey consisted of 44 100-meter long transects oriented perpendicular to the shoreline, beginning at the upstream end of the survey area and continuing downstream. The divers searched an area one-meter wide along the transect line, and each transect was divided into 10-meter sections. Mussels were recorded separately for each 10-meter section, as well as substrate information and depths.

A total of 22 qualitative searches were performed during the mussel survey. Searches were limited to the area between adjacent transects that both contained mussel densities at or above 0.5 mussels per square meter, which is classified as a mussel bed according to the *Draft Protocol for Mussel Surveys in the Ohio River Where Dredging/Disposal/Development Activity Is Proposed* developed by the Ohio River Valley Ecosystem Mollusk Subgroup (April 2004). The searches were performed for a minimum of five minutes if no mussels were found and a maximum of ten minutes if mussels were encountered. All live mussels were identified to species, and approximate age was recorded. After processing, mussels were returned to the areas where they were collected.

During the survey, 1,719 live mussels representing 23 species were encountered, including 1,242 individuals of 22 species from the semi-quantitative survey and 477 individuals of 17 species from the qualitative searches. A total of 97 juvenile mussels (i.e., $\leq$5 years old) were encountered during the survey, indicating that recruitment has occurred in the survey area. The number and abundance of each species identified during the survey is summarized in the following table.

Scientific Name	Common Name	Total	Percentage
Quadrula nodulata	wartyback	631	36.71%
Fusconaia ebena	ebonyshell	545	31.70%
Quadrula quadrula	mapleleaf	202	11.75%
Amblema plicata	threeridge	111	6.46%
Obovaria olivaria	hickorynut	58	3.37%
Obliquaria reflexa	threehorn wartyback	43	2.50%
Potamilus alatus	pink heelsplitter	33	1.92%
Megalonaias nervosa	washboard	21	1.22%
Lampsilis teres	yellow sandshell	14	0.81%
Quadrula pustulosa	pimpleback	13	0.76%
Fusconaia flava	Wabash pigtoe	8	0.47%
Ligumia recta	black sandshell	8	0.47%
Potamilus capax	fat pocketbook	8	0.47%
Ellipsaria lineolata	butterfly	7	0.41%
Quadrula apiculata	southern mapleleaf	4	0.23%
Lampsilis cardium	plain pocketbook	3	0.17%
Leptodea fragilis	fragile papershell	3	0.17%
Quadrula metanevra	monkeyface	2	0.12%
Elliptio crassidens	elephant-ear	1	0.06%
Lasmigona complanata	white heelsplitter	1	0.06%
Pleurobema cordatum	Ohio pigtoe	1	0.06%
Potamilus ohiensis	pink papershell	1	0.06%
Truncilla truncata	deertoe	1	0.06%
Total Number of Mussels		**1,719**	---

Federal and state listed individuals identified during the survey included 545 ebonyshells, eight fat pocketbooks, seven butterflies, two monkeyfaces, and one elephant-ear. Ebonyshells were found throughout the majority of the survey area between 30 and 100 meters from shore and were only absent from nine transects and six qualitative search areas. The eight fat pocketbook individuals were found between 35 and 75 meters from shore along Transects 14, 16, 19 and 40 and in Qualitative Search Areas 14, 16, 18, and 19. The seven butterfly individuals were located between 70 and 100 meters from shore along Transect 40 and in Qualitative Search Area 22. The two monkeyface individuals were found between 40 and 50 meters from shore along Transect 8 and in Qualitative Search Area 12, respectively. The elephant-ear individual was located between 70 and 80 meters from shore along Transect 40.

Mussel densities along the 10-meter transect sections ranged from zero to 12 mussels per square meter. As previously discussed, a density of 0.5 mussels per square meter is considered to represent a mussel bed, which correlates to five or more mussels per 10-meter section. Based on this definition, 71 of the 440 10-meter sections meet the minimum threshold for a mussel bed due to the presence of five or more mussels

(Figure 4). All federal and state listed individuals encountered along transects were found within mussel beds, with the exception of 22 ebonyshells and two fat pocketbooks found within 10-meter sections that contained less than five mussels. The 10-meter sections that do not contain mussel beds but had ebonyshell or fat pocketbook individuals are shown on Figure 4.

The results of the transect survey also show that only a few mussels were encountered within 30 to 40 meters of the shoreline. This trend continued farther from shore for some transects, extending up to 70 meters. The habitat information collected during the survey shows that the substrate in this area consists of 80 to 100 percent clay and has little to no sand or gravel. The clay is hard-packed, which makes it difficult for mussels to bury in the substrate and find suitable anchoring locations. The areas closest to shore are also impacted by barges that hit and rest on the bottom while being temporarily fleeted against the shoreline, resulting in disturbance of fine sediment and further compacting the substrate. Based on these factors, this area is considered unsuitable for mussels.

The habitat in the survey area improves riverward of the unsuitable area along the shoreline, with higher compositions of sand and gravel in the substrate. Mussel densities increased as substrate conditions improved, and the majority of mussels encountered during the survey were found between 40 and 50 meters from shore. Suitable habitat conditions and high mussel densities continued throughout the remainder of the survey transects (60 to 90 meters), with slight declines observed at the ends of the transects (90 to 100 meters). The water level elevation ranged from 303.4 feet to 311.8 feet during the survey, with water depths of zero to 33 feet along the transects. Depth readings were obtained from the divers' pneumofathometer and are considered accurate to within six inches. A copy of the mussel survey report prepared by MCDI is included as Appendix B.

1.C DESCRIPTION OF PROJECT ACTIVITIES

The construction and operation components of the proposed project are presented below.

1.C.1 Construction Component

The construction component of the proposed project includes installation of the spud and spar barges and anchor in each fleeting area. Design plans for the project are shown on Figure 3 and provided in Appendix C. The construction component activities are discussed in greater detail below.

Spud and Spar Barge Installation

Each fleeting area will include two spud barges and two spar barges to provide a mooring structure for fleeted barges. The spud and spar barges will be positioned in a linear configuration (i.e., end-to-end) parallel to the shoreline at a distance of 60 to 150 feet. Each barge will be approximately 200 feet long by 35 feet wide. Tow boats will be used to move the barges into place and maintain their positions until secured. Each spud barge will be secured to the river bottom using two 30-inch diameter spud piles, resulting in a total of four spud piles per mooring structure. Six sets of spud and spar barges will be located in the facility, resulting in a total of 24 spud piles. Each spud pile will have a footprint of approximately five square feet; therefore, the total area of river bottom that will be impacted by the spud piles is 120 square feet. Spud piles will be lowered by crane into a spud well that begins on the barge deck and continues through the hull, allowing the pile to contact the river bottom. This configuration will allow the spud barge to move vertically as the water level fluctuates. The weight of the spud pile will cause it to sink up to five feet into the substrate, and no pile driving will be required. After installation of the spud piles, the spar barges will be connected to the spud barges with barge wires to complete the mooring structure. All work associated with spud/spar barge installation will be performed from the river, and no onshore work will be required. The spud/spar barges are designed to be permanent structures and are not anticipated to be moved after installation.

Anchor Installation

A ship anchor will be used at each of the six spud and spar barge configurations as a secondary support mechanism for the spud/spar barges. The anchor will be positioned upstream and shoreward of the barges and attached to the upstream spud barge by a chain. The anchor will be lowered by crane and securely set into the substrate. Each anchor will have a footprint of approximately 33 square feet, resulting in a total area of impact to the river bottom of 198 square feet. The anchor chain will then be extended to the spud barge with sufficient slack to accommodate vertical movement of the barge. Each chain will be a minimum of two inches in diameter and approximately 270 feet long. No onshore work will be required during anchor installation, and all work will be completed from the river.

1.C.2 Operation Component

The operation component of the proposed project includes barge fleeting and boat operation. These activities are discussed further in the following sections.

Barge Fleeting

Barges will be temporarily fleeted in the fleeting areas during assembly and disassembly of barge tows. Barges will be delivered to and retrieved from the fleeting areas on a daily basis. Barges that are being transferred from one tow to another tow will typically enter and leave the fleeting area within a 24-hour period. Barges awaiting transport to a separate facility for loading, unloading, or repair may be fleeted for longer periods, with an estimated average fleeting period of two to three days. Navigational delays, such as lock closures, low water levels, or inclement weather, may result in longer barge fleeting periods. Although each fleeting area will be capable of holding up to 72 barges (including the spud and spar barges), the fleeting areas will rarely be at full capacity due to the continuous movement of barges in and out. If a fleeting area does reach capacity, it would likely be the result of an unforeseen event and be expected to last for a short duration.

Fleeted barges will be temporarily moored to the spud/spar barges or other fleeted barges. Barges will be arranged to maximize the assembly and disassembly of barge tows; however, fleeting will generally begin in the upstream portion of the fleeting area and continue downstream or riverward. No barges will be fleeted on the shoreward side of the spud/spar barges, and no fleeting operations will occur onshore.

The design and location of the fleeting areas were selected to allow barges to be fleeted offshore and prevent barges from hitting or resting on the river bottom. The location of the fleeting facility was based on the 302-foot normal pool elevation of the Olmsted Locks and Dam. Based on this elevation, the fleeting areas will be located in water of sufficient depth to keep barges afloat and avoid grounding, regardless of draft. The spud and spar barges will be empty and draft two feet or less. River bottom elevations at the spud/spar barge locations range from 276 to 295 feet, with an average elevation of 285 feet. Based on the normal pool elevation of 302 feet, water depths at these locations range from seven to 26 feet and average 17 feet. As a result, a minimum of five feet will be maintained between the hulls of the spud/spar barges and the river bottom at the normal pool elevation of 302 feet documented for the Olmsted Pool of the Ohio River.

A water level below 302 feet could result in the spud and spar barges hitting or resting on the river bottom; however, the water level in the Olmsted Pool has remained at or above 302 feet the majority of the time since operation of the renovated Olmsted Locks and Dam began in August 2018. Data from U.S. Geological Survey Gage 03611000, located at Paducah, Kentucky across the river from the upstream extent of the proposed fleeting facility, shows that the river was at or above the normal pool elevation of 302 feet on 582 days out of 731 days (80%) between August 1, 2018 and August 31, 2020. During the other 149 days when the pool elevation was below 302 feet, the lowest recorded pool elevation was only 299.54 feet on September 5, 2018, shortly after operation of the dam began. Water levels below 300 feet were recorded

six other times between August 16 and September 7, 2018; however, the pool elevation has not dropped below 300 feet since that time. At the lowest recorded elevation of 299.54 feet, a minimum distance of two and a half feet would be maintained between the spud/spar barges and the river bottom, with a distance of at least three feet during the remainder of the time the river was below normal pool. This data demonstrates that the water level maintained by the Olmsted Locks and Dam over the last two years is sufficient to prevent the spud/spar barges from hitting or resting on the river bottom. One of the primary goals of the Olmsted Locks and Dam project was to provide better control and maintenance of the pool above the dam, and this data indicates that the water level is unlikely to drop low enough to allow the spud/spar barges to contact the river bottom. In the unlikely event that the water level did drop low enough to allow the spud/spar barges to contact the river bottom, it would be the result of a major problem with the dam or other catastrophic event that would be a singular occurrence or occur infrequently over a long period of time.

The draft of fleeted barges will vary based on load, with empty barges drafting two feet or less and fully loaded barges drafting up to 12 feet. Drafts of fleeted barges are controlled by managing loads based on river conditions, dam draft restrictions, and travel routes. Barge draft will be used to help determine the position of barges in the fleeting areas and ensure that barges are not placed in areas where they may hit or rest on the bottom. During periods when water levels are below normal pool, barge fleeting will be adjusted accordingly to prevent fleeted barges from hitting or resting on the river bottom.

Barge loads will be secured to prevent materials from entering the river during fleeting maneuvers. No materials will be loaded or unloaded from barges in the fleeting areas. The barges do not contain engines or other mechanisms that require fuel, oil, hydraulic fluid, or other hazardous materials that could leak or spill. Barges may be cleaned and repaired in the fleeting areas at times, but these activities will not occur on a daily basis. Cleaning in the fleeting areas will be limited to barges carrying non-hazardous dry cargo only, and cleaning products will be prevented from entering the river. Repairs will be performed in a manner that avoids the input of contaminants and materials into the river. All residual products from the cleaning and repair processes will be collected and removed to ensure that no contaminants enter the river. In addition, barge cleaning and repair will be similar to current practices occurring along the river.

Boat Operation

Tow boats will operate in the fleeting areas on a daily basis. Large tow boats used during barge transport will travel to the fleeting areas to disassemble their barge tows and assemble new tows for transport. After landing, smaller tugboats will disassemble and assemble the barge tows and maneuver barges within the fleeting areas. Large tow boats have engines up to 10,500 horsepower (hp), with a maximum draft of approximately 10 feet. The smaller tugboats typically have engines up to 2,000 hp and a maximum draft of approximately nine feet. Barge fleeting is controlled, close-quarters work and requires slow, precise

movements to properly position the barges without damaging them, the boats, or the spud/spar barges. Tow boats and tugboats will be operating well below their speed and engine capacities, with an estimated operating speed of approximately two miles per hour or less. Boats will operate in water with sufficient depth to prevent their hulls or propellers from striking the bottom to avoid damage to the boats and river substrate. All boats used in the fleeting areas will have propellers that are fixed horizontally, and propeller wash will be directed horizontally instead of downward towards the river bottom. Propeller wash is the disturbed mass of water pushed aft (or fore when the propeller is in reverse) by the boat propeller. Propeller wash will also be directed away from the shoreline and shallow areas to the maximum extent practicable. Tow boats and tugboats will be driven to the fleeting facility as needed and will not be stored in the fleeting areas.

A Facility Operation Plan will also be implemented for all activities in the fleeting facility. The plan outlines the practices necessary to fleet barges in a safe and efficient manner and provides guidance and operating procedures for barge mooring and fleeting during various operating conditions. The plan also includes monitoring and maintenance protocols for the fleeting facility and emergency procedures in the event of a fleet breakaway. The emergency procedures include a Vessel Response Plan that outlines response procedures for specific incidents, including spill mitigation. The Facility Operating Plan will be posted in HELM, a computer system utilized to house the Ingram Barge Company Safety Management System and Vessel Response Plan, and will be accessible to Ingram vessel crewmembers at all times. A copy of the Facility Operating Plan is included as Appendix D.

1.C.3 Summary of Project Impacts

Based on the proposed construction and operation activities, the area of risk to the 12 mussel species will be limited to the 24 spud pile locations and the six anchor/anchor chain locations. The total area of impact to the river bottom from the spud piles will be 120 square feet, with each impact area separated by a minimum distance of 180 feet. The anchors/anchor chains will result in a total of 198 square feet of impact to the river bottom, with each impact area separated by more than 1,900 feet.

1.D ANTICIPATED ADVERSE EFFECTS ON LISTED SPECIES

The following sections include an analysis of effects that may occur as a result of the proposed project to the 12 mussel species. Based on activities associated with the project and known threats to these species, the following effects have been identified: sediment disturbance; water quality degradation; crushing or striking of individuals; displacement of individuals; and alteration of fish host habitat. These effects are discussed further in the following sections.

1.D.1 Sediment Disturbance

All construction components could result in sediment disturbance. The installation of spud piles into the river substrate will result in minimal sediment disturbance at each location. Displacement of sediment will occur where the spud piles contact the substrate, and sediment deposition may occur adjacent to the structures from the accumulation of displaced sediment. Sediment displacement could cause the substrate to become unsuitable for mussels, and sediment deposition could bury or smother mussels depending on the amount of deposition.

As discussed in Section 1.C.1, each spud pile (24) will have a footprint of approximately five square feet, resulting in a total area of impact to the river bottom of 120 square feet. The impacts areas will be dispersed throughout the fleeting facility due to the separation of each spud pile by a minimum of 180 feet. The piles will sink into the substrate by gravity instead of pile driving, reducing the disturbance to the substrate. Based on the mussel survey, the spud pile locations are predominately comprised of clay with varying amounts of sand. Disturbance of the hard-packed clay is expected to be minor and result in minimal displacement from the pile location. Sand may enter the water column upon contact of the pile with the substrate; however, the heavier particles are expected to settle a short distance from the impact area. The substrate conditions are anticipated to result in a low volume of sediment deposition around the spud pile, allowing buried mussels to reach the substrate surface more easily or move from the area if necessary. Additionally, the spud piles will be located in areas of suitable mussel habitat, minimizing the distance an affected individual would need to travel to reach suitable habitat. The minimal amount of sediment disturbance is also not anticipated to alter habitat to the extent that fish hosts would move to other areas or decrease their exposure to mussels. Based on the small footprint of the spud piles and the minimal amount of sediment disturbance from installation, effects to the 12 mussel species from sediment disturbance associated with spud pile installation are considered insignificant.

Installation of the anchors will also result in minimal sediment disturbance to the river substrate at each location. Each anchor has a footprint of approximately 33 square feet, resulting in a total area of impact to the river bottom of 198 square feet. Each anchor will be separated by more than 1,900 feet, dispersing the impacts throughout the fleeting facility. The anchors will be located in the area along the shoreline where the substrate is 80 to 100 percent hard-packed clay and is not suitable for mussels. As discussed above, sediment excavation and deposition in this substrate type are expected to be minimal. Based on these factors, sediment disturbance from anchor installation is unlikely to affect the mussel species and is considered insignificant.

After anchor installation, sediment disturbance could be caused by the anchor chains hitting or resting on the river bottom, particularly at low water levels when the chain is more likely to contact the substrate. The

anchor chains will contact the substrate near the anchor attachment at all times, except during periods of high water. The chains may move slightly as a result of flow, resulting in minor sediment disturbance directly adjacent to the chain. The anchor chains associated with Fleeting Areas 1, 2, 5, and 6 will be located entirely within the unsuitable habitat area along the shoreline. As discussed under anchor installation, the substrate in this area is 80 to 100 percent hard-packed clay and is not suitable for mussels. Sediment displacement and deposition in this substrate type are expected to be minimal and unlikely to affect the mussel species.

The anchor chains in Fleeting Areas 3 and 4 will cross areas of suitable habitat between the anchor and spud barge. Sediment disturbance will occur where the chain contacts the substrate, and the amount of disturbance will vary based on flow and water level. As water levels fluctuate and the spud barge moves up and down, the chain will become tighter or looser, causing the chain to lift from the substrate during high flows and contact more of the substrate during low flows. Fluctuations in the water level will occur slowly over an extended period of time, causing the anchor chains to contact or lift off the substrate with minimal force and movement. This movement will result in sediment disturbance; however, the amount of disturbance is expected to be minimal, occur over an extended period of time, and be localized to the chain location. Based on the location of most of the anchor chains in unsuitable habitat and the minimal amount of sediment disturbance anticipated to suitable habitat in Fleeting Areas 3 and 4, effects to the 12 mussel species from sediment disturbance associated with anchor chain movement are considered insignificant.

Sediment disturbance from the spud/spar barges and fleeted barges hitting or resting on the river bottom is not anticipated within the fleeting areas. As discussed in Section 1.C.2, the proposed fleeting areas were purposely located in deeper water to prevent spud/spar barges and fleeted barges from contacting the riverbank or bottom. At the normal pool elevation of 302 feet, a minimum of five feet will be maintained between the spud/spar barges and the river bottom. In addition, water level data since the renovation of the Olmsted Locks and Dam indicate that water levels will not drop low enough to allow the spud/spar barges to contact the river bottom. Fleeted barges will begin in water ranging in depth from 10 to 26 feet, and depths will continue to increase as barges are fleeted toward the river. Fleeted barge drafts will vary between two feet and 12 feet based on load, resulting in a minimum distance of eight feet between the barge hulls and river bottom at the shallowest point and a greater distance throughout the rest of the fleeting areas. Barge draft will be used to determine the position of barges in the fleeting areas and ensure that barges are not placed in areas where they may hit or rest on the bottom, including during low water levels.

The presence of the spud and spar barges in the fleeting areas will result in minor flow modifications that could cause sediment disturbance. These barges will be permanent structures and will act as impediments to flow, slowing water as it moves around the barges and potentially allowing suspended sediment from upstream to settle in the project area. Water that is forced under the barges will increase in velocity, which

could lead to scouring of the substrate due to the decreased depth of the river at the barge locations. Scouring is likely to result in the suspension of sediment, which could be transported and deposited downstream. The excavation and deposition of sediment from flow modifications at the spud/spar barges could alter habitat in the project area to the extent that it is no longer suitable for mussels. Individuals in these areas would be required to move to suitable habitat, potentially resulting in increased energy expenditure and decreased fitness. This sediment disturbance could also alter fish host habitat to the extent that individuals vacate the area and are no longer exposed to mussels. As a result, flow modifications from the spud and spar barges are likely to result in unavoidable impacts from sediment disturbance, resulting in adverse effects to the 12 mussel species.

Fleeted barges will be delivered to and retrieved from the fleeting areas on a daily basis, with the majority of barges temporarily fleeted for less than 24 hours. Barges will be repositioned frequently as barge tows are assembled and disassembled, and the configuration of barges in the fleeting area will continually change. Fleeted barges will also be located in deeper water than the spud/spar barges, reducing the potential for sediment disturbance. Based on these factors, sediment disturbance associated with flow modification from the majority of fleeted barges is expected to be minimal. Some barges may be fleeted for up to two to three days; however, sediment disturbance will be temporary, and affected areas are anticipated to return to pre-existing conditions through natural river processes after the barge is removed. Due to the minimal nature of these disturbances, sediment disturbances associated with the fleeted barges are not expected to alter fish host habitat. Therefore, effects to the 12 mussel species from sediment disturbance caused by flow modifications from fleeted barges are considered insignificant.

Tow boats and tugboats will operate in the fleeting areas on a daily basis and will likely cause some sediment disturbance as a result of propeller wash. These vessels will be operating well below their speed and engine power capacities and will avoid shallow areas where the hulls or propellers could strike the river bottom. All boats used in the fleeting areas will have horizontally fixed propellers, and propeller wash will be directed away from the shoreline and shallow areas to the maximum extent practicable. The effects of propeller wash are also expected to be discountable at depths of 20 feet or greater. Propeller wash may result in sediment disturbance in shallower areas, however, by scouring sediment in one location and causing deposition in another location. Finer sediments may enter the water column and lead to sediment deposition downstream. Excavation of sediment could alter habitat to the extent it becomes unsuitable for mussels, causing individuals to move to suitable habitat. This movement would result in increased energy expenditure that could lead to decreased fitness and increased competition with other individuals. This disturbance could also result in deposition of sediment adjacent to the scoured area as larger particles are moved along the river bottom and accumulate in new areas. Sediment deposition may result in alteration or loss of habitat, as well as bury or smother mussels. The abundance of fish hosts and their exposure to mussels may also be affected by habitat alteration or loss from sediment disturbance. Based on these

factors, operation of tow boats and tugboats in the fleeting areas will cause sediment disturbance, resulting in adverse effects to the 12 mussel species.

The sediment disturbance described above could also result in impacts to habitat for fish hosts for the 12 mussel species. Sediment excavation and deposition may damage or bury habitat used for foraging, reproduction, and sheltering. The alteration or loss of habitat could cause fish hosts to move to a more suitable area, limiting their exposure to the mussel species and potentially affecting mussel reproduction and recruitment.

1.D.2 Water Quality Degradation

All construction components could result in water quality degradation as a result of sediment disturbance. Suspension of fine sediment could lead to increased turbidity and decreased dissolved oxygen, which may result in harm or mortality of mussels or cause individuals to move from an area if these conditions persist for an extended time. Degradation of water quality could be caused during spud pile and anchor installation as these structures contact the river bottom and displace sediment into the water column. However, as previously discussed, each spud pile will only impact five square feet of the river bottom, and each spud pile will be separated by a minimum of 180 feet. The substrate at the spud pile locations consists of clay with varying amounts of sand, which are unlikely to enter the water column in significant amounts or remain suspended for an extended time. Each anchor will only impact 33 square feet of the river bottom and will be separated by more than 1,900 feet. These structures will also be located in areas with clay and sand substrates that were determined to be unsuitable mussel habitat. As a result, sediment disturbance associated with spud pile and anchor installation is unlikely to significantly increase turbidity or decrease dissolved oxygen levels; therefore, effects to the 12 mussel species are considered insignificant.

After anchor installation, sediment disturbance from the anchor chains hitting or resting on the river bottom could degrade water quality through sediment suspension. As previously discussed, the majority of the anchor chains are located in the unsuitable habitat area that consists of clay with varying amounts of sand. These substrate types are unlikely to enter the water column in significant amounts or remain suspended for an extended time. Sediment disturbance from the anchor chains in Fleeting Areas 3 and 4 is also expected to be minimal. Water level fluctuations will cause the chains to slowly lift from or contact the river bottom slowly over time, and the chains are unlikely to forcefully hit or move around in the substrate. The minor sediment disturbance generated from these incremental movements is not anticipated to result in large amounts of suspended sediment that could increase turbidity or decrease dissolved oxygen levels. Any sediment that does enter the water column is expected to settle quickly within or near the chain location. Based on these factors, effects to the 12 mussel species from water quality degradation associated with anchor chain movement are considered insignificant.

As discussed in the previous section, the spud and spar barges are not expected to disturb sediment by hitting or resting on the river bottom; therefore, water quality degradation from sediment suspension caused by these barges contacting the substrate is considered unlikely. The presence of the spud and spar barges in the fleeting areas will result in minor flow modifications that could cause water quality degradation. Water that is forced under the barges will increase in velocity, which could lead to scouring of the substrate. Sediment that becomes suspended during scouring could remain in the water column and lead to increased turbidity and decreased dissolved oxygen levels. Persistence of these conditions could affect the ability of mussels to respire, feed, and reproduce, resulting in potential harm to mussels or causing them to move to more suitable areas. Water quality degradation may also affect fish hosts by impairing respiration, resulting in fish leaving an area where mussels may be present. As a result, adverse effects to the 12 mussel species are anticipated from water quality degradation associated with flow modifications from barge fleeting.

Fleeted barges are also not expected to hit or rest on the river bottom due to their location in areas of deeper water. Fleeted barges will only be in the fleeting areas on a temporary basis (typically less than 24 hours) and will be repositioned and reconfigured frequently, reducing the potential for significant sediment disturbance from long-term flow modification. The fleeted barges will also be located in deeper water than the spud/spar barges, further reducing the potential for sediment disturbance. Based on the limited potential for sediment disturbance from flow modification by fleeted barges, water quality degradation from sediment disturbance is expected to be minimal. Barges that are fleeted longer than 24 hours have an increased potential for water quality degradation caused by sediment disturbance; however, effects to water quality will be short-term and are anticipated to disperse rapidly after the barge is removed. Significant degradation of water quality from fleeted barges is not anticipated, and effects to the 12 mussel species are considered insignificant.

Some barges will contain materials while fleeted, and water quality degradation could occur if these materials contain potential contaminants that enter the river. To avoid water contamination, barge loads will be secured to prevent materials from entering the river during fleeting maneuvers. No materials will be loaded or unloaded from barges in the fleeting areas. The barges do not contain engines or other mechanisms that require fuel, oil, hydraulic fluid, or other hazardous materials that could leak or spill. Barge cleaning in the fleeting areas will be limited to barges carrying non-hazardous dry cargo only, and cleaning products will be prevented from entering the river. Repairs to barges will be performed in a manner that avoids the input of contaminants and materials into the river. All residual products from the cleaning and repair processes will be collected and removed to ensure that no contaminants enter the river. Based on these factors, effects to the 12 mussel species from water quality degradation from contaminants associated with barge fleeting are considered insignificant.

As previously discussed, propeller wash from tow boats and tugboats operating in the fleeting areas is anticipated to cause sediment disturbance in shallower portions of the project area. This disturbance could cause fine sediments to enter the water column, and prolonged sediment suspension over an extended time may lead to increased turbidity and decreased dissolved oxygen levels. These impacts could result in harassment and harm of mussels by affecting their ability to respire, feed, and reproduce. Degradation of water quality from suspended sediment may also cause fish hosts to move from the affected area, potentially limiting their exposure to mussels. Potential impacts to the mussel species from water quality degradation associated with propeller wash will be minimized to the extent possible; however, adverse effects to the 12 mussel species are anticipated as a result of these impacts.

The tow boats and tugboats used in the fleeting areas will contain petroleum-based products such as fuel, oil, and hydraulic fluid. Other potentially hazardous materials on the boats may include cleaning products, sanitary waste, and other necessary chemicals. Degradation of water quality could occur if these materials leak or spill into the river while boats are operating in the fleeting areas. The potential for leaks and spills will be minimized by storing the boats in a separate facility and driving to the fleeting facility as needed for daily operations. The likelihood of leaks and spills from boats operating in the fleeting areas is expected to be similar to current conditions, as boats use the proposed fleeting areas now for temporary fleeting and travel. Normal boat maintenance and repair activities may occur within the fleeting areas; however, protocols in the Facility Operating Plan will be implemented to prevent contaminants from entering the river. If a leak or spill occurs, the procedures in the Vessel Response Plan will be immediately implemented to address and mitigate the spill. In addition, petroleum products typically float on the water's surface during a spill, thereby reducing potential impacts to mussels in the substrate. Based on these factors, effects to the 12 mussel species from water quality degradation associated with contaminants from boat operation are considered insignificant.

Water quality degradation from the construction components may also result in impacts to fish hosts for the 12 mussel species. Changes to water quality from sediment suspension or contaminants could cause fish hosts to abandon areas where mussels are present, reducing their exposure to mussels and limiting mussel reproductive potential.

1.D.3 Crushing or Striking of Individuals

All construction components could result in crushing or striking of individuals, with the exception of anchor installation. Anchor installation is not expected to crush or strike individuals due to the locations of the anchors in the unsuitable habitat area along the shoreline.

The spud piles may crush or strike mussels when lowered into the river substrate. The piles will be installed approximately 40 to 60 meters from shore where the majority of mussels were found during the survey, and several piles will be placed in or directly adjacent to mussel bed and listed mussel locations. Each spud pile will have a footprint of five square feet, and the total area of impact to the river bottom for the fleeting facility will be 120 square feet. As previously discussed, the impact area for each spud pile will be separated by a minimum of 180 feet. Potential impacts to the mussel species from spud pile installation will be minimized to the extent possible; however, adverse effects to the 12 mussel species are anticipated from crushing or striking individuals during spud pile installation.

The anchor chains associated with Fleeting Areas 1, 2, 5, and 6 will be located in the unsuitable habitat area and are not expected to crush or strike individuals. The anchor chains in Fleeting Areas 3 and 4 cross suitable habitat where mussels may be located. The chains will be approximately two inches in diameter and will only move within a limited area. Although horizontal and vertical movement of the chain could strike an individual, chain movement is expected to be slow and unlikely to generate enough force to significantly impact an individual. Contact to an individual from the chain is anticipated to be similar to coarse sediments and other small debris striking the individual during normal or high flows. Individuals that are agitated by chain contact can move a short distance to other suitable habitat outside the span of the chain. Chain contact with mussels is also expected to decrease over time as individuals become habituated to or move away from the chain. Based on the location of most of the anchor chains in unsuitable habitat and the minimal amount of impact anticipated to individuals from the anchor chains in Fleeting Areas 3 and 4, the effects to the 12 mussel species from crushing or striking of individuals from anchor chain movement are considered insignificant.

The proposed fleeting facility is designed to prevent barges from hitting or resting on the river bottom at the normal pool elevation of 302 feet, and the water level in the project area has not dropped low enough to allow the spud/spar barges to contact the river bottom since operation of the renovated Olmsted Locks and Dam began in August 2018. Based on this data, crushing and striking of mussels from barges contacting the river bottom is unlikely and is not expected to result in adverse effects to the 12 mussel species. Fleeted barges will be positioned in the fleeting areas to ensure that the hulls do not hit or rest on the bottom, and barges will be repositioned or moved from the facility during low water levels to prevent contact with the river bottom.

Tow boats and tugboats will be operated in water with sufficient depth to prevent the hulls and propellers from hitting the river bottom to avoid damage to the vessels and the potential to crush or strike mussels. As a result, operation of tow boats and tugboats is unlikely to crush or strike individuals, and adverse effects to the 12 mussel species are not anticipated as a result of boat operation.

Crushing or striking of fish hosts is not anticipated from the construction or operation components due to their mobility. The spud piles and anchors will be lowered by crane in a slow, controlled manner and will not be dropped rapidly through the water or onto the substrate. Barges and boats will avoid hitting the substrate, and fish hosts are unlikely to be struck by vessels that contact the river bottom due to their mobility and conditioning to existing barge and boat traffic in the river.

1.D.4 Displacement of Individuals

Construction components that may result in displacement of individuals include spud pile installation, anchor chain movement, and boat operation. During spud pile installation, an individual directly adjacent to the pile location may be displaced as sediment is moved when the pile contacts the substrate. As discussed previously, the spud piles have a small footprint (five square feet) and will impact a total of 120 square feet of the substrate in areas comprised of hard-packed clay and sand. Displacement of these substrate types is expected to be minimal and only extend a short distance from the pile location. Additionally, the piles will be located in areas of suitable mussel habitat, and an individual that is displaced is likely to land within a suitable location. Based on these factors, effects to the 12 mussel species from displacement associated with spud pile installation are considered insignificant.

The anchor chains associated with Fleeting Areas 1, 2, 5, and 6 will be located entirely within the unsuitable habitat area where no mussels were found. As a result, the anchor chains in these areas will not displace individuals. The anchor chains in Fleeting Areas 3 and 4 will span areas of suitable habitat and could displace an individual as the chain moves horizontally from flow or vertically during water fluctuations. Chain movement is expected to be slow and is unlikely to generate enough force to significantly displace an individual due to the small size of the chain (approximately two inches in diameter). Contact with the chain could move an individual a short distance; however, the individual is expected to remain within suitable habitat. The potential for displacement is also expected to decrease over time as individuals become habituated to or move away from the chain. Based on the location of most of the anchor chains in unsuitable habitat and the minimal amount of impact anticipated to individuals from the anchor chains in Fleeting Areas 3 and 4, effects to the 12 mussel species from displacement of individuals from anchor chain movement are considered insignificant.

Propeller wash from tow boats and tugboats is unlikely to displace individuals in deep water. Boats will be operating well below their speed and engine power capacities in the fleeting areas, reducing the amount of force generated by the propeller. All boats will also have horizontally fixed propellers, which will direct the majority of the propeller force horizontally instead of downward towards the river bottom. However, the slope of the river bottom near shore and in shallower areas may result in horizontal propeller wash being directed at the substrate with enough force to displace mussels. Based on the location of the shoreward

side of the fleeting areas along the boundary of the unsuitable habitat area, an individual located in suitable habitat could be displaced to unsuitable habitat by a boat operating in this portion of the fleeting area. Displacement of an individual to the unsuitable habitat area could result in harm or mortality if it is unable to travel back to suitable habitat. Therefore, adverse effects to the 12 mussel species are anticipated as a result of displacement from boat operation.

1.D.5 Fish Host Habitat

All construction components could result in impacts to fish host habitat. Potential effects to fish host habitat from these components are similar to those for the mussel species and are included under the previous sections. However, the presence of floating barges could affect fish hosts in a manner that does not affect mussels or their habitat. Floating barges may negatively impact fish host habitat by shading the water underneath, causing it to become unsuitable for some fish species or activities, such as feeding or reproduction. If the habitat becomes unsuitable, fish hosts may leave the area and no longer come into contact with mussels.

Conversely, visibility in the Ohio River is typically low due to turbidity, and the shade created by the barges may not be detectable on the river bottom. As a result, fish hosts that typically inhabit benthic areas may not alter their behavior or reduce their exposure to mussels. The shade provided by the barges may also result in the area underneath becoming more suitable for certain species or activities. Fish hosts that are positively affected by the barges may move into the project area or congregate in greater numbers, which could increase their exposure to the mussel species. Greater exposure to fish hosts could increase the reproductive success of the mussel species and enhance recruitment in the project area. As a result, the reproductive success of the mussel species in the project area could be reduced or improved by barge fleeting.

Fleeted barges will be repositioned and reconfigured frequently as barge tows are disassembled and assembled, and any effects to host fish, positive or negative, are expected to be temporary. The fleeted barges will also be located in deeper water where shade from the barges may be undetectable at or near the river bottom, resulting in no behavioral differences in fish hosts. Based on the potential for barge fleeting to have positive and negative effects on fish hosts and mussel reproduction, the effects to the 12 mussel species from alteration of fish host habitat are considered insignificant.

1.D.6 Cumulative Effects

Cumulative effects are those that are reasonably certain to take place in the future as a result of activities unrelated to the proposed project. The purpose of the proposed fleeting facility is to provide a designated

location for the temporary fleeting of barges during assembly and disassembly of barge tows. Future activities, such as increased residential or commercial development, agricultural practices, increased traffic, or tourism, in the area are not reasonably certain to occur as a result of the project. Based on these factors, no cumulative effects to the 12 mussel species are anticipated as a result of the project.

1.D.7 Summary of Effects

Potential effects to the 12 mussel species from the proposed project include sediment disturbance, water quality degradation, crushing or striking of individuals, displacement of individuals, and alteration of fish host habitat. The determination of effects to the mussel species from these impacts is summarized in the following table.

Stressor	Activity	Effect Determination	
		Adverse	Insignificant or Discountable
Sediment Disturbance	Spud Pile Installation		X
	Anchor Installation		X
	Anchor Chain Movement		X
	Barge Fleeting	X	
	Boat Operation	X	
Water Quality Degradation	Spud Pile Installation		X
	Anchor Installation		X
	Anchor Chain Movement		X
	Barge Fleeting	X	
	Boat Operation	X	
Crushing or Striking of Individuals	Spud Pile Installation	X	
	Anchor Installation		X
	Anchor Chain Movement		X
	Barge Fleeting		X
	Boat Operation		X
Displacement of Individuals	Spud Pile Installation		X
	Anchor Installation		X
	Anchor Chain Movement		X
	Barge Fleeting		X
	Boat Operation	X	
Alteration of Fish Host Habitat	Spud Pile Installation		X
	Anchor Installation		X
	Anchor Chain Movement		X
	Barge Fleeting	X	
	Boat Operation	X	

2.0 MINIMIZATION AND MITIGATION MEASURES

The proposed measures that will be implemented to minimize and mitigate effects to the 12 mussel species from the proposed project are described below in terms of the plans to minimize the area affected, plans for management of the affected area, a description of minimization and mitigation measures, proposed monitoring, adaptive management practices, and verification of funding for mitigation.

2.A PLANS TO MINIMIZE THE AREA AFFECTED

The offshore fleeting facility is designed to minimize impacts to the river by avoiding contact with the shoreline and limiting interaction with the river bottom. The shoreline within the project area is currently used for unorganized temporary barge fleeting, which involves either tying off to trees or deadman anchors onshore or continuously pushing barges into the shoreline with tow boats. This fleeting method requires the grounding of barges against the river bottom and bank, which can result in damage to barges and tow boats, decrease efficiency during barge tow assembly and disassembly, and increase safety concerns due to working in shallow water. Barge contact with the riverbank and channel also causes bank erosion, sediment disturbance, substrate compaction, and water quality degradation. Continuous engine use by tow boats positioned offshore also results in sediment disturbance and water quality degradation in the river channel. The offshore design of the proposed fleeting facility will avoid or reduce these impacts, as well as prevent temporary fleeting along the shoreline in the future.

The use of spud piles and anchors to secure the fleeting facility will also minimize impacts to the river bottom. Each spud pile will have a footprint of only five square feet, resulting in a total impact to the river bottom of 120 square feet. Each spud pile impact will be separated by a minimum distance of 180 feet. No pile driving will be utilized during spud pile installation, further reducing impacts to the bottom. Each anchor will have a footprint of approximately 33 square feet and be located in the unsuitable habitat area along the shoreline. In addition, all work associated with construction and operation of the fleeting facility will be performed from the river, thus avoiding impacts to the shoreline and adjacent floodplain.

The location of the fleeting facility offshore will also allow barges and boats to operate in deeper water. The greater water depth will help prevent barges and boats from hitting or resting on the river bottom and minimize the effects of propeller wash, thereby minimizing the area affected by the project.

2.A.1 Estimated Number of Individuals to be Taken

Data from the semi-quantitative survey was used to calculate a mussel density for the survey area. Based on a total of 44 transects with a search area of 100 square meters each (100 meters long by one meter

wide), the semi-quantitative survey area consisted of 4,400 square meters. A total of 1,242 individuals were collected within the 4,400-square meter survey area, resulting in an estimated mussel density of 0.28 mussels per square meter.

Direct impacts to the river bottom are limited to the spud pile locations and will result in a total area of impact of 120 square feet (11.15 square meters). Based on an estimated mussel density of 0.28 mussels per square meter and a direct impact area of 11.15 square meters, four mussels are estimated to be taken during spud pile installation.

The ebonyshell comprised 30.68% of the total number of mussels collected; therefore, this species has the highest likelihood of take of the listed species. The butterfly and fat pocketbook comprised 0.40% and 0.32% of the total number of mussels collected, respectively, resulting in the second and third highest likelihood of take of the listed species. Only one individual each of the elephant-ear and monkeyface were collected during the survey, representing 0.08% of the total number of mussels collected. The purple wartyback, spike, pink mucket, orangefoot pimpleback, sheepnose, Ohio pigtoe, and rabbitsfoot were not encountered during the survey; however, these species have been found in the Brookport Bed downstream of the project and are assumed to be present in the survey area. The presence of these seven species is assumed to be below the percentage of the elephant-ear and monkeyface (0.08%). Therefore, these seven species have the lowest likelihood of take.

2.A.2 Estimated Amount of Habitat Affected

The project area encompasses 152.78 acres along the right descending bank of the Ohio River. The entire project area is considered suitable habitat for the 12 mussel species, with the exception of the area along the shoreline. As discussed in Section 1.B.14, the portion of the project area between the shoreline and 30 to 40 meters from the shoreline does not provide suitable habitat for the 12 mussel species due to the hard-packed clay substrate and impacts from the temporary fleeting of barges along the shoreline. This unsuitable habitat area totals 36.47 acres, reducing the amount of suitable habitat in the project area to 116.31 acres. The anchors and the majority of anchor chains will be located in the unsuitable habitat area and are not expected to affect habitat for the listed mussel species.

Portions of the project area where the water depth is 20 feet or greater are not anticipated to be impacted by construction or operation of the fleeting facility. The spud and spar barge configurations and anchors/anchor chains will not be located in these areas, and impacts from barge fleeting and boat operation are not expected to disturb the river bottom below this depth. Therefore, these areas are excluded from the amount of suitable habitat that could be affected by the project. The depth readings recorded during the mussel survey only extend to the end of the 100-meter long survey transects; therefore, only the

areas with recorded depths of 20 feet or greater were excluded. These areas total 11.29 acres, resulting in a total amount of affected habitat of 105.02 acres.

Within the 105.02 acres of affected habitat in the Ohio River, approximately 120 square feet of the river bottom will be directly impacted during installation of the 24 spud piles. The spud piles will be located in areas of suitable mussel habitat, and several piles will be placed in or directly adjacent to mussel beds and the locations of listed individuals.

2.B PLANS FOR MANAGEMENT OF THE AFFECTED AREA

The proposed project is not anticipated to significantly alter or prevent the continued use of the project area by the 12 mussel species. The spud pile locations will no longer be available for use by mussels; however, the amount of habitat loss on the river bottom at each location is considered insignificant (only five square feet). The total amount of river bottom impacted for all 24 spud piles is 120 square feet, which is minimal compared to the abundance of habitat in the project area (4,574,671 square feet). In addition, these impact areas will be dispersed throughout the facility and separated by a minimum of 180 feet. Other activities associated with construction of the project are not expected to affect use of the project area by the 12 mussel species.

Barge fleeting and boat use during operation of the fleeting facility will be similar to current activities in the project area. As previously discussed, the portion of the project area along the shoreline is used for unorganized, temporary barge fleeting, and the riverward portion of the project area is used as a travel route for barge tows moving up and down river. Mussels have persisted in the project area despite these activities, and the anticipated impacts associated with the fleeting facility are expected to be similar or reduced compared to current uses. As a result, use of the project area by the 12 mussel species is expected to continue after completion of the fleeting facility. In addition, mussel use of the area could potentially increase when temporary fleeting along the shoreline ceases once the fleeting facility is in place. Based on the expected continued use of the project area by the 12 mussel species, no management plans for the project area are proposed.

2.C DESCRIPTION OF AVOIDANCE, MINIMIZATION, AND MITIGATION MEASURES

Avoidance, minimization, and mitigation measures for the proposed project are discussed below.

Avoidance

Based on the location of the proposed project within the channel of the Ohio River, the size of the project area, and the broad distribution and abundance of mussels and suitable habitat in the project area, impacts to the 12 mussel species and their habitat is unavoidable.

Minimization

The following measures are proposed to minimize impacts from the proposed project to the 12 mussel species and their habitat.

(1) Prior to construction activities, mussels will be collected from the 24 spud pile locations and relocated to a suitable site outside the project area. The relocation efforts will be coordinated and supervised by a permitted malacologist. Divers will collect mussels by hand from the direct area of impact, including the five-square foot area for each spud pile plus a 10-meter buffer around the pile. The 10-meter buffer is included to account for any variance in the placement of the pile during installation. Collected mussels will be temporarily held in containers filled with river water to simulate natural conditions during transport to the relocation site. Due to the potential to collect both state and federally listed species, the relocation site will be approved by the IDNR and USFWS to confirm that the site provides suitable conditions that are similar to the collection site. The relocation will be performed as close as possible to the start of construction to reduce the potential for mussels to recolonize the spud pile locations; however, timing of the relocation will also be dependent on river and climatic conditions, including appropriate air and water temperatures. If relocation efforts are required when appropriate conditions cannot be met, Ingram will seek approval for a variance from the IDNR and USFWS. After completion of relocation efforts, a summary report will be submitted to the IDNR and USFWS.

(2) Locate anchors and anchor chains in areas of unsuitable mussel habitat, where possible.

(3) Place the spud and spar barges in water of sufficient depth to prevent barges from hitting or resting on the substrate.

(4) Position barges within the fleeting areas to prevent barges from hitting or resting on the substrate.

(5) Barge cleaning in the fleeting areas will be limited to barges carrying non-hazardous dry cargo only. Cleaning products will be prevented from entering the river, and all residual products from barge cleaning will be collected and removed.

(6) Follow all procedures and protocols listed in the Facility Operating Plan.

(7) Operate boats in a manner that prevents hulls and propellers from hitting the substrate.

(8) Direct boat propeller wash away from the shoreline and shallow areas to the maximum extent practicable.

(9) Implement procedures in the Vessel Response Plan to address and mitigate spills.

These minimization measures are anticipated to help reduce adverse effects to the 12 mussel species and their habitat; however, these measures are not expected to eliminate all adverse effects that may result from the proposed project. Therefore, mitigation is proposed for take of the listed mussel species, as discussed below.

Mitigation

The IDNR requires mitigation measures to provide conservation benefits 5.5 times larger than the adverse impacts to the affected species. Based on an estimated take of four mussels from direct impacts associated with spud pile installation, Ingram proposes to mitigate for the take of 22 individuals. When determining the appropriate mitigation measures for take of state listed species, the IDNR reviews the status and population trends of the affected species, the area of impact, the degree of impact, and the estimated take. Based on these factors, Ingram proposes a contribution to the Kentucky Aquatic Resources Fund (KARF) in the amount $53,472 to be used for propagation, culture, and other recovery efforts for the 12 mussel species. These species are commonly found within the same waterways in similar habitats throughout Illinois and Kentucky, such as the Ohio River, and the proposed mitigation will help restore populations, increase distribution, and preserve habitat for all 12 species. The enhancement and establishment of mussel beds with newly propagated individuals will increase abundance and diversity, improve water quality, and attract fish hosts, which will increase survivorship, reproductive success, and recruitment for all species.

2.D MONITORING PLAN

Monitoring is proposed to examine the effects of the proposed project on the 12 mussel species over time. Monitoring will consist of a mussel survey of the project area five years after completion of the construction phase of the project (i.e., installation of the mooring structures in all fleeting areas). The Year 5 post-construction survey will follow the same protocols as the pre-construction mussel survey, except that only the semi-quantitative (transect) portion within the project area (Transects 3 to 41) will be performed. Assessing the same transects as the pre-construction survey will allow for comparison of results between the two surveys and document any changes that have occurred since construction and operation of the fleeting facility. No qualitative searches will be conducted between transects due to the difficulty in accurately comparing pre and post-construction results using qualitative methods. No additional post-construction mussel surveys or monitoring are proposed under this plan.

Following completion of the post-construction survey in Year 5, a survey report will be prepared and submitted to the IDNR. The report will summarize the results of the survey and discuss any relevant

changes to the mussel community observed in the project area. The report will also be submitted to the USFWS KFO, as required by federal permits.

2.E ADAPTIVE MANAGEMENT PRACTICES

Adaptive management practices will be implemented as conditions change or unforeseen circumstances occur in the fleeting facility to avoid impacts to the 12 mussel species. Environmental conditions in the Ohio River are most likely to change due to water level fluctuations from dam operations, flooding, and drought. During low water levels, areas with sufficient depths for barge fleeting and boat operation during normal flow may become too shallow for these activities. During these events, fleeted barges with the potential to hit or rest on the river bottom will be moved to deeper water or areas outside of the fleeting facility. Boat operation in the fleeting facility will also be modified to avoid shallow areas and prevent impacts to mussels from striking and propeller wash.

Operations in the fleeting facility will also be monitored and adjusted as necessary during periods of high flow and flooding. High water operations are addressed in Section F of the Facility Operating Plan (Appendix D). The plan also includes facility monitoring procedures and emergency procedures to be used during fleet breakaway or other unexpected events.

2.F VERIFICATION OF FUNDING

Ingram will include the proposed KARF contribution as part of the funding for the proposed project. The KARF contribution will be a condition of the Section 10 permit from the USACE and must be completed prior to construction of the fleeting facility. Ingram is committed to funding the project and therefore, by extension, committed to funding the mitigation.

3.0 ALTERNATIVES ANALYSIS

Ingram conducted an alternatives analysis for the proposed project to determine a Preferred Alternative. The analysis was completed through a multistep screening process involving three levels:

- Level I – described and screened geographic alternatives
- Level II – described and screened on- and offshore anchoring alternatives
- Level III – described and screened offshore anchoring methods

The three screening levels were used to identify a set of practical or reasonable alternatives to develop and carry forward for detailed analysis. The results of the screening are summarized in the following sections.

Level I Screening – Geographic Alternatives

The proposed fleeting facility needs to be in close proximity to the existing Ingram facility in Paducah, Kentucky. Locating the facility too far up or downstream would make it impracticable to disassemble and assemble barge tows in an efficient manner, as tugboats and barges used in the fleeting areas would originate from the Ingram facility. The US Highway (US) 45 Bridge also poses navigational challenges, and the constant need to navigate tugboats and barges to and from fleeting areas downstream of the bridge adds unnecessary safety and navigational concerns. In addition, the Brookport Bed is located downstream of the bridge, which contains multiple federal and state listed mussel species. Therefore, a permanent fleeting facility downstream of the US 45 Bridge was not considered further.

Based on the above considerations, the location for the proposed fleeting facility was limited to the area between the US 45 Bridge (approximately RM 937.5) and three miles upstream of the confluence of the Ohio River and Tennessee River (approximately RM 930). The left descending bank upstream of the US 45 Bridge has insufficient room to accommodate an approximately 11,300-linear foot fleeting facility due to the number of existing public and private dock facilities, permitted fleeting areas, boat ramps, and water intake structures. As a result, the left descending bank was eliminated from consideration. Existing fleeting facilities also exist along the right descending bank upstream of RM 935, causing the only available area with sufficient linear length along the right descending bank to be the area between RM 935 and 937.4. Based on these factors, this portion of the right descending bank was selected as the preferred location for the fleeting facility.

Level II Screening – On- and Offshore Anchoring Alternatives

Once the preferred geographic location was selected, on- and offshore methods for securing the fleeting facility were evaluated as they relate to potential impacts to historic and archeological resources under the National Historic Preservation Act, aquatic and terrestrial species listed under federal and state endangered species acts, floodplains, and waters of the U.S. Two onshore methods were evaluated, including anchoring and non-anchoring systems.

<u>Onshore Anchoring System</u>

An onshore anchoring system would involve the use of a deadman anchor, which consists of a block of concrete (or similar material) that is buried onshore. The depth of the concrete block is dependent on site specific soil conditions but is typically eight to 10 feet below ground surface. A barge wire is secured to the top of the concrete block and connected to the spar barge in the river. A deadman anchor system involves either one or two anchors that are connected to the up and downstream spar barge based on site conditions. Use of a deadman anchor draws the barges closer to shore, resulting in grounding of barges on the river

bottom during low pool elevations and constant contact with the shoreline. Barge contact with the riverbank and channel causes bank erosion, sediment disturbance, substrate compaction, and water quality degradation.

While the deadman anchor(s) would be placed in upland areas, construction access to excavate the area and access the site with the necessary construction equipment would require clearing and grading activities. The adjacent property has several dirt roads available for use, however, access to the shore would require construction of new roads resulting in tree removal (potential bat habitat) and placement of fill in emergent and forested wetland areas and within the 100-year floodplain of the Ohio River. These impacts would be permanent due to the need to access the deadman anchors for long term maintenance. In addition, use of this system at the project site would require excavation into native soils that could potentially contain archeological resources.

An onshore non-anchoring system does not include the use of any anchoring devices to secure the barges or result in permanent structures within the water or onshore. Instead, barges are pushed into the shoreline by tow boats to maintain their position, which requires the grounding of barges against the river bottom and bank, potentially damaging barges and tow boats. This method also decreases efficiency during barge tow assembly due to the increased caution necessary when working in shallow water. As discussed above, barge contact with the riverbank and channel also causes bank erosion, sediment disturbance, substrate compaction, and water quality degradation. Continuous engine use by tow boats positioned offshore also results in sediment disturbance and water quality degradation in the river channel.

Offshore Anchoring System

An offshore anchoring system would involve the use of an anchor or piles on the river bottom (or a combination of both) to secure the spar barges. The anchor is placed on the river bottom, and a chain connects the anchor to the spar barge. Typically, only one anchor is attached to the upstream spar barge. The use of piles involves adding spud barges to the end of the spar barges and installing spud piles into the river bottom. A barge wire is used to provide additional security between the spud and spar barges.

As the offshore system is not physically connected to the shore, the barges remain farther away from the shore in water depth sufficient to avoid grounding the barges on the river bottom. Maintenance for this type of system is done from a barge or tow boat and does not require landward access.

While the offshore anchoring system has the potential to impact federal and state listed mussel species in the Ohio River, it would not impact wetlands or floodplains, require tree removal, or potentially impact buried archeological resources. Therefore, the offshore anchoring system was chosen as the preferred anchoring alternative for the project. The following table summarizes the results of the Level II Screening.

Evaluation	Onshore Anchor	Onshore Non-Anchoring	Offshore Anchor
Historic and archeological resources	Five previous cultural resource surveys have been conducted in the project vicinity, resulting in eight archaeological sites, two cemeteries, and ten historic-age structures recorded within one mile of the project. Of these resources, only one archaeological site (11MX64), is located near the proposed project.	There are no known cultural resources along or within the Ohio River near the proposed project, and the potential to discover unrecorded cultural resources is very low.	There are no known cultural resources along or within the Ohio River near the proposed project, and the potential to discover unrecorded cultural resources is very low.
Waters of the US – Waterways	No streams or ditches are present in the area required for access to the deadman anchors. No fill would be placed in the Ohio River.	No fill would be placed in the Ohio River.	Placement of the anchor and/or spud piles would not result in changes to the hydrology of the Ohio River and would be regulated as structures and not a discharge of fill material.
Waters of the US – Wetlands	Permanent fill in emergent and forested wetlands required.	No fill placed in wetlands.	No fill placed in wetlands.
Floodplains	Permanent fill placed in the 100-year floodplain may result in a rise in base flood elevations that could require mitigation.	No fill placed in the floodway (Ohio River).	Anchors or spud piles would not result in an increase in base flood elevations in the Ohio River floodway.
Listed bat species	Permanent removal of suitable habitat from tree removal.	No removal of suitable habitat.	No removal of suitable habitat.
Listed mussel species	Suitable habitat is present in the Ohio River, and mussel species could be affected. Frequent grounding of barges would increase river bottom disturbance.	Suitable habitat is present in the Ohio River, and mussel species could be affected. Frequent grounding of barges would increase river bottom disturbance, and frequent use of tow boats would increase sediment disturbance and water quality.	Suitable habitat is present in the Ohio River, and mussel species could be affected.

Level III Screening – Offshore Anchoring Methods

The third level of screening evaluated the methods of securing the offshore anchoring system, including an anchor, piles, or a combination of both. All methods will result in minor impacts to the river bottom; therefore, the screening focused on the safety and security of the fleeting facility.

Both offshore anchoring methods are used along the Ohio River, with use of an anchor being the most prevalent. Both systems effectively hold the fleet in place in a secure manner; however, it is possible that barges can break away during severe weather or barge-to-barge allision. Utilizing both an anchor at the

upstream end and spud piles at the up and downstream ends provides redundancy in the security system of the fleet, thereby reducing the potential of barge break away. For this reason, the use of both an anchor and spud piles was chosen as the preferred offshore anchoring alternative for the project.

No Action Alternative

The No Action Alternative would not result in a new, permitted fleeting area along this stretch of the Ohio River, and Ingram would continue to utilize the James Marine, Inc. fleeting area. Barges would continue to be tied off to deadman anchors onshore or continuously pushed into the shoreline by tow boats to maintain their position. Grounding of barges against the river bottom and bank would continue to damage barges and tow boats and cause bank erosion, sediment disturbance, substrate compaction, and water quality degradation.

Preferred Alternative

As noted in the previous section, the Preferred Alternative includes an offshore anchoring system that utilizes an anchor at the upstream end and spud piles at both the up and downstream ends. This system avoids onshore impacts and minimizes impacts to the aquatic environment, especially those resulting from barge grounding along the shoreline. The Preferred Alternative is described in greater detail in Section C. Description of Project Activities.

4.0 SURVIVAL AND RECOVERY OF LISTED SPECIES

Although the proposed project will result in adverse effects to the 12 mussel species within the project area, construction and operation of the fleeting facility is not expected to reduce the likelihood of the survival or recovery of these species in Illinois. As discussed in Section 1.B.13, all 12 mussel species are found in the Brookport Bed downstream of the project in greater numbers than the project area. The project is not expected to result in adverse effects to these mussels or habitat in the Brookport Bed. The ebonyshell, butterfly, and fat pocketbook are also known upstream of the project area. Based on these occurrences, the project is not anticipated to reduce the likelihood of survival or recovery of these species within or near the project area.

In addition to the above occurrences for the 12 mussel species, the majority of these species are found in multiple counties and river systems in Illinois. Based on the Illinois Threatened and Endangered Species by County List (July 23, 2018) published by the Illinois Natural Heritage Database, the Illinois counties and river systems with occurrences of the 12 mussel species are summarized in the following table.

Species	IL Counties	River System
purple wartyback	15	Illinois, Kankakee, Ohio, Rock, Wabash
butterfly	14	Mississippi, Ohio
elephant-ear	8	Mississippi, Ohio, Wabash
spike	28	Illinois, Kankakee, Kaskaskia, Ohio, Rock, Wabash
ebonyshell	20	Illinois, Mississippi, Ohio, Wabash
pink mucket	---	Ohio
orangefoot pimpleback	2	Ohio
sheepnose	12	Kankakee, Kaskaskia, Mississippi, Ohio, Wabash
Ohio pigtoe	3	Mississippi, Ohio
fat pocketbook	8	Mississippi, Ohio, Wabash
rabbitsfoot	3	Ohio, Wabash
monkeyface	39	Illinois, Kankakee, Mississippi, Ohio, Rock, Wabash

Based on the occurrence of the 12 mussel species in the Ohio River outside the project area and within other river systems in Illinois, the proposed project will not reduce the likelihood of survival or recovery of these species within the State of Illinois.

5.0 IMPLEMENTING AGREEMENT

The IDNR is responsible for the review of this Conservation Plan and subsequent issuance of the Incidental Take Authorization. Ingram is responsible for following and implementing all requirements under the Conservation Plan and Incidental Take Authorization, including all avoidance, minimization, and mitigation measures. Ingram is also responsible for completing the monitoring and subsequent reporting under the Conservation Plan.

Construction of the proposed fleeting facility is anticipated to begin in October 2020 and take approximately six months to construct. Barge fleeting will begin in the fleeting areas immediately after construction. This schedule is contingent upon completion of the ITA process with the IDNR and Section 10 permit process with the USACE.

By signing below, the participant certifies that they have the legal authority to carry out their respective obligations and responsibilities under the Conservation Plan. Ingram and its contractors will also comply with all other federal, state, and local regulations and adhere to the conditions and requirements associated with all authorizations and permits obtained for the proposed project.

O. W. Harrell VII

Mr. Oscar Harrell
Vice President of Operations,
Performance, and Development
Ingram Barge Company
1000 S. Third Street
Paducah, Kentucky 42003

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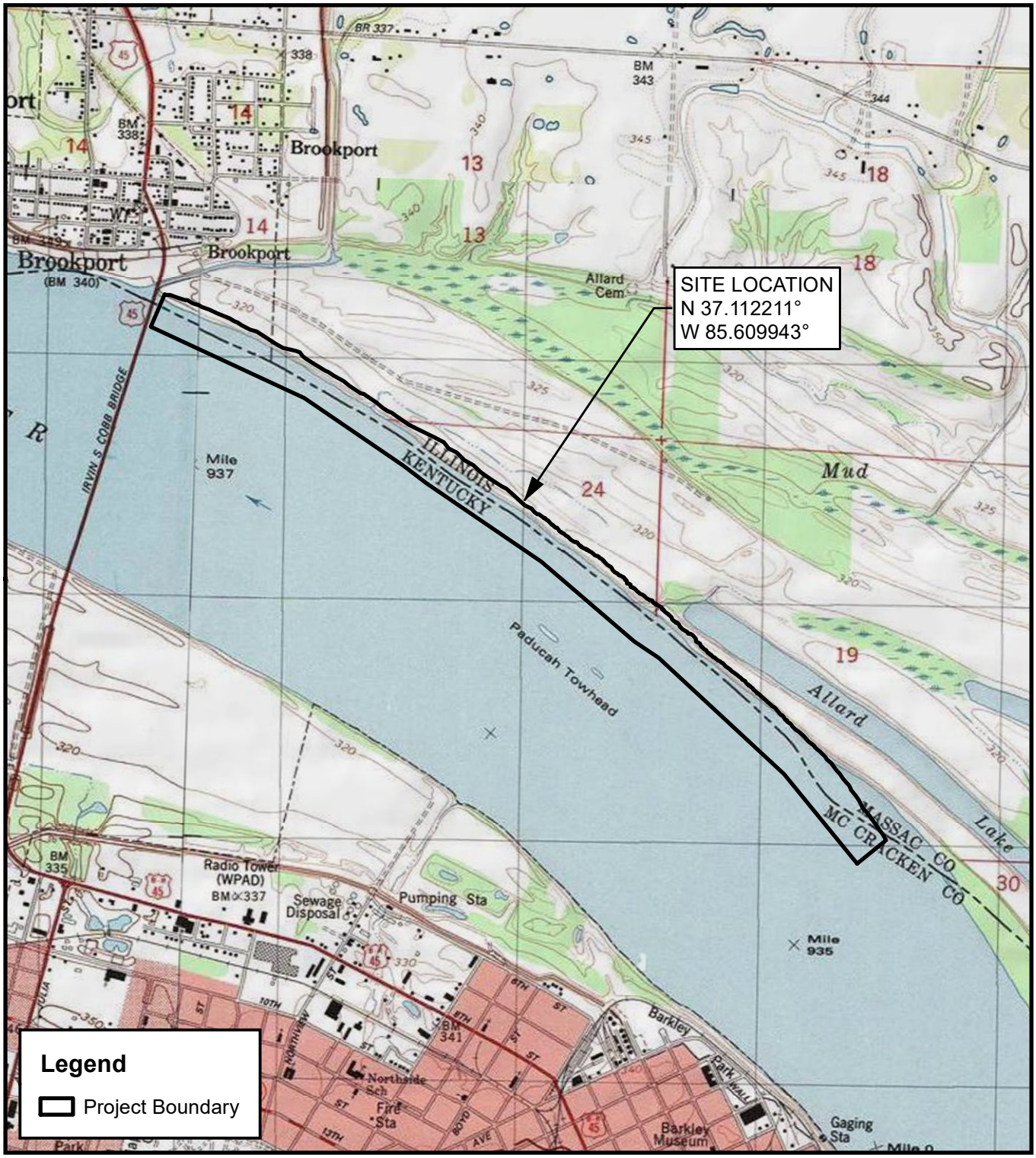
FIGURES

Source: USA Topo Maps, (2013) National Geographic Society, USGS 7.5-minute Topographic Map - Paducah East, Kentucky Quadrangle.



INGRAM BARGE FLEETING FACILITY
MASSAC COUNTY, ILLINOIS AND
MCCRACKEN COUNTY, KENTUCKY

REDWING
ECOLOGICAL SERVICES, INC.

PROJECT LOCATION MAP

REVISED DATE: 06-09-20 | DRAWN BY: EDB

FIGURE 1

P:\2019 Projects\19-146-Ingram Barge Fleeting Area\Figures\Project Location Map.mxd, 06-9-2020, ebowman

Source: World Imagery - Esri and the GIS User Community (2019); Project design provided by HDR, Inc.

INGRAM BARGE FLEETING FACILITY
MASSAC COUNTY, ILLINOIS AND
MCCRACKEN COUNTY, KENTUCKY

REVISED DATE: 06-09-20 | DRAWN BY: EDB/SRB

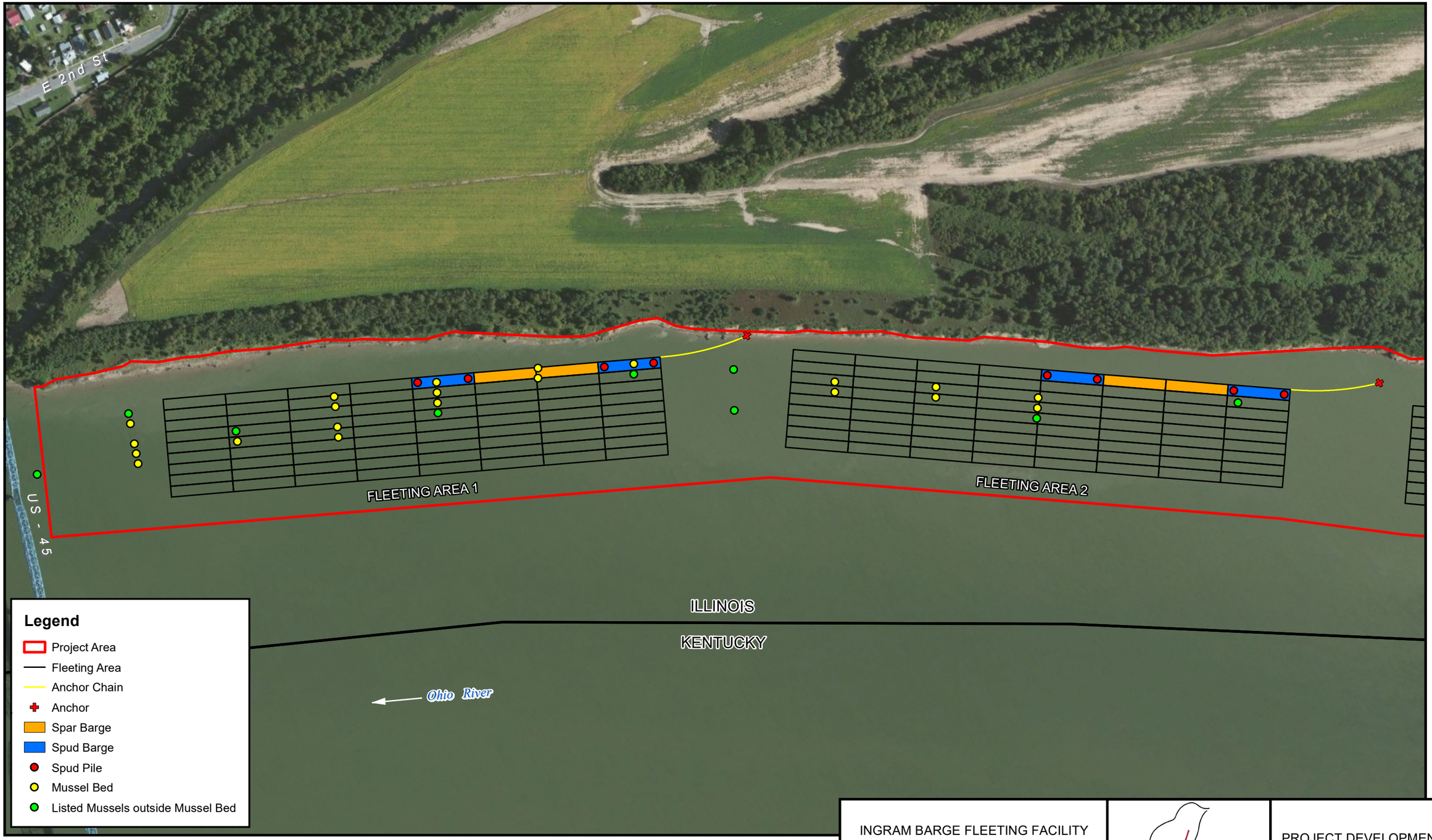
REDWING ECOLOGICAL SERVICES, INC.

PROJECT AREA MAP

FIGURE 2

P:\2019 Projects\19-146-Ingram Barge Fleeting Area\Figures\Project Area Map.mxd, 06-9-2020, ebowman

Source: World Imagery - Esri and the GIS User Community (2019); Project design provided by HDR, Inc.; Mussel survey data provided by Mainstream Commercial Divers, Inc.



INGRAM BARGE FLEETING FACILITY
MASSAC COUNTY, ILLINOIS AND
MCCRACKEN COUNTY, KENTUCKY

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REDWING ECOLOGICAL SERVICES, INC.

PROJECT DEVELOPMENT MAP

FIGURE 3
SHEET 1 of 3

P:\2019 Projects\19-146-Ingram Barge Fleeting Area\Figures\Project Development Map_BA.mxd, 06-9-2020, ebowman

Source: World Imagery - Esri and the GIS User Community (2019); Project design provided by HDR, Inc.; Mussel survey data provided by Mainstream Commercial Divers, Inc.

INGRAM BARGE FLEETING FACILITY
MASSAC COUNTY, ILLINOIS AND
MCCRACKEN COUNTY, KENTUCKY

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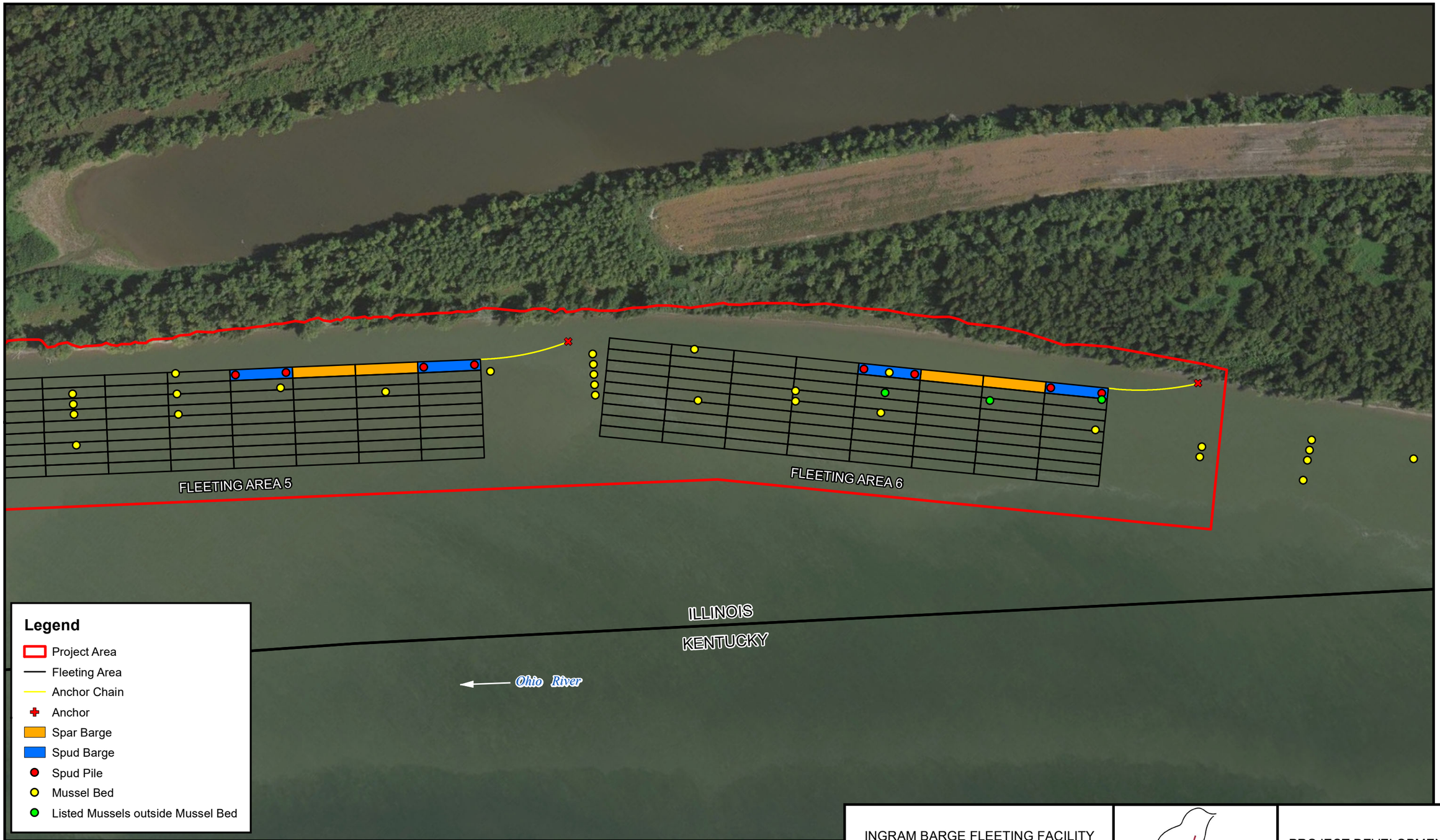
REDWING ECOLOGICAL SERVICES, INC.

PROJECT DEVELOPMENT MAP

FIGURE 3
SHEET 2 of 3

P:\2019 Projects\19-146-Ingram Barge Fleeting Area\Figures\Project Development Map_BA.mxd, 06-9-2020, ebowman

Source: World Imagery - Esri and the GIS User Community (2019); Project design provided by HDR, Inc.; Mussel survey data provided by Mainstream Commercial Divers, Inc.



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REDWING ECOLOGICAL SERVICES, INC.

PROJECT DEVELOPMENT MAP

FIGURE 3
SHEET 3 of 3

P:\2019 Projects\19-146-Ingram Barge Fleeting Area\Figures\Project Development Map_BA.mxd, 06-9-2020, ebowman

Source: World Imagery - Esri and the GIS User Community (2019); Project design provided by HDR, Inc.; Mussel survey data provided by Mainstream Commercial Divers, Inc.

NOTE: MUSSEL SURVEY PERFORMED BY MAINSTREAM COMMERCIAL DIVERS, INC. BETWEEN OCTOBER 15 AND NOVEMBER 2, 2018.

INGRAM BARGE FLEETING FACILITY
MASSAC COUNTY, ILLINOIS AND
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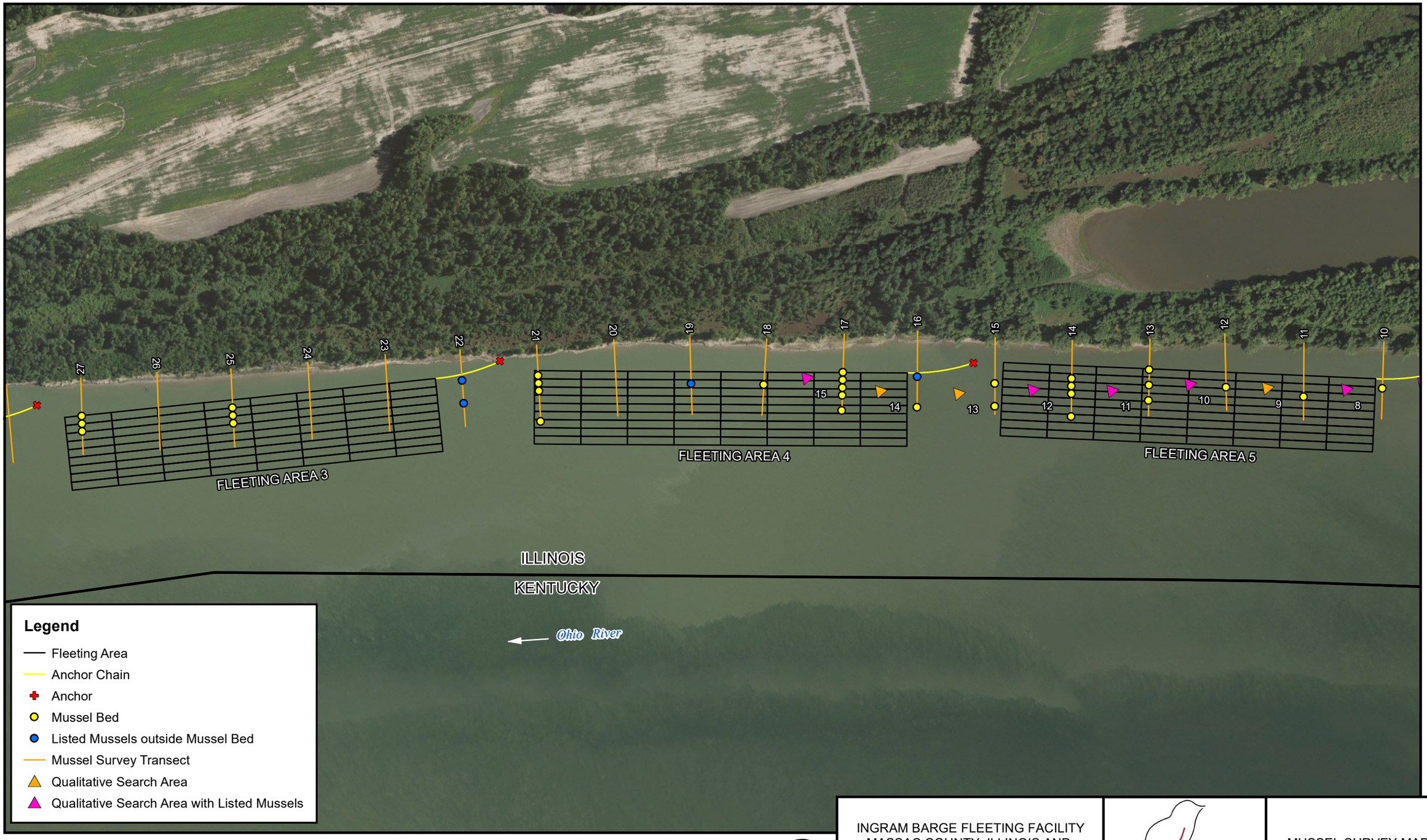
REDWING ECOLOGICAL SERVICES, INC.

MUSSEL SURVEY MAP

FIGURE 4
SHEET 1 of 3

P:\2019 Projects\19-146-Ingram Barge Fleeting Area\Figures\Mussel Survey Map_CP.mxd, 06-9-2020, ebowman

Source: World Imagery - Esri and the GIS User Community (2019); Project design provided by HDR, Inc.; Mussel survey data provided by Mainstream Commercial Divers, Inc.



Legend

- Fleeting Area
- Anchor Chain
- Anchor
- Mussel Bed
- Listed Mussels outside Mussel Bed
- Mussel Survey Transect
- Qualitative Search Area
- Qualitative Search Area with Listed Mussels

0 200 400 800 1,200 1,600 Feet

NOTE: MUSSEL SURVEY PERFORMED BY MAINSTREAM COMMERCIAL DIVERS, INC. BETWEEN OCTOBER 15 AND NOVEMBER 2, 2018.

INGRAM BARGE FLEETING FACILITY
MASSAC COUNTY, ILLINOIS AND
MCCRACKEN COUNTY, KENTUCKY

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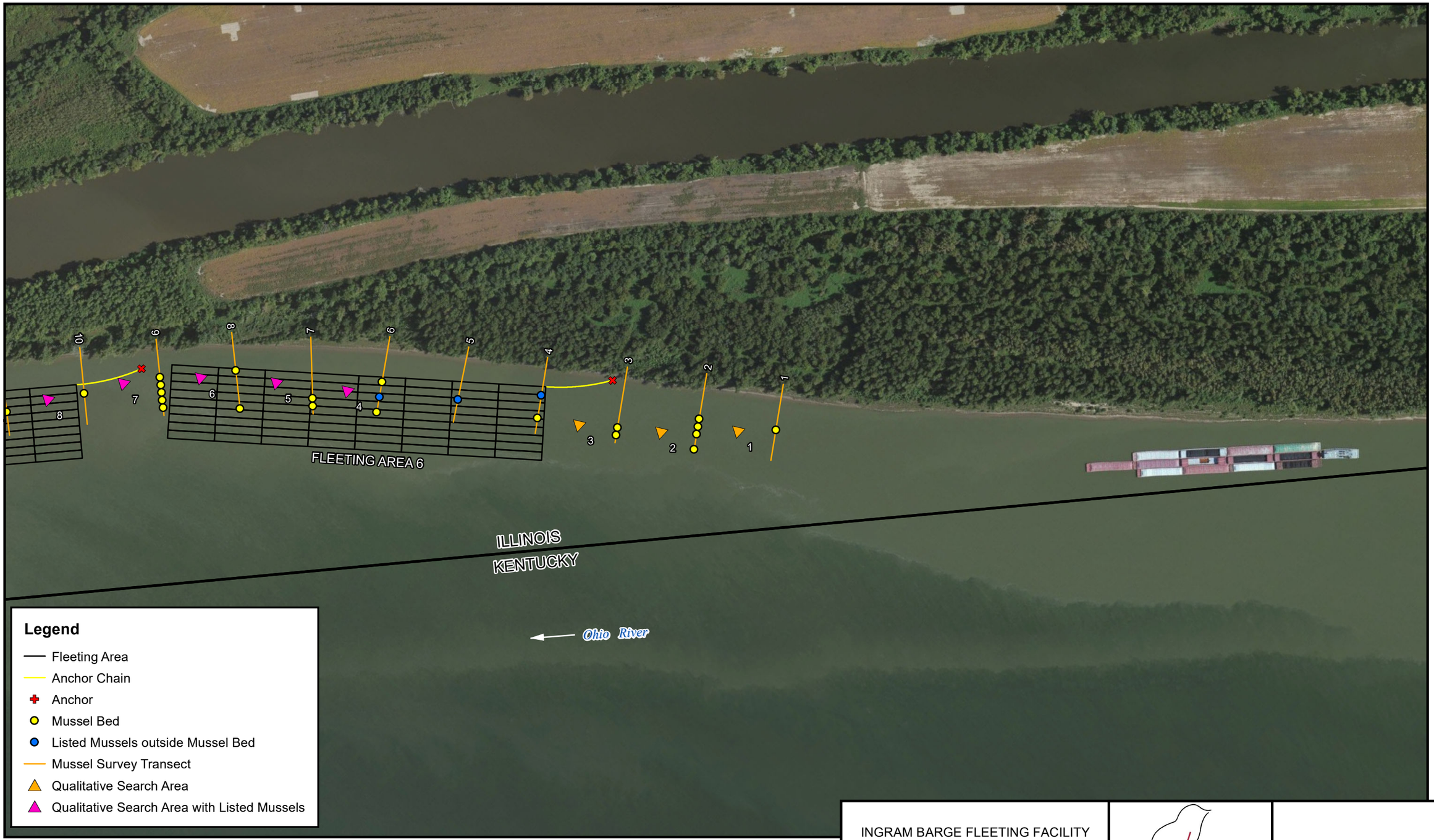
REDWING ECOLOGICAL SERVICES, INC.

MUSSEL SURVEY MAP

FIGURE 4
SHEET 2 of 3

P:\2019 Projects\19-146-Ingram Barge Fleeting Area\Figures\Mussel Survey Map_CP.mxd, 06-9-2020, ebowman

Source: World Imagery - Esri and the GIS User Community (2019); Project design provided by HDR, Inc.; Mussel survey data provided by Mainstream Commercial Divers, Inc.



0 200 400 800 1,200 1,600 Feet

NOTE: MUSSEL SURVEY PERFORMED BY MAINSTREAM COMMERCIAL DIVERS, INC. BETWEEN OCTOBER 15 AND NOVEMBER 2, 2018.

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REDWING ECOLOGICAL SERVICES, INC.

MUSSEL SURVEY MAP

FIGURE 4
SHEET 3 of 3

P:\2019 Projects\19-146-Ingram Barge Fleeting Area\Figures\Mussel Survey Map_CP.mxd, 06-9-2020, ebowman

PHOTOGRAPHS

Photograph 1: View of the central portion of the project area, facing south from the right descending bank of the Ohio River. May 23, 2018.

Photograph 2: View of the upstream portion of the project area, facing southeast from the right descending bank of the Ohio River. May 23, 2018.

Photograph 3: View of the downstream portion of the project area, facing west from the right descending bank of the Ohio River. May 23, 2018.

Photograph 4: View of the upstream portion of the project area, facing east from the Ohio River. May 23, 2018.

Photograph 5: View of the downstream portion of the project area, facing northwest from the Ohio River. May 23, 2018.

Photograph 6: Example of mussels encountered during the mussel survey. Photograph provided by MCDI.

Photograph 7: Lateral view of a fat pocketbook (*Potamilus capax*) encountered during the mussel survey. Photograph provided by MCDI.

Photograph 8: Umbo view of a fat pocketbook (*Potamilus capax*) encountered during the mussel survey. Photograph provided by MCDI.

APPENDIX A

USFWS COORDINATION

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kentucky Ecological Services Field Office
J C Watts Federal Building, Room 265
330 West Broadway
Frankfort, KY 40601-8670
Phone: (502) 695-0468 Fax: (502) 695-1024
http://www.fws.gov/frankfort/

In Reply Refer To: March 23, 2020
Consultation Code: 04EK1000-2019-SLI-0747
Event Code: 04EK1000-2020-E-02167
Project Name: Barge Fleeting Area

Subject: Updated list of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

Your concern for the protection of endangered and threatened species is greatly appreciated. The purpose of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.) (ESA) is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. The species list attached to this letter fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the ESA to provide information as to whether any proposed or listed species may be present in the area of a proposed action. This is not a concurrence letter; additional consultation with the Service may be required.

The Information in Your Species List:

The enclosed species list identifies federal trust species and critical habitat that may occur within the boundary that you entered into IPaC. For your species list to most accurately represent the species that may potentially be affected by the proposed project, the boundary that you input into IPaC should represent the entire “action area” of the proposed project by considering all the potential “effects of the action,” including potential direct, indirect, and cumulative effects, to federally-listed species or their critical habitat as defined in 50 CFR 402.02. This includes effects of any “interrelated actions” that are part of a larger action and depend on the larger action for their justification and “interdependent actions” that have no independent utility apart from the action under consideration (e.g.; utilities, access roads, etc.) and future actions that are reasonably certain to occur as a result of the proposed project (e.g.; development in response to a new road). If your project is likely to have significant indirect effects that extend well beyond the project footprint (e.g., long-term impacts to water quality), we highly recommend that you

coordinate with the Service early to appropriately define your action area and ensure that you are evaluating all the species that could potentially be affected.

We must advise you that our database is a compilation of collection records made available by various individuals and resource agencies available to the Service and may not be all-inclusive. This information is seldom based on comprehensive surveys of all potential habitats and, thus, does not necessarily provide conclusive evidence that species are present or absent at a specific locality. New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list.

Please note that “critical habitat” refers to specific areas identified as essential for the conservation of a species that have been designated by regulation. Critical habitat usually does not include all the habitat that the species is known to occupy or all the habitat that may be important to the species. Thus, even if your project area does not include critical habitat, the species on the list may still be present.

Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the ESA, the accuracy of this species list should be verified after 90 days. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and associated information. To re-access your project in IPaC, go to the IPaC web site (https://ecos.fws.gov/ipac/), select “Need an updated species list?”, and enter the consultation code on this letter.

ESA Obligations for Federal Projects:

Under sections 7(a)(1) and 7(a)(2) of the ESA and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

If a Federal project (a project authorized, funded, or carried out by a federal agency) may affect federally-listed species or critical habitat, the Federal agency is required to consult with the Service under section 7 of the ESA, pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at: http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). Recommended contents of a Biological Assessment are described at 50 CFR 402.12. For projects other than major construction activities, the Service suggests that a biological evaluation

similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat.

ESA Obligations for Non-federal Projects:

Proposed projects that do not have a federal nexus (non-federal projects) are not subject to the obligation to consult under section 7 of the ESA. However, section 9 of the ESA prohibits certain activities that directly or indirectly affect federally-listed species. These prohibitions apply to all individuals subject to the jurisdiction of the United States. Non-federal project proponents can request technical assistance from the Service regarding recommendations on how to avoid and/or minimize impacts to listed species. The project proponent can choose to implement avoidance, minimization, and mitigation measures in a proposed project design to avoid ESA violations.

Additional Species-specific Information:

In addition to the species list, IPaC also provides general species-specific technical assistance that may be helpful when designing a project and evaluating potential impacts to species. To access this information from the IPaC site (https://ecos.fws.gov/ipac/), click on the text “My Projects” on the left of the black bar at the top of the screen (you will need to be logged into your account to do this). Click on the project name in the list of projects; then, click on the “Project Home” button that appears. Next, click on the “See Resources” button under the “Resources” heading. A list of species will appear on the screen. Directly above this list, on the right side, is a link that will take you to pdfs of the “Species Guidelines” available for species in your list. Alternatively, these documents and a link to the “ECOS species profile” can be accessed by clicking on an individual species in the online resource list.

Next Steps:

Requests for additional technical assistance or consultation from the Kentucky Field Office should be submitted following guidance on the following page http://www.fws.gov/frankfort/PreDevelopment.html and the document retrieved by clicking the “outline” link at that page. When submitting correspondence about your project to our office, please include the Consultation Tracking Number in the header of this letter. (There is no need to provide us with a copy of the IPaC-generated letter and species list.)

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Kentucky Ecological Services Field Office
J C Watts Federal Building, Room 265
330 West Broadway
Frankfort, KY 40601-8670
(502) 695-0468

This project's location is within the jurisdiction of multiple offices. Expect additional species list documents from the following office, and expect that the species and critical habitats in each document reflect only those that fall in the office's jurisdiction:

Southern Illinois Sub-Office
Southern Illinois Sub-office
8588 Route 148
Marion, IL 62959-5822
(618) 997-3344

Project Summary

Consultation Code: 04EK1000-2019-SLI-0747

Event Code: 04EK1000-2020-E-02167

Project Name: Barge Fleeting Area

Project Type: TRANSPORTATION

Project Description: Barge fleeting area

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/37.10966035336142N88.60527378081534W

Counties: Massac, IL | McCracken, KY

Endangered Species Act Species

There is a total of 15 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Note that 3 of these species should be considered only under certain conditions.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
Gray Bat *Myotis grisescens*	Endangered

No critical habitat has been designated for this species.
This species only needs to be considered under the following conditions:
- The project area includes potential gray bat habitat.

Species profile: https://ecos.fws.gov/ecp/species/6329
General project design guidelines:
https://ecos.fws.gov/ipac/guideline/design/population/21/office/42431.pdf

Indiana Bat *Myotis sodalis*	Endangered

There is **final** critical habitat for this species. Your location is outside the critical habitat.
This species only needs to be considered under the following conditions:
- The project area includes known 'summer 1' habitat.

Species profile: https://ecos.fws.gov/ecp/species/5949
General project design guidelines:
https://ecos.fws.gov/ipac/guideline/design/population/1/office/42431.pdf

Northern Long-eared Bat *Myotis septentrionalis*	Threatened

No critical habitat has been designated for this species.
This species only needs to be considered under the following conditions:
- The specified area includes areas in which incidental take would not be prohibited under the 4(d) rule. For reporting purposes, please use the "streamlined consultation form," linked to in the "general project design guidelines" for the species.

Species profile: https://ecos.fws.gov/ecp/species/9045
General project design guidelines:
https://ecos.fws.gov/ipac/guideline/design/population/10043/office/42431.pdf

Birds

NAME	STATUS
Least Tern *Sterna antillarum*	Endangered

Population: interior pop.
No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/8505

Clams

NAME	STATUS
Clubshell *Pleurobema clava*	Endangered
Population: Wherever found; Except where listed as Experimental Populations No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3789 General project design guidelines: https://ecos.fws.gov/ipac/guideline/design/population/352/office/42431.pdf	
Fanshell *Cyprogenia stegaria*	Endangered
No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4822 General project design guidelines: https://ecos.fws.gov/ipac/guideline/design/population/368/office/42431.pdf	
Fat Pocketbook *Potamilus capax*	Endangered
No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/2780 General project design guidelines: https://ecos.fws.gov/ipac/guideline/design/population/342/office/42431.pdf	
Northern Riffleshell *Epioblasma torulosa rangiana*	Endangered
No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/527 General project design guidelines: https://ecos.fws.gov/ipac/guideline/design/population/374/office/42431.pdf	
Orangefoot Pimpleback (pearlymussel) *Plethobasus cooperianus*	Endangered
No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1132 General project design guidelines: https://ecos.fws.gov/ipac/guideline/design/population/340/office/42431.pdf	
Purple Cat's Paw (=purple Cat's Paw Pearlymussel) *Epioblasma obliquata obliquata*	Endangered
Population: Wherever found; Except where listed as Experimental Populations No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/5602 General project design guidelines: https://ecos.fws.gov/ipac/guideline/design/population/323/office/42431.pdf	
Rabbitsfoot *Quadrula cylindrica cylindrica*	Threatened
There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/5165 General project design guidelines: https://ecos.fws.gov/ipac/guideline/design/population/3645/office/42431.pdf	
Ring Pink (mussel) *Obovaria retusa*	Endangered
No critical habitat has been designated for this species.	

NAME	STATUS

Species profile: https://ecos.fws.gov/ecp/species/4128
General project design guidelines:
https://ecos.fws.gov/ipac/guideline/design/population/341/office/42431.pdf

Rough Pigtoe *Pleurobema plenum* — Endangered
No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/6894
General project design guidelines:
https://ecos.fws.gov/ipac/guideline/design/population/338/office/42431.pdf

Sheepnose Mussel *Plethobasus cyphyus* — Endangered
No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/6903
General project design guidelines:
https://ecos.fws.gov/ipac/guideline/design/population/7816/office/42431.pdf

Spectaclecase (mussel) *Cumberlandia monodonta* — Endangered
No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/7867
General project design guidelines:
https://ecos.fws.gov/ipac/guideline/design/population/4490/office/42431.pdf

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Southern Illinois Sub-Office
Southern Illinois Sub-office
8588 Route 148
Marion, IL 62959-5822
Phone: (618) 997-3344 Fax: (618) 997-8961
http://www.fws.gov/midwest/Endangered/section7/s7process/step1.html

In Reply Refer To: March 23, 2020
Consultation Code: 03E18100-2019-SLI-0246
Event Code: 03E18100-2020-E-01238
Project Name: Barge Fleeting Area

Subject: Updated list of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The attached species list identifies any federally threatened, endangered, proposed and candidate species that may occur within the boundary of your proposed project or may be affected by your proposed project. The list also includes designated critical habitat if present within your proposed project area or affected by your project. This list is provided to you as the initial step of the consultation process required under section 7(c) of the Endangered Species Act, also referred to as Section 7 Consultation.

Section 7 of the Endangered Species Act of 1973 requires that actions authorized, funded, or carried out by Federal agencies not jeopardize federally threatened or endangered species or adversely modify designated critical habitat. To fulfill this mandate, Federal agencies (or their designated non-federal representative) must consult with the Service if they determine their project “may affect” listed species or critical habitat. Under the ESA, it is the responsibility of the Federal action agency or its designated respresentative to determine if a proposed action "may affect" endangered, threatened, or proposed species, or designated critical habitat, and if so, to consult with the Service further. Similarly, it is the responsibility of the Federal action agency or project proponent, not the Service to make "no effect" determinations. If you determine that your proposed action will have "no effect" on threatened or endangered species or their respective critical habitat, you do not need to seek concurrence with the Service. Nevertheless, it is a violation of Federal law to harm or harass any federally-listed threatened or endangered fish or wildlife species without the appropriate permit.

Under 50 CFR 402.12(e) (the regulations that implement Section 7 of the Endangered Species Act) the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally. You may verify the list by visiting the ECOS-IPaC website

http://ecos.fws.gov/ipac/ at regular intervals during project planning and implementation and completing the same process you used to receive the attached list. As an alternative, you may contact this Ecological Services Field Office for updates.

Please use the species list provided and visit the U.S. Fish and Wildlife Service's Region 3 Section 7 Technical Assistance website http://www.fws.gov/midwest/endangered/section7/s7process/index.html. This website contains step-by-step instructions which will help you determine if your project will have an adverse effect on listed species and will help lead you through the Section 7 process.

For all wind energy projects and projects that include installing towers that use guy wires or are over 200 feet in height, please contact this field office directly for assistance, even if no federally listed plants, animals or critical habitat are present within your proposed project or may be affected by your proposed project.

Although no longer protected under the Endangered Species Act, be aware that bald eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*) and Migratory Bird Treaty Act *(*16 U.S.C. 703 *et seq*), as are golden eagles. Projects affecting these species may require measures to avoid harming eagles or may require a permit. If your project is near an eagle nest or winter roost area, see our Eagle Permits website http://www.fws.gov/midwest/midwestbird/EaglePermits/index.html to help you determine if you can avoid impacting eagles or if a permit may be necessary.

We appreciate your concern for threatened and endangered species. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Southern Illinois Sub-Office
Southern Illinois Sub-office
8588 Route 148
Marion, IL 62959-5822
(618) 997-3344

This project's location is within the jurisdiction of multiple offices. Expect additional species list documents from the following office, and expect that the species and critical habitats in each document reflect only those that fall in the office's jurisdiction:

Kentucky Ecological Services Field Office
J C Watts Federal Building, Room 265
330 West Broadway
Frankfort, KY 40601-8670
(502) 695-0468

Project Summary

Consultation Code: 03E18100-2019-SLI-0246

Event Code: 03E18100-2020-E-01238

Project Name: Barge Fleeting Area

Project Type: TRANSPORTATION

Project Description: Barge fleeting area

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/37.10966035336142N88.60527378081534W

Counties: Massac, IL | McCracken, KY

Endangered Species Act Species

There is a total of 9 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
Indiana Bat *Myotis sodalis* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/5949	Endangered
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Threatened

Birds

NAME	STATUS
Least Tern *Sterna antillarum* Population: interior pop. No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8505	Endangered

Clams

NAME	STATUS
Fat Pocketbook *Potamilus capax* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/2780	Endangered
Orangefoot Pimpleback (pearlymussel) *Plethobasus cooperianus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1132	Endangered
Pink Mucket (pearlymussel) *Lampsilis abrupta* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/7829	Endangered
Rabbitsfoot *Quadrula cylindrica cylindrica* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/5165	Threatened
Sheepnose Mussel *Plethobasus cyphyus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6903	Endangered
Spectaclecase (mussel) *Cumberlandia monodonta* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/7867	Endangered

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

USFWS National Wildlife Refuge Lands And Fish Hatcheries

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kentucky Ecological Services Field Office
330 West Broadway, Suite 265
Frankfort, Kentucky 40601
(502) 695-0468

July 3, 2019

US Army Corps of Engineers
Louisville District
Attn: Jason Rhodes
CELRL-RDS, Room 752
P.O. Box 59
Louisville, Kentucky 40201

Subject: FWS 2019-B-0449; USACE LRL 2019-288; Request to Initiate Formal Consultation; Ingram Barge Fleeting Facility; Massac County, Illinois and McCracken County, Kentucky

Dear Mr. Rhoades:

This letter acknowledges the U.S. Fish and Wildlife Service's (Service) receipt of your letter dated June 13, 2019 and received June 19, 2019. We offer the following comments in accordance with the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*). This is not a concurrence letter. Please read carefully, as further consultation with the Service may be required to meet the obligation of section 7(a)(2) of the Endangered Species Act (ESA).

PROPOSED PROJECT/PROJECT HISTORY

The U.S. Army Corps of Engineers, Louisville District (Corps) is reviewing an application for a Department of the Army (DA) authorization for impacts to waters of the United States (U.S.). The DA permit is necessary for the construction and maintenance of a barge fleeting facility along the right descending bank of the Ohio River between river mile 935 and 937.4. The proposed federal action (action) would be the Corps' issuance of a DA permit for impacts to waters of the U.S.

NO EFFECT DETERMINATIONS

The Corps has made "no effect" determinations for gray bat (*Myotis grisescens*), Indiana bat (*Myotis sodalis*), and northern long-eared bat (*Myotis septentrionalis*). There is no statutory requirement for the Service to concur with a "no effect" determination; however, the Service acknowledges these determinations.

SECTION 7 CONSULTATION

INFORMAL CONSULTATION

The Corps has determined that the proposed action may affect, but is not likely to adversely affect (NLAA) the following federally listed mussels: clubshell (*Pleurobema clava*), fanshell (*Cyprogenia stegaria*), northern riffleshell (*Epioblasma torulosa rangiana*), orangefoot pimpleback (*Plethobasus cooperianus*), purple cat's paw (*Epioblasma obliquata obliquata*), rabbitsfoot (*Quadrula cylindrica cylindrica*), ring pink (*Obovaria retusa*), rough pigtoe (*Pleurobema plenum*), sheepnose (*Plethobasus cyphyus*), and spectaclecase (*Cumberlandia monodonta*). The Corps' NLAA determinations for these species are based on the lack of verified presence within the proposed fleeting area. However, the intent of the completed mussel survey was to provide an overview of the mussel assemblage and mussel abundance present at the future barge fleeting area. These data would provide an indication of the potential for the occurrence of federally listed mussels. Based on the diverse assemblage of mussel species detected at this location (23 species), the known occurrence of orangefoot pimpleback, pink mucket, rabbitsfoot, and sheepnose at sites above and below the proposed fleeting area, and the rarity and low detection rates of federally listed mussels, the Service cannot discount the likelihood that additional federally listed mussels are present in the proposed barge fleeting area.

Based on the information currently provided, the Service cannot concur with your NLAA determinations for orangefoot pimpleback, pink mucket, rabbitsfoot, and sheepnose mussel. The Service, however, is able to concur with your NLAA determination for clubshell, fanshell, northern riffleshell, purple cat's paw, ring pink, rough pigtoe, and spectacle case based on the lack of recent observations during surveys near the proposed barge fleeting facility.

FORMAL CONSULTATION

The Corps has determined that the proposed action may affect, and is likely to adversely affect (LAA) the fat pocketbook (*Potamilus capax*), and requested to initiate formal consultation for this species. The Service agrees with the Corps' determination that the proposed action is LAA this species; however, the Service has not received all of the information necessary to initiate formal consultation on the Ingram Barge Fleeting Facility. To complete the initiation package, we will need the information described in the following section "Additional Information Needed."

ADDITIONAL INFORMATION NEEDED (50 CFR §402.14(c))

1. A description of the action to be considered. The information provided to the Service is sufficient.
2. A description of the specific area that may be affected by the action. The Corps' June 13, 2019, letter does not discuss which areas away from the main navigational channel will be impacted by tow boat operations during construction, operation, and maintenance of the fleeting facility. Therefore, the Service requests clarification on the area that will be affected by the proposed action.
3. A description of any listed species or critical habitat that may be affected by the proposed action. The Service agrees with the species included in the Corps' consultation request.

However, the Service requests the Corps include critical habitat for the rabbitsfoot in the consultation request.

4. A description of the manner in which the action may affect any listed species or critical habitat and an analysis of any cumulative effects. The Service requests that the Corps provide an effects analysis that describes how the proposed action may affect federally listed species and critical habitat. In addition to the construction activities, the operation and maintenance of the proposed barge facility should be evaluated, as these activities are dependent upon the construction. Cumulative effects, under section 7 of the ESA, "are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR §402.02)."
5. Relevant reports, including any environmental impact statement, environmental assessment, or biological assessment prepared. Please provide any additional information needed to supplement your formal consultation request based on the final project proposal.
6. Any other relevant available information on the action, the affected listed species, or critical habitat.

CONCLUSION

The Corps has determined that the proposed action will have no effect on gray bat, Indiana bat, and northern long-eared bat. The Service acknowledges these determinations and has no further comments regarding these species. The Corps has also determined that the proposed action is NLAA the clubshell, fanshell, northern riffleshell, orangefoot pimpleback, purple cat's paw, rabbitsfoot, ring pink, rough pigtoe, sheepnose, and spectaclecase. At this time, the Service cannot concur with a NLAA determinations for orangefoot pimpleback, pink mucket, rabbitsfoot, and sheepnose mussel due to the rational provided.

The Corps has requested initiation of formal consultation on the fat pocketbook. The Service has determined that additional information is necessary to initiate formal consultation on this species and has identified the specific information that is requested. The Service has also indicated that the action would occur within rabbitsfoot critical habitat and should be addressed in the formal consultation.

The formal consultation process for this project will not begin until we receive all of the information. We will notify you when we receive this additional information; our notification letter will also outline the dates within which formal consultation will be completed and when the Corps will receive the biological opinion on the proposed action.

Thank you for your request and we look forward to working with you on this consultation. If you wish to set up a meeting or have any questions, please contact Santiago Martín of my staff at 502/695-0468 extension 116.

Sincerely,

Virgil Lee Andrews, Jr.
Field Supervisor

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kentucky Ecological Services Field Office
330 West Broadway, Suite 265
Frankfort, Kentucky 40601
(502) 695-0468

April 28, 2020

Mr. David Baldridge
U.S. Army Corps of Engineers
Louisville District
CELRL-OP-FS, Room 752
P.O. Box 59
Louisville, Kentucky 40201

Subject: FWS 2019-B-0449; 2019-F-0747; USACE No.: LRL-2019-288-jwr; Ingram Barge Company; Barge Fleeting Facility; Massac County, Illinois and McCracken County, Kentucky

Dear Mr. Baldridge:

This letter acknowledges the U.S. Fish and Wildlife Service's (Service) April 24, 2020 receipt of the U.S. Army Corps of Engineers' (USACE) letter, dated April 23, 2020, regarding the above-referenced project and attached Biological Assessment (BA) prepared Redwing Ecological Services, Inc. (Redwing). The applicant, Ingram Barge Company, is proposing to construct and maintain a barge fleeting/mooring facility on the right bank of the Ohio River near Brookport, Massac County, Illinois and McCracken County, Kentucky. The Service offers the following comments in accordance with the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq*.).

The USACE made "may affect - likely to adversely affect" (MA-LAA) determinations for the federally listed fat pocketbook (*Potamilus capax*), orangefoot pimpleback (*Plethobasus cooperianus*), pink mucket (*Lampsilis abrupta*), sheepnose mussel (*Plethobasus cyphyus*), and rabbitsfoot (*Quadrula cylindrica cylindrica*). In the BA, Redwing provided information describing the adverse effects likely to occur to these species. Based on the information in the BA, the Service agrees that it is appropriate to initiate formal section 7 consultation. Therefore, the Service concurs with your MA-LAA determinations for these species.

The USACE made "may affect - not likely to adversely affect" determinations (MA-NLAA) for the following federally listed species: clubshell (*Pleurobema clava*), fanshell (*Cyprogenia stegaria*), northern riffleshell (*Epioblasma torulosa rangiana*), purple cat's paw (*Epioblasma obliquata obliquata*), ring pink (*Obovaria retusa*), rough pigtoe (*Pleurobema plenum*), spectaclecase (*Cumberlandia monodonta*), and least tern (*Sterna antillarum*). Upon

consideration of the information provided in the BA, the Service concurs with the MA-NLAA determinations for these species based on either a lack of suitable habitat for these species or negative survey data, as appropriate.

In addition, the USACE made a MA-NLAA determination for rabbitsfoot critical habitat. The BA stated that the effects to the primary constituent element of this species' critical habitat area will be insignificant, with minor changes to river channel and bank, flow regime, water and sediment quality, and fish host species within critical habitat unit RF20. Based on the information provided, the Service concurs with your MA-NLAA determination for rabbitsfoot critical habitat.

The USACE also made "no effect" determinations for the gray bat (*Myotis grisescens*), Indiana bat (*Myotis sodalis*), and northern long-eared bat (*Myotis septentrionalis*) based on the lack of disturbance to suitable habitat for these species. There is no statutory requirement to request concurrence with a "no effect" determination; however, the Service acknowledges these determinations and has no additional comments or concerns regarding these species.

Section 7 allows the Service up to 90 calendar days to conclude formal consultation with your agency and an additional 45 calendar days to prepare our biological opinion (unless we mutually agree to an extension). At this time, we believe that we can provide you with our biological opinion no later than September 6, 2020.

As a reminder, the Endangered Species Act requires that, after initiation of formal consultation, the Federal action agency may not make any irreversible or irretrievable commitment of resources that limits future options. This practice ensures that agency actions do not preclude the formulation or implementation of reasonable and prudent alternatives that avoid jeopardizing the continued existence of endangered or threatened species or destroying or modifying their critical habitats.

If you have any questions or concerns about this consultation or the consultation process in general, please feel free to contact Santiago Martín at (931) 525-4987 or santiago_martin@fws.gov.

Sincerely,

Virgil Lee Andrews, Jr.
Field Supervisor

cc: Matthew Mangan, Service (electronic)
Doug Dawson, KDFWR (electronic)
Brad Hayes, ILDNR (electronic)
Seth Bishop, Redwing (electronic)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kentucky Ecological Services Field Office
330 West Broadway, Suite 265
Frankfort, Kentucky 40601
(502) 695-0468

April 28, 2020

Mr. David Baldridge
U.S. Army Corps of Engineers
Louisville District
CELRL-OP-FS, Room 752
P.O. Box 59
Louisville, Kentucky 40201

Subject: FWS 2019-B-0449; 2019-F-0747; USACE No.: LRL-2019-288-jwr; Ingram Barge Company; Barge Fleeting Facility; Massac County, Illinois and McCracken County, Kentucky

Dear Mr. Baldridge:

This letter acknowledges the U.S. Fish and Wildlife Service's (Service) April 24, 2020 receipt of the U.S. Army Corps of Engineers' (USACE) letter, dated April 23, 2020, regarding the above-referenced project and attached Biological Assessment (BA) prepared Redwing Ecological Services, Inc. (Redwing). The applicant, Ingram Barge Company, is proposing to construct and maintain a barge fleeting/mooring facility on the right bank of the Ohio River near Brookport, Massac County, Illinois and McCracken County, Kentucky. The Service offers the following comments in accordance with the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq*.).

The USACE made "may affect - likely to adversely affect" (MA-LAA) determinations for the federally listed fat pocketbook (*Potamilus capax*), orangefoot pimpleback (*Plethobasus cooperianus*), pink mucket (*Lampsilis abrupta*), sheepnose mussel (*Plethobasus cyphyus*), and rabbitsfoot (*Quadrula cylindrica cylindrica*). In the BA, Redwing provided information describing the adverse effects likely to occur to these species. Based on the information in the BA, the Service agrees that it is appropriate to initiate formal section 7 consultation. Therefore, the Service concurs with your MA-LAA determinations for these species.

The USACE made "may affect - not likely to adversely affect" determinations (MA-NLAA) for the following federally listed species: clubshell (*Pleurobema clava*), fanshell (*Cyprogenia stegaria*), northern riffleshell (*Epioblasma torulosa rangiana*), purple cat's paw (*Epioblasma obliquata obliquata*), ring pink (*Obovaria retusa*), rough pigtoe (*Pleurobema plenum*), spectaclecase (*Cumberlandia monodonta*), and least tern (*Sterna antillarum*). Upon

consideration of the information provided in the BA, the Service concurs with the MA-NLAA determinations for these species based on either a lack of suitable habitat for these species or negative survey data, as appropriate.

In addition, the USACE made a MA-NLAA determination for rabbitsfoot critical habitat. The BA stated that the effects to the primary constituent element of this species' critical habitat area will be insignificant, with minor changes to river channel and bank, flow regime, water and sediment quality, and fish host species within critical habitat unit RF20. Based on the information provided, the Service concurs with your MA-NLAA determination for rabbitsfoot critical habitat.

The USACE also made "no effect" determinations for the gray bat (*Myotis grisescens*), Indiana bat (*Myotis sodalis*), and northern long-eared bat (*Myotis septentrionalis*) based on the lack of disturbance to suitable habitat for these species. There is no statutory requirement to request concurrence with a "no effect" determination; however, the Service acknowledges these determinations and has no additional comments or concerns regarding these species.

Section 7 allows the Service up to 90 calendar days to conclude formal consultation with your agency and an additional 45 calendar days to prepare our biological opinion (unless we mutually agree to an extension). At this time, we believe that we can provide you with our biological opinion no later than September 6, 2020.

As a reminder, the Endangered Species Act requires that, after initiation of formal consultation, the Federal action agency may not make any irreversible or irretrievable commitment of resources that limits future options. This practice ensures that agency actions do not preclude the formulation or implementation of reasonable and prudent alternatives that avoid jeopardizing the continued existence of endangered or threatened species or destroying or modifying their critical habitats.

If you have any questions or concerns about this consultation or the consultation process in general, please feel free to contact Santiago Martín at (931) 525-4987 or santiago_martin@fws.gov.

Sincerely,

VIRGIL ANDREWS Digitally signed by VIRGIL ANDREWS
Date: 2020.04.28 14:39:38 -04'00'

Virgil Lee Andrews, Jr.
Field Supervisor

cc: Matthew Mangan, Service (electronic)
Doug Dawson, KDFWR (electronic)
Brad Hayes, ILDNR (electronic)
Seth Bishop, Redwing (electronic)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kentucky Ecological Services Field Office
330 West Broadway, Suite 265
Frankfort, Kentucky 40601
(502) 695-0468

August 17, 2020

Mr. David Baldridge
U.S. Army Corps of Engineers
Louisville District
CELRL-OP-FS, Room 752
P.O. Box 59
Louisville, Kentucky 40201

Subject: FWS 2019-B-0449; 2019-F-0747; USACE No.: LRL-2019-288-jwr; Ingram Barge Company; Barge Fleeting Facility; Massac County, Illinois and McCracken County, Kentucky

Dear Mr. Baldridge:

The attached document is the U.S. Fish and Wildlife Service's (Service) Final Biological Opinion based on our review of the proposed Ingram Barge Company project at Ohio River Mile 935 - 937.4 in McCracken County, Kentucky and Massac County, Illinois, and its effects on the federally listed Fat Pocketbook (*Potamilus capax*), Orangefoot Pimpleback (*Plethobasus cooperianus*), Pink Mucket (*Lampsilis abrupta*), Rabbitsfoot (*Quadrula cylindrica cylindrica*), and Sheepnose Mussel (*Plethobasus cyphyus*) under section 7(a)(2) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq*.). This Biological Opinion is based on information provided in the April 21, 2020 Biological Assessment (BA) for the project, available literature, and other sources of information available to us and/or in our files. A complete administrative record of this consultation is on file at the Service's Kentucky Field Office in Frankfort, Kentucky at the address above.

The Service received a copy of the U.S. Army Corps of Engineers' (Corps) April 23, 2020 letter requesting formal consultation on this project, along the BA that was prepared for this project. The Service responded to the Corps with a letter dated April 28, 2020 accepting the Corps request to initiate formal consultation on these five listed mussel species. In the same letter, the Service concurred with the Corps' "may affect – not likely to adversely affect" determinations for seven federally listed mussels and the Least Tern, and acknowledged the Corps' "no effect" determination for three bats species. The Service also concurred with the Corps that this proposed activity would not appreciably diminish features essential to the designated critical habitat for the rabbitsfoot mussel.

The Service's Kentucky Field Office appreciates the cooperation of the Corps during this consultation. For further coordination on this biological opinion, please contact Jennifer Garland at the address shown at the top of this biological opinion, via email at KentuckyES@fws.gov or at 502/695-04686.

Sincerely,

Virgil Lee Andrews, Jr.
Field Supervisor

cc: Doug Dawson, KDFWR, Frankfort, KY

United States Department of the Interior

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Sincerely,

VIRGIL ANDREWS

Digitally signed by VIRGIL ANDREWS
Date: 2020.08.17 16:43:23 -04'00'

Virgil Lee Andrews, Jr.
Field Supervisor

cc: Doug Dawson, KDFWR, Frankfort, KY

APPENDIX B

MUSSEL SURVEY REPORT

A MUSSEL SURVEY BETWEEN APPROXIMATE OHIO RIVER MILES 935 AND 937.4 ALONG THE RIGHT DESCENDING BANK FOR A PROPOSED BARGE FLEETING AREA

Performed for:

HDR Engineering, Inc.

Mainstream Commercial Divers, Inc.
Murray, KY (270) 753-9654
www.MainstreamDivers.com

Report Prepared by:

Charles A. Morgan

January 2019

322 C.C. Lowry Drive, Murray, KY 42071 Office: (270) 753-9654 Fax: (270)753-0165

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A Mussel Survey between Approximate Ohio River Miles 935 and 937.4 Along the Right Descending Bank for a Proposed Barge Fleeting Area

ABSTRACT

Mainstream Commercial Divers, Inc. (MCDI) conducted a mussel survey between approximate Ohio River Miles (ORM) 935 and 937.4 for HDR Engineering, Inc. (HDR). The mussel survey was performed at and around the footprint of a proposed barge fleeting area. According to information provided to MCDI, the proposed facility is anticipated to extend approximately 12,515 feet (approximately 3,815 meters or 2.37 miles) along the right descending shore and is anticipated to measure approximately 175 feet (approximately 53 meters) wide. To assess the mussel community in and around the proposed barge fleeting area, a mussel survey was performed to search an area extending 100 meters (approximately 328 feet) riverward from the right descending shore for the entire extent of the proposed fleeting area footprint, as well as an upstream, downstream, and lateral buffer. The survey was designed to assess the current mussel fauna in an effort to determine if concentrations of mussels exist and if the potential exists for state or federally listed endangered or threatened mussel species to be present in and around the proposed barge fleeting area.

For ten days between October 15th and November 2nd, 2018, divers having experience in mussel collection conducted a systematic search of the area to retrieve as many native mussels (via hand digging in the substrate) as possible. The mussel survey consisted of 44 100-meter long transect searches oriented perpendicular to the right descending shore, with Transects 1 and 2 placed approximately 150 and 50 meters, respectively, upstream of the upstream extent of the proposed barge fleeting area footprint to serve as the upstream buffer, Transects 3 through 41 placed at approximate 100 meter intervals along the length of the barge fleeting area, and Transects 42, 43, and 44 placed approximately 100, 200, and 300 meters, respectively, downstream of the downstream extent of the proposed barge fleeting area footprint to serve as the downstream buffer. The transects extended approximately 10 to 40 meters riverward of the approximate proposed footprint area to serve as the lateral buffer. Each 100-meter long transect line was divided into 10-meter sections, and the mussels encountered within each section were recorded separately. The divers searched an area one meter wide along the length of each transect line and spent approximately five minutes searching each 10-meter section to locate mussels or suitable mussel habitat. Timed qualitative searches, 22 in total, were also performed in areas between the transect searches where sufficiently high mussel concentrations were found. The mussels from each 10-meter section of each transect search and from each timed qualitative search were recorded individually for species, approximate age, and shell length.

During the survey, 1,719 live mussels from 23 species were encountered. The mussel species found at the site were *Amblema plicata, Ellipsaria lineolata, Elliptio crassidens, Fusconaia ebena, Fusconaia flava, Lampsilis cardium, Lampsilis teres, Lasmigona complanata, Leptodea fragilis, Ligumia recta, Megalonaias nervosa, Obliquaria reflexa, Obovaria olivaria, Pleurobema cordatum, Potamilus alatus, Potamilus capax, Potamilus ohiensis, Quadrula apiculata, Quadrula metanevra, Quadrula nodulata, Quadrula pustulosa, Quadrula quadrula,* and *Truncilla truncata*. Eight individuals of the Illinois state and federally endangered mussel species *Potamilus capax* were encountered during the survey. Individuals from three Illinois endangered species, including *Elliptio crassidens, Fusconaia ebena,* and *Potamilus capax*, and two Illinois threatened species, including *Ellipsaria lineolata* and *Ligumia recta*, were also encountered. The numbers of Illinois listed mussels found within the state of Illinois are in total 5 *Ellipsaria lineolata,* 1 *Elliptio crassidens*, 511 *Fusconaia ebena,* 7 *Ligumia recta*, and 8 *Potamilus capax*. One individual of Illinois state endangered species *Pleurobema cordatum* was encountered, but it was found on the Kentucky side of the survey area. No fewer than 97 juvenile mussels (<5 years old) were encountered during the survey.

INTRODUCTION

Between approximate Ohio River Mile (ORM) 935 and 937.4, a barge fleeting area is proposed to be installed along the right descending shore. To assess the mussel community in and around the footprint of the proposed barge fleeting area, extending approximately 3,815 meters (12,515 feet) along the shore and approximately 53 meters (175 feet) out from the shore, a mussel survey was performed to search an area extending 100 meters (approximately 328 feet) out from the left descending shore, and 4,330 meters (approximately 14,200 feet) along the left descending shore using semi-quantitative and qualitative methods (Figure 1).

For ten days between October 15th and November 2nd, 2018, a mussel survey was conducted by Mainstream Commercial Divers, Inc. (MCDI) between approximate ORM 935 and 937.4. The survey was designed to assess the current mussel fauna to determine what concentrations of mussels exist and if the potential exists for listed endangered or threatened mussel species to be present in and around the footprint of the proposed barge fleeting area.

METHODS

The mussel survey consisted of 44 100-meter long transect searches oriented perpendicular to the right descending shore, with Transects 1 and 2 placed approximately 150 and 50 meters, respectively, upstream of the upstream extent of the proposed barge fleeting area footprint to serve as the upstream buffer, Transects 3 through 41 placed at approximate 100 meter intervals along the length of the barge fleeting area, and Transects 42, 43, and 44 placed approximately 100, 200, and 300 meters, respectively, downstream of the downstream extent of the proposed barge fleeting area footprint to serve as the downstream buffer (Figure 1). The transects extended approximately 10 to 40 meters riverward of the approximate proposed footprint area to serve as the lateral buffer. Each 100-meter long transect line was divided into 10-meter sections, and the mussels encountered within each section were recorded separately.

Additionally, twenty-two qualitative searches were performed between adjacent transect searches each containing mussel densities at or above 0.5 mussels/m^2 (Figure 1). The qualitative searches were performed for particular durations, with the minimum duration being five minutes if no mussels were located, and a maximum of ten minutes

if mussels were encountered. Unlike semi-quantitative searches, qualitative searches are not performed within a discrete area and thus a density approximation cannot be determined from their data.

Transect search positions and the placements of the approximate centers of the qualitative search areas were located in the field using a Trimble Geo7x handheld device, giving sub-meter position accuracy (Table 1).

Mussels were collected by a professional dive crew having considerable experience in mussel survey techniques and certified to meet all Association of Diving Contractors International (ADCI) and Occupational Safety and Health Administration (OSHA) diving requirements. The divers searched an area one meter wide along one side of each transect line and all mussels located within each 10-meter long section were sent to the surface for identification. The entire length of each transect line was surveyed. Substrate information and depths were recorded at the ends of each 10-meter section. Substrate information was based on the Wentworth Scale from a visual description of the surface material provided by the diver. Depth readings were obtained from the diver's pneumofathometer (accuracy ±6").

During processing, all live mussels were identified by species and approximate age and recorded on a data sheet by MCDI's malacologist. The out-of-water processing time for each mussel was less than five minutes and exposure to extreme temperature changes was avoided. After processing, the mussels were returned, live, near to the areas from which they were collected.

RESULTS AND DISCUSSION

The Ohio River was surveyed for freshwater mussels and mussel habitat between approximate ORM 935 and 937.4 along the right descending bank from October 15th to November 2nd, 2018. According to the river gauge managed by the USACE at Paducah, KY, the river elevation varied between an approximate daily average of 303.37 and 311.8 feet above mean sea level. Divers had consistently low visibility between 6 to 8 inches and a low to moderate current.

During the entire survey, including the transect searches as well as the qualitative searches, 1,719 live mussels from twenty-three species were encountered. The mussel species found at the site were *Amblema plicata, Ellipsaria lineolata, Elliptio crassidens, Fusconaia ebena, Fusconaia flava, Lampsilis cardium, Lampsilis teres,*

Lasmigona complanata, Leptodea fragilis, Ligumia recta, Megalonaias nervosa, Obliquaria reflexa, Obovaria olivaria, Pleurobema cordatum, Potamilus alatus, Potamilus capax, Potamilus ohiensis, Quadrula apiculata, Quadrula metanevra, Quadrula nodulata, Quadrula pustulosa, Quadrula quadrula, and *Truncilla truncata.* The most common species in the sampled mussel community was *Quadrula nodulata* at 36.71% of the observed population (Table 2). *Fusconaia ebena*, *Quadrula quadrula*, and *Amblema plicata* also constituted significant portions of the sampled mussel community, with each representing 31.7%, 11.75%, and 6.46%, respectively, of the sampled mussel community (Table 2).

Eight individuals of the Illinois state and federally endangered mussel species *Potamilus capax* were encountered during the survey. Individuals from three Illinois endangered species, including *Elliptio crassidens, Fusconaia ebena,* and *Potamilus capax*, and two Illinois threatened species, including *Ellipsaria lineolata* and *Ligumia recta*, were also encountered. The numbers of Illinois listed mussels found within the state of Illinois are in total 5 *Ellipsaria lineolata*, 1 *Elliptio crassidens*, 511 *Fusconaia ebena*, 7 *Ligumia recta*, and 8 *Potamilus capax*. One individual of Illinois state endangered species *Pleurobema cordatum* was encountered, but it was found on the Kentucky side of the survey area. No fewer than 97 juvenile mussels (<5 years old) were encountered during the survey.

During the survey of only the transect lines, 1,242 live mussels from twenty-two species were encountered (Table 3; Figures 2 – 16). The percentages of mussel species encountered during only the transect searches are very similar to the percentages for the combined transect and qualitative search totals with *Quadrula nodulata*, the most abundant mussel species, differing by less than 2% from the combined search method total (Table 3).

When examining the data from each 10-meter section of the transect searches, a pattern appears that shows for most of the transect searches, there are very few mussels found between shore and 40 meters from shore, and in many of the transect searches that distance was longer, up to 70 meters from shore in some transects (Table 4; Figures 2 – 16). In observing the totals per 10-meter sections, the mussel numbers begin rising sharply, on average, after 40-meters from shore to a peak abundance between 50 and 60-meters from shore, followed by a

sizeable drop in abundance 70-meters from shore, followed by another rise in mussel numbers around 80-meters from shore, followed by yet another drop leading out to 100-meters from shore (Table 4).

The estimated mussel density along the transects, based on the entirety of each transect length surveyed, ranged from 0 to 2.97 mussels per square meter (Table 5). Estimated maximum density along the transects, based solely on the individual 10-meter sections, ranged from 0 to 12.0 mussels per square meter (Table 5). The *Draft Protocol for Mussel Surveys in the Ohio River Where Dredging/Disposal/Development Activity Is Proposed* (Draft Ohio River Protocol), developed by the Ohio River Valley Ecosystem Mollusk Subgroup (April 2004), designates that five or greater observed mussels (by surface search) within a 10-meter section (= 0.5/m^2) represent a mussel concentration (bed). Based on this definition, 30 of the total 44 transect lines contain 10-meter sections that would be considered at or above the minimum threshold of containing a mussel bed; however, only 71 of the total 440 10-meter sections contained a high enough number of mussels to meet the minimum threshold to constitute a mussel bed (Tables 4 and 5; Figures 2-16).

The substrate for much of the surveyed river bottom was comprised of clay or a mixture of primarily clay with lesser amounts of either sand or gravel (Table 6; Figures 2 – 16). A trend was observed in much of the center of the survey area where a majority of clay substrate near shore gave way to a substrate comprised of mostly sand occasionally interspersed with gravel as the distance from shore increased, seen clearly from Transect 16 through Transect 38 (Table 6).

In an effort to locate additional species and determine if any state or federally listed species could inhabit the proposed barge fleeting area, or areas upstream, downstream, or riverward of the fleeting area footprint, twenty-two qualitative searches were performed with each one placed between each adjacent pair of transect searches in the areas of highest mussel concentrations, as determined by the maximum densities observed per each 10-meter transect section on the adjacent transect lines (Figure 1). The twenty-two qualitative searches in total yielded 477 live mussels from seventeen species (Table 7). The trend in mussel percentages during the qualitative searches roughly mirrored those observed during the

transect searches, with both *Quadrula nodulata* and *Fusconaia ebena* comprising nearly 70% of the observed mussel community (Table 7).

CONCLUSIONS

During the transect searches, 1,242 live mussels from twenty-two unionid species were collected, recorded, and returned live to near their original position (Table 3). During the timed qualitative searches, 477 live mussels from seventeen unionid species were collected, recorded, and returned live to near their original position (Table 7). In total, 1,719 live mussels from 23 unionid species were encountered (Table 2).

Eight individuals of the Illinois state and federally endangered mussel species *Potamilus capax* were encountered during the survey, and were recorded for mass, approximate age, and spatial dimensions (Table 8). Individuals from three Illinois endangered species, including *Elliptio crassidens, Fusconaia ebena,* and *Potamilus capax,* and two Illinois threatened species, including *Ellipsaria lineolata* and *Ligumia recta,* were also encountered. The numbers of Illinois listed mussels found within the state of Illinois are in total 5 *Ellipsaria lineolata,* 1 *Elliptio crassidens,* 511 *Fusconaia ebena,* 7 *Ligumia recta,* and 8 *Potamilus capax*.

One individual of Illinois state endangered species *Pleurobema cordatum* was encountered, but it was found on the Kentucky side of the survey area. No fewer than 97 juvenile mussels (<5 years old) were encountered during the survey.

In accordance with the requirement given by Illinois Department of Natural Resources to age and measure for length all mussels encountered during the survey, all mussels were approximately aged, measured for length, and tabulated including their location of encounter (Table 9).

The survey area between approximate ORM 935 and 937.4 along the right descending shore has areas of very low mussel densities, principally near the shore as well as at particular areas within the 2.4-mile extent of the survey site, such as at Transects 22 through 24 and Transects 28 through 36, while certain portions of the area have high mussel densities, such as at Transect 40. Based on the *Draft Ohio River Protocol* (2004), 30 of the total 44 transect lines contained enough mussels to constitute a mussel bed, but only 71 of the 440 total 10-meter transect sections surveyed during the semi-quantitative searches would be at or above the minimum threshold for containing a mussel bed (Table 4; Figures 2-16).

ACKNOWLEDGMENTS

We would like to thank the divers from Mainstream Commercial Divers, Inc. for conducting a professional survey.

Disclaimer:

Depth measurements are approximate and sediment types are subjective and are neither intended nor provided for engineering purposes. They are intended only to provide a description of mussel habitat.

LITERATURE CITED

Ohio River Valley Ecosystem Mollusk Subgroup. 2004. *Draft Protocol for Mussel Surveys in the Ohio River Where Dredging/Disposal/Development Activity is Proposed*. Unpublished. 5pp

Table 1. Site coordinates for the shore side ends of the transect search lines and approximate center points of the qualitative searches between approximate Ohio River Miles 935 and 937.4. Coordinates are provided in Kentucky State Plane South (Feet) NAD83 and Geographic (Decimal Degrees) NAD83.

	KY State Plane South (feet)		Geographic (decimal degrees)	
	Easting	Northing	Latitude	Longitude
Transect 1	812081.09	1931757.76	37.09933	-88.59071
Transect 2	811894.89	1932030.34	37.10006	-88.59137
Transect 3	811687.05	1932300.02	37.10078	-88.59211
Transect 4	811486.43	1932579.42	37.10153	-88.59283
Transect 5	811293.29	1932858.20	37.10228	-88.59352
Transect 6	811098.42	1933137.51	37.10303	-88.59422
Transect 7	810868.72	1933385.58	37.10369	-88.59503
Transect 8	810655.45	1933648.72	37.10440	-88.59579
Transect 9	810416.81	1933867.45	37.10498	-88.59663
Transect 10	810170.16	1934083.61	37.10555	-88.59750
Transect 11	809907.74	1934305.02	37.10614	-88.59842
Transect 12	809673.01	1934554.61	37.10681	-88.59925
Transect 13	809412.80	1934743.94	37.10730	-88.60016
Transect 14	809155.43	1934956.48	37.10787	-88.60107
Transect 15	808910.57	1935179.43	37.10846	-88.60193
Transect 16	808674.65	1935416.68	37.10909	-88.60276
Transect 17	808426.28	1935610.36	37.10960	-88.60363
Transect 18	808158.17	1935809.79	37.11013	-88.60457
Transect 19	807909.98	1936026.38	37.11070	-88.60545
Transect 20	807656.30	1936231.63	37.11124	-88.60634
Transect 21	807387.46	1936428.52	37.11176	-88.60728
Transect 22	807123.43	1936624.74	37.11228	-88.60820
Transect 23	806865.76	1936818.25	37.11279	-88.60911
Transect 24	806590.75	1937006.09	37.11328	-88.61007
Transect 25	806321.78	1937200.77	37.11379	-88.61101
Transect 26	806067.81	1937392.61	37.11430	-88.61190
Transect 27	805803.73	1937586.57	37.11481	-88.61283
Transect 28	805541.58	1937772.41	37.11530	-88.61375
Transect 29	805251.44	1937923.32	37.11569	-88.61476
Transect 30	804978.91	1938097.11	37.11614	-88.61571
Transect 31	804700.69	1938255.89	37.11655	-88.61668
Transect 32	804427.01	1938452.43	37.11707	-88.61764
Transect 33	804150.06	1938629.26	37.11753	-88.61861

Table 1. Continued

	KY State Plane South (feet)		Geographic (decimal degrees)	
	Easting	Northing	Latitude	Longitude
Transect 34	803869.35	1938797.30	37.11797	-88.61959
Transect 35	803602.73	1938970.41	37.11842	-88.62052
Transect 36	803311.66	1939083.31	37.11871	-88.62153
Transect 37	803032.43	1939264.80	37.11918	-88.62250
Transect 38	802729.65	1939422.12	37.11959	-88.62356
Transect 39	802419.68	1939551.37	37.11992	-88.62463
Transect 40	802102.23	1939676.79	37.12024	-88.62574
Transect 41	801799.47	1939809.18	37.12058	-88.62679
Transect 42	801482.33	1939926.55	37.12087	-88.62789
Transect 43	801159.47	1940031.44	37.12113	-88.62900
Transect 44	800821.28	1940130.37	37.12138	-88.63017
Qualitative 1	811803.91	1931775.79	37.09935	-88.59166
Qualitative 2	811579.21	1932015.62	37.09999	-88.59246
Qualitative 3	811365.31	1932296.49	37.10075	-88.59322
Qualitative 4	810805.72	1933124.00	37.10297	-88.59522
Qualitative 5	810626.39	1933372.46	37.10364	-88.59586
Qualitative 6	810423.29	1933625.25	37.10432	-88.59658
Qualitative 7	810183.47	1933852.11	37.10492	-88.59743
Qualitative 8	809915.56	1934044.41	37.10542	-88.59837
Qualitative 9	809660.61	1934269.11	37.10602	-88.59926
Qualitative 10	809417.75	1934495.43	37.10662	-88.60012
Qualitative 11	809144.30	1934691.40	37.10714	-88.60108
Qualitative 12	808887.60	1934913.67	37.10773	-88.60198
Qualitative 13	808634.81	1935108.12	37.10824	-88.60287
Qualitative 14	808385.09	1935332.85	37.10883	-88.60375
Qualitative 15	808180.92	1935580.78	37.10950	-88.60447
Qualitative 16	804477.97	1938191.50	37.11636	-88.61744
Qualitative 17	804207.25	1938395.22	37.11689	-88.61839
Qualitative 18	803400.58	1938922.98	37.11828	-88.62121
Qualitative 19	803106.62	1939037.14	37.11857	-88.62223
Qualitative 20	802800.36	1939165.66	37.11889	-88.62329
Qualitative 21	802487.26	1939257.27	37.11912	-88.62437
Qualitative 22	802168.69	1939349.56	37.11934	-88.62547

Table 2. Mussel species totals and percentages for the entire survey between Ohio River Miles 935 and 937.4

Scientific Name	Common Name	Total	Percent Abundance
Amblema plicata	Threeridge	111	6.46%
Ellipsaria lineolata	Butterfly	7	0.41%
Elliptio crassidens	Elephantear	1	0.06%
Fusconaia ebena	Ebonyshell	545	31.70%
Fusconaia flava	Wabash Pigtoe	8	0.47%
Lampsilis cardium	Plain Pocketbook	3	0.17%
Lampsilis teres	Yellow Sandshell	14	0.81%
Lasmigona complanata	White Heelsplitter	1	0.06%
Leptodea fragilis	Fragile Papershell	3	0.17%
Ligumia recta	Black Sandshell	8	0.47%
Megalonaias nervosa	Washboard	21	1.22%
Obliquaria reflexa	Threehorn Wartyback	43	2.50%
Obovaria olivaria	Hickorynut	58	3.37%
Pleurobema cordatum	Ohio Pigtoe	1	0.06%
Potamilus alatus	Pink Heelsplitter	33	1.92%
Potamilus capax	Fat Pocketbook	8	0.47%
Potamilus ohiensis	Pink Papershell	1	0.06%
Quadrula apiculata	Southern Mapleleaf	4	0.23%
Quadrula metanevra	Monkeyface	2	0.12%
Quadrula nodulata	Wartyback	631	36.71%
Quadrula pustulosa	Pimpleback	13	0.76%
Quadrula quadrula	Mapleleaf	202	11.75%
Truncilla truncata	Deertoe	1	0.06%
Total Number of Mussels		1,719	100.00%
Total Number of Species		23	

Table 3. Mussel species totals and percentages for the transect searches between Ohio River Miles 935 and 937.4

Scientific Name	Common Name	Total	Percent Abundance
Amblema plicata	Threeridge	72	5.80%
Ellipsaria lineolata	Butterfly	5	0.40%
Elliptio crassidens	Elephantear	1	0.08%
Fusconaia ebena	Ebonyshell	381	30.68%
Fusconaia flava	Wabash Pigtoe	6	0.48%
Lampsilis cardium	Plain Pocketbook	2	0.16%
Lampsilis teres	Yellow Sandshell	9	0.72%
Lasmigona complanata	White Heelsplitter	1	0.08%
Leptodea fragilis	Fragile Papershell	3	0.24%
Ligumia recta	Black Sandshell	5	0.40%
Megalonaias nervosa	Washboard	17	1.37%
Obliquaria reflexa	Threehorn Wartyback	38	3.06%
Obovaria olivaria	Hickorynut	44	3.54%
Pleurobema cordatum	Ohio Pigtoe	1	0.08%
Potamilus alatus	Pink Heelsplitter	22	1.77%
Potamilus capax	Fat Pocketbook	4	0.32%
Quadrula apiculata	Southern Mapleleaf	4	0.32%
Quadrula metanevra	Monkeyface	1	0.08%
Quadrula nodulata	Wartyback	473	38.08%
Quadrula pustulosa	Pimpleback	11	0.89%
Quadrula quadrula	Mapleleaf	141	11.35%
Truncilla truncata	Deertoe	1	0.08%
Total Number of Mussels		1,242	100.00%
Total Number of Species		22	

Table 4. Number of mussels encountered within each 10-meter section of each of the transect searches

	Transect Searches																						
10-meter Section (Distance from Shore)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
0-10m																							
10m-20m																							
20m-30m	1		3						1														
30m-40m					2								7								16	4	
40m-50m				4	2			88	7					5			35	3	1	2	9	1	2
50m-60m	5	12				16			15	8		4	28	33	10	2	12	10	1		9		2
60m-70m		5			1	1		4	5	4	10	8		5			11			1		2	3
70m-80m	1	16	5	6		3	18		9				8	3			10	2			2		
80m-90m	2		26				9		7						9					3			
90m-100m		6	1			7	1	7		1		1	1	5		18	5	2	3		5		
Totals	9	39	35	10	5	27	28	99	44	13	10	13	44	51	19	20	73	17	5	6	41	7	7

Table 4 continued on next page

Table 4. Continued

	Transect Searches																					
10-meter Section (Distance from Shore)	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**Totals**
0-10m																						0
10m-20m									1													1
20m-30m						1							5									11
30m-40m	3										4	10	7								3	56
40m-50m		12		5		2		5	5	16	1	2	1	21	1		3	3				236
50m-60m	2	7		9	2			6	9	8		1		24	9	1	27	1				273
60m-70m		10		8	1			1	4	4	2	1		10	12		4	1	2	5		125
70m-80m		3	4	2				2		1	2	1		3		1	120	1		5	1	229
80m-90m			3	2	1	1					4				10	8	116	1	1	1		204
90m-100m	1		1	2					2	1					5		27	1			4	107
Totals	6	32	8	28	4	4	0	14	21	30	13	15	13	58	37	10	297	8	3	11	8	1,242

Table 5. Number of mussels of each species encountered within each of the transect searches between Ohio River Miles 935 and 937.4

	Transect Searches														
Scientific Name	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Amblema plicata		4	1	1	1	10	4	3	2	3	1	7	2	4	1
Ellipsaria lineolata															
Elliptio crassidens															
Fusconaia ebena		3	5	2	1	9	3	63	21	3	2	2	4	9	3
Fusconaia flava	1						5								
Lampsilis cardium												1			
Lampsilis teres									1				1		
Lasmigona complanata													1		
Leptodea fragilis														1	
Ligumia recta								1							
Megalonaias nervosa						1									
Obliquaria reflexa		1	2	1				2					3	2	1
Obovaria olivaria		1						3	2	2			2	6	
Pleurobema cordatum															
Potamilus alatus	1		2	1		1	1	1	2						
Potamilus capax														1	
Quadrula apiculata															
Quadrula metanevra								1							
Quadrula nodulata	7	28	21	3	1	5	8	18	11	5	5	3	25	26	13
Quadrula pustulosa					1		1		1						
Quadrula quadrula		2	4	2	1	1	6	7	4		2		6	2	1
Truncilla truncata															
Number of Mussels Collected	9	39	35	10	5	27	28	99	44	13	10	13	44	51	19
Number of Species Collected	3	6	6	6	5	6	7	9	8	4	4	4	8	8	5
Estimated area sampled (m^2)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Est. Density per Transect Line (#/m^2)	0.09	0.39	0.35	0.10	0.05	0.27	0.28	0.99	0.44	0.13	0.10	0.13	0.44	0.51	0.19
Max. Density per 10-meter section (#/m^2)	0.50	1.60	2.60	0.60	0.20	1.60	1.80	8.80	1.50	0.80	1.00	0.80	2.80	3.30	1.00

Table 5 continued on next page

Table 5. Continued

	Transect Searches														
Scientific Name	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Amblema plicata		3								1					
Ellipsaria lineolata															
Elliptio crassidens															
Fusconaia ebena	1	11	2			3	3			4		1		1	
Fusconaia flava															
Lampsilis cardium															
Lampsilis teres		1													
Lasmigona complanata															
Leptodea fragilis				1											
Ligumia recta															
Megalonaias nervosa															
Obliquaria reflexa		8			1	2	2		2			3			
Obovaria olivaria		3	1			2				3		1			
Pleurobema cordatum															
Potamilus alatus	1														
Potamilus capax	1			1											
Quadrula apiculata															
Quadrula metanevra															
Quadrula nodulata	15	31	11	2	5	34	2	7	3	21	8	23	4	3	
Quadrula pustulosa		2													
Quadrula quadrula	2	14	3	1					1	3					
Truncilla truncata															
Number of Mussels Collected	20	73	17	5	6	41	7	7	6	32	8	28	4	4	0
Number of Species Collected	5	8	4	4	2	4	3	1	3	5	1	4	1	2	0
Estimated area sampled (m^2)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Est. Density per Transect Line (#/m^2)	0.20	0.73	0.17	0.05	0.06	0.41	0.07	0.07	0.06	0.32	0.08	0.28	0.04	0.04	0.00
Max. Density per 10-meter section (#/m^2)	1.80	3.50	1.00	0.30	0.30	1.60	0.40	0.30	0.30	1.20	0.40	0.90	0.20	0.20	0.00

Table 5 continued on next page

Table 5. Continued

	Transect Searches														
Scientific Name	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**Totals**
Amblema plicata					2	1	1	4		11	3	1	1		72
Ellipsaria lineolata										5					5
Elliptio crassidens										1					1
Fusconaia ebena	1	1	3	3	4	2	24	14	8	154	1		5	5	381
Fusconaia flava															6
Lampsilis cardium										1					2
Lampsilis teres			1		1	1		2		1					9
Lasmigona complanata															1
Leptodea fragilis				1											3
Ligumia recta						1				3					5
Megalonaias nervosa						1		2		7	2		2	2	17
Obliquaria reflexa										8					38
Obovaria olivaria	1		1				6		1	9					44
Pleurobema cordatum													1		1
Potamilus alatus		1				2	1	1		6		1			22
Potamilus capax										1					4
Quadrula apiculata										4					4
Quadrula metanevra															1
Quadrula nodulata	12	17	24	9	8	4	17	4		29				1	473
Quadrula pustulosa										6					11
Quadrula quadrula		2	1			1	9	10	1	50	2	1	2		141
Truncilla truncata										1					1
Number of Mussels Collected	14	21	30	13	15	13	58	37	10	297	8	3	11	8	1,242
Number of Species Collected	3	4	5	3	4	8	6	7	3	17	4	3	5	3	22
Estimated area sampled (m^2)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
Est. Density per Transect Line (#/m^2)	0.14	0.21	0.30	0.13	0.15	0.13	0.58	0.37	0.10	2.97	0.08	0.03	0.11	0.08	
Max. Density per 10-meter section (#/m^2)	0.60	0.90	1.60	0.40	1.00	0.70	2.40	1.20	0.80	12.00	0.30	0.20	0.50	0.40	

Table 6. Ohio River transects, approximate bottom elevation, water depth at pool elevation for each day of the survey (obtained from the US Corps of Engineers river gauge at Paducah, KY), and type of sediment recorded at each 10-meter interval along the transects. (Elevations and depths are only approximate and are not intended to be used for engineering or navigational purposes. Depth and substrate are only intended to describe mussel habitat.)

Transect Mark	Transect 1			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	308.06	0	100% Clay	Hard
10 m	298.06	10	100% Clay	Medium-Hard
20 m	294.06	14	100% Clay	Hard
30 m	286.06	22	100% Clay	Medium
40 m	284.06	24	100% Clay	Loose over Hard
50 m	281.06	27	100% Clay	Hard
60 m	281.06	27	100% Clay	Hard
70 m	281.06	27	10% Sand, 90% Clay	Loose over Hard
80 m	282.06	26	50% Sand, 50% Clay	Hard
90 m	281.06	27	90% Sand, 10% Clay	Hard
100 m	280.06	28	90% Sand, 10% Clay	Hard

Transect Mark	Transect 2			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	308.06	0	100% Clay	Loose over Hard
10 m	300.06	8	100% Clay	Loose over Hard
20 m	293.06	15	100% Clay	Loose over Hard
30 m	288.06	20	100% Clay	Hard
40 m	285.06	23	100% Clay	Loose over Hard
50 m	283.06	25	5% Sand, 95% Clay	Loose over Hard
60 m	282.06	26	60% Sand, 40% Clay	Medium over Hard
70 m	282.06	26	50% Sand, 50% Clay	Medium over Hard
80 m	281.56	26.5	100% Sand	Medium
90 m	281.06	27	90% Sand, 10% Clay	Loose over Hard
100 m	281.06	27	100% Sand	Medium

Table 6. Continued

Transect Mark	Transect 3			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	308.06	0	100% Clay	Hard
10 m	302.06	6	100% Clay	Loose
20 m	297.06	11	100% Clay	Hard
30 m	292.06	16	100% Clay	Hard
40 m	288.06	20	10% Sand, 90% Clay	Medium to Hard
50 m	287.06	21	100% Clay	Hard
60 m	287.06	21	100% Clay	Hard
70 m	284.06	24	100% Sand	Loose
80 m	283.06	25	90% Sand, 10% Clay	Loose to Medium
90 m	283.06	25	100% Sand	Medium to Hard
100 m	282.06	26	100% Sand	Medium to Hard

Transect Mark	Transect 4			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	308.06	0	100% Clay	Hard
10 m	304.06	4	100% Clay	Loose
20 m	300.06	8	100% Clay	Loose
30 m	297.06	11	100% Clay	Loose
40 m	292.06	16	100% Clay	Medium to Hard
50 m	292.06	16	100% Clay	Medium to Hard
60 m	289.06	19	10% Sand, 90% Clay	Hard
70 m	286.06	22	10% Sand, 90% Clay	Hard
80 m	284.06	24	10% Gravel, 10% Sand, 80% Clay	Medium to Hard
90 m	284.06	24	100% Sand	Hard
100 m	284.06	24	30% Sand, 70% Clay	Hard

Table 6. Continued

Transect Mark	Transect 5			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	310.06	0	100% Clay	Medium to Hard
10 m	305.06	5	100% Clay	Medium
20 m	301.06	9	100% Clay	Medium to Hard
30 m	299.06	11	100% Clay	Hard
40 m	297.06	13	10% Sand, 90% Clay	Medium
50 m	295.06	15	10% Sand, 90% Clay	Medium
60 m	295.06	15	30% Gravel, 70% Clay	Medium to Hard
70 m	292.06	18	100% Clay	Hard
80 m	291.06	19	30% Sand, 70% Clay	Hard
90 m	288.06	22	20% Gravel, 20% Sand, 60% Clay	Medium
100 m	287.06	23	90% Sand, 10% Clay	Medium to Hard

Transect Mark	Transect 6			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	306.06	4	100% Clay	Loose to Medium
10 m	302.06	8	100% Clay	Loose over Hard
20 m	298.06	12	100% Clay	Medium to Hard
30 m	297.06	13	100% Clay	Medium
40 m	296.06	14	100% Clay	Loose to Medium
50 m	296.06	14	10% Sand, 90% Clay	Hard
60 m	298.06	12	10% Gravel, 90% Clay	Medium
70 m	291.06	19	20% Gravel, 80% Clay	Medium
80 m	288.06	22	20% Gravel, 80% Clay	Medium
90 m	287.06	23	20% Gravel, 30% Sand, 50% Clay	Medium to Hard
100 m	287.06	23	40% Gravel, 60% Clay	Hard

Table 6. Continued

Transect Mark	Transect 7			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	306.06	4	100% Clay	Loose
10 m	301.06	9	100% Clay	Loose
20 m	297.06	13	100% Clay	Loose to Medium
30 m	296.06	14	20% Sand, 80% Clay	Hard
40 m	295.06	15	30% Gravel, 70% Clay	Medium
50 m	294.06	16	10% Gravel, 90% Clay	Hard
60 m	290.06	20	10% Gravel, 90% Clay	Hard
70 m	290.06	20	10% Gravel, 90% Clay	Hard
80 m	288.06	22	30% Gravel, 20% Sand, 50% Clay	Hard
90 m	287.06	23	20% Gravel, 60% Sand, 20% Clay	Medium
100 m	288.06	22	100% Sand	Medium

Transect Mark	Transect 8			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	310.06	0	100% Clay	Loose
10 m	306.06	4	100% Clay	Loose
20 m	300.06	10	100% Clay	Loose over Hard
30 m	298.06	12	100% Clay	Loose over Hard
40 m	293.06	17	100% Clay	Loose over Hard
50 m	290.06	20	100% Sand	Medium
60 m	290.06	20	10% Gravel, 90% Sand	Medium to Hard
70 m	290.06	20	90% Gravel, 10% Sand	Hard
80 m	288.56	21.5	80% Gravel, 20% Sand	Hard
90 m	288.06	22	90% Gravel, 10% Sand	Hard
100 m	288.06	22	80% Gravel, 10% Sand, 10% Clay	Hard

Table 6. Continued

Transect Mark	Transect 9			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	310.89	0	100% Clay	Hard with Scattered Timber Debris
10 m	301.89	9	100% Clay	Medium
20 m	298.89	12	100% Clay	Medium
30 m	293.89	17	100% Clay	Medium to Hard
40 m	289.89	21	100% Clay	Medium to Hard
50 m	285.89	25	100% Clay	Medium
60 m	285.89	25	30% Sand, 70% Clay	Medium to Hard
70 m	285.89	25	10% Sand, 90% Clay	Hard
80 m	285.89	25	70% Sand, 30% Clay	Medium to Hard
90 m	285.89	25	10% Sand, 90% Clay	Hard
100 m	286.89	24	10% Sand, 90% Clay	Medium to Hard

Transect Mark	Transect 10			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	310.89	0	100% Clay	Loose to Medium
10 m	305.89	5	100% Clay	Loose
20 m	300.89	10	100% Clay	Hard
30 m	297.89	13	100% Clay	Hard
40 m	285.89	25	100% Clay	Medium to Hard
50 m	284.89	26	50% Sand, 50% Clay	Medium to Hard
60 m	283.89	27	90% Sand, 10% Clay	Medium
70 m	286.89	24	90% Sand, 10% Clay	Hard
80 m	285.89	25	25% Gravel, 25% Sand, 50% Clay	Hard
90 m	286.89	24	20% Gravel, 80% Sand	Hard
100 m	285.89	25	20% Gravel, 80% Sand	Hard

Table 6. Continued

Transect Mark	Transect 11			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	306.89	4	100% Clay	Hard
10 m	298.89	12	100% Clay	Loose over Hard
20 m	290.89	20	100% Clay	Hard
30 m	287.89	23	100% Clay	Hard
40 m	285.89	25	100% Clay	Hard
50 m	283.89	27	20% Sand, 80% Clay	Medium
60 m	284.89	26	20% Gravel, 80% Sand	Hard
70 m	283.89	27	100% Sand	Hard
80 m	284.89	26	100% Sand	Hard
90 m	284.89	26	100% Sand	Hard
100 m	285.89	25	10% Sand, 90% Clay	Loose over Hard

Transect Mark	Transect 12			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	310.89	0	100% Clay	Medium
10 m	304.89	6	100% Clay	Hard
20 m	299.89	11	100% Clay	Hard
30 m	296.89	14	100% Clay	Hard
40 m	288.89	22	100% Clay	Hard
50 m	283.89	27	100% Clay	Hard
60 m	282.89	28	100% Sand	Medium to Hard
70 m	282.89	28	95% Gravel, 5% Sand	Hard
80 m	283.89	27	80% Gravel, 20% Sand	Medium to Hard
90 m	283.89	27	100% Sand	Hard
100 m	283.89	27	50% Sand, 50% Clay	Loose to Medium

Table 6. Continued

Transect Mark	Transect 13			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	311.8	0	100% Clay	Hard
10 m	301.8	10	100% Clay	Hard
20 m	299.8	12	100% Clay	Hard
30 m	289.8	22	100% Clay	Hard
40 m	283.8	28	25% Gravel, 25% Sand, 50% Clay	Loose to Medium
50 m	281.8	30	10% Gravel, 40% Sand, 50% Clay	Medium
60 m	282.8	29	100% Sand	Medium to Hard with Scattered Timber Debris
70 m	281.8	30	50% Sand, 50% Clay	Medium to Hard
80 m	283.8	28	50% Sand, 50% Clay	Medium to Hard
90 m	283.8	28	70% Sand, 30% Clay	Hard
100 m	283.8	28	10% Sand, 90% Clay	Medium Sand over Loose Clay

Transect Mark	Transect 14			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	309.8	2	100% Clay	Loose
10 m	308.8	3	100% Clay	Loose to Medium
20 m	300.8	11	100% Clay	Hard
30 m	296.8	15	100% Clay	Medium to Hard
40 m	285.8	26	100% Clay	Hard
50 m	281.8	30	20% Gravel, 80% Sand	Loose to Medium
60 m	281.8	30	100% Sand	Medium
70 m	281.8	30	70% Sand, 30% Clay	Medium
80 m	281.8	30	100% Clay	Hard
90 m	281.8	30	80% Sand, 20% Clay	Medium to Hard
100 m	282.8	29	90% Sand, 10% Clay	Hard

Table 6. Continued

Transect Mark	Transect 15			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	306.8	5	100% Clay	Hard
10 m	301.8	10	100% Clay	Hard
20 m	286.8	25	100% Clay	Hard
30 m	281.8	30	100% Clay	Medium to Hard
40 m	282.8	29	100% Clay	Medium to Hard
50 m	282.8	29	100% Sand	Medium to Hard
60 m	278.8	33	100% Sand	Medium to Hard
70 m	281.8	30	100% Sand	Medium to Hard
80 m	281.8	30	80% Sand, 20% Clay	Medium to Hard
90 m	281.8	30	100% Sand	Medium to Hard
100 m	282.8	29	50% Sand, 50% Clay	Loose

Transect Mark	Transect 16			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	311.8	0	100% Clay	Loose
10 m	305.8	6	100% Clay	Loose
20 m	300.8	11	100% Clay	Loose over Hard
30 m	293.8	18	100% Clay	Medium over Hard
40 m	290.8	21	100% Clay	Hard
50 m	283.8	28	20% Gravel, 80% Sand	Medium over Hard
60 m	282.8	29	20% Gravel, 80% Sand	Medium over Hard
70 m	281.8	30	100% Sand	Hard
80 m	282.8	29	100% Sand	Medium over Hard
90 m	281.8	30	20% Gravel, 80% Sand	Hard
100 m	282.8	29	100% Sand	Medium over Hard

Table 6. Continued

Transect Mark	Transect 17			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	311.58	0	100% Clay	Hard
10 m	307.58	4	100% Clay	Hard
20 m	301.58	10	100% Clay	Hard
30 m	296.58	15	100% Clay	Medium
40 m	283.58	28	100% Clay	Loose to Medium
50 m	281.58	30	50% Gravel, 50% Sand	Medium to Hard
60 m	280.58	31	100% Sand	Medium to Hard
70 m	282.58	29	100% Sand	Medium to Hard
80 m	282.58	29	90% Sand, 10% Clay	Medium
90 m	283.58	28	100% Sand	Hard
100 m	282.58	29	10% Gravel, 90% Sand	Medium to Hard

Transect Mark	Transect 18			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	311.58	0	100% Clay	Hard
10 m	302.58	9	100% Clay	Loose over Hard
20 m	299.58	12	100% Clay	Hard
30 m	293.58	18	100% Clay	Hard
40 m	286.58	25	100% Clay	Hard
50 m	284.58	27	20% Sand, 80% Clay	Medium to Hard with Scattered Timber Debris
60 m	283.58	28	20% Gravel, 30% Sand, 50% Clay	Loose to Medium
70 m	282.58	29	80% Sand, 20% Clay	Loose to Medium
80 m	282.58	29	100% Sand	Medium to Hard
90 m	282.58	29	100% Sand	Medium
100 m	282.58	29	100% Sand	Medium

Table 6. Continued

Transect Mark	Transect 19			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	311.58	0	100% Clay	Hard
10 m	302.58	9	100% Clay	Loose
20 m	295.58	16	100% Clay	Hard
30 m	289.58	22	100% Clay	Hard
40 m	287.58	24	100% Clay	Hard
50 m	285.58	26	100% Sand	Medium to Hard
60 m	284.58	27	100% Sand	Medium
70 m	284.58	27	100% Sand	Medium to Hard
80 m	284.58	27	100% Sand	Hard
90 m	284.58	27	100% Sand	Medium to Hard
100 m	284.58	27	100% Sand	Hard

Transect Mark	Transect 20			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	311.58	0	100% Clay	Loose to Medium
10 m	301.58	10	100% Clay	Hard
20 m	296.58	15	100% Clay	Loose to Medium
30 m	287.58	24	100% Clay	Medium to Hard
40 m	283.58	28	20% Sand, 80% Clay	Loose
50 m	282.58	29	100% Sand	Medium to Hard
60 m	284.58	27	100% Sand	Hard
70 m	286.58	25	100% Sand	Hard
80 m	285.58	26	100% Sand	Medium to Hard
90 m	285.58	26	100% Sand	Hard
100 m	284.58	27	100% Sand	Hard

Table 6. Continued

Transect Mark	Transect 21			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	311.52	0	100% Clay	Hard
10 m	299.52	12	100% Clay	Loose to Medium
20 m	291.52	20	100% Clay	Medium to Hard
30 m	283.52	28	10% Sand, 90% Clay	Medium to Hard
40 m	283.52	28	80% Sand, 20% Clay	Medium to Hard
50 m	283.52	28	100% Sand	Medium
60 m	283.52	28	100% Sand	Medium to Hard
70 m	284.52	27	100% Sand	Hard
80 m	284.52	27	100% Sand	Medium
90 m	284.52	27	100% Sand	Loose to Medium
100 m	284.52	27	100% Sand	Medium

Transect Mark	Transect 22			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	311.52	0	100% Clay	Loose to Medium
10 m	306.52	5	100% Clay	Loose
20 m	293.52	18	100% Clay	Loose to Medium
30 m	288.52	23	100% Clay	Medium to Hard
40 m	284.52	27	70% Sand, 30% Clay	Medium to Hard
50 m	284.52	27	100% Sand	Medium to Hard
60 m	284.52	27	100% Sand	Hard
70 m	284.52	27	100% Sand	Medium
80 m	284.52	27	100% Sand	Medium to Hard
90 m	284.52	27	100% Sand	Medium to Hard
100 m	284.52	27	100% Sand	Medium

Table 6. Continued

Transect Mark	Transect 23			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	311.52	0	100% Clay	Hard
10 m	306.52	5	100% Clay	Hard
20 m	298.52	13	100% Clay	Medium to Hard
30 m	286.52	25	100% Clay	Loose to Medium
40 m	284.52	27	70% Sand, 30% Clay	Medium
50 m	284.52	27	100% Sand	Medium to Hard
60 m	284.52	27	100% Sand	Loose to Medium
70 m	284.52	27	100% Sand	Medium to Hard
80 m	284.52	27	100% Sand	Medium
90 m	284.52	27	100% Sand	Hard
100 m	284.52	27	100% Sand	Medium to Hard

Transect Mark	Transect 24			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	311.52	0	100% Clay	Medium to Hard
10 m	304.52	7	100% Clay	Hard
20 m	300.52	11	100% Clay	Hard
30 m	292.52	19	100% Clay	Hard
40 m	285.52	26	100% Sand	Medium to Hard
50 m	284.52	27	100% Sand	Hard
60 m	284.52	27	100% Sand	Medium to Hard
70 m	284.52	27	10% Gravel, 90% Sand	Hard
80 m	284.52	27	100% Sand	Medium
90 m	284.52	27	100% Sand	Hard
100 m	284.52	27	100% Sand	Medium to Hard

Table 6. Continued

Transect Mark	Transect 25			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	303.53	0	100% Clay	Loose
10 m	302.53	1	100% Clay	Hard
20 m	298.53	5	100% Clay	Medium to Hard
30 m	294.53	9	100% Clay	Medium to Hard
40 m	288.53	15	100% Clay	Hard
50 m	284.53	19	50% Sand, 50% Clay	Medium
60 m	283.53	20	80% Sand, 20% Clay	Medium to Hard
70 m	284.53	19	100% Sand	Medium
80 m	283.53	20	100% Sand	Medium
90 m	283.53	20	100% Sand	Medium
100 m	283.53	20	100% Sand	Hard

Transect Mark	Transect 26			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	303.53	0	100% Clay	Loose
10 m	300.53	3	100% Clay	Medium
20 m	298.53	5	100% Clay	Hard
30 m	297.53	6	100% Clay	Medium to Hard
40 m	293.53	10	100% Clay	Hard
50 m	287.53	16	100% Clay	Hard
60 m	285.53	18	10% Sand, 90% Clay	Medium
70 m	284.53	19	50% Sand, 50% Clay	Medium to Hard
80 m	286.53	17	90% Sand, 10% Clay	Loose to Medium
90 m	284.53	19	100% Sand	Medium
100 m	284.53	19	100% Sand	Medium to Hard

Table 6. Continued

Transect Mark	Transect 27			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	303.53	0	100% Clay	Loose
10 m	299.53	4	100% Clay	Medium to Hard
20 m	298.53	5	100% Clay	Medium to Hard
30 m	292.53	11	100% Clay	Medium to Hard
40 m	288.53	15	100% Clay	Hard
50 m	287.53	16	20% Sand, 80% Clay	Medium to Hard
60 m	287.53	16	80% Sand, 20% Clay	Medium to Hard
70 m	286.53	17	100% Sand	Medium
80 m	286.53	17	70% Sand, 30% Clay	Loose to Medium
90 m	286.53	17	100% Sand	Medium to Hard
100 m	286.53	17	100% Sand	Medium to Hard

Transect Mark	Transect 28			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	303.53	0	100% Clay	Loose
10 m	298.53	5	100% Clay	Loose
20 m	291.53	12	10% Sand, 90% Clay	Medium
30 m	289.53	14	100% Clay	Medium to Hard
40 m	287.53	16	100% Clay	Medium to Hard
50 m	287.53	16	100% Clay	Medium to Hard
60 m	287.53	16	50% Sand, 50% Clay	Medium
70 m	287.53	16	50% Sand, 50% Clay	Medium
80 m	287.53	16	50% Sand, 50% Clay	Medium
90 m	287.53	16	80% Sand, 20% Clay	Loose to Medium
100 m	287.53	16	80% Sand, 20% Clay	Loose to Medium

Table 6. Continued

Transect Mark	Transect 29			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	303.53	0	100% Clay	Loose
10 m	293.53	10	100% Clay	Hard
20 m	288.53	15	100% Clay	Hard
30 m	286.53	17	100% Clay	Hard
40 m	285.53	18	100% Clay	Hard
50 m	285.53	18	80% Sand, 20% Clay	Medium
60 m	285.53	18	80% Sand, 20% Clay	Medium
70 m	285.53	18	80% Sand, 20% Clay	Medium
80 m	285.53	18	80% Sand, 20% Clay	Medium
90 m	285.53	18	80% Sand, 20% Clay	Medium
100 m	285.53	18	80% Sand, 20% Clay	Loose to Medium

Transect Mark	Transect 30			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	303.53	0	100% Clay	Loose
10 m	292.53	11	100% Clay	Hard
20 m	284.53	19	100% Clay	Medium to Hard
30 m	284.53	19	5% Sand, 95% Clay	Hard
40 m	285.53	18	100% Clay	Hard
50 m	284.53	19	20% Sand, 80% Clay	Medium to Hard
60 m	284.53	19	20% Sand, 80% Clay	Medium to Hard
70 m	284.53	19	80% Sand, 20% Clay	Loose to Medium
80 m	284.53	19	80% Sand, 20% Clay	Medium
90 m	284.53	19	80% Sand, 20% Clay	Medium
100 m	284.53	19	80% Sand, 20% Clay	Medium

Table 6. Continued

Transect Mark	Transect 31			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	303.53	0	100% Clay	Hard
10 m	294.53	9	100% Clay	Medium to Hard
20 m	285.53	18	100% Clay	Medium to Hard
30 m	286.53	17	100% Clay	Loose to Medium
40 m	284.53	19	100% Clay	Hard
50 m	283.53	20	20% Sand, 80% Clay	Medium
60 m	283.53	20	20% Sand, 80% Clay	Medium to Hard
70 m	283.53	20	80% Sand, 20% Clay	Loose to Medium
80 m	283.53	20	80% Sand, 20% Clay	Loose to Medium
90 m	283.53	20	90% Sand, 10% Clay	Loose
100 m	283.53	20	90% Sand, 10% Clay	Medium

Transect Mark	Transect 32			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	303.37	0	100% Clay	Hard
10 m	300.37	3	100% Clay	Medium to Hard
20 m	292.37	11	100% Clay	Loose to Medium
30 m	287.37	16	100% Clay	Hard
40 m	284.37	19	100% Clay	Hard
50 m	282.37	21	20% Sand, 80% Clay	Medium to Hard
60 m	283.37	20	100% Sand	Medium to Hard
70 m	283.37	20	100% Sand	Medium
80 m	283.37	20	80% Sand, 20% Clay	Medium
90 m	283.37	20	20% Sand, 80% Clay	Loose to Medium
100 m	283.37	20	100% Sand	Medium

Table 6. Continued

Transect Mark	Transect 33			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	303.37	0	100% Clay	Medium to Hard
10 m	299.37	4	100% Clay	Medium
20 m	292.37	11	100% Clay	Hard
30 m	287.37	16	100% Clay	Hard
40 m	282.37	21	100% Clay	Hard
50 m	282.37	21	40% Sand, 60% Clay	Medium
60 m	282.37	21	100% Sand	Medium to Hard
70 m	282.37	21	100% Sand	Medium
80 m	282.37	21	100% Sand	Medium to Hard
90 m	283.37	20	80% Sand, 20% Clay	Medium
100 m	282.37	21	60% Sand, 40% Clay	Loose to Medium

Transect Mark	Transect 34			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	303.37	0	100% Clay	Loose
10 m	299.37	4	100% Clay	Hard
20 m	290.37	13	100% Clay	Medium to Hard
30 m	285.37	18	100% Clay	Medium to Hard
40 m	282.37	21	40% Sand, 60% Clay	Loose to Medium
50 m	281.37	22	70% Sand, 30% Clay	Medium to Hard
60 m	282.37	21	100% Sand	Hard
70 m	282.37	21	100% Sand	Medium
80 m	282.37	21	100% Sand	Loose to Medium
90 m	283.37	20	100% Sand	Medium to Hard
100 m	282.37	21	20% Sand, 80% Clay	Medium to Hard

Table 6. Continued

Transect Mark	Transect 35			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	303.37	0	90% Sand, 10% Clay	Loose
10 m	300.37	3	90% Sand, 10% Clay	Loose
20 m	290.37	13	20% Sand, 80% Clay	Medium
30 m	280.37	23	90% Sand, 10% Clay	Medium
40 m	279.37	24	70% Sand, 30% Clay	Medium with Scattered Timber Debris
50 m	279.37	24	90% Sand, 10% Clay	Loose to Medium
60 m	280.37	23	90% Sand, 10% Clay	Medium
70 m	280.37	23	90% Sand, 10% Clay	Loose
80 m	279.37	24	90% Sand, 10% Clay	Loose to Medium
90 m	279.37	24	90% Sand, 10% Clay	Loose
100 m	278.37	25	90% Sand, 10% Clay	Loose

Transect Mark	Transect 36			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	303.37	0	100% Clay	Hard
10 m	292.37	11	10% Sand, 90% Clay	Medium to Hard
20 m	283.37	20	50% Sand, 50% Clay	Medium
30 m	278.37	25	90% Sand, 10% Clay	Medium
40 m	277.37	26	90% Sand, 10% Clay	Loose to Medium
50 m	277.37	26	90% Sand, 10% Clay	Loose
60 m	277.37	26	90% Sand, 10% Clay	Loose
70 m	277.37	26	90% Sand, 10% Clay	Loose
80 m	278.37	25	90% Sand, 10% Clay	Loose
90 m	276.37	27	90% Sand, 10% Clay	Loose
100 m	279.37	24	100% Sand	Loose

Table 6. Continued

Transect Mark	Transect 37			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	306.11	0	100% Sand	Loose
10 m	299.11	7	90% Sand, 10% Clay	Medium
20 m	294.11	12	30% Sand, 70% Clay	Medium to Hard
30 m	286.11	20	70% Sand, 30% Clay	Hard
40 m	281.11	25	70% Sand, 30% Clay	Hard
50 m	277.11	29	90% Sand, 10% Clay	Medium to Hard
60 m	276.11	30	90% Sand, 10% Clay	Loose to Medium
70 m	276.11	30	90% Sand, 10% Clay	Medium to Hard
80 m	276.11	30	90% Sand, 10% Clay	Loose
90 m	275.11	31	90% Sand, 10% Clay	Loose to Medium
100 m	278.11	28	100% Sand	Loose

Transect Mark	Transect 38			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	306.11	0	100% Clay	Hard
10 m	300.11	6	20% Sand, 80% Clay	Hard
20 m	297.11	9	20% Sand, 80% Clay	Hard
30 m	293.11	13	100% Clay	Hard
40 m	287.11	19	100% Clay	Hard
50 m	285.11	21	100% Clay	Hard
60 m	280.11	26	40% Gravel, 60% Sand	Hard
70 m	284.11	22	80% Sand, 20% Clay	Medium to Hard
80 m	281.11	25	20% Gravel, 60% Sand, 20% Clay	Hard
90 m	281.11	25	50% Gravel, 40% Sand, 10% Clay	Hard
100 m	278.11	28	10% Gravel, 90% Sand	Hard

Table 6. Continued

Transect Mark	Transect 39			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	306.11	0	100% Clay	Hard
10 m	300.11	6	10% Sand, 90% Clay	Hard
20 m	299.11	7	100% Clay	Hard
30 m	296.11	10	100% Clay	Hard
40 m	290.11	16	100% Clay	Hard
50 m	283.11	23	100% Clay	Hard
60 m	282.11	24	60% Sand, 40% Clay	Medium
70 m	282.11	24	40% Boulder, 40% Sand, 20% Clay	Hard
80 m	281.11	25	40% Boulder, 40% Sand, 20% Clay	Hard
90 m	280.11	26	40% Gravel, 60% Sand	Medium
100 m	273.11	33	50% Sand, 50% Clay	Loose

Transect Mark	Transect 40			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	306.11	0	100% Clay	Hard
10 m	302.11	4	100% Clay	Hard
20 m	299.11	7	100% Clay	Hard
30 m	297.11	9	100% Clay	Hard
40 m	295.11	11	100% Clay	Hard
50 m	287.11	19	100% Clay	Hard
60 m	284.11	22	20% Sand, 80% Clay	Medium to Hard
70 m	278.11	28	50% Sand, 50% Clay	Medium to Hard
80 m	276.11	30	50% Sand, 50% Clay	Medium to Hard
90 m	276.11	30	80% Sand, 20% Clay	Medium
100 m	276.11	30	20% Sand, 80% Clay	Medium

Table 6. Continued

Transect Mark	Transect 41			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	310.1	0	100% Clay	Hard
10 m	303.1	7	100% Clay	Loose
20 m	300.1	10	100% Clay	Loose with Scattered Timber Debris
30 m	299.1	11	30% Gravel, 70% Clay	Medium to Hard with Scattered Timber Debris
40 m	297.1	13	40% Gravel, 60% Clay	Hard
50 m	291.1	19	100% Clay	Hard
60 m	290.1	20	80% Gravel, 20% Clay	Hard with Scattered Boulders
70 m	287.1	23	90% Gravel, 10% Clay	Hard with Scattered Boulders
80 m	287.1	23	90% Gravel, 10% Clay	Hard
90 m	284.1	26	30% Gravel, 70% Clay	Hard
100 m	283.1	27	30% Gravel, 20% Sand, 50% Clay	Hard

Transect Mark	Transect 42			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	310.1	0	100% Clay	Hard
10 m	303.1	7	100% Clay	Medium to Hard
20 m	300.1	10	100% Clay	Loose
30 m	300.1	10	100% Clay	Loose with Scattered Timber Debris
40 m	297.1	13	100% Clay	Loose with Scattered Timber Debris
50 m	292.1	18	100% Clay	Loose with Scattered Timber Debris
60 m	289.1	21	100% Clay	Medium with Scattered Timber Debris
70 m	286.1	24	100% Clay	Medium with Scattered Timber Debris
80 m	285.1	25	30% Gravel, 70% Clay	Hard
90 m	282.1	28	50% Gravel, 50% Clay	Hard
100 m	280.1	30	50% Gravel, 50% Sand	Medium to Hard

Table 6. Continued

Transect Mark	Transect 43			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	310.1	0	100% Clay	Hard
10 m	305.1	5	100% Clay	Loose
20 m	300.1	10	100% Clay	Loose
30 m	292.1	18	50% Gravel, 50% Clay	Hard with Scattered Boulders
40 m	286.1	24	100% Clay	Medium with Scattered Boulders
50 m	284.1	26	100% Clay	Loose with Scattered Timber Debris
60 m	283.1	27	80% Gravel, 20% Clay	Hard with Scattered Timber Debris
70 m	280.1	30	90% Gravel, 10% Clay	Hard
80 m	280.1	30	10% Gravel, 90% Clay	Hard with Scattered Timber Debris
90 m	281.1	29	100% Clay	Medium with Scattered Timber Debris
100 m	281.1	29	100% Clay	Medium with Scattered Timber Debris

Transect Mark	Transect 44			
	Bottom Elev. (Ft)	**Depth (Ft)**	**Sediment**	**Compactness and Notes**
0 m	310.1	0	100% Clay	Loose
10 m	305.1	5	100% Clay	Loose
20 m	300.1	10	20% Boulder, 40% Sand, 40% Clay	Medium
30 m	289.1	21	90% Sand, 10% Clay	Loose
40 m	286.1	24	50% Sand, 50% Clay	Medium to Hard with Scattered Timber Debris
50 m	282.1	28	20% Boulder, 40% Cobble, 40% Sand	Hard
60 m	281.1	29	50% Boulder, 50% Cobble	Hard
70 m	281.1	29	50% Cobble, 50% Gravel	Hard
80 m	281.1	29	50% Cobble, 50% Gravel	Hard
90 m	280.1	30	50% Gravel, 50% Sand	Hard
100 m	280.1	30	20% Boulder, 80% Sand	Hard

Table 7. Number of mussels of each species encountered during each of the timed qualitative searches between Ohio River Miles 935 and 937.4

	Qualitative Searches																							
Scientific Name	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**Totals**	**Percent Abundance**
Amblema plicata				5	1	1	1			6						3		1	1	7	10	3	39	8.18%
Ellipsaria lineolata																						2	2	0.42%
Fusconaia ebena				5	1	3	5	13		5	3	2			1	16	2	39	10	15	29	15	164	34.38%
Fusconaia flava																			1	1			2	0.42%
Lampsilis cardium																			1				1	0.21%
Lampsilis teres				1															1	2	1		5	1.05%
Ligumia recta																		1			2		3	0.63%
Megalonaias nervosa																		1			1	2	4	0.84%
Obliquaria reflexa				1							1				1			1			1		5	1.05%
Obovaria olivaria			1	1				6						1			2				3		14	2.94%
Potamilus alatus					1											1			2	4	2	1	11	2.31%
Potamilus capax														1		1		1	1				4	0.84%
Potamilus ohiensis										1													1	0.21%
Quadrula metanevra												1											1	0.21%
Quadrula nodulata			5	1	1	7	4	24		9	17	10		1	13	20	17	9	5	9	6		158	33.12%
Quadrula pustulosa							1													1			2	0.42%
Quadrula quadrula			2	2	5	2	2	1		7	1				2			3	2	12	17	3	61	12.79%
Number of Mussels Collected	0	0	8	16	9	13	13	44	0	28	22	13	0	3	17	41	21	56	24	51	72	26	477	100.00%
Number of Species Collected	0	0	3	7	5	4	5	4	0	5	4	3	0	3	4	5	3	8	9	8	10	6	17	
Collection Time (minutes)	10	10	10	10	10	10	10	10	5	10	10	10	5	10	10	10	10	10	10	10	10	10	Total Search Time: 210 minutes	
CPUE (# mussels per man hour)	0	0	48	96	54	78	78	264	0	168	132	78	0	18	102	246	126	336	144	306	432	156	Mean CPUE: 136.3	

Table 8. List of the federally listed mussels found during the entire survey, including weight, dimensions, approximate age, location, and photo reference

Species	**Weight** (g)	**Length** (mm)	**Width** (mm)	**Height** (mm)	**Age** (yr.)	**Location**	**Photo Reference**
Potamilus capax	291	114	89	65	6	Transect 14; 50-60m from shore	Photos 5 and 6
Potamilus capax	237	102	78	66	5	Transect 16; 50-60m from shore	Photos 7 and 8
Potamilus capax	292	112	92	71	8	Transect 19; 50-60m from shore	Photos 9 and 10
Potamilus capax	98	78	61	53	3	Qualitative 14; 75m from shore	Photos 11 and 12
Potamilus capax	1,105	131	105	81	6	Qualitative 16; 55m from shore	Photos 13 and 14
Potamilus capax	194	89	74	59	3	Qualitative 18; 35m from shore	Photos 15 and 16
Potamilus capax	354	120	91	72	5	Transect 40; 50-60m from shore	Photos 17 and 18
Potamilus capax	215	108	80	61	4	Qualitative 19; 45m from shore	Photos 19 and 20

Table 9. Encountered mussel species, approximate age, length, and locations where found

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Amblema plicata	Threeridge	13	98.02	Transect 2; 50-60m from shore
		11	95.4	Transect 2; 50-60m from shore
		11	99.07	Transect 2; 50-60m from shore
		10	81.57	Transect 2; 70-80m from shore
		9	77.43	Transect 3; 70-80m from shore
		11	83.19	Transect 4; 40-50m from shore
		9	70.26	Transect 5; 30-40m from shore
		11	94.35	Transect 6; 50-60m from shore
		10	82.75	Transect 6; 50-60m from shore
		10	84.02	Transect 6; 50-60m from shore
		8	77.3	Transect 6; 50-60m from shore
		13	96.98	Transect 6; 50-60m from shore
		14	104.48	Transect 6; 50-60m from shore
		9	83.14	Transect 6; 50-60m from shore
		11	89.27	Transect 6; 50-60m from shore
		12	91.26	Transect 6; 70-80m from shore
		15	97.58	Transect 6; 90-100m from shore
		9	72.75	Transect 7; 70-80m from shore
		11	94.94	Transect 7; 70-80m from shore
		11	89.6	Transect 7; 70-80m from shore
		12	67.5	Transect 7; 70-80m from shore
		12	75.57	Qualitative 4; 70m from shore
		11	79.43	Qualitative 4; 70m from shore
		10	84.06	Qualitative 4; 70m from shore
		10	68.44	Qualitative 4; 70m from shore
		13	70.24	Qualitative 4; 70m from shore
		12	97	Transect 8; 40-50m from shore
		11	85	Transect 8; 90-100m from shore
		8	88	Transect 8; 90-100m from shore
		12	98	Transect 9; 60-70m from shore
		10	84	Transect 9; 60-70m from shore
		10	95	Transect 10; 50-60m from shore
		12	91	Transect 10; 50-60m from shore
		10	89	Transect 10; 50-60m from shore
		9	83	Transect 11; 60-70m from shore
		15	104	Transect 12; 50-60m from shore
		9	90	Transect 12; 50-60m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Amblema plicata	Threeridge	10	88	Transect 12; 50-60m from shore
		11	95	Transect 12; 60-70m from shore
		13	92	Transect 12; 60-70m from shore
		15	112	Transect 12; 60-70m from shore
		9	71	Transect 12; 60-70m from shore
		12	119	Transect 13; 30-40m from shore
		10	96	Transect 13; 30-40m from shore
		13	107	Transect 14; 40-50m from shore
		12	92	Transect 14; 40-50m from shore
		11	92	Transect 14; 50-60m from shore
		10	98	Transect 14; 50-60m from shore
		7	85	Qualitative 5; 60m from shore
		11	108	Qualitative 6; 50m from shore
		8	74	Transect 15; 50-60m from shore
		12	106	Qualitative 7; 50m from shore
		10	100	Transect 17; 40-50m from shore
		9	88	Transect 17; 40-50m from shore
		6	60	Transect 17; 40-50m from shore
		7	77	Qualitative 10; 60m from shore
		11	90	Qualitative 10; 60m from shore
		12	92	Qualitative 10; 60m from shore
		10	89	Qualitative 10; 60m from shore
		11	105	Qualitative 10; 60m from shore
		11	94	Qualitative 10; 60m from shore
		10	105	Transect 25; 40-50m from shore
		9	100	Qualitative 16; 55m from shore
		10	100	Qualitative 16; 55m from shore
		6	59	Qualitative 16; 55m from shore
		7	82	Transect 35; 30-40m from shore
		9	87	Transect 35; 30-40m from shore
		5	62	Transect 36; 30-40m from shore
		11	121	Qualitative 18; 35m from shore
		11	93	Transect 37; 40-50m from shore
		9	105	Transect 38; 50-60m from shore
		11	94	Transect 38; 50-60m from shore
		10	97	Transect 38; 60-70m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Amblema plicata	Threeridge	12	130	Transect 38; 90-100m from shore
		10	97	Transect 40; 50-60m from shore
		6	75	Transect 40; 50-60m from shore
		4	45	Transect 40; 50-60m from shore
		19	120	Transect 40; 70-80m from shore
		4	54	Transect 40; 70-80m from shore
		5	54	Transect 40; 70-80m from shore
		10	89	Transect 40; 70-80m from shore
		9	91	Transect 40; 80-90m from shore
		18	109	Transect 40; 80-90m from shore
		15	111	Transect 40; 80-90m from shore
		16	101	Transect 40; 90-100m from shore
		17	118	Transect 41; 40-50m from shore
		9	86	Transect 41; 40-50m from shore
		12	109	Transect 41; 50-60m from shore
		6	60	Transect 42; 60-70m from shore
		11	110	Transect 43; 60-70m from shore
		10	96	Qualitative 19; 45m from shore
		9	82	Qualitative 20; 60m from shore
		10	102	Qualitative 20; 60m from shore
		16	101	Qualitative 20; 60m from shore
		8	65	Qualitative 20; 60m from shore
		17	108	Qualitative 20; 60m from shore
		10	77	Qualitative 20; 60m from shore
		12	100	Qualitative 20; 60m from shore
		9	74	Qualitative 21; 75m from shore
		11	79	Qualitative 21; 75m from shore
		10	83	Qualitative 21; 75m from shore
		13	88	Qualitative 21; 75m from shore
		9	77	Qualitative 21; 75m from shore
		9	83	Qualitative 21; 75m from shore
		12	86	Qualitative 21; 75m from shore
		10	89	Qualitative 21; 75m from shore
		10	87	Qualitative 21; 75m from shore
		12	93	Qualitative 21; 75m from shore
		16	111	Qualitative 22; 85m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Amblema plicata	Threeridge	15	109	Qualitative 22; 85m from shore
		20	107	Qualitative 22; 85m from shore
Ellipsaria lineolata	Butterfly	7	78	Transect 40; 70-80m from shore
		6	82	Transect 40; 80-90m from shore
		9	97	Transect 40; 80-90m from shore
		10	80	Transect 40; 90-100m from shore
		13	78	Transect 40; 90-100m from shore
		9	60	Qualitative 22; 85m from shore
		10	84	Qualitative 22; 85m from shore
Elliptio crassidens	Elephantear	17	138	Transect 40; 70-80m from shore
Fusconaia ebena	Ebonyshell	9	62.34	Transect 2; 60-70m from shore
		11	67.9	Transect 2; 70-80m from shore
		11	64.8	Transect 2; 90-100m from shore
		18	85.84	Transect 3; 70-80m from shore
		10	67.72	Transect 3; 80-90m from shore
		12	72.95	Transect 3; 80-90m from shore
		6	47.73	Transect 3; 80-90m from shore
		5	39.63	Transect 3; 80-90m from shore
		12	76.34	Transect 4; 40-50m from shore
		5	42.49	Transect 4; 70-80m from shore
		14	82.7	Transect 5; 60-70m from shore
		8	61.27	Transect 6; 50-60m from shore
		12	75.74	Transect 6; 50-60m from shore
		11	80.25	Transect 6; 50-60m from shore
		14	79.93	Transect 6; 70-80m from shore
		12	82.94	Transect 6, 90-100m from shore
		15	86.6	Transect 6, 90-100m from shore
		12	74.14	Transect 6, 90-100m from shore
		13	75.94	Transect 6, 90-100m from shore
		12	70.49	Transect 6, 90-100m from shore
		13	73.32	Transect 7; 70-80m from shore
		15	75.18	Transect 7; 70-80m from shore
		12	70.57	Transect 7; 70-80m from shore
		10	75.57	Qualitative 4; 70m from shore
		11	79.43	Qualitative 4; 70m from shore
		13	84.06	Qualitative 4; 70m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
		8	68.44	Qualitative 4; 70m from shore
		10	70.27	Qualitative 4; 70m from shore
		12	86	Transect 8; 40-50m from shore
		13	85	Transect 8; 40-50m from shore
		9	79	Transect 8; 40-50m from shore
		5	39	Transect 8; 40-50m from shore
		5	41	Transect 8; 40-50m from shore
		6	46	Transect 8; 40-50m from shore
		5	39	Transect 8; 40-50m from shore
		7	57	Transect 8; 40-50m from shore
		6	43	Transect 8; 40-50m from shore
		11	81	Transect 8; 40-50m from shore
		9	69	Transect 8; 40-50m from shore
		9	70	Transect 8; 40-50m from shore
		14	88	Transect 8; 40-50m from shore
		11	81	Transect 8; 40-50m from shore
		12	77	Transect 8; 40-50m from shore
Fusconaia ebena	Ebonyshell	13	79	Transect 8; 40-50m from shore
		10	75	Transect 8; 40-50m from shore
		12	87	Transect 8; 40-50m from shore
		11	80	Transect 8; 40-50m from shore
		12	76	Transect 8; 40-50m from shore
		12	77	Transect 8; 40-50m from shore
		13	81	Transect 8; 40-50m from shore
		11	84	Transect 8; 40-50m from shore
		11	74	Transect 8; 40-50m from shore
		12	77	Transect 8; 40-50m from shore
		11	80	Transect 8; 40-50m from shore
		12	78	Transect 8; 40-50m from shore
		11	76	Transect 8; 40-50m from shore
		10	79	Transect 8; 40-50m from shore
		11	80	Transect 8; 40-50m from shore
		12	84	Transect 8; 40-50m from shore
		11	77	Transect 8; 40-50m from shore
		13	80	Transect 8; 40-50m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Fusconaia ebena	Ebonyshell	12	81	Transect 8; 40-50m from shore
		10	86	Transect 8; 40-50m from shore
		11	85	Transect 8; 40-50m from shore
		10	76	Transect 8; 40-50m from shore
		13	87	Transect 8; 40-50m from shore
		10	78	Transect 8; 40-50m from shore
		9	78	Transect 8; 40-50m from shore
		13	80	Transect 8; 40-50m from shore
		11	80	Transect 8; 40-50m from shore
		12	80	Transect 8; 40-50m from shore
		10	84	Transect 8; 40-50m from shore
		9	66	Transect 8; 40-50m from shore
		14	85	Transect 8; 40-50m from shore
		11	83	Transect 8; 40-50m from shore
		10	84	Transect 8; 40-50m from shore
		11	77	Transect 8; 40-50m from shore
		13	92	Transect 8; 40-50m from shore
		11	77	Transect 8; 40-50m from shore
		10	67	Transect 8; 40-50m from shore
		11	80	Transect 8; 40-50m from shore
		6	59	Transect 8; 40-50m from shore
		10	69	Transect 8; 40-50m from shore
		11	83	Transect 8; 40-50m from shore
		8	57	Transect 8; 40-50m from shore
		15	84	Transect 8; 60-70m from shore
		7	54	Transect 8; 60-70m from shore
		12	75	Transect 8; 60-70m from shore
		11	77	Transect 8; 60-70m from shore
		8	51	Transect 8; 90-100m from shore
		10	42	Transect 8; 90-100m from shore
		11	78	Transect 9; 40-50m from shore
		14	85	Transect 9; 40-50m from shore
		6	44	Transect 9; 40-50m from shore
		10	71	Transect 9; 40-50m from shore
		10	81	Transect 9; 50-60m from shore
		11	73	Transect 9; 50-60m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Fusconaia ebena	Ebonyshell	12	85	Transect 9; 50-60m from shore
		6	39	Transect 9; 50-60m from shore
		12	78	Transect 9; 50-60m from shore
		12	81	Transect 9; 50-60m from shore
		11	77	Transect 9; 50-60m from shore
		12	79	Transect 9; 60-70m from shore
		5	40	Transect 9; 60-70m from shore
		6	47	Transect 9; 60-70m from shore
		11	86	Transect 9; 70-80m from shore
		12	76	Transect 9; 70-80m from shore
		11	70	Transect 9; 70-80m from shore
		5	40	Transect 9; 70-80m from shore
		6	42	Transect 9; 70-80m from shore
		12	84	Transect 9; 80-90m from shore
		11	75	Transect 9; 80-90m from shore
		11	86	Transect 10; 50-60m from shore
		9	64	Transect 10; 50-60m from shore
		11	68	Transect 10; 60-70m from shore
		11	73	Transect 11; 60-70m from shore
		12	80	Transect 11; 60-70m from shore
		11	81	Transect 12; 60-70m from shore
		10	74	Transect 12; 60-70m from shore
		5	38	Transect 13; 50-60m from shore
		8	58	Transect 13; 50-60m from shore
		9	66	Transect 13; 50-60m from shore
		8	64	Transect 13; 70-80m from shore
		10	73	Transect 14; 50-60m from shore
		15	87	Transect 14; 50-60m from shore
		6	45	Transect 14; 50-60m from shore
		5	33	Transect 14; 50-60m from shore
		10	59	Transect 14; 50-60m from shore
		10	70	Transect 14; 50-60m from shore
		7	87	Transect 14; 50-60m from shore
		6	35	Transect 14; 50-60m from shore
		5	45	Transect 14; 60-70m from shore
		10	75	Qualitative 5; 60m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Fusconaia ebena	Ebonyshell	11	85	Qualitative 6; 50m from shore
		10	70	Qualitative 6; 50m from shore
		9	69	Qualitative 6; 50m from shore
		5	38	Transect 15; 50-60m from shore
		6	50	Transect 15; 50-60m from shore
		11	79	Transect 15; 80-90m from shore
		5	43	Transect 16; 90-100m from shore
		12	77	Qualitative 7; 50m from shore
		10	86	Qualitative 7; 50m from shore
		5	38	Qualitative 7; 50m from shore
		12	75	Qualitative 7; 50m from shore
		10	65	Qualitative 7; 50m from shore
		10	76	Qualitative 8; 60m from shore
		11	80	Qualitative 8; 60m from shore
		11	73	Qualitative 8; 60m from shore
		10	75	Qualitative 8; 60m from shore
		11	91	Qualitative 8; 60m from shore
		12	82	Qualitative 8; 60m from shore
		12	77	Qualitative 8; 60m from shore
		11	73	Qualitative 8; 60m from shore
		8	62	Qualitative 8; 60m from shore
		9	60	Qualitative 8; 60m from shore
		6	50	Qualitative 8; 60m from shore
		9	65	Qualitative 8; 60m from shore
		5	44	Qualitative 8; 60m from shore
		11	86	Transect 17; 40-50m from shore
		15	87	Transect 17; 40-50m from shore
		11	75	Transect 17; 40-50m from shore
		5	53	Transect 17; 40-50m from shore
		5	48	Transect 17; 40-50m from shore
		15	88	Transect 17; 50-60m from shore
		5	39	Transect 17; 50-60m from shore
		9	70	Transect 17; 60-70m from shore
		12	80	Transect 17; 70-80m from shore
		4	33	Transect 17; 70-80m from shore
		5	40	Transect 17; 90-100m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Fusconaia ebena	Ebonyshell	9	73	Transect 18; 50-60m from shore
		6	48	Transect 18; 50-60m from shore
		10	75	Qualitative 10; 60m from shore
		9	74	Qualitative 10; 60m from shore
		13	84	Qualitative 10; 60m from shore
		10	68	Qualitative 10; 60m from shore
		8	70	Qualitative 10; 60m from shore
		9	80	Qualitative 11; 65m from shore
		7	64	Qualitative 11; 65m from shore
		5	49	Qualitative 11; 65m from shore
		5	50	Qualitative 12; 65m from shore
		5	49	Qualitative 12; 65m from shore
		5	35	Qualitative 15; 50m from shore
		11	88	Transect 21; 30-40m from shore
		5	57	Transect 21; 30-40m from shore
		5	54	Transect 21; 50-60m from shore
		5	45	Transect 22; 30-40m from shore
		4	30	Transect 22; 30-40m from shore
		8	61	Transect 22; 60-70m from shore
		15	91	Transect 25; 40-50m from shore
		14	93	Transect 25; 40-50m from shore
		9	77	Transect 25; 40-50m from shore
		7	50	Transect 25; 50-60m from shore
		7	65	Transect 27; 50-60m from shore
		5	41	Transect 29; 40-50m from shore
		9	78	Transect 31; 60-70m from shore
		10	67	Transect 32; 40-50m from shore
		10	76	Transect 33; 40-50m from shore
		7	59	Transect 33; 40-50m from shore
		9	61	Transect 33; 40-50m from shore
		9	75	Transect 34; 30-40m from shore
		8	70	Transect 34; 30-40m from shore
		12	93	Transect 34; 70-80m from shore
		11	95	Qualitative 16; 55m from shore
		14	94	Qualitative 16; 55m from shore
		10	80	Qualitative 16; 55m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Fusconaia ebena	Ebonyshell	9	80	Qualitative 16; 55m from shore
		8	65	Qualitative 16; 55m from shore
		16	70	Qualitative 16; 55m from shore
		14	70	Qualitative 16; 55m from shore
		13	71	Qualitative 16; 55m from shore
		14	75	Qualitative 16; 55m from shore
		8	60	Qualitative 16; 55m from shore
		9	59	Qualitative 16; 55m from shore
		17	78	Qualitative 16; 55m from shore
		9	65	Qualitative 16; 55m from shore
		11	80	Qualitative 16; 55m from shore
		14	85	Qualitative 16; 55m from shore
		6	40	Qualitative 16; 55m from shore
		11	80	Qualitative 17; 50m from shore
		10	75	Qualitative 17; 50m from shore
		14	98	Transect 35; 30-40m from shore
		12	85	Transect 35; 30-40m from shore
		10	82	Transect 35; 40-50m from shore
		12	93	Transect 35; 40-50m from shore
		12	87	Transect 36; 30-40m from shore
		9	77	Transect 36; 30-40m from shore
		11	90	Qualitative 18; 35m from shore
		14	82	Qualitative 18; 35m from shore
		10	79	Qualitative 18; 35m from shore
		9	66	Qualitative 18; 35m from shore
		5	52	Qualitative 18; 35m from shore
		9	74	Qualitative 18; 35m from shore
		8	80	Qualitative 18; 35m from shore
		10	78	Qualitative 18; 35m from shore
		7	67	Qualitative 18; 35m from shore
		13	99	Qualitative 18; 35m from shore
		8	64	Qualitative 18; 35m from shore
		9	58	Qualitative 18; 35m from shore
		12	72	Qualitative 18; 35m from shore
		11	87	Qualitative 18; 35m from shore
		13	62	Qualitative 18; 35m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Fusconaia ebena	Ebonyshell	12	73	Qualitative 18; 35m from shore
		14	79	Qualitative 18; 35m from shore
		15	83	Qualitative 18; 35m from shore
		11	80	Qualitative 18; 35m from shore
		16	92	Qualitative 18; 35m from shore
		14	77	Qualitative 18; 35m from shore
		13	83	Qualitative 18; 35m from shore
		18	91	Qualitative 18; 35m from shore
		12	82	Qualitative 18; 35m from shore
		12	71	Qualitative 18; 35m from shore
		11	76	Qualitative 18; 35m from shore
		8	67	Qualitative 18; 35m from shore
		13	81	Qualitative 18; 35m from shore
		9	76	Qualitative 18; 35m from shore
		16	85	Qualitative 18; 35m from shore
		13	89	Qualitative 18; 35m from shore
		11	79	Qualitative 18; 35m from shore
		10	73	Qualitative 18; 35m from shore
		13	82	Qualitative 18; 35m from shore
		19	93	Qualitative 18; 35m from shore
		10	69	Qualitative 18; 35m from shore
		18	97	Qualitative 18; 35m from shore
		14	83	Qualitative 18; 35m from shore
		10	88	Qualitative 18; 35m from shore
		15	79	Transect 37; 40-50m from shore
		16	95	Transect 37; 40-50m from shore
		15	94	Transect 37; 40-50m from shore
		8	69	Transect 37; 40-50m from shore
		14	75	Transect 37; 40-50m from shore
		9	82	Transect 37; 40-50m from shore
		17	98	Transect 37; 40-50m from shore
		12	82	Transect 37; 40-50m from shore
		6	48	Transect 37; 40-50m from shore
		7	57	Transect 37; 40-50m from shore
		9	67	Transect 37; 40-50m from shore
		7	58	Transect 37; 40-50m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Fusconaia ebena	Ebonyshell	9	68	Transect 37; 40-50m from shore
		16	94	Transect 37; 40-50m from shore
		7	63	Transect 37; 40-50m from shore
		13	100	Transect 37; 50-60m from shore
		10	66	Transect 37; 50-60m from shore
		13	76	Transect 37; 50-60m from shore
		8	59	Transect 37; 50-60m from shore
		16	98	Transect 37; 60-70m from shore
		9	67	Transect 37; 60-70m from shore
		10	75	Transect 37; 60-70m from shore
		5	40	Transect 37; 60-70m from shore
		5	45	Transect 37; 70-80m from shore
		15	95	Transect 38; 50-60m from shore
		9	83	Transect 38; 50-60m from shore
		10	77	Transect 38; 50-60m from shore
		6	70	Transect 38; 60-70m from shore
		8	64	Transect 38; 60-70m from shore
		5	49	Transect 38; 60-70m from shore
		11	87	Transect 38; 80-90m from shore
		12	79	Transect 38; 80-90m from shore
		8	72	Transect 38; 80-90m from shore
		7	55	Transect 38; 80-90m from shore
		8	73	Transect 38; 80-90m from shore
		8	61	Transect 38; 80-90m from shore
		7	58	Transect 38; 90-100m from shore
		5	52	Transect 38; 90-100m from shore
		7	55	Transect 39; 70-80m from shore
		11	80	Transect 39; 80-90m from shore
		11	83	Transect 39; 80-90m from shore
		8	64	Transect 39; 80-90m from shore
		7	65	Transect 39; 80-90m from shore
		13	96	Transect 39; 80-90m from shore
		12	85	Transect 39; 80-90m from shore
		9	75	Transect 39; 80-90m from shore
		12	83	Transect 40; 40-50m from shore
		6	60	Transect 40; 50-60m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Fusconaia ebena	Ebonyshell	5	47	Transect 40; 50-60m from shore
		7	52	Transect 40; 50-60m from shore
		5	40	Transect 40; 50-60m from shore
		5	45	Transect 40; 50-60m from shore
		6	45	Transect 40; 50-60m from shore
		7	50	Transect 40; 50-60m from shore
		10	68	Transect 40; 70-80m from shore
		8	70	Transect 40; 70-80m from shore
		9	64	Transect 40; 70-80m from shore
		5	38	Transect 40; 70-80m from shore
		6	50	Transect 40; 70-80m from shore
		10	80	Transect 40; 70-80m from shore
		5	40	Transect 40; 70-80m from shore
		8	54	Transect 40; 70-80m from shore
		12	86	Transect 40; 70-80m from shore
		5	40	Transect 40; 70-80m from shore
		11	73	Transect 40; 70-80m from shore
		6	57	Transect 40; 70-80m from shore
		8	65	Transect 40; 70-80m from shore
		8	64	Transect 40; 70-80m from shore
		11	72	Transect 40; 70-80m from shore
		12	89	Transect 40; 70-80m from shore
		11	70	Transect 40; 70-80m from shore
		9	73	Transect 40; 70-80m from shore
		11	79	Transect 40; 70-80m from shore
		5	50	Transect 40; 70-80m from shore
		11	70	Transect 40; 70-80m from shore
		10	88	Transect 40; 70-80m from shore
		5	50	Transect 40; 70-80m from shore
		7	60	Transect 40; 70-80m from shore
		11	76	Transect 40; 70-80m from shore
		8	60	Transect 40; 70-80m from shore
		11	85	Transect 40; 70-80m from shore
		9	80	Transect 40; 70-80m from shore
		12	84	Transect 40; 70-80m from shore
		9	65	Transect 40; 70-80m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Fusconaia ebena	Ebonyshell	5	33	Transect 40; 70-80m from shore
		9	67	Transect 40; 70-80m from shore
		11	72	Transect 40; 70-80m from shore
		14	85	Transect 40; 70-80m from shore
		8	62	Transect 40; 70-80m from shore
		14	90	Transect 40; 70-80m from shore
		11	73	Transect 40; 70-80m from shore
		8	60	Transect 40; 70-80m from shore
		15	88	Transect 40; 70-80m from shore
		8	65	Transect 40; 70-80m from shore
		5	56	Transect 40; 70-80m from shore
		15	80	Transect 40; 70-80m from shore
		14	76	Transect 40; 70-80m from shore
		9	62	Transect 40; 70-80m from shore
		8	60	Transect 40; 70-80m from shore
		5	38	Transect 40; 70-80m from shore
		6	58	Transect 40; 70-80m from shore
		5	38	Transect 40; 70-80m from shore
		8	54	Transect 40; 70-80m from shore
		11	85	Transect 40; 70-80m from shore
		8	68	Transect 40; 70-80m from shore
		6	50	Transect 40; 70-80m from shore
		7	61	Transect 40; 70-80m from shore
		9	57	Transect 40; 70-80m from shore
		7	59	Transect 40; 70-80m from shore
		9	54	Transect 40; 70-80m from shore
		5	38	Transect 40; 70-80m from shore
		6	45	Transect 40; 70-80m from shore
		5	50	Transect 40; 70-80m from shore
		3	24	Transect 40; 70-80m from shore
		4	31	Transect 40; 70-80m from shore
		4	27	Transect 40; 70-80m from shore
		5	41	Transect 40; 70-80m from shore
		4	28	Transect 40; 70-80m from shore
		16	80	Transect 40; 80-90m from shore
		8	59	Transect 40; 80-90m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Fusconaia ebena	Ebonyshell	11	71	Transect 40; 80-90m from shore
		4	34	Transect 40; 80-90m from shore
		6	44	Transect 40; 80-90m from shore
		12	81	Transect 40; 80-90m from shore
		8	61	Transect 40; 80-90m from shore
		10	64	Transect 40; 80-90m from shore
		11	80	Transect 40; 80-90m from shore
		10	74	Transect 40; 80-90m from shore
		11	63	Transect 40; 80-90m from shore
		14	79	Transect 40; 80-90m from shore
		11	76	Transect 40; 80-90m from shore
		5	47	Transect 40; 80-90m from shore
		5	41	Transect 40; 80-90m from shore
		9	71	Transect 40; 80-90m from shore
		8	55	Transect 40; 80-90m from shore
		9	54	Transect 40; 80-90m from shore
		13	77	Transect 40; 80-90m from shore
		11	66	Transect 40; 80-90m from shore
		6	46	Transect 40; 80-90m from shore
		7	57	Transect 40; 80-90m from shore
		8	46	Transect 40; 80-90m from shore
		5	42	Transect 40; 80-90m from shore
		13	74	Transect 40; 80-90m from shore
		5	41	Transect 40; 80-90m from shore
		7	51	Transect 40; 80-90m from shore
		11	68	Transect 40; 80-90m from shore
		9	57	Transect 40; 80-90m from shore
		8	63	Transect 40; 80-90m from shore
		6	37	Transect 40; 80-90m from shore
		9	66	Transect 40; 80-90m from shore
		7	52	Transect 40; 80-90m from shore
		6	41	Transect 40; 80-90m from shore
		8	56	Transect 40; 80-90m from shore
		6	51	Transect 40; 80-90m from shore
		8	50	Transect 40; 80-90m from shore
		9	74	Transect 40; 80-90m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Fusconaia ebena	Ebonyshell	8	68	Transect 40; 80-90m from shore
		5	33	Transect 40; 80-90m from shore
		9	66	Transect 40; 80-90m from shore
		9	70	Transect 40; 80-90m from shore
		9	65	Transect 40; 80-90m from shore
		11	82	Transect 40; 80-90m from shore
		12	71	Transect 40; 80-90m from shore
		7	52	Transect 40; 80-90m from shore
		9	67	Transect 40; 80-90m from shore
		11	69	Transect 40; 80-90m from shore
		12	71	Transect 40; 80-90m from shore
		10	79	Transect 40; 80-90m from shore
		5	37	Transect 40; 80-90m from shore
		8	59	Transect 40; 80-90m from shore
		9	60	Transect 40; 80-90m from shore
		9	56	Transect 40; 80-90m from shore
		10	67	Transect 40; 80-90m from shore
		13	72	Transect 40; 80-90m from shore
		5	34	Transect 40; 80-90m from shore
		7	54	Transect 40; 80-90m from shore
		9	68	Transect 40; 80-90m from shore
		9	61	Transect 40; 80-90m from shore
		7	60	Transect 40; 80-90m from shore
		8	56	Transect 40; 80-90m from shore
		9	62	Transect 40; 80-90m from shore
		10	70	Transect 40; 80-90m from shore
		4	31	Transect 40; 80-90m from shore
		7	54	Transect 40; 80-90m from shore
		5	35	Transect 40; 80-90m from shore
		5	31	Transect 40; 80-90m from shore
		5	38	Transect 40; 80-90m from shore
		5	29	Transect 40; 80-90m from shore
		14	84	Transect 40; 90-100m from shore
		13	87	Transect 40; 90-100m from shore
		9	61	Transect 40; 90-100m from shore
		5	51	Transect 40; 90-100m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Fusconaia ebena	Ebonyshell	16	86	Transect 40; 90-100m from shore
		14	72	Transect 40; 90-100m from shore
		12	76	Transect 40; 90-100m from shore
		9	64	Transect 40; 90-100m from shore
		5	46	Transect 40; 90-100m from shore
		6	34	Transect 40; 90-100m from shore
		4	24	Transect 40; 90-100m from shore
		4	20	Transect 40; 90-100m from shore
		9	59	Transect 41; 90-100m from shore
		5	50	Transect 43; 60-70m from shore
		5	48	Transect 43; 60-70m from shore
		14	95	Transect 43; 70-80m from shore
		13	90	Transect 43; 70-80m from shore
		7	48	Transect 43; 70-80m from shore
		5	49	Transect 44; 30-40m from shore
		5	49	Transect 44; 30-40m from shore
		10	79	Transect 44; 90-100m from shore
		5	57	Transect 44; 90-100m from shore
		7	65	Transect 44; 90-100m from shore
		6	58	Qualitative 19; 45m from shore
		5	50	Qualitative 19; 45m from shore
		13	76	Qualitative 19; 45m from shore
		7	71	Qualitative 19; 45m from shore
		12	84	Qualitative 19; 45m from shore
		6	52	Qualitative 19; 45m from shore
		6	61	Qualitative 19; 45m from shore
		13	90	Qualitative 19; 45m from shore
		10	82	Qualitative 19; 45m from shore
		14	102	Qualitative 19; 45m from shore
		7	55	Qualitative 20; 60m from shore
		13	79	Qualitative 20; 60m from shore
		11	73	Qualitative 20; 60m from shore
		12	81	Qualitative 20; 60m from shore
		9	53	Qualitative 20; 60m from shore
		8	67	Qualitative 20; 60m from shore
		7	59	Qualitative 20; 60m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Fusconaia ebena	Ebonyshell	12	77	Qualitative 20; 60m from shore
		7	68	Qualitative 20; 60m from shore
		9	56	Qualitative 20; 60m from shore
		12	76	Qualitative 20; 60m from shore
		9	62	Qualitative 20; 60m from shore
		5	47	Qualitative 20; 60m from shore
		7	55	Qualitative 20; 60m from shore
		11	66	Qualitative 20; 60m from shore
		12	70	Qualitative 21; 75m from shore
		10	76	Qualitative 21; 75m from shore
		9	74	Qualitative 21; 75m from shore
		8	41	Qualitative 21; 75m from shore
		5	61	Qualitative 21; 75m from shore
		9	76	Qualitative 21; 75m from shore
		14	74	Qualitative 21; 75m from shore
		5	41	Qualitative 21; 75m from shore
		7	52	Qualitative 21; 75m from shore
		4	41	Qualitative 21; 75m from shore
		5	48	Qualitative 21; 75m from shore
		5	47	Qualitative 21; 75m from shore
		5	35	Qualitative 21; 75m from shore
		5	40	Qualitative 21; 75m from shore
		6	46	Qualitative 21; 75m from shore
		7	50	Qualitative 21; 75m from shore
		4	40	Qualitative 21; 75m from shore
		4	31	Qualitative 21; 75m from shore
		4	34	Qualitative 21; 75m from shore
		4	35	Qualitative 21; 75m from shore
		7	63	Qualitative 21; 75m from shore
		5	45	Qualitative 21; 75m from shore
		4	38	Qualitative 21; 75m from shore
		6	50	Qualitative 21; 75m from shore
		4	32	Qualitative 21; 75m from shore
		5	54	Qualitative 21; 75m from shore
		6	53	Qualitative 21; 75m from shore
		10	68	Qualitative 21; 75m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Fusconaia ebena	Ebonyshell	9	65	Qualitative 21; 75m from shore
		11	71	Qualitative 22; 85m from shore
		4	36	Qualitative 22; 85m from shore
		10	76	Qualitative 22; 85m from shore
		10	55	Qualitative 22; 85m from shore
		7	58	Qualitative 22; 85m from shore
		8	61	Qualitative 22; 85m from shore
		12	91	Qualitative 22; 85m from shore
		14	79	Qualitative 22; 85m from shore
		14	82	Qualitative 22; 85m from shore
		8	52	Qualitative 22; 85m from shore
		15	92	Qualitative 22; 85m from shore
		9	66	Qualitative 22; 85m from shore
		11	80	Qualitative 22; 85m from shore
		16	80	Qualitative 22; 85m from shore
		9	62	Qualitative 22; 85m from shore
Fusconaia flava	Wabash Pigtoe	9	62.34	Transect 1; 50-60m from shore
		5	36.45	Transect 7; 80-90m from shore
		12	81.9	Transect 7; 80-90m from shore
		12	82.56	Transect 7; 80-90m from shore
		11	65.66	Transect 7; 80-90m from shore
		11	76.01	Transect 7; 80-90m from shore
		12	85	Qualitative 19; 45m from shore
		11	81	Qualitative 20; 60m from shore
Lampsilis cardium	Plain Pocketbook	10	139	Transect 12; 60-70m from shore
		12	130	Transect 40; 80-90m from shore
		11	138	Qualitative 19; 45m from shore
Lampsilis teres	Yellow Sandshell	9	126.96	Qualitative 4; 70m from shore
		11	141	Transect 9; 50-60m from shore
		10	141	Transect 13; 30-40m from shore
		11	148	Transect 17; 40-50m from shore
		10	143	Transect 33; 40-50m from shore
		10	143	Transect 35; 30-40m from shore
		7	136	Transect 36; 20-30m from shore
		12	143	Transect 38; 50-60m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Lampsilis teres	Yellow Sandshell	10	142	Transect 38; 90-100m from shore
		11	124	Transect 40; 70-80m from shore
		9	132	Qualitative 19; 45m from shore
		8	124	Qualitative 20; 60m from shore
		10	133	Qualitative 20; 60m from shore
		11	117	Qualitative 21; 75m from shore
Lasmigona complanata	White Heelsplitter	10	116	Transect 13; 50-60m from shore
Leptodea fragilis	Fragile Papershell	6	101	Transect 14; 40-50m from shore
		4	95	Transect 19; 40-50m from shore
		5	105	Transect 34; 80-90m from shore
Ligumia recta	Black Sandshell	5	117	Transect 8; 90-100m from shore
		14	170	Transect 36; 30-40m from shore
		11	157	Qualitative 18; 35m from shore
		12	146	Transect 40; 50-60m from shore
		18	176	Transect 40; 70-80m from shore
		12	153	Transect 40; 90-100m from shore
		13	141	Qualitative 21; 75m from shore
		10	138	Qualitative 21; 75m from shore
Megalonaias nervosa	Washboard	13	147.82	Transect 6; 50-60m from shore
		15	168	Transect 36; 20-30m from shore
		19	169	Qualitative 18; 35m from shore
		10	154	Transect 38; 50-60m from shore
		17	163	Transect 38; 90-100m from shore
		16	135	Transect 40; 50-60m from shore
		12	125	Transect 40; 50-60m from shore
		15	155	Transect 40; 80-90m from shore
		18	161	Transect 40; 80-90m from shore
		34	189	Transect 40; 80-90m from shore
		23	152	Transect 40; 90-100m from shore
		29	160	Transect 40; 90-100m from shore
		14	160	Transect 41; 70-80m from shore
		7	85	Transect 41; 80-90m from shore
		40	195	Transect 43; 60-70m from shore
		23	158	Transect 43; 70-80m from shore
		10	111	Transect 44; 70-80m from shore
		13	115	Transect 44; 90-100m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Megalonaias nervosa	Washboard	36	173	Qualitative 21; 75m from shore
		15	130	Qualitative 22; 85m from shore
		34	178	Qualitative 22; 85m from shore
Obliquaria reflexa	Threehorn Wartyback	6	48.8	Transect 2; 70-80m from shore
		11	43.55	Transect 3; 20-30m from shore
		8	49.63	Transect 3; 70-80m from shore
		4	28.53	Transect 4; 40-50m from shore
		6	40.23	Qualitative 4; 70m from shore
		5	34	Transect 8; 40-50m from shore
		6	43	Transect 8; 40-50m from shore
		4	33	Transect 13; 50-60m from shore
		7	41	Transect 13; 50-60m from shore
		5	41	Transect 13; 70-80m from shore
		5	35	Transect 14; 50-60m from shore
		4	32	Transect 14; 70-80m from shore
		6	37	Transect 15; 80-90m from shore
		6	41	Transect 17; 40-50m from shore
		5	37	Transect 17; 40-50m from shore
		6	37	Transect 17; 40-50m from shore
		8	42	Transect 17; 40-50m from shore
		8	35	Transect 17; 40-50m from shore
		5	37	Transect 17; 60-70m from shore
		8	51	Transect 17; 70-80m from shore
		4	31	Transect 17; 90-100m from shore
		6	41	Qualitative 11; 65m from shore
		6	40	Transect 20; 80-90m from shore
		3	28	Qualitative 15; 50m from shore
		9	50	Transect 21; 30-40m from shore
		5	41	Transect 21; 50-60m from shore
		8	41	Transect 22; 30-40m from shore
		5	34	Transect 22; 40-50m from shore
		6	35	Transect 24; 30-40m from shore
		5	36	Transect 24; 90-100m from shore
		8	44	Transect 27; 50-60m from shore
		8	44	Transect 27; 60-70m from shore
		7	39	Transect 27; 60-70m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Obliquaria reflexa	Threehorn Wartyback	6	41	Qualitative 18; 35m from shore
		8	45	Transect 40; 40-50m from shore
		9	45	Transect 40; 60-70m from shore
		5	38	Transect 40; 70-80m from shore
		7	47	Transect 40; 70-80m from shore
		13	35	Transect 40; 80-90m from shore
		10	36	Transect 40; 80-90m from shore
		8	39	Transect 40; 90-100m from shore
		10	44	Transect 40; 90-100m from shore
		9	40	Qualitative 21; 75m from shore
Obovaria olivaria	Hickorynut	8	51.9	Transect 2; 60-70m from shore
		6	57.93	Qualitative 3; 80m from shore
		7	61.1	Qualitative 4; 70m from shore
		6	56	Transect 8; 40-50m from shore
		9	66	Transect 8; 40-50m from shore
		11	80	Transect 8; 40-50m from shore
		6	50	Transect 9; 50-60m from shore
		6	58	Transect 9; 80-90m from shore
		6	53	Transect 10; 50-60m from shore
		8	59	Transect 10; 60-70m from shore
		6	50	Transect 13; 50-60m from shore
		6	51	Transect 13; 70-80m from shore
		8	68	Transect 14; 50-60m from shore
		6	66	Transect 14; 50-60m from shore
		6	58	Transect 14; 50-60m from shore
		9	60	Transect 14; 50-60m from shore
		9	56	Transect 14; 60-70m from shore
		10	74	Transect 14; 90-100m from shore
		6	57	Qualitative 8; 60m from shore
		7	63	Qualitative 8; 60m from shore
		5	55	Qualitative 8; 60m from shore
		5	51	Qualitative 8; 60m from shore
		5	45	Qualitative 8; 60m from shore
		4	39	Qualitative 8; 60m from shore
		9	57	Transect 17; 70-80m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
		6	44	Transect 17; 70-80m from shore
		7	50	Transect 17; 90-100m from shore
		6	58	Transect 18; 40-50m from shore
		4	43	Qualitative 14; 75m from shore
		10	63	Transect 21; 30-40m from shore
		7	60	Transect 21; 90-100m from shore
		7	62	Transect 25; 60-70m from shore
		9	75	Transect 25; 60-70m from shore
		5	51	Transect 25; 60-70m from shore
		9	63	Transect 27; 80-90m from shore
		7	53	Transect 31; 50-60m from shore
		5	53	Transect 33; 50-60m from shore
		8	58	Qualitative 17; 50m from shore
		5	53	Qualitative 17; 50m from shore
		10	68	Transect 37; 50-60m from shore
		9	55	Transect 37; 50-60m from shore
Obovaria olivaria	Hickorynut	10	68	Transect 37; 50-60m from shore
		6	45	Transect 37; 50-60m from shore
		9	55	Transect 37; 50-60m from shore
		9	76	Transect 38; 60-70m from shore
		5	53	Transect 39; 80-90m from shore
		8	60	Transect 40; 50-60m from shore
		13	82	Transect 40; 70-80m from shore
		6	44	Transect 40; 70-80m from shore
		12	76	Transect 40; 70-80m from shore
		4	41	Transect 40; 70-80m from shore
		4	33	Transect 40; 70-80m from shore
		9	60	Transect 40; 70-80m from shore
		5	64	Transect 40; 80-90m from shore
		10	64	Transect 40; 80-90m from shore
		10	72	Qualitative 21; 75m from shore
		6	60	Qualitative 21; 75m from shore
		7	64	Qualitative 21; 75m from shore
Pleurobema cordatum	Ohio Pigtoe	13	98	Transect 43; 70-80m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Potamilus alatus	Pink Heelsplitter	6	61.26	Transect 1; 20-30m from shore
		5	84.95	Transect 3; 20-30m from shore
		8	127.19	Transect 3; 80-90m from shore
		7	104.85	Transect 4; 70-80m from shore
		14	131.86	Transect 6; 50-60m from shore
		11	130.69	Transect 7; 70-80m from shore
		5	92	Transect 8; 40-50m from shore
		10	117	Transect 9; 20-30m from shore
		5	113	Transect 9; 40-50m from shore
		7	110	Qualitative 5; 60m from shore
		9	147	Transect 16; 50-60m from shore
		8	146	Transect 32; 10-20m from shore
		10	130	Qualitative 16; 55m from shore
		11	131	Transect 36; 20-30m from shore
		10	133	Transect 36; 20-30m from shore
		8	129	Transect 37; 40-50m from shore
		11	121	Transect 38; 80-90m from shore
		12	135	Transect 40; 50-60m from shore
		11	139	Transect 40; 50-60m from shore
		11	115	Transect 40; 60-70m from shore
		9	154	Transect 40; 60-70m from shore
		10	136	Transect 40; 80-90m from shore
		14	119	Transect 40; 90-100m from shore
		9	131	Transect 42; 60-70m from shore
		5	105	Qualitative 19; 45m from shore
		10	157	Qualitative 19; 45m from shore
		6	114	Qualitative 20; 60m from shore
		6	121	Qualitative 20; 60m from shore
		11	135	Qualitative 20; 60m from shore
		6	108	Qualitative 20; 60m from shore
		9	125	Qualitative 21; 75m from shore
		12	121	Qualitative 21; 75m from shore
		13	147	Qualitative 22; 85m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Potamilus capax	Fat Pocketbook	6	114	Transect 14; 50-60m from shore
		5	102	Transect 16; 50-60m from shore
		8	112	Transect 19; 50-60m from shore
		3	78	Qualitative 14; 75m from shore
		6	131	Qualitative 16; 55m from shore
		3	89	Qualitative 18; 35m from shore
		5	120	Transect 40; 50-60m from shore
		4	108	Qualitative 19; 45m from shore
Potamilus ohiensis	Pink Papershell	6	102	Qualitative 10; 60m from shore
Quadrula apiculata	Southern Mapleleaf	12	70	Transect 40; 70-80m from shore
		11	65	Transect 40; 70-80m from shore
		10	55	Transect 40; 70-80m from shore
		8	63	Transect 40; 80-90m from shore
Quadrula metanevra	Monkeyface	9	78	Transect 8; 40-50m from shore
		7	66	Qualitative 12; 65m from shore
Quadrula nodulata	Wartyback	9	55.41	Transect 1; 50-60m from shore
		12	58.43	Transect 1; 50-60m from shore
		11	59.77	Transect 1; 50-60m from shore
		4	35.05	Transect 1; 50-60m from shore
		9	55.03	Transect 1; 70-80m from shore
		9	55.16	Transect 1; 80-90m from shore
		16	60.74	Transect 1; 80-90m from shore
		11	55.67	Transect 2; 50-60m from shore
		5	45.19	Transect 2; 50-60m from shore
		10	57.2	Transect 2; 50-60m from shore
		10	61.6	Transect 2; 50-60m from shore
		10	53.97	Transect 2; 50-60m from shore
		9	47.4	Transect 2; 50-60m from shore
		6	48.83	Transect 2; 50-60m from shore
		8	51.96	Transect 2; 50-60m from shore
		9	47.87	Transect 2; 60-70m from shore
		11	55.14	Transect 2; 60-70m from shore
		11	59.49	Transect 2; 60-70m from shore
		7	50.1	Transect 2; 70-80m from shore
		8	56.13	Transect 2; 70-80m from shore
		7	57.29	Transect 2; 70-80m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Quadrula nodulata	Wartyback	7	54.91	Transect 2; 70-80m from shore
		8	52.18	Transect 2; 70-80m from shore
		7	57.7	Transect 2; 70-80m from shore
		8	48.88	Transect 2; 70-80m from shore
		8	47.61	Transect 2; 70-80m from shore
		9	51.49	Transect 2; 70-80m from shore
		9	53.6	Transect 2; 70-80m from shore
		8	54.65	Transect 2; 70-80m from shore
		9	59.11	Transect 2; 70-80m from shore
		8	47.8	Transect 2; 70-80m from shore
		9	55.66	Transect 2; 90-100m from shore
		7	30.07	Transect 2; 90-100m from shore
		12	61.56	Transect 2; 90-100m from shore
		8	58.82	Transect 2; 90-100m from shore
		5	47.25	Transect 3; 20-30m from shore
		8	55.01	Transect 3; 70-80m from shore
		8	50	Transect 3; 70-80m from shore
		10	55.98	Transect 3; 80-90m from shore
		9	54.97	Transect 3; 80-90m from shore
		7	49.49	Transect 3; 80-90m from shore
		7	51.15	Transect 3; 80-90m from shore
		6	50.39	Transect 3; 80-90m from shore
		5	42.5	Transect 3; 80-90m from shore
		7	49.37	Transect 3; 80-90m from shore
		7	48.6	Transect 3; 80-90m from shore
		8	55.57	Transect 3; 80-90m from shore
		9	53.71	Transect 3; 80-90m from shore
		8	49.58	Transect 3; 80-90m from shore
		7	47.92	Transect 3; 80-90m from shore
		10	55.98	Transect 3; 80-90m from shore
		3	38.55	Transect 3; 80-90m from shore
		3	41.64	Transect 3; 80-90m from shore
		7	44.56	Transect 3; 80-90m from shore
		10	61.9	Transect 3; 80-90m from shore
		8	56.38	Transect 3; 90-100m from shore
		8	62.11	Transect 4; 40-50m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Quadrula nodulata	Wartyback	9	48.27	Transect 4; 70-80m from shore
		10	51.79	Transect 4; 70-80m from shore
		10	54.46	Qualitative 3; 80m from shore
		8	46.57	Qualitative 3; 80m from shore
		13	62.27	Qualitative 3; 80m from shore
		8	48.26	Qualitative 3; 80m from shore
		5	40.28	Qualitative 3; 80m from shore
		4	33.07	Transect 5; 40-50m from shore
		8	55.91	Transect 6; 50-60m from shore
		9	53.4	Transect 6; 50-60m from shore
		8	53.92	Transect 6; 60-70m from shore
		8	45.74	Transect 6; 70-80m from shore
		10	65.42	Transect 6; 90-100m from shore
		8	49.5	Transect 7; 70-80m from shore
		9	50.02	Transect 7; 70-80m from shore
		8	53.65	Transect 7; 70-80m from shore
		10	60.8	Transect 7; 70-80m from shore
		5	37.06	Transect 7; 80-90m from shore
		8	55.16	Transect 7; 80-90m from shore
		11	61.93	Transect 7; 80-90m from shore
		7	47.78	Transect 7; 90-100m from shore
		9	56.34	Qualitative 4; 70m from shore
		8	61	Transect 8; 40-50m from shore
		9	58	Transect 8; 40-50m from shore
		9	60	Transect 8; 40-50m from shore
		7	51	Transect 8; 40-50m from shore
		11	59	Transect 8; 40-50m from shore
		10	61	Transect 8; 40-50m from shore
		8	57	Transect 8; 40-50m from shore
		7	50	Transect 8; 40-50m from shore
		8	61	Transect 8; 40-50m from shore
		6	50	Transect 8; 40-50m from shore
		9	55	Transect 8; 40-50m from shore
		10	57	Transect 8; 40-50m from shore
		8	58	Transect 8; 40-50m from shore
		6	43	Transect 8; 40-50m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Quadrula nodulata	Wartyback	4	30	Transect 8; 40-50m from shore
		5	34	Transect 8; 40-50m from shore
		9	51	Transect 8; 90-100m from shore
		8	42	Transect 8; 90-100m from shore
		9	64	Transect 9; 40-50m from shore
		6	43	Transect 9; 50-60m from shore
		4	35	Transect 9; 50-60m from shore
		9	56	Transect 9; 50-60m from shore
		5	40	Transect 9; 50-60m from shore
		9	56	Transect 9; 70-80m from shore
		5	36	Transect 9; 70-80m from shore
		4	35	Transect 9; 70-80m from shore
		7	49	Transect 9; 80-90m from shore
		6	42	Transect 9; 80-90m from shore
		8	57	Transect 9; 80-90m from shore
		7	50	Transect 10; 50-60m from shore
		10	60	Transect 10; 50-60m from shore
		7	60	Transect 10; 60-70m from shore
		8	61	Transect 10; 60-70m from shore
		9	54	Transect 10; 90-100m from shore
		10	68	Transect 11; 60-70m from shore
		9	59	Transect 11; 60-70m from shore
		10	63	Transect 11; 60-70m from shore
		5	38	Transect 11; 60-70m from shore
		5	43	Transect 11; 60-70m from shore
		13	62	Transect 12; 50-60m from shore
		10	62	Transect 12; 60-70m from shore
		8	60	Transect 12; 90-100m from shore
		8	62	Transect 13; 30-40m from shore
		7	59	Transect 13; 30-40m from shore
		5	50	Transect 13; 30-40m from shore
		10	64	Transect 13; 50-60m from shore
		8	52	Transect 13; 50-60m from shore
		8	55	Transect 13; 50-60m from shore
		5	36	Transect 13; 50-60m from shore
		7	53	Transect 13; 50-60m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Quadrula nodulata	Wartyback	8	55	Transect 13; 50-60m from shore
		6	45	Transect 13; 50-60m from shore
		6	39	Transect 13; 50-60m from shore
		8	61	Transect 13; 50-60m from shore
		9	63	Transect 13; 50-60m from shore
		5	43	Transect 13; 50-60m from shore
		5	45	Transect 13; 50-60m from shore
		5	38	Transect 13; 50-60m from shore
		5	40	Transect 13; 50-60m from shore
		8	58	Transect 13; 50-60m from shore
		7	48	Transect 13; 50-60m from shore
		9	60	Transect 13; 70-80m from shore
		5	40	Transect 13; 70-80m from shore
		8	55	Transect 13; 70-80m from shore
		9	62	Transect 13; 70-80m from shore
		5	37	Transect 13; 70-80m from shore
		9	69	Transect 13; 90-100m from shore
		8	63	Transect 14; 40-50m from shore
		10	63	Transect 14; 40-50m from shore
		10	63	Transect 14; 50-60m from shore
		9	61	Transect 14; 50-60m from shore
		8	55	Transect 14; 50-60m from shore
		6	47	Transect 14; 50-60m from shore
		5	38	Transect 14; 50-60m from shore
		5	41	Transect 14; 50-60m from shore
		8	46	Transect 14; 50-60m from shore
		7	44	Transect 14; 50-60m from shore
		10	73	Transect 14; 50-60m from shore
		15	87	Transect 14; 50-60m from shore
		6	45	Transect 14; 50-60m from shore
		5	33	Transect 14; 50-60m from shore
		10	59	Transect 14; 50-60m from shore
		10	70	Transect 14; 50-60m from shore
		7	47	Transect 14; 50-60m from shore
		6	35	Transect 14; 50-60m from shore
		8	52	Transect 14; 60-70m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Quadrula nodulata	Wartyback	5	37	Transect 14; 60-70m from shore
		9	61	Transect 14; 60-70m from shore
		8	60	Transect 14; 70-80m from shore
		8	55	Transect 14; 90-100m from shore
		9	56	Transect 14; 90-100m from shore
		8	54	Transect 14; 90-100m from shore
		6	49	Transect 14; 90-100m from shore
		4	39	Qualitative 5; 60m from shore
		10	59	Qualitative 6; 50m from shore
		7	48	Qualitative 6; 50m from shore
		6	49	Qualitative 6; 50m from shore
		4	38	Qualitative 6; 50m from shore
		5	44	Qualitative 6; 50m from shore
		4	33	Qualitative 6; 50m from shore
		6	45	Qualitative 6; 50m from shore
		8	63	Transect 15; 50-60m from shore
		6	49	Transect 15; 50-60m from shore
		8	55	Transect 15; 50-60m from shore
		5	39	Transect 15; 50-60m from shore
		5	37	Transect 15; 50-60m from shore
		4	29	Transect 15; 50-60m from shore
		12	56	Transect 15; 80-90m from shore
		5	42	Transect 15; 80-90m from shore
		5	47	Transect 15; 80-90m from shore
		5	49	Transect 15; 80-90m from shore
		4	34	Transect 15; 80-90m from shore
		5	41	Transect 15; 80-90m from shore
		5	44	Transect 15; 80-90m from shore
		7	54	Transect 16; 90-100m from shore
		12	58	Transect 16; 90-100m from shore
		8	54	Transect 16; 90-100m from shore
		6	40	Transect 16; 90-100m from shore
		9	50	Transect 16; 90-100m from shore
		7	54	Transect 16; 90-100m from shore
		7	49	Transect 16; 90-100m from shore
		9	64	Transect 16; 90-100m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Quadrula nodulata	Wartyback	8	63	Transect 16; 90-100m from shore
		9	52	Transect 16; 90-100m from shore
		13	60	Transect 16; 90-100m from shore
		14	75	Transect 16; 90-100m from shore
		10	64	Transect 16; 90-100m from shore
		8	63	Transect 16; 90-100m from shore
		7	52	Transect 16; 90-100m from shore
		4	43	Qualitative 7; 50m from shore
		4	37	Qualitative 7; 50m from shore
		5	48	Qualitative 7; 50m from shore
		5	43	Qualitative 7; 50m from shore
		9	70	Qualitative 8; 60m from shore
		8	66	Qualitative 8; 60m from shore
		5	40	Qualitative 8; 60m from shore
		5	31	Qualitative 8; 60m from shore
		6	49	Qualitative 8; 60m from shore
		8	60	Qualitative 8; 60m from shore
		8	50	Qualitative 8; 60m from shore
		10	51	Qualitative 8; 60m from shore
		5	42	Qualitative 8; 60m from shore
		10	61	Qualitative 8; 60m from shore
		8	56	Qualitative 8; 60m from shore
		5	44	Qualitative 8; 60m from shore
		4	35	Qualitative 8; 60m from shore
		6	49	Qualitative 8; 60m from shore
		5	48	Qualitative 8; 60m from shore
		8	58	Qualitative 8; 60m from shore
		5	40	Qualitative 8; 60m from shore
		8	57	Qualitative 8; 60m from shore
		5	49	Qualitative 8; 60m from shore
		8	64	Qualitative 8; 60m from shore
		5	45	Qualitative 8; 60m from shore
		9	47	Qualitative 8; 60m from shore
		12	70	Qualitative 8; 60m from shore
		8	55	Qualitative 8; 60m from shore
		8	65	Transect 17; 40-50m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Quadrula nodulata	Wartyback	8	52	Transect 17; 40-50m from shore
		10	59	Transect 17; 40-50m from shore
		4	35	Transect 17; 40-50m from shore
		9	50	Transect 17; 40-50m from shore
		6	39	Transect 17; 40-50m from shore
		5	39	Transect 17; 40-50m from shore
		13	75	Transect 17; 50-60m from shore
		11	59	Transect 17; 50-60m from shore
		9	56	Transect 17; 50-60m from shore
		9	58	Transect 17; 50-60m from shore
		5	46	Transect 17; 50-60m from shore
		6	47	Transect 17; 50-60m from shore
		4	35	Transect 17; 50-60m from shore
		6	39	Transect 17; 50-60m from shore
		9	52	Transect 17; 50-60m from shore
		9	58	Transect 17; 60-70m from shore
		6	50	Transect 17; 60-70m from shore
		7	47	Transect 17; 60-70m from shore
		5	44	Transect 17; 60-70m from shore
		8	53	Transect 17; 60-70m from shore
		4	37	Transect 17; 60-70m from shore
		4	38	Transect 17; 60-70m from shore
		4	30	Transect 17; 60-70m from shore
		4	30	Transect 17; 60-70m from shore
		10	69	Transect 17; 70-80m from shore
		9	57	Transect 17; 70-80m from shore
		7	51	Transect 17; 70-80m from shore
		8	47	Transect 17; 70-80m from shore
		9	57	Transect 17; 70-80m from shore
		9	58	Transect 17; 90-100m from shore
		8	60	Transect 18; 40-50m from shore
		6	56	Transect 18; 50-60m from shore
		7	55	Transect 18; 50-60m from shore
		9	56	Transect 18; 50-60m from shore
		10	52	Transect 18; 50-60m from shore
		6	41	Transect 18; 50-60m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Quadrula nodulata	Wartyback	7	50	Transect 18; 50-60m from shore
		5	37	Transect 18; 50-60m from shore
		8	63	Transect 18; 70-80m from shore
		5	40	Transect 18; 70-80m from shore
		5	35	Transect 18; 90-100m from shore
		7	53	Qualitative 10; 60m from shore
		9	50	Qualitative 10; 60m from shore
		11	63	Qualitative 10; 60m from shore
		9	60	Qualitative 10; 60m from shore
		9	56	Qualitative 10; 60m from shore
		8	65	Qualitative 10; 60m from shore
		9	55	Qualitative 10; 60m from shore
		9	57	Qualitative 10; 60m from shore
		8	53	Qualitative 10; 60m from shore
		6	48	Qualitative 11; 65m from shore
		10	46	Qualitative 11; 65m from shore
		6	39	Qualitative 11; 65m from shore
		8	55	Qualitative 11; 65m from shore
		4	33	Qualitative 11; 65m from shore
		5	45	Qualitative 11; 65m from shore
		6	46	Qualitative 11; 65m from shore
		8	53	Qualitative 11; 65m from shore
		9	58	Qualitative 11; 65m from shore
		12	70	Qualitative 11; 65m from shore
		9	53	Qualitative 11; 65m from shore
		8	50	Qualitative 11; 65m from shore
		8	55	Qualitative 11; 65m from shore
		6	50	Qualitative 11; 65m from shore
		5	40	Qualitative 11; 65m from shore
		8	57	Qualitative 11; 65m from shore
		5	42	Qualitative 11; 65m from shore
		6	45	Transect 19; 90-100m from shore
		7	55	Transect 19; 90-100m from shore
		8	60	Transect 20; 40-50m from shore
		10	67	Transect 20; 40-50m from shore
		6	51	Transect 20; 60-70m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Quadrula nodulata	Wartyback	8	58	Transect 20; 80-90m from shore
		8	55	Transect 20; 80-90m from shore
		8	56	Qualitative 12; 65m from shore
		7	60	Qualitative 12; 65m from shore
		8	60	Qualitative 12; 65m from shore
		5	48	Qualitative 12; 65m from shore
		6	39	Qualitative 12; 65m from shore
		5	50	Qualitative 12; 65m from shore
		10	51	Qualitative 12; 65m from shore
		5	45	Qualitative 12; 65m from shore
		5	38	Qualitative 12; 65m from shore
		9	59	Qualitative 12; 65m from shore
		8	54	Qualitative 14; 75m from shore
		5	39	Qualitative 15; 50m from shore
		5	44	Qualitative 15; 50m from shore
		4	37	Qualitative 15; 50m from shore
		4	33	Qualitative 15; 50m from shore
		9	53	Qualitative 15; 50m from shore
		9	51	Qualitative 15; 50m from shore
		7	50	Qualitative 15; 50m from shore
		10	57	Qualitative 15; 50m from shore
		9	57	Qualitative 15; 50m from shore
		9	51	Qualitative 15; 50m from shore
		10	50	Qualitative 15; 50m from shore
		5	45	Qualitative 15; 50m from shore
		4	36	Qualitative 15; 50m from shore
		9	63	Transect 21; 30-40m from shore
		10	59	Transect 21; 30-40m from shore
		5	49	Transect 21; 30-40m from shore
		8	54	Transect 21; 30-40m from shore
		9	61	Transect 21; 30-40m from shore
		7	53	Transect 21; 30-40m from shore
		10	66	Transect 21; 30-40m from shore
		5	57	Transect 21; 30-40m from shore
		4	43	Transect 21; 30-40m from shore
		8	53	Transect 21; 30-40m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Quadrula nodulata	Wartyback	8	58	Transect 21; 30-40m from shore
		5	44	Transect 21; 30-40m from shore
		8	66	Transect 21; 40-50m from shore
		5	40	Transect 21; 40-50m from shore
		6	50	Transect 21; 40-50m from shore
		5	38	Transect 21; 40-50m from shore
		9	65	Transect 21; 40-50m from shore
		7	51	Transect 21; 40-50m from shore
		5	45	Transect 21; 40-50m from shore
		4	34	Transect 21; 40-50m from shore
		5	45	Transect 21; 40-50m from shore
		10	58	Transect 21; 50-60m from shore
		5	40	Transect 21; 50-60m from shore
		8	51	Transect 21; 50-60m from shore
		8	53	Transect 21; 50-60m from shore
		5	40	Transect 21; 50-60m from shore
		4	31	Transect 21; 50-60m from shore
		5	45	Transect 21; 50-60m from shore
		10	64	Transect 21; 70-80m from shore
		4	30	Transect 21; 70-80m from shore
		7	59	Transect 21; 90-100m from shore
		8	48	Transect 21; 90-100m from shore
		5	32	Transect 21; 90-100m from shore
		4	30	Transect 21; 90-100m from shore
		10	56	Transect 22; 30-40m from shore
		4	35	Transect 22; 60-70m from shore
		11	59	Transect 23; 40-50m from shore
		8	54	Transect 23; 40-50m from shore
		6	43	Transect 23; 50-60m from shore
		9	55	Transect 23; 50-60m from shore
		10	60	Transect 23; 60-70m from shore
		7	59	Transect 23; 60-70m from shore
		9	64	Transect 23; 60-70m from shore
		8	60	Transect 24; 30-40m from shore
		5	45	Transect 24; 50-60m from shore
		5	43	Transect 24; 50-60m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Quadrula nodulata	Wartyback	5	43	Transect 25; 40-50m from shore
		8	61	Transect 25; 40-50m from shore
		7	60	Transect 25; 40-50m from shore
		8	56	Transect 25; 40-50m from shore
		6	53	Transect 25; 40-50m from shore
		9	64	Transect 25; 50-60m from shore
		8	60	Transect 25; 50-60m from shore
		7	56	Transect 25; 50-60m from shore
		10	67	Transect 25; 50-60m from shore
		8	58	Transect 25; 50-60m from shore
		5	46	Transect 25; 50-60m from shore
		8	53	Transect 25; 60-70m from shore
		9	69	Transect 25; 60-70m from shore
		9	54	Transect 25; 60-70m from shore
		9	60	Transect 25; 60-70m from shore
		6	40	Transect 25; 60-70m from shore
		5	43	Transect 25; 60-70m from shore
		4	31	Transect 25; 60-70m from shore
		9	59	Transect 25; 70-80m from shore
		10	64	Transect 25; 70-80m from shore
		5	46	Transect 25; 70-80m from shore
		8	57	Transect 26; 70-80m from shore
		11	58	Transect 26; 70-80m from shore
		7	50	Transect 26; 70-80m from shore
		8	58	Transect 26; 70-80m from shore
		9	56	Transect 26; 80-90m from shore
		7	43	Transect 26; 80-90m from shore
		5	38	Transect 26; 80-90m from shore
		7	53	Transect 26; 90-100m from shore
		10	65	Transect 27; 40-50m from shore
		7	49	Transect 27; 40-50m from shore
		8	58	Transect 27; 40-50m from shore
		9	64	Transect 27; 40-50m from shore
		7	65	Transect 27; 40-50m from shore
		9	60	Transect 27; 50-60m from shore
		8	61	Transect 27; 50-60m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Quadrula nodulata	Wartyback	7	45	Transect 27; 50-60m from shore
		4	41	Transect 27; 50-60m from shore
		5	40	Transect 27; 50-60m from shore
		4	38	Transect 27; 50-60m from shore
		5	35	Transect 27; 50-60m from shore
		10	60	Transect 27; 60-70m from shore
		7	58	Transect 27; 60-70m from shore
		8	49	Transect 27; 60-70m from shore
		9	44	Transect 27; 60-70m from shore
		10	60	Transect 27; 60-70m from shore
		5	40	Transect 27; 60-70m from shore
		9	55	Transect 27; 70-80m from shore
		4	36	Transect 27; 70-80m from shore
		4	30	Transect 27; 80-90m from shore
		5	40	Transect 27; 90-100m from shore
		5	44	Transect 27; 90-100m from shore
		5	31	Transect 28; 50-60m from shore
		5	36	Transect 28; 50-60m from shore
		5	41	Transect 28; 60-70m from shore
		8	51	Transect 28; 80-90m from shore
		7	58	Transect 29; 20-30m from shore
		8	60	Transect 29; 40-50m from shore
		7	57	Transect 29; 80-90m from shore
		8	59	Transect 31; 40-50m from shore
		8	58	Transect 31; 40-50m from shore
		9	65	Transect 31; 40-50m from shore
		7	48	Transect 31; 40-50m from shore
		5	38	Transect 31; 40-50m from shore
		10	67	Transect 31; 50-60m from shore
		9	58	Transect 31; 50-60m from shore
		8	57	Transect 31; 50-60m from shore
		7	50	Transect 31; 50-60m from shore
		6	45	Transect 31; 50-60m from shore
		8	60	Transect 31; 70-80m from shore
		7	47	Transect 31; 70-80m from shore
		8	57	Transect 32; 40-50m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Quadrula nodulata	Wartyback	9	54	Transect 32; 40-50m from shore
		5	46	Transect 32; 40-50m from shore
		7	55	Transect 32; 40-50m from shore
		9	60	Transect 32; 50-60m from shore
		9	57	Transect 32; 50-60m from shore
		7	54	Transect 32; 50-60m from shore
		8	59	Transect 32; 50-60m from shore
		5	42	Transect 32; 50-60m from shore
		6	46	Transect 32; 50-60m from shore
		5	38	Transect 32; 50-60m from shore
		5	38	Transect 32; 50-60m from shore
		10	50	Transect 32; 60-70m from shore
		8	51	Transect 32; 60-70m from shore
		5	37	Transect 32; 60-70m from shore
		5	32	Transect 32; 60-70m from shore
		7	42	Transect 32; 90-100m from shore
		9	62	Transect 33; 40-50m from shore
		8	58	Transect 33; 40-50m from shore
		9	55	Transect 33; 40-50m from shore
		8	45	Transect 33; 40-50m from shore
		9	62	Transect 33; 40-50m from shore
		8	53	Transect 33; 40-50m from shore
		8	55	Transect 33; 40-50m from shore
		10	60	Transect 33; 40-50m from shore
		7	47	Transect 33; 40-50m from shore
		8	55	Transect 33; 40-50m from shore
		3	25	Transect 33; 40-50m from shore
		9	63	Transect 33; 50-60m from shore
		9	57	Transect 33; 50-60m from shore
		7	58	Transect 33; 50-60m from shore
		9	54	Transect 33; 50-60m from shore
		8	47	Transect 33; 50-60m from shore
		5	38	Transect 33; 50-60m from shore
		8	50	Transect 33; 50-60m from shore
		7	57	Transect 33; 60-70m from shore
		7	50	Transect 33; 60-70m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Quadrula nodulata	Wartyback	5	41	Transect 33; 60-70m from shore
		4	35	Transect 33; 60-70m from shore
		9	55	Transect 33; 70-80m from shore
		8	53	Transect 33; 90-100m from shore
		5	45	Transect 34; 30-40m from shore
		5	38	Transect 34; 30-40m from shore
		6	49	Transect 34; 40-50m from shore
		8	65	Transect 34; 60-70m from shore
		10	67	Transect 34; 60-70m from shore
		10	63	Transect 34; 70-80m from shore
		6	58	Transect 34; 80-90m from shore
		10	60	Transect 34; 80-90m from shore
		4	30	Transect 34; 80-90m from shore
		7	57	Qualitative 16; 55m from shore
		8	59	Qualitative 16; 55m from shore
		8	60	Qualitative 16; 55m from shore
		9	58	Qualitative 16; 55m from shore
		8	54	Qualitative 16; 55m from shore
		8	50	Qualitative 16; 55m from shore
		5	45	Qualitative 16; 55m from shore
		9	55	Qualitative 16; 55m from shore
		6	45	Qualitative 16; 55m from shore
		6	46	Qualitative 16; 55m from shore
		8	60	Qualitative 16; 55m from shore
		10	59	Qualitative 16; 55m from shore
		9	60	Qualitative 16; 55m from shore
		4	39	Qualitative 16; 55m from shore
		10	52	Qualitative 16; 55m from shore
		8	57	Qualitative 16; 55m from shore
		9	60	Qualitative 16; 55m from shore
		10	56	Qualitative 16; 55m from shore
		7	57	Qualitative 16; 55m from shore
		11	65	Qualitative 16; 55m from shore
		10	54	Qualitative 17; 50m from shore
		9	62	Qualitative 17; 50m from shore
		7	55	Qualitative 17; 50m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Quadrula nodulata	Wartyback	7	52	Qualitative 17; 50m from shore
		8	55	Qualitative 17; 50m from shore
		8	60	Qualitative 17; 50m from shore
		7	47	Qualitative 17; 50m from shore
		7	47	Qualitative 17; 50m from shore
		8	50	Qualitative 17; 50m from shore
		10	64	Qualitative 17; 50m from shore
		11	70	Qualitative 17; 50m from shore
		8	51	Qualitative 17; 50m from shore
		7	48	Qualitative 17; 50m from shore
		4	33	Qualitative 17; 50m from shore
		4	28	Qualitative 17; 50m from shore
		5	41	Qualitative 17; 50m from shore
		6	46	Qualitative 17; 50m from shore
		8	61	Transect 35; 30-40m from shore
		4	32	Transect 35; 30-40m from shore
		4	37	Transect 35; 30-40m from shore
		4	45	Transect 35; 30-40m from shore
		5	40	Transect 35; 30-40m from shore
		8	53	Transect 35; 50-60m from shore
		9	53	Transect 35; 60-70m from shore
		7	47	Transect 35; 70-80m from shore
		10	62	Transect 36; 20-30m from shore
		8	50	Transect 36; 30-40m from shore
		9	53	Transect 36; 30-40m from shore
		10	60	Transect 36; 40-50m from shore
		7	59	Qualitative 18; 35m from shore
		9	60	Qualitative 18; 35m from shore
		10	58	Qualitative 18; 35m from shore
		9	53	Qualitative 18; 35m from shore
		8	51	Qualitative 18; 35m from shore
		5	48	Qualitative 18; 35m from shore
		4	42	Qualitative 18; 35m from shore
		5	47	Qualitative 18; 35m from shore
		7	60	Qualitative 18; 35m from shore
		10	59	Transect 37; 40-50m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Quadrula nodulata	Wartyback	7	50	Transect 37; 40-50m from shore
		7	55	Transect 37; 40-50m from shore
		8	48	Transect 37; 50-60m from shore
		9	65	Transect 37; 50-60m from shore
		9	61	Transect 37; 50-60m from shore
		8	58	Transect 37; 50-60m from shore
		9	45	Transect 37; 50-60m from shore
		8	56	Transect 37; 50-60m from shore
		4	37	Transect 37; 50-60m from shore
		10	52	Transect 37; 50-60m from shore
		10	56	Transect 37; 50-60m from shore
		8	67	Transect 37; 60-70m from shore
		7	53	Transect 37; 60-70m from shore
		9	60	Transect 37; 60-70m from shore
		9	63	Transect 37; 70-80m from shore
		9	63	Transect 37; 70-80m from shore
		8	58	Transect 38; 60-70m from shore
		8	66	Transect 38; 60-70m from shore
		5	43	Transect 38; 80-90m from shore
		6	49	Transect 38; 80-90m from shore
		8	60	Transect 40; 50-60m from shore
		6	48	Transect 40; 50-60m from shore
		5	39	Transect 40; 60-70m from shore
		5	42	Transect 40; 70-80m from shore
		5	44	Transect 40; 70-80m from shore
		5	45	Transect 40; 70-80m from shore
		5	44	Transect 40; 70-80m from shore
		6	45	Transect 40; 70-80m from shore
		6	39	Transect 40; 70-80m from shore
		5	44	Transect 40; 70-80m from shore
		4	40	Transect 40; 70-80m from shore
		8	57	Transect 40; 70-80m from shore
		10	53	Transect 40; 70-80m from shore
		4	32	Transect 40; 70-80m from shore
		7	55	Transect 40; 70-80m from shore
		4	37	Transect 40; 70-80m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Quadrula nodulata	Wartyback	4	27	Transect 40; 70-80m from shore
		10	62	Transect 40; 70-80m from shore
		10	41	Transect 40; 80-90m from shore
		5	36	Transect 40; 80-90m from shore
		5	30	Transect 40; 80-90m from shore
		6	39	Transect 40; 80-90m from shore
		7	40	Transect 40; 80-90m from shore
		5	36	Transect 40; 80-90m from shore
		5	41	Transect 40; 80-90m from shore
		5	35	Transect 40; 80-90m from shore
		6	46	Transect 40; 80-90m from shore
		9	43	Transect 40; 80-90m from shore
		5	38	Transect 40; 90-100m from shore
		4	40	Transect 44; 30-40m from shore
		8	60	Qualitative 19; 45m from shore
		5	38	Qualitative 19; 45m from shore
		5	48	Qualitative 19; 45m from shore
		5	43	Qualitative 19; 45m from shore
		4	38	Qualitative 19; 45m from shore
		8	49	Qualitative 20; 60m from shore
		10	55	Qualitative 20; 60m from shore
		9	56	Qualitative 20; 60m from shore
		9	48	Qualitative 20; 60m from shore
		5	40	Qualitative 20; 60m from shore
		5	45	Qualitative 20; 60m from shore
		4	37	Qualitative 20; 60m from shore
		8	50	Qualitative 20; 60m from shore
		9	60	Qualitative 20; 60m from shore
		4	34	Qualitative 21; 75m from shore
		9	59	Qualitative 21; 75m from shore
		9	65	Qualitative 21; 75m from shore
		8	55	Qualitative 21; 75m from shore
		5	44	Qualitative 21; 75m from shore
		6	49	Qualitative 21; 75m from shore
Quadrula pustulosa	Pimpleback	6	43.75	Transect 5; 30-40m from shore
		8	41.62	Transect 7; 70-80m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Quadrula pustulosa	Pimpleback	8	57	Transect 9; 80-90m from shore
		11	54	Qualitative 7; 50m from shore
		5	40	Transect 17; 40-50m from shore
		8	48	Transect 17; 50-60m from shore
		12	70	Transect 40; 70-80m from shore
		11	65	Transect 40; 70-80m from shore
		10	55	Transect 40; 70-80m from shore
		9	54	Transect 40; 80-90m from shore
		13	55	Transect 40; 80-90m from shore
		9	34	Transect 40; 80-90m from shore
		9	51	Qualitative 20; 60m from shore
Quadrula quadrula	Mapleleaf	4	41	Transect 2; 50-60m from shore
		10	69.12	Transect 2; 90-100m from shore
		9	74.66	Transect 3; 80-90m from shore
		8	70.93	Transect 3; 80-90m from shore
		7	57.15	Transect 3; 80-90m from shore
		8	51.97	Transect 3; 80-90m from shore
		6	53.92	Transect 4; 70-80m from shore
		9	57.33	Transect 4; 70-80m from shore
		8	61.49	Qualitative 3; 80m from shore
		9	66.65	Qualitative 3; 80m from shore
		8	67.77	Transect 5; 40-50m from shore
		7	62.53	Transect 6; 50-60m from shore
		5	45.08	Transect 7; 70-80m from shore
		9	58.22	Transect 7; 70-80m from shore
		10	82.47	Transect 7; 70-80m from shore
		10	62.04	Transect 7; 70-80m from shore
		9	59.4	Transect 7; 70-80m from shore
		4	37.5	Transect 7; 80-90m from shore
		8	53.18	Qualitative 4; 70m from shore
		9	61.28	Qualitative 4; 70m from shore
		11	69	Transect 8; 40-50m from shore
		8	60	Transect 8; 40-50m from shore
		5	42	Transect 8; 40-50m from shore
		4	41	Transect 8; 40-50m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
		7	62	Transect 8; 40-50m from shore
		8	63	Transect 8; 40-50m from shore
		9	64	Transect 8; 40-50m from shore
		6	58	Transect 9; 40-50m from shore
		9	63	Transect 9; 50-60m from shore
		6	65	Transect 9; 50-60m from shore
		8	58	Transect 9; 70-80m from shore
		9	81	Transect 11; 60-70m from shore
		6	47	Transect 11; 60-70m from shore
		9	85	Transect 13; 30-40m from shore
		8	59	Transect 13; 50-60m from shore
		9	68	Transect 13; 50-60m from shore
		9	71	Transect 13; 50-60m from shore
		7	55	Transect 13; 50-60m from shore
		6	52	Transect 13; 50-60m from shore
		7	58	Transect 14; 50-60m from shore
		6	48	Transect 14; 70-80m from shore
Quadrula quadrula	Mapleleaf	9	73	Qualitative 5; 60m from shore
		8	64	Qualitative 5; 60m from shore
		7	55	Qualitative 5; 60m from shore
		8	67	Qualitative 5; 60m from shore
		7	64	Qualitative 5; 60m from shore
		9	67	Qualitative 6; 50m from shore
		6	53	Qualitative 6; 50m from shore
		9	57	Transect 15; 50-60m from shore
		6	58	Transect 16; 90-100m from shore
		4	43	Transect 16; 90-100m from shore
		11	60	Qualitative 7; 50m from shore
		6	49	Qualitative 7; 50m from shore
		7	59	Qualitative 8; 60m from shore
		12	80	Transect 17; 40-50m from shore
		9	73	Transect 17; 40-50m from shore
		10	70	Transect 17; 40-50m from shore
		12	76	Transect 17; 40-50m from shore
		10	78	Transect 17; 40-50m from shore
		8	61	Transect 17; 40-50m from shore

Table 9. Continued

Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Quadrula quadrula	Mapleleaf	9	77	Transect 17; 40-50m from shore
		5	42	Transect 17; 40-50m from shore
		5	40	Transect 17; 40-50m from shore
		3	28	Transect 17; 40-50m from shore
		6	46	Transect 17; 40-50m from shore
		7	54	Transect 17; 40-50m from shore
		5	50	Transect 17; 40-50m from shore
		5	47	Transect 17; 90-100m from shore
		4	42	Transect 18; 40-50m from shore
		5	43	Transect 18; 50-60m from shore
		5	40	Transect 18; 70-80m from shore
		9	80	Qualitative 10; 60m from shore
		9	72	Qualitative 10; 60m from shore
		8	58	Qualitative 10; 60m from shore
		7	57	Qualitative 10; 60m from shore
		8	55	Qualitative 10; 60m from shore
		7	61	Qualitative 10; 60m from shore
		5	50	Qualitative 10; 60m from shore
		6	54	Qualitative 11; 65m from shore
		4	34	Transect 19; 90-100m from shore
		6	55	Qualitative 15; 50m from shore
		5	42	Qualitative 15; 50m from shore
		7	54	Transect 24; 30-40m from shore
		8	65	Transect 25; 40-50m from shore
		8	61	Transect 25; 40-50m from shore
		9	68	Transect 25; 40-50m from shore
		6	47	Transect 32; 50-60m from shore
		10	72	Transect 32; 50-60m from shore
		9	60	Transect 33; 40-50m from shore
		9	71	Transect 36; 30-40m from shore
		9	87	Qualitative 18; 35m from shore
		7	59	Qualitative 18; 35m from shore
		3	29	Qualitative 18; 35m from shore
		7	65	Transect 37; 40-50m from shore
		9	65	Transect 37; 50-60m from shore
		7	65	Transect 37; 50-60m from shore

Table 9. Continued

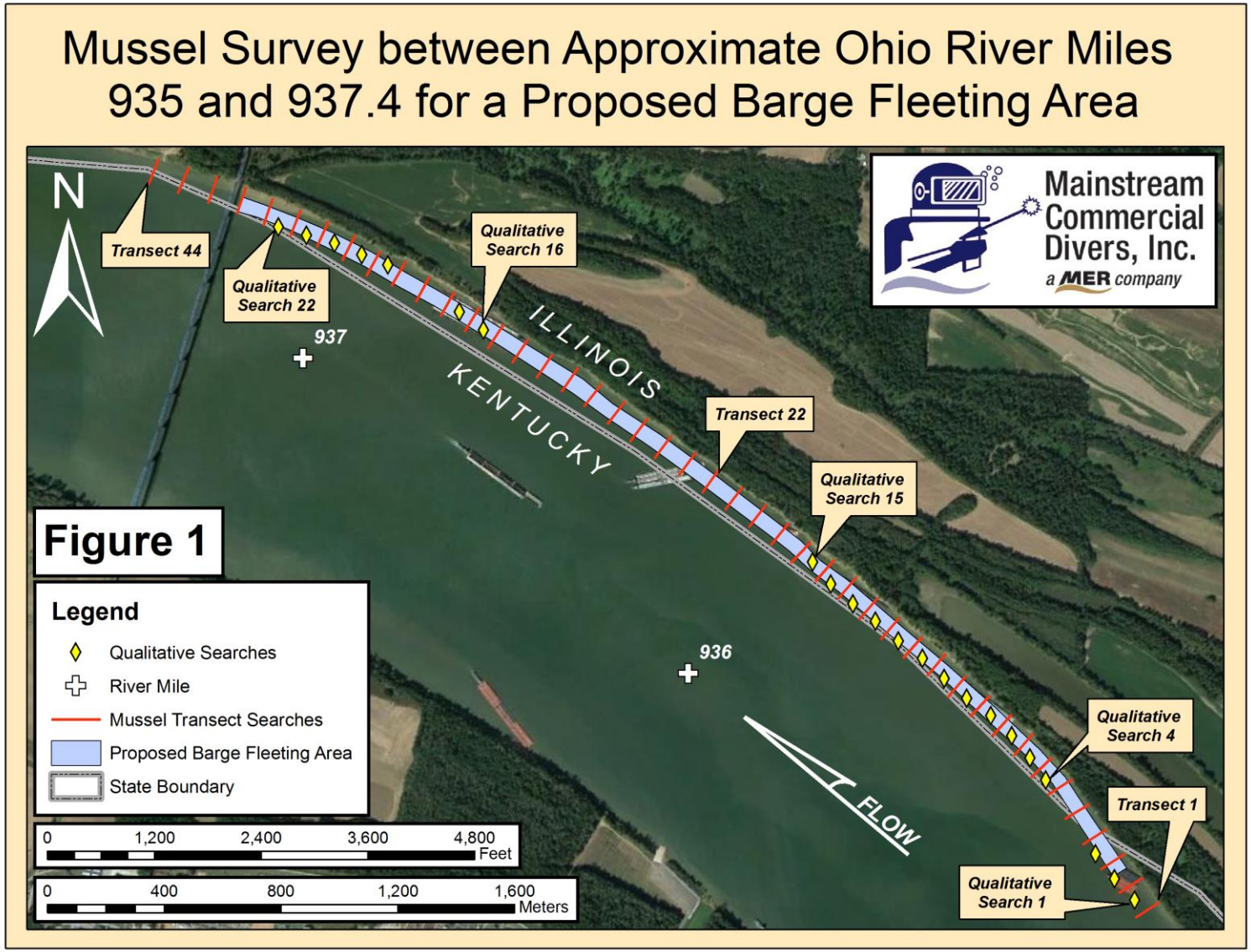
Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
		8	60	Transect 37; 50-60m from shore
		6	50	Transect 37; 50-60m from shore
		7	55	Transect 37; 50-60m from shore
		8	47	Transect 37; 50-60m from shore
		8	71	Transect 37; 60-70m from shore
		9	65	Transect 37; 60-70m from shore
		8	60	Transect 38; 50-60m from shore
		8	82	Transect 38; 50-60m from shore
		9	77	Transect 38; 50-60m from shore
		8	68	Transect 38; 60-70m from shore
		7	60	Transect 38; 60-70m from shore
		9	73	Transect 38; 60-70m from shore
		9	61	Transect 38; 60-70m from shore
		12	81	Transect 38; 60-70m from shore
		8	71	Transect 38; 60-70m from shore
		8	59	Transect 38; 80-90m from shore
		7	59	Transect 39; 50-60m from shore
		5	42	Transect 40; 40-50m from shore
Quadrula quadrula	Mapleleaf	8	70	Transect 40; 50-60m from shore
		9	68	Transect 40; 50-60m from shore
		9	63	Transect 40; 50-60m from shore
		10	58	Transect 40; 50-60m from shore
		11	82	Transect 40; 50-60m from shore
		7	63	Transect 40; 50-60m from shore
		6	56	Transect 40; 50-60m from shore
		6	52	Transect 40; 50-60m from shore
		12	97	Transect 40; 70-80m from shore
		15	72	Transect 40; 70-80m from shore
		9	80	Transect 40; 70-80m from shore
		12	83	Transect 40; 70-80m from shore
		6	52	Transect 40; 70-80m from shore
		10	73	Transect 40; 70-80m from shore
		6	52	Transect 40; 70-80m from shore
		12	95	Transect 40; 70-80m from shore
		13	75	Transect 40; 70-80m from shore
		10	65	Transect 40; 70-80m from shore
		15	99	Transect 40; 70-80m from shore

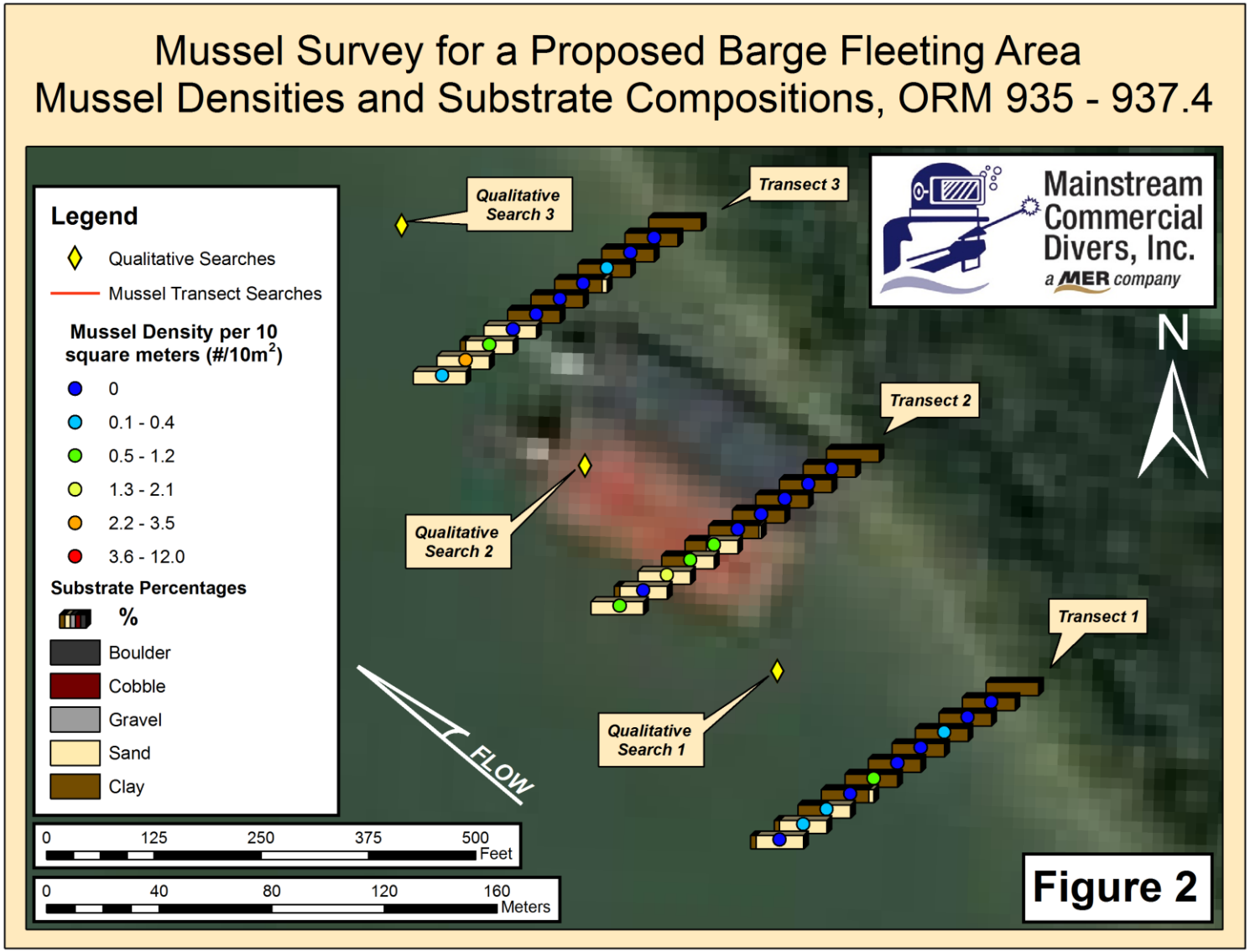
Table 9. Continued

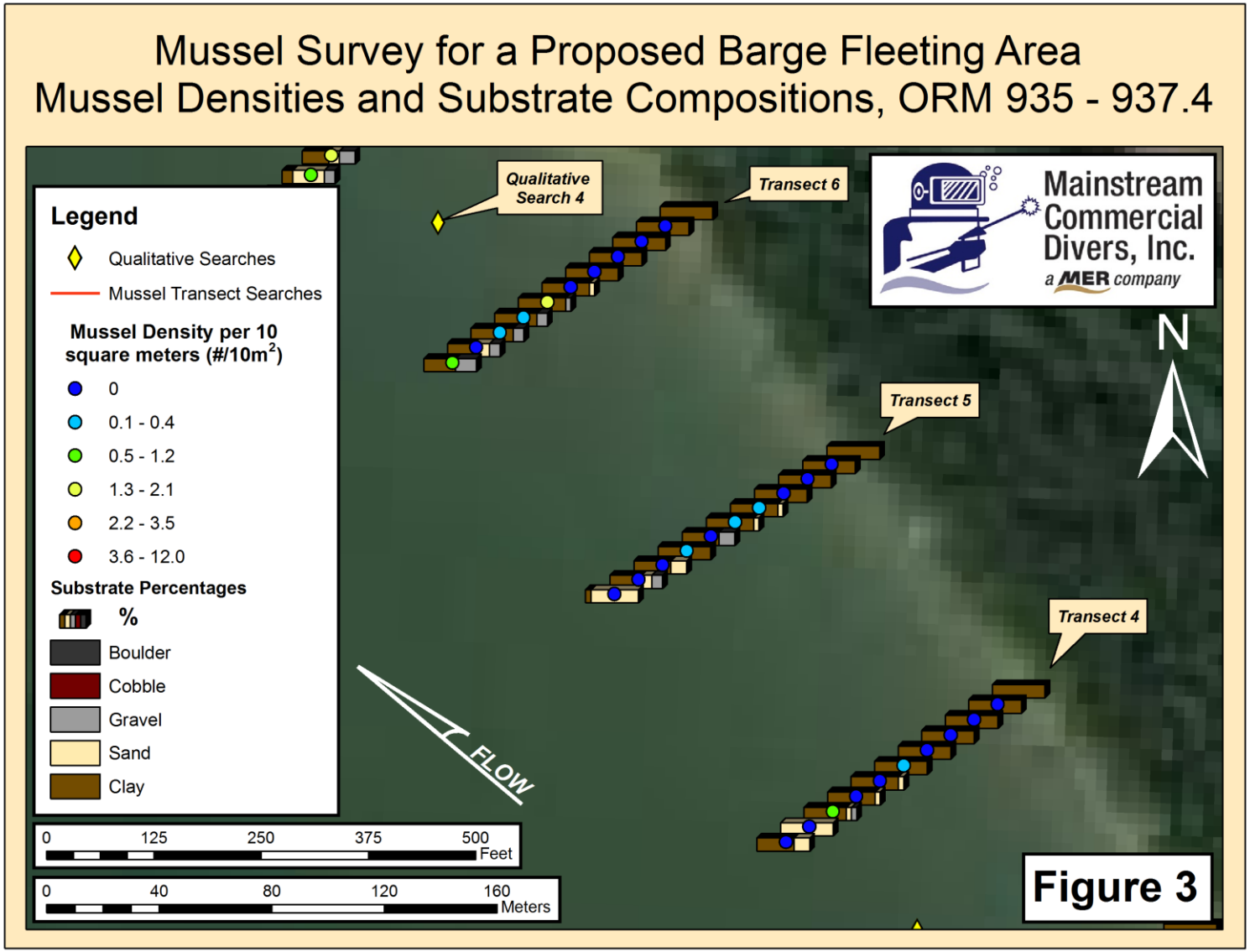
Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
		17	92	Transect 40; 70-80m from shore
		9	72	Transect 40; 70-80m from shore
		5	45	Transect 40; 70-80m from shore
		8	60	Transect 40; 70-80m from shore
		9	66	Transect 40; 70-80m from shore
		9	60	Transect 40; 70-80m from shore
		10	63	Transect 40; 70-80m from shore
		9	60	Transect 40; 70-80m from shore
		13	85	Transect 40; 80-90m from shore
		7	47	Transect 40; 80-90m from shore
		6	49	Transect 40; 80-90m from shore
		9	58	Transect 40; 80-90m from shore
		7	71	Transect 40; 80-90m from shore
		14	84	Transect 40; 80-90m from shore
		13	88	Transect 40; 80-90m from shore
		8	68	Transect 40; 80-90m from shore
		12	90	Transect 40; 80-90m from shore
		11	60	Transect 40; 80-90m from shore
Quadrula quadrula	Mapleleaf	5	38	Transect 40; 80-90m from shore
		9	69	Transect 40; 80-90m from shore
		14	86	Transect 40; 80-90m from shore
		4	31	Transect 40; 80-90m from shore
		10	67	Transect 40; 80-90m from shore
		8	54	Transect 40; 80-90m from shore
		12	93	Transect 40; 80-90m from shore
		9	59	Transect 40; 90-100m from shore
		12	91	Transect 40; 90-100m from shore
		13	87	Transect 40; 90-100m from shore
		12	87	Transect 40; 90-100m from shore
		8	51	Transect 40; 90-100m from shore
		9	68	Transect 41; 40-50m from shore
		10	69	Transect 41; 60-70m from shore
		9	66	Transect 42; 80-90m from shore
		9	79	Transect 43; 60-70m from shore
		5	50	Transect 43; 80-90m from shore
		9	72	Qualitative 19; 45m from shore
		8	67	Qualitative 19; 45m from shore

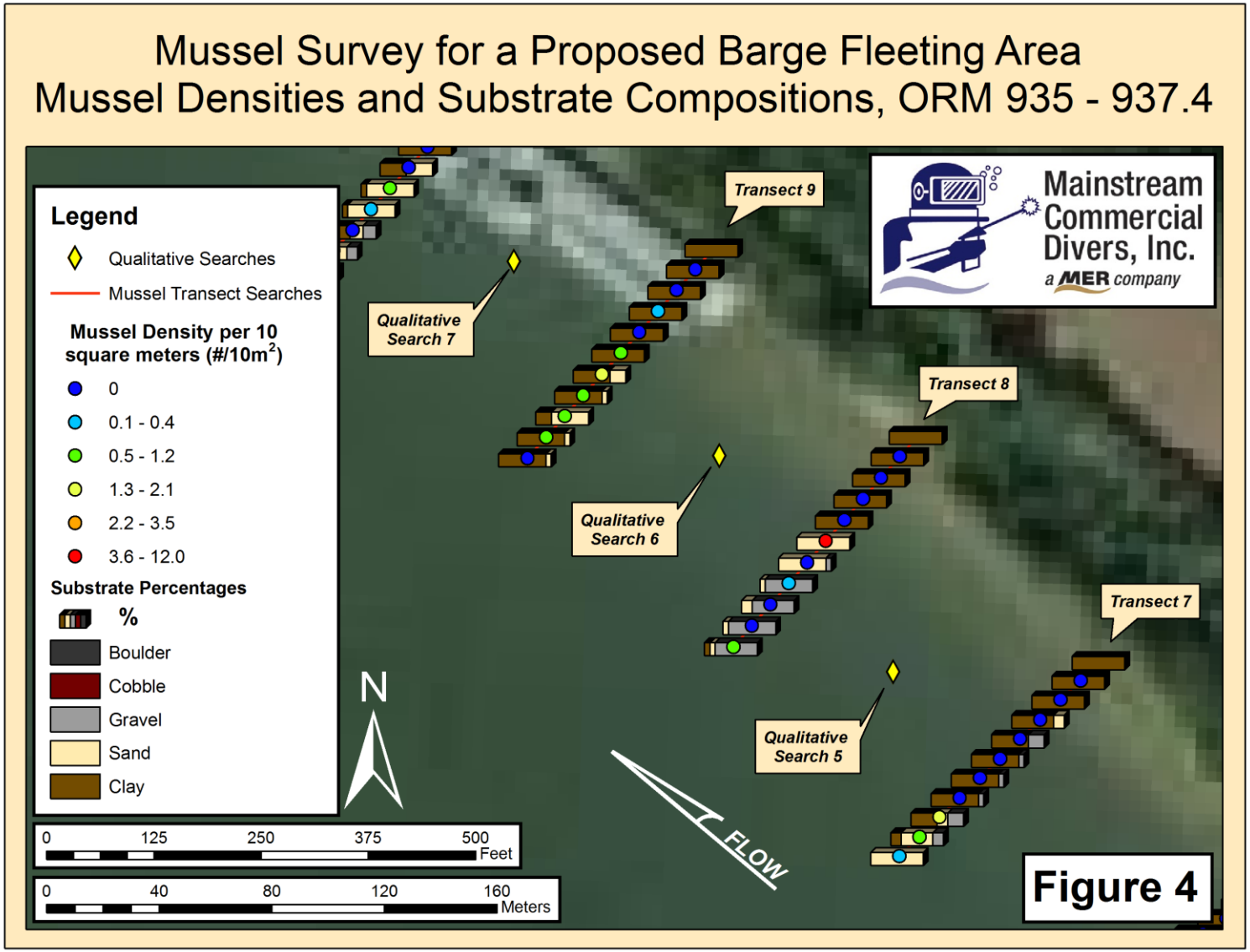
Table 9. Continued

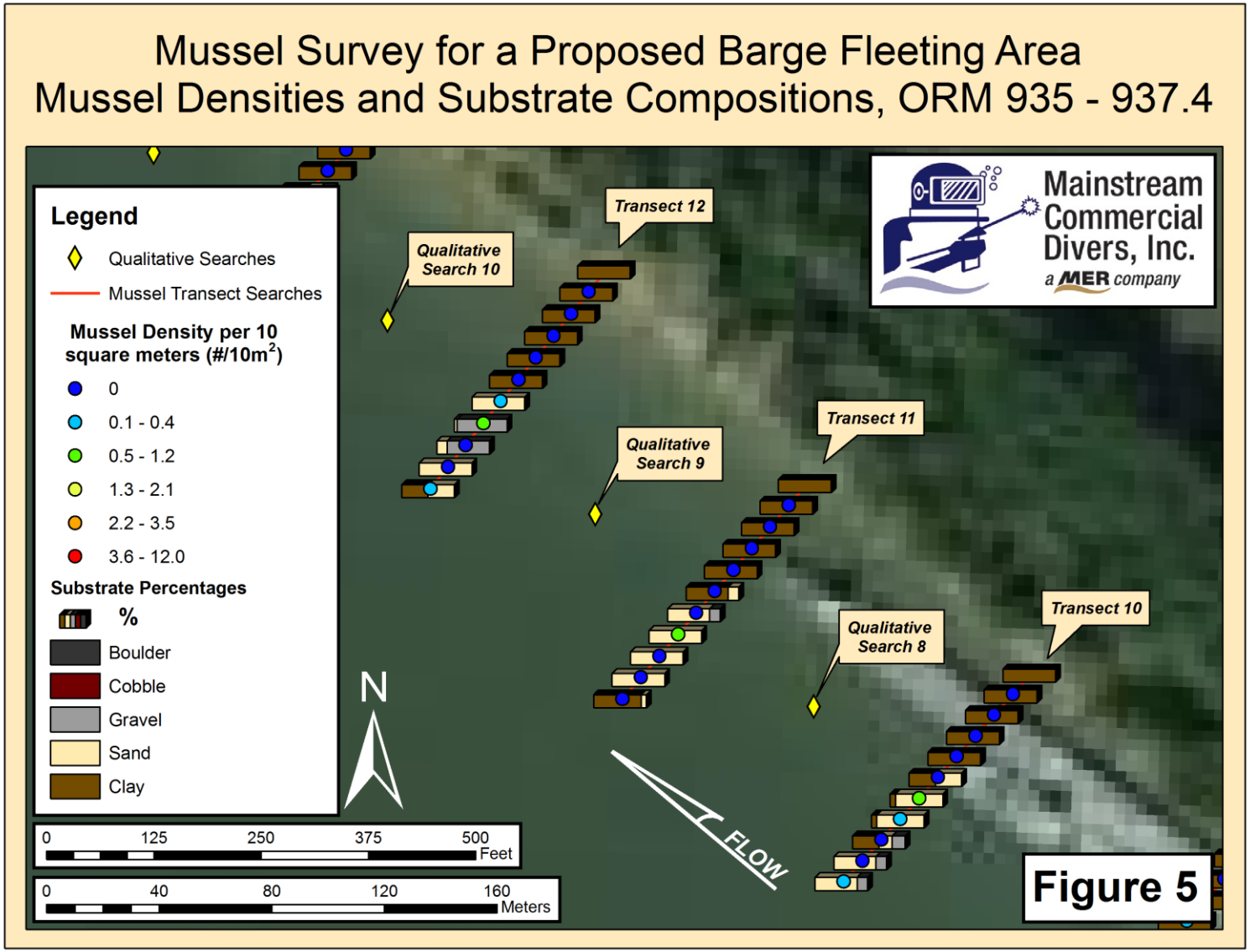
Scientific Name	Common Name	Age (years)	Length (mm)	Location Found
Quadrula quadrula	Mapleleaf	9	66	Qualitative 20; 60m from shore
		9	64	Qualitative 20; 60m from shore
		10	69	Qualitative 20; 60m from shore
		8	58	Qualitative 20; 60m from shore
		9	63	Qualitative 20; 60m from shore
		10	78	Qualitative 20; 60m from shore
		11	68	Qualitative 20; 60m from shore
		7	65	Qualitative 20; 60m from shore
		9	62	Qualitative 20; 60m from shore
		9	72	Qualitative 20; 60m from shore
		10	78	Qualitative 20; 60m from shore
		8	64	Qualitative 20; 60m from shore
		11	79	Qualitative 21; 75m from shore
		8	60	Qualitative 21; 75m from shore
		9	58	Qualitative 21; 75m from shore
		14	79	Qualitative 21; 75m from shore
		9	84	Qualitative 21; 75m from shore
		7	54	Qualitative 21; 75m from shore
		10	69	Qualitative 21; 75m from shore
		12	96	Qualitative 21; 75m from shore
		10	62	Qualitative 21; 75m from shore
		8	70	Qualitative 21; 75m from shore
		10	75	Qualitative 21; 75m from shore
		10	68	Qualitative 21; 75m from shore
		7	63	Qualitative 21; 75m from shore
		8	65	Qualitative 21; 75m from shore
		8	60	Qualitative 21; 75m from shore
		8	58	Qualitative 21; 75m from shore
		11	77	Qualitative 21; 75m from shore
		10	91	Qualitative 22; 85m from shore
		9	76	Qualitative 22; 85m from shore
		11	85	Qualitative 22; 85m from shore
Truncilla truncata	Deertoe	7	49	Transect 40; 80-90m from shore

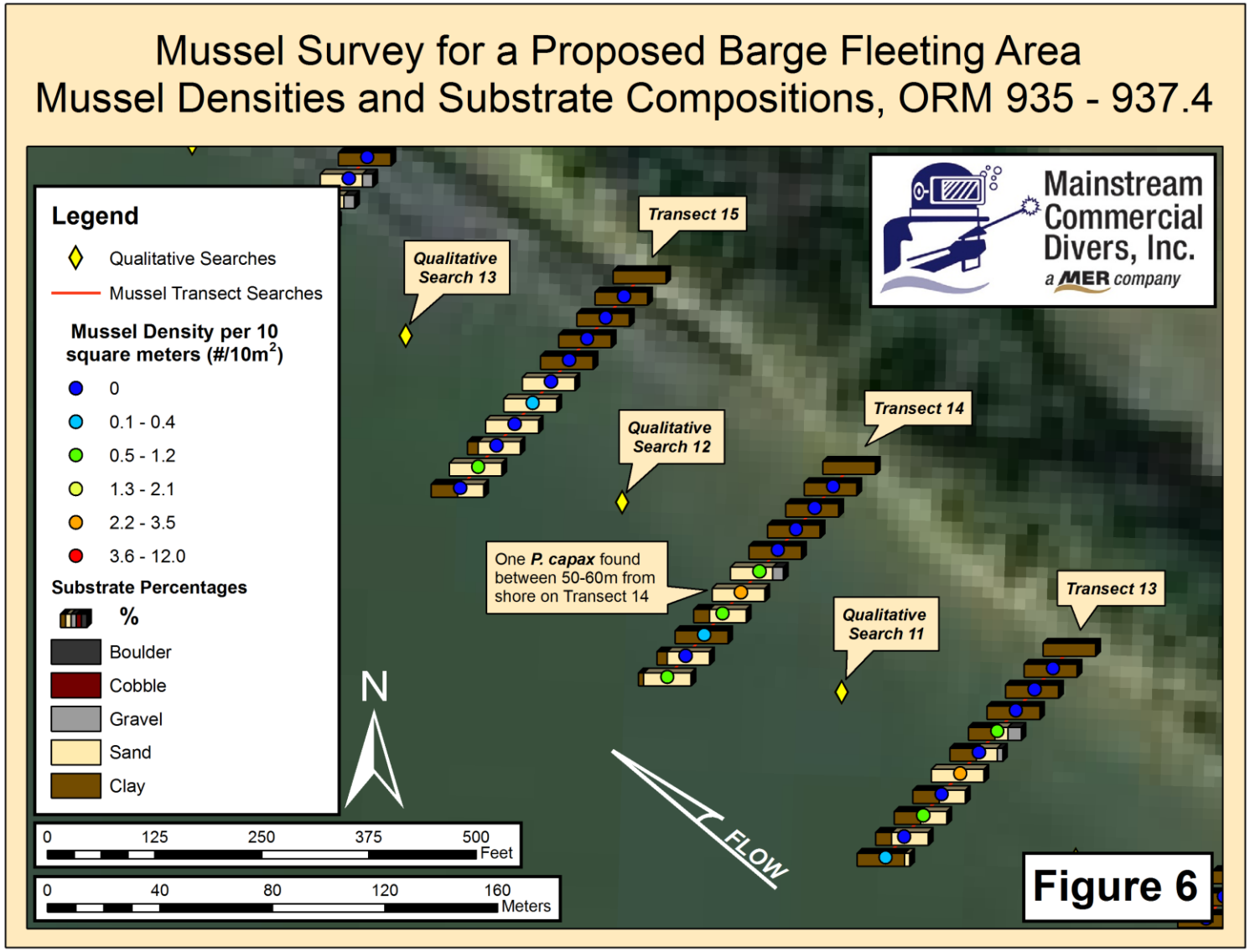

Mussel Survey between Approximate Ohio River Miles 935 and 937.4 for a Proposed Barge Fleeting Area
N
Transect 44
Qualitative Search 22
Qualitative Search 16
937
ILLINOIS
KENTUCKY
Transect 22
Qualitative Search 15
936
Qualitative Search 4
Transect 1
Qualitative Search 1
FLOW
Mainstream Commercial Divers, Inc.
a MER company
Figure 1
Legend
Qualitative Searches
River Mile
Mussel Transect Searches
Proposed Barge Fleeting Area
State Boundary
0 1,200 2,400 3,600 4,800 Feet
0 400 800 1,200 1,600 Meters

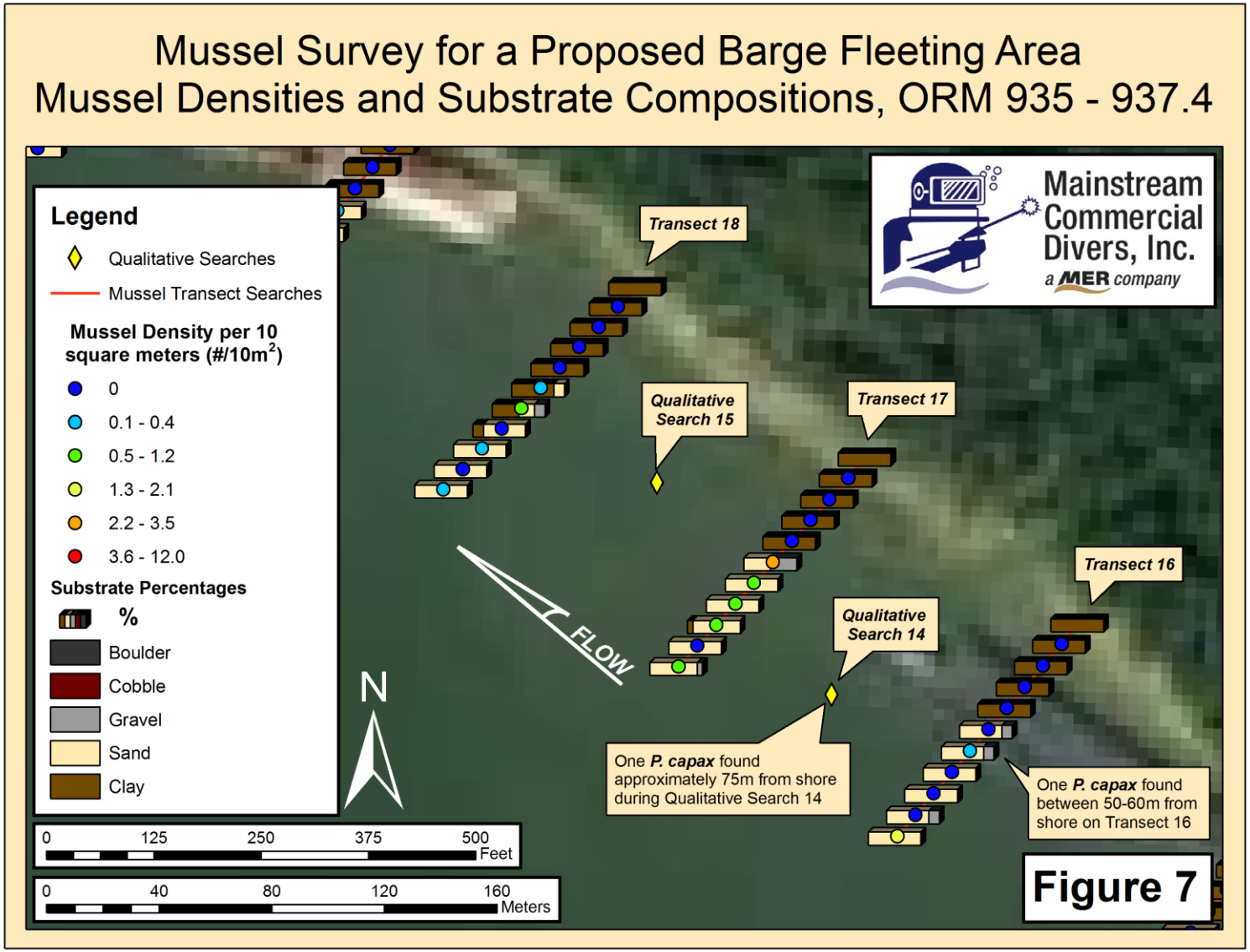

Mussel Survey for a Proposed Barge Fleeting Area
Mussel Densities and Substrate Compositions, ORM 935 - 937.4
Legend
Qualitative Searches
Mussel Transect Searches
Mussel Density per 10 square meters (#/10m²)
0
0.1 - 0.4
0.5 - 1.2
1.3 - 2.1
2.2 - 3.5
3.6 - 12.0
Substrate Percentages
%
Boulder
Cobble
Gravel
Sand
Clay
Qualitative Search 3
Transect 3
Transect 2
Qualitative Search 2
Transect 1
Qualitative Search 1
FLOW
Mainstream Commercial Divers, Inc.
a MER company
N
0 125 250 375 500 Feet
0 40 80 120 160 Meters
Figure 2

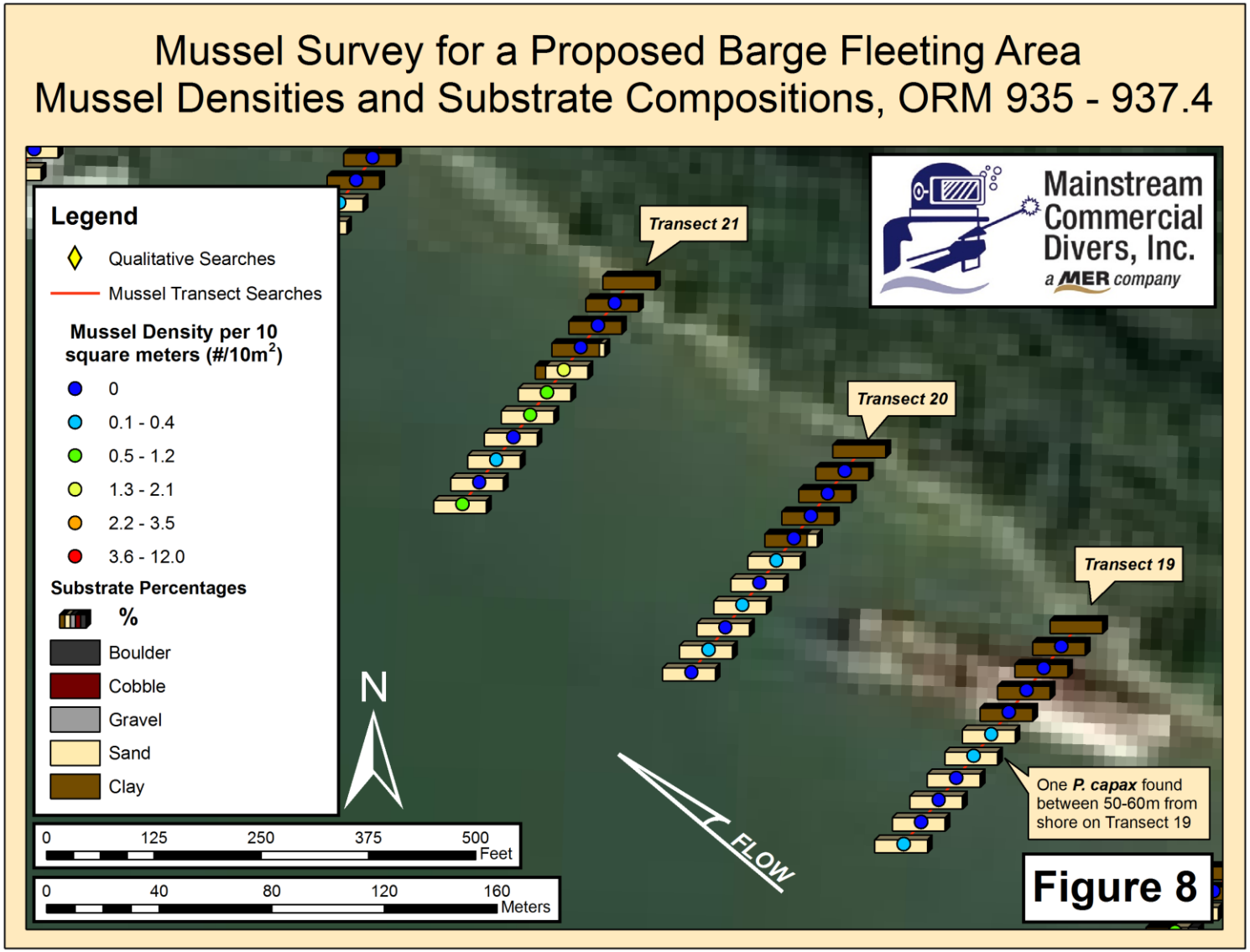

Mussel Survey for a Proposed Barge Fleeting Area
Mussel Densities and Substrate Compositions, ORM 935 - 937.4
Legend
Qualitative Searches
Mussel Transect Searches
Mussel Density per 10 square meters (#/10m²)
0
0.1 - 0.4
0.5 - 1.2
1.3 - 2.1
2.2 - 3.5
3.6 - 12.0
Substrate Percentages
%
Boulder
Cobble
Gravel
Sand
Clay
Qualitative Search 4
Transect 6
Transect 5
Transect 4
FLOW
Mainstream Commercial Divers, Inc.
a MER company
N
0 125 250 375 500 Feet
0 40 80 120 160 Meters
Figure 3

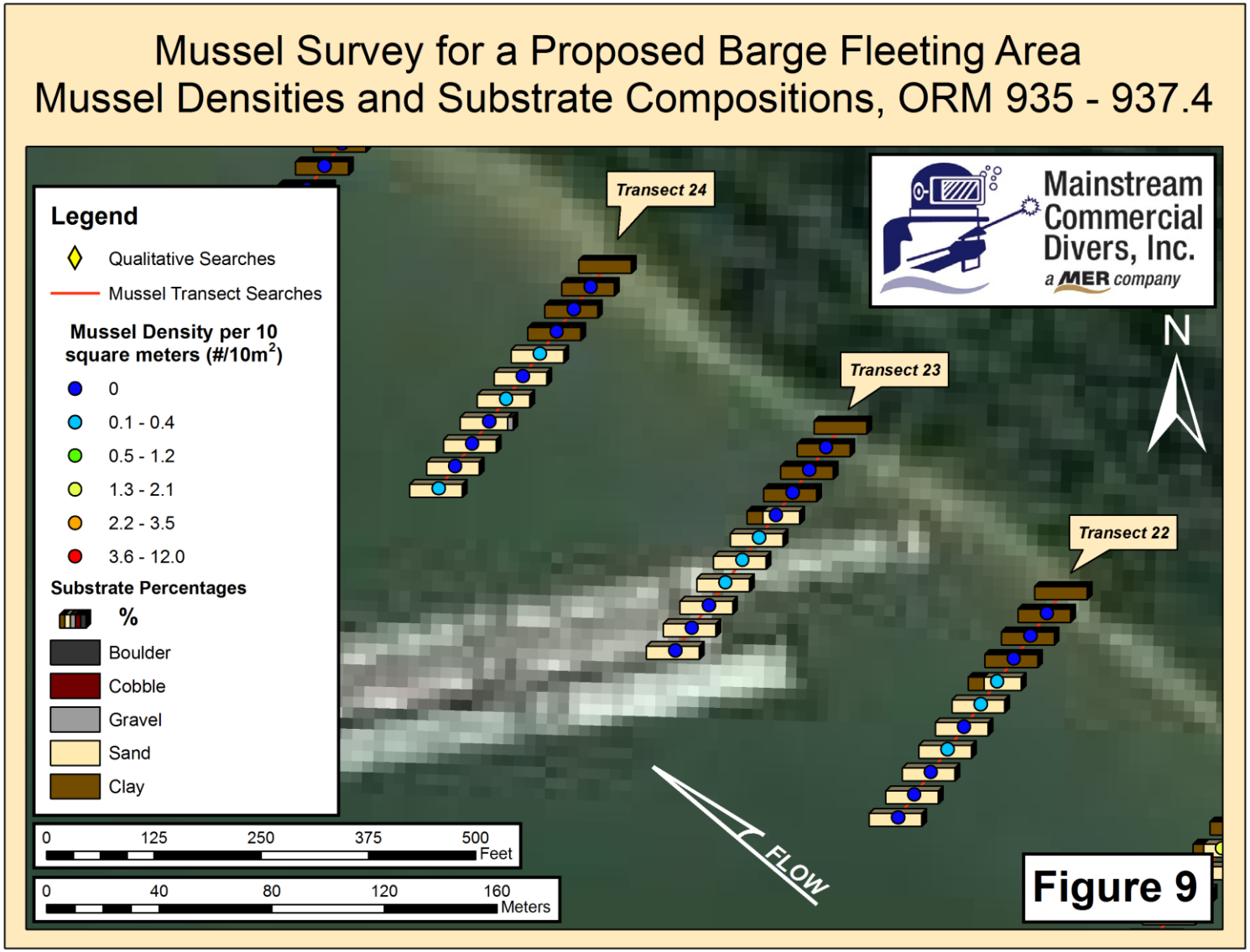

Mussel Survey for a Proposed Barge Fleeting Area
Mussel Densities and Substrate Compositions, ORM 935 - 937.4
Legend
Qualitative Searches
Mussel Transect Searches
Mussel Density per 10 square meters (#/10m2)
0
0.1 - 0.4
0.5 - 1.2
1.3 - 2.1
2.2 - 3.5
3.6 - 12.0
Substrate Percentages
%
Boulder
Cobble
Gravel
Sand
Clay
Transect 9
Transect 8
Transect 7
Qualitative Search 7
Qualitative Search 6
Qualitative Search 5
Mainstream Commercial Divers, Inc.
a MER company
N
FLOW
0 125 250 375 500 Feet
0 40 80 120 160 Meters
Figure 4

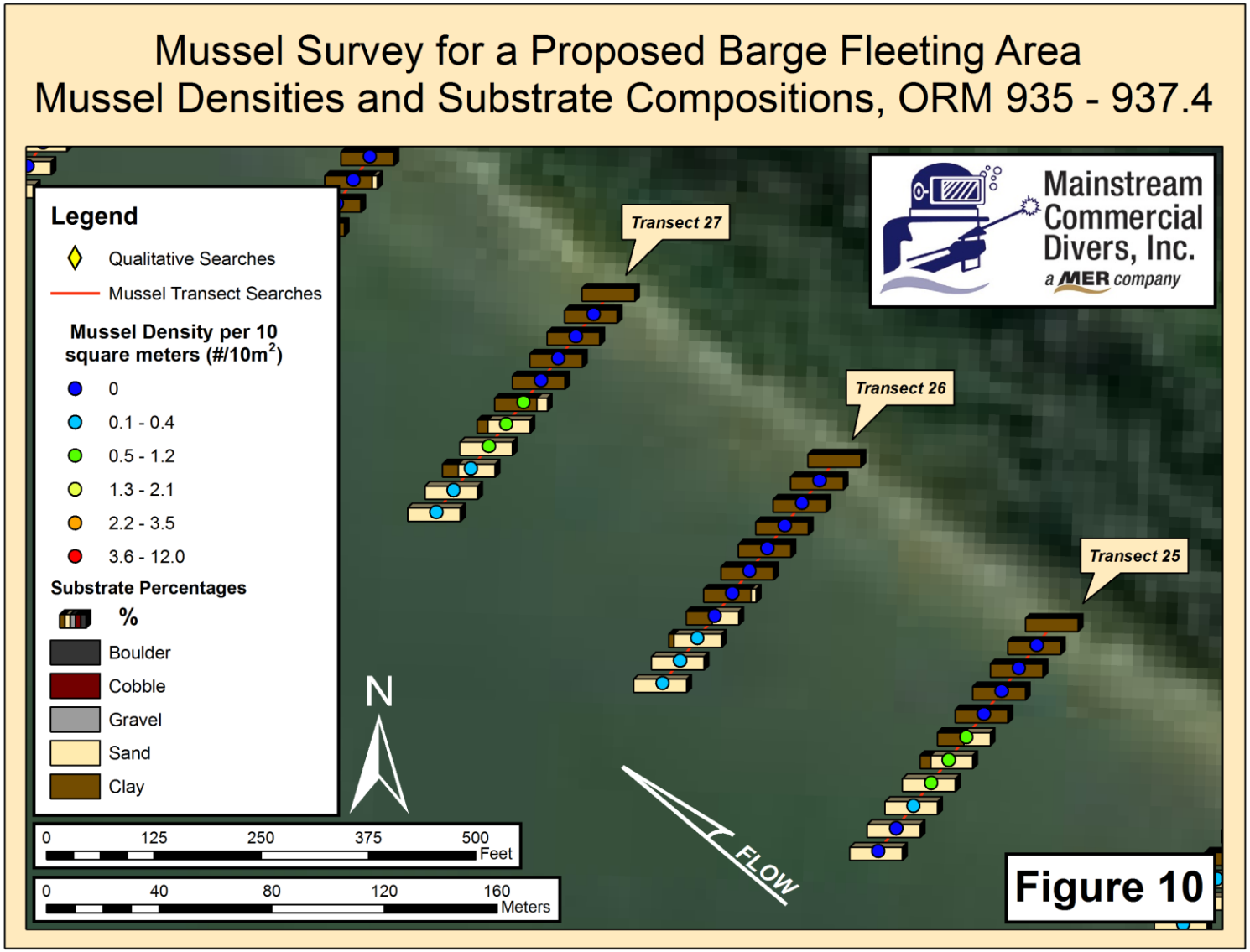

Mussel Survey for a Proposed Barge Fleeting Area
Mussel Densities and Substrate Compositions, ORM 935 - 937.4
Legend
Qualitative Searches
Mussel Transect Searches
Mussel Density per 10 square meters (#/10m²)
0
0.1 - 0.4
0.5 - 1.2
1.3 - 2.1
2.2 - 3.5
3.6 - 12.0
Substrate Percentages
%
Boulder
Cobble
Gravel
Sand
Clay
Transect 12
Qualitative Search 10
Transect 11
Qualitative Search 9
Transect 10
Qualitative Search 8
Mainstream Commercial Divers, Inc.
a MER company
N
FLOW
0 125 250 375 500 Feet
0 40 80 120 160 Meters
Figure 5

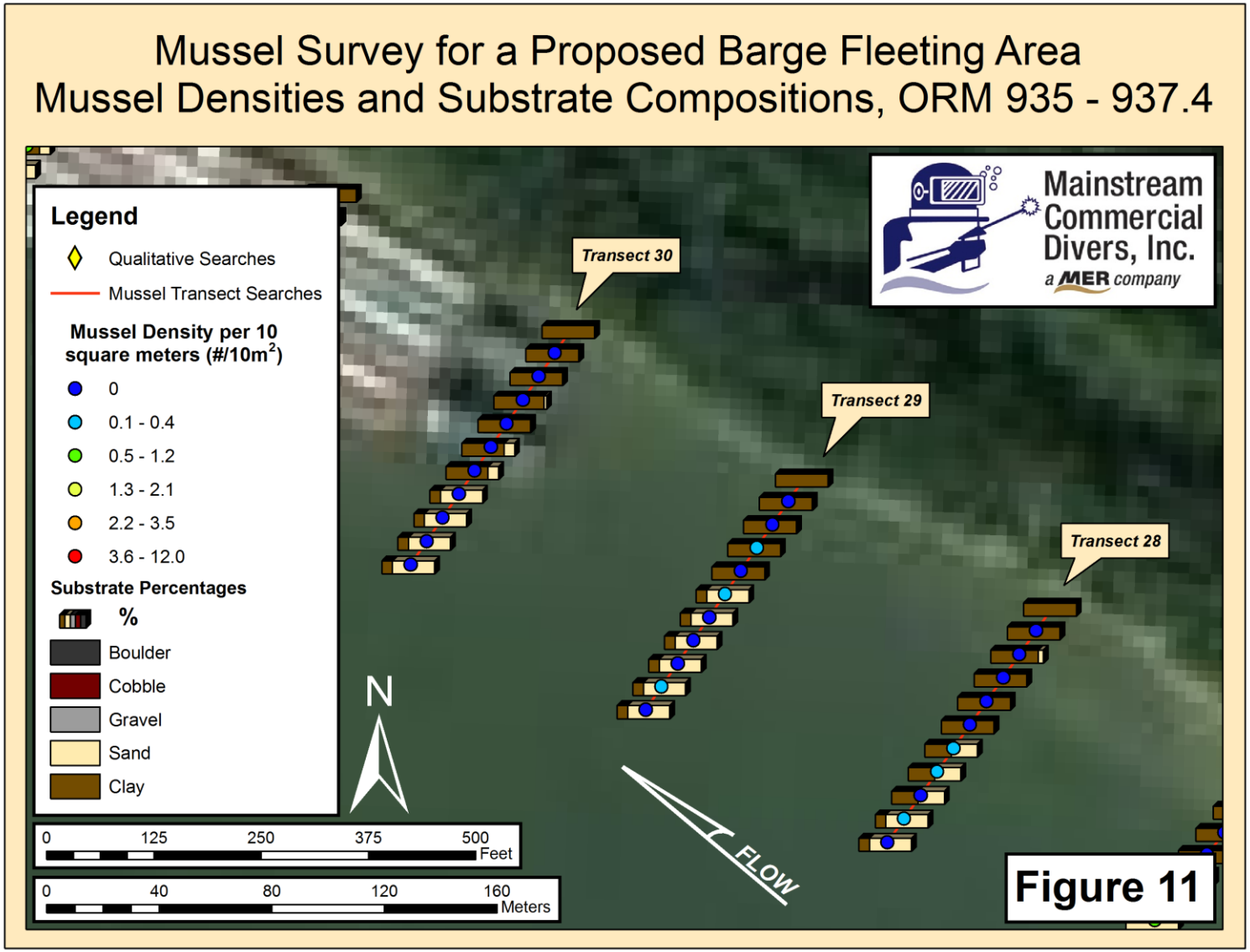

Mussel Survey for a Proposed Barge Fleeting Area
Mussel Densities and Substrate Compositions, ORM 935 - 937.4
Legend
Qualitative Searches
Mussel Transect Searches
Mussel Density per 10 square meters (#/10m²)
0
0.1 - 0.4
0.5 - 1.2
1.3 - 2.1
2.2 - 3.5
3.6 - 12.0
Substrate Percentages
%
Boulder
Cobble
Gravel
Sand
Clay
Transect 15
Qualitative Search 13
Transect 14
Qualitative Search 12
One P. capax found between 50-60m from shore on Transect 14
Transect 13
Qualitative Search 11
Mainstream Commercial Divers, Inc.
a MER company
N
FLOW
0 125 250 375 500 Feet
0 40 80 120 160 Meters
Figure 6

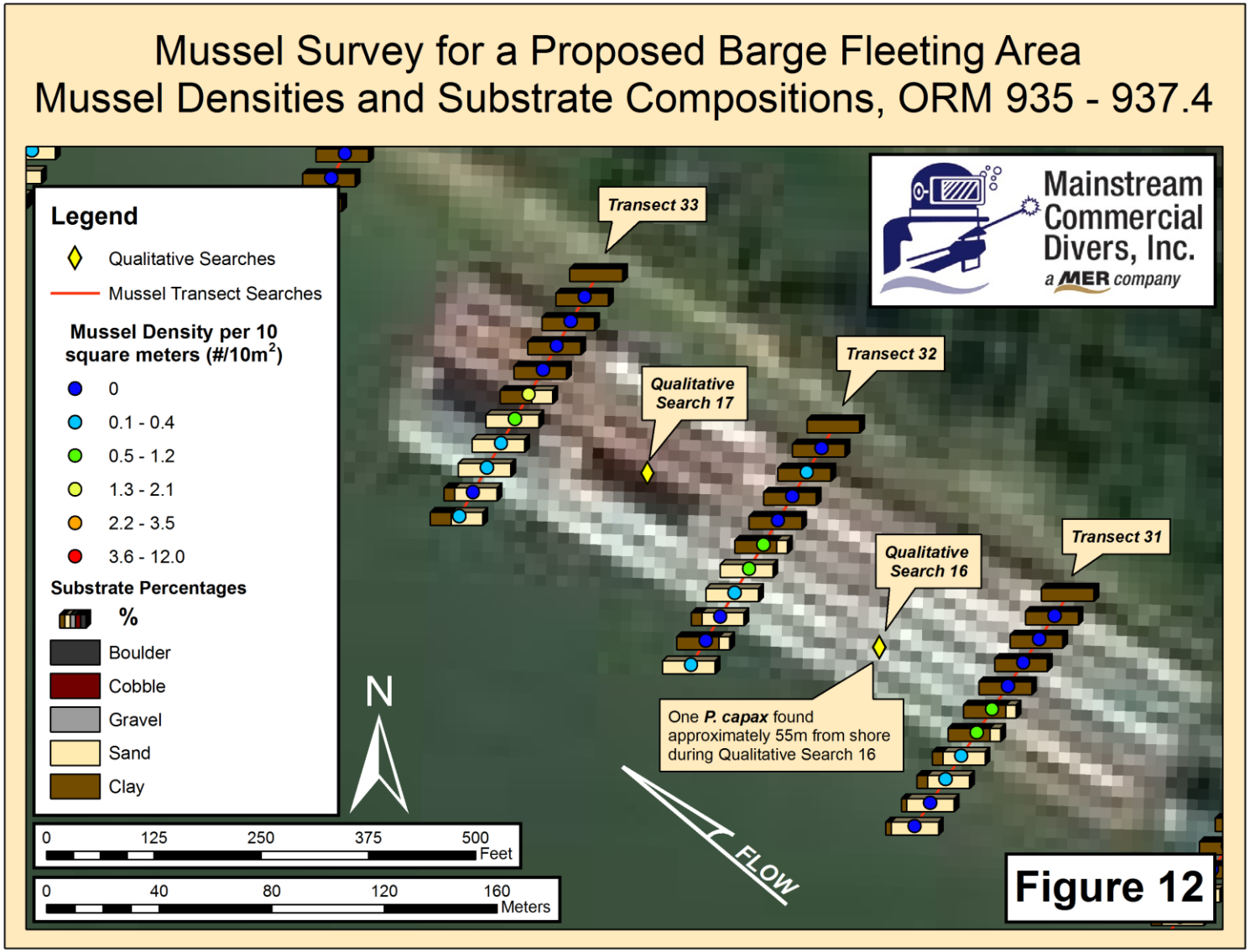

Mussel Survey for a Proposed Barge Fleeting Area
Mussel Densities and Substrate Compositions, ORM 935 - 937.4
Legend
Qualitative Searches
Mussel Transect Searches
Mussel Density per 10 square meters (#/10m²)
0
0.1 - 0.4
0.5 - 1.2
1.3 - 2.1
2.2 - 3.5
3.6 - 12.0
Substrate Percentages
%
Boulder
Cobble
Gravel
Sand
Clay
Transect 18
Qualitative Search 15
Transect 17
Transect 16
Qualitative Search 14
FLOW
N
One P. capax found approximately 75m from shore during Qualitative Search 14
One P. capax found between 50-60m from shore on Transect 16
Mainstream Commercial Divers, Inc.
a MER company
0 125 250 375 500 Feet
0 40 80 120 160 Meters
Figure 7

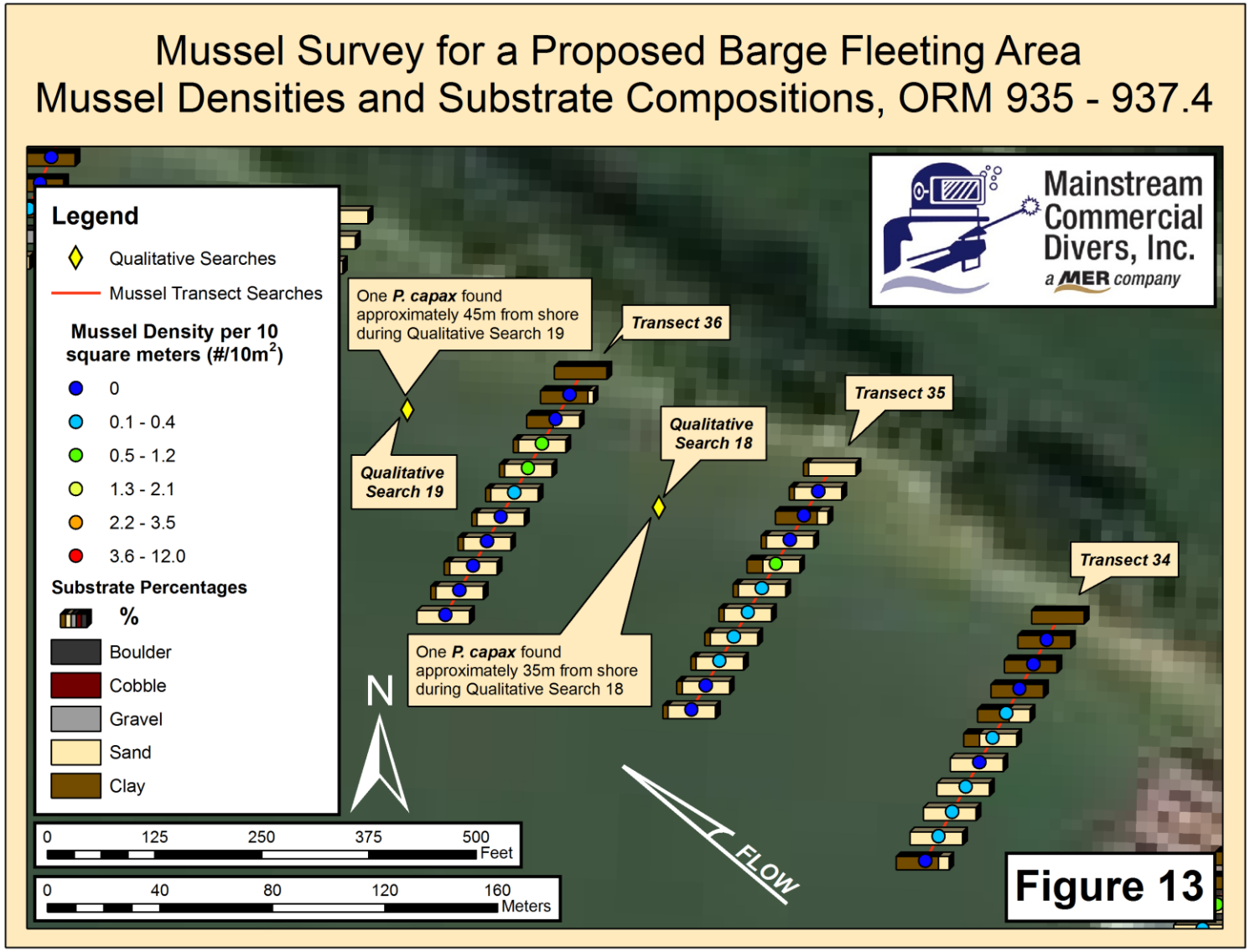

Mussel Survey for a Proposed Barge Fleeting Area
Mussel Densities and Substrate Compositions, ORM 935 - 937.4
Legend
Qualitative Searches
Mussel Transect Searches
Mussel Density per 10 square meters (#/10m²)
0
0.1 - 0.4
0.5 - 1.2
1.3 - 2.1
2.2 - 3.5
3.6 - 12.0
Substrate Percentages
%
Boulder
Cobble
Gravel
Sand
Clay
Transect 21
Transect 20
Transect 19
Mainstream Commercial Divers, Inc.
a MER company
N
FLOW
0 125 250 375 500 Feet
0 40 80 120 160 Meters
One P. capax found between 50-60m from shore on Transect 19
Figure 8

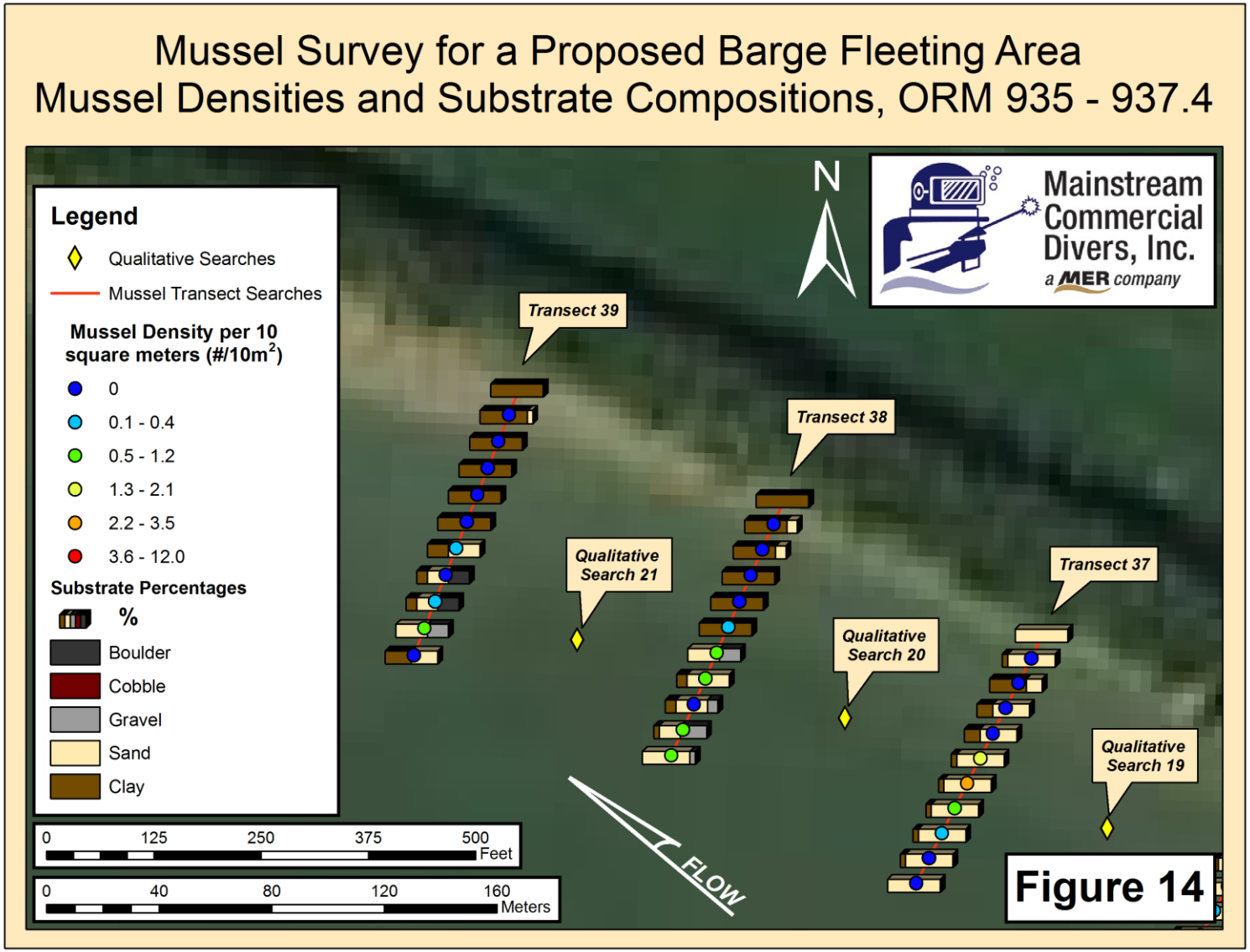

Mussel Survey for a Proposed Barge Fleeting Area
Mussel Densities and Substrate Compositions, ORM 935 - 937.4
Legend
Qualitative Searches
Mussel Transect Searches
Mussel Density per 10 square meters (#/10m²)
0
0.1 - 0.4
0.5 - 1.2
1.3 - 2.1
2.2 - 3.5
3.6 - 12.0
Substrate Percentages
%
Boulder
Cobble
Gravel
Sand
Clay
0 125 250 375 500 Feet
0 40 80 120 160 Meters
Transect 24
Transect 23
Transect 22
Mainstream Commercial Divers, Inc.
a MER company
N
FLOW
Figure 9

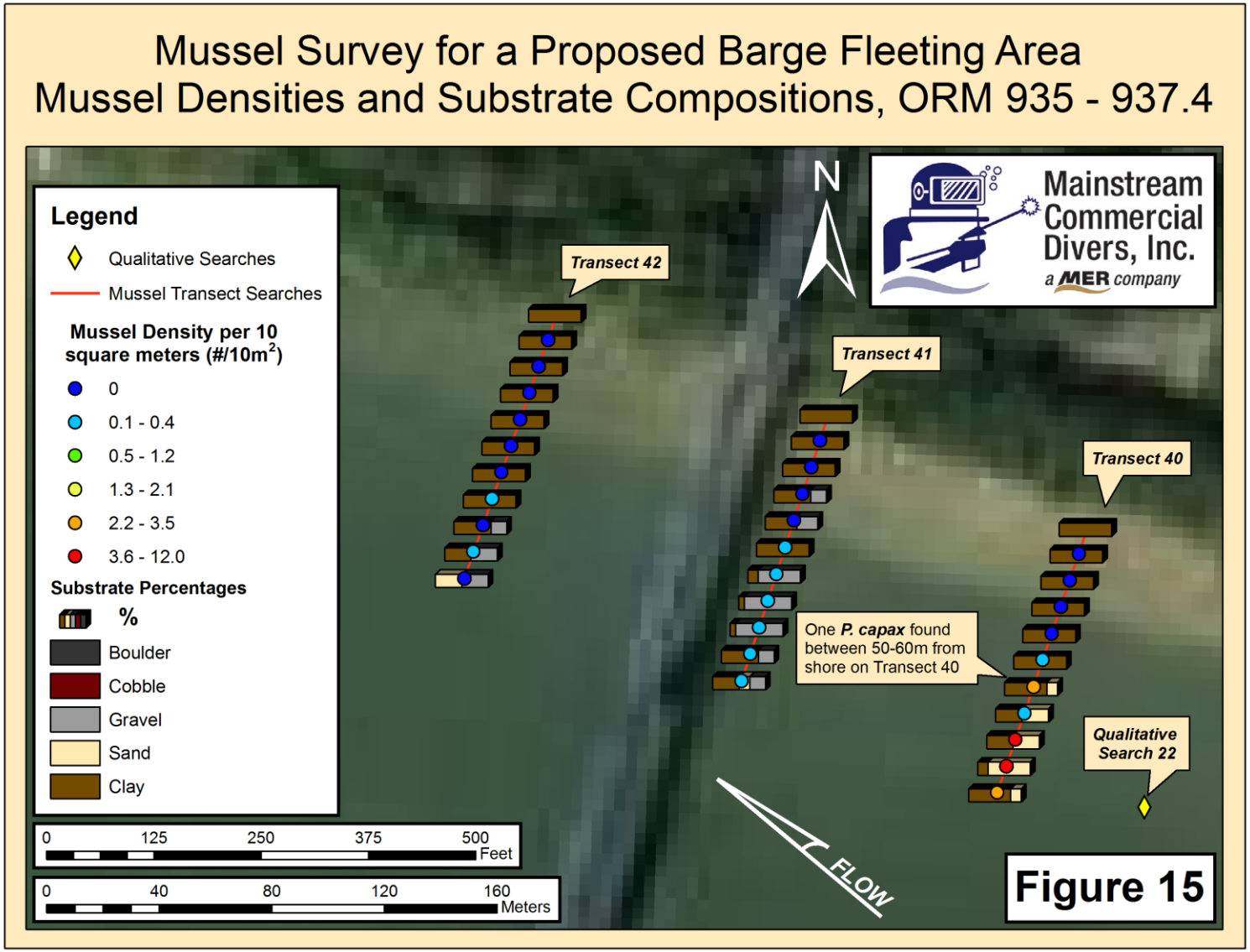

Mussel Survey for a Proposed Barge Fleeting Area
Mussel Densities and Substrate Compositions, ORM 935 - 937.4
Legend
Qualitative Searches
Mussel Transect Searches
Mussel Density per 10 square meters (#/10m²)
0
0.1 - 0.4
0.5 - 1.2
1.3 - 2.1
2.2 - 3.5
3.6 - 12.0
Substrate Percentages
%
Boulder
Cobble
Gravel
Sand
Clay
Transect 27
Transect 26
Transect 25
N
FLOW
0 125 250 375 500 Feet
0 40 80 120 160 Meters
Mainstream Commercial Divers, Inc.
a MER company
Figure 10


Mussel Survey for a Proposed Barge Fleeting Area
Mussel Densities and Substrate Compositions, ORM 935 - 937.4
Legend
Qualitative Searches
Mussel Transect Searches
Mussel Density per 10 square meters (#/10m²)
0
0.1 - 0.4
0.5 - 1.2
1.3 - 2.1
2.2 - 3.5
3.6 - 12.0
Substrate Percentages
%
Boulder
Cobble
Gravel
Sand
Clay
Transect 30
Transect 29
Transect 28
N
FLOW
0 125 250 375 500 Feet
0 40 80 120 160 Meters
Mainstream Commercial Divers, Inc.
a MER company
Figure 11


Mussel Survey for a Proposed Barge Fleeting Area
Mussel Densities and Substrate Compositions, ORM 935 - 937.4
Legend
Qualitative Searches
Mussel Transect Searches
Mussel Density per 10 square meters (#/10m²)
0
0.1 - 0.4
0.5 - 1.2
1.3 - 2.1
2.2 - 3.5
3.6 - 12.0
Substrate Percentages
%
Boulder
Cobble
Gravel
Sand
Clay
N
0 125 250 375 500 Feet
0 40 80 120 160 Meters
Transect 33
Transect 32
Transect 31
Qualitative Search 17
Qualitative Search 16
One P. capax found approximately 55m from shore during Qualitative Search 16
FLOW
Mainstream Commercial Divers, Inc.
a MER company
Figure 12


Mussel Survey for a Proposed Barge Fleeting Area
Mussel Densities and Substrate Compositions, ORM 935 - 937.4
Legend
Qualitative Searches
Mussel Transect Searches
Mussel Density per 10 square meters (#/10m²)
0
0.1 - 0.4
0.5 - 1.2
1.3 - 2.1
2.2 - 3.5
3.6 - 12.0
Substrate Percentages
%
Boulder
Cobble
Gravel
Sand
Clay
One P. capax found approximately 45m from shore during Qualitative Search 19
Transect 36
Transect 35
Transect 34
Qualitative Search 19
Qualitative Search 18
One P. capax found approximately 35m from shore during Qualitative Search 18
N
FLOW
0 125 250 375 500 Feet
0 40 80 120 160 Meters
Mainstream Commercial Divers, Inc.
a MER company
Figure 13


Mussel Survey for a Proposed Barge Fleeting Area
Mussel Densities and Substrate Compositions, ORM 935 - 937.4
Legend
Qualitative Searches
Mussel Transect Searches
Mussel Density per 10 square meters (#/10m²)
0
0.1 - 0.4
0.5 - 1.2
1.3 - 2.1
2.2 - 3.5
3.6 - 12.0
Substrate Percentages
%
Boulder
Cobble
Gravel
Sand
Clay
N
Mainstream Commercial Divers, Inc.
a MER company
Transect 39
Transect 38
Transect 37
Qualitative Search 21
Qualitative Search 20
Qualitative Search 19
FLOW
0 125 250 375 500 Feet
0 40 80 120 160 Meters
Figure 14


Mussel Survey for a Proposed Barge Fleeting Area
Mussel Densities and Substrate Compositions, ORM 935 - 937.4
Legend
Qualitative Searches
Mussel Transect Searches
Mussel Density per 10 square meters (#/10m²)
0
0.1 - 0.4
0.5 - 1.2
1.3 - 2.1
2.2 - 3.5
3.6 - 12.0
Substrate Percentages
%
Boulder
Cobble
Gravel
Sand
Clay
0 125 250 375 500 Feet
0 40 80 120 160 Meters
N
Mainstream Commercial Divers, Inc.
a MER company
Transect 42
Transect 41
Transect 40
One P. capax found between 50-60m from shore on Transect 40
Qualitative Search 22
FLOW
Figure 15

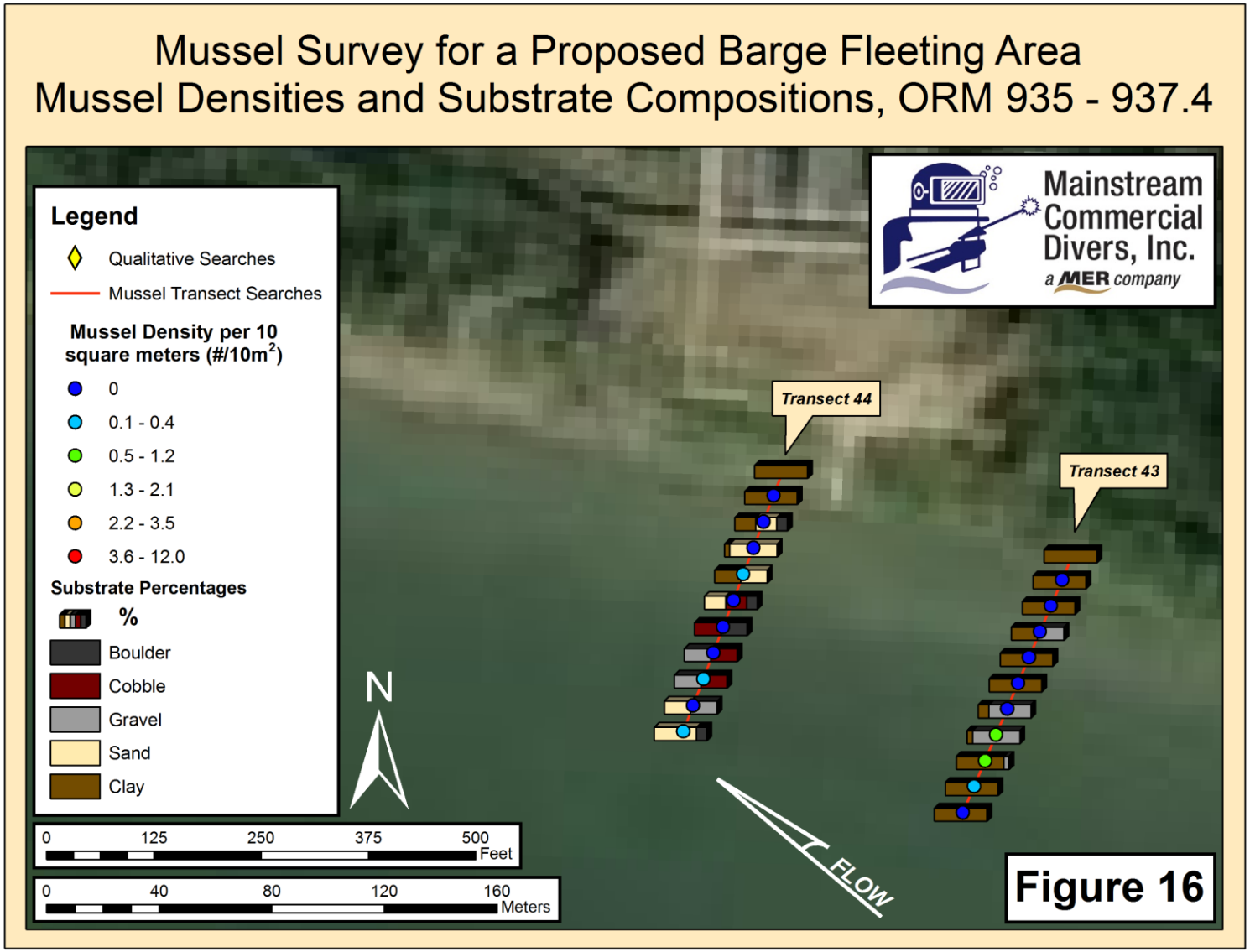

Mussel Survey for a Proposed Barge Fleeting Area
Mussel Densities and Substrate Compositions, ORM 935 - 937.4
Legend
Qualitative Searches
Mussel Transect Searches
Mussel Density per 10 square meters (#/10m²)
0
0.1 - 0.4
0.5 - 1.2
1.3 - 2.1
2.2 - 3.5
3.6 - 12.0
Substrate Percentages
%
Boulder
Cobble
Gravel
Sand
Clay
N
0 125 250 375 500 Feet
0 40 80 120 160 Meters
Transect 44
Transect 43
FLOW
Mainstream Commercial Divers, Inc.
a MER company
Figure 16

Photo 1. Right descending shore facing downstream at the beginning of Transect 21.

Photo 2. Right descending shoreline at the beginning of Transect 31.

Photo 3. Mussels encountered along Transect 33, between 40 and 50 meters from shore.

Photo 4. Mussels encountered during Qualitative Search 19, centered approximately 45 meters from shore.

Photos 5. *Potamilus capax* encountered along Transect 14 between 50 and 60 meters from shore.

Photo 6. Umbo view of the *Potamilus capax.*

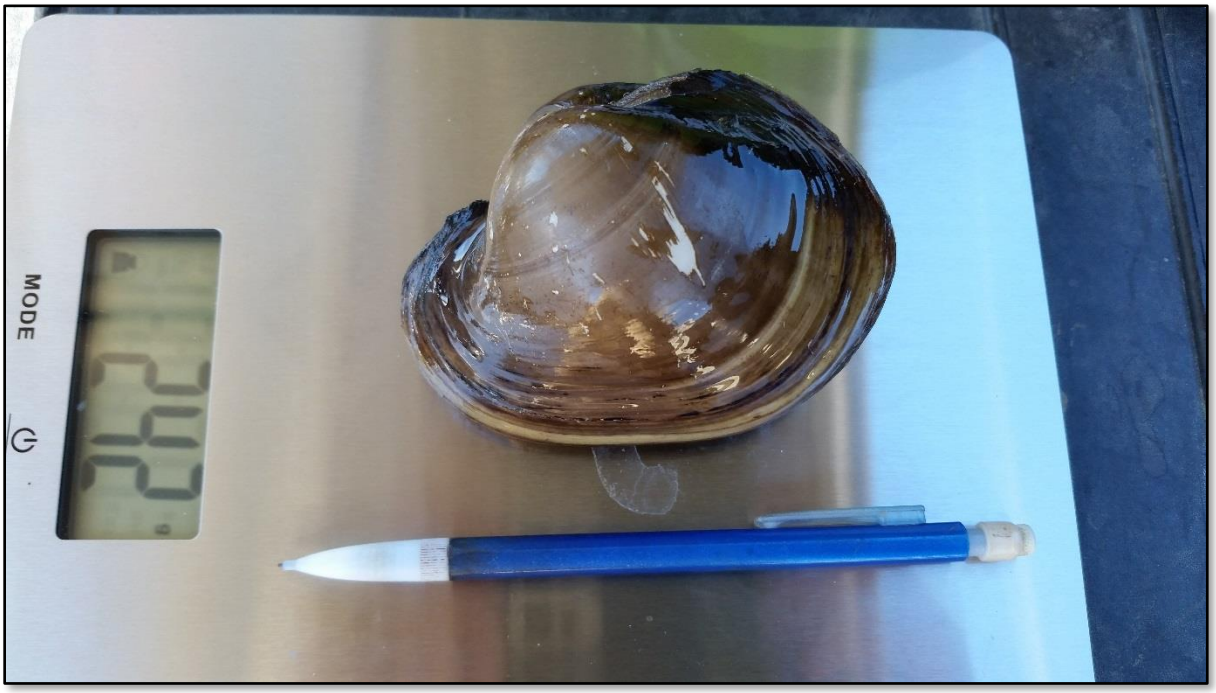


Photo 7. *Potamilus capax* encountered along Transect 16 between 50 and 60 meters from shore.

Photo 8. Umbo view of the *Potamilus capax*.

Photo 9. *Potamilus capax* encountered along Transect 19 between 50 and 60 meters from shore.

Photo 10. Umbo view of the *Potamilus capax*.

Photo 11. *Potamilus capax* encountered during Qualitative Search 14, centered approximately 75 meters from shore.

Photo 12. Umbo view of the *Potamilus capax*.

Photo 13. *Potamilus capax* encountered during Qualitative Search 16, centered approximately 55 meters from shore.

Photo 14. Umbo view of the *Potamilus capax*.

Photo 15. *Potamilus capax* encountered during Qualitative Search 18, centered approximately 35 meters from the shore.

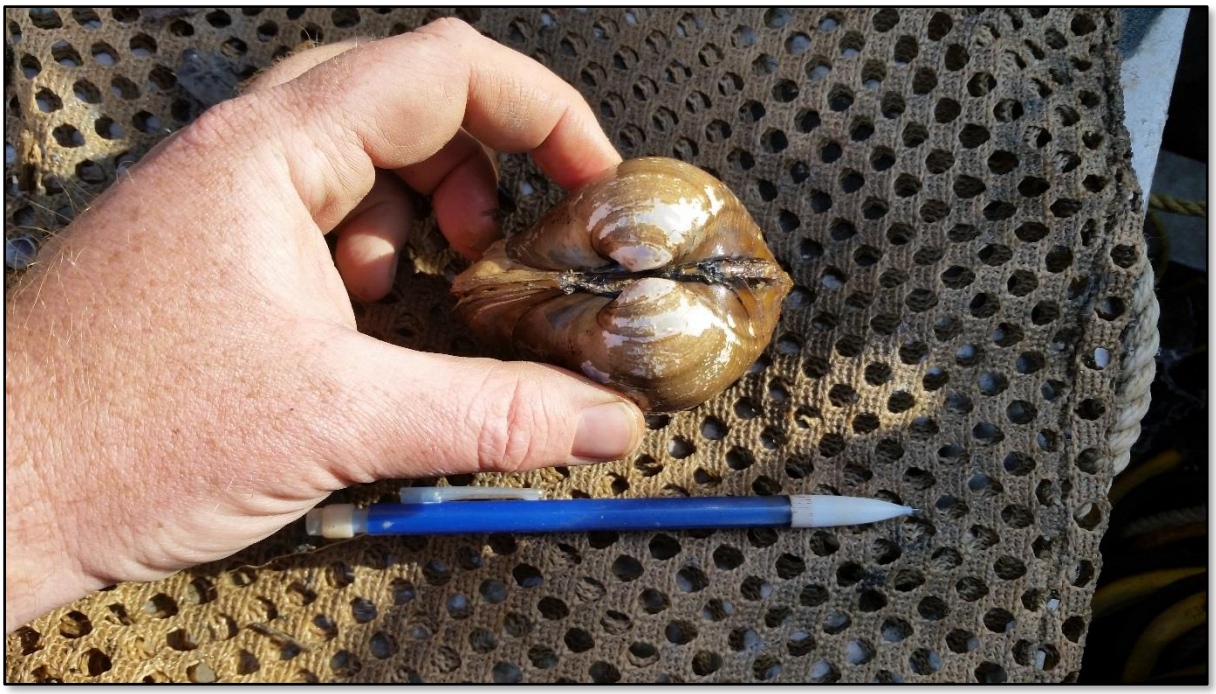


Photo 16. Umbo view of the *Potamilus capax*.

Photo 17. *Potamilus capax* encountered along Transect 40 between 50 and 60 meters from shore.

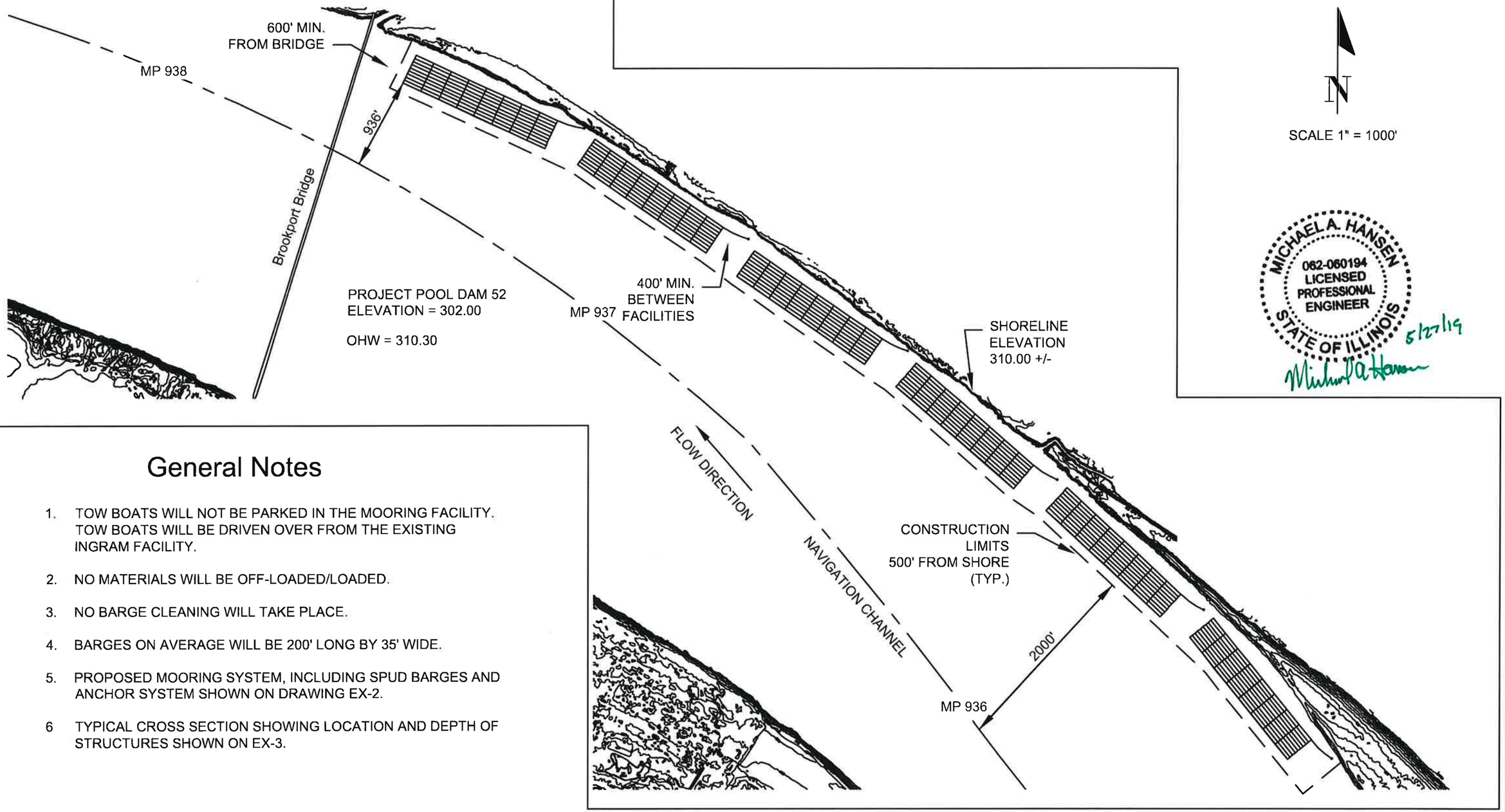
Photo 18. Umbo view of the *Potamilus capax*.

Photo 19. *Potamilus capax* encountered during Qualitative Search 19, centered approximately 45 meters from shore.

Photo 20. Umbo view of the *Potamilus capax*.

APPENDIX C

PROJECT DESIGN PLANS



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5/22/19

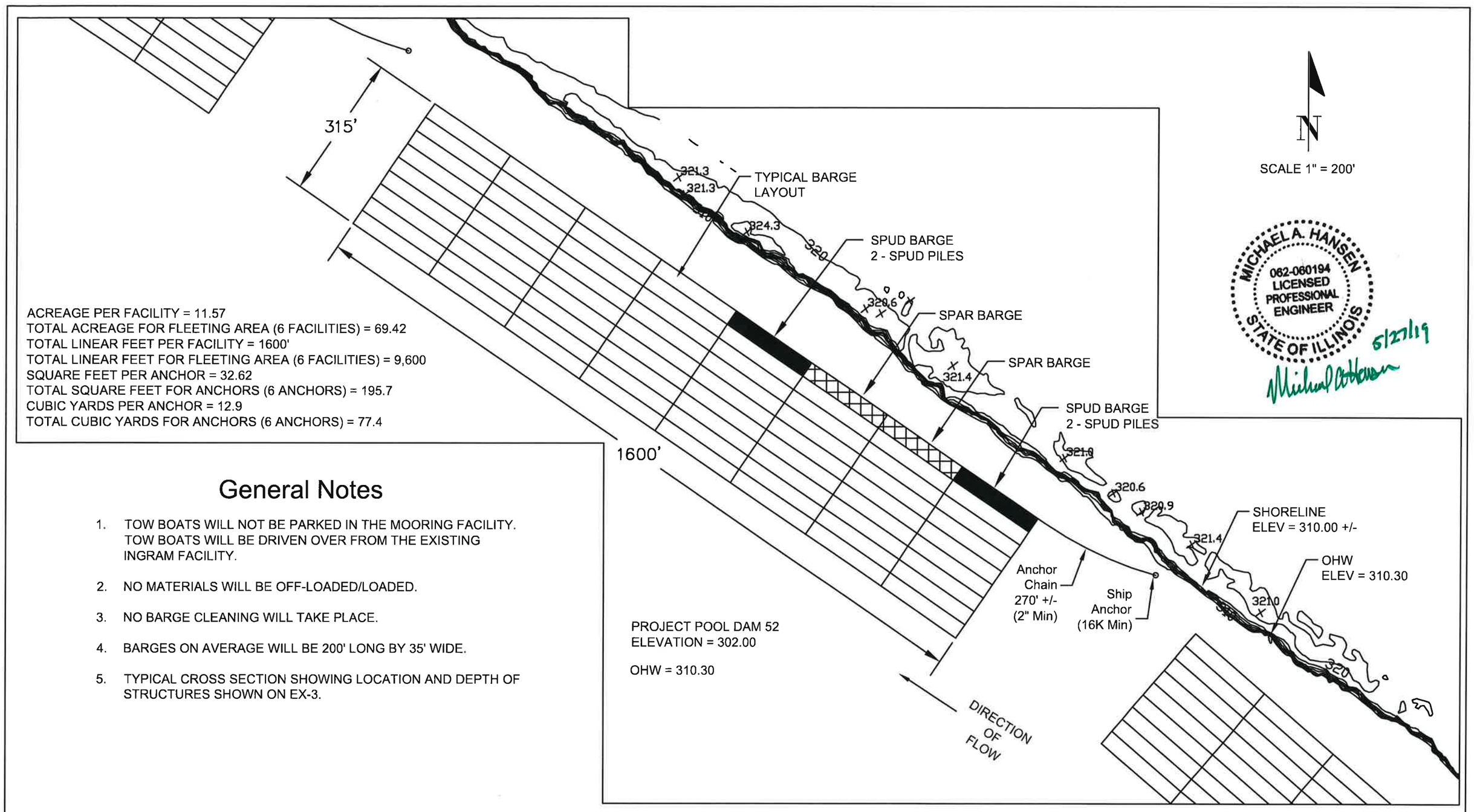
Michael A Hansen

General Notes

1. TOW BOATS WILL NOT BE PARKED IN THE MOORING FACILITY. TOW BOATS WILL BE DRIVEN OVER FROM THE EXISTING INGRAM FACILITY.
2. NO MATERIALS WILL BE OFF-LOADED/LOADED.
3. NO BARGE CLEANING WILL TAKE PLACE.
4. BARGES ON AVERAGE WILL BE 200' LONG BY 35' WIDE.
5. PROPOSED MOORING SYSTEM, INCLUDING SPUD BARGES AND ANCHOR SYSTEM SHOWN ON DRAWING EX-2.
6 TYPICAL CROSS SECTION SHOWING LOCATION AND DEPTH OF STRUCTURES SHOWN ON EX-3.

HDR

PROJECT TITLE	INGRAM FLEETING FACILITY
SHEET TITLE	FLEETING FACILITY FIGURE LRL-2019-288-jwr
PROJECT NUMBER	10128498
PROJECT MANAGER	M.HANSEN
DATE	05-02-19
REFERENCE SHEET	
REFERENCE DOCUMENT	
EXHIBIT NUMBER	**EX-1**



ACREAGE PER FACILITY = 11.57
TOTAL ACREAGE FOR FLEETING AREA (6 FACILITIES) = 69.42
TOTAL LINEAR FEET PER FACILITY = 1600'
TOTAL LINEAR FEET FOR FLEETING AREA (6 FACILITIES) = 9,600
SQUARE FEET PER ANCHOR = 32.62
TOTAL SQUARE FEET FOR ANCHORS (6 ANCHORS) = 195.7
CUBIC YARDS PER ANCHOR = 12.9
TOTAL CUBIC YARDS FOR ANCHORS (6 ANCHORS) = 77.4

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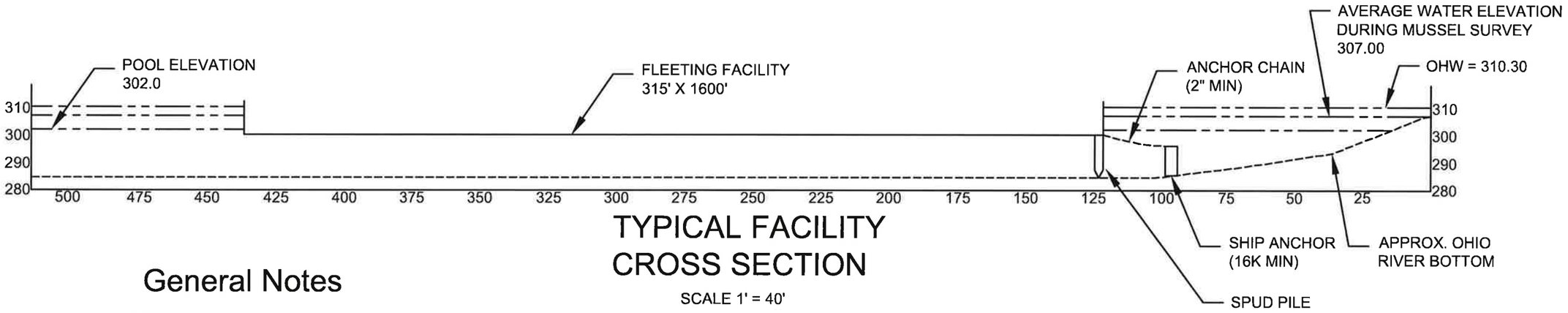
General Notes

1. TOW BOATS WILL NOT BE PARKED IN THE MOORING FACILITY. TOW BOATS WILL BE DRIVEN OVER FROM THE EXISTING INGRAM FACILITY.
2. NO MATERIALS WILL BE OFF-LOADED/LOADED.
3. NO BARGE CLEANING WILL TAKE PLACE.
4. BARGES ON AVERAGE WILL BE 200' LONG BY 35' WIDE.
5. TYPICAL CROSS SECTION SHOWING LOCATION AND DEPTH OF STRUCTURES SHOWN ON EX-3.

HDR

PROJECT TITLE	INGRAM FLEETING FACILITY
SHEET TITLE	MOORING FIGURE LRL-2019-288-jwr
PROJECT NUMBER	10128498
PROJECT MANAGER	M.HANSEN
DATE	05-02-19
REFERENCE SHEET	
REFERENCE DOCUMENT	
EXHIBIT NUMBER	EX-2



TYPICAL FACILITY CROSS SECTION

SCALE 1' = 40'

General Notes

1. SPAR BARGES MAY REST ON THE RIVER BOTTOM DURING TIMES OF LOW FLOW.
2. BARGE DRAFT DEPTH IS APPROXIMATELY 12 FEET.
3. BATHYMETRIC SURVEY WAS NOT COMPLETED. RIVER DEPTHS ARE EXTRAPOLATED FROM THE 2018 MUSSEL SURVEY.
4. CROSS SECTION IS REPRESENTATIVE OF CONDITIONS ALONG THE FLEETING AREA.
5. THE NARROWEST POINT BETWEEN THE FLEETING FACILITY AND NAVIGATION CHANNEL IS APPROXIMATELY 936'

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PROJECT TITLE
INGRAM FLEETING FACILITY
SHEET TITLE
FACILITY CROSS SECTION
LRL-2019-288-jwr

PROJECT NUMBER
10128498
PROJECT MANAGER
M.HANSEN
DATE
05-02-19

REFERENCE SHEET
REFERENCE DOCUMENT
EXHIBIT NUMBER
EX-3

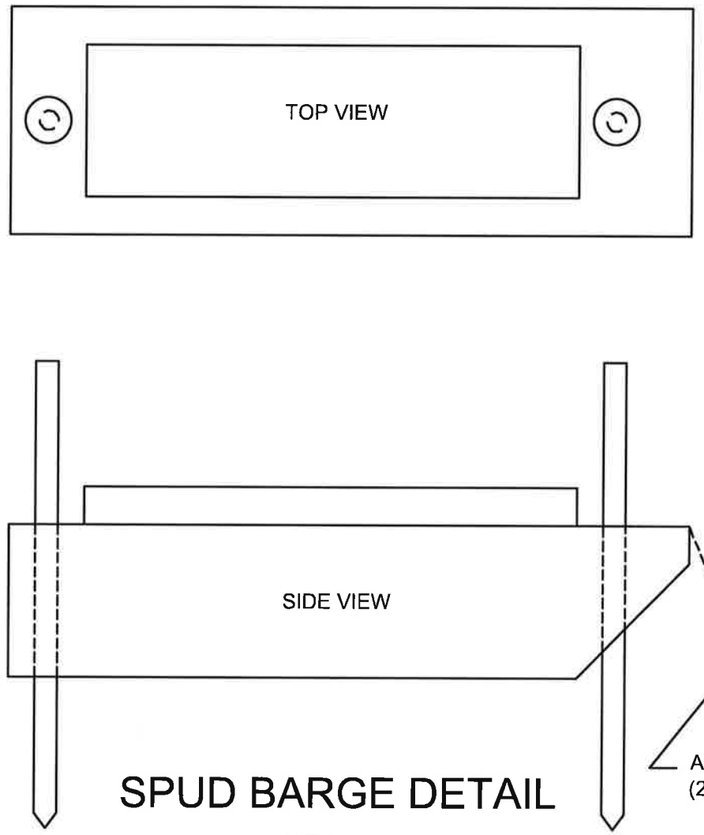
SPUD PILE INFORMATION

SPUD WELL = 36-INCH DIAMETER STEEL PIPE PILE

SPUD PILE = 30-INCH DIAMETER STEEL PIPE PILE

SPUD PILE LENGTH OVERALL = 65 FEET

SIDEWALL THICKNESS OF PIPE PILE = .75-INCH



SPUD BARGE DETAIL

N.T.S.

SQUARE FEET PER SPUD PILE = 707
TOTAL SQUARE FEET OF PILE PER SPUD BARGE (2 SPUD PILES) = 1,414
TOTAL SQUARE FEET OF PILE PER FLEETING (4 SPUD PILES) = 2,282
APPROXIMATE CUBIC YARDS BELOW OHW PER SPUD PILE = 38,885
APPROXIMATE TOTAL CUBIC YARDS BELOW OHW PER PILE PER SPUD BARGE (2 SPUD PILES) = 77,770
APPROXIMATE TOTAL CUBIC YARDS BELOW OHW OF PILE PER FLEEING (4 SPUD PILES) = 155,540

General Notes

1. THE SPUD WELLS WILL BE WELDED AND BRACED THROUGH THE BARGE HULL, AND THE SPUD PILE WILL BE PLACED IN THE SPUD WELL WITH A CRANE.
2. ONCE THE BARGE IS IN PLACE, THE SPUD PILES WILL BE LOWERED TO CONTACT THE RIVER BOTTOM AND SECURE THE BARGE IN PLACE, ALLOWING THE BARGE TO TRAVEL VERTICALLY, UP & DOWN AS THE RIVER LEVEL FLUCTUATES.
3. THE SPUDS WILL SINK INTO THE SUBSTRATE UP TO FIVE FEET. PER INDUSTRY STANDARD, THE WEIGHT OF THE SPUD PILES WILL SINK THE SPUD PILES INTO THE SUBSTRATE. NO PILE DRIVING WILL BE REQUIRED.
4. ONCE POSITIONED, THE SPUD BARGES ARE GENERALLY NOT MOVED. IF ON RARE OCCASION REPOSITIONING IS DEEMED NECESSARY DUE TO CHANGES IN RIVER CONDITIONS OR FLEETING ARRANGEMENTS, THE SPUD BARGE LOCATIONS WOULD BE ADJUSTED, BUT THIS IS NOT ANTICIPATED.
5. THE ANCHOR WILL BE POSITIONED UPRIVER FROM THE UPPER SPUD BARGE IN EACH RESPECTIVE TIER. THE CHAIN WILL BE EXTENDED, WITH ENOUGH SLACK TO ENABLE THE BARGES TO HAVE FREE VERTICAL TRAVEL TO ACCOMMODATE THE KNOWN RANGE OF LOW AND HIGH WATER ELEVATION FOR THE AREA.
6. A SPUD BARGE WILL BE PLACED AT EITHER END OF THE SPAR BARGE ARRANGEMENT AS SHOWN ON EX-2. TWO SPUD BARGES ARE INCLUDED IN EACH FLEETING. THE ANCHOR AND CHAIN IS A SECONDARY SUPPORT MECHANISM.

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Michael A Hansen
5-22-19

HDR

PROJECT TITLE
INGRAM FLEETING FACILITY
SHEET TITLE
SPUD BARGE DETAIL
LRL-2019-288-jwr

PROJECT NUMBER
10128498
PROJECT MANAGER
M.HANSEN
DATE
05-22-19

REFERENCE SHEET
REFERENCE DOCUMENT
EXHIBIT NUMBER
EX-4

APPENDIX D

FACILITY OPERATING PLAN

INGRAM BARGE COMPANY

PADUCAH FLEET

FACILITY OPERATING PLAN

INGRAM BARGE COMPANY FACILITY OPERATIONS PLAN

PADUCAH, KY

The purpose of this plan is to outline the practices necessary to fleet barges in a safe and efficient manner in the Ingram Barge Company Paducah Fleet. The Ingram Barge Company Paducah Fleet encompasses fleeting space from Mile 930.5 to Mile 934 (Revise to Mile 937.4 upon approval of USACE Permit Application ID No. LRL-2019-288-jwr) on the Right Descending Bank of the Ohio River. Additionally, existing fleeting space on the outside of Owen's Island from approximately 932.4 to 934.2 near the left descending bank of the Ohio River constitutes part of the Ingram Barge Company Paducah Fleet. This plan summarizes relevant portions of Ingram Barge Company Safety Management Systems and the Vessel Response Plan, and provides guidance and operating procedures to those involved in barge mooring and fleeting during the various operating conditions encountered. Specific protocols outlined below address periods of high water and emergencies.

This plan, posted in HELM (the computer system utilized to house the Ingram Barge Company Safety Management System and Vessel Response Plan) remains accessible and available to all Ingram vessel crewmembers at all times. *Nothing in this Facility Operations Plan supersedes Ingram Barge Company's SMS, USCG regulation, or the Vessel Response Plan.*

Contents of this plan include:

A: Communications

The Ingram Barge Company Paducah Fleet will have a Coordinator Vessel designated twenty-four hours per day, seven days a week. The Captain of the Coordinator Vessel will be available on VHF Radio Channel 17 (the fleet channel). Further, a Fleet Dispatcher will be available on scene during a day shift from 04:30 - 16:30 on VHF Radio Channel 11. The following resources are available via telephone:

Day Fleet Dispatcher (On Scene)	(270) 441. 1630
Night Fleet Dispatcher (Columbus, KY)	(270) 677- 6011
Steve Milam- Manager, Vessel Operations	(270) 441.1603 (office)
	(270) 748- 7699 (cell)
John Parks- GM Fleet Dispatch	(615) 298- 7594 (office)
	(615) 604- 3964 (cell)

B: Barge Receiving Procedures

Prior to arrival, the wheelman of an arriving line haul vessel will contact the Captain on the Coordinator Vessel. The Captain of the Coordinator Vessel (or other harbor vessel wheelman as designated by the Coordinator) will instruct the wheelman on an arriving line haul vessel as to where to land the arriving tow (VNAV 11).

Before landing a tow, adding additional weight to a fleet, harbor vessel crews will, whenever possible, inspect shore wires and wires across the head of the fleet to insure the tow can safely be fleeted (VNAV 11). This additional inspection is to supplement (and not replace) the day and night watch Coordinator Vessel inspection of the entire fleet.

The Captain on the Coordinator Vessel (or harbor vessel wheelman designated by Coordinator Vessel) will discuss with the wheelman on the line haul vessel any specific river conditions that may affect the landing of a tow (VNAV 11).

Vessel crews will insure barges are pumped and in proper condition according to policy (VNAV 11).

Vessel crews will secure tow to the fleet utilizing proper rigging, and by laying adequate leads (VNAV 11).

C: Fleet Mooring

Harbor vessel crewmembers will inspect portable and stationary rigging through the normal course of work on permanent spar barges while working in the fleets. Harbor vessel crewmembers will remove broken portable rigging on permanent spar barges and dispose of it appropriately (DECK 09). Harbor vessel crewmembers will properly mark broken stationary rigging on permanent spar barges and report to Barge Maintenance (DECK 09).

Harbor vessel crewmembers will inspect permanent spar barges through the normal course of work. Harbor vessel crewmembers will report any damage to or deficiency of permanent spar barges to the proper Manager of Vessel Operations on call (SMS 37).

Harbor vessel crewmembers will inspect all mooring apparatus through the normal course of work. Harbor vessel crewmembers will report any damage to or deficiency of permanent mooring apparatus to the proper Manager of Vessel Operations on call (SMS 37).

D: Facility Monitoring

At the beginning of every twelve-- hour day watch, as soon as light, the vessel crew on the Coordinator Vessel (or harbor vessel designated by the Coordinator) will transit throughout the entire Paducah Fleet inspecting spar barges, shore wires, the head of each fleet and collecting fleet lights to be recharged.

At the beginning of every twelve-- hour night watch, prior to dark, the vessel crew on the Coordinator Vessel (or harbor vessel designated by the Coordinator) will transit throughout the entire Paducah Fleet inspecting spar barges, shore wires, the head of each fleet, and distributing fleet lights to insure fleets remain lit in accordance with USCG Regulation.

E: Fleeting Area Maintenance

As tow work is conducted, harbor vessel crewmembers will inspect rigging and shore wires to insure barges remain properly secured in all fleets. Deficiencies found will be corrected through general maintenance activities as needed.

F: High Water Operations

Harbor vessel crewmembers will institute high water operation procedures at the direction of the Manager of Vessel Operations as the Paducah gauge approaches 36' with projection of an appreciable, continuing rise. The Manager of Vessel Operations may initiate high water operations regardless of river stage projections any time unusual circumstances are present (i.e. rapid rising river, extreme drift/ ice conditions, impending major weather events, etc.) (VNAV 06).

Upon implementation of High Water Operation, vessel crewmembers will implement high water tie offs which include (VNAV 06):

- Across the head of fleet:
    - Tie off to spar barges; two down river leads and an up river lead all piped tight with a breast wire piped tight.
    - Across the rest of the head a down river and an opposite lead.
- First coupling down:
    - An up river and a down river piped tight all the way across the tow and the tie off.
- Rest of the couplings:
    - Alternate leads attempting not to utilize breast wires or single part rigging in these couplings.
- Additional requirements:
    - At the beginning of each watch, the Captain of the Coordinator Vessel (or vessel designated by the coordinator) will check all tie offs, and mooring apparatus, logging checks in the vessel log.
- Prior to the anticipated implementation of High Water Operations, the Manager of Vessel Operations will consult Customer Service to evaluate the need to station a high water boat in the fleet.
- Prior to implementation of High Water Operations, the Manager of Vessel Operations will distribute an email outlining the High Water Tie Off requirements to all vessels working in the Ingram Barge Company Paducah Fleet.
- Prior to implementation of High Water Operations, the Manager of Vessel Operations will distribute an email outlining the Downstream Maneuver Procedure (VNAV 03) to all vessels working in the Ingram Barge Company Paducah Fleet.

G: Emergency Procedures

In the event of a fleet breakaway, the Captain on the Coordinator Vessel will contact the Manager of Vessel Operations as soon as safe and practical to do so. Further required reporting to the United States Coast Guard will occur under the direction of the Manager of Vessel Operations (SMS 37).

Each vessel operating in the Ingram Barge Company Paducah Fleet will have access to and is subject to operation under the Vessel Response Plan (housed on HELM).

The Vessel Response Plan is a very extensive document outlining topics and providing response procedures for the following areas (among others):

- Company Certification Statement
- Revision Record
- Distribution List
- List of Vessels Covered Under Plan
- List of Captain of the Port Zones
- Overview
- Notifications to be Made by Vessel Personnel
- Notifications to be Made by Shore- Based Personnel
- Notifications to be Made by Spill Management Team
- Onboard Mitigation Spill Procedures for:
    - Transfer system leak/ Tank overflow/ or Suspected leak
    - Grounding/ or Stranding
    - Collision or Allision
    - Explosion and/ or Fire
    - Hull Failure
    - Excessive List
    - Equipment Failure
    - Discharge Removal Equipment Deployment
    - Emergency Towing
    - Damage Stability and Hull Stress Considerations
    - Location of Barge and Non- Tank Vessel Plans
- Shore Based Response Activities
    - Qualified Individual Responsibilities and Authority
    - Transferring Responsibilities to Shore Based Spill Management Team
    - Coordinating Actions with FOSC
    - Response Organization Structure
- Incident Command System (ICS)
    - ICS Overview
    - ICS Positions: Roles and Responsibilities
    - ICS Forms

- List of Contacts
    - Vessel Owner
    - Qualified Individual
    - Internal First Responders
    - Internal Spill Management Team
    - Key Corporate Contacts
    - Contract Spill Management Team
    - Insurance Representatives/ Surveyors.
    - Oil Spill Removal Organizations (OSRO's)
    - Emergency Lightering, Salvage, and Fire Fighting
- Training and Exercise Procedures
    - Training Procedures
    - Training Records
    - Exercise Procedures
    - Exercise Guidance
    - Exercise Records
    - Plan Review, Update, and Revisions