

Illinois Department of Natural Resources
CONSERVATION PLAN
(Application for an Incidental Take Authorization)
Per 520 ILCS 10/5.5 and 17 Ill. Adm. Code 1080

150-day minimum required for public review, biological and legal analysis, and permitting

PROJECT APPLICANT: ExxonMobil Pipeline Company (EMPCo)

PROJECT NAME: S-232 Mustang Lockport to Patoka Crude Oil Pipeline – Kankakee River Crossing Project

COUNTY: Will County, Illinois

AMOUNT OF IMPACT AREA: 9,117 square feet (0.32 acres) below OHWM of Kankakee River

Armoring – Pipeline armoring will occur across 34 feet of the existing 50-foot pipeline right-of-way (ROW).

Staging and Access – Access for the north bank of the project will occur at the entrance to Rivals Lookout Park, where construction equipment will then access the ROW and staging will utilize existing timber mats located within the ROW, as needed. Staging and access for the south bank of the project site will occur at the intersection of the pipeline ROW and Illinois Highway 113 (IL-113) and will utilize the existing cleared ROW. All construction activities/impacts within the existing upland ROW will be temporary and returned to pre-construction conditions following project completion.

The incidental taking of endangered and threatened species shall be authorized by the Illinois Department of Natural Resources (IDNR) only if an applicant submits a conservation plan to the IDNR Incidental Take Coordinator that meets the following criteria:

1. A ***description of the impact likely to result*** from the proposed taking of the species that would be covered by the authorization, including but not limited to -

A) *Identification of the **area to be affected** by the proposed action, include a legal description and a detailed description including street address, map(s), and GIS shapefile. Include an indication of ownership or control of affected property. Attach photos of the project area.*

The S-232 Mustang Lockport to Patoka Pipeline is an existing 18-inch crude oil pipeline operated by EMPCo (service provider) on behalf of Mustang Pipeline Partners, that crosses the Kankakee River, a perennial stream that flows north/northwest into the Des Plaines River (**Figure 1**). During a routine assessment of the existing 18-inch S-232 pipeline crossing of the Kankakee River, EMPCo identified streambed scour conditions that have reduced the depth of cover over the existing pipeline. To protect against future scour, EMPCo has elected to install grout-filled articulated mat armoring over the existing pipeline, as depicted in the project design plans in **Appendix A** and **Figure 2**. The proposed armoring activities will further minimize the impacts to listed mussel species by reducing the potential for future streambed scour and degradation resulting in the loss of aquatic habitat. The proposed armoring activities will also protect against pipeline damage due to exposure, which will help ensure that the aquatic wildlife, including listed mussel species, are not impacted by the consequences of potential pipeline damage.

The ordinary high water mark (OHWM) width of the Kankakee River at the pipeline crossing is approximately 500 feet and the maximum water depth in the study area is approximately seven feet (41.243983, -88.124546). The stream channel is broad and shallow, with a bank height of approximately 8 to 12 feet and a gravel-cobble substrate. Site photographs are provided in **Appendix B**. The associated pipeline right-of-way (ROW) is actively maintained (e.g., mowed) and no other jurisdictional wetland features were observed within the proposed project impact area.

The project is located within a reach of the Kankakee River located in Custer Park, Will County, Illinois, in Section 19, Township 32N, R10E. Access for the north bank of the project will utilize the entrance to Rivals Lookout Park, where construction equipment will use preexisting timber mats. Access for the south bank of the project site will be accessed at the intersection of the pipeline ROW and IL-113.

Table 1. Property Ownership Information, Address, and Legal Description

Property Owner	Property Address	Tax Parcel Identification Number	Legal Description
Lakeland Agribusiness, Inc. (north bank surface owner)	(vacant) South Rivals Road, Wilmington, IL 60481	08-25-19-101-002-0000	THAT PRT OF THE NW1/4 OF SEC. 19, T32N-R10E DAF: BEG AT THE NW COR OF THE E1/2 OF SD NW1/4; THC S ALG THE W LN OF SD E1/2, 197 FT; THC E AT RIGHT ANGTS TO SD W LN, 149 FT; THC S PARL TO SD W LN 895 FT TO THE N'LY BANK OF THE KANKAKEE RIVER; THC SE'LY ALG SD N BANK TO THE W ROW LN OF RESTHAVEN RD; THC N ALG SD W LN TO THE N LN OF SD NW1/4; THC W ALG THE N LN OF THE NW1/4 TO THE POB.
Heidemarie Murrell (south bank surface owner)	(vacant) West Route 113, Custer Park, IL 60481	01-25-19-103-014-0000	LANDS SITUATED IN THE FRACT'L S1/2 OF THE NW1/4 OF SEC. 19, T32N-R10E DAF: COMM AT THE CENTER OF HWY RTE 113 S, AT THE SD NE COR OF BLK 1 OF MARTHA HYMES SUB AFRSD; THC DUE N TO THE LOW WATER MARK OF THE KANKAKEE RIVER; THC US SD RIVER 100 FT IN A SE'LY DIRECTION ALG THE MEANDERINGS THRF AT LOW WATER MARK TO THE POB; THC DUE S TO THE CENTER OF SD HWY; THC IN A SE'LY DIRECTION ALG THE CNTRLN OF SD HWY TO A LN RUNNING DUE N & S AT A DIST OF 300 FT DUE E FROM THE POB; THC DUE N ALG SD LN TO THE LOW WATER MARK OF THE KANKAKEE RIVER; THC IN A NW'LY DIRECTION ALG THE MEANDERINGS AT LOW WATER MARK OF SD RIVER TO THE POB

The project includes the placement of approximately 175 cubic yards of grout-filled articulated mat armoring along two segments of the pipeline that exhibit a reduced depth of cover and/or prior concrete bag pipe armoring, which will be replaced or improved (**Appendix A** and **Figure 2**). These two segments comprise approximately 262 linear feet of the 500-foot OHWM width and the armoring will be placed across 34 feet of the existing 50-foot pipeline ROW in these locations. The fabric mats are custom made off site and formed in place with grout within the river. The pre-made fabric mats are specifically sized to fit the project working requirements and include internal cables for added strength, and integrated zippers for fabric mat interconnectivity. The unfilled fabric mats will be placed into position by dive contractors and temporarily staked or weighted until they are filled with grout via an internal PVC pipe.

A concrete pump truck will be positioned on the upland bank, within the project ROW, where it will be filled by concrete supply trucks. As each fabric mat section is filled with grout, it will be connected to the next mat and filled, until all mats are filled within a given area. The zippers will be oriented in line with stream flow to prevent turbulent flow and erosion, and the fully cured mats will form approximately six-inch raised square blocks, each of which will be approximately six inches in height above the stream bed. The concrete utilized in the mats will also be enhanced with a non-toxic enzyme to speed the grout curing time. Downstream sediment/turbidity curtains will be used during project activities to maintain downstream water quality throughout the project and prevent adverse impacts to environmental receptors. Best management practices for installation of the grout filled fabric mats are provided in **Appendix C** and will be utilized during construction to prevent and/or respond to an accidental grout release.

Although a grout release is unlikely, the physical nature of a grout release would have a relatively localized impact (e.g., the grout would either disperse in the water and be trapped by the sediment curtain or quickly harden into a solid mass that could later be removed by hand). **Appendix C** will serve as a contingency plan for an accidental release of grout. All associated equipment will be staged/stored outside of the river and above the OHWM in a controlled area in order to further minimize instream impacts.

The combined armoring placement areas and temporary workspace, referred to as the area of direct impact (ADI), is approximately 14,122 square feet (1,312 square meters) (**Appendix A** and **Figure 2**). The currently proposed ADIs are larger than the original ADIs presented in the March 3, 2021 ITA package, but they do still fall within the original freshwater mussel survey boundaries, which includes the originally proposed ADI and mussel survey buffers. Thus, no new (un-surveyed) areas will be included in the currently proposed ADIs. As indicated in a subsequent email response to IDNR, U.S. Army Corps of Engineers (USACE), and U.S. Fish and Wildlife Service (USFWS) by Arcadis dated May 25, 2021, although the disturbance footprint (i.e., ADI) increased slightly with the new grout-filled articulated mat armoring approach, it still occurs within the overall original freshwater survey boundaries (i.e., the original ADI and survey buffers). The current ADI is now approximately 0.32 acres (14,122 square feet), compared to the original ADI of 0.13 acres.

The coordinates and site information for ADI-1 (North) and ADI-2 (South) sites are as follows:

ADI-1 (North): 9,117 square feet/847 square meters

- 41.244426, -88.124334
- ADI within the Kankakee River will consist of 17 feet of armoring on the upstream and downstream sides of the pipe, along 17 linear feet of the pipeline.
- Site access will occur at Rivals Lookout Park, 35149 – 35107 S. Rivals Rd, Wilmington, Will County, Illinois.
- Grant of ROW for ADI-1 is provided in **Appendix D**.

- Representative site photos are presented in **Appendix B**.

ADI-2 (South): 5,005 square feet/465 square meters

- 41.243551, -88.12494
- ADI within the Kankakee River will consist of 17 feet of armoring on the upstream and downstream sides of the pipe, along 92 linear feet of the pipeline.
- Site access will occur at 21368 – 21426 Illinois 113, Wilmington, Will County, Illinois.
- Grant of ROW for ADI-2 is provided in **Appendix D**.
- Representative site photos are presented in **Appendix B**.

The pipeline armoring design will account for variability in water depths within the river and will be designed not to alter normal downstream flows or create a low-head damming effect within the river. The armoring height will be minimized to the extent practical and the proposed project will not adversely impact marine navigation or natural biological spawning cycles. No additional fill material, beyond what is described herein, will be placed within the project areas outside of the existing pipeline ROW. The temporarily disturbed areas within the ROW, other than the two segments subject to the mitigation, will be returned to the pre-existing contours and elevations of the substrate, where possible. The anticipated length of time for completion of the pipeline armoring is approximately four weeks and is anticipated to begin in the third or fourth quarter of 2021 (late summer/early fall).

Agency Coordination

Arcadis initiated formal consultation with IDNR on August 24, 2020 and submitted an EcoCAT project review request (#2103470). That initial coordination led to additional coordination with the U.S. Army Corps of Engineers (USACE) for Section 404 permitting and with the USFWS for potential impacts to federally listed threatened and endangered (T&E) species. Arcadis engaged in further consultation with Nathan Grider (IDNR Impact Assessment Section Manager), Bradley Hayes (IDNR Resource Planner), Brian Metzke (IDNR State Aquatic Ecologist), and Shawn Cirton (USFWS Biologist) throughout August and September 2020.

Based on coordination with USFWS and IDNR, it was determined that state and federally listed T&E freshwater mussel species were known to occur within the project area (as described in other third-party survey data). EMPCo contracted with Arcadis to conduct a freshwater mussel survey to evaluate the potential for impacts to freshwater mussels, including state and federally listed T&E mussel species, within the project area. Arcadis submitted a Freshwater Mussel Survey and Relocation Plan to IDNR and USFWS on September 21, 2020. Arcadis received IDNR's conditional approval of the plan and a Non-listed Mussel Salvage and Relocation Permit on September 29, 2020.

Arcadis coordinated a teleconference call with Heather Osborn (IDNR), Shawn Cirton (USFWS), Julie Rimbault (USACE), and representatives with EMPCo and Arcadis on April 23, 2021 to further discuss mussel impacts, including the federally listed sheepsnose mussel, and the subsequent state Incidental Take Authorization (ITA) and federal USFWS Incidental Take Permit (ITP) process. Arcadis submitted the ITA request and Conservation Plan to IDNR on March 3, 2021 followed by a supplemental information letter to IDNR on May 5, 2021. Arcadis submitted a draft Biological Assessment (BA) to USFWS on April 30, 2021 and a final revised BA to USFWS on August 8, 2021.

*B) **Biological data** on the affected species including life history needs and habitat characteristics. Attach all pre-construction biological survey reports.*

On behalf of EMPCo, Arcadis submitted a Freshwater Mussel Survey and Relocation Plan to IDNR on September 21, 2020. Arcadis received IDNR's conditional approval of the plan and a Non-listed Mussel Salvage and Relocation Permit on September 29, 2020. Arcadis conducted the field survey from September 28th to October 7th, 2020. The subsequent freshwater mussel survey report was submitted to IDNR for review on December 4th, 2020. Please see the attached freshwater mussel survey report (Arcadis 2020) for complete findings (**Appendix E**).

The survey extent included the two ADI locations (estimated to be 862 m² at the time of the survey and prior to a reduction of the ADI/pipeline armoring area), a 10-meter upstream buffer (575 m²), 10-meter lateral buffer on each available side (1,650 m²), and a 30-meter downstream buffer (1,725 m²) (**Figure 3**). The following state and federally listed threatened and endangered (T&E) freshwater mussel species were observed during the field survey and are the subject of this conservation plan.

Monkeyface (*Quadrula metanevra*): The monkeyface inhabits medium to large rivers in gravel or mixed sand and gravel substrates (Cummings and Mayer, 1992). Monkeyface spawn in spring and glochidia are released in summer. Female Monkeyface display a diminutive mantle lure to attract hosts. Once the host fish attacks the lure, glochidia are ejected in the water in order to attach to the hosts gills or skin (Fritts et al., 2012). Monkeyface utilize a wide variety of minnow species in several genera as suitable glochidial hosts in contrast to other Quadrule genera, all of which use catfish (Coker et al., 1921; Fritts et al., 2012). Glochidia live as parasites on the host fish until they develop into juvenile mussels, at which point they detach and fall to the streambed (Minnesota Department of Natural Resources [MNDNR], 2020).

Purple Wartyback (*Cyclonaias tuberculata*): The purple wartyback can be found in medium to large rivers containing rock, gravel, or mixed sand and gravel substrates in swift currents (Cummings and Mayer, 1992). The purple wartyback, like the monkeyface, is tachytictic, which is a short-term brooder with females having larvae present in their outer gills between May and late August. Glochidia have been documented to use channel catfish (*Ictalurus punctatus*), yellow bullhead (*Ameiurus natalis*), flathead catfish (*Pylodictis olivaris*), and black bullhead (*Ameiurus melas*) as hosts (Hove, 1997).

Sheepnose (*Plethobasus cyphus*): The sheepnose can be found in shallow areas with moderate to swift currents that flow over coarse sand and gravel of larger rivers and streams. They have also been found in areas of mud, cobble, and rock and in large rivers they may be found in deep runs (U.S. Fish and Wildlife Service [USFWS], 2019). The only confirmed wild sheepnose host is the sauger (*Stizostedion canadense*). Threats to sheepnose consist of dams, population fragmentation, sedimentation, pollution, and channelization (USFWS, 2002).

Spike (*Elliptio dilatata*): The spike can be found in small to large streams and occasionally lakes in substrates ranging from gravel or mud in depths ranging from 2 to 24 feet (Cummings and Mayer, 1992; MNDNR, 2020). The spike is tachytictic, with females brooding their young from May to August before being released. Fish hosts include gizzard shad (*Dorosoma cepedianum*), flathead catfish, white crappie (*Pomoxis annularis*), black crappie (*Pomoxis nigromaculatus*), and yellow perch (*Perca flavescens*) (Fuller, 1974).

Tables 2 and 3 below provide the survey summary results for T&E species within ADI-1 and ADI-2 and their associated buffer zones, respectively.

Table 2. ADI-1 (North) and Associated Buffer Zone Survey Results Summary

Common Name	Scientific Name	Total Number of Individuals Collected	Average Valve Length (mm)	Minimum Valve Length (mm)	Maximum Valve Length (mm)
Monkeyface	<i>Quadrula metanevra</i>	140	69	35	101
Purple Wartyback	<i>Cyclonaias tuberculata</i>	389	53	5	90
Sheepnose	<i>Plethobasus cyphus</i>	12	84	65	98
Spike	<i>Elliptio dilatata</i>	3	72	23	101
Total		544			

Table 3. ADI-2 (South) and Associated Buffer Zone Survey Results Summary

Common Name	Scientific Name	Total Number of Individuals Collected	Average Valve Length (mm)	Minimum Valve Length (mm)	Maximum Valve Length (mm)
Monkeyface	<i>Quadrula metanevra</i>	21	62	45	98
Purple Wartyback	<i>Cyclonaias tuberculata</i>	152	50	15	104
Sheepnose	<i>Plethobasus cyphus</i>	2	72	59	85
Spike	<i>Elliptio dilatata</i>	1	38	38	38
Total		176			

C) Description of project activities that will result in taking of an endangered or threatened species, including practices and equipment to be used, a timeline of proposed activities, and any permitting reviews, such as a USFWS biological opinion or USACE wetland review. Please consider all potential impacts such as noise, vibration, light, predator/prey alterations, habitat alterations, increased traffic, etc.

Description of Proposed Activities

This ITA is requesting relocation of state-listed freshwater mussel species that are present within each ADI prior to mitigation activities (i.e., placement of grout-filled articulated mat armoring). During the proposed pipeline mitigation activities, federal and state-listed freshwater mussel species that are present within, or adjacent to, the area of proposed impact may be taken if not relocated from the impact area prior to armoring activities. If present during the armoring activities, the placement of riprap could crush individuals, resulting in a direct take. The planned diver-assisted placement of grout-filled articulated mats will reduce the possibility of misplacement of armoring material that could otherwise crush species outside of the ADI. It is possible that the placement of matting could cover suitable habitat, thereby removing it from the aquatic ecosystem. However, due to the high scour around the existing pipeline and the resultant loss of substrate adjacent to the pipe and within the ADI, the placement of grout-filled articulated mat armoring can also enhance the aquatic ecosystem by trapping rocks, gravel, and sand,

which may allow mussels to colonize the area. No cofferdams, in-stream excavation, or dewatering activities will occur during the project.

Permitting Activities

On behalf of EMPCo, Arcadis is concurrently coordinating the following permits:

- Verification of eligibility for coverage under the U. S. Army Corps of Engineers (USACE) Chicago District Regional Permit (RP) 7 and RP-9 for pipeline maintenance activities below the OHWM of the Kankakee River (Joint Permit Application).
- USACE Section 10 Authorization for work within a Section 10 Navigable Waterway.
- Illinois Department of Natural Resources/Office of Water Resources (IDNR/OWR) project approval pursuant to the Rivers, Lakes, and Streams Act (615 Illinois Compiled Statutes [ILCS] 5 and Illinois Administrative Code, Title 17: Conservation, Chapter I: Dept of Natural Resources, Part 3700 Construction in Floodways of Rivers, Lakes and Streams (Joint Permit Application);
- On February 16, 2017, the Illinois Environmental Protection Agency (IEPA) granted Section 401 certification, with conditions, for all Regional Permits, except for activities within a selected list of waterbodies, as noted in USACE RP-4 and RP-8. The project will be authorized under RP-7 and RP-9. Therefore, this project is covered under the existing Section 401 Water Quality Certification.
- IEPA National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permit authorization, if upland disturbance as defined by General NPDES Permit No. ILR10 will exceed 1 acre.
- IDNR, Office of Water Resources Floodway Permit, Part 3708 Floodway Construction in Northeastern Illinois
- Will-South Cook Soil Water Conservation District, Soil Erosion and Sediment Control Plan if required based on USACE permit review.
- Will County Land Use Department approval for work in the mapped 100-year floodplain.

Schedule

The anticipated length of time for completion of the pipeline armoring is approximately four weeks and is anticipated to begin in the third or fourth quarter of 2021 (late summer/early fall). However, rainfall and river flow can delay the start of the project until conditions are deemed safe for project crews to begin armoring activities. Once conditions are safe, construction crews will mobilize to the site. Installation of as-needed temporary timber mats along the proposed access routes and laydown/staging areas and other stormwater controls (BMPs) will take approximately four to five days to install. Heavy equipment will be mobilized to the site along with diving personnel. Once started, armoring activities are expected to last approximately two weeks. Once the project is complete, all equipment and materials will be removed from the project area and all areas temporarily disturbed during construction will be returned to pre-project contours and elevations to the extent practicable.

*D) Explanation of the anticipated **adverse effects on listed species**;*

- *How will the proposed actions impact each of the species' life cycle stages?*

The pipeline armoring activities will occur during the third or fourth quarter (late summer/early fall) of 2021, which is during the normally active biological period of freshwater mussels and prior to colder fall/winter temperatures that often signal downward embedment by mussels and reduced biological activity. The project schedule is short term and temporary and is not anticipated to adversely impact any particular freshwater mussel

species life cycle. However, during pipeline armoring activities, federal and state-listed freshwater mussel species that are present within, or adjacent to, the area of proposed impact may be taken if not relocated from the impact area prior to armoring activities. If present during the armoring activities, mussels living in the ADI could be crushed, dislodged, buried, or die from exposure during construction. Excavation could impact mussels through physical disturbance and being permanently covered by materials (e.g., burial from siltation/sedimentation), which may negatively affect respiration, feeding, and/or reproduction. In addition to these direct impacts, impacts from an accidental release of grout could include siltation and sedimentation, which may also negatively affect mussel respiration, feeding, and/or reproduction.

As described by Butler (2002), siltation and general sedimentation runoff has been implicated in the decline of stream mussel populations and specific biological impacts on mussels from excessive sediment include reduced feeding and respiratory efficiency from clogged gills, disrupted metabolic processes, reduced growth rates, increased substrate instability, limited burrowing activity, and physical smothering. In addition, mussels may be indirectly affected when increased turbidity significantly reduces the amount of light available for aquatic plant photosynthesis and the production of unionid food items. However, the BMPs and accidental grout release measures provided in **Appendix C** will preserve downstream water quality, outside of the ADI, and protect those mussels that are not relocated.

Additionally, the placement of grout-filled articulated mats could cover suitable habitat, thereby removing it from the aquatic ecosystem. However, due to the high scour around the existing pipeline and the resultant loss of substrate adjacent to the pipe and within the ADI, the placement of grout-filled articulated mat armoring can also enhance the aquatic ecosystem by trapping rocks, gravel, and sand, which may allow mussels to colonize the area.

- *Describe potential impacts to individuals and the population. Include information on the species life history strategy (life span, age at first reproduction, fecundity, recruitment, survival) to indicate the most sensitive life history stages.*

An abundance of freshwater mussels (14,359 individuals), representing 18 genera and 22 species, were observed during the 2020 mussel survey (Appendix D). Of those 14,359 individuals, 720 were T&E species, which included three state-listed species, the purple wartyback (n=541), monkeyface (n=161), and spike (n=4), and one federally listed species, sheepsnose (n=14). Based on the relative abundance of these species, no adverse impacts to the larger populations are anticipated from the project. However, individuals of these species may be impacted if they are not properly relocated outside of the area of direct impact. The long term reproductivity of each individual may or may not be affected by the relocation effort but could include delayed reproductive cycles or reduced fecundity.

- *Identify where there is uncertainty, place reasonable bounds around the uncertainty, and describe how the bounds were determined. For example, indicate if it is uncertain how many individuals will be taken, make a reasonable estimate with high and low bounds, and describe how those estimates were made.*

Freshwater mussels are generally sessile or exhibit low mobility relative to other species. The abundance and take estimates are based on site-specific survey data and are considered accurate and appropriate. Arcadis included a 70 percent depletion goal in the 2020 mussel relocation effort and will implement the same depletion goal during the proposed 2021 T&E mussel relocation effort. Therefore, the take estimates are considered relatively accurate. However, the greatest uncertainty involves whether the 70 percent depletion goal is

accurately achieved or misrepresents the overall population in some manner. Arcadis aims to overcome this uncertainty by implementing rigorous scientific methods, based on prevailing scientific literature, and carried out through exhaustive field survey efforts.

2) *Measures the applicant will take to **minimize and mitigate** that impact and the **funding** that will be available to undertake those measures, including, but not limited to -*

*A) Plans to **minimize the area affected** by the proposed action, the estimated **number of individuals** of each endangered or threatened species that will be taken, and the **amount of habitat affected** (please provide an estimate of area by habitat type for each species).*

Surveys, Relocation, and Handling

The proposed project was designed in a way that minimizes the in-stream project footprint and minimizes the amount of adverse in-stream impacts. Work activities will also be isolated to the existing pipeline ROW and only in those areas that warrant armoring (e.g., ADI-1 and ADI-2). The location of in-stream relocation efforts and subsequent pipeline armoring activities will be verified/ensured using a hand-help GPS unit capable of sub-meter accuracy. No work will occur until the location of the appropriate work area has been verified. EMPCo also assures that all work will occur in the known impact areas by implementing diver assisted placement of grout-filled articulated mats. Additionally, no in-stream excavation, cofferdams, or dewatering will occur.

The project will seek to minimize the effects of the pipeline armoring by Arcadis biologists conducting a second relocation in 2021, largely focused on relocating T&E species and incidental observations of non-listed mussel species. During the placement of armoring materials, divers will assist heavy equipment and hand-place riprap to further prevent adverse impacts and errant riprap placement. This will reduce the risk of armoring materials crushing individuals and prevent impacts to aquatic habitat outside of the ADI.

Surveys during the 2021 season will be conducted in a similar manner as in 2020, both visually and tactilely, but will implement qualitative search methods focused on finding and relocating T&E mussels within the ADI. The salvage relocation will also be conducted during favorable conditions when water temperature is at or above 59° Fahrenheit. Tactile surveys, or “brailing”, will consist of manually feeling the substrate for the presence of mussels on the surface, and to a depth of approximately 15 centimeters below the surface. The ADI will again be salvaged for mussels using the survey methods detailed in the Freshwater Mussel Survey and Relocation Report (**Attachment E**) and a multiple pass design to ensure >70 percent recovery of T&E mussels. This multi-pass method includes resurveying each ADI up to three times and has been shown to be effective under good conditions.

Biologist will document the size, sex, and life stage (e.g., age) of all collected individuals. At least 25 percent of all relocated state-listed mussels will be marked with a Passive Integrated Transponder (PIT) tag so that they may be found again in the subsequent monitoring efforts. All listed mussels will be transported in mesh bags approximately 4,500 feet upstream of the ADI (41.241642°, -88.109075°) to the mapped relocation site (**Figure 4**). All non-listed mussels will be relocated to the prior approved 2020 mussel relocation area, approximately 1,250 feet downstream of the ADI.

Prior to mussel relocation, qualified Arcadis mussel surveyors will survey the proposed upstream relocation site for suitable habitat (e.g., substrate conditions, water/flow conditions, mussel communities similar in species diversity and abundance). Surveys of the potential relocation site will ensure that habitat conditions are similar to the habitat within the ADI and site survey documentation will be provided to IDNR and USFWS prior to translocating any mussels to ensure the relocation habitat is suitable. Mussels collected during the survey will be periodically relocated before additional survey (as needed) to

reduce stockpiling and stress on freshwater mussels. When relocated, all listed mussel species will be properly placed within the new substrate (i.e., umbo down and posterior end facing out of the substrate) in the upstream relocation area. Non-listed mussel species will be properly broadcasted from a boat in the prior downstream relocation area.

Based on the 2020 survey results, the proposed 70 percent T&E relocation depletion in 2021, and the anticipated area of impact associated with ADI-1 and ADI-2, the total amount of take is estimated to be 210 individuals. **Table 4** provides additional information regarding T&E take estimates.

Table 4. Estimated Take of Threatened and Endangered Freshwater Mussels within ADI-1 and ADI-2.

Species	ADI-1 (North) 362 m ²		ADI-2 (South) 199 m ²		Total Number of Estimated Mussels in both ADI (561m ²)	Total Number of Estimated Mussels to be Salvaged / Relocated (70% depletion)	Estimated Take from Direct Impacts (30% missed mussels during salvage / relocation)
	Quantitative Sampling Density (No./m ²)*	Estimated Number of Mussels	Quantitative Sampling Density (No./m ²)*	Estimated Number of Mussels			
Monkeyface	0.35	127	0.22	44	171	120	51
Purple Wartyback	1.05	380	0.67	133	513	359	154
Sheepnose	0.0	12**	0.0	2**	14**	10	4
Spike	0.0	3**	0.0	1**	4**	3	1
Total (All Species)	1.40	522	0.89	180	702	492	210

*Density is based on extrapolation of quantitative sampling quadrats and includes results from all quadrats in both the ADI and survey buffer areas.

**No mussels were observed in the quantitative sample plots. Estimated number of mussels is the actual total number of mussels observed during the 2020 field survey across all survey methods (quantitative quadrats, semi-quantitative transects, and qualitative timed search). Actual potential take may be less than data shown.

Notes: ADI's will be surveyed to 70% depletion during the 2021 Survey and Relocation effort, which will occur prior to construction.

C) *Description of all measures to be implemented to avoid, minimize, and mitigate the effects of the proposed action on endangered or threatened species.*

- *Avoidance measures include working outside the species' habitat.*
- *Minimization measures include timing work when species is less sensitive, reducing the project footprint, or relocating species out of the impact area.*
- *Mitigation is additional beneficial actions that will be taken for the species such as needed research, conservation easements, propagation, habitat work, or recovery planning.*
- *It is the **applicant's responsibility to propose mitigation measures**. IDNR expects applicants to provide species conservation benefits 5.5 times larger than their adverse impact.*

Additional Mitigation

To minimize and mitigate the effects of the armoring activities on the T&E mussel species, a salvage effort will be completed within the two ADI locations to at least 70% efficiency. All listed and non-listed species will be relocated to the designated relocation area (**Figure 4**). In addition, EMPCo proposes the following impact mitigation measures.

- Diver-assisted hand placement of grout-filled articulated mats will occur to prevent uncontrolled placement of materials, which could damage existing pipeline and create additional environmental disturbances.
- No additional fill material will be placed within the project area (other than the two segments subject to the mitigation), and temporarily disturbed areas of the ROW will be returned to the pre-existing contours and elevations following project completion, where applicable.
- All associated equipment will be staged/stored outside of the river and above the OHWM in a controlled area in order to further minimize instream impacts.
- Work will be performed during low flow when there is less risk of misplacing armoring material that could otherwise crush individuals or destroy habitat.
- The pipeline armoring design will account for variability in water depths within the river and will be designed not to alter normal downstream flows or create a low-head damming effect within the river.
- The armoring height will be minimized to the extent practical and the proposed project will not adversely impact marine navigation or natural biological spawning cycles.
- Biologists will be on-site to monitor armoring activities during the duration of the project.
- Implementation of soil erosion control devices (BMPs) in the adjacent upland environment and sediment control devices within the in-stream environment. Biologists will also inspect and monitor these control devices during construction and post-construction site stabilization.

In addition to the mitigation measures above, EMPCo agrees to commit funds to the Illinois Wildlife Preservation Fund for research and conservation measures benefitting freshwater mussel resources in Illinois. EMPCo proposes to provide funds in the amount of \$30,000, which will be provided to the Wildlife Preservation Fund within 90 days of the approval of the ITA. Additional details of the payment will be developed and finalized once approved by IDNR under this ITA application.

*B) **Plans for management of the area** affected by the proposed action that will **enable continued use** of the area by endangered or threatened species by maintaining/re-establishing suitable habitat (for example, native species planting, invasive species control, use of other best management practices, restored hydrology, etc.).*

Following completion of the proposed mitigation armoring, the disturbed areas above the OHWM (i.e., the staging and access areas) will be returned to pre-construction conditions by reseeded, as needed, with native seed mix. Upland BMPs such as silt fencing or straw wattles will be used, as needed, to prevent sediment-laden runoff from entering the Kankakee River. If applicable (i.e., if upland disturbance exceeds 1 acre), upland BMP inspections and maintenance will be documented until final stabilization has been achieved per General NPDES Permit No. ILR10. The pipeline armoring design will not alter normal down stream flows or create low-head damming effect within the river. The natural hydrology of the Kankakee River will be unaffected by the proposed armoring activities. Armoring materials will discourage streambed scour, and over time allow finer sediment to fill back in and may provide suitable aquatic habitat for the listed species. Therefore, the proposed armoring of the pipeline is not anticipated to impact the continued use of the river segment for all listed T&E species.

*D) Plans for **monitoring** the effects of the proposed actions on endangered or threatened species, such as monitoring the species' survival rates, reproductive rates, and habitat before and after construction, include a plan for follow-up **reporting to IDNR**. Monitoring surveys should be targeted at reducing the uncertainty identified in Section 1.d.*

Approved biologists will be onsite during project armoring activities to provide construction monitoring as well as evaluating in-stream water quality and habitat conditions. Sediment curtains will be used instream, directly downstream of the ADI, to manage sediments and prevent downstream water quality impacts during project construction. Upland BMPs such as silt fencing or straw wattles will also be used, as needed, to prevent sediment-laden runoff from entering the Kankakee River from the upland workspace. If project coverage under Illinois Environmental Protection Agency (IEPA's) General Storm Water National Pollution Discharge Elimination System (NPDES) Permit for Construction Activities (ILR10) is applicable, upland BMP inspections and maintenance will be documented until final stabilization has been achieved per ILR10.

Post project mussel monitoring will also be conducted within the ADIs and relocation area to evaluate the salvage/relocation success. Monitoring surveys will be conducted for 10 years, with surveys being conducted every other year after the completion of construction and relocation, beginning in year 2 (i.e., years 2, 4, 6, 8, and 10). Three of the five monitoring events (years 2, 6, and 8) will include non-intrusive monitoring (limited excavation). Years 4 and 10 will have full excavations to record growth and confirm survivorship. The monitoring will evaluate both the impacts of the construction in the ADI and evaluate the success of the relocated population in the relocation area, as described below.

a. ADI Post-Construction Monitoring: The monitoring protocol for the site will be in general accordance with the approach used for the initial mussel survey but will only involve quantitative and qualitative methods (no transect searches). The quantitative method will evaluate mussel density and diversity within 0.25 square meter quadrats equidistantly spaced across the ADIs and the survey will only occur in the defined ADIs.

b. Relocated Mussels: Monitoring of relocated mussels will include a search for PIT-tagged individuals from the initial relocation effort within the relocation area. At least 50% of PIT tagged individuals will be found, excavated, checked for mortality, measured, and replaced into the substrate. If changes in the stream conditions do not allow for 50% recovery of PIT tagged individuals within the defined relocation area (e.g., because of predation; streambed scour; or if flood flow redistributes mussels downstream), these conditions will be documented and reported to IDNR and USFWS. Results of % recovery and mortality will be reported within 45 days of each monitoring event.

A monitoring report will be prepared to summarize the condition of mussel populations following each monitoring event and submitted to the IDNR and USFWS within 45 days of each monitoring event. The

population estimates will be used to evaluate the general success of the salvage/relocation effort and identify potential methods of improvement on future projects. The monitoring effort will also evaluate perceived changes in habitat following project completion and provide an assessment of the effects of those changes on mussel populations (as applicable). Additionally, post-project monitoring at the project site will compare mussel presence and diversity to pipeline protection projects (in similar sized river systems) that use rip rap, which was originally proposed. The monitoring will be done in a way that allows the mussel habitat benefits of the two pipeline protection methods to be compared to inform future projects.

*E) **Adaptive management practices** that will be used to deal with changed or unforeseen circumstances that may affect the endangered or threatened species.*

- *Adaptive management is a way to make decisions in the face of uncertainty by monitoring the uncertain element over time and adjusting to the new information. Adaptive management requires identifying objectives and uncertainties, thinking through a range of potential outcomes, developing triggers that will lead to different actions being taken, and monitoring to detect those triggers.*
- *Consider environmental variables such as flooding, drought, and species dynamics as well as other catastrophes. Management practices should include contingencies and specific triggers. Note: Not foreseeing any changes does not qualify as an adaptive management plan.*

Due to the limited extent of instream activities, and temporary effects of pipeline armoring, EMPCo does not anticipate any additional modifications to the in-stream habitat or additional impacts to the listed mussel species as a result of the project. The project area has experienced natural scour and erosion of the stream bed and loss of armoring materials due to normal stream flow and periodic high-velocity/intensity flood events over time. These erosive effects have exposed the existing pipeline, which creates a potential risk of pipeline damage which, in turn, could impact the aquatic ecosystem.

The proposed armoring activities will stabilize and protect the pipeline from continued erosion and scour. The streambed (other than the two segments subject to the mitigation) will be returned to pre-existing contours and elevations of the substrate, where possible. The project design, and associated BMPs, will not adversely impact marine navigation or natural biological spawning cycles. These armoring activities will further minimize the impacts to listed mussel species by reducing the potential for future streambed scour and degradation resulting in the loss of aquatic habitat. The armoring activities will also protect against pipeline damage due to exposure, which will help ensure that the aquatic wildlife, including listed mussel species, are not impacted by the consequences of potential pipeline damage.

EMPCo will continue to monitor its pipeline infrastructure to ensure operational safety and ROW management. Should any future changes to EMPCo infrastructure be proposed that may have the potential to impact listed mussel species, separate coordination would be initiated with IDNR. Future changes may include unforeseen erosion or armoring failure; scour of the existing mussel habitat within the pipeline ROW; changes in high or low flows. EMPCo currently conducts periodic operations and maintenance inspections on its pipelines to evaluate at-risk infrastructure and site conditions. EMPCo will continue to conduct these inspections within the project area.

*F) **Verification that adequate funding exists** to support and implement all minimization and mitigation activities described in the conservation plan. This may be in the form of bonds, certificates of insurance, escrow accounts, or other financial instruments adequate to carry out all aspects of the conservation plan.*

EMPCo has thoroughly reviewed, considered, and understands all constraints and conditions outlined in this conservation plan, including the potential costs associated with compliance to this plan. EMPCo understands that once the ITA is approved, and prior to beginning any instream work on this project, adequate funds will need to be allocated and accounted for to ensure that all of the terms and conditions of this ITA are covered. EMPCo has the financial strength to meet any obligations associated with this plan, as written. Insurance or bonding may often be required to show a potential source of funds available to meet an entity's contractual and/or legal obligations. Because of its financial strength, EMPCo has the ability to self-insure substantial risks, where permitted by law. The absence of outside insurance does not alter or reduce the legal responsibilities of contracting parties to one another or to third parties. If requested, a copy of EMPCo's Letter of Self Insurance can be provided. EMPCo has anticipated the minimization and mitigation requirements addressed within this conservation plan and understands that if changes are made to the project that could potentially impact new listed mussel species resources, additional coordination with IDNR would be required.

3) A description of **alternative actions** the applicant considered that would reduce take, and the reasons that each of those alternatives was not selected. A **"no-action" alternative** shall be included in this description of alternatives. Please describe the economic, social, and ecological tradeoffs of each action.

- Consideration of **alternative actions** is an important tool in conservation planning as it allows for thinking of other options and evaluating the potential outcomes in terms of all relevant objectives. However, to be useful it requires creativity in developing alternatives and systematic analysis in evaluating the alternatives.
- In evaluating alternatives, describe the economic, social, and ecological tradeoffs of each.

Proposed Action

Streambed scour conditions have led to reduced depth of cover over the existing S-232 Mustang Lockport to Patoka pipeline at its Kankakee River crossing. Natural scour of the streambed and migration of prior concrete bag pipe armoring over time has occurred due to normal stream flow and from periodic high velocity/intensity flood events. The mitigation of installing grout-filled articulated mat armoring over the existing pipeline at select areas of inadequate cover will protect the pipe from future scour. This mitigation method is based on similar mitigation projects throughout the country and provides proven long-term pipeline protection. The proposed impact avoidance measures are based on conditions observed within the project area, available biological resource information, and current scientific literature.

Alternative Action - 1

The first alternative action considered by EMPCo was the installation of the new pipeline using conventional open-cut pipe installation methods. However, this method was not considered a suitable approach for the project when compared to the Proposed Action. Although commonly and effectively used under certain circumstances, conventional pipe installation involves excavation within the streambed to create a trench for the placement of the new pipe. The existing pipeline would either be simultaneously removed, or properly abandoned in place. This method would also involve the use of coffer dams and bypass pumps to dewater the excavated workspace below the OHWM of the Kankakee River. This method would have the potential to cause greater short-term environmental impacts to wildlife and habitat due to the increased instream work activities. As a result, this alternative was not chosen as the preferred alternative.

No-action Alternative

The No-action alternative has the potential to result in continued stream bed scour, which may increase the potential for pipeline damage and impacts to the surrounding habitat and species present within the Kankakee River. As previously mentioned, the integrity of the current pipeline was determined to be sound and the pipe could safely remain in operation, if properly armored. As a result, this alternative was not chosen as the preferred alternative.

4) *Data and information to indicate that the proposed taking **will not reduce the likelihood of the survival** of the endangered or threatened species in the wild within the State of Illinois, the biotic community of which the species is a part, or the habitat essential to the species existence in Illinois.*

Arcadis submitted a Freshwater Mussel Survey and Relocation Plan to IDNR on September 21, 2020. Arcadis received IDNR's conditional approval of the plan and a Non-listed Mussel Salvage and Relocation Permit on September 29, 2020. Arcadis conducted the field survey from September 28th to October 7th, 2020. The subsequent freshwater mussel survey report was submitted to IDNR for review on December 4th, 2020. Please see the attached freshwater mussel survey report (Arcadis 2020) for complete findings (**Appendix D**).

5) *An **implementing agreement**, which shall include, but not be limited to (on a separate piece of paper containing signatures):*

A) Names and signatures of all participants in the execution of the conservation plan;

B) The obligations and responsibilities of each of the identified participants with schedules and deadlines for completion of activities included in the conservation plan and a schedule for preparation of progress reports to be provided to the IDNR;

C) Certification that each participant in the execution of the conservation plan has the legal authority to carry out their respective obligations and responsibilities under the conservation plan;

D) Assurance of compliance with all other federal, State and local regulations pertinent to the proposed action and to execution of the conservation plan;

E) Copies of any final federal authorizations for a taking already issued to the applicant, if any.

The following individuals will confirm that all actions proposed in this conservation plan will be effectively implemented and executed. EMPCo certifies that each of the following participants in the execution of this conservation plan has the legal authority to carry out their respective obligations and responsibilities under the conservation plan. The information provided herein is compliant with all other federal, state, and local regulations pertinent to the proposed action and execution of the conservation plan (as described above with regard to associated permitting actions). Copies of final federal authorizations for take will be provided in **Appendix D**, once received.

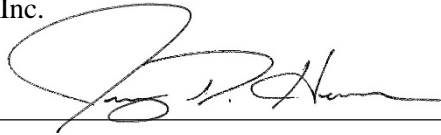
Clint Beck
Right of Way & Claims Manager
ExxonMobil Pipeline Company

Signature: Clint Beck

Mr. Devin Thibodeaux will serve as the EMPCo point of contact and implementation representative for the project. Mr. Thibodeaux will instruct staff of critical project considerations, permit requirements, and changes to project plans or regulatory guidance.

Jeremy Henson, CE
Ecology Group Leader/Principal Ecologist
Arcadis U.S., Inc.

Signature: _____



Mr. Henson will serve as the Arcadis point of contact and implementation representative for the project. Mr. Henson will provide technical oversight, ensure monitoring schedules are met, and instruct staff of critical project considerations, permit requirements, and changes to project plans or regulatory guidance.

References:

Arcadis. 2020. S-232 Mustang Lockport to Patoka Crude Oil Pipeline Repair – Kankakee River Crossing Project, Custer Park, Illinois, Freshwater Mussel Survey and Relocation Report. Created for ExxonMobil Pipeline Company. December 2020.

Butler R.S. 2002. Status Assessment Report for the Sheepnose, *Plethobasus cyphus*, Occurring in the Mississippi River system (U.S. Fish and Wildlife Service, Regions 3, 4, and 5).

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Fritts, Andrea & Sietman, Bernard & Hove, Mark & Rudh, Nissa & Davis, Mike & Heath, David. 2012. Early Life History and Conservation Status of the Monkeyface, *Theliderma metanevra* (Mollusca: Bivalvia) in Minnesota and Wisconsin. Walkerana. 15. 99-112. 10.31931/fmbc.v15i2.2012.99-112.

Fuller, S. L. H. 1974. Clams and mussels (Mollusca: Bivalvia). Pages 215-273 in C. W. Hart, Jr., and S. L. H. Fuller, editors. Pollution Ecology of Freshwater Invertebrates. Academic Press, New York.

Hove, M. and A.R. Kapuscinski. 1998. Ecological relationships between six rare Minnesota mussels and their host fishes. Final Report to the Minnesota Department of Natural Resources, Natural Heritage

Illinois Natural Heritage Database. 2020. Illinois Threatened and Endangered Species by County. Available online at <https://www2.illinois.gov/dnr/ESPB/Pages/default.aspx>. Accessed December 15, 2020.

Minnesota Department of Natural Resources (MNDNR). 2020. Rare Species Guide. Available online at <https://www.dnr.state.mn.us/rsg/index.html>. Accessed December 13, 2020.

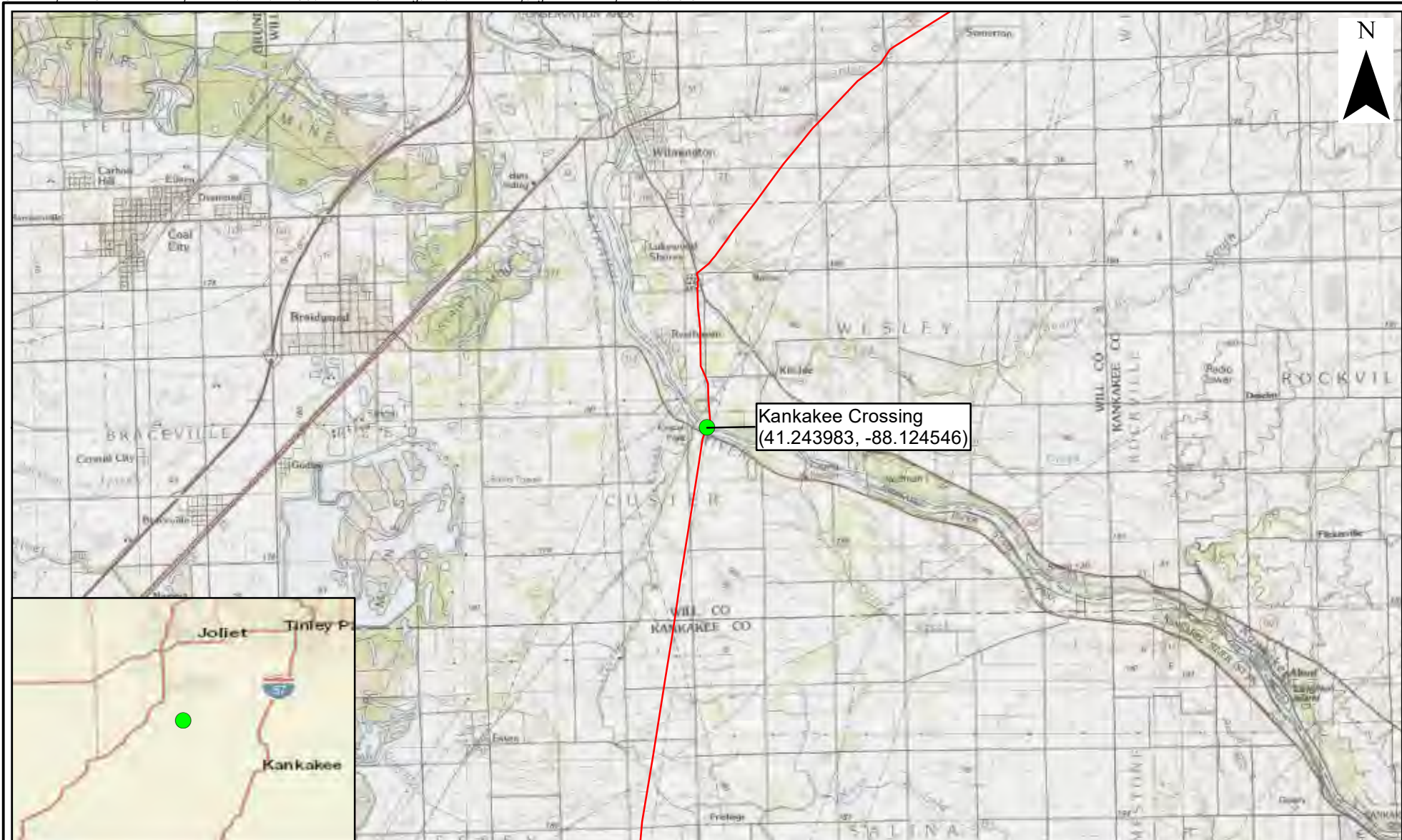
U.S. Fish and Wildlife Service (USFWS). 2019. Information for Planning and Consultation Tool (IPaC). Available online at <https://ecos.fws.gov/ipac/>. (Accessed August 24, 2020).

USFWS. 2002. Status Assessment Report for the sheepshead, *Plethobasus cyphus*, occurring in the Mississippi River system (U.S. Fish and Wildlife Service Regions 3, 4, and 5). Ohio River Valley Ecosystem Team.



PLEASE SUBMIT TO: Incidental Take Authorization Coordinator, Illinois Department of Natural Resources, Division of Natural Heritage, One Natural Resources Way, Springfield, IL, 62702 OR DNR.ITAcordinator@illinois.gov

July 2016

Figures



LEGEND

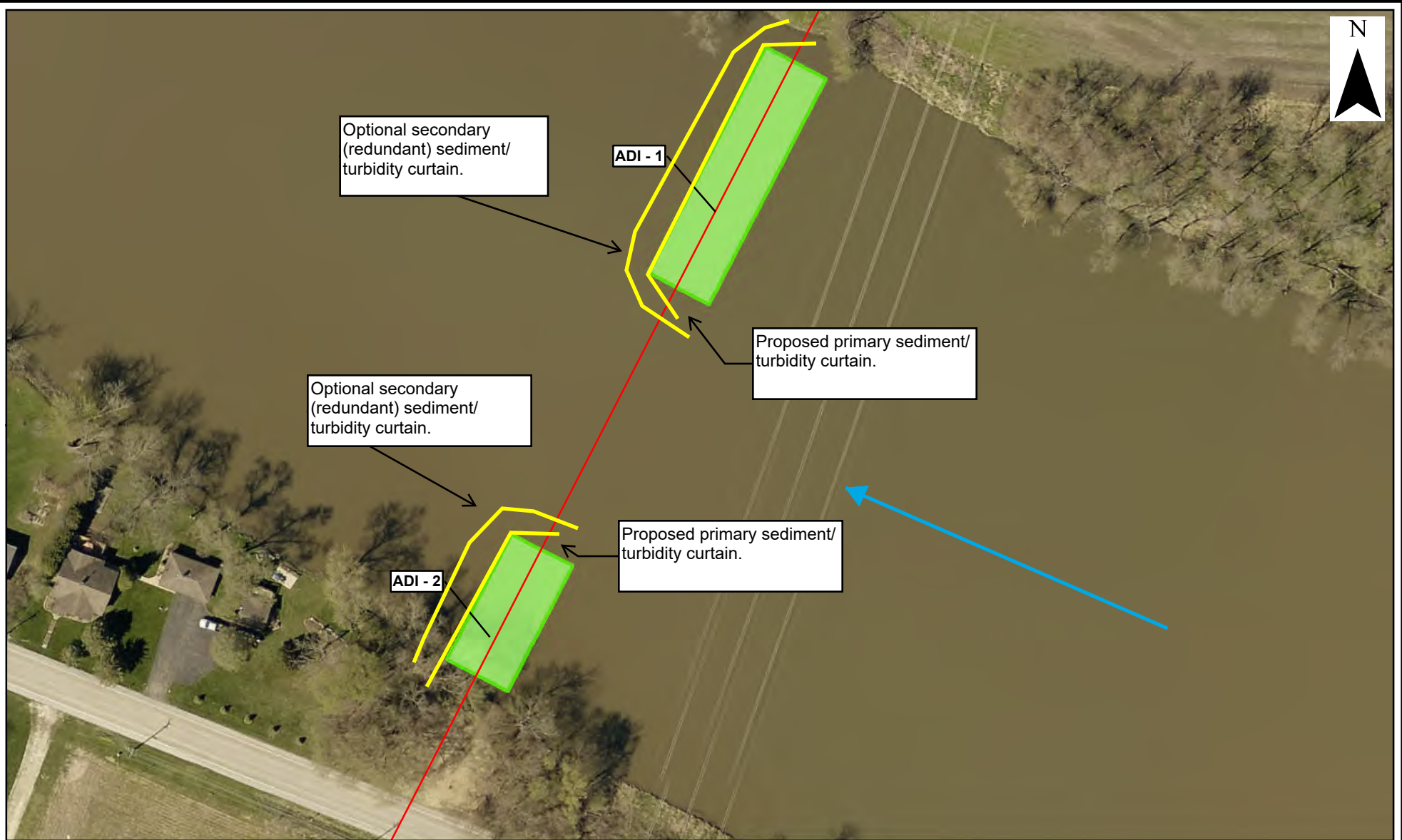
-  PIPELINE WATER CROSSING MUSSEL SURVEY LOCATION
-  EMPCO PIPELINE SYSTEM

EXXONMOBIL PIPELINE COMPANY
HOUSTON, TEXAS
KANKAKEE RIVER PIPELINE ARMORING PROJECT
WILL COUNTY, ILLINOIS




SITE VICINITY MAP

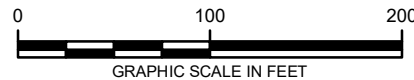


FIGURE
1



LEGEND

-  FLOW DIRECTION ARROW
-  EMPCO PIPELINE SYSTEM
-  AREA OF DIRECT IMPACT (ADI)









EXXONMOBIL PIPELINE COMPANY
HOUSTON, TEXAS
KANKAKEE RIVER PIPELINE ARMORING PROJECT
WILL COUNTY, ILLINOIS

SITE DETAILS MAP



FIGURE
2



- LEGEND**
-  FLOW DIRECTION ARROW
 -  EMPCO PIPELINE SYSTEM
 -  AREA OF DIRECT IMPACT (ADI)
 -  UPSTREAM BUFFER
 -  DOWNSTREAM BUFFER
 -  LATERAL BUFFER








EXXONMOBIL PIPELINE COMPANY
HOUSTON, TEXAS
KANKAKEE RIVER PIPELINE ARMORING PROJECT
WILL COUNTY, ILLINOIS

ADI BUFFER AREAS

 *Design & Consultancy for natural and built assets* | **FIGURE 3**



LEGEND

-  EMPCO PIPELINE SYSTEM
-  FLOW DIRECTION ARROW
-  RELOCATION AREA
-  AREA OF DIRECT IMPACT (ADI)
-  ADI BUFFER

EXXONMOBIL PIPELINE COMPANY
HOUSTON, TEXAS
KANKAKEE RIVER PIPELINE ARMORING PROJECT
WILL COUNTY, ILLINOIS

**NON-THREATENED AND ENDANGERED
MUSSEL RELOCATION AREA**

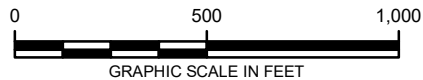
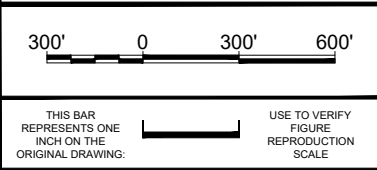


FIGURE
4

Appendix A:

Project Design Plan

CITY: DIV\GROUP: DB: LD: PIC: PM: TM: LYNONE=OFF=REF*
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No.	Date	Revisions	By	Ckd

Professional Engineer's Name		
Professional Engineer's No.		
State	Date Signed	Project Mgr.
Designed by	Drawn by	Checked by

DRAFT
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 CONSTRUCTION

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 ENGINEERING FIRM F-533
 ARCADIS U.S., INC.

ARTICULATING MAT MITIGATION DESIGN • WILL COUNTY, ILLINOIS
 S-232 MUSTANG LOCKPORT TO PATOKA CRUDE OIL PIPELINE AT THE KANKAKEE RIVER

SITE LOCATION MAP

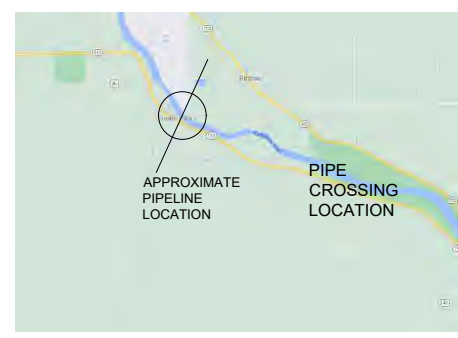
GENERAL

ARCADIS Project No. 30060311
Date APRIL 2021
ARCADIS U.S., INC 10205 WESTHEIMER RD. SUITE 800 HOUSTON, TX 77042 TEL: 713.953.4800

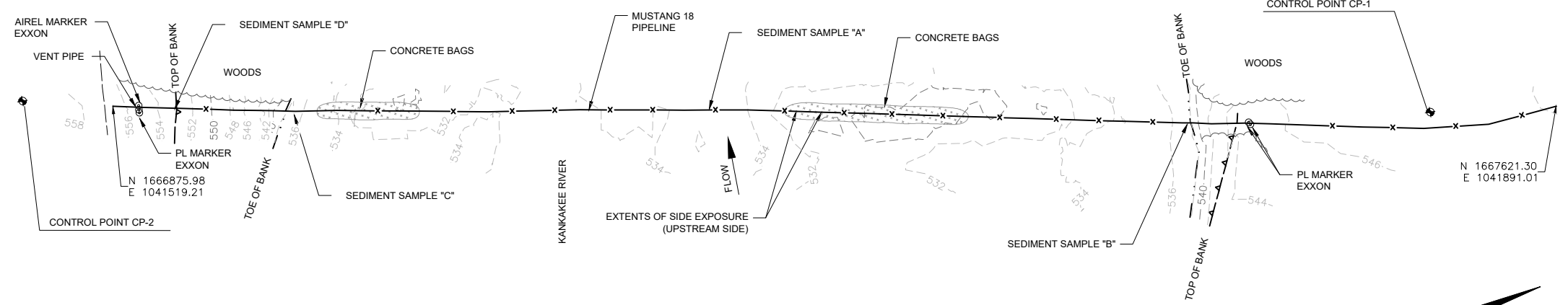
G-100

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 Grid, Arrows, Ruler, Xrefs, POOP-DESIGN-X-TITLE
 PROJECT NAME:

SOURCE:
 BASEMAP PROVIDED BY ARCADIS, INC SURVEY DATED 07/14/2020;
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 VERT: NAVD88



LOCATION MAP
NOT TO SCALE



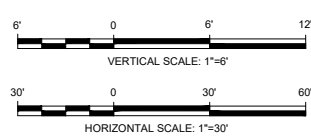
HORZ: NAD83 ILLINOIS STATE PLANES, EAST ZONE 1283-EF
 VERT: NAVD88
 GPS OBSERVATION: VRS VIRTUAL REFERENCE STATION (7/14/20)
 MINIMUM DEPTH OF COVER MEASUREMENT= 0
 SURVEY METHOD= TRIMBLE R10 GNSS ON THE VRS NETWORK

CONTROL POINT TABLE				
BM NO.	DESC	NORTH	EAST	ELEV.
CP-1	IRW/CAP	1667554.73	1041861.52	547.11
CP-2	60D NAIL	1666830.73	1041492.96	559.08

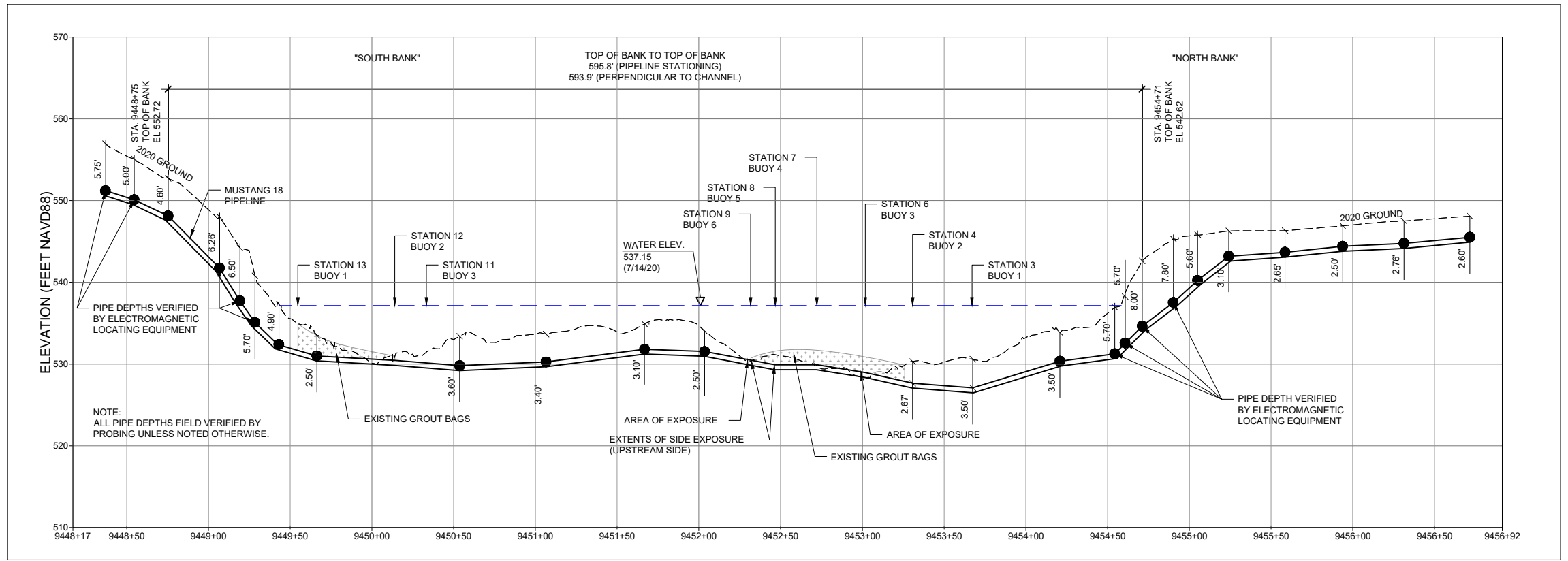
WATER SURFACE ELEVATION TABLE				
LOCATION	NORTH	EAST	ELEV.	DISTANCE TO PIPELINE
UPSTREAM	1667430.52	1041785.98	537.20	19'
DOWNSTREAM	1667421.46	1041818.24	537.11	15'

SEDIMENT SAMPLE TABLE			
SAMPLE #	NORTH	EAST	DEPTH
A	1667182.37	1041674.63	0-6"
B	1667427.45	1041804.09	0-6"
C	1666968.21	1041568.34	0-6"
D	1666906.22	1041536.73	0-6"

- LEGEND:
- x — x — 18" EMPCO PIPELINE
 - - - 532 - - - 1 FOOT CONTOUR INTERVAL
 - - - 550 - - - 5 FEET CONTOUR INTERVAL
 - - - - - TOP OF BANK
 - - - - - TOE OF BANK
 - [Pattern] EXISTING GROUT BAGS
 - [Pattern] EXISTING GROUND



PIPE DESCRIPTION: 18"
 18" O.D.
KANKAKEE RIVER, IL



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CONSTRUCTION**

ARCADIS
 Design & Consultancy
 For natural and built assets
 TEXAS REGISTERED
 ENGINEERING FIRM F-533
 ARCADIS U.S., INC.

ARTICULATING MAT MITIGATION DESIGN • WILL COUNTY, ILLINOIS
 S-232 MUSTANG LOCKPORT TO PATOKA CRUDE OIL PIPELINE AT THE KANKAKEE RIVER

SURVEY CONTROL SHEET

GENERAL

ARCADIS Project No.
 30060311
 Date
 APRIL 2021
 ARCADIS U.S., INC
 10205 WESTHEIMER RD.
 SUITE 800
 HOUSTON, TX 77042
 TEL: 713.953.4800

G-101

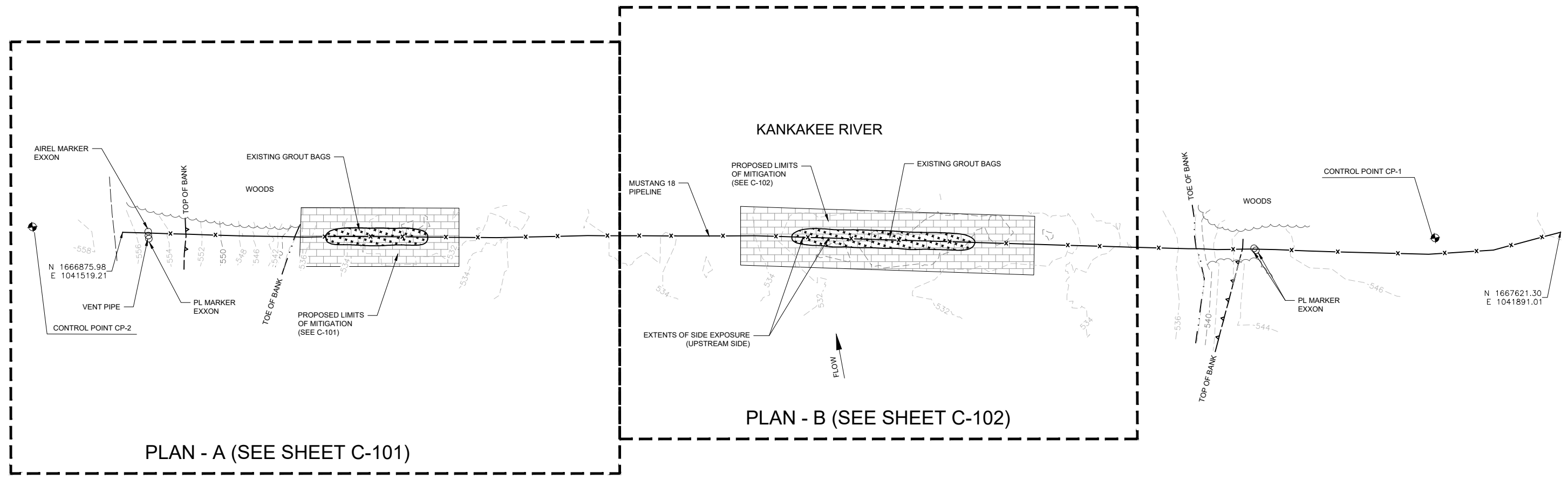
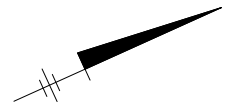
No.	Date	Revisions	By	Ckd

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 AND MAY NOT BE REUSED OR ALTERED IN WHOLE OR IN PART WITHOUT THE
 EXPRESS WRITTEN PERMISSION OF SAME.

Professional Engineer's Name
 Professional Engineer's No.
 State Date Signed Project Mgr.
 Designed by Drawn by Checked by

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING. USE TO VERIFY FIGURE REPRODUCTION SCALE.

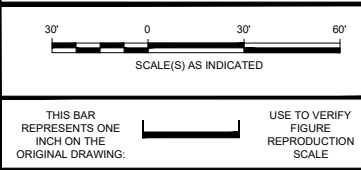
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LEGEND:

—x—x—x—	MBGB PIPELINE
---12---	1 FOOT CONTOUR INTERVAL
---15---	5 FEET CONTOUR INTERVAL
---▽---	TOP OF BANK
---···---	TOE OF BANK
[Hatched Box]	PROPOSED LIMITS OF MATS

SOURCE:
 BASEMAP PROVIDED BY ARCADIS, INC SURVEY DATED 07/14/2020;
 HORZ: NAD83 ILLINOIS STATE PLANES, EAST ZONE 1283-EF
 VERT: NAVD88



No.	Date	Revisions	By	Ckd

Professional Engineer's Name		
Professional Engineer's No.		
State	Date Signed	Project Mgr.
Designed by	Drawn by	Checked by

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NOT FOR
CONSTRUCTION**

TEXAS REGISTERED
 ENGINEERING FIRM F-533
 ARCADIS U.S., INC.

ARTICULATING MAT MITIGATION DESIGN • WILL COUNTY, ILLINOIS
 S-232 MUSTANG LOCKPORT TO PATOKA CRUDE OIL PIPELINE AT THE KANKAKEE RIVER
EXISTING OVERALL SITE PLAN
 CIVIL

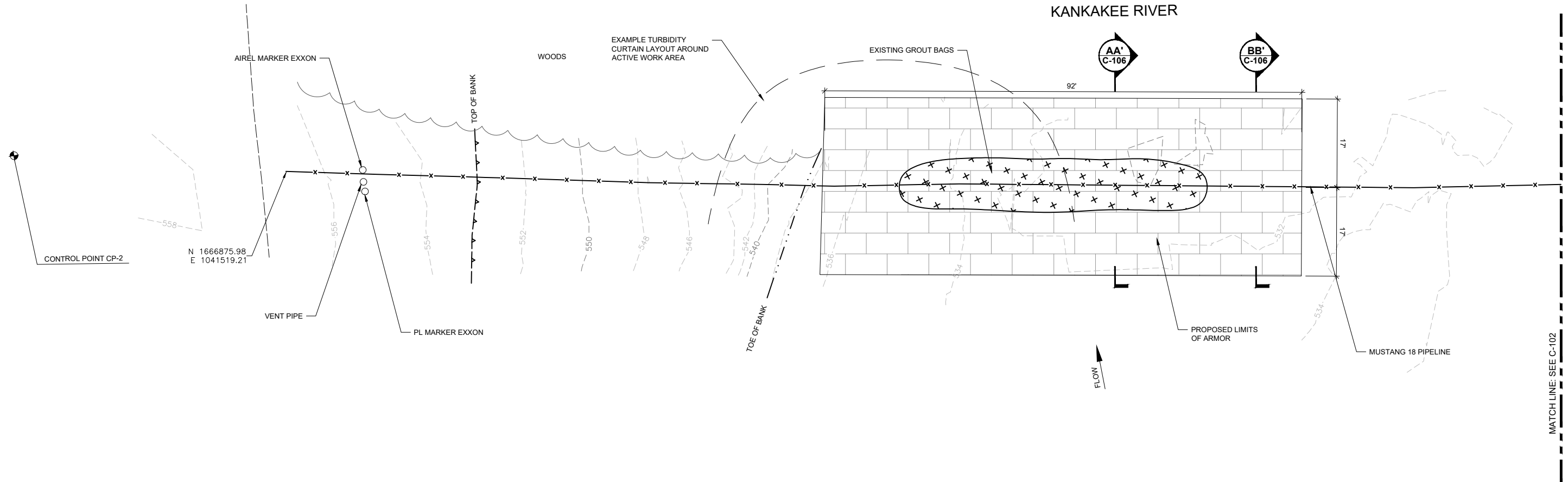
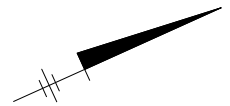
ARCADIS Project No. 30060311
Date APRIL 2021
ARCADIS U.S., INC 10205 WESTHEIMER RD. SUITE 800 HOUSTON, TX 77042 TEL: 713.953.4800

C-100

CITY: DIV/GRUP: DB: LD: PIC: PM: T.M: L.YR ON="OFF" REF: C:\Users\larsar64739\BIM_360\arcadis\AUS-EXXONMOBIL-KANKAKEE RIVER-WILL COUNTY\Project Files\202101-1\Progress\01-DWG\PCOP-DESIGN-DRC\101-PROPOSED PLANS AND PROFILES.dwg LAYOUT: C-101 SAVED: 4/28/2021 12:43 PM ACADVER: 23.1.S (LMS TECH) PAGES: 23 PAGES SETUP: ---
 XREFS: IMAGES: PROJECT NAME: ---
 B10: COOP-DESIGN-X-TITLE
 PCOP-DESIGN-X-BASE

NOTES:

1. CONTRACTOR SHALL, VIA DIVERS, CONFIRM THE CONDITIONS ARE THE SAME AS REPRESENTED IN SURVEY PERFORMED 7/14/2020.
2. DIVERS SHALL IDENTIFY ANY LARGE DEBRIS LOCATED WITHIN PROPOSED MAT FOOTPRINT (SUCH AS TREES) AND REMOVE PRIOR TO MAT PLACEMENT.



LEGEND:

—x—x—	MBGB PIPELINE
---12---	1 FOOT CONTOUR INTERVAL
---15---	5 FEET CONTOUR INTERVAL
---▲---▲---	TOP OF BANK
---●---●---	TOE OF BANK
~~~~~	TREE LINE
[Grid]	PROPOSED LIMITS OF MATS

**SOURCE:**  
 BASEMAP PROVIDED BY ARCADIS, INC SURVEY DATED 07/14/2020;  
 HORZ: NAD83 ILLINOIS STATE PLANES, EAST ZONE 1283-EF  
 VERT: NAVD88



No.	Date	Revisions	By	Ckd

Professional Engineer's Name		
Professional Engineer's No.		
State	Date Signed	Project Mgr.
Designed by	Drawn by	Checked by

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NOT FOR  
CONSTRUCTION**

TEXAS REGISTERED  
ENGINEERING FIRM F-533  
ARCADIS U.S., INC.

ARTICULATING MAT MITIGATION DESIGN • WILL COUNTY, ILLINOIS  
 S-232 MUSTANG LOCKPORT TO PATOKA CRUDE OIL PIPELINE AT THE KANKAKEE RIVER

**PROPOSED SITE PLAN - A**

CIVIL

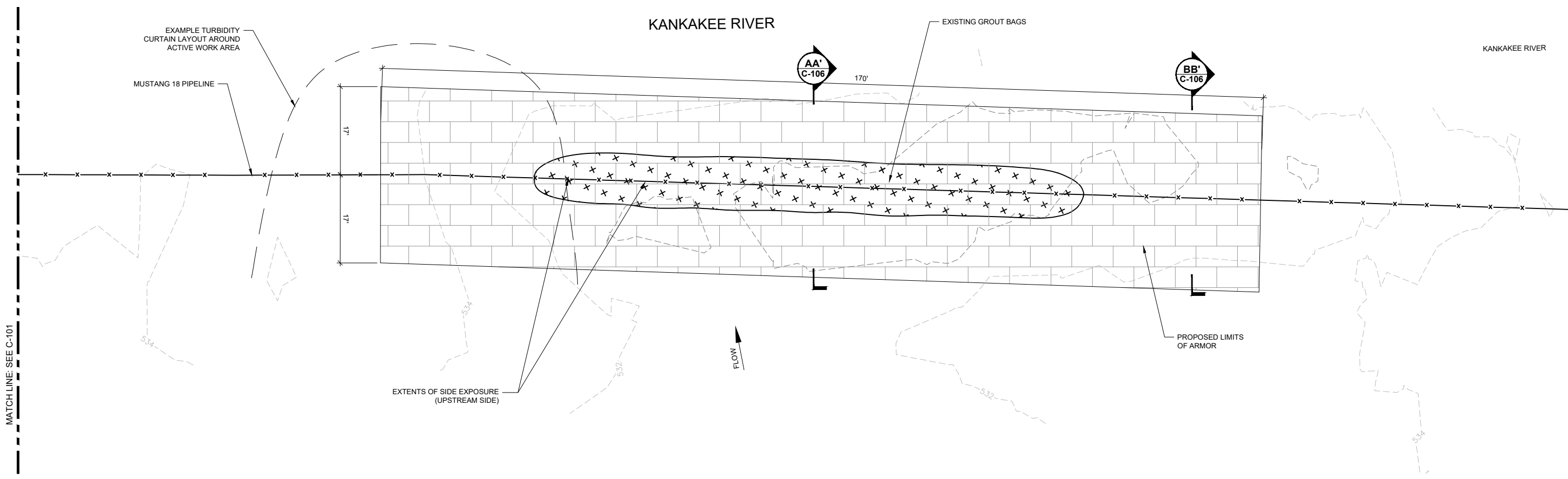
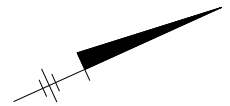
ARCADIS Project No. 30060311
Date APRIL 2021
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**C-101**

MATCH LINE: SEE C-102

CITY: D:\GROUP: DB: LD: PIC: PM: T.M: LYRON+OFF+REF+ C:\Users\lraar6739\BIM_360\arcadis\AUS-EXXONMOBIL-KANKAKEE RIVER-WILL COUNTY\Project Files\202101-1n Progress\01-DWG\PCOP-DESIGN-DRG-101-PROPOSED PLANS AND PROFILES.dwg LAYOUT: C-102 SAVED: 4/28/2021 12:43 PM ACADYER: 231S (LMS TECH) PAGES: 1 OF 1  
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 XREFS: IMAGES: PROJECTNAME: ---  
 910 PCOP-DESIGN-X-TITLE  
 PCOP-DESIGN-X-BASE

- NOTES:**
1. CONTRACTOR SHALL, VIA DIVERS, CONFIRM THE CONDITIONS ARE THE SAME AS REPRESENTED IN SURVEY PERFORMED 7/14/2020.
  2. DIVERS SHALL IDENTIFY ANY LARGE DEBRIS LOCATED WITHIN PROPOSED MAT FOOTPRINT (SUCH AS TREES) AND REMOVE PRIOR TO MAT PLACEMENT.



- LEGEND:**
- x—x—x— MBGB PIPELINE
  - - - 12 - - - 1 FOOT CONTOUR INTERVAL
  - - - 15 - - - 5 FEET CONTOUR INTERVAL
  - ▲-▲-▲-▲- TOP OF BANK
  - TOE OF BANK
  - [Grid Pattern] PROPOSED LIMITS OF MATS

**SOURCE:**  
 BASEMAP PROVIDED BY ARCADIS, INC SURVEY DATED 07/14/2020;  
 HORZ: NAD83 ILLINOIS STATE PLANES, EAST ZONE 1283-EF  
 VERT: NAVD88



No.	Date	Revisions	By	Ckd

Professional Engineer's Name		
Professional Engineer's No.		
State	Date Signed	Project Mgr.
Designed by	Drawn by	Checked by

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 ARCADIS U.S., INC.

ARTICULATING MAT MITIGATION DESIGN • WILL COUNTY, ILLINOIS  
 S-232 MUSTANG LOCKPORT TO PATOKA CRUDE OIL PIPELINE AT THE KANKAKEE RIVER

**PROPOSED SITE PLAN - B**

CIVIL

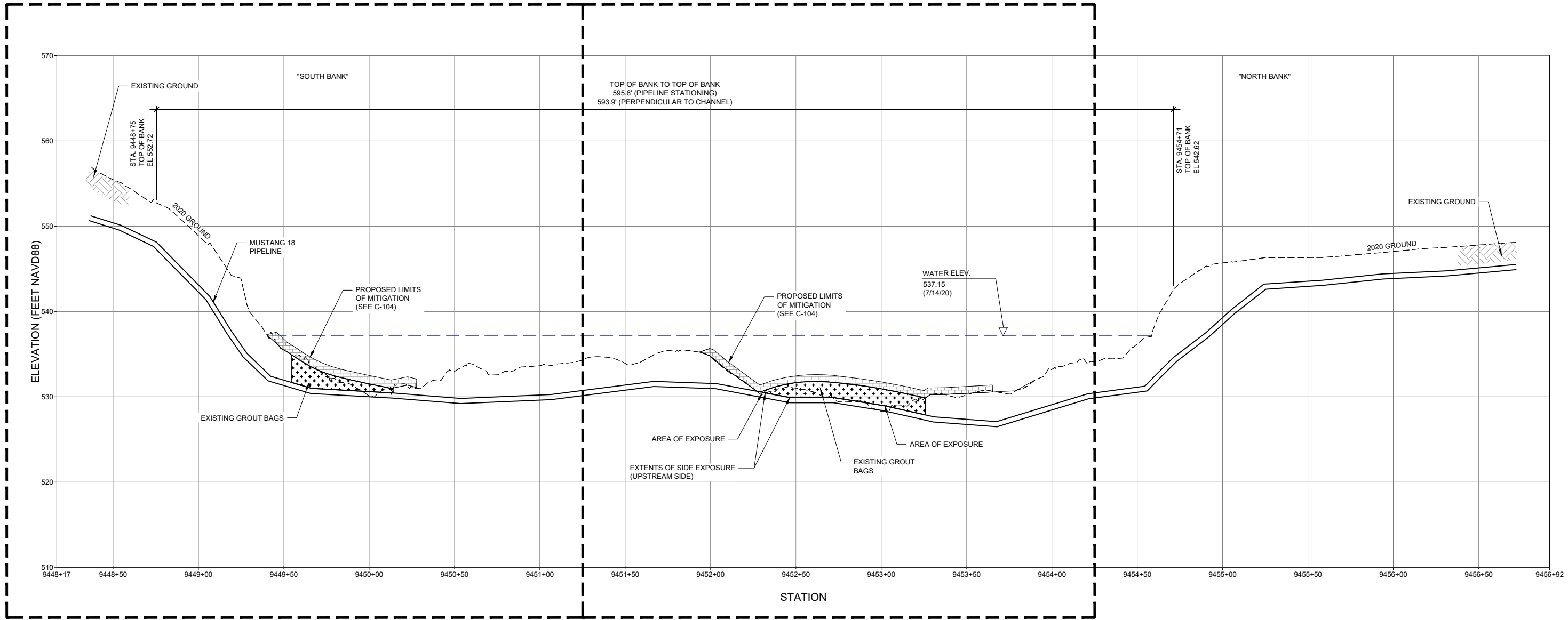
ARCADIS Project No. 30060311
Date APRIL 2021
ARCADIS U.S., INC 10205 WESTHEIMER RD. SUITE 800 HOUSTON, TX 77042 TEL: 713.953.4800

**C-102**

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYN ON=OFF=REF: C:\Users\lraarack\OneDrive\Documents\Projects\Will County\Illinois\Project Files\2021\01\In Progress\01-DWG\PCOP-DESIGN-DRC100&C103\EXISTING OVERALL PLAN AND PROFILE.dwg LAYOUT: C-103 SAVED: 4/28/2021 12:25 PM ACADVER: 23.1S (LMS TECH) PLOTSETUP: --- PLOTSTYLETABLE: AUS-NC\SIMOD FULL MONO.CTB PLOTTED: 4/28/2021 12:38 PM BY: S HASARE, KAREPPA XREFS: IMAGES: PROJECTNAME: ---

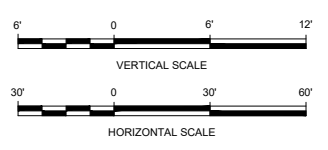
PROFILE - A (SEE SHEET C-104)

PROFILE - B (SEE SHEET C-105)



**LEGEND:**

- EXISTING GROUT BAGS
- EXISTING GROUND
- PROPOSED LIMITS OF MATS
- 18" EMPCO PIPELINE



SOURCE:  
 BASEMAP PROVIDED BY ARCADIS, INC SURVEY DATED 07/14/2020;  
 HORZ: NAD83 ILLINOIS STATE PLANES, EAST ZONE 1283-EF  
 VERT: NAVD88

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Professional Engineer's Name		
Professional Engineer's No.		
State	Date Signed	Project Mgr.
Designed by	Drawn by	Checked by

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ARTICULATING MAT MITIGATION DESIGN • WILL COUNTY, ILLINOIS  
 S-232 MUSTANG LOCKPORT TO PATOKA CRUDE OIL PIPELINE AT THE KANKAKEE RIVER

**EXISTING OVERALL PROFILE**

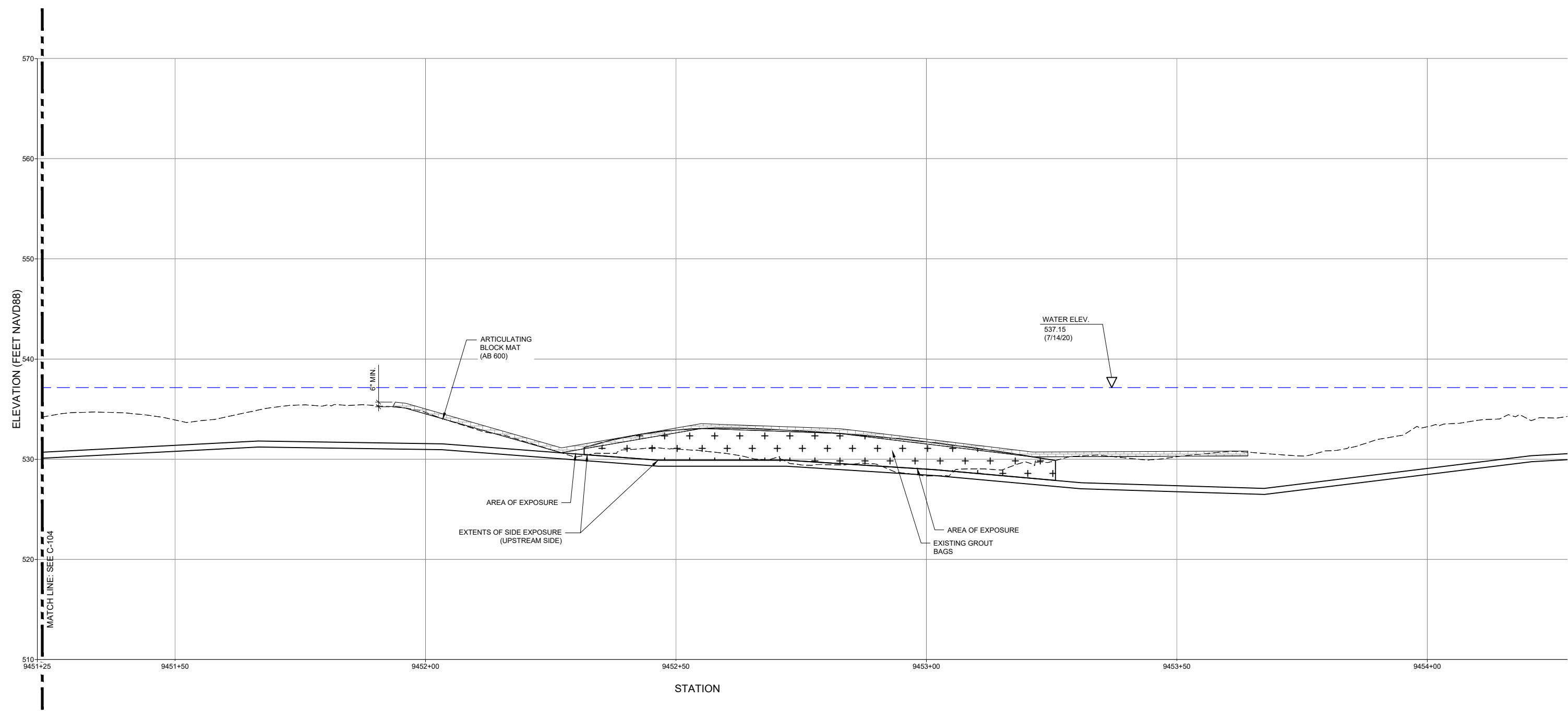
CIVIL

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Date APRIL 2021
ARCADIS U.S., INC 10205 WESTHEIMER RD. SUITE 800 HOUSTON, TX 77042 TEL: 713.953.4800

**C-103**



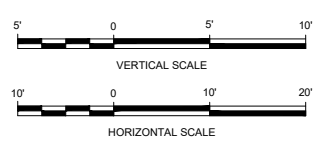
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 XREFS: IMAGES: PROJECTNAME: ---  
 S:\COP-DESIGN\X-TITLE  
 PCOP-DESIGN\X-BASE



**LEGEND:**

	EXISTING GROUT BAGS
	6" ARTICULATING MATS
	EXISTING GROUND
	18" EMPCO PIPELINE

- NOTES:**
1. EXTEND RIP RAP IN BOTH DIRECTIONS TO A POINT WHERE THERE IS APPROXIMATELY 3' OF EXISTING COVER OVER THE PIPELINE.
  2. ENSURE THAT THE SURFACE IS SMOOTH AND FREE OF LARGE OBJECTS OR DISTINCT CHANGES IN ELEVATION PRIOR TO PLACING MATS.



**SOURCE:**  
 BASEMAP PROVIDED BY ARCADIS, INC SURVEY DATED 07/14/2020;  
 HORZ: NAD83 ILLINOIS STATE PLANES, EAST ZONE 1283-EF  
 VERT: NAVD88

Professional Engineer's Name			
Professional Engineer's No.			
State	Date Signed	Project Mgr.	
Designed by	Drawn by	Checked by	
No.	Date	Revisions	By Ckd

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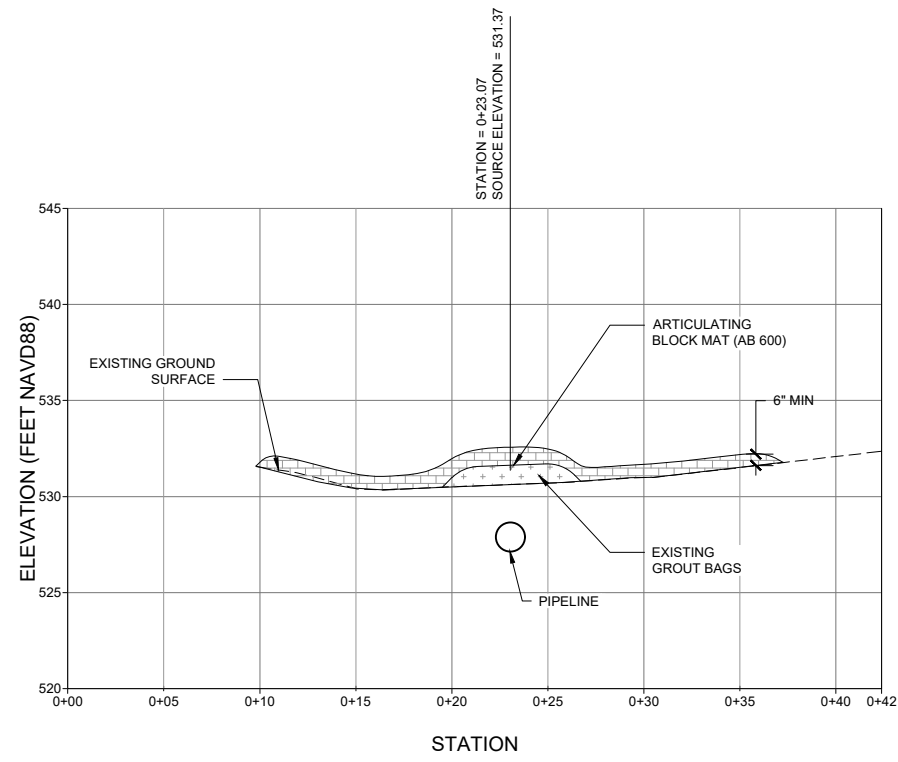
ARTICULATING MAT MITIGATION DESIGN • WILL COUNTY, ILLINOIS  
 S-232 MUSTANG LOCKPORT TO PATOKA CRUDE OIL PIPELINE AT THE KANKAKEE RIVER

**PROPOSED PROFILE - B**

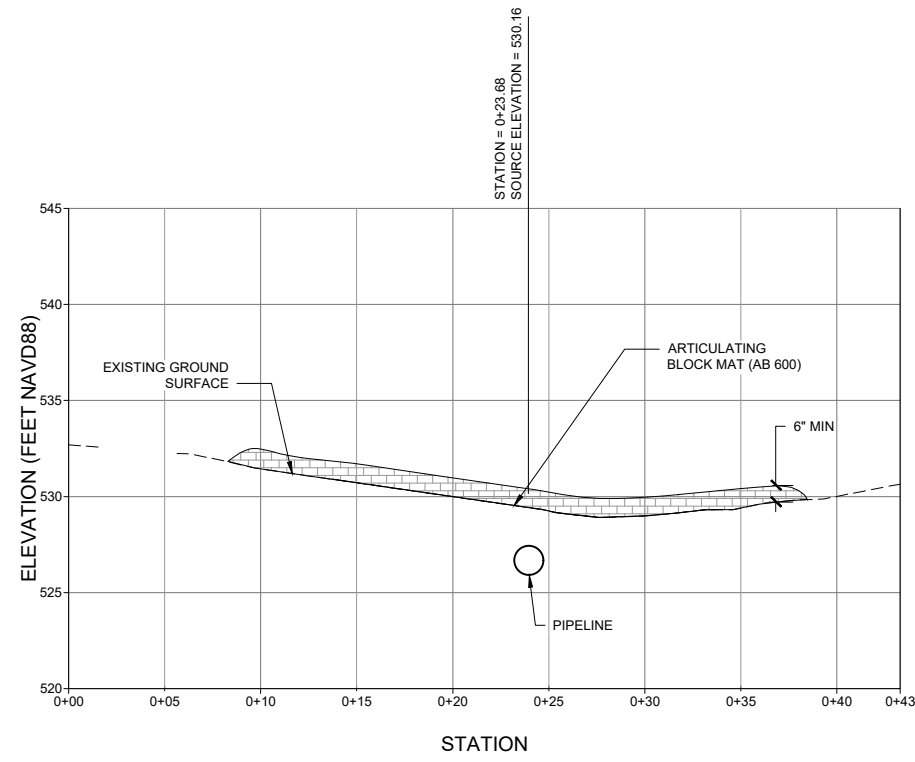
CIVIL

ARCADIS Project No. 30060311	<b>C-105</b>
Date APRIL 2021	
ARCADIS U.S., INC 10205 WESTHEIMER RD. SUITE 800 HOUSTON, TX 77042 TEL: 713.953.4800	

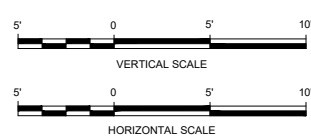
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 XREFS: IMAGES: PROJECTNAME: ---  
 BIG: COOP-DESIGN-X-TITLE  
 PCOP-DESIGN-X-BASE



**TYPICAL CROSS SECTION AA'  
 THROUGH EXISTING GROUT BAGS**



**TYPICAL CROSS SECTION BB' THROUGH  
 AREA WITHOUT GROUT BAGS**



**LEGEND:**  
 ARTICULATING BLOCK MAT (AB 600)  
 EXISTING GROUT BAGS

**SOURCE:**  
 BASEMAP PROVIDED BY ARCADIS, INC SURVEY DATED 07/14/2020;  
 HORZ: NAD83 ILLINOIS STATE PLANES, EAST ZONE 1283-EF  
 VERT: NAVD88

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Professional Engineer's No.		
State	Date Signed	Project Mgr.
Designed by	Drawn by	Checked by

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 S-232 MUSTANG LOCKPORT TO PATOKA CRUDE OIL PIPELINE AT THE KANKAKEE RIVER

**PROPOSED CROSS SECTIONS**

CIVIL

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**C-106**





CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYRON+ OFF=REF* C:\Users\lhasare\OneDrive\Documents\ARCADIS\EXXONMOBIL\KANKAKEE RIVER\WILL COUNTY - ILLINOIS\Project Files\202101-In Progress\01-DWG\PCOP-DESIGN-DRG\100-SJ.M.dwg LAYOUT: C-200 SAVED: 4/28/2021 1:09 PM ACADVER: 23.1S (LMS TECH) PAGES: 23 PLOTSTYLETABLE: AUS: NCSMOD FULL MONO.CTB PLOTTED: 4/28/2021 1:11 PM BY: S HASARE, KAREPPA PROJECTNAME: PCOP-DESIGN-X-TITLE PCOP-DESIGN-X-BASE

**BASIS OF DESIGN AND NOTES:**

**GENERAL:**

1. SURVEY DRAWING PROVIDED BY ARCADIS, INC. WITH A DATE OF SURVEY OF 7/14/2020.
2. VERIFY EXISTING CONDITIONS AND DIMENSIONS AND NOTIFY ENGINEER OF ANY CONDITIONS WHICH DO NOT COMPLY WITH PLANS AND SPECIFICATIONS.
3. THE BODY OF WATER AT THE CROSSING IS CONSIDERED A NAVIGATIONAL WATER WAY.

**STREAM GEOMORPHOLOGY:**

1. THE HYDROLOGY, HYDRAULICS, AND SCOUR FOR THE 100YEAR FLOOD EVENT WERE PROVIDED BY EMPCO:
  - a. DISCHARGE: 68,000 CUBIC FEET PER SECOND
  - b. AVERAGE CHANNEL VELOCITY: 5.15 FEET PER SECOND
  - c. VELOCITY AT THE TOP OF PIPE: 4.69 FEET PER SECOND
  - d. TOTAL MAXIMUM POTENTIAL SCOUR DEPTH: 3.0 FEET

**GEOTECHNICAL**

PER THE UNDERWATER INSPECTION REPORT PREPARED BY J.F. BRENNAN COMPANY, INC. FROM AN INSPECTION PERFORMED ON 7/28/2020, THE RIVER BOTTOM CONSISTED OF SAND AND SMALL GRAVEL, WITH SCATTERED ROCKS MEASURING APPROXIMATELY 3-4 INCHES.

**ARTICULATING BLOCK MATS:**

1. USE SYNTHETEX HYDROTEX ARTICULATING BLOCK MATS (AB600) WITH  $\frac{3}{8}$ " DIAMETER POLYESTER CABLES.

SYNTHETEX  
 5550 TRIANGLE PARKWAY  
 SUITE 220 PEACHTREE CORNERS,  
 GEORGIA 30092 USA.  
 TEL: 770-399-5051

2. REFER TO MANUFACTURER'S SPECIFICATIONS FOR FABRIC AND CABLES FOR QUALITY CONTROL.
3. GROUT FOR ARTICULATING BLOCK MATS, REFER TO MANUFACTURER'S SPECIFICATIONS. ANY PRODUCTS USED SHALL BE NON-TOXIC.

**ROCK GUARD:**

1. CONTRACTOR SHALL, VIA DIVERS, CONFIRM THAT THE PIPELINE HAS ROCK GUARD @ OR SIMILAR PROTECTION INSTALLED AROUND THE PIPELINE WHERE THE PIPELINE IS EXPOSED. IF NO ROCK GUARD IS FOUND, CONTRACTOR SHALL INSTALL NEW ROCK GUARD @ (15 FEET WIDE) OVER EXPOSED PIPE.
2. ROCK GUARD MATERIAL SHALL BE "ROCK GURD @ SD" FROM INDUSTRIAL FABRICS, INC. OR AN EXXONMOBIL APPROVED EQUAL.

**MONITORING PLAN:**

1. CONDUCT A SURVEY OF THE ARMOR EXTENTS IMMEDIATELY FOLLOWING CONSTRUCTION
2. FOLLOW THIS INSPECTION PLAN:
  - a. CONDUCT A PROFESSIONAL SURVEY OF THE CHANNEL BOTTOM AT LEAST ONCE EVERY FIVE YEARS TO VERIFY THAT THERE ARE NO CHANGES IN ARMOR ELEVATIONS THAT WOULD INDICATE SCOUR AND/OR EROSION.
  - b. CONFIRM THIS PLAN IS IN AGREEMENT WITH THE WATER CROSSING PROGRAM MONITORING PLAN BASED ON RECLASSIFICATION FOLLOWING MITIGATION IMPLEMENTATION.
3. AS DETERMINED BY INSPECTION, ADDITIONAL ARMOR WILL BE PLACED TO MAINTAIN THE REQUIRED MINIMUM THICKNESS, AS NECESSARY.

**CONSTRUCTION OBSERVATION:**

TO PROPERLY MONITOR CONSTRUCTION PROGRESS, QUALITY, DESIGN CONFORMANCE, AND TO MAINTAIN CONSISTENT COMMUNICATION BETWEEN ALL PARTIES, THE ENGINEER OR A DESIGNATED ENGINEER'S REPRESENTATIVE WILL PROVIDE OBSERVATION DURING CONSTRUCTION. THE PRIMARY RESPONSIBILITY OF THE ENGINEER WILL BE TO APPROPRIATELY AND EFFICIENTLY RESOLVE TECHNICAL, SCHEDULING, COORDINATION, AND CONSTRUCTABILITY ISSUES. THE ENGINEER WILL ALSO BE RESPONSIBLE FOR THE FOLLOWING:

1. AS REQUIRED AND REQUESTED BY PROJECT OWNER, REVIEW FIELD CHANGE ORDERS TO PROPERLY TRACK AND ADDRESS VARIABLE FIELD CONDITIONS. FIELD CHANGE ORDER CONDITIONS WILL BE COMMUNICATED IMMEDIATELY WITH OWNER.
2. ASSIST WITH RESOLVING PROBLEMS DUE TO ACTUAL FIELD CONDITIONS ENCOUNTERED.

**TURBIDITY CURTAINS:**

1. TYPE III TURBIDITY CURTAINS SHALL BE IN-PLACE DOWNSTREAM OF THE ACTIVE CONSTRUCTION AREA PRIOR TO THE PUMPING OF GROUT TO FORM THE ARTICULATING BLOCK MATS.
2. TURBIDITY CURTAINS SHALL EXTEND THE ENTIRE DEPTH OF THE RIVER.

**TABLE OF QUANTITIES:**

DESCRIPTION	UNITS	QUANTITY
AB 600 SYNTHETEX ARITICULATING BLOCK FABRIC AREA	SQ. FEET	11,300
GROUT FOR ARTICULATING BLOCK MATS	CUBIC YARDS	175

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USE TO VERIFY FIGURE REPRODUCTION SCALE

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Professional Engineer's No.		
State	Date Signed	Project Mgr.
Designed by	Drawn by	Checked by

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for natural and built assets

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ARCADIS U.S., INC.

ARTICULATING MAT MITIGATION DESIGN • WILL COUNTY, ILLINOIS  
 S-232 MUSTANG LOCKPORT TO PATOKA CRUDE OIL PIPELINE AT THE KANKAKEE RIVER

**GENERAL NOTES**

GENERAL

ARCADIS Project No. 30060311
Date APRIL 2021
ARCADIS U.S., INC 10205 WESTHEIMER RD. SUITE 800 HOUSTON, TX 77042 TEL: 713.953.4800

**C-200**

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# **Appendix B:**

## **Site Photographs**

## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



### Photograph: 1

**Description:**  
Overview of the S-232  
Mustang Lockport to  
Patoka Pipeline ROW  
as it crosses the  
Kankakee River.

**Direction:**  
South

**Date:** 9/28/2020



### Photograph: 2

**Description:**  
Additional view of the  
S-232 Mustang  
Lockport to Patoka  
Pipeline ROW as it  
crosses the Kankakee  
River.

**Direction:**  
North

**Date:** 10/7/2020



## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



**Photograph: 3**

**Description:**

View of the downstream portion of the study area at the pipeline ROW crossing of the Kankakee River.

**Direction:**

West

**Date:** 10/1/2020



**Photograph: 4**

**Description:**

View of the most common substrate type within the study area.

**Direction:**

N/A

**Date:** 10/7/2020

# **Appendix C:**

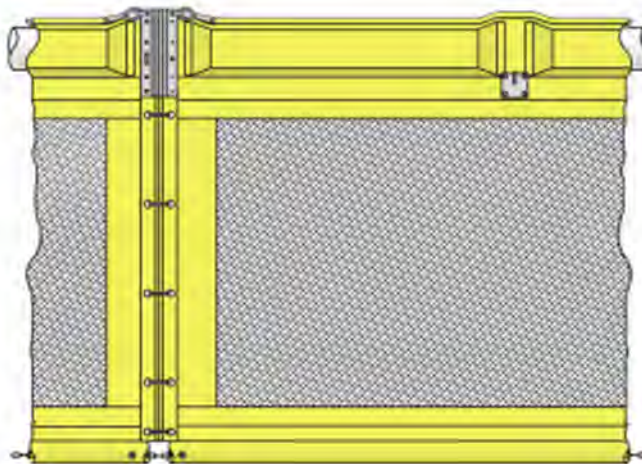
**Best Management  
Practices for  
Construction and  
Installation of  
Articulating Block  
Fabric Formed Concrete**

# Best Management Practices and Accidental Grout Release Plan for Construction and Installation of Articulating Block Fabric Formed Concrete

## Site Preparation

- Prior to the mussel salvage effort, the in-stream ADI will be properly located and clearly marked. Temporary bank and in-stream reference marking will be done in such a manner as to assist the salvage team.
- Areas on which fabric form panels are to be placed will be constructed to the lines, grades, contours, and dimensions shown on the construction design drawings.
- The areas will be free of organic material and obstructions, such as roots and projecting stones, to allow the fabric to be positioned correctly as to not fail during flood or high flow events.
- Installation of sediment/turbidity curtains:
  - The contractor will install Type III curtains for highest grade/flow velocities (see example in **Figures 1 and 2** below).
  - Curtains will be placed within the ADI, as close as possible to the work activities.
  - Sediment/turbidity curtains will be appropriately installed and regularly inspected during the project.
  - Sediment/turbidity curtains will remain in place during active construction phases and will not be removed until all instream work is complete.
  - Spare silt curtains will remain on-hand and implemented, as needed.

*Figure 1. Typical Cross-section of Sediment/Turbidity Curtain.*



*Figure 2. Example of Deployed Sediment/Turbidity Curtain in Waterway.*



## **Inspection**

- Immediately prior to the fabric form panels being placed, the prepared area will be inspected by the biological monitor and engineer, and no form panels will be placed until the area has been approved.
- Onsite dive support, consisting of multiple divers, will also conduct an inspection and provide ongoing monitoring during the project execution.
- Divers will remain in water during active grout filling operations to provide active monitoring for grout release.
- Divers will have two-radio communication to communicate any observed issues.
- Divers may also have video live-stream capabilities on diver equipment (depending on contractor).
  - Top water monitoring will also be conducted by personnel in boats.
  - Grouting operations will be stop immediately if an accidental release is identified by notifying the grout pump operator.
  - Divers will identify and resolve all issues and repair prior restarting.
- Grout truck pumping pressures will be actively monitored during operations. Grout pumping valves will be easily accessible for rapid closure in the event of an accidental grout release.
- Grout hose connections will be properly secured to prevent unintended hose disconnection and accidental grout release.



## **Fabric Form Placement**

- When placing fabric grout panels, an allowance for approximately 10% contraction of the panel in each direction will occur as a result of fine aggregate concrete (grout) filling.
- Adjacent fabric panels will be joined in the field by means of integrated zippers. If conventional means of joining fabric panels is not an option, adjacent panels may be overlapped by a minimum of three feet to form a lap joint, pending approval by the engineer. Based on flow direction, the upstream panel will overlap the downstream form.
- In no case will butt joints between panels be permitted.
- Panels will be weighted or staked in place prior to filling to secure correct positioning.
- Immediately prior to underwater placement, the assembled panels will be inspected by the lead engineer for approval.

## **Fine Aggregate Concrete Pumping**

- Fine aggregate concrete will be pumped in such a manner that excessive pressure on the fabric panels is avoided. Consultation with the fabric panel manufacturer with regard to the selection of grout/concrete pumps will be completed prior to project implementation.
- A non-toxic grout will be used, as well as a non-toxic enzyme to speed grout curing.
- Cold joints will be avoided. A cold joint is defined as one in which pumping of the fine aggregate concrete into a given section of panel is discontinued or interrupted for an interval of forty-five minutes or more.
- The sequence of fine aggregate concrete will ensure complete filling of the fabric formed concrete panel to the appropriate thickness as specified by the lead engineer.

## **Construction Completion Inspection**

- Once the fine aggregate concrete has weighed itself, staking will be removed from the fabric panels.
- Divers will inspect the fabric panels for releases of fine aggregate concrete or tearing of the fabric. Upon completion, the lead engineer will approve the placement and construction of the fabric panel with fine aggregate concrete.
- If a release occurs and results in solidified grout inside or outside of the ADI, the contractor will remove the large solid pieces of grout and properly dispose of them outside of the river.

# **Appendix D:**

## **Grant of Right-of-Way**

See file 110 for Original

PATL-621

Will County  
Sec. 12-32N-12E

STATE OF



ILLINOIS

ADLAI E. STEVENSON, Governor

PERMIT  
No. 6510

Department of  
**Public Works and Buildings**  
Division of Waterways

201 W. Monroe St.  
Springfield, Illinois

Permission Is Hereby Granted, this 15th day of March 1949

To

THE TEXAS-EMPIRE PIPE LINE COMPANY  
BOX 2420 TULSA, OKLAHOMA

To cross with 18" OD welded steel pipe line all streams in Marion, Fayette, Shelby, Moultrie, Piatt, Champaign, Ford, Livingston, Kankakee and Will Counties, (including Kaskaskia River, SE $\frac{1}{4}$  NE $\frac{1}{4}$  Sec. 11, T 8N, R 2E, Fayette; Sangamon River, NE $\frac{1}{4}$  NE $\frac{1}{4}$  Sec. 15, T 19N, R 6E, Piatt; Kankakee River, SW $\frac{1}{4}$  NW $\frac{1}{4}$  Sec. 19, T 32N, R 10E, Will),

in accordance with an application dated March 9, 1949, and the specifications and plans entitled

Proposed 18" line from Patoka Station to Wilmington,  
Station, Drawings 2845 R-1, dated 2/8/49  
3084 R-3, " 1/21/49  
3085 R-3, " 1/21/49  
3096 R-3, " 1/25/49

filed with the Department of Public Works and Buildings and made a part hereof, and subject to the terms and special conditions contained herein:

Examined and Recommended:

C. Pemberton  
C. Pemberton Engineer of Permits.

Approved:

Chas. P. Casey  
Chas. P. Casey Director

Approval Recommended:

Thomas B. Casey  
Thomas B. Casey Chief Engineer.

THIS PERMIT is subject to the following conditions:

- (a) This permit is granted in accordance with an act entitled: "AN ACT in relation to the regulation of the rivers, lakes and streams of the State of Illinois," approved June 10, 1911.
- (b) This permit does not convey or recognize any title of the Permittee to any submerged or other lands, and furthermore, does not convey, lease or provide any right or rights of occupancy or use of the public or private property on which the proposed project or any part thereof will be located, or otherwise grant to the Permittee any right or interest in or to said property whether said property is owned or possessed by the State of Illinois or by any private or public party or parties.
- (c) This permit does not in any way release the Permittee from any liability for damage to persons or property caused by or resulting from the work covered by this permit, and does not sanction any injury to private property or invasion of private rights, or infringement of any Federal, State or local laws or regulations.
- (d) The Permittee shall remove all piling, cofferdams, false work, excavation and the material incident to the construction of the project herein authorized, from the river, stream or lake in which the work is done, at his own expense. Should the Permittee fail to remove such structures or material, the State reserves the right to have such removal made at the expense of the Permittee. If future operations for public navigation by the State or Federal Government or public interests of any character necessitate any changes in the position of any part of the structure or structures herein authorized, such changes shall be made by and at the expense of the Permittee or his successors in such manner as shall be fixed and determined by the State of Illinois, acting by and through the Department of Public Works and Buildings, or other properly constituted agency, and within sixty (60) days from receipt of written notice of such necessity from said Department or other properly constituted agency.
- (e) If the work herein permitted is not completed on or before December 31, 1952 this permit shall cease and be null and void.
- (f) The execution and details of the work hereby authorized shall be subject to the supervision and approval of the Department of Public Works and Buildings—Division of Waterways.
- (g) Starting work on the construction hereby authorized shall be considered full acceptance by the Permittee of all the terms and conditions of this permit; however, the attached acceptance, properly executed by the Permittee, must be filed in the office of the Department of Public Works and Buildings, Division of Waterways, Springfield, Illinois, within sixty (60) days of the date hereof or this permit shall be null and void.
- (h) There shall be no deviation from the plans submitted and hereby approved unless the proposed change in plans shall first have been submitted to and approved, in writing, by the State of Illinois acting by and through its Department of Public Works and Buildings.
- (i) The Department of Public Works and Buildings in issuing this permit has relied upon the statements and representations made by the Permittee in his application therefor, and in case any statement or representation in said application is found to be false, this permit may be revoked at the option of the Department of Public Works and Buildings, and when so revoked all rights of the Permittee hereunder shall thereupon and thereby become null and void.
- (j) If the Permittee is required by an act of Congress to obtain a permit from any Federal authority for leave to do the things granted by this permit, then such Federal permit shall be obtained before this permit becomes effective.
- (k) If the project authorized herein is located in or along a lake, the Permittee or his successors shall make no claim whatsoever to any right, title or interest in and to any accretions caused by the construction of said project, and by the acceptance of this permit agrees to remise, convey, release, and quit claim unto the People of the State of Illinois, for the use and benefit of the public, all rights to any accretions which may accrue to said real estate because of said project.
- (1) This permit is subject to further special conditions as follows:

The top of the proposed pipe line shall be placed not less than two feet below the bed of the streams.



# **Appendix E:**

**Arcadis 2020  
Freshwater Mussel  
Survey Report**

ExxonMobil Pipeline Company

**S-232 MUSTANG LOCKPORT TO  
PATOKA CRUDE OIL PIPELINE  
REPAIR – KANKAKEE RIVER  
CROSSING PROJECT**

**CUSTER PARK, ILLINOIS**

Freshwater Mussel Survey and Relocation Report

December 2020

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**S-232 MUSTANG  
LOCKPORT TO  
PATOKA CRUDE  
OIL PIPELINE  
REPAIR –  
KANKAKEE RIVER  
CROSSING  
PROJECT CUSTER  
PARK, ILLINOIS**

Freshwater Mussel Survey and  
Relocation Report

Prepared for:

ExxonMobil Pipeline Company

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Date:

December 2020

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# 1 INTRODUCTION

Arcadis U.S., Inc. (Arcadis) was contracted by ExxonMobil Pipeline Company (EMPCo) to provide environmental consulting services for the S-232 Mustang Lockport to Patoka Crude Oil Pipeline Repair Project in Custer Park, Will County, Illinois (**Figure 1**). The S-232 Mustang Lockport to Patoka Pipeline is an 18-inch crude oil pipeline operated by EMPCo that crosses the Kankakee River, a perennial stream that flows north/northwest into the Des Plaines River. During a routine assessment of the existing 18-inch S-232 pipeline crossing, EMPCo identified streambed scour conditions that have led to reduced depth of cover over the existing pipeline. As a result, EMPCo has selected a mitigation approach of installing rock riprap armoring over the existing pipeline to protect the pipe from future scour, as depicted in the project design plan in **Appendix A**.

The ordinary high water mark (OHWM) width of the Kankakee River at the pipeline crossing is approximately 500 feet and the maximum water depth in the study area is approximately seven feet. The stream channel is broad and shallow, with a bank height of approximately 8-12 feet and a gravel-cobble substrate. Site photographs are provided in **Appendix B**. While the design of the pipeline armoring mitigation is ongoing, the proposed pipeline armoring includes the placement of approximately 373 cubic yards of filter gravel and riprap along two segments of the pipeline that exhibit inadequate depth of cover and/or prior concrete bag pipe armoring. The proposed project design is further detailed in section 1.1. The anticipated length of time for completion of the pipeline armoring is approximately three weeks and is anticipated to begin in the second quarter (spring/summer) of 2021.

Based on a preliminary pipeline dive inspection completed during July and August 2020, as well as an abundance of publicly available natural resource data, the Kankakee River is a diverse and resource-rich environment that provides an abundance of suitable habitat for freshwater mussels. The Kankakee River is also listed as a Category II, III, and VI site in the Illinois Natural Areas Inventory (INAI), specifically denoting the area has an unusual concentration of flora or fauna and high-quality streams. Therefore, Arcadis initiated formal consultation with Illinois Department of Natural Resources (IDNR) on August 24, 2020 and submitted an Ecological Compliance Assessment Tool (EcoCAT) project review request (#2103470). Based on initial coordination with IDNR, it was determined that a freshwater mussel survey would be needed to evaluate the potential for impacts to freshwater mussels, including state and federally listed threatened and endangered (T&E) mussel species. Permanent relocation of non-listed mussels to an approved relocation area was also recommended as a component of resource management.

Arcadis biologists conducted an initial presence/absence survey and relocation of non-listed mussel species from September 28th to October 7th, 2020. This survey and relocation effort were conducted to achieve three objectives:

- 1) identify and quantify the presence of state and federally listed T&E mussel species within the study area,
- 2) identify all non-listed mussel species within the study area, and
- 3) relocate all non-listed mussel species out of each ADI this year, assuming little to no mussel movement/disbursement will occur over the winter months before the spring 2021 construction schedule due to low mussel mobility and their preference to burrow into the substrate. Additionally, freshwater mussels tend to be less biologically active, and burrow deeper into the substrate, when water temperatures fall below approximately 59° Fahrenheit.

The results of the survey and relocation effort are provided herein.

## 1.1 Proposed Project Design

As detailed in the September 2020 Freshwater Mussel Survey and Relocation Plan, the proposed project design plan involves placing approximately 373 cubic yards of filter gravel and riprap along two segments of the pipeline that exhibit inadequate depth of cover and/or prior concrete bag pipe armoring, which will be replaced or improved (**Appendix A**). The riprap size and volume will be confirmed through the design process, but is anticipated to be 8-inch diameter angular rock. These two segments comprise approximately 290 linear feet of the overall 500-foot OHWM width and the riprap will likely be placed across 20 feet of the existing 50-foot pipeline right-of-way (ROW) in these locations. It is anticipated the riprap will be placed by a long-reach excavator from the north and south riverbanks. The combined armoring placement areas, referred to as the area of direct impact (ADI), is approximately 5,800 square feet (539 square meters[m²]) (**Figure 2**). Diver-assisted hand placement of riprap may also occur to prevent uncontrolled dumping of riprap, which could damage the existing pipeline and create additional environmental disturbances. All associated equipment will be staged/stored outside of the river and above the OHWM in a controlled area in order to further minimize instream impacts.

The pipeline armoring design will account for variability in water depths within the river and will be designed not to alter normal downstream flows or create a low-head damming effect within the river. The armoring height will be minimized to the extent practical and the proposed project will not adversely impact marine navigation or natural biological spawning cycles. No additional fill material will be placed within the project areas outside of the existing pipeline right-of-way (ROW) and the areas will be returned to the pre-existing contours and elevations of the substrate, where possible.

## 1.2 Agency Coordination and Permitting

Due to the proposed project's potential to impact aquatic resources, Arcadis requested consultation with IDNR to discuss the proposed project, evaluate potential impacts to aquatic resources, and determine the applicable permitting required for biotic surveys, species relocations, and project approval. Arcadis submitted an online project review request to IDNR using the Ecological Compliance Assessment Tool (EcoCAT) (#2103470) on August 24, 2020 and engaged in further consultation with IDNR representatives Nathan Grider (IDNR Impact Assessment Section Manager), Bradley Hayes (IDNR Resource Planner), Brian Metzke (IDNR State Aquatic Ecologist), and Shawn Cirton (USFWS Biologist) throughout August and September. Because the Kankakee River is listed as a Category II, III, and VI site (i.e., Specific suitable habitat for state-listed species or state-listed species relocations; State dedicated Natural Preserves, Land and Water Reserves, and Natural Heritage Landmarks; Unusual concentrations of Flora and Fauna), IDNR initially recommended a freshwater mussel survey and relocation of non-listed species before project implementation.

Arcadis submitted a Freshwater Mussel Survey and Relocation Plan to IDNR on September 21, 2020. Arcadis received IDNR's conditional approval of the plan and a Non-listed Mussel Salvage and Relocation Permit on September 29, 2020. The Relocation Permit allowed Arcadis to relocate all non-listed native freshwater mussel species from within the project area prior to project implementation. Because Arcadis and IDNR anticipated the presence of state and federally listed T&E species, Arcadis conducted the mussel survey at the end of the Fall 2020 survey season to provide additional information needed to apply a state Incidental Take Authorization (ITA) and federal U.S. Fish and Wildlife Service (USFWS) Incidental Take Permit (ITP) during the subsequent winter months. The estimated timeline for

approval of the ITA is approximately three to five months, which would potentially result in issuance of the ITA in February 2020, and the subsequent T&E relocation effort would be further delayed to June 2020 due to winter conditions.

## 2 SPECIES AND HABITAT DISTRIBUTION

Freshwater mussels, of the family Unionidae, are important components of aquatic ecosystems and are represented by more than 300 species in North America, compared to just 12 species in Europe (Haag, 2012). Of the approximately 300 species in North America, Illinois is home to approximately 62 extant native freshwater mussel species, which serve as important ecological indicators of the health of freshwater ecosystems (Shasteen et al., 2013). Due to their lack of mobility and their tendency to bioaccumulate pollutants, freshwater mussels can also act as an important indicator species for determining contamination in aquatic ecosystems.

Aside from providing a food source for other wildlife species, freshwater mussels serve as filter-feeding organisms that can have a direct impact on water quality within an aquatic system. Freshwater mussels inhabit a variety of aquatic ecosystems, including large and small rivers, lakes, ponds, canals, and reservoirs and the substrate composition often determines the suitability for mussels to occur in an area. According to (Howells, et al., 1996; 2014), freshwater mussels typically prefer stable, cohesive substrates, whereas deep and/or shifting sand and soft silts are considered unsuitable substrates. In addition, mussels are more frequently found in protected areas, such as the downstream side of logs or gravel bars which allow them to better withstand swifter currents (Haag, 2012), and they are less likely to occur at depths below 25 feet.

Native freshwater mussels are under ever greater threats and pressure today. Mussels in Illinois are primarily threatened from past harvesting, land-use changes, channel alteration, anthropogenic inputs, and construction and operation of dams on Illinois rivers (Haag, 2012; Shasteen et al., 2013.) The spread of non-native and/or invasive species, such as the zebra mussel (*Dreissena polymorpha*) and quagga mussel (*Dreissena bugensis*), are also a growing concern.

According to the Illinois Natural Heritage Database (INHD), there are seven state and/or federally listed T&E freshwater mussel species of potential occurrence in Will County, Illinois, including monkeyface (*Quadrula metanevra*), purple wartyback (*Cyclonaias tuberculata*), snuffbox (*Epioblasma triquetra*), spike (*Elliptio dilatata*), slippershell (*Alasmidonta viridis*), sheepnose (*Plethobasus cyphus*), and salamander mussel (*Simpsonaias ambigua*) (INHD, 2019). According to the EcoCAT report for the project site (#2103470), black sandshell (*Ligumia recta*) is also listed as threatened for Will County; however, consultation with IDNR on September 29, 2020 indicated that the black sandshell was delisted in Illinois and the monkeyface was added (which was not included in the EcoCAT report provided in **Appendix C**). Furthermore, a query of the Illinois Natural History Survey (INHS) database and consultation with IDNR identified documented occurrences of four of the listed species (monkeyface, purple wartyback, spike, and sheepnose) within the Kankakee River (Cummings and Tiemann, 2014; EnviroScience, 2016; 2018).

## 3 REGULATORY FRAMEWORK

### 3.1 State-listed Threatened and Endangered Species

In 1981, IDNR's Illinois Endangered Species Protection Board established a listing of all threatened and endangered species in the state. This list is subsequently updated every five years with the most recent

review occurring in 2019. Threatened species are those in which the Illinois Endangered Species Protection Board has determined to be at risk of becoming statewide endangered, while endangered species are threatened with statewide extinction. Laws and regulations pertaining to Illinois T&E species are contained in Section 520 ILCS 10/ Chapter 8 (i.e., Illinois Endangered Species Protection Act) of the Illinois Compiled Statutes (ILCS). Illinois regulations prohibit the taking, possession, transportation, or sale of any of the species designated by state law as threatened or endangered without the issuance of a permit (e.g., Incidental Take Authorization).

In 2011, the Illinois Endangered Species Protection Board listed 25 of the 62 extant species (44 percent) as threatened or endangered (Shasteen et al., 2013). According to the INHD's annotated list of T&E species, six of the T&E freshwater mussel species potentially occur in Will County (INHD, 2019).

### **3.2 Section 404(b)(1) Guidelines**

Under Title 40 of the Code of Federal Regulations (CFR) - Part 230, the United State (U.S.) Congress authorized the Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material. Section 404 regulates discharges of dredge or fill material into Waters of the U.S. The purpose of these Guidelines is to restore and maintain the chemical, physical, and biological integrity of waters of the United States through the control of discharges of dredged or fill material. Fundamental to these Guidelines is the precept that dredged or fill material should only be discharged into the aquatic ecosystem if:

1. It can be demonstrated that such a discharge will have minimum to no impacts on affecting ecosystems of concern, individually,
2. Or in combination with known and/or probable impacts of other activities affecting the ecosystems of concern.

The ecosystem of concern for the project described herein relates to the Kankakee River, which is a Water of the U.S. Waters of the U.S. are defined as all waters that are, were, or may be used in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide. Waters of the U.S. generally include all interstate waters as well as lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds (see 40 CFR 232.3 for complete definition).

Under Subpart D of the Guidelines, potential impacts on biological characteristics of the aquatic ecosystem are considered when determining compliance with the 404(b)(1) guidelines. Biological characteristics are called out as 1) Threatened and Endangered Species, 2) Fish, crustaceans, mollusks, and other aquatic organisms in the food web, and 3) Other wildlife.

## **4 METHODS**

### **4.1 Field Survey and Relocation**

Arcadis reviewed site maps, aerial photographs, natural resource database accounts, and other relevant scientific literature to complete preliminary determinations of the available resources, potentially suitable habitat, and known extent (or proximity) of freshwater mussels within the study area. The mussel survey protocols described herein are based on preferred survey method guidance provided by IDNR paired with standardized mussel survey techniques outlined in prevailing scientific literature. The survey was conducted under Arcadis' Illinois Scientific Collector's Permit (#NH20.6438) and Illinois Endangered and

Threatened Species Permit (#7477). Surveys for federally listed T&E species were conducted under USFWS Section 10(A)1(a) Recovery Permit #TE90423C-0. Relocation of non-listed freshwater mussels was conducted under and IDNR Aquatic Life Relocation Permit dated September 28, 2020.

The survey extent included the two ADI locations (estimated to be 862 m² at the time of the survey and prior to a reduction of the ADI/pipeline armoring area), a 10-meter upstream buffer (575 m²), 10-meter lateral buffer on each available side (1,650 m²), and a 30-meter downstream buffer (1,725 m²) (**Figure 3**). Qualified Arcadis scientific divers conducted a combination of qualitative, semi-quantitative, and quantitative survey methods to meet the study objectives described above. Surveys were conducted both visually and tactilely, particularly in low visibility conditions. Tactile surveys, or “brailing”, consisted of manually feeling the substrate for the presence of mussels on the surface, and to a depth of approximately 15 centimeters below the surface. Snorkel surveys were completed in accessible areas less than approximately three feet deep, while dive surveys were completed in deeper areas. The approved survey areas and permanent relocation site coordinates are provided below in **Table 1**.

**Table 1. Coordinates for the Survey Area Location and Approved Mussel Relocation Area**

Site	Latitude	Longitude
Northern Survey Area Location	41.244426	-88.124334
Southern Survey Area Location	41.243551	-81.12494
Approved Mussel Relocation Area	41.247196	-88.129622

#### 4.1.1 Semi-Quantitative Surveys

Semi-quantitative surveys were conducted to evaluate the distribution and relative abundance of mussel species within the study area. These surveys also aided in detecting rare or T&E species by standardizing the survey effort across the study area. Twelve (12) semi-quantitative survey transects were established perpendicular to flow and spaced approximately 10 meters apart across each ADI and associated buffer area (**Figure 4**). Transect lines began approximately 10 meters upstream of the (ADI) to evaluate the upstream buffer area and continued to 30 meters downstream of the ADI to evaluate the downstream buffer area. Each survey transect also extended 10 meters on either side of the ADI to evaluate the lateral buffer area.

Two biologists surveyed each transect line, with one on each side of the line, while surveying/sweeping a 1-meter area in front of them. General habitat conditions and relative mussel species diversity, density, and distribution was recorded along each transect and is provided in Section 5. All observed mussels were placed in mesh bags and kept under water until completion of the transect. All live mussels were then identified, enumerated, and measured, with voucher photographs taken of each species. All listed T&E mussel species were recorded and safely replaced back in the study area. All non-listed mussels observed during the semi-quantitative surveys were permanently removed for relocation.

Transect lines were also marked at 10-meter intervals to indicate the location of a quantitative survey plot (see survey method description below). Biologists stopped at each 10-meter interval and completed the quantitative survey before advancing down the survey transect.



### 4.1.2 Quantitative Surveys

Quantitative quadrat sampling can be useful in detecting and identifying small or juvenile mussel species, or those that are buried deeper in the substrate. Quantitative quadrat sampling data can also be used as a representative population estimate for determining take of listed T&E species across the study area. Biologists collected a 0.25-m² quadrat sample at each 10-meter interval along the semi-quantitative survey transects for a total of 52 quadrats. An initial total of 54 quadrats were proposed for sampling, but two quadrats were eliminated due to high amounts of glass in the substrate causing a health and safety risk to field personnel (**Figure 4**). Each quadrat was surveyed for three (3) minutes of search time and the sampling consisted of excavating the substrate within the sampling quadrat to a depth of 15 centimeters, or bedrock. The excavated material, including all mussels therein, were placed in a 6-millimeter mesh bag and tagged with the corresponding transect/quadrant number. The sample bag was temporarily clipped in location to the survey transect line for the completion of the semi-quantitative transect survey. Once the transect survey was complete, all quadrat sample bags were retrieved and processed on the bank. Substrate composition/depth, water depth, water quality, and other habitat variables were also recorded for each quadrat sample and are provided in Section 5.

### 4.1.3 Qualitative Surveys

Following completion of the semi-quantitative and quantitative surveys, timed-search qualitative surveys were conducted in each ADI location for a period of 60 minutes. Each ADI was surveyed by two Arcadis biologists, for a total of two person-hours (120 minutes) per ADI (four person-hours [240 minutes] altogether). This method was used to provide maximum survey coverage within the ADI and evaluate those portions of the ADI that were not covered by the semi-quantitative or quantitative survey efforts. All observed mussels were placed in mesh bags and kept under water until completion of the survey. All live mussels were then identified, enumerated, and measured, with voucher pictures taken of each species. All listed T&E mussel species were recorded and safely replaced back in the ADI. All non-listed mussels observed during the qualitative surveys were permanently removed for relocation. Results of the qualitative surveys are provided below in Section 5.

### 4.1.4 Relocation

The ADI was salvaged for mussels using a combination of mussel removal from the aforementioned surveys and a multiple pass design to ensure >70 percent recovery of T&E mussels. This multi-pass method included resurveying each survey transect up to three times, which has been shown to be effective under good conditions (EnviroScience, 2016). A similar effort was used for the salvage/relocation component of the ITA. However, all state and federally listed mussels were returned to the location found and will be relocated once an approved ITA is issued.

All non-listed mussels were transported in mesh bags approximately 1,250 feet downstream of the ADI to the permanent relocation site (**Figure 4**). A 15-minute qualitative timed-search survey was conducted within the relocation site to confirm the presence of live freshwater mussels and similar flow and substrate conditions. The relocation site is larger than the overall collection area (approximately 22,300 m²) and contains similar habitat conditions that are beneficial to the survival and reproduction of freshwater mussels. Mussels collected during survey transects were periodically relocated before additional survey transects were searched to reduce stockpiling and stress on freshwater mussels.

#### 4.1.5 Water Quality Assessment

Water quality measurements and habitat characteristics were collected within both the survey and relocation areas. Water temperature, depth, flow rate, dissolved oxygen (DO), conductivity, and pH were measured at the start of each day of the survey using a Yellow Springs Institute (YSI) Series 6920 multiprobe, or similar device. The instrument was equipped with an optical DO probe. As specified by the manufacturer, this instrument has the following accuracy: temperature,  $\pm 0.15$  degrees Celsius ( $^{\circ}\text{C}$ ); specific conductance, 0.001 mS/cm; pH,  $\pm 0.2$ ; DO,  $\pm 0.2$  milligrams per liter (mg/L).

Digital photographs were taken of the study area and substrate material documented during the survey. Photographs were also taken of live and dead mussels to document the current condition of the localized population.

#### 4.2 Data-collection and Reporting

The locations of survey area boundaries, key habitat features, and state-listed species or resources (i.e., survey and relocation areas) were recorded using a Trimble GeoXH GPS unit, capable of submeter accuracy, in the World Geodetic System 1984 (WGS84) geographic datum coordinate system. The survey and relocation areas were analyzed in a geographic information system (GIS) using ESRI ArcMap 10.4 software and overlain onto georeferenced aerial photo base imagery, as provided on **Figure 3**.

This report includes 1) data compiled from the tasks outlined above, 2) appropriate site and specimen photographs, and 3) appropriate maps of the study area in relation to field observation and survey design.

### 5 SURVEY RESULTS

A total of 14,359 freshwater mussels were collected live across all three survey methods, representing 18 genera and 22 species (**Table 2**). Of those 14,359 species, 724 were T&E species, which included three state-listed species, the purple wartyback ( $n=542$ ), monkeyface ( $n=164$ ), and spike ( $n=4$ ), and one federally listed species, sheepsnose ( $n=14$ ) (**Figures 8 through 12**). The five most common species collected were the mucket (86 percent of total individuals), purple wartyback (4 percent), pimpleback (2 percent), plain pocketbook (2 percent), and black sandshell (1 percent), which comprise approximately 95 percent of all individuals collected during the survey effort. A fairly uniform substrate existed within the streambed, consisting predominantly of sandy gravel and cobble, with some areas of exposed bedrock or bedded sand due to scour adjacent to the pipeline. Additionally, many individual mussels were not found within any substrate and instead were found lying horizontally on the surface of the streambed. Survey data by method is provided in greater detail in the subsections below.

**Table 2. Freshwater Mussel Species Collected During the Kankakee River Survey**

Common Name	Scientific Name	Total Number of Live Individuals Observed
Black sandshell	<i>Ligumia recta</i>	179
Creek heelsplitter	<i>Lasmigona compressa</i>	1
Creeper	<i>Strophitus undulatus</i>	18

Deertoe	<i>Truncilla truncata</i>	26
Elktoe	<i>Alasmidonta marginata</i>	5
Ellipse	<i>Venustaconcha ellipsiformis</i>	9
Fat mucket	<i>Lampsilis siliquoidea</i>	21
Fluted-shell	<i>Lasmigona costata</i>	77
Fragile papershell	<i>Leptodea costata</i>	10
Monkeyface*	<i>Quadrula metanevra</i>	164
Mucket	<i>Actinonaias ligamentina</i>	12,397
Pimpleback	<i>Quadrula pustulosa</i>	281
Pink heelsplitter	<i>Potamilus alatus</i>	14
Plain pocketbook	<i>Lampsilis cardium</i>	228
Purple wartyback*	<i>Cyclonaias tuberculata</i>	542
Round pigtoe	<i>Pleurobema sintoxia</i>	166
Sheepnose**	<i>Plethobasus cyphus</i>	14
Spike*	<i>Elliptio dilatata</i>	4
Threehorn wartyback	<i>Obliquaria reflexa</i>	3
Threeridge	<i>Amblema plicata</i>	136
Washboard	<i>Megalonaias nervosa</i>	102
White heelsplitter	<i>Lasmigona complanata</i>	1

*State-listed threatened species; **Federally listed endangered species

### 5.1.1 Semi-Quantitative Survey Results

Semi-quantitative surveys were conducted to evaluate the distribution and relative abundance of mussel species within the northern and southern study areas (northern study area is associated with ADI-1 and the southern study area is associated with ADI-2). **Table 3** provides a summary of the survey results in each study area.

**Table 3. Semi-Quantitative Survey Results Summary**

Study Area	Total Number of Individuals Collected	Total Number of Species Identified	Number of T&E Species Identified	Number of Individual T&E Collected
<b>ADI-1 (North)</b>	8,047	22	4	480
<b>ADI-2 (South)</b>	4,016	18	3	141

A total of 8,047 freshwater mussels, including 343 purple wartybacks, 125 monkeyfaces, 9 sheepsnose, and 3 spikes were collected along the transect lines in the northern study area. A total of 4,016 freshwater mussels, including 126 purple wartybacks, 13 monkeyfaces, and 2 sheepsnose were collected along the transect lines in the southern study area (**Figure 13**). Further survey data for the northern and southern study areas is provided in **Table 4** and **Table 5**, respectively.

**Table 4. ADI-1 (North) Study Area – Semi-Quantitative Survey Results**

Common Name	Scientific Name	Total Number of Individuals Collected	Average Valve Length (mm)	Minimum Valve Length (mm)	Maximum Valve Length (mm)
Black sandshell	<i>Ligumia recta</i>	104	113	36	139
Creek heelsplitter	<i>Lasmigona compressa</i>	1	45	45	45
Creepers	<i>Strophitus undulatus</i>	6	53	48	58
Deertoe	<i>Truncilla truncata</i>	11	38	24	79
Elktoe	<i>Alasmidonta marginata</i>	5	49	34	58
Ellipse	<i>Venustaconcha ellipsiformis</i>	1	41	41	41
Fat mucket	<i>Lampsilis siliquoidea</i>	8	70	48	88
Fluted-shell	<i>Lasmigona costata</i>	30	90	66	117
Fragile papershell	<i>Leptodea fragilis</i>	3	56	54	58
Monkeyface	<i>Quadrula metanevra</i>	125	69	35	101
Mucket	<i>Actinonaias ligamentina</i>	6,809	93	6	131
Pimpleback	<i>Quadrula pustulosa</i>	204	32	7	60
Pink heelsplitter	<i>Potamilus alatus</i>	4	94	76	122
Plain pocketbook	<i>Lampsilis cardium</i>	157	91	28	125
Purple Wartyback	<i>Cyclonaias tuberculata</i>	343	53	5	90
Round pigtoe	<i>Pleurobema sintoxia</i>	96	72	35	94
Sheepsnose	<i>Plethobasus cyphus</i>	9	84	65	98

Spike	<i>Elliptio dilatata</i>	3	72	23	101
Threehorn wartyback	<i>Obliquaria reflexa</i>	1	29	29	29
Threeridge	<i>Amblema plicata</i>	81	68	32	102
Washboard	<i>Megalonaias nervosa</i>	45	110	17	142
White heelsplitter	<i>Lasmigona complanata</i>	1	92	92	92
<b>Total</b>		<b>8,047</b>			

Table 5. ADI-2 (South) Study Area – Semi-Quantitative Survey Results

Common Name	Scientific Name	Total Number of Individuals Collected	Average Valve Length (mm)	Minimum Valve Length (mm)	Maximum Valve Length (mm)
Black sandshell	<i>Ligumia recta</i>	34	113	87	135
Creek heelsplitter	<i>Lasmigona compressa</i>	--	--	--	--
Creeper	<i>Strophitus undulatus</i>	10	60	49	69
Deertoe	<i>Truncilla truncata</i>	10	31	15	48
Elktoe	<i>Alasmidonta marginata</i>	--	--	--	--
Ellipse	<i>Venustaconcha ellipsiformis</i>	5	43	37	50
Fat mucket	<i>Lampsilis siliquoidea</i>	9	67	48	82
Fluted-shell	<i>Lasmigona costata</i>	32	82	60	106
Fragile papershell	<i>Leptodea fragilis</i>	6	77	58	105
Monkeyface	<i>Quadrula metanevra</i>	13	62	45	98
Mucket	<i>Actinonaias ligamentina</i>	3,571	93	9	131
Pimpleback	<i>Qadrula pustulosa</i>	49	32	13	50
Pink heelsplitter	<i>Potamilus alatus</i>	9	82	45	95
Plain pocketbook	<i>Lampsilis cardium</i>	39	90	58	113
Purple Wartyback	<i>Cyclonaias tuberculata</i>	126	50	15	104
Round pigtoe	<i>Pleurobema sintoxia</i>	36	69	37	89
Sheepnose	<i>Plethobasus cyphus</i>	2	72	59	85
Spike	<i>Elliptio dilatata</i>	--	--	--	--
Threehorn wartyback	<i>Obliquaria reflexa</i>	1	30	30	30
Threeridge	<i>Amblema plicata</i>	31	72	43	96



Washboard	<i>Megalonaias nervosa</i>	33	105	55	145
White heelsplitter	<i>Lasmigona complanata</i>	--	--	--	--
<b>Total</b>		<b>4,016</b>			

As depicted in **figures 13 through 15**, **Table 6** provides the semi-quantitative survey results for each transect in the northern and southern study areas. Survey data provided in the tables herein and on **Figure 13** indicated that just over twice the number of freshwater mussels were collected in the northern study area compared to the southern. This was expected due to the larger size of the northern study area. Additional data shows a lack of mussel density and diversity (**Figure 13 and 14**) immediately downstream from the pipeline where major scour is occurring; however, mussel occurrence increased in the subsequent transects as they extend further downstream of the scour disturbance. Of the 12,063 mussels collected in both survey areas during the semi-quantitative survey, 11,442 non-listed mussels were relocated to the downstream relocation area.

**Table 6. Semi-Quantitative Survey Transect Results Summary in ADI-1 and ADI-2**

Study Area Transect	Total Number of Individuals Collected	Total Number of Species Identified	Number of T&E Species Collected	Number of T&E Species Identified
<b>ADI-1 (North)</b>				
1	1,546	17	145	4
2	1,740	15	81	3
3	1,102	16	36	3
4	792	10	83	2
5	1,112	15	37	3
6	1,755	20	98	4
<b>ADI-2 (South)</b>				
1	715	14	34	2
2	467	14	17	3
3	682	12	18	2
4	324	14	12	2
5	1,185	18	45	3
6	642	14	15	2

### 5.1.2 Quantitative Survey Results

Quantitative sampling was completed at a total of 52 separate 0.25-m² quadrats to gather representative population estimates for determining take of listed T&E species across the study area. Quadrats 1A and 2A in the northern study area were not surveyed due to health and safety risks resulting from high

amounts of broken glass in the substrate. Of the 52 quadrats sampled, eight reported 0 mussels collected; 19 reported 1-5 mussels; 14 reported 6-10 mussels; nine reported 11-15; one reported 16-20 mussels; and one reported 26-30 mussels (**Figure 6**). **Table 7** below provides a summary of the quantitative quadrat sampling data.

**Table 7. Qualitative Quadrat Sampling Results Summary**

Study Area Quadrats	Total Number of Individuals Collected	Total Number of Species Identified	Number of T&E Species Collected
ADI-1 (North)	200	12	12
ADI-2 (South)	107	9	4

The density of freshwater mussels in each quadrat does not directly reflect the species diversity within each quadrat. The highest density quadrat was 3A in the southern study area, with 26 mussels, but contained only mucklets. Of the three most diverse quadrats, each with five species, Quadrat 3D north contained 7 mussels, Quadrat 6E north contained 9 mussels, and Quadrat 5C south contained 16 mussels (**Figure 7**).

Two state-listed species were collected in the sampled quadrats, the monkeyface and purple wartyback. Monkeyface were collected in quadrats D3, E6, and F5 in the northern study area and C5 in the southern area, all containing one individual (**Figure 8**). Purple wartybacks were collected in quadrats B6, C1, C2, D3, E4, F2, and F5 in the northern study area and B1, C4, and C5 in the southern area. All quadrats contained one individual except C1, which contained two purple wartybacks (**Figure 9**). No sheepsnose or spikes were collected in the quadrats (**Figure 10 and 11**). Of the twelve total quadrats containing state-listed T&E species, D3 and F5 in the northern study area and C5 in the southern study area contained both the monkeyface and purple wartyback (**Figure 12**).

### 5.1.3 Qualitative Survey Results

Two Arcadis biologists conducted timed-search qualitative surveys in each ADI for a period of 60 minutes resulting in a total survey time of 120 minutes in each ADI. The focus of this survey method was to provide maximum coverage of the ADI. During these timed surveys, divers focused on portions of the ADI that were not covered by the semi-quantitative or qualitative survey efforts.

A total of 774 freshwater mussels were collected in ADI-1 (**Figure 15**), representing 11 genera and 13 species (**Table 8**). Two live state-listed species, the purple wartyback (n=38) and monkeyface (n=12), and one live federally listed species, the sheepsnose (n=3), were also collected during this survey. The five most common species collected were the mucket (83 percent of total individuals), purple wartyback (5 percent), black sandshell (3 percent), plain pocketbook (2 percent), and monkeyface (2 percent), which comprise approximately 95 percent of all individuals collected during the survey effort.

**Table 8. ADI-1 (North) Study Area – Qualitative Survey Results**

Common Name	Scientific Name	Number of Individuals Collected	Average Valve Length (mm)	Minimum Valve Length (mm)	Maximum Valve Length (mm)
Black sandshell	<i>Ligumia recta</i>	20	115	49	133
Creek heelsplitter	<i>Lasmigona compressa</i>	--	--	--	--
Creeper	<i>Strophitus undulatus</i>	1	55	55	55
Deertoe	<i>Truncilla truncata</i>	--	--	--	--
Elktoe	<i>Alasmidonta marginata</i>	--	--	--	--
Ellipse	<i>Venustaconcha ellipsiformis</i>	--	--	--	--
Fat mucket	<i>Lampsilis siliquoidea</i>	2	85	78	92
Fluted-shell	<i>Lasmigona costata</i>	--	--	--	--
Fragile papershell	<i>Leptodea fragilis</i>	--	--	--	--
Monkeyface*	<i>Quadrula metanevra</i>	12	70	50	88
Mucket	<i>Actinonaias ligamentina</i>	646	98	55	130
Pimpleback	<i>Qadrula pustulosa</i>	8	46	30	86
Pink heelsplitter	<i>Potamilus alatus</i>	1	113	113	113
Plain pocketbook	<i>Lampsilis cardium</i>	18	101	73	118
Purple Wartyback	<i>Cyclonaias tuberculata</i>	38	49	32	75
Round pigtoe	<i>Pleurobema sintoxia</i>	10	72	56	89
Sheepnose	<i>Plethobasus cyphus</i>	3	73	62	78
Spike	<i>Elliptio dilatata</i>	--	--	--	--
Threehorn wartyback	<i>Obliquaria reflexa</i>	--	--	--	--
Threeridge	<i>Amblema plicata</i>	11	68	33	97
Washboard	<i>Megalonaias nervosa</i>	4	113	92	135
White heelsplitter	<i>Lasmigona complanata</i>	--	--	--	--
<b>Total</b>		<b>774</b>			

Although the size of the ADI is much smaller than ADI-1, a total of 1,253 freshwater mussels were collected in the ADI-2 (**Figure 15**), representing 14 genera and 15 species (**Table 9**). Three live state-listed species, the purple wartyback (n=23), monkeyface (n=7), and spike (n=1), were also collected during the survey. The five most common species collected were the mucket (89 percent of total individuals), purple wartyback (2 percent), round pigtoe (2 percent), washboard (1 percent), and black

sandshell (1 percent), which comprises approximately 95 percent of all individuals collected during the survey effort.

Table 9. ADI-2 (South) Study Area – Qualitative Survey Results

Common Name	Scientific Name	Number of Individuals Collected	Average Valve Length (mm)	Minimum Valve Length (mm)	Maximum Valve Length (mm)
Black sandshell	<i>Ligumia recta</i>	15	118	99	128
Creek heelsplitter	<i>Lasmigona compressa</i>	--	--	--	--
Creeper	<i>Strophitus undulatus</i>	--	--	--	--
Deertoe	<i>Truncilla truncata</i>	2	32	22	42
Elktoe	<i>Alasmidonta marginata</i>	--	--	--	--
Ellipse	<i>Venustaconcha ellipsiformis</i>	2	50	43	57
Fat mucket	<i>Lampsilis siliquoidea</i>	2	57	53	60
Fluted-shell	<i>Lasmigona costata</i>	14	80	53	105
Fragile papershell	<i>Leptodea fragilis</i>	1	79	79	79
Monkeyface*	<i>Quadrula metanevra</i>	7	67	33	90
Mucket	<i>Actinonaias ligamentina</i>	1,113	97	11	135
Pimpleback	<i>Qadrula pustulosa</i>	13	40	25	50
Pink heelsplitter	<i>Potamilus alatus</i>	--	--	--	--
Plain pocketbook	<i>Lampsilis cardium</i>	11	104	77	117
Purple Wartyback*	<i>Cyclonaias tuberculata</i>	23	58	12	118
Round pigtoe	<i>Pleurobema sintoxia</i>	21	64	15	85
Sheepnose**	<i>Plethobasus cyphus</i>	--	--	--	--
Spike*	<i>Elliptio dilatata</i>	1	38	38	38
Threehorn wartyback	<i>Obliquaria reflexa</i>	--	--	--	--
Threeridge	<i>Amblema plicata</i>	11	65	45	86
Washboard	<i>Megalonaias nervosa</i>	17	101	53	140
White heelsplitter	<i>Lasmigona complanata</i>	--	--	--	--
<b>Total</b>		<b>1,253</b>			

### 5.1.4 Water Quality Data

Water quality data was gathered each day of surveying within the study area and once in the relocation area prior to relocation of freshwater mussels. Water quality within the Kankakee River was considered good, based upon the water quality parameters provided in **Table 10**; however, turbidity increased throughout the survey duration, which reduced visibility through the water column and reduced the likelihood of finding mussels based on sight. Most freshwater mussels were found by manually feeling and digging through the substrate.

**Table 10. Water Quality Parameters within the Kankakee River Freshwater Mussel Survey and Relocation Areas**

Water Quality Parameters	Survey Area									Relocation Area
Date	9/28	9/29	9/30	10/1	10/2	10/3	10/5	10/6	10/7	9/28
Temperature (°C)	19.6	16.6	17.4	14.8	14.7	14.6	13.2	14.4	15.4	15.4
Specific conductance (mS/cm)	0.664	0.645	0.007	0.650	0.606	0.604	0.537	0.585	0.585	0.593
pH	8.58	8.49	7.91	8.60	8.70	8.65	8.70	8.75	8.80	8.92
Oxidation Reduction Potential (ORP) (mV)	104.2	98.5	140.9	102.9	109.0	92.8	79.1	111.8	114.7	121.1
Turbidity (ntu)	5.48	3.98	2.90	10.98	3.65	4.17	3.11	3.40	3.18	3.97

Average water temperature average during the survey was approximately 15.6° Celsius (60.08° Fahrenheit), which is within the temperature threshold where most freshwater mussels are active. Furthermore, based on the number of species and size classes collected, temperature effects do not seem to be limiting abundance, diversity, or reproduction within the study area. The survey was completed prior to the fall season, which is the timeframe when water temperatures begin to drop below a thermal threshold that limits mussel behaviors, such as orientation and horizontal and vertical movements (Waller et al., 1999). Once water temperature begins to seasonally decline, most freshwater mussel species begin to burrow deeper into the substrate and enter a period of torpor that lasts throughout winter (Amyot and Downing, 1997).

No other material was collected during the survey effort. All non-listed mussels collected were relocated to the relocation area and no mortality was observed during the survey duration. As a result, no adverse impacts to freshwater mussels are anticipated within the relocation area. Photographs of the survey area and mussel species are provided in **Appendix B**.

## 6 CONCLUSIONS

A wide range of age groups was observed during the survey, indicating a high degree of freshwater mussel recruitment within the Kankakee River. One invasive species, Asian clam (*Corbicula fluminea*),



was observed throughout the survey area. Although Asian clams were not enumerated during the survey, it should be noted that they occurred at densities far greater than native freshwater mussels. Asian clams and native freshwater mussels co-occur in many riverine systems; however, Asian clam impacts on native freshwater mussels remains relatively unknown.

Based on the survey results within the study area, scour on the downstream side of the pipeline appears to have contributed to a reduction in the density/diversity of freshwater mussel species immediately downstream of the pipeline. However, mussel occurrence increases in the adjacent areas as they extend further downstream of the scour disturbance.

Multiple state and federal T&E mussel species were observed during the 2020 mussel survey and an ITA and ITP will be required prior to the commencement of pipeline armoring activities in the summer of 2021. The enclosed 2020 survey data will be used to estimate take and apply for a state ITA and federal ITP throughout the 2020/2021 winter months. and once an ITA/ITP authorization is provided, Arcadis will conduct a second relocation in 2021 largely focused on relocating T&E species and incidental observations of non-listed mussel species.

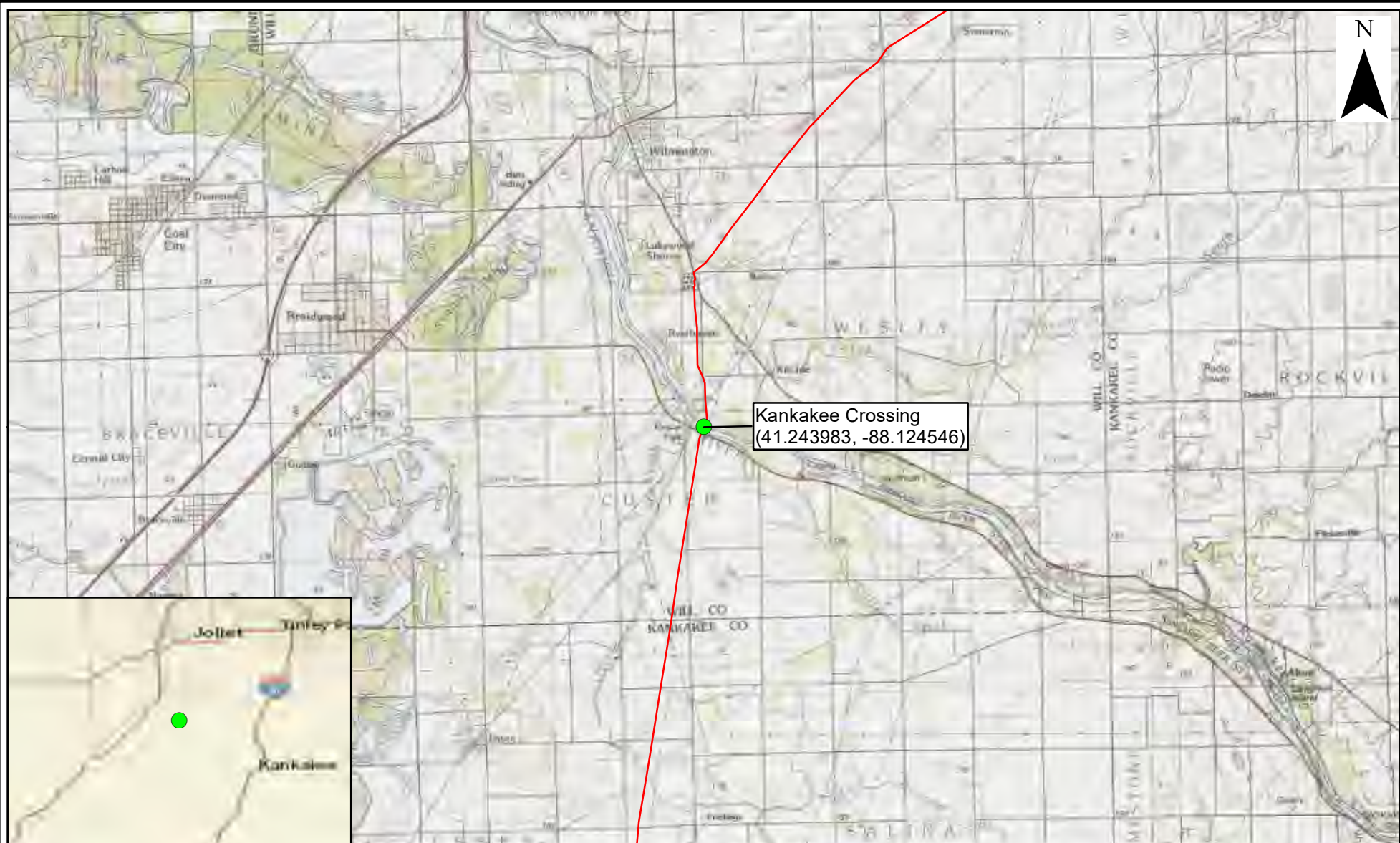
Of the 14,359 mussels collected in both survey areas during the field survey, 13,635 non-listed mussels were relocated to the downstream relocation area, thereby reducing the potential relocation effort in the spring of 2021. This approach is particularly important to better manage dynamic project schedules, account for schedule variability, and anticipate increased spring river flows and degraded survey/relocation conditions.

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# FIGURES



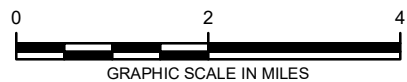


**LEGEND**

-  PIPELINE WATER CROSSING  
MUSSEL SURVEY LOCATION
-  EMPCO PIPELINE SYSTEM

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
**SITE VICINITY MAP**



**FIGURE**  
**1**

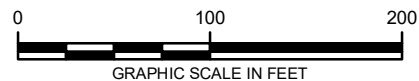


**LEGEND**

-  FLOW DIRECTION ARROW
-  EMPCO PIPELINE SYSTEM
-  AREA OF DIRECT IMPACT (ADI)

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**SITE DETAILS MAP**



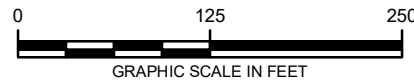
**FIGURE**  
**2**





**LEGEND**

- FLOW DIRECTION ARROW
- EMPCO PIPELINE SYSTEM
- AREA OF DIRECT IMPACT (ADI)
- UPSTREAM BUFFER
- DOWNSTREAM BUFFER
- LATERAL BUFFER



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**ADI BUFFER AREAS**

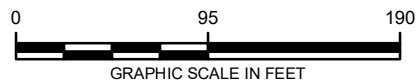


**FIGURE**  
**3**



**LEGEND**

- QUANTITATIVE SURVEY QUADRATS (10-METER SPACING)
- SEMI-QUANTITATIVE SURVEY TRANSECTS (10-METER SPACING)
- ➔ FLOW DIRECTION ARROW
- EMPCO PIPELINE SYSTEM
- AREA OF DIRECT IMPACT (ADI)
- ▭ ADI BUFFER



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**MUSSEL SURVEY SAMPLING MAP**








FIGURE  
**4**





**LEGEND**

-  EMPCO PIPELINE SYSTEM
-  FLOW DIRECTION ARROW
-  RELOCATION AREA
-  AREA OF DIRECT IMPACT (ADI)
-  ADI BUFFER

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**NON-THREATENED AND ENDANGERED  
MUSSEL RELOCATION AREA**

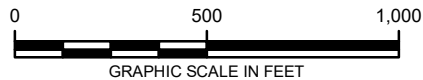


FIGURE  
**5**



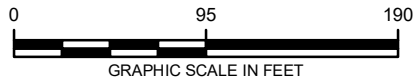
**LEGEND**

FRESHWATER MUSSEL DENSITY (ALL SPECIES)

- 0
- 1 - 5
- 6 - 10
- 11 - 15
- 16 - 20
- 26 - 30

- ✗ QUADRAT NOT SURVEYED DUE TO LARGE AMOUNTS OF GLASS IN SUBSTRATE
- SEMI-QUANTITATIVE SURVEY TRANSECTS (10-METER SPACING)
- ➡ FLOW DIRECTION
- EMPCO PIPELINE SYSTEM

- AREA OF DIRECT IMPACT (ADI)
- ▭ ADI BUFFER



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**OVERALL MUSSEL DENSITY IN QUANTITATIVE QUADRATS**



FIGURE  
**6**





**LEGEND**

NUMBER OF MUSSEL SPECIES TYPE

- 0
- 1
- 2
- 3
- 4
- 5

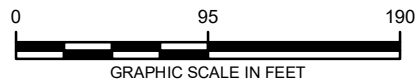
✘ QUADRAT NOT SURVEYED DUE TO LARGE AMOUNTS OF GLASS IN SUBSTRATE

— SEMI-QUANTITATIVE SURVEY TRANSECTS (10-METER SPACING)

➡ FLOW DIRECTION

— EMPCO PIPELINE SYSTEM

■ AREA OF DIRECT IMPACT (ADI)  
 - - - ADI BUFFER



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**OVERALL MUSSEL DIVERSITY IN QUANTITATIVE QUADRATS**



FIGURE  
**7**



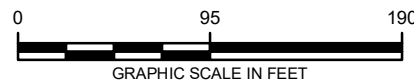


**LEGEND**

DENSITY OF MONKEYFACE  
(*Quadrula metanevra*)

- 0
- 1
- ✗ QUADRAT NOT SURVEYED DUE TO LARGE AMOUNTS OF GLASS IN SUBSTRATE

- SEMI-QUANTITATIVE SURVEY TRANSECTS (10-METER SPACING)
- ➡ FLOW DIRECTION ARROW
- EMPCO PIPELINE SYSTEM
- AREA OF DIRECT IMPACT (ADI)
- ▭ ADI BUFFER



EXXONMOBIL PIPELINE COMPANY  
HOUSTON, TEXAS  
**KANKAKEE RIVER PIPELINE ARMORING PROJECT**  
WILL COUNTY, ILLINOIS

**THREATENED AND ENDANGERED SPECIES**  
**DENSITY IN QUANTITATIVE QUADRATS -**  
**MONKEYFACE (*Quadrula metanevra*)**



FIGURE  
**8**

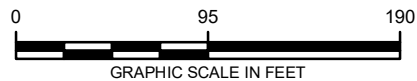


**LEGEND**

DENSITY OF PURPLE WARTYBACK  
(*Cyclonaias tuberculata*)

- 0
- 1
- 2
- ✗ QUADRAT NOT SURVEYED DUE TO LARGE AMOUNTS OF GLASS IN SUBSTRATE

- SEMI-QUANTITATIVE SURVEY TRANSECTS (10-METER SPACING)
- ➡ FLOW DIRECTION ARROW
- EMPCO PIPELINE SYSTEM
- AREA OF DIRECT IMPACT (ADI)
- ▭ ADI BUFFER



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HOUSTON, TEXAS  
**KANKAKEE RIVER PIPELINE ARMORING PROJECT**  
WILL COUNTY, ILLINOIS

**THREATENED AND ENDANGERED SPECIES DENSITY IN QUANTITATIVE QUADRATS - PURPLE WARTYBACK (*Cyclonaias tuberculata*)**



**FIGURE 9**

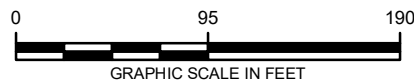


**LEGEND**

DENSITY OF SHEEPNOSE  
(*Plethobasus cyphus*)

- 0
- ✗ QUADRAT NOT SURVEYED DUE TO LARGE AMOUNTS OF GLASS IN SUBSTRATE
- SEMI-QUANTITATIVE SURVEY TRANSECTS (10-METER SPACING)

- ➡ FLOW DIRECTION ARROW
- EMPCO PIPELINE SYSTEM
- AREA OF DIRECT IMPACT (ADI)
- ▭ ADI BUFFER



EXXONMOBIL PIPELINE COMPANY  
HOUSTON, TEXAS  
**KANKAKEE RIVER PIPELINE ARMORING PROJECT**  
WILL COUNTY, ILLINOIS

**THREATENED AND ENDANGERED SPECIES**  
**DENSITY IN QUANTITATIVE QUADRATS -**  
**SHEEPNOSE (*Plethobasus cyphus*)**



FIGURE  
**10**





**LEGEND**

DENSITY OF SPIKE  
(*Elliptio dilatata*)

● 0

✘ QUADRAT NOT SURVEYED DUE TO LARGE AMOUNTS OF GLASS IN SUBSTRATE

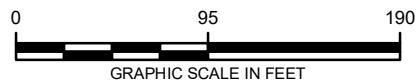
— SEMI-QUANTITATIVE SURVEY TRANSECTS (10-METER SPACING)

➡ FLOW DIRECTION ARROW

— EMPCO PIPELINE SYSTEM

■ AREA OF DIRECT IMPACT (ADI)

▭ ADI BUFFER



EXXONMOBIL PIPELINE COMPANY  
HOUSTON, TEXAS  
**KANKAKEE RIVER PIPELINE ARMORING PROJECT**  
**WILL COUNTY, ILLINOIS**

**THREATENED AND ENDANGERED SPECIES**  
**DENSITY IN QUANTITATIVE QUADRATS -**  
**SPIKE (*Elliptio dilatata*)**

**ARCADIS** Design & Consulting  
for natural and  
built assets

**FIGURE**  
**11**

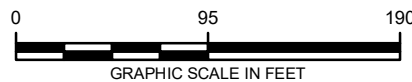


**LEGEND**

**THREATENED & ENDANGERED SPECIES DIVERSITY**

- MONKEYFACE (*Quadrula metanevra*)
- PURPLE WARTYBACK (*Cyclonaias tuberculata*)
- ◐ MONKEYFACE (*Quadrula metanevra*) AND PURPLE WARTYBACK (*Cyclonaias tuberculata*)

- NO THREATENED AND ENDANGERED SPECIES
- ✗ QUADRAT NOT SURVEYED DUE TO LARGE AMOUNTS OF GLASS IN SUBSTRATE
- SEMI-QUANTITATIVE SURVEY
- TRANSECTS (10-METER SPACING)
- ➔ FLOW DIRECTION ARROW
- EMPCO PIPELINE SYSTEM
- AREA OF DIRECT IMPACT (ADI)
- ADI BUFFER



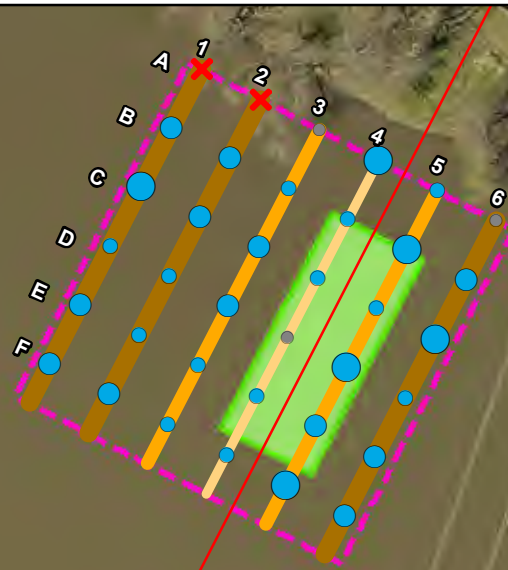
EXXONMOBIL PIPELINE COMPANY  
HOUSTON, TEXAS  
**KANKAKEE RIVER PIPELINE ARMORING PROJECT**  
WILL COUNTY, ILLINOIS

**THREATENED AND ENDANGERED SPECIES DIVERSITY IN QUANTITATIVE QUADRATS**



**FIGURE 12**

Study Area North	
Transect Number	Number of Mussels Found
1	1,546
2	1,740
3	1,102
4	792
5	1,112
6	1,755



Study Area South	
Transect Number	Number of Mussels Found
1	715
2	467
3	682
4	324
5	1,185
6	642

**LEGEND**

FRESHWATER MUSSEL DENSITY (ALL SPECIES) IN QUANTITATIVE QUADRATS

- 0
- 1 - 5
- 6 - 10
- 11 - 15
- 16 - 20
- 26 - 30

✘ QUADRAT NOT SURVEYED DUE TO LARGE AMOUNTS OF GLASS IN SUBSTRATE

FRESHWATER MUSSEL DENSITY IN SEMI-QUANTITATIVE TRANSECTS

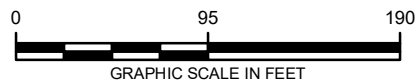
- 100 - 500
- 501 - 750
- 751 - 1000
- 1001 - 1500
- 1501 - 2000

➡ FLOW DIRECTION ARROW

— EMPCO PIPELINE SYSTEM

■ AREA OF DIRECT IMPACT (ADI)

▭ ADI BUFFER



EXXONMOBIL PIPELINE COMPANY  
HOUSTON, TEXAS  
**KANKAKEE RIVER PIPELINE ARMORING PROJECT**  
WILL COUNTY, ILLINOIS

**OVERALL MUSSEL DENSITY IN SEMI-QUANTITATIVE TRANSECTS**



FIGURE  
**13**





**LEGEND**

NUMBER OF MUSSEL SPECIES TYPE

- 0
- 1
- 2
- 3
- 4
- 5

✘ QUADRAT NOT SURVEYED DUE TO LARGE AMOUNTS OF GLASS IN SUBSTRATE

OVERALL MUSSEL DIVERSITY IN SEMI-QUANTITATIVE TRANSECTS

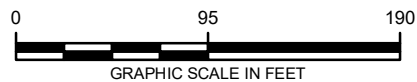
- 10 - 12
- 13 - 15
- 16 - 18
- 19 - 21

➡ FLOW DIRECTION ARROW

— EMPCO PIPELINE SYSTEM

■ AREA OF DIRECT IMPACT (ADI)

▭ ADI BUFFER



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**KANKAKEE RIVER PIPELINE ARMORING PROJECT**  
WILL COUNTY, ILLINOIS

**OVERALL MUSSEL DIVERSITY IN SEMI-QUANTITATIVE TRANSECTS**



FIGURE  
**14**

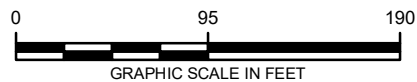


**LEGEND**

THREATENED AND ENDANGERED SPECIES DIVERSITY

- 2
- 3
- 4

- FLOW DIRECTION ARROW
- EMPCO PIPELINE SYSTEM
- AREA OF DIRECT IMPACT (ADI)
- ADI BUFFER



EXXONMOBIL PIPELINE COMPANY  
HOUSTON, TEXAS  
**KANKAKEE RIVER PIPELINE ARMORING PROJECT**  
WILL COUNTY, ILLINOIS

**THREATENED AND ENDANGERED SPECIES  
DIVERSITY IN SEMI-QUANTITATIVE TRANSECTS**



**FIGURE  
15**



ADI North	
Total Mussel Density for Qualitative Survey	774
Mussel Diversity for Qualitative Survey	13
Threatened and Endangered Species Density for Qualitative Survey	53
Threatened and Endangered Species Diversity for Qualitative Survey	3

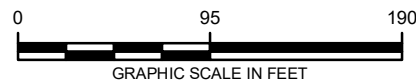
ADI South	
Total Mussel Density for Qualitative Survey	1253
Mussel Diversity for Qualitative Survey	15
Threatened and Endangered Species Density for Qualitative Survey	31
Threatened and Endangered Species Diversity for Qualitative Survey	3



**LEGEND**

- EMPCO PIPELINE SYSTEM
- AREA OF DIRECT IMPACT (ADI)
- ADI BUFFER

NOTE:  
 QUALITATIVE SURVEY CONSISTED OF ONE HOUR TIMED SURVEY (SURVEY CONDUCTED BY TWO ARCADIS SCIENTIFIC DIVERS FOR A TOTAL SURVEY TIME OF TWO SURVEY HOURS).



EXXONMOBIL PIPELINE COMPANY  
 HOUSTON, TEXAS  
**KANKAKEE RIVER PIPELINE ARMORING PROJECT**  
**WILL COUNTY, ILLINOIS**

**AREA OF DIRECT IMPACT (ADI)**  
**QUALITATIVE SURVEY RESULTS**



FIGURE  
**16**

# APPENDIX A

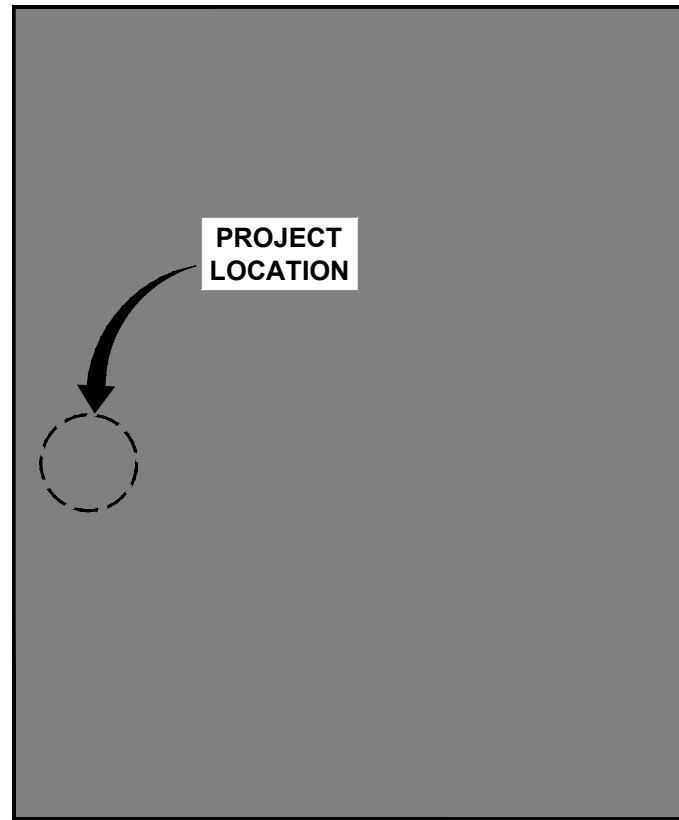
Project Design Plan



CITY:SYRACUSE,NY DIV:GROUP:ENV:CAD DBK SARTORI PIC:J.C. KIRSCHNER PM:D. GOMES TM:S. BOGART LVR:(Ctrl)ON=OFF=REF  
C:\Users\Pa01041\BIM_360\Arcadis\IANA - EXXON MOBIL\Project Files\EMPCO - Water Crossing\2020\Kankakee River Crossing\3006031101-DWG\PCOP-DESIGN-DRQ100-COVER.dwg LAYOUT: COVER PLOT: 11/5/2020 6:51 PM ACADVER: 23.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE:  
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XREFS: IMAGES: PROJECTNAME: ---  
IL_Bonfield_20180728_TW_geo.jpg  
IL_Symmeton_20180724_TW_geo.jpg

# CONTRACT DRAWINGS

# WILL COUNTY, ILLINOIS ARMORING MITIGATION DESIGN



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CONSTRUCTION

DATE ISSUED / DATE REVISED  
**NOVEMBER 2020**

**EXXONMOBIL PIPELINE COMPANY  
KANKAKEE RIVER, WILL COUNTY, ILLINOIS**

## INDEX TO DRAWINGS

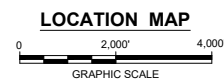
### GENERAL

G100 SITE LOCATION MAP  
G101 SURVEY CONTROL SHEET

### CIVIL

C100 EXISTING OVERALL SITE PLAN  
C101 PROPOSED SITE PLAN - A  
C102 PROPOSED SITE PLAN - B  
C103 EXISTING OVERALL PROFILE  
C104 PROPOSED PROFILE - A  
C105 PROPOSED PROFILE - B  
C106 PROPOSED CROSS SECTIONS  
C200 GENERAL NOTES

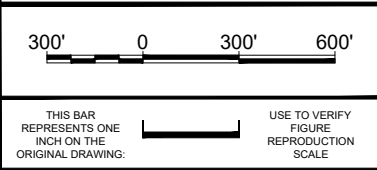
REFERENCE: BASE MAP USGS 7.5 MINUTE QUADRANGLE,  
MORGANS POINT, TEXAS, 2019.



TEXAS REGISTERED ENGINEERING FIRM F-533  
ARCADIS U.S., INC.



CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYNONE=OFF=REF*  
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 PROJECT NAME:



No.	Date	Revisions	By	Ckd

Professional Engineer's Name		
Professional Engineer's No.		
State	Date Signed	Project Mgr.
Designed by	Drawn by	Checked by

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CONSTRUCTION

TEXAS REGISTERED  
 ENGINEERING FIRM F-533  
 ARCADIS U.S., INC.

ARMORING MITIGATION DESIGN • WILL COUNTY, ILLINOIS  
 S-232 MUSTANG LOCKPORT TO PATOKA CRUDE OIL PIPELINE AT THE KANKAKEE RIVER  
**SITE LOCATION MAP**  
 GENERAL

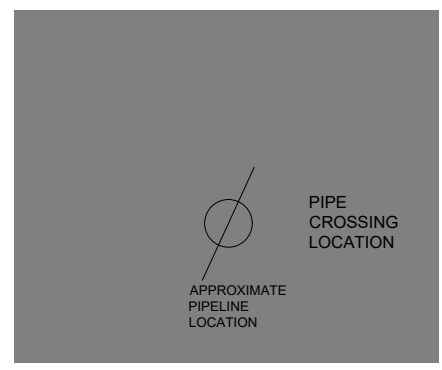
ARCADIS Project No. 30060311
Date NOVEMBER 2020
ARCADIS U.S., INC 10205 WESTHEIMER RD. SUITE 800 HOUSTON, TX 77042 TEL: 713.953.4800

G-100



CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYNONE+OFF=REF: C:\Users\p01041\OneDrive\Documents\Projects\Kankakee River Crossing\3006031101-DWG\PCOP-DESIGN-DRG101-SURVEY CONTROL.dwg LAYOUT: G-101  
 PROJECT NAME: Kankakee River Crossing  
 PROJECT NUMBER: 3006031101  
 PROJECT DATE: 11/14/2020  
 PROJECT TITLE: S-232 MUSTANG LOCKPORT TO PATOKA CRUDE OIL PIPELINE AT THE KANKAKEE RIVER  
 DRAWN BY: ANJANEYAKUMAR, PAVAN KUMAR  
 CHECKED BY: ANJANEYAKUMAR, PAVAN KUMAR  
 DATE: 11/14/2020  
 SCALE: AS SHOWN  
 SHEET: G-101 OF 101

SOURCE:  
 BASEMAP PROVIDED BY ARCADIS, INC SURVEY DATED 07/14/2020;  
 HORZ: NAD83 ILLINOIS STATE PLANES, EAST ZONE 1283-EF  
 VERT: NAVD88

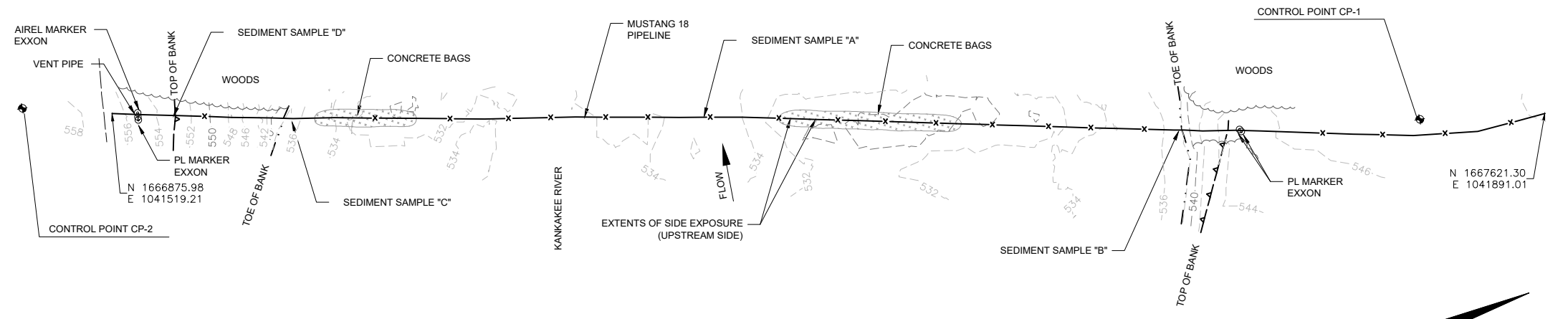
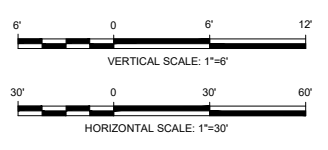
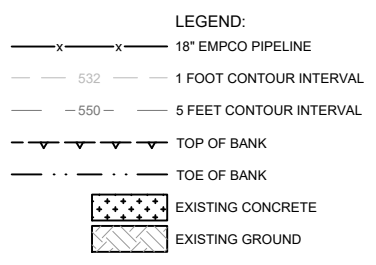


HORZ: NAD83 ILLINOIS STATE PLANES, EAST ZONE 1283-EF  
 VERT: NAVD88  
 GPS OBSERVATION: VRS VIRTUAL REFERENCE STATION (7/14/20)  
 MINIMUM DEPTH OF COVER MEASUREMENT= 0  
 SURVEY METHOD= TRIMBLE R10 GNSS ON THE VRS NETWORK

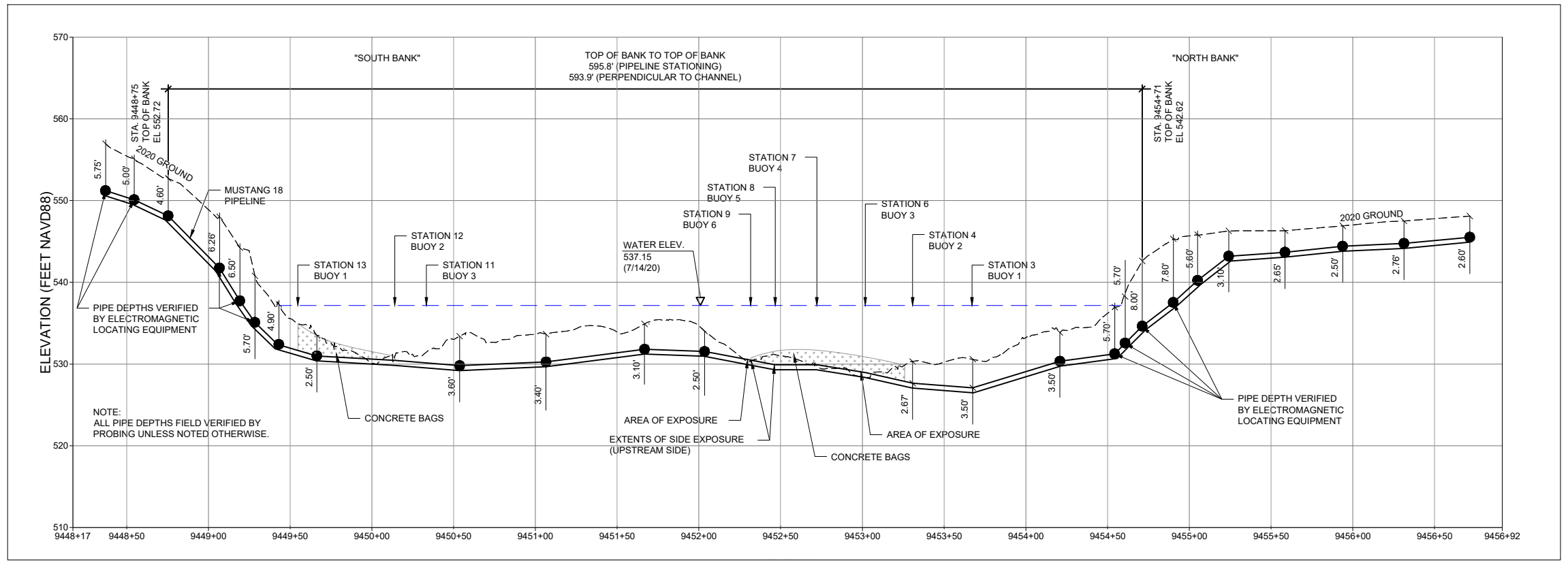
CONTROL POINT TABLE				
BM NO.	DESC	NORTH	EAST	ELEV.
CP-1	IRW/CAP	1667554.73	1041861.52	547.11
CP-2	60D NAIL	1666830.73	1041492.96	559.08

WATER SURFACE ELEVATION TABLE				
LOCATION	NORTH	EAST	ELEV.	DISTANCE TO PIPELINE
UPSTREAM	1667430.52	1041785.98	537.20	19'
DOWNSTREAM	1667421.46	1041818.24	537.11	15'

SEDIMENT SAMPLE TABLE			
SAMPLE #	NORTH	EAST	DEPTH
A	1667182.37	1041674.63	0-6"
B	1667427.45	1041804.09	0-6"
C	1666968.21	1041568.34	0-6"
D	1666906.22	1041536.73	0-6"



PIPE DESCRIPTION: 18"  
 18" O.D.  
**KANKAKEE RIVER, IL**



No.	Date	Revisions	By	Ckd

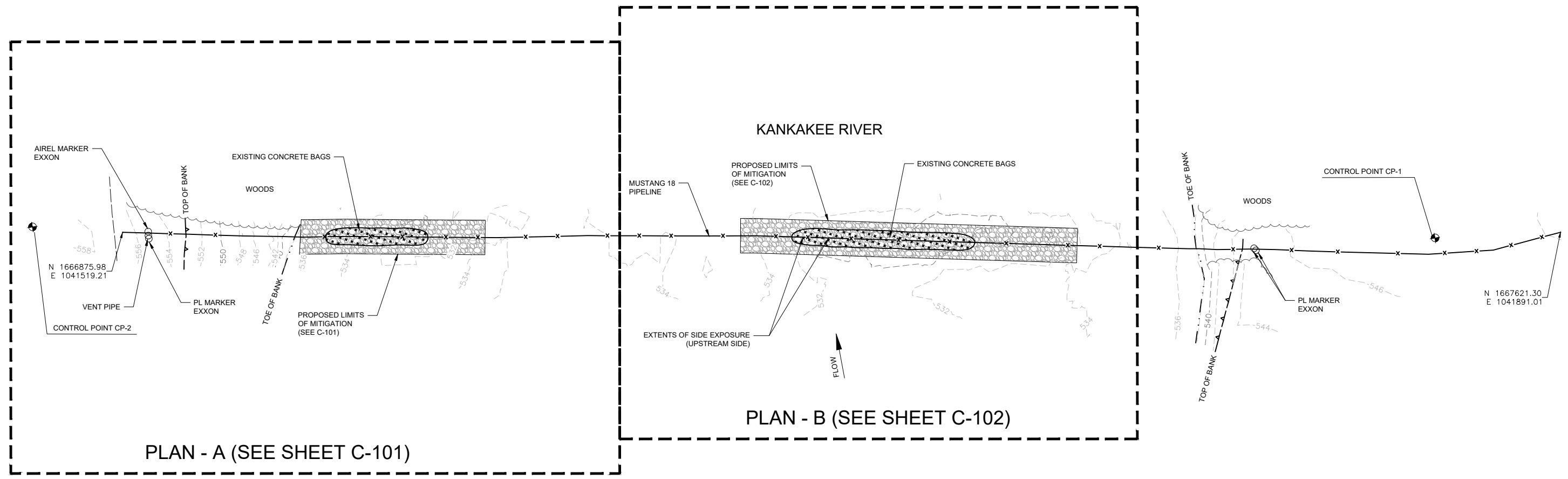
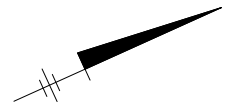
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 TEXAS REGISTERED ENGINEERING FIRM F-533  
 ARCADIS U.S., INC.

ARMORING MITIGATION DESIGN • WILL COUNTY, ILLINOIS  
 S-232 MUSTANG LOCKPORT TO PATOKA CRUDE OIL PIPELINE AT THE KANKAKEE RIVER  
**SURVEY CONTROL SHEET**  
 GENERAL

ARCADIS Project No. 30060311  
 Date NOVEMBER 2020  
 ARCADIS U.S., INC  
 10205 WESTHEIMER RD.  
 SUITE 800  
 HOUSTON, TX 77042  
 TEL: 713.953.4800  
**G-101**

CITY: DIV/GROUP: DB: LD: PIC: PM: T.M: LYR: ON: OFF: REF: C:\Users\p10411\OneDrive\Arcadis\ANA - EXXON MOBIL\Project Files\EMPCO - Water Crossing\2020\Kankakee River Crossing\3006031101-DWG\PCOP-DESIGN-DRC100-EXISTING OVERALL PLAN AND PROFILE.dwg LAYOUT: C-100 SAVED: 11/22/2020 4:17 PM ACADVER: 23.1S (LMS TECH) PAGESETUP: --- PLOTSTYLETABLE: AUS-NC5MOD FULL MONO.CTB PLOTTED: 11/22/2020 5:12 PM BY: ANJANEYAKUMAR, PAVAN KUMAR XREFS: IMAGES: PROJECTNAME: ---



PLAN - A (SEE SHEET C-101)

PLAN - B (SEE SHEET C-102)

LEGEND:

—x—x—x—	MBGB PIPELINE
---12---	1 FOOT CONTOUR INTERVAL
---15---	5 FEET CONTOUR INTERVAL
---▲---	TOP OF BANK
---●---	TOE OF BANK
[Pattern]	PROPOSED LIMITS OF ARMOR

SOURCE:  
 BASEMAP PROVIDED BY ARCADIS, INC SURVEY DATED 07/14/2020;  
 HORZ: NAD83 ILLINOIS STATE PLANES, EAST ZONE 1283-EF  
 VERT: NAVD88



No.	Date	Revisions	By	Ckd

Professional Engineer's Name		
Professional Engineer's No.		
State	Date Signed	Project Mgr.
Designed by	Drawn by	Checked by

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 S-232 MUSTANG LOCKPORT TO PATOKA CRUDE OIL PIPELINE AT THE KANKAKEE RIVER

## EXISTING OVERALL SITE PLAN

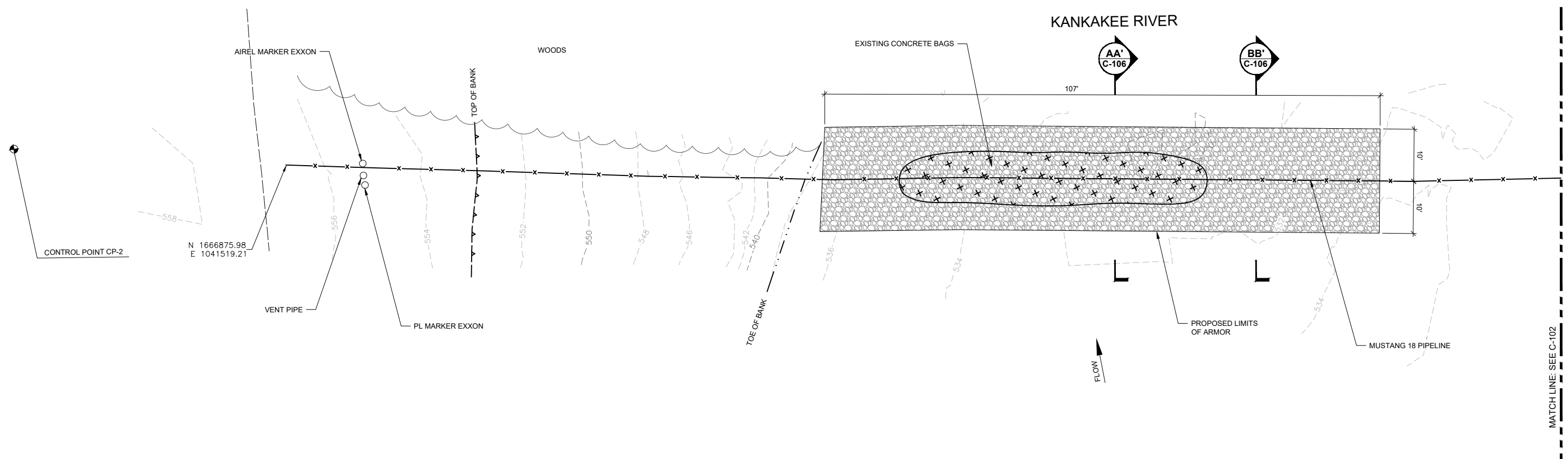
CIVIL

ARCADIS Project No. 30060311
Date NOVEMBER 2020
ARCADIS U.S., INC 10205 WESTHEIMER RD. SUITE 800 HOUSTON, TX 77042 TEL: 713.953.4800

**C-100**

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- NOTES:**
1. CONTRACOR SHALL, VIA DIVERS, CONFIRM THE CONDITIONS ARE THE SAME AS REPRESENTED IN SURVEY PERFORMED 7/14/2020.
  2. DIVERS SHALL IDENTIFY ANY LARGE DEBRIS LOCATED WITHIN PROPOSED ROCK FOOTPRINT (SUCH AS TREES) AND REMOVE PRIOR TO ROCK PLACEMENT.



**LEGEND:**

—x—x—	MBGB PIPELINE
---12---	1 FOOT CONTOUR INTERVAL
---15---	5 FEET CONTOUR INTERVAL
---▲---	TOP OF BANK
---●---	TOE OF BANK
~ ~ ~	TREE LINE
[Shaded Area]	PROPOSED LIMITS OF ARMOR

**SOURCE:**  
 BASEMAP PROVIDED BY ARCADIS, INC SURVEY DATED 07/14/2020;  
 HORZ: NAD83 ILLINOIS STATE PLANES, EAST ZONE 1283-EF  
 VERT: NAVD88



No.	Date	Revisions	By	Ckd

Professional Engineer's Name		
Professional Engineer's No.		
State	Date Signed	Project Mgr.
Designed by	Drawn by	Checked by

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ARMORING MITIGATION DESIGN • WILL COUNTY, ILLINOIS  
 S-232 MUSTANG LOCKPORT TO PATOKA CRUDE OIL PIPELINE AT THE KANKAKEE RIVER

**PROPOSED SITE PLAN - A**

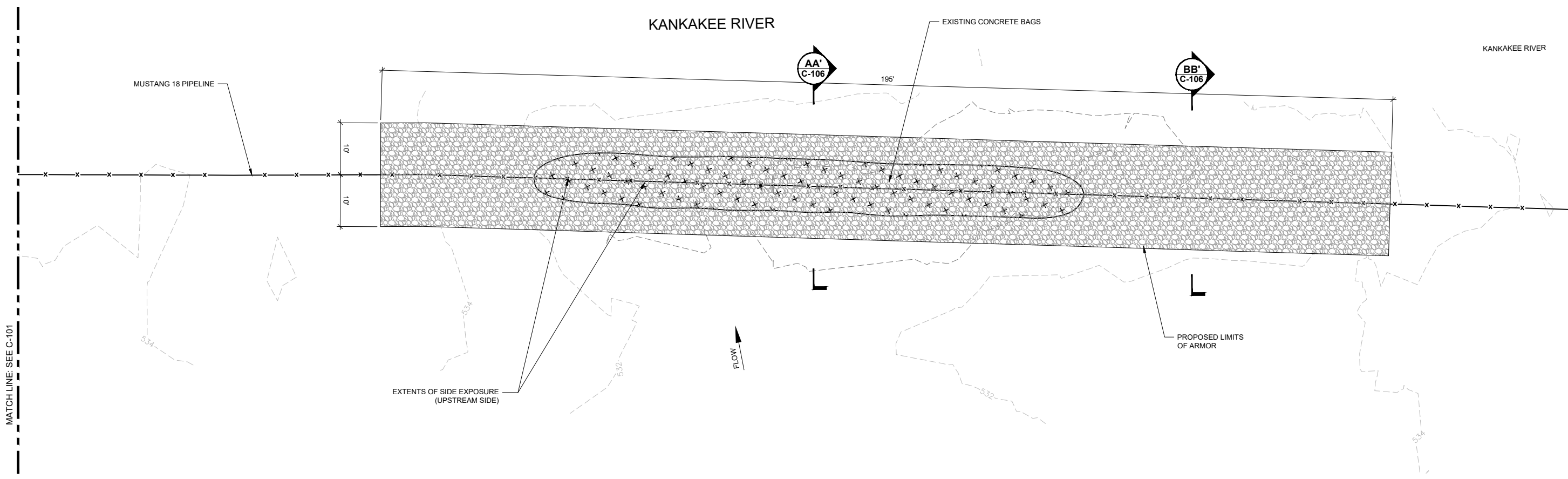
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ARCADIS Project No. 30060311  
 Date NOVEMBER 2020  
 ARCADIS U.S., INC  
 10205 WESTHEIMER RD.  
 SUITE 800  
 HOUSTON, TX 77042  
 TEL: 713.953.4800

**C-101**

CITY: DIV/GROUP: DB: LD: PIC: PM: T.M: L.YR ON="OFF" REF: C:\Users\p01041\BIM\360\Arcadis\ANA - EXXON MOBIL\Project Files\EMPCO - Water Crossing\2020\Kankakee River Crossing\3006031101-DWG\PCOP-DESIGN-DRC101-PROPOSED PLANS AND PROFILES.dwg LAYOUT: C-102 SAVED: 11/12/2020 4:41 PM ACADVER: 23.1S (LMS TECH) PAGESETUP: C:\Users\p01041\BIM\360\Arcadis\ANA - EXXON MOBIL\Project Files\EMPCO - Water Crossing\2020\Kankakee River Crossing\3006031101-DWG\PCOP-DESIGN-DRC101-PROPOSED PLANS AND PROFILES.dwg LAYOUT: C-102 SAVED: 11/12/2020 5:05 PM BY: ANANEYAKUMAR, PAVAN KUMAR XREFS: IMAGES: PROJECTNAME: ---

- NOTES:**
1. CONTRACTOR SHALL, VIA DIVERS, CONFIRM THE CONDITIONS ARE THE SAME AS REPRESENTED IN SURVEY PERFORMED 7/14/2020.
  2. DIVERS SHALL IDENTIFY ANY LARGE DEBRIS LOCATED WITHIN PROPOSED ROCK FOOTPRINT (SUCH AS TREES) AND REMOVE PRIOR TO ROCK PLACEMENT.



**LEGEND:**

—x—x—x—	MBGB PIPELINE
---12---	1 FOOT CONTOUR INTERVAL
---15---	5 FEET CONTOUR INTERVAL
---▲---	TOP OF BANK
---●---	TOE OF BANK
[Hatched Pattern]	PROPOSED LIMITS OF ARMOR

**SOURCE:**  
 BASEMAP PROVIDED BY ARCADIS, INC SURVEY DATED 07/14/2020;  
 HORZ: NAD83 ILLINOIS STATE PLANES, EAST ZONE 1283-EF  
 VERT: NAVD88



No.	Date	Revisions	By	Ckd

Professional Engineer's Name		
Professional Engineer's No.		
State	Date Signed	Project Mgr.
Designed by	Drawn by	Checked by

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ARMORING MITIGATION DESIGN • WILL COUNTY, ILLINOIS  
 S-232 MUSTANG LOCKPORT TO PATOKA CRUDE OIL PIPELINE AT THE KANKAKEE RIVER

**PROPOSED SITE PLAN - B**

CIVIL

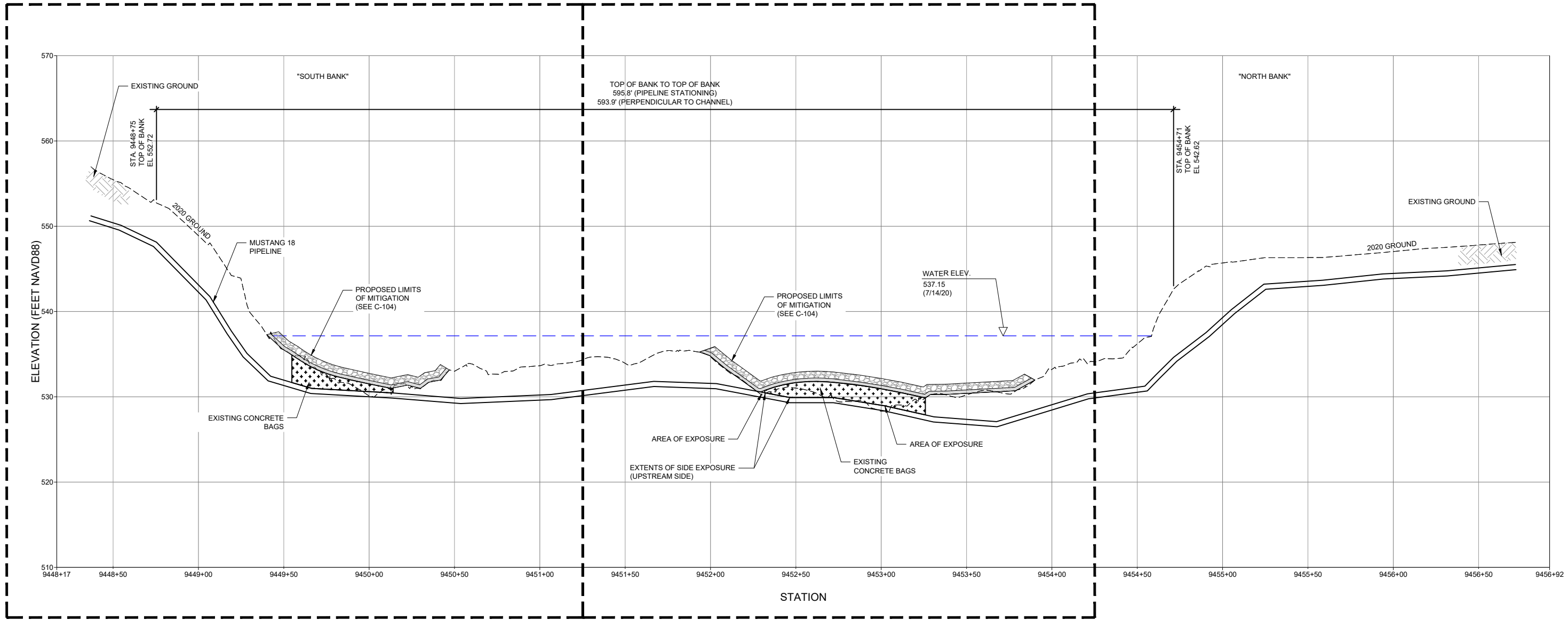
ARCADIS Project No. 30060311
Date NOVEMBER 2020
ARCADIS U.S., INC 10205 WESTHEIMER RD. SUITE 800 HOUSTON, TX 77042 TEL: 713.953.4800

**C-102**

CITY: DIV/GRP: DB: LD: PIC: PM: T.M: L.YR ON: OFF: REF: C:\Users\va01040\BIM\360\Arcadis\ANA - EXXON MOBIL\Project Files\EMPCO - Water Crossing\2020\Kankakee River Crossing\3006031101-DWG\PCOP-DESIGN-DRC100-EXISTING OVERALL PLAN AND PROFILE.dwg LAYOUT: C-103 SAVED: 11/17/2020 5:54 PM ACADVER: 23.1S (LMS TECH) PAGES: 1 PROJECTNAME: ---

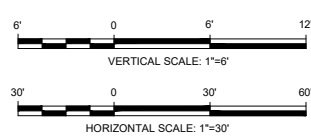
PROFILE - A (SEE SHEET C-104)

PROFILE - B (SEE SHEET C-105)



**LEGEND:**

- EXISTING CONCRETE
- FILTER LAYER
- EXISTING GROUND
- PROPOSED LIMITS OF ARMOR
- 18" EMPCO PIPELINE



SOURCE:  
 BASEMAP PROVIDED BY ARCADIS, INC SURVEY DATED 07/14/2020;  
 HORZ: NAD83 ILLINOIS STATE PLANES, EAST ZONE 1283-EF  
 VERT: NAVD88

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**ARCADIS** Design & Consultancy for natural and built assets

TEXAS REGISTERED ENGINEERING FIRM F-533  
 ARCADIS U.S., INC.

Professional Engineer's Name		
Professional Engineer's No.		
State	Date Signed	Project Mgr.
Designed by	Drawn by	Checked by

ARMORING MITIGATION DESIGN • WILL COUNTY, ILLINOIS  
 S-232 MUSTANG LOCKPORT TO PATOKA CRUDE OIL PIPELINE AT THE KANKAKEE RIVER

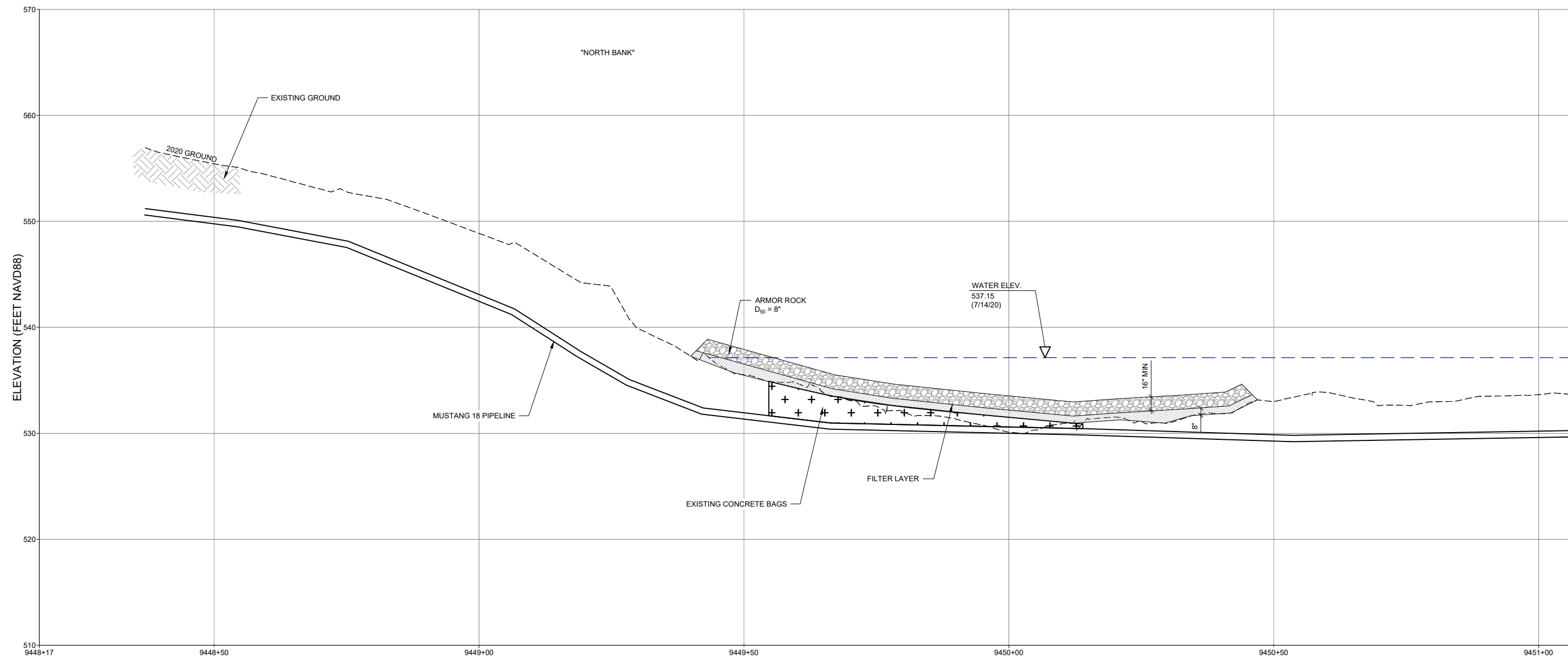
**EXISTING OVERALL PROFILE**

CIVIL

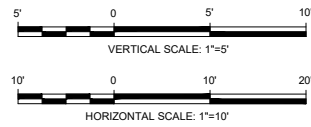
ARCADIS Project No. 30060311	<b>C-103</b>
Date NOVEMBER 2020	
ARCADIS U.S., INC 10205 WESTHEIMER RD. SUITE 800 HOUSTON, TX 77042 TEL: 713.953.4800	



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MATCH LINE: SEE C-105



**LEGEND:**

	EXISTING CONCRETE
	FILTER LAYER
	8" ARMOR ROCK
	EXISTING GROUND
	18" EMPCO PIPELINE

**NOTES:**

- EXTEND RIP RAP IN BOTH DIRECTIONS TO A POINT WHERE THERE IS APPROXIMATELY 3' OF EXISTING COVER OVER THE PIPELINE.

**SOURCE:**  
 BASEMAP PROVIDED BY ARCADIS, INC SURVEY DATED 07/14/2020;  
 HORZ: NAD83 ILLINOIS STATE PLANES, EAST ZONE 1283-EF  
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ARMORING MITIGATION DESIGN • WILL COUNTY, ILLINOIS  
 S-232 MUSTANG LOCKPORT TO PATOKA CRUDE OIL PIPELINE AT THE KANKAKEE RIVER

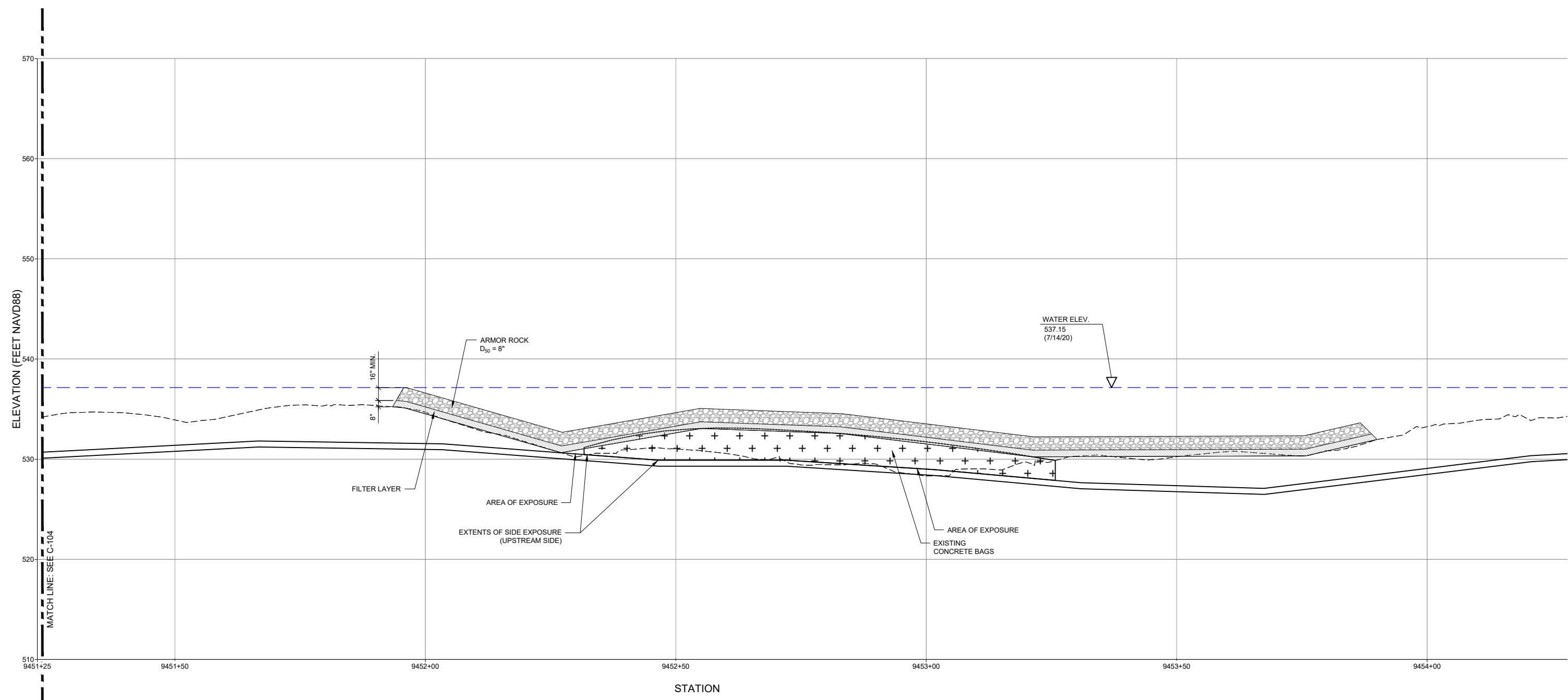
**PROPOSED PROFILE - A**

CIVIL

ARCADIS Project No. 30060311
Date NOVEMBER 2020
ARCADIS U.S., INC 10205 WESTHEIMER RD. SUITE 800 HOUSTON, TX 77042 TEL: 713.953.4800

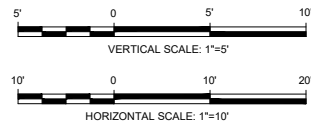
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**LEGEND:**

	EXISTING CONCRETE
	FILTER LAYER
	8" ARMOR ROCK
	EXISTING GROUND
	18" EMPCO PIPELINE



**NOTES:**

- EXTEND RIP RAP IN BOTH DIRECTIONS TO A POINT WHERE THERE IS APPROXIMATELY 3' OF EXISTING COVER OVER THE PIPELINE.

**SOURCE:**  
 BASEMAP PROVIDED BY ARCADIS, INC SURVEY DATED 07/14/2020;  
 HORZ: NAD83 ILLINOIS STATE PLANES, EAST ZONE 1283-EF  
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 TEXAS REGISTERED ENGINEERING FIRM F-533  
 ARCADIS U.S., INC.

ARMORING MITIGATION DESIGN • WILL COUNTY, ILLINOIS  
 S-232 MUSTANG LOCKPORT TO PATOKA CRUDE OIL PIPELINE AT THE KANKAKEE RIVER

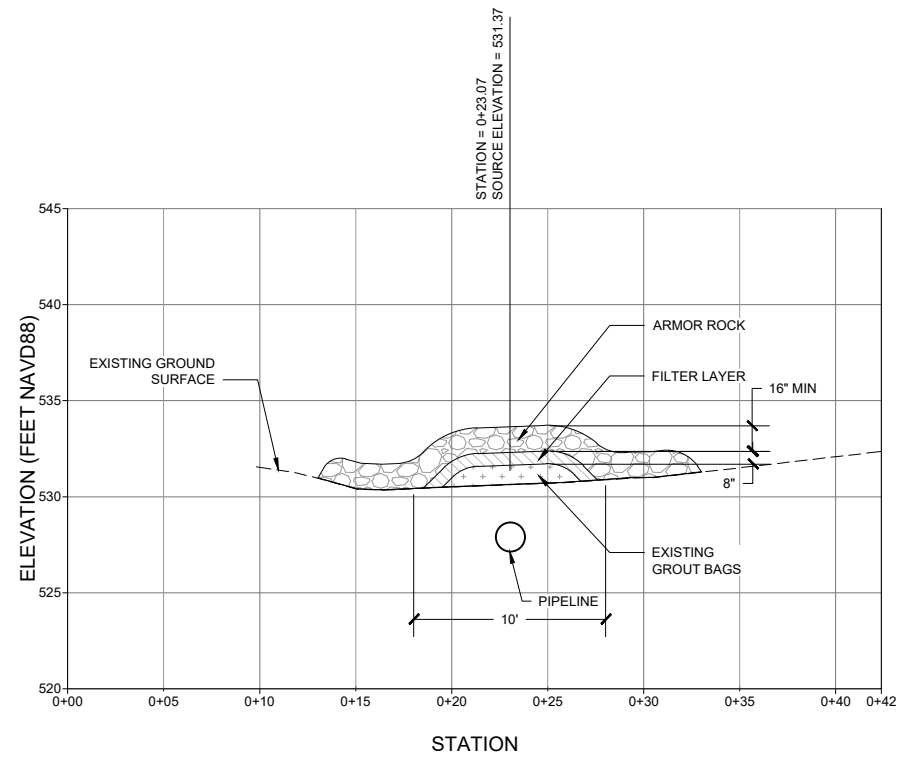
**PROPOSED PROFILE - B**

CIVIL

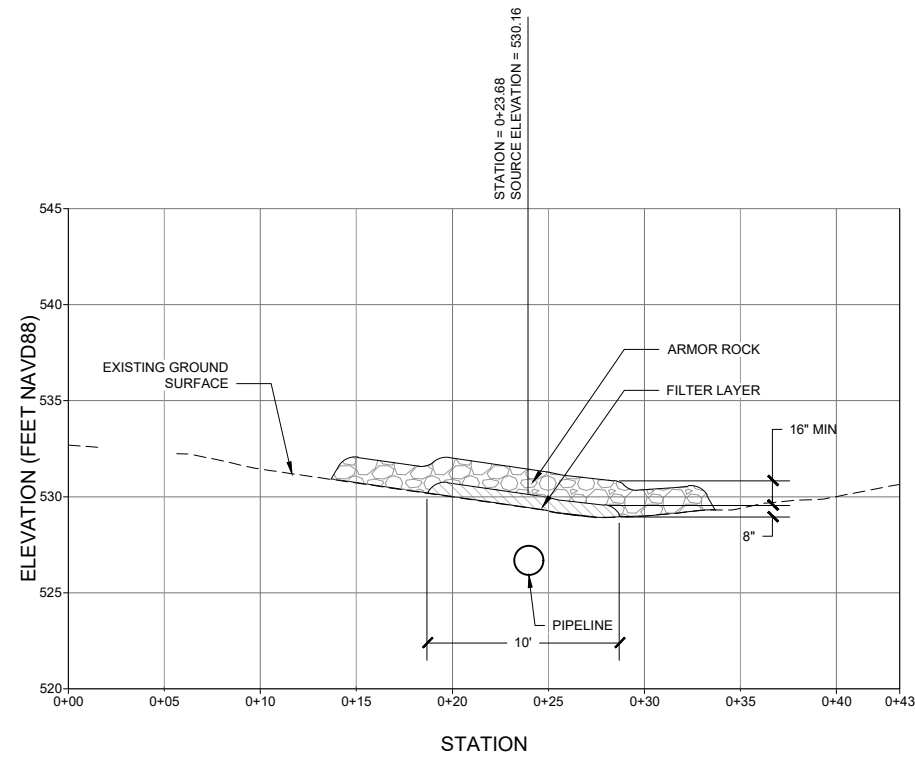
ARCADIS Project No. 30060311
Date NOVEMBER 2020
ARCADIS U.S., INC 10205 WESTHEIMER RD. SUITE 800 HOUSTON, TX 77042 TEL: 713.953.4800

**C-105**

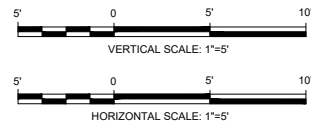
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 XREFS: IMAGES: PROJECTNAME: ---  
 BIG: COORDINATE: TITLE: POOP-DESIGN-X-BASE



**TYPICAL CROSS SECTION AA'  
THROUGH EXISTING GROUT BAGS**



**TPICAL CROSS SECTION BB'  
THROUGH AREA WITHOUT GROUT BAGS**



- LEGEND:**
- FILTER LAYER
  - D₅₀ 8" ARMOR ROCK
  - EXISTING GROUT BAGS

SOURCE:  
 BASEMAP PROVIDED BY ARCADIS, INC SURVEY DATED 07/14/2020;  
 HORZ: NAD83 ILLINOIS STATE PLANES, EAST ZONE 1283-EF  
 VERT: NAVD88

<p>THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING.</p> <p>USE TO VERIFY FIGURE REPRODUCTION SCALE</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>No.</th> <th>Date</th> <th>Revisions</th> <th>By</th> <th>Ckd</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table> <p>THIS DRAWING IS THE PROPERTY OF THE ARCADIS ENTITY IDENTIFIED IN THE TITLE BLOCK AND MAY NOT BE REUSED OR ALTERED IN WHOLE OR IN PART WITHOUT THE EXPRESS WRITTEN PERMISSION OF SAME.</p>	No.	Date	Revisions	By	Ckd						<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="3">Professional Engineer's Name</td> </tr> <tr> <td colspan="3">Professional Engineer's No.</td> </tr> <tr> <td>State</td> <td>Date Signed</td> <td>Project Mgr.</td> </tr> <tr> <td>Designed by</td> <td>Drawn by</td> <td>Checked by</td> </tr> </table>	Professional Engineer's Name			Professional Engineer's No.			State	Date Signed	Project Mgr.	Designed by	Drawn by	Checked by	<p><b>DRAFT NOT FOR CONSTRUCTION</b></p>	<p>ARCADIS U.S., INC.      TEXAS REGISTERED ENGINEERING FIRM F-533</p>	<p>ARMORING MITIGATION DESIGN • WILL COUNTY, ILLINOIS        S-232 MUSTANG LOCKPORT TO PATOKA CRUDE OIL PIPELINE AT THE KANKAKEE RIVER</p> <p><b>PROPOSED CROSS SECTIONS</b></p> <p>CIVIL</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>ARCADIS Project No. 30060311</td> </tr> <tr> <td>Date NOVEMBER 2020</td> </tr> <tr> <td>ARCADIS U.S., INC 10205 WESTHEIMER RD. SUITE 800 HOUSTON, TX 77042 TEL: 713.953.4800</td> </tr> </table>	ARCADIS Project No. 30060311	Date NOVEMBER 2020	ARCADIS U.S., INC 10205 WESTHEIMER RD. SUITE 800 HOUSTON, TX 77042 TEL: 713.953.4800	<b>C-106</b>
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CITY: DIV\GROUP: DB: LD: PIC: PM: TM: LYRON+OFF=REF* C:\Users\lv010401\OneDrive\Arcadis\ANA - EXXON MOBIL\Project Files\EMPCO - Water Crossing\2020\Kankakee River Crossing\30060311\01-DWG\PCOP-DESIGN-DRG100-SLM.dwg LAYOUT: C-200 SAVED: 11/17/2020 4:57 PM ACADVER: 23.1S (LMS TECH) PAGES: 1 PLOTSTYLETABLE: AUS: NCSMOD FULL MONO.CTB PLOTTED: 11/17/2020 5:54 PM BY: CHANDREGOWDA, VIKRAM

**BASIS OF DESIGN AND NOTES:**

**GENERAL:**

1. SURVEY DRAWING PROVIDED BY ARCADIS, INC. WITH A DATE OF SURVEY OF 7/14/2020.
2. VERIFY EXISTING CONDITIONS AND DIMENSIONS AND NOTIFY ENGINEER OF ANY CONDITIONS WHICH DO NOT COMPLY WITH PLANS AND SPECIFICATIONS.
3. THE BODY OF WATER AT THE CROSSING IS CONSIDERED A NAVIGATIONAL WATER WAY.

**STREAM GEOMORPHOLOGY:**

1. THE HYDROLOGY, HYDRAULICS, AND SCOUR FOR THE 100YEAR FLOOD EVENT WERE PROVIDED BY EMPCO:
  - a. DISCHARGE: 68,000 CUBIC FEET PER SECOND
  - b. AVERAGE CHANNEL VELOCITY: 5.15 FEET PER SECOND
  - c. VELOCITY AT THE TOP OF PIPE: 4.69 FEET PER SECOND
  - d. TOTAL MAXIMUM POTENTIAL SCOUR DEPTH: 3.0 FEET

**GEOTECHNICAL**

PER THE UNDERWATER INSPECTION REPORT PREPARED BY J.F. BRENNAN COMPANY, INC. FROM AN INSPECTION PERFORMED ON 7/28/2020, THE RIVER BOTTOM CONSISTED OF SAND AND SMALL GRAVEL, WITH SCATTERED ROCKS MEASURING APPROXIMATELY 3-4 INCHES.

**8" ROCK:**

1. PROVIDE WIDE-GRADED AND WELL-GRADED ANGULAR STONE WITH A D50 OF 8 INCHES:
  - a. THE STONE SHALL CONSIST OF FIELD STONE OR ROUGH UNHEWN QUARRY STONE
  - b. THE STONE SHALL BE HARD AND ANGULAR AND OF A QUALITY THAT WILL NOT DISINTEGRATE ON EXPOSURE TO WATER OR WEATHERING
  - c. THE SPECIFIC GRAVITY OF THE INDIVIDUAL STONES SHALL BE AT LEAST 2.5
2. THE ROCK RIP RAP SIZE AND THICKNESS IS IN ACCORDANCE WITH THE FOLLOWING METHODS:
  - a. THE ARMY CORPS OF ENGINEERS ENGINEERING (USACE) MANUAL EM-1110-2-1601 (EM-1110-2-1601) RESULTING IN A DESIGN ROCK SIZE OF 12 INCHES
  - i. SAFETY FACTOR (Sf) = 1.5
  - ii. RADIUS/WIDTH (Rc/W) = 4.2
  - iii. SIDE SLOPE ANGLE = 20 DEGREES
  - iv. CROSS SECTION MAXIMUM VELOCITY = 5.15 FEET PER SECOND
  - b. BLAAUW (1978) EROSION OF BOTTOM AND SLOPING BANKS CAUSED BY THE SCREW RACE OF MANEUVERING BOATS RESULTING IN A DESIGN D50 ROCK SIZE OF 9 INCHES
  - i. APPLIED ENGINE POWER/PROPELLER IN (PD) = 500 HORSEPOWER
  - ii. PROPELL DIAMETER (DP) = 1.5 FEET
  - iii. DISTANCE FROM PROPELLER TO CHANNEL BOTTOM (HP) = 5 FEET

**FILTER GRAVEL:**

1. PROVIDE FILTER GRAVEL CONSISTING OF A 50% BLEND OF ASTM #3 AGGREGATE AND 50% ASTM #9 AGGREGATE.
2. FILTER GRAVEL SHOULD BE RELEASED WITHIN 3 FEET OF THE CHANNEL BOTTOM TO PREVENT MATERIAL FROM MOVING DOWNSTREAM.
3. FILTER GRAVEL IS SIZED IN ACCORDANCE WITH THE NATURAL RESOURCES CONSERVATION SERVICE (NRCS) PART 633 OF THE NATIONAL ENGINEERING HANDBOOK (NEH) - CHAPTER 26 - GRADATION DESIGN OF SAND AND GRAVEL FILTERS ISSUED OCTOBER 1994.
4. FILTER GRAVEL IS TO BE PLACED WITH VELOCITIES NEAR THE CHANNEL BOTTOM OF LESS THAN 3 FEET PER SECOND.

**ROCK GUARD:**

1. CONTRACTOR SHALL, VIA DIVERS, CONFIRM THAT THE PIPELINE HAS ROCK GUARD OR SIMILAR PROTECTION INSTALLED AROUND THE PIPELINE WHERE THE PIPELINE IS EXPOSED. IF NO ROCK GUARD IS FOUND, CONTRACTOR SHALL INSTALL NEW ROCK GUARD (15 FEET WIDE) OVER EXPOSED PIPE.
2. ROCK GUARD MATERIAL SHALL BE "ROCK GURD SD" FROM INDUSTRIAL FABRICS, INC. OR AN EXXONMOBIL APPROVED EQUAL.

**MONITORING PLAN:**

1. CONDUCT A SURVEY OF THE ROCK EXTENTS IMMEDIATELY FOLLOWING CONSTRUCTION
2. FOLLOW THIS INSPECTION PLAN:
  - a. CONDUCT A PROFESSIONAL SURVEY OF THE CHANNEL BOTTOM AT LEAST ONCE EVERY FIVE YEARS TO VERIFY THAT THERE ARE NO CHANGES IN ROCK ELEVATIONS THAT WOULD INDICATE SCOUR AND/OR EROSION.
  - b. CONFIRM THIS PLAN IS IN AGREEMENT WITH THE WATER CROSSING PROGRAM MONITORING PLAN BASED ON RECLASSIFICATION FOLLOWING MITIGATION IMPLEMENTATION.
3. AS DETERMINED BY INSPECTION, ADDITIONAL ROCK WILL BE PLACED TO MAINTAIN THE REQUIRED MINIMUM THICKNESS, AS NECESSARY.

**CONSTRUCTION OBSERVATION:**

TO PROPERLY MONITOR CONSTRUCTION PROGRESS, QUALITY, DESIGN CONFORMANCE, AND TO MAINTAIN CONSISTENT COMMUNICATION BETWEEN ALL PARTIES, THE ENGINEER OR A DESIGNATED ENGINEER'S REPRESENTATIVE WILL PROVIDE OBSERVATION DURING CONSTRUCTION. THE PRIMARY RESPONSIBILITY OF THE ENGINEER WILL BE TO APPROPRIATELY AND EFFICIENTLY RESOLVE TECHNICAL, SCHEDULING, COORDINATION, AND CONSTRUCTABILITY ISSUES. THE ENGINEER WILL ALSO BE RESPONSIBLE FOR THE FOLLOWING:

1. AS REQUIRED AND REQUESTED BY PROJECT OWNER, REVIEW FIELD CHANGE ORDERS TO PROPERLY TRACK AND ADDRESS VARIABLE FIELD CONDITIONS. FIELD CHANGE ORDER CONDITIONS WILL BE COMMUNICATED IMMEDIATELY WITH OWNER.
2. ASSIST WITH RESOLVING PROBLEMS DUE TO ACTUAL FIELD CONDITIONS ENCOUNTERED.

**TABLE OF QUANTITIES:**

DESCRIPTION	UNITS	QUANTITY
8 INCH ROCK	CUBIC YARDS	298
FILTER GRAVEL	CUBIC YARDS	75

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Design & Consultancy for natural and built assets

TEXAS REGISTERED ENGINEERING FIRM F-533  
ARCADIS U.S., INC.

ARMORING MITIGATION DESIGN • WILL COUNTY, ILLINOIS  
S-232 MUSTANG LOCKPORT TO PATOKA CRUDE OIL PIPELINE AT THE KANKAKEE RIVER

**GENERAL NOTES**

GENERAL

ARCADIS Project No. 30060311
Date NOVEMBER 2020
ARCADIS U.S., INC 10205 WESTHEIMER RD. SUITE 800 HOUSTON, TX 77042 TEL: 713.953.4800

**C-200**

# APPENDIX B

## Photographic Log





## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



### Photograph: 1

**Description:**  
Overview of the S-232 Mustang Lockport to Patoka Pipeline ROW as it crosses the Kankakee River.

**Direction:**  
South

**Date:** 9/28/2020



### Photograph: 2

**Description:**  
Additional view of the S-232 Mustang Lockport to Patoka Pipeline ROW as it crosses the Kankakee River.

**Direction:**  
North

**Date:** 10/7/2020

## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



**Photograph: 3**

**Description:**

View of the downstream portion of the study area at the pipeline ROW crossing of the Kankakee River.

**Direction:**

West

**Date:** 10/1/2020



**Photograph: 4**

**Description:**

View of the most common substrate type within the study area.

**Direction:**

N/A

**Date:** 10/7/2020



## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



**Photograph: 5**

**Description:**  
View of the left valve of  
black sandshell  
(*Ligumia recta*).

**Direction:**  
N/A

**Date:** 9/28/2020



**Photograph: 6**

**Description:**  
Doral view of the umbo  
of a black sandshell  
(*Ligumia recta*).

**Direction:**  
N/A

**Date:** 9/28/2020

## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



**Photograph: 7**

**Description:**  
View of the left valve of  
creeper (*Strophitus*  
*undulatus*).

**Direction:**  
N/A

**Date:** 9/29/2020



**Photograph: 8**

**Description:**  
Dorsal view of the  
umbo of creeper  
(*Strophitus undulatus*)

**Direction:**  
N/A

**Date:** 9/29/2020



## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



**Photograph: 9**

**Description:**  
View the left valve of  
deertoe (*Truncilla  
truncata*).

**Direction:**  
N/A

**Date:** 9/28/2020



**Photograph: 10**

**Description:**  
Dorsal view of the  
umbo of deertoe  
(*Truncilla truncata*)

**Direction:**  
West

**Date:** 9/29/2020



## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



**Photograph: 11**

**Description:**  
View of the left valve of  
elktoe (*Alasmidonta  
marginata*)

**Direction:**  
N/A

**Date:** 9/29/2020



**Photograph: 12**

**Description:**  
Dorsal view of the  
umbo of elktoe  
(*Alasmidonta  
marginata*)

**Direction:**  
N/A

**Date:** 9/29/2020

## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



**Photograph: 13**

**Description:**  
View of the left valve of  
ellipse (*Venustaconcha*  
*ellipsiformis*)

**Direction:**  
N/A

**Date:** 9/29/2020



**Photograph: 14**

**Description:**  
Dorsal view of the  
umbo of ellipse  
(*Venustaconcha*  
*ellipsiformis*)

**Direction:**  
N/A

**Date:** 9/29/2020



## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



**Photograph: 15**

**Description:**  
View of the left valve of  
fluted-shell (*Lasmigona*  
*costata*).

**Direction:**  
N/A

**Date:** 9/29/2020



**Photograph: 16**

**Description:**  
Dorsal view of the  
umbo of fluted-shell  
(*Lasmigona costata*).

**Direction:**  
N/A

**Date:** 9/29/2020

## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



**Photograph: 17**

**Description:**  
View of the left valve of  
fragile papershell  
(*Leptodea fragilis*).

**Direction:**  
N/A

**Date:** 9/29/2020



**Photograph: 18**

**Description:**  
Dorsal view of the  
umbo of fragile  
papershell (*Leptodea  
fragilis*).

**Direction:**  
N/A

**Date:** 9/29/2020



## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



**Photograph: 19**

**Description:**  
View of the left valve of  
monkeyface (*Quadrula  
metanevra*).

**Direction:**  
N/A

**Date:** 9/29/2020



**Photograph: 20**

**Description:**  
Dorsal view of the  
umbo of monkeyface  
(*Quadrula metanevra*).

**Direction:**  
N/A

**Date:** 9/29/2020

## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



**Photograph: 21**

**Description:**  
View of the left valve of  
pimpleback (*Quadrula  
pustulosa*)

**Direction:**  
N/A

**Date:** 9/29/2020



**Photograph: 22**

**Description:**  
Dorsal view of the  
umbo of pimpleback  
(*Quadrula pustulosa*).

**Direction:**  
N/A

**Date:** 9/29/2020



## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



**Photograph: 23**

**Description:**  
View of the left valve of  
pink heelsplitter  
(*Potamilus alatus*)

**Direction:**  
N/A

**Date:** 9/29/2020



**Photograph: 24**

**Description:**  
Dorsal view of the  
umbo of pink  
heelsplitter (*Potamilus  
alatus*).

**Direction:**  
N/A

**Date:** 9/29/2020

## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



**Photograph: 25**

**Description:**  
View of the left valve of  
plain pocketbook  
(*Lampsilis cardium*)

**Direction:**  
N/A

**Date:** 9/29/2020



**Photograph: 26**

**Description:**  
Dorsal view of the  
umbo of plain  
pocketbook (*Lampsilis  
cardium*).

**Direction:**  
N/A

**Date:** 9/29/2020



## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



**Photograph: 27**

**Description:**  
View of the left valve of  
purple wartyback  
(*Cyclonaias*  
*tuberculata*)

**Direction:**  
N/A

**Date:** 9/29/2020



**Photograph: 28**

**Description:**  
Dorsal view of the  
umbo of purple  
wartyback (*Cyclonaias*  
*tuberculata*).

**Direction:**  
N/A

**Date:** 9/29/2020

## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



**Photograph: 29**

**Description:**  
View of the left valve of  
sheepnose  
(*Plethobasus cyphyus*)

**Direction:**  
N/A

**Date:** 9/29/2020



**Photograph: 30**

**Description:**  
Dorsal view of the  
umbo of sheepnose  
(*Plethobasus cyphyus*).

**Direction:**  
N/A

**Date:** 9/29/2020



## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



**Photograph: 31**

**Description:**  
View of the left valve of  
spike (*Elliptio dilatata*)

**Direction:**  
N/A

**Date:** 10/2/2020



**Photograph: 32**

**Description:**  
Dorsal view of the  
umbo of spike (*Elliptio  
dilatata*).

**Direction:**  
N/A

**Date:** 10/2/2020

## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



**Photograph: 33**

**Description:**  
View of the left valve of  
threehorn wartyback  
(*Obliquaria reflexa*)

**Direction:**  
N/A

**Date:** 10/2/2020



**Photograph: 34**

**Description:**  
Dorsal view of the  
umbo of threehorn  
wartyback (*Obliquaria  
reflexa*).

**Direction:**  
N/A

**Date:** 10/2/2020



## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



**Photograph: 35**

**Description:**  
View of the left valve of  
three-ridge (*Amblema  
plicata*)

**Direction:**  
N/A

**Date:** 9/28/2020



**Photograph: 36**

**Description:**  
Dorsal view of the  
umbo of three-ridge  
(*Amblema plicata*).

**Direction:**  
N/A

**Date:** 9/28/2020

## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



**Photograph: 37**

**Description:**  
View of the left valve of  
washboard  
(*Megaloniaias nervosa*)

**Direction:**  
N/A

**Date:** 9/28/2020



**Photograph: 38**

**Description:**  
Dorsal view of the  
umbo of washboard  
(*Megaloniaias nervosa*).

**Direction:**  
N/A

**Date:** 9/28/2020



## PHOTOGRAPH LOG

ExxonMobil Pipeline Company  
S-232 Mustang Lockport to Patoka  
Kankakee River, Will County, IL



**Photograph: 39**

**Description:**  
View of the left valve of  
white heelsplitter  
(*Lasmigona  
complanata*)

**Direction:**  
N/A

**Date:** 9/29/2020



**Photograph: 40**

**Description:**  
Dorsal view of the  
umbo of white  
heelsplitter (*Lasmigona  
complanata*).

**Direction:**  
N/A

**Date:** 9/29/2020

# APPENDIX C

IDNR EcoCAT Report #2103470







**Applicant:** Arcadis  
**Contact:** Jeremy Henson  
**Address:** 1717 W. 6th Street  
 Suite 210  
 Austin, TX 78703

**IDNR Project Number:** 2103470  
**Date:** 08/24/2020  
**Alternate Number:** 2102957

**Project:** Kankakee Pipeline Repair Project  
**Address:** 21400 IL-113, Custer Park

**Description:** Our client has an existing crude oil pipeline that crosses the Kankakee River in Will County. The pipeline is being evaluated for potential repair (as needed) and Arcadis is assessing the potential for impacts to sensitive species in the project area.

### Natural Resource Review Results

The Illinois Natural Heritage Database shows the following protected resources may be in the vicinity of the project location:

- Kankakee River Segment INAI Site
- Black Sandshell (*Ligumia recta*)
- Mudpuppy (*Necturus maculosus*)
- Pallid Shiner (*Hybopsis amnis*)
- Purple Wartyback (*Cyclonaias tuberculata*)
- River Redhorse (*Moxostoma carinatum*)
- Sheepnose (*Plethobasus cyphus*)
- Spike (*Elliptio dilatata*)
- Western Sand Darter (*Ammocrypta clarum*)

**An IDNR staff member will evaluate this information and contact you to request additional information or to terminate consultation if adverse effects are unlikely.**

#### Location

The applicant is responsible for the accuracy of the location submitted for the project.

**County:** Will

**Township, Range, Section:**

32N, 10E, 19



**IL Department of Natural Resources**  
**Contact**  
 Bradley Hayes  
 217-785-5500  
 Division of Ecosystems & Environment

**Government Jurisdiction**  
 U.S. Army Corps of Engineers

## **Disclaimer**

The Illinois Natural Heritage Database cannot provide a conclusive statement on the presence, absence, or condition of natural resources in Illinois. This review reflects the information existing in the Database at the time of this inquiry, and should not be regarded as a final statement on the site being considered, nor should it be a substitute for detailed site surveys or field surveys required for environmental assessments. If additional protected resources are encountered during the project's implementation, compliance with applicable statutes and regulations is required.

## **Terms of Use**

By using this website, you acknowledge that you have read and agree to these terms. These terms may be revised by IDNR as necessary. If you continue to use the EcoCAT application after we post changes to these terms, it will mean that you accept such changes. If at any time you do not accept the Terms of Use, you may not continue to use the website.

1. The IDNR EcoCAT website was developed so that units of local government, state agencies and the public could request information or begin natural resource consultations on-line for the Illinois Endangered Species Protection Act, Illinois Natural Areas Preservation Act, and Illinois Interagency Wetland Policy Act. EcoCAT uses databases, Geographic Information System mapping, and a set of programmed decision rules to determine if proposed actions are in the vicinity of protected natural resources. By indicating your agreement to the Terms of Use for this application, you warrant that you will not use this web site for any other purpose.
2. Unauthorized attempts to upload, download, or change information on this website are strictly prohibited and may be punishable under the Computer Fraud and Abuse Act of 1986 and/or the National Information Infrastructure Protection Act.
3. IDNR reserves the right to enhance, modify, alter, or suspend the website at any time without notice, or to terminate or restrict access.

## **Security**

EcoCAT operates on a state of Illinois computer system. We may use software to monitor traffic and to identify unauthorized attempts to upload, download, or change information, to cause harm or otherwise to damage this site. Unauthorized attempts to upload, download, or change information on this server is strictly prohibited by law.

Unauthorized use, tampering with or modification of this system, including supporting hardware or software, may subject the violator to criminal and civil penalties. In the event of unauthorized intrusion, all relevant information regarding possible violation of law may be provided to law enforcement officials.

## **Privacy**

EcoCAT generates a public record subject to disclosure under the Freedom of Information Act. Otherwise, IDNR uses the information submitted to EcoCAT solely for internal tracking purposes.

# APPENDIX D

Combined Mussel Survey Data



## ADI North - Transect 1

Survey Data					
Common Name	Scientific Name	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Black sandshell	<i>Ligumia recta</i>	22	110	36	134
Creek heelsplitter	<i>Lasmigona compressa</i>	1	45	45	45
Creeper	<i>Strophitus undulatus</i>	1	58	58	58
Deertoe	<i>Truncilla truncata</i>	3	34	24	40
Fat mucket	<i>Lampsilis siliquoidea</i>	1	73	73	73
Fluted-shell	<i>Lasmigona costata</i>	8	86	69	98
Monkeyface*	<i>Quadrula metanevra</i>	45	70	45	101
Mucket	<i>Actinonaias ligamentina</i>	1,251	96	18	131
Pimpleback	<i>Qadrula pustulosa</i>	37	35	9	60
Pink heelsplitter	<i>Potamilus alatus</i>	1	98	98	98
Plain pocketbook	<i>Lampsilis cardium</i>	17	90	47	118
Purple Wartyback*	<i>Cyclonaias tuberculata</i>	97	56	22	90
Round pigtoe	<i>Pleurobema sintoxia</i>	23	72	48	90
Sheepnose**	<i>Plethobasus cyphus</i>	1	85	85	85
Spike*	<i>Elliptio dilatata</i>	2	58	23	93
Threeridge	<i>Amblema plicata</i>	16	66	32	87
Washboard	<i>Megalonaias nervosa</i>	20	109	17	135
<b>Total</b>		<b>1546</b>			

Quadrat 1F						
Common Name	Scientific Name	Length of Shell	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Mucket	<i>Actinonaias ligamentina</i>	110, 118, 103, 88, 94, 94, 92, 88	8	98.38	88	118
Washboard	<i>Megalonaias nervosa</i>	97	1	97	97	97
<b>Total</b>			<b>9</b>			

Quadrat 1A not surveyed due to large amounts of glass in substrate.

Quadrat 1B						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Ellipse	<i>Venustaconcha ellipsiformis</i>	30	1	30	30	30
Mucket	<i>Actinonaias ligamentina</i>	83, 108, 65, 74, 84, 94, 97, 110	8	89	65	110
<b>Total</b>			<b>9</b>			

Quadrat 1C						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Mucket	<i>Actinonaias ligamentina</i>	85, 91, 95, 98, 108, 92, 92, 88, 94, 68	10	91	85	108
Purple Wartyback	<i>Cyclonaias tuberculata</i>	51, 63	2	57	51	63
Washboard	<i>Megalonaias nervosa</i>	16	1	16	16	16
<b>Total</b>			<b>13</b>			

Quadrat 1D						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Mucket	<i>Actinonaias ligamentina</i>	115, 93	2	104	93	115
<b>Total</b>			<b>2</b>			

Quadrat 1E						
Common Name	Scientific Name	Length of Shell	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Deertoe	<i>Truncilla truncata</i>	30	1	30	30	30
Mucket	<i>Actinonaias ligamentina</i>	112, 97, 110,	5	103	95	112
<b>Total</b>			<b>6</b>			





## ADI North - Transect 2

Survey Data						
Common Name	Scientific Name	Number of Individuals Relocated	Avg Shell Length	Min Shell Length	Max Shell Length	
Black sandshell	<i>Ligumia recta</i>	23	114	98	134	
Creek heelsplitter	<i>Lasmigona compressa</i>	--	--	--	--	
Creeper	<i>Strophitus undulatus</i>	--	--	--	--	
Deertoe	<i>Truncilla truncata</i>	4	33	26	36	
Fat mucket	<i>Lampsilis siliquoidea</i>	1	88	88	88	
Fluted-shell	<i>Lasmigona costata</i>	9	89	83	100	
Fragile papershell	<i>Leptodea fragilis</i>	1	56	56	56	
Monkeyface*	<i>Quadrula metanevra</i>	26	67	45	86	
Mucket	<i>Actinonaias ligamentina</i>	1,503	94	26	129	
Pimpleback	<i>Qadrula pustulosa</i>	41	34	10	50	
Pink heelsplitter	<i>Potamilus alatus</i>	1	122	122	122	
Plain pocketbook	<i>Lampsilis cardium</i>	29	95	37	118	
Purple Wartyback*	<i>Cyclonaias tuberculata</i>	53	54	7	90	
Round pigtoe	<i>Pleurobema sintoxia</i>	19	75	45	91	
Sheepnose**	<i>Plethobasus cyphus</i>	2	77	65	88	
Spike*	<i>Elliptio dilatata</i>	--	--	--	--	
Threeridge	<i>Amblema plicata</i>	19	65	39	102	
Washboard	<i>Megalonaias nervosa</i>	9	111	87	142	
<b>Total</b>		<b>1740</b>				

Quadrat 1A not surveyed due to large amounts of glass in substrate.

Quadrat 2B						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Mucket	<i>Actinonaias ligamentina</i>	105, 104, 92, 94, 103, 84, 87, 93	8	95	84	105
Plain pocketbook	<i>Lampsilis cardium</i>	104	1	104	104	104
			<b>Total</b>	<b>9</b>		

Quadrat 2C						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Mucket	<i>Actinonaias ligamentina</i>	82, 88, 92, 27, 82, 106, 105, 62	8	81	27	106
Purple Wartyback*	<i>Cyclonaias tuberculata</i>	72	1	72	72	72
			<b>Total</b>	<b>9</b>		

Quadrat 2D						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Mucket	<i>Actinonaias ligamentina</i>	93, 76, 77	3	82	76	93
			<b>Total</b>	<b>3</b>		

Quadrat 2E						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Deertoe	<i>Truncilla truncata</i>	27	1	27	27	27
Mucket	<i>Actinonaias ligamentina</i>	88, 93, 34	3	72	34	93
			<b>Total</b>	<b>4</b>		

Quadrat 2F						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Black sandshell	<i>Ligumia recta</i>	137	1	137	137	137
Mucket	<i>Actinonaias ligamentina</i>	100, 96, 30	3	75	30	100
Pimpleback	<i>Qadrula pustulosa</i>	15	1	15	15	15
Purple Wartyback*	<i>Cyclonaias tuberculata</i>	57	1	57	57	57
			<b>Total</b>	<b>6</b>		



ADI North - Transect 3

Survey Data						
Common Name	Scientific Name	Number of Individuals Relocated	Avg Shell Length	Min Shell Length	Max Shell Length	
Black sandshell	<i>Ligumia recta</i>	12	115	91	139	
Creek heelsplitter	<i>Lasmigona compressa</i>	-- --	--	--	--	
Creeper	<i>Strophitus undulatus</i>	1	56	56	56	
Deertoe	<i>Truncilla truncata</i>	-- --	--	--	--	
Elktoe	<i>Alasmidonta marginata</i>	1	34	34	34	
Fat mucket	<i>Lampsilis siliquoidea</i>	1	70	70	70	
Fluted-shell	<i>Lasmigona costata</i>	2	80	78	81	
Fragile papershell	<i>Leptodea fragilis</i>	-- --	--	--	--	
Monkeyface*	<i>Quadrula metanevra</i>	5	62	50	71	
Mucket	<i>Actinonaias ligamentina</i>	995	89	6	128	
Pimpleback	<i>Qadrula pustulosa</i>	18	31	10	48	
Pink heelsplitter	<i>Potamilus alatus</i>	1	76	76	76	
Plain pocketbook	<i>Lampsilis cardium</i>	23	88	50	125	
Purple Wartyback*	<i>Cyclonaias tuberculata</i>	29	50	5	79	
Round pigtoe	<i>Pleurobema sintoxia</i>	4	66	55	79	
Sheepnose**	<i>Plethobasus cyphus</i>	2	79	77	80	
Spike*	<i>Elliptio dilatata</i>	-- --	--	--	--	
Threehorn wartyback	<i>Obliquaria reflexa</i>	1	29	29	29	
Threeridge	<i>Amblema plicata</i>	3	82	66	98	
Washboard	<i>Megalonaias nervosa</i>	4	111	101	116	
<b>Total</b>		<b>1102</b>				

Quadrat 3F						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Black sandshell	<i>Ligumia recta</i>	87	1	87	87	87
Mucket	<i>Actinonaias ligamentina</i>	92, 86	2	89	86	92
<b>Total</b>			<b>3</b>			

Quadrat 3A						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
No Mussels						

Quadrat 3B						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Mucket	<i>Actinonaias ligamentina</i>	62, 60, 85, 69, 79	5	71	60	79
<b>Total</b>			<b>5</b>			

Quadrat 3C						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Black sandshell	<i>Ligumia recta</i>	113, 107	2	110	107	113
Mucket	<i>Actinonaias ligamentina</i>	94, 101, 90, 84	4	92	84	101
<b>Total</b>			<b>6</b>			

Quadrat 3D						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Monkeyface*	<i>Quadrula metanevra</i>	40	1	40	40	40
Mucket	<i>Actinonaias ligamentina</i>	86, 86, 90	3	87	86	90
Pimpleback	<i>Qadrula pustulosa</i>	25	1	25	25	25
Purple Wartyback*	<i>Cyclonaias tuberculata</i>	42	1	42	42	42
Threeridge	<i>Amblema plicata</i>	25	1	25	25	25
<b>Total</b>			<b>7</b>			

Quadrat 3E						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Mucket	<i>Actinonaias ligamentina</i>	88, 108	2	98	88	108
<b>Total</b>			<b>2</b>			





ADI North - Transect 4

Survey Data						
Common Name	Scientific Name	Number of Individuals Relocated	Avg Shell Length	Min Shell Length	Max Shell Length	
Black sandshell	<i>Ligumia recta</i>	17	115	93	131	
Creek heelsplitter	<i>Lasmigona compressa</i>	--	--	--	--	
Creeper	<i>Strophitus undulatus</i>	--	--	--	--	
Deertoe	<i>Truncilla truncata</i>	--	--	--	--	
Elktoe	<i>Alasmidonta marginata</i>	--	--	--	--	
Fat mucket	<i>Lampsilis siliquoidea</i>	--	--	--	--	
Fluted-shell	<i>Lasmigona costata</i>	1	95	95	95	
Fragile papershell	<i>Leptodea fragilis</i>	--	--	--	--	
Monkeyface*	<i>Qadrula metanevra</i>	21	67	44	90	
Mucket	<i>Actinonaias ligamentina</i>	583	92	22	125	
Pimpleback	<i>Qadrula pustulosa</i>	40	31	7	53	
Pink heelsplitter	<i>Potamilus alatus</i>	--	--	--	--	
Plain pocketbook	<i>Lampsilis cardium</i>	23	88	65	122	
Purple Wartyback*	<i>Cyclonaias tuberculata</i>	62	51	30	77	
Round pigtoe	<i>Pleurobema sintoxia</i>	20	68	35	90	
Sheepnose**	<i>Plethobasus cyphus</i>	--	--	--	--	
Spike*	<i>Elliptio dilatata</i>	--	--	--	--	
Threehorn wartyback	<i>Obliquaria reflexa</i>	--	--	--	--	
Threeridge	<i>Amblema plicata</i>	20	70	35	97	
Washboard	<i>Megalonaias nervosa</i>	5	121	109	129	
<b>Total</b>		<b>792</b>				

Quadrat 4F						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Mucket	<i>Actinonaias ligamentina</i>	90, 85	2	88	85	90
Pimpleback	<i>Qadrula pustulosa</i>	15	1	15	15	15
<b>Total</b>			<b>3</b>			

Quadrat 4A						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Black sandshell	<i>Ligumia recta</i>	108	1	108	108	108
Mucket	<i>Actinonaias ligamentina</i>	94, 95, 106, 79, 89, 90, 93, 105, 83	9	93	79	106
Pimpleback	<i>Qadrula pustulosa</i>	29	1	29	29	29
<b>Total</b>			<b>11</b>			

Quadrat 4B						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Mucket	<i>Actinonaias ligamentina</i>	95	1	95	95	95
<b>Total</b>			<b>1</b>			

Quadrat 4C						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Pimpleback	<i>Qadrula pustulosa</i>	34	1	34	34	34
<b>Total</b>			<b>1</b>			

Quadrat 4D						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
No mussels						

Quadrat 4E						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Black sandshell	<i>Ligumia recta</i>	75	1	75	75	75
Mucket	<i>Actinonaias ligame</i>	107, 36, 28	3	57	28	107
Purple Wartyback*	<i>Cyclonaias tubercu</i>	44	1	44	44	44
<b>Total</b>			<b>5</b>			



ADI North - Transect 5

Survey Data					
Common Name	Scientific Name	Number of Individuals Relocated	Avg Shell Length	Min Shell Length	Max Shell Length
Black sandshell	<i>Ligumia recta</i>	13	106	72	127
Creek heelsplitter	<i>Lasmigona compressa</i>	--	--	--	--
Creeper	<i>Strophitus undulatus</i>	1	55	55	55
Deertoe	<i>Truncilla truncata</i>	2	54	28	79
Elktoe	<i>Alasmidonta marginata</i>	1	46	46	46
Fat mucket	<i>Lampsilis siliquoidea</i>	2	71	66	76
Fluted-shell	<i>Lasmigona costata</i>	2	84	66	102
Fragile papershell	<i>Leptodea fragilis</i>	1	54	54	54
Monkeyface*	<i>Quadrula metanevra</i>	7	74	48	101
Mucket	<i>Actinonaias ligamentina</i>	989	90	11	129
Pimpleback	<i>Qadrula pustulosa</i>	21	29	7	41
Pink heelsplitter	<i>Potamilus alatus</i>	--	--	--	--
Plain pocketbook	<i>Lampsilis cardium</i>	26	89	28	115
Purple Wartyback*	<i>Cyclonaias tuberculata</i>	27	49	8	86
Round pigtoe	<i>Pleurobema sintoxia</i>	11	69	43	85
Sheepnose**	<i>Plethobasus cyphus</i>	3	88	83	93
Spike*	<i>Elliptio dilatata</i>	--	--	--	--
Threehorn wartyback	<i>Obliquaria reflexa</i>	--	--	--	--
Threeridge	<i>Amblema plicata</i>	6	66	53	78
Washboard	<i>Megalonaias nervosa</i>	--	--	--	--
<b>Total</b>		<b>1112</b>			

Quadrat 5F						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Monkeyface	<i>Quadrula metanevra</i>	49	1	49	49	49
Mucket	<i>Actinonaias ligamentina</i>	115, 120, 101, 85, 100, 110, 90, 95, 105, 105, 86, 94, 95	13	100	85	120
Purple wartyback	<i>Cyclonaias tuberculata</i>	44	1	44	44	44
<b>Total</b>			<b>15</b>			

Quadrat 5A						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Mucket	<i>Actinonaias ligamentina</i>	86, 73, 88	3	82	73	88
<b>Total</b>			<b>3</b>			

Quadrat 5B						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Fluted-shell	<i>Lasmigona costata</i>	73	1	73	73	73
Mucket	<i>Actinonaias ligamentina</i>	92, 75, 80, 88, 84, 80, 125, 108, 73, 76	10	88	73	125
Pimpleback	<i>Qadrula pustulosa</i>	32	1			
<b>Total</b>			<b>12</b>			

Quadrat 5C						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Mucket	<i>Actinonaias ligamentina</i>	105, 75, 98, 78	4	89	75	105
Purple wartyback	<i>Cyclonaias tuberculata</i>	60	1	60	60	60
<b>Total</b>			<b>5</b>			

Quadrat 5D						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Mucket	<i>Actinonaias ligamentina</i>	96, 89, 96, 80, 89, 90, 70, 93, 85, 118, 82	11	90	70	118
<b>Total</b>			<b>11</b>			

Quadrat 5E						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Mucket	<i>Actinonaias ligamentina</i>	30, 83, 99, 69, 42, 88, 93, 50	8	69	30	99
Pimpleback	<i>Qadrula pustulosa</i>	38	1	38	38	38
<b>Total</b>			<b>9</b>			





ADI North - Transect 6

Survey Data						
Common Name	Scientific Name	Number of Individuals Relocated	Avg Shell Length	Min Shell Length	Max Shell Length	
Black sandshell	<i>Ligumia recta</i>	17	115	95	132	
Creek heelsplitter	<i>Lasmigona compressa</i>	--	--	--	--	
Creeper	<i>Strophitus undulatus</i>	3	49	48	52	
Deertoe	<i>Truncilla truncata</i>	2	39	29	48	
Elktoe	<i>Alasmidonta marginata</i>	3	55	49	58	
Ellipse	<i>Venustaconcha ellipsiformis</i>	1	41	41	41	
Fat mucket	<i>Lampsilis siliquoidea</i>	3	61	48	73	
Fluted-shell	<i>Lasmigona costata</i>	8	99	83	117	
Fragile papershell	<i>Leptodea fragilis</i>	1	58	58	58	
Monkeyface*	<i>Quadrula metanevra</i>	21	71	35	99	
Mucket	<i>Actinonaias ligamentina</i>	1,488	94	11	129	
Pimpleback	<i>Qadrula pustulosa</i>	47	30	11	44	
Pink heelsplitter	<i>Potamilus alatus</i>	1	81	81	81	
Plain pocketbook	<i>Lampsilis cardium</i>	39	94	36	117	
Purple Wartyback*	<i>Cyclonaias tuberculata</i>	75	54	28	83	
Round pigtoe	<i>Pleurobema sintoxia</i>	19	74	40	94	
Sheepnose**	<i>Plethobasus cyphus</i>	1	98	98	98	
Spike*	<i>Elliptio dilatata</i>	1	101	101	101	
Threehorn wartyback	<i>Obliquaria reflexa</i>	--	--	--	--	
Threeridge	<i>Amblema plicata</i>	17	67	45	88	
Washboard	<i>Megalonaias nervosa</i>	7	104	89	130	
White heelsplitter	<i>Lasmigona complanata</i>	1	92	92	92	
<b>Total</b>		<b>1755</b>				

Quadrat 6A						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
No mussels						

Quadrat 6B						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Mucket	<i>Actinonaias ligamentina</i>	108, 107, 69, 88, 86, 68, 96, 66	8	86	66	108
Purple Wartyback*	<i>Cyclonaias tuberculata</i>	41	1	41	41	41
<b>Total</b>			<b>9</b>			

Quadrat 6C						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Mucket	<i>Actinonaias ligamentina</i>	113, 98, 98, 65, 89, 68, 83, 68, 83, 120, 91	11	87	65	120
<b>Total</b>			<b>11</b>			

Quadrat 6D						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Mucket	<i>Actinonaias ligamentina</i>	87, 105, 108, 97, 87	5	97	87	108
<b>Total</b>			<b>5</b>			

Quadrat 6E						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Monkeyface*	<i>Quadrula metanevra</i>	66	1	66	66	66
Mucket	<i>Actinonaias ligamentina</i>	90, 95, 110, 101, 87	5	95	81	110
Plain pocketbook	<i>Lampsilis cardium</i>	95	1	95	95	95
Round pigtoe	<i>Pleurobema sintoxia</i>	82	1	82	82	82
Washboard	<i>Megalonaias nervosa</i>	44	1	44	44	44
<b>Total</b>			<b>9</b>			



## Northern Survey Area - Qualitative Results

Common Name	Scientific Name	Number of Individuals Relocated	Avg Shell Length	Min Shell Length	Max Shell Length
Black sandshell	<i>Ligumia recta</i>	20	115	49	133
Creek heelsplitter	<i>Lasmigona compressa</i>	--	--	--	--
Creeper	<i>Strophitus undulatus</i>	1	55	55	55
Deertoe	<i>Truncilla truncata</i>	--	--	--	--
Elktoe	<i>Alasmidonta marginata</i>	--	--	--	--
Ellipse	<i>Venustaconcha ellipsiformis</i>	--	--	--	--
Fat mucket	<i>Lampsilis siliquoidea</i>	2	85	78	92
Fluted-shell	<i>Lasmigona costata</i>	--	--	--	--
Fragile papershell	<i>Leptodea fragilis</i>	--	--	--	--
Monkeyface*	<i>Quadrula metanevra</i>	12	70	50	88
Mucket	<i>Actinonaias ligamentina</i>	646	98	55	130
Pimpleback	<i>Qadrula pustulosa</i>	8	46	30	86
Pink heelsplitter	<i>Potamilus alatus</i>	1	113	113	113
Plain pocketbook	<i>Lampsilis cardium</i>	18	101	73	118
Purple Wartyback*	<i>Cyclonaias tuberculata</i>	38	49	32	75
Round pigtoe	<i>Pleurobema sintoxia</i>	10	72	56	89
Sheepnose**	<i>Plethobasus cyphus</i>	3	73	62	78
Spike*	<i>Elliptio dilatata</i>	--	--	--	--
Threehorn wartyback	<i>Obliquaria reflexa</i>	--	--	--	--
Threeridge	<i>Amblema plicata</i>	11	68	33	97
Washboard	<i>Megalonaias nervosa</i>	4	113	92	135
White heelsplitter	<i>Lasmigona complanata</i>	--	--	--	--
<b>Total</b>		<b>774</b>			



## Northern Survey Area - Semi-Quantitative Results

Common Name	Scientific Name	Total Number of Individuals	Overall Average Shell Length	Overall Minimum Shell Length	Overall Maximum Shell Length
Black sandshell	<i>Ligumia recta</i>	104	113	36	139
Creek heelsplitter	<i>Lasmigona compressa</i>	1	45	45	45
Creepers	<i>Strophitus undulatus</i>	6	53	48	58
Deertoe	<i>Truncilla truncata</i>	11	38	24	79
Elktoe	<i>Alasmidonta marginata</i>	5	49	34	58
Ellipse	<i>Venustaconcha ellipsiformis</i>	1	41	41	41
Fat mucket	<i>Lampsilis siliquoidea</i>	8	70	48	88
Fluted-shell	<i>Lasmigona costata</i>	30	90	66	117
Fragile papershell	<i>Leptodea fragilis</i>	3	56	54	58
Monkeyface*	<i>Quadrula metanevra</i>	125	69	35	101
Mucket	<i>Actinonaias ligamentina</i>	6,809	93	6	131
Pimpleback	<i>Quadrula pustulosa</i>	204	32	7	60
Pink heelsplitter	<i>Potamilus alatus</i>	4	94	76	122
Plain pocketbook	<i>Lampsilis cardium</i>	157	91	28	125
Purple Wartback*	<i>Cyclonaias tuberculata</i>	343	53	5	90
Round pigtoe	<i>Pleurobema sintoxia</i>	96	72	35	94
Sheepnose**	<i>Plethobasus cyphus</i>	9	84	65	98
Spike*	<i>Elliptio dilatata</i>	3	72	23	101
Threehorn wartyback	<i>Obliquaria reflexa</i>	1	29	29	29
Threeridge	<i>Amblema plicata</i>	81	68	32	102
Washboard	<i>Megalonaias nervosa</i>	45	110	17	142
White heelsplitter	<i>Lasmigona complanata</i>	1	92	92	92
<b>Total</b>		<b>8,047</b>			

ADI South - Transect 1

Survey Data						
Common Name	Scientific Name	Number of Individuals Relocated	Avg Shell Length	Min Shell Length	Max Shell Length	
Black sandshell	<i>Ligumia recta</i>	4	110	105	113	
Creek heelsplitter	<i>Lasmigona compressa</i>	--	--	--	--	
Creepers	<i>Strophitus undulatus</i>	1	57	57	57	
Deertoe	<i>Truncilla truncata</i>	--	--	--	--	
Ellipse	<i>Venustaconcha ellipsiformis</i>	1	38	38	38	
Fat mucket	<i>Lampsilis siliquoidea</i>	1	71	71	71	
Fluted-shell	<i>Lasmigona costata</i>	7	75	60	90	
Fragile papershell	<i>Leptodea fragilis</i>	3	65	58	75	
Monkeyface*	<i>Quadrula metanevra</i>	1	66	66	66	
Mucket	<i>Actinonaias ligamentina</i>	628	93	23	126	
Pimpleback	<i>Qadrula pustulosa</i>	5	32	23	38	
Pink heelsplitter	<i>Potamilus alatus</i>	--	--	--	--	
Plain pocketbook	<i>Lampsilis cardium</i>	13	97	79	113	
Purple Wartyback*	<i>Cyclonaias tuberculata</i>	33	51	28	72	
Round pigtoe	<i>Pleurobema sintoxia</i>	11	75	69	83	
Sheepnose**	<i>Plethobasus cyphus</i>	--	--	--	--	
Spike*	<i>Elliptio dilatata</i>	--	--	--	--	
Threeridge	<i>Amblema plicata</i>	2	83	75	91	
Washboard	<i>Megalonaias nervosa</i>	5	120	75	142	
<b>Total</b>		<b>715</b>				

Quadrat 1A						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Mucket	<i>Actinonaias ligamentina</i>	83	1	83	83	83
<b>Total</b>			<b>1</b>			

Quadrat 1B						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
Mucket	<i>Actinonaias ligamentina</i>	75, 95, 75, 78, 81, 99, 80, 91	8	84.3	75	99
Plain pocketbook	<i>Lampsilis cardium</i>	36	1	36	36	36
Purple Wartyback*	<i>Cyclonaias tuberculata</i>	51	1	51	51	51
	<i>Pleurobema</i>					
Round pigtoe	<i>sintoxia</i>	76	1	76	76	76
<b>Total</b>			<b>11</b>			

Quadrat 1C						
Common Name	Scientific Name	Length of Shell (mm)	Number of Individuals	Avg Shell Length	Min Shell Length	Max Shell Length
<b>No Mussels</b>						

State and Federally Listed T&E Shell Length from Transect 1 (not including Quad data)											
Common Name	Scientific Name	Length of Shell (mm)									
Monkeyface	<i>Quadrula metanerva</i>	66									
Purple Wartyback	<i>Cyclonaias tuberculata</i>	66	35	55	67	53	52	28	49	66	66
		42	72	66	55	63	59	47	38	50	50
		43	47	69	45	55	37	58	57	40	36
		41	41	40							
Spike	<i>Elliptio dilatata</i>										
Sheepnose**	<i>Plethobasus cyphus</i>										













## Southern Survey Area - Qualitative Results

Common Name	Scientific Name	Number of Individuals Relocated	Avg Shell Length	Min Shell Length	Max Shell Length
Black sandshell	<i>Ligumia recta</i>	15	118	99	128
Creek heelsplitter	<i>Lasmigona compressa</i>	--	--	--	--
Creeper	<i>Strophitus undulatus</i>	--	--	--	--
Deertoe	<i>Truncilla truncata</i>	2	32	22	42
Elktoe	<i>Alasmidonta marginata</i>	--	--	--	--
Ellipse	<i>Venustaconcha ellipsiformis</i>	2	50	43	57
Fat mucket	<i>Lampsilis siliquoidea</i>	2	57	53	60
Fluted-shell	<i>Lasmigona costata</i>	14	80	53	105
Fragile papershell	<i>Leptodea fragilis</i>	1	79	79	79
Monkeyface*	<i>Quadrula metanevra</i>	7	67	33	90
Mucket	<i>Actinonaias ligamentina</i>	1,113	97	11	135
Pimpleback	<i>Qadrula pustulosa</i>	13	40	25	50
Pink heelsplitter	<i>Potamilus alatus</i>	--	--	--	--
Plain pocketbook	<i>Lampsilis cardium</i>	11	104	77	117
Purple Wartyback*	<i>Cyclonaias tuberculata</i>	23	58	12	118
Round pigtoe	<i>Pleurobema sintoxia</i>	21	64	15	85
Sheepnose**	<i>Plethobasus cyphus</i>	--	--	--	--
Spike*	<i>Elliptio dilatata</i>	1	38	38	38
Threehorn wartyback	<i>Obliquaria reflexa</i>	--	--	--	--
Threeridge	<i>Amblema plicata</i>	11	65	45	86
Washboard	<i>Megalonaias nervosa</i>	17	101	53	140
White heelsplitter	<i>Lasmigona complanata</i>	--	--	--	--
<b>Total</b>		<b>1253</b>			



## Southern Survey Area - Semi-Quantitative Results

Common Name	Scientific Name	Total Number of Individuals	Overall Average Shell Length	Overall Minimum Shell Length	Overall Maximum Shell Length
Black sandshell	<i>Ligumia recta</i>	34	113	87	135
Creek heelsplitter	<i>Lasmigona compressa</i>	--	--	--	--
Creeper	<i>Strophitus undulatus</i>	10	60	49	69
Deertoe	<i>Truncilla truncata</i>	10	31	15	48
Elktoe	<i>Alasmidonta marginata</i>	--	--	--	--
Ellipse	<i>Venustaconcha ellipsiformis</i>	5	43	37	50
Fat mucket	<i>Lampsilis siliquoidea</i>	9	67	48	82
Fluted-shell	<i>Lasmigona costata</i>	32	82	60	106
Fragile papershell	<i>Leptodea fragilis</i>	6	77	58	105
Monkeyface*	<i>Quadrula metanevra</i>	13	62	45	98
Mucket	<i>Actinonaias ligamentina</i>	3,571	93	9	131
Pimpleback	<i>Qadrula pustulosa</i>	49	32	13	50
Pink heelsplitter	<i>Potamilus alatus</i>	9	82	45	95
Plain pocketbook	<i>Lampsilis cardium</i>	39	90	58	113
Purple Wartyback*	<i>Cyclonaias tuberculata</i>	126	50	15	104
Round pigtoe	<i>Pleurobema sintoxia</i>	36	69	37	89
Sheepnose**	<i>Plethobasus cyphyus</i>	2	72	59	85
Spike*	<i>Elliptio dilatata</i>	--	--	--	--
Threehorn wartyback	<i>Obliquaria reflexa</i>	1	30	30	30
Threeridge	<i>Amblema plicata</i>	31	72	43	96
Washboard	<i>Megalonaias nervosa</i>	33	105	55	145
White heelsplitter	<i>Lasmigona complanata</i>	--	--	--	--
<b>Total</b>		<b>4,016</b>			

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A decorative graphic consisting of three thin orange lines. One line is horizontal, extending across the width of the page. Two other lines are diagonal, starting from the bottom left and extending towards the top right, intersecting the horizontal line.