

**Missouri River Pallid Sturgeon Survey  
Route 19 Bridge Replacement Project  
Hermann, Missouri**

**Final Report  
Prepared for the Missouri Highways and Transportation Commission**

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## Summary

The Federal Highway Administration (FHWA) and the Missouri Department of Transportation (MoDOT) are proposing to replace the Route 19 bridge that crosses the Missouri River at Hermann, Missouri in Gasconade and Montgomery Counties. The Missouri Department of Transportation contracted with the U.S. Fish and Wildlife Service, Columbia Fishery Resources Office in Columbia, Missouri (CFRO) to obtain information on the potential impacts of this project on the endangered pallid sturgeon (*Scaphirhynchus albus*).

Three thousand seventeen fish were collected in 8525 hours of sampling effort from January 2000 through March 2001. Three pallid sturgeon and fourteen pallid sturgeon \* shovelnose sturgeon hybrids were collected within the project area. These fish were collected between November and May in the complex habitat areas behind wing dikes. All construction activities that would alter streamflow, modify depths, or impact sediment loading within the wing dike fields should be avoided during this time period.

## Introduction

The Federal Highway Administration (FHWA) and the Missouri Department of Transportation (MoDOT) are proposing to replace the Route 19 bridge that crosses the Missouri River at Hermann, Missouri in Gasconade and Montgomery Counties. There are currently two construction alternatives under consideration in the Final Environmental Impact Statement. Alternative 5-W1 is MoDOT's preferred alternative (Figure 1). Proposed construction activities are further described in the Final Environmental Impact Statement prepared by MoDOT to evaluate impacts on threatened and endangered species, as well as many other environmental, land use, historical resource, and economic impacts (Missouri Department of Transportation, 1999).

Section 7 of the Endangered Species Act states that Federal Agencies are required to ensure that actions that are authorized, funded, or implemented by them do not jeopardize the continued existence of threatened or endangered species that may inhabit the area. In order to obtain more information on the potential impacts of this project on the endangered pallid sturgeon (*Scaphirhynchus albus*), the Missouri Department of Transportation contracted with the U.S. Fish and Wildlife Service, Columbia Fishery Resources Office in Columbia, Missouri (CFRO). The information provided in this report will aid MoDOT in developing a Biological Assessment in compliance with the section 7 consultation.

CFRO collected a pallid sturgeon down river of the project area at Missouri River mile 95.5R in previous surveys (Grady et al 2000). At least three pallid sturgeon produced and stocked by the Missouri Department of Conservation in 1994-95 have been caught and released within three miles of the project area by sport anglers. There are also unconfirmed reports of commercial fishermen capturing several individuals in channel maintenance dike fields in the immediate vicinity of the bridge.

Fishery surveys were conducted to evaluate distribution, relative abundance and habitat associations of pallid sturgeon and other Missouri River fishes in the river reach from RM 96 to RM 99.

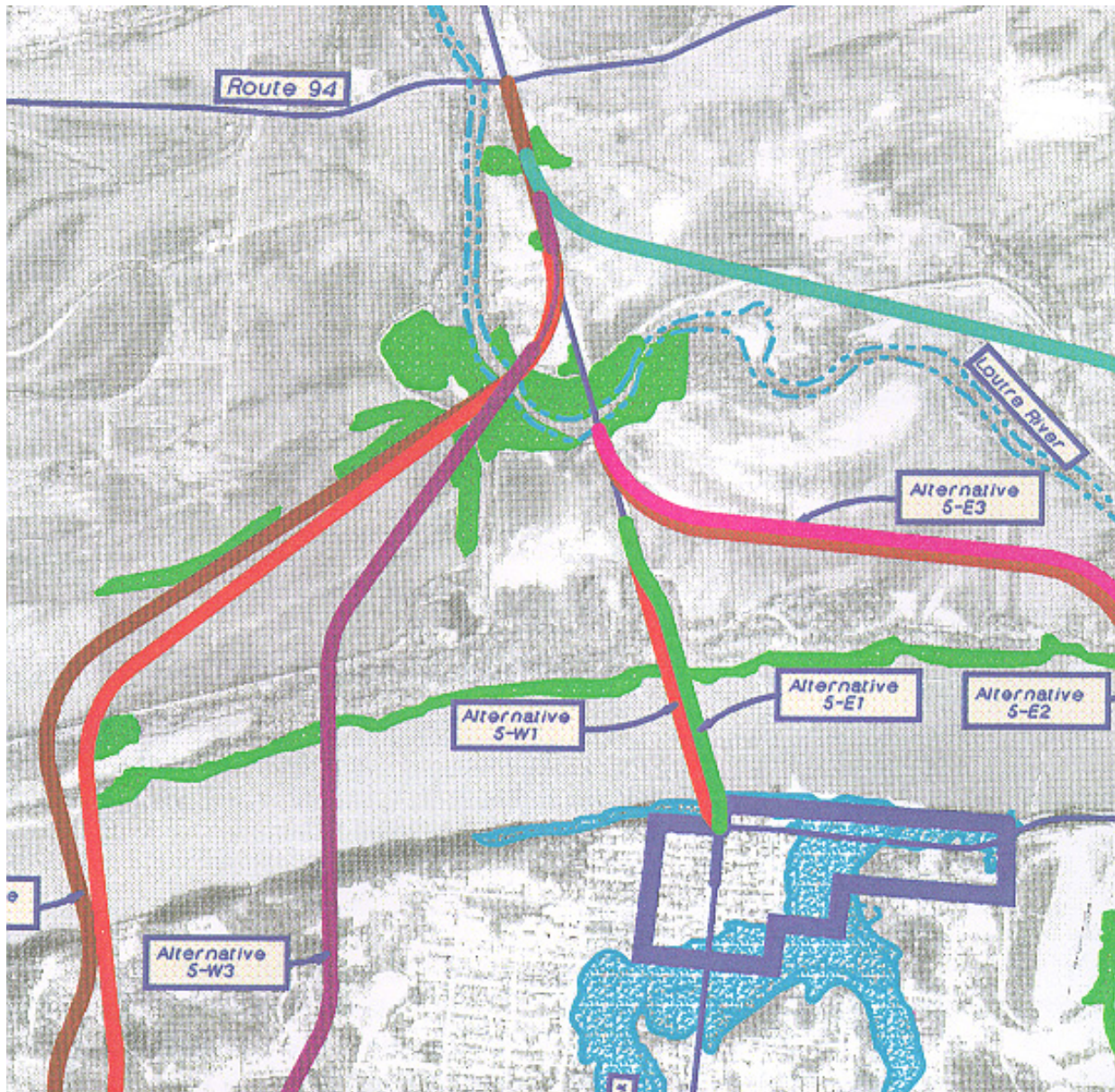
## Methods

Ten to twelve channel maintenance or L-head dikes in the project area were sampled monthly for a 16-month period beginning in January 2000. Nets were set in the area immediately down river of the dikes, exact net location varied as it was subject to river stage and flow conditions.

Overnight stationary gill nets were run January through June 2000, September to November 2000, and February to March 2001. These nets were 100 feet long with alternating 25 foot panels of 1 and 2 inch square mesh. Two-hundred foot long, 10 feet deep gill nets with alternating panels of 3 and 4 inch square mesh were added in

February and March 2001. Missouri Department of Conservation fish biologists reported successful capture of large pallid sturgeon with larger mesh sizes in 2000. (Craig Gemming, pers. comm.) Gill nets were set and run daily for three consecutive net nights. Low flows and ice jams prevented river sampling in December 2000 and January 2001.

Figure 1. Map of construction alternatives for the Route 19 bridge replacement (MoDOT 2000).



As sturgeon are particularly susceptible to stress in the heat of summer, alternate gears were used in July and August 2000. Stationary gill nets were set for three to eight hour

time periods in July 2000 and for 2 hour periods in August 2000. Drifting trammel nets were run in July 2000. Trammel net dimensions were: 125 feet long and 6 feet deep with one 5-inch mesh wall and one 10-inch mesh wall. Four foot diameter hoop nets with 1 ½ inch square mesh webbing were substituted for overnight gill nets sets in August.

A benthic trawl was also used in and adjacent to the sandbar flat areas between river miles 97.0 and 97.5 to sample for larval and juvenile sturgeon in August 2000. The trawl was equipped with a roller rock lead line and the following dimensions: 6.4-ft wide, 1.6-ft high, 18-ft long, 1/8-inch inner mesh, 1.5-inch outer chafing mesh, and 6.5-inch cod opening. Trawling was conducted from the bow of the boat while traveling downstream with the engine in reverse. The engine speed was slightly faster than the flow of the river to keep the trawl inflated. Fish were also sampled in the sand bar flats area using a 7.6-m (25-ft) long, 2.4-m (8-ft) deep drag seine with 6-mm (1/4-in) mesh.

Depth, column velocity, bottom velocity, temperature, conductivity and turbidity were measured at every net location during each sampling period. Exact net locations were recorded with a GPS unit. (Maps of net locations can be found in Appendix A.)

All large fish collected were weighed to the nearest gram, measured to the nearest mm, and released at the site of common capture. Small fish species collected in the benthic trawl were fixed in 10% formalin for laboratory identification and enumeration. Morphometric measurements and meristic counts were made on all pallid sturgeon, all suspected pallid sturgeon hybrids, and a subsample of shovelnose sturgeon in accordance with Pallid Sturgeon Recovery Team guidelines. These measurements were used to determine the fish's Character Index value; unique sets of values have been identified for each species (Sheehan et al 1991). Barbel samples from these fish were also sent to Southern Illinois University for future genetic analysis. All pallid sturgeon and suspected hybrids were checked for the presence of coded wire or PIT tags implanted in wild and hatchery produced fish over the past several years. All pallid sturgeon collected and not previously implanted with PIT tags were tagged according to Pallid Sturgeon Recovery Team guidelines.

Statistical analyses were conducted using the Statistical Analysis System (SAS 1990). The Shapiro-Wilk test was used to determine if fish numbers represented random samples from normal distributions (SAS Institute Inc. 1991, Zar 1984).

The Jaccard index was calculated to determine the degree of species association between pallid sturgeon, pallid sturgeon hybrids, and shovelnose sturgeon with other large river fish species. The Jaccard Index is the proportion of the number of sampling units where both species occur to the total number of sampling units where at least one of the species is found (Ludwig and Reynolds 1988):

$$JI = a / (a + b + c)$$

where a = the number of sampling units where both species occur

b = the number of sampling units where species A occurs, but not species B  
c = the number of sampling units where species B occurs, but not species A.

The Spearman and Pearson correlation coefficients were used to determine the covariation in abundance between pallid sturgeon, hybrid sturgeon, and shovelnose sturgeon and other large river fish species caught in stationary gill nets (Ludwig and Reynolds 1988). Monthly samples were grouped based on water temperature to determine covariation by season.

## Results

In total, 3017 fish of 39 species (and one hybrid) were collected in the project area from January 2000 to March 2001. As can be seen in Table 1, the majority (67%) of the fish catch was composed of sturgeon species followed by river carpsucker (9%), blue catfish (5%), goldeye (4%) and freshwater drum (4%), all native large river fish species. Stationary gill nets are the most effective gear available for targeting sturgeon species in the Lower Missouri River (Grady et al 2001) and were effective in the project area. Drifting trammel nets and seines failed to catch fish within the project vicinity. No larval or juvenile sturgeon were collected in benthic trawling or seining efforts. (Fish catch by net can be found in Appendix B. All other habitat parameters are summarized in Appendix C.)

Three healthy pallid sturgeon and 14 pallid sturgeon \* shovelnose sturgeon hybrids were collected within the project vicinity between November and May (Table 2). One pallid sturgeon and 8 hybrids were collected either adjacent to the wing dike immediately below the current bridge or adjacent to the wing dikes immediately upstream and downstream of the current bridge (Figures 2 and 3). All three of the pallid sturgeon collected lacked PIT tags, indicating they had not been stocked by hatchery personnel or previously captured by biologists within the last three years.

Pallid sturgeon were collected in water 2.0 to 7.2 m deep with bottom velocities of 0.08 and 0.58 m/s. Catch rates of pallid sturgeon were not large enough to statistically examine potential differences in habitat preferences with shovelnose sturgeon or their hybrids. Substrate information will be available upon the completion of USGS's bathymetric survey work.

Pallid sturgeon were collected with shovelnose sturgeon, river carpsucker, blue sucker, freshwater drum, and goldeye within the project vicinity. The Jaccard index was used to measure the degree of association between pallid sturgeon and each of these species. Index values did not indicate a large degree of association for pallid sturgeon, pallid sturgeon hybrids or shovelnose sturgeon and any of the other collected species. There was a slight degree of association between shovelnose sturgeon and river carpsucker (JI =0.35), however this was not apparent in other Missouri River datasets (Grady et al 2001).

Monthly net samples were assigned a seasonal grouping of spring, summer, autumn, or winter based on water surface temperature (Figure 4). Pearson and Spearman correlation coefficients were computed to examine correlations in abundance of pallid sturgeon, pallid sturgeon hybrids, and shovelnose sturgeon with the abundance of other large river fish species by season. The Spearman correlation coefficient was the more appropriate choice for examining this dataset as the fish catch numbers were not normally distributed. The only significant positive correlation in species abundance found for pallid sturgeon with the Spearman correlation coefficient was with freshwater drum in winter samples (Tables 3 and 4). Pallid sturgeon hybrids had significant positive correlations with blue catfish and goldeye in spring, goldeye and sauger in summer, and shorthead redhorse in winter. Shovelnose sturgeon had significant positive correlations with blue catfish, freshwater drum, and river carpsucker in summer and significant negative correlations with river carpsucker and smallmouth buffalo in winter.

Strong and significant correlations between an understudied or endangered species and an abundant, well-studied species would allow biologists to reference known habitat preferences for the correlating species. However, even the strongest correlation found in this dataset, between pallid sturgeon hybrid abundance and sauger abundance in summer, only has a weak  $R^2$  value of 0.19. We are, therefore, unable to make inferences about pallid sturgeon hybrid habitat use based on known sauger life history information.

Table 1. Fish species collected in the Route 19 Bridge Replacement Project Area, January 2000 to March 2001.

Common Name	Scientific Name	Total Catch
Chestnut Lamprey	<i>Ichthyomyzon castaneus</i>	4
Pallid Sturgeon	<i>Scaphirhynchus albus</i>	3
Pallid Sturgeon Hybrid	<i>Scaphirhynchus hybrid</i>	14
Shovelnose Sturgeon	<i>Scaphirhynchus platyrhynchus</i>	1990
Lake Sturgeon	<i>Acipenser fulvescens</i>	1
Paddlefish	<i>Polyodon spathula</i>	5
Longnose Gar	<i>Lepisosteus osseus</i>	36
Shortnose Gar	<i>Lepisosteus platostomus</i>	14
Skipjack Herring	<i>Alosa chrysochloris</i>	5
Gizzard Shad	<i>Dorosoma cepedianum</i>	28
Goldeye	<i>Hiodon alosoides</i>	129
Common Carp	<i>Cyprinus carpio</i>	25
Bighead Carp	<i>Hypophthalmichthys nobilis</i>	1
Grass Carp	<i>Ctenopharyngodon idella</i>	2
Silver Chub	<i>Hybopsis storeriana</i>	2
Speckled Chub	<i>Hybopsis aestivalis</i>	2
Sturgeon Chub	<i>Hybopsis gelida</i>	10
River Carpsucker	<i>Carpiodes carpio</i>	258
Quillback Carpsucker	<i>Carpiodes cyprinus</i>	1
Highfin Carpsucker	<i>Carpiodes velifer</i>	4
White Sucker	<i>Catostomus commersoni</i>	4
Blue Sucker	<i>Cycleptus elongatus</i>	9
Northern Hogsucker	<i>Hypentelium nigricans</i>	1
Smallmouth Buffalo	<i>Ictiobus bubalus</i>	37
Bigmouth Buffalo	<i>Ictiobus cyprinellus</i>	2
Black Buffalo	<i>Ictiobus niger</i>	1
River Redhorse	<i>Moxostoma carinatum</i>	1
Black Redhorse	<i>Moxostoma duquesnei</i>	2
Golden Redhorse	<i>Moxostoma erythrurum</i>	2
Shorthead Redhorse	<i>Moxostoma macrolepidotum</i>	47
Blue Catfish	<i>Ictalurus furcatus</i>	140
Channel Catfish	<i>Ictalurus punctatus</i>	59
Tadpole Madtom	<i>Noturus gyrinus</i>	1
Flathead Catfish	<i>Pylodictus olivaris</i>	7
White Bass	<i>Morone chrysops</i>	12
Striped Bass	<i>Morone saxatilis</i>	2
Bluegill	<i>Lepomis macrochirus</i>	1
White Crappie	<i>Pomoxis annularis</i>	1
Black Crappie	<i>Pomoxis nigromaculatus</i>	3
Walleye	<i>Stizostedion vitreum</i>	1
Sauger	<i>Stizostedion canadense</i>	39
Freshwater Drum	<i>Aplodinotus grunniens</i>	106



Table 2. Habitat and size information for pallid sturgeon and pallid sturgeon \* shovelnose sturgeon hybrids collected in the Route 19 Bridge Replacement Project Area, January 2000 to March 2001.

Species	Date	Dike #	Riverstage (ft at Hermann gage)	Temp (C)	Average Depth (m)	Bottom Velocity (m/s)	Fork Length (mm)	Weight (g)
Pallid	03/14/00	104.40	5.7	11.3	5.5	0.08	701	1333
Pallid	04/11/00	102.95	6.7	15	2.0	0.58	785	1733
Pallid	11/15/00	104.85	6.9	7	7.2	NA <sup>1</sup>	761	NA <sup>1</sup>
Hybrid	01/11/00	103.74	6.02	5.5	3.8	0.05	606	665
Hybrid	01/11/00	104.0	6.02	5.1	3.8	0.02	574	642
Hybrid	01/12/00	101.6	5.9	6.1	5.0	-0.02 <sup>2</sup>	556	596
Hybrid	01/12/00	101.6	5.9	6.1	5.0	-0.02 <sup>2</sup>	655	1174
Hybrid	01/13/00	103.76	5.95	3.7	4.9	0.14	552	599
Hybrid	01/13/00	101.6	5.95	4.2	5.0	0.04	684	1092
Hybrid	01/13/00	101.6	5.95	4.2	5.0	0.04	653	957
Hybrid	01/13/00	101.6	5.95	4.2	5.0	0.04	675	1022
Hybrid	02/15/00	103.74	4.3	7.1	2.9	0.16	591	777
Hybrid	02/15/00	103.76	4.3	6.0	3.4	0.17	630	1090
Hybrid	02/17/00	104.05	6.0	3.9	3.1	0.33	655	1010
Hybrid	03/13/00	104.0	5.66	11.6	4.1	0.05	630	1042
Hybrid	05/15/00	103.5	5.98	21.3	5.5	0.09	640	1046
Hybrid	05/17/00	104.4	6.13	21.8	3.3	0.08	487	400

<sup>1</sup> Data is Not Available due to equipment malfunction.

<sup>2</sup> Negative velocity values occur where eddies push water upstream.

# Pallid and Pallid Hybrid Net Locations

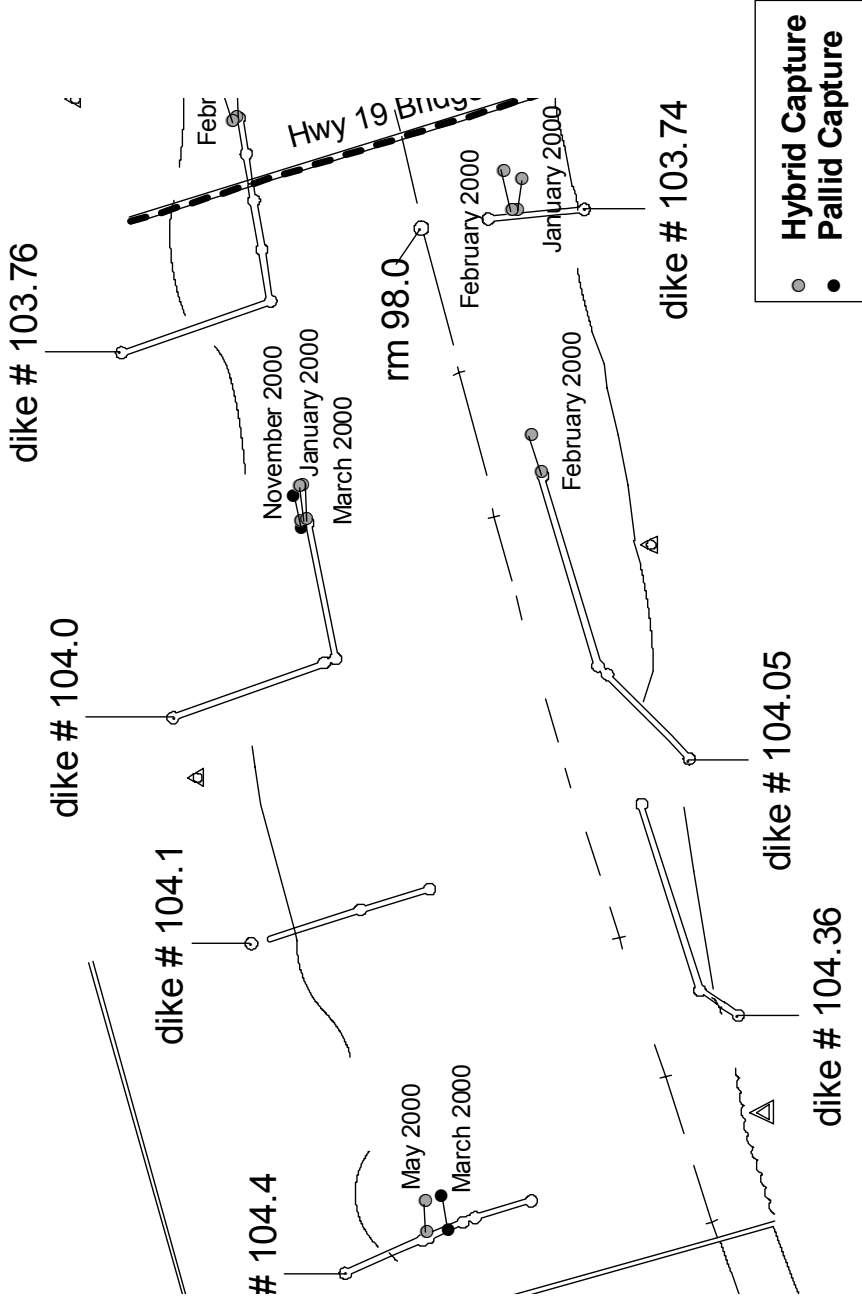


Figure 2. Locations of pallid sturgeon and pallid sturgeon \* shovelnose sturgeon hybrid captures above the current Highway 19 bridge placement.

# Pallid and Hybrid Net Locations

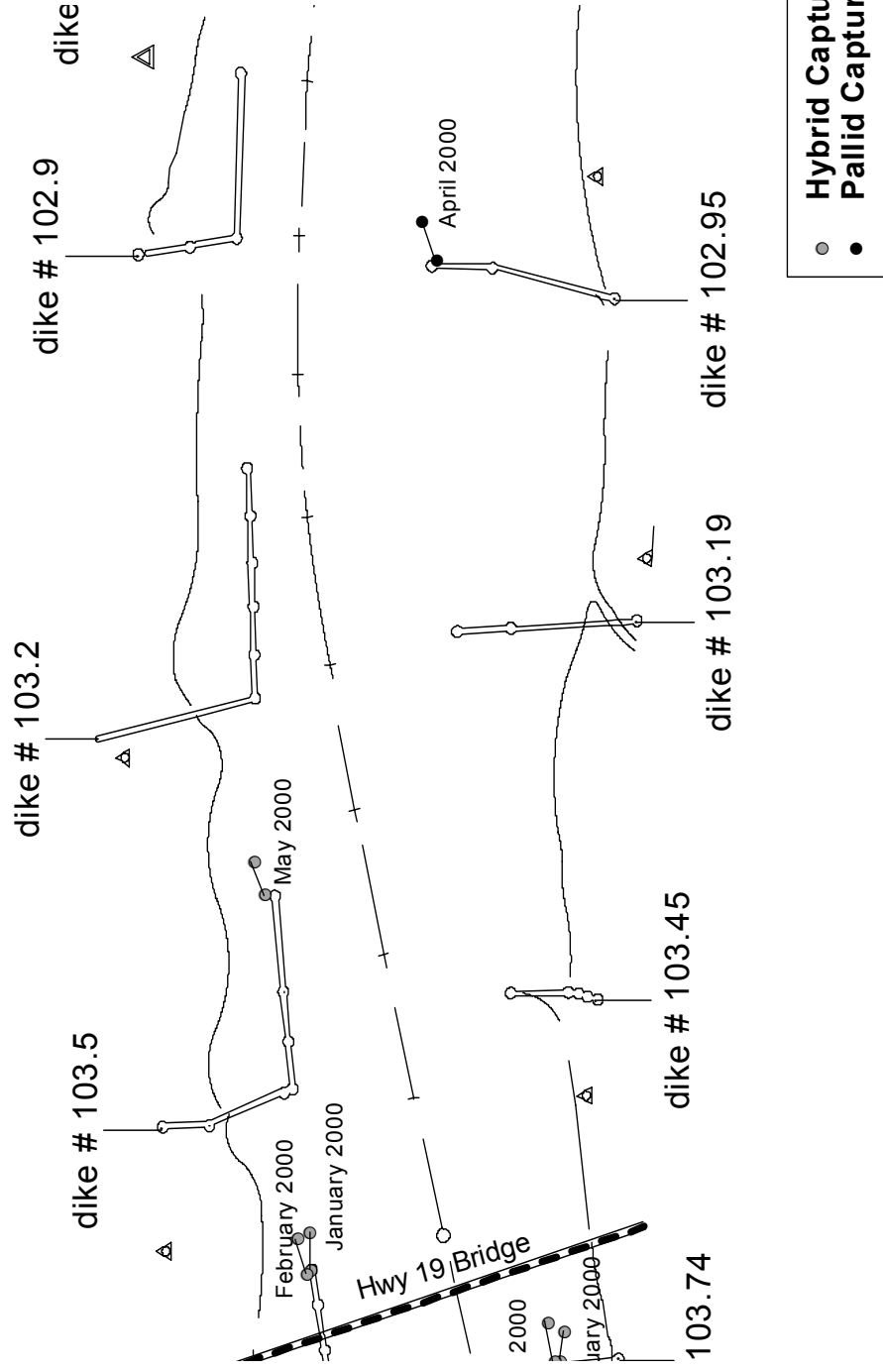


Figure 3. Locations of pallid sturgeon and pallid sturgeon \* shovelnose sturgeon hybrid captures below the current Highway 19 bridge placement.

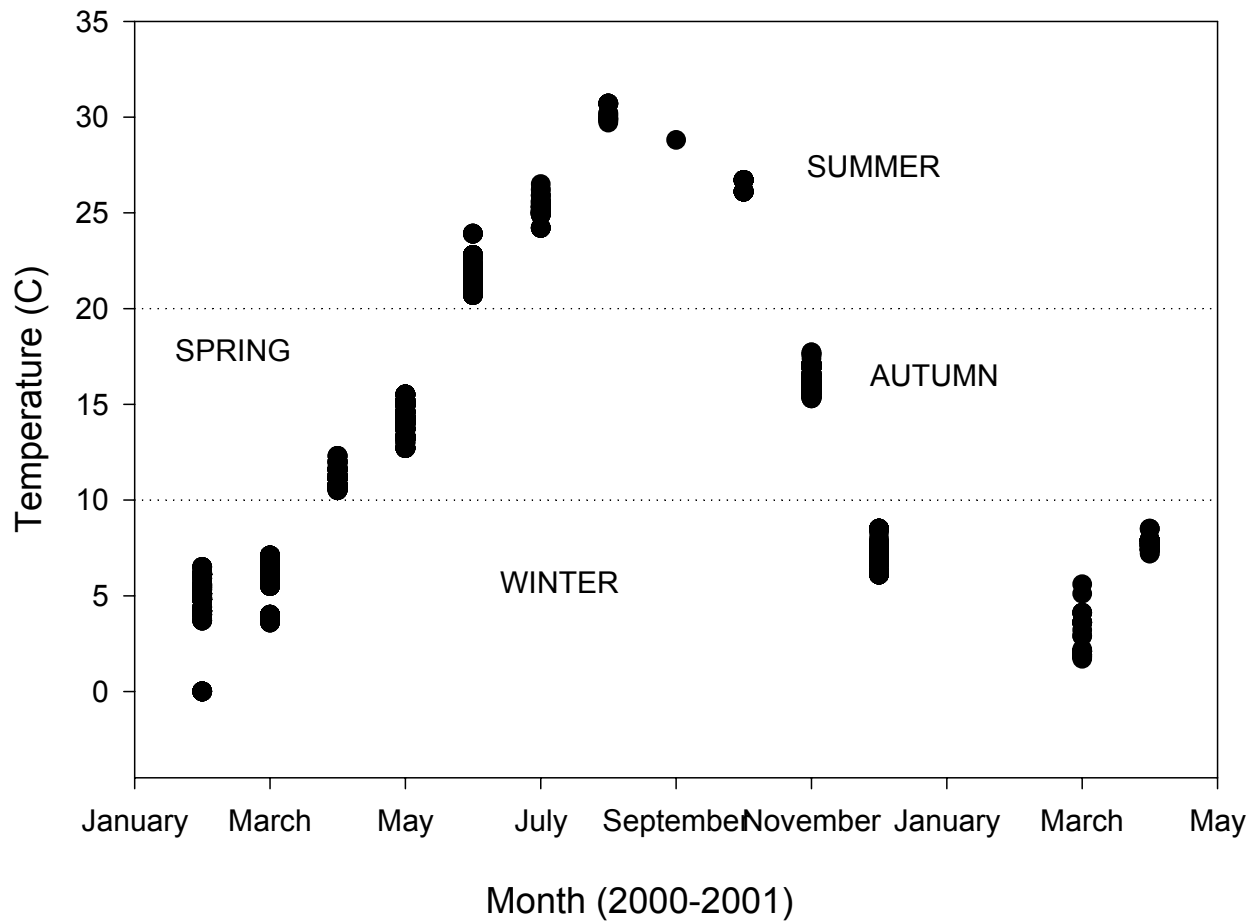


Figure 4. Temperature values for nets fished by month (2000-2001) in the Route 19 Bridge Replacement Project Area and seasonal "assignments" based on temperature values.

Table 3. Pearson product-moment correlations and Spearman rank correlations for pallid sturgeon (PLS), pallid sturgeon \* shovelnose sturgeon hybrids (PXH), shovelnose sturgeon (HSN) and other large river fish abundance data in spring and summer as computed by PROC CORR (SAS System). (BCF = blue catfish, FRD = freshwater drum, GNE = goldeye, RCS = river carpsucker, SAB = smallmouth buffalo, SAR = sauger, and SHR = shorthead redhorse)

Spring	PEARSON PRODUCT-MOMENT CORRELATIONS									
Species	PLS	PXH	HSN	BCF	FRD	GNE	RCS	SAB	SAR	SHR
PLS	1.00	-0.02	0.32	-0.07	-0.06	-0.04	-0.07	-0.04	-0.05	-0.05
PXH	-0.02	1.00	0.16	0.21	-0.04	<b>0.85**</b>	-0.09	-0.03	-0.04	-0.03
HSN	0.23	0.15	1.00	-0.06	0.02	0.06	-0.15	-0.03	0.03	-0.09
BCF	-0.07	<b>0.26*</b>	-0.08	1.00	0.00	<b>0.29*</b>	-0.11	-0.10	<b>0.24*</b>	0.12
FRD	-0.06	-0.04	-0.05	0.07	1.00	-0.05	-0.08	0.03	-0.10	-0.09
GNE	-0.08	<b>0.31**</b>	0.02	<b>0.30*</b>	-0.04	1.00	-0.06	-0.02	0.15	0.18
RCS	-0.06	-0.12	-0.18	-0.02	-0.07	0.09	1.00	0.02	-0.10	0.09
SAB	-0.04	-0.03	0.01	-0.11	0.10	0.06	0.05	1.00	-0.07	-0.06
SAR	-0.06	-0.04	0.04	<b>0.34**</b>	-0.11	<b>0.26*</b>	-0.05	-0.08	1.00	0.05
SHR	-0.05	-0.03	-0.09	0.16	-0.10	0.18	0.10	-0.07	0.09	1.00
N=72	SPEARMAN RANK CORRELATIONS									
Summer	PEARSON PRODUCT-MOMENT CORRELATIONS									
Species	PLS	PXH	HSN	BCF	FRD	GNE	RCS	SAB	SAR	SHR
PLS	---	---	---	---	---	---	---	---	---	---
PXH	---	1.00	-0.04	<b>0.19*</b>	0.04	<b>0.20*</b>	0.01	-0.03	<b>0.44**</b>	-0.01
HSN	---	-0.02	1.00	0.13	<b>0.25**</b>	0.03	<b>0.20*</b>	-0.03	-0.01	0.03
BCF	---	0.22	<b>0.25**</b>	1.00	<b>0.18*</b>	0.09	<b>0.21*</b>	0.09	<b>0.33**</b>	-0.03
FRD	---	0.09	<b>0.37**</b>	<b>0.24**</b>	1.00	0.05	<b>0.24**</b>	-0.12	0.14	-0.05
GNE	---	<b>0.28**</b>	0.08	0.13	0.15	1.00	0.13	-0.09	0.15	-0.02
RCS	---	0.08	<b>0.32**</b>	0.13	<b>0.41**</b>	<b>0.19*</b>	1.00	-0.09	0.21	<b>0.21*</b>
SAB	---	-0.03	-0.11	0.03	-0.13	-0.10	-0.13	1.00	-0.07	-0.03
SAR	---	<b>0.44**</b>	0.06	<b>0.29**</b>	<b>0.24**</b>	<b>0.22*</b>	0.09	-0.07	1.00	-0.02
SHR	---	-0.01	0.07	-0.04	-0.06	-0.03	0.17	-0.03	-0.02	1.00
N=126	SPEARMAN RANK CORRELATIONS									

\* = significant at 5% probability level

\*\* = significant at 1% probability level

Table 4. Pearson product-moment correlations and Spearman rank correlations for

pallid sturgeon (PLS), pallid sturgeon \* shovelnose sturgeon hybrids (PXH), shovelnose sturgeon (HSN) and other large river fish abundance data in autumn and winter as computed by PROC CORR (SAS System). (BCF = blue catfish, FRD = freshwater drum, GNE = goldeye, RCS = river carpsucker, SAB = smallmouth buffalo, SAR = sauger, and SHR = shorthead redhorse)

Autumn	PEARSON PRODUCT-MOMENT CORRELATIONS									
Species	PLS	PXH	HSN	BCF	FRD	GNE	RCS	SAB	SAR	SHR
PLS	---	---	---	---	---	---	---	---	---	---
PXH	---	---	---	---	---	---	---	---	---	---
HSN	---	---	1.00	0.10	---	---	-0.21	---	---	---
BCF	---	---	0.07	1.00	---	---	-0.08	---	---	---
FRD	---	---	---	---	---	---	---	---	---	---
GNE	---	---	---	---	---	---	---	---	---	---
RCS	---	---	-0.15	-0.09	---	---	1.00	---	---	---
SAB	---	---	---	---	---	---	---	---	---	---
SAR	---	---	---	---	---	---	---	---	---	---
SHR	---	---	---	---	---	---	---	---	---	---
N=31	SPEARMAN RANK CORRELATIONS									
Winter	PEARSON PRODUCT-MOMENT CORRELATIONS									
Species	PLS	PXH	HSN	BCF	FRD	GNE	RCS	SAB	SAR	SHR
PLS	1.00	-0.02	0.05	-0.03	0.15	0.06	-0.05	-0.03	-0.04	-0.04
PXH	-0.02	1.00	0.09	-0.05	0.01	0.05	0.03	-0.07	0.05	0.11
HSN	0.10	0.05	1.00	<b>0.58**</b>	-0.05	0.16	<b>-0.19*</b>	-0.15	-0.10	-0.04
BCF	-0.04	-0.05	0.08	1.00	0.01	<b>0.19*</b>	-0.10	-0.06	-0.00	-0.02
FRD	<b>0.22*</b>	-0.00	-0.01	0.09	1.00	<b>0.30**</b>	<b>0.18*</b>	-0.03	0.02	-0.06
GNE	0.15	-0.04	0.13	<b>0.23**</b>	0.14	1.00	-0.05	-0.13	0.14	0.02
RCS	-0.06	0.05	<b>-0.21*</b>	-0.07	<b>0.23*</b>	-0.00	1.00	<b>0.18*</b>	0.11	<b>0.21*</b>
SAB	-0.03	-0.09	<b>-0.28**</b>	-0.09	0.01	-0.16	0.15	1.00	-0.12	-0.10
SAR	-0.04	0.14	-0.08	0.01	0.06	0.11	0.13	-0.15	1.00	0.19
SHR	-0.04	<b>0.19*</b>	0.05	-0.06	-0.03	0.03	<b>0.19*</b>	-0.10	<b>0.21*</b>	1.00
N=128	SPEARMAN RANK CORRELATIONS									

\* = significant at 5% probability level

\*\* = significant at 1% probability level

### Discussion

## *Pallid Sturgeon Life History and Habitat Use*

The pallid sturgeon was listed as an endangered species because of habitat alteration and the threat of hybridization with shovelnose sturgeon *S. platyrhynchus* (Federal Register 55 [September 6, 1990]: 36641-36647). Pallid sturgeon were still fairly common in many parts of the Missouri and Mississippi River systems as of 1967 but have declined with development of the river systems for flood control and navigation (Kallemeyn 1983). Pallid sturgeon were 1 in every 396 (0.25%) river sturgeons collected in the Lower Missouri and Middle Mississippi Rivers in the late 1970s (Carlson et al 1985). The ratio of wild pallid sturgeon to all river sturgeon collected dropped to 1 in 633 (0.16%) in the 1990s (Grady et al 2001). A recent survey of sturgeon biologists indicates that pallid sturgeon may have been eliminated from 47.6% of the lakes and streams they were reported to have lived in (Hesse and Carreiro 1997).

The pallid sturgeon's preferred habitat is large, turbid rivers (Kallemeyn 1983). This bottom dwelling species usually occurs in faster water than shovelnose sturgeon (Forbes and Richardson 1905). Carlson et al (1985) captured pallid sturgeon in the late 1970s in the main channel of the Missouri River along sandbars at the inside of river bends and behind wing dikes with deeply scoured trenches. Most of the pallid sturgeon collected by Grady et al (2001) were caught in deep holes associated with wing dikes. One pallid sturgeon was caught in a side channel habitat in the Middle Mississippi River. Pallid sturgeon collected in the Lower Missouri River were caught in wing dike scour holes associated with shallow depositional areas (Jacobson and Laustrup 2000). Sheehan et al (1998) speculated that between wing dike areas may be used as velocity refugia and/or feeding stations.

Pallid sturgeon avoid areas without turbidity and current (Erickson 1992). Pallid sturgeon in the Upper Missouri River are reported to occupy a wide range of bottom velocities from 0 to 1.37 m/s (Bramblett 1996, Clancey 1990, Erickson 1992). Sandy substrates were preferred by pallid sturgeon in the Upper Missouri River (Bramblett 1996) and Atchafalaya Rivers (Constant et al 1997). However, spawning is believed to occur over gravel or cobble substrates. The range of water depths used by pallid sturgeon varies across studies and is probably related to the habitat available within the area (Steve Krentz, pers. comm.). Bramblett (1996) found pallid sturgeon used macrohabitats which were more specific and restrictive than shovelnose sturgeon. Macrohabitats used by pallid sturgeon in the Upper Missouri River were dynamic with a diversity of depths, velocities and substrates. Within the Highway 19 Bridge Replacement Project Area wing dike fields are the only available areas of habitat diversity outside of the main navigation channel (Figure 5).

Movement patterns of pallid sturgeon vary seasonally based on temperature and discharge. Erickson (1992) and Bramblett (1996) observed lowest movement rates for pallid sturgeon in winter months and significant positive correlations between water temperature and movement rates.

Larval and juvenile sturgeon species were collected in the Lisbon Bottoms Chute, a re-created side channel, in the late 1990s (Louise Mauldin, pers. comm.). The Lisbon Bottoms area provides a unique backwater habitat complex, still rare in the Lower Missouri River. No larval pallid sturgeon were collected in the Project Area or in the main channel of the Missouri River in extensive sampling by the Benthic Fishes Consortium (Dieterman et al 1996)

### *Potential Impacts to Fishery Resources*

Although pallid sturgeon hybrids are not expressly protected by the Endangered Species Act, the identification of sturgeon hybrids is highly subjective. Field biologists working in the Lower Missouri and Middle Mississippi Rivers seem to be able to identify pallid sturgeon and their hybrids with some level of certainty (Grady et al 2001). However, there is substantial overlap in the ranges of Character Index values assigned to the two groups of fish (Sheehan et al 1999). Campton (2000) advised that detecting hybrids through morphological and meristic characters can only provide circumstantial evidence of hybridization. It is often impossible to distinguish mixed ancestry individuals if hybridization has proceeded past the first generation. Therefore, we advise MoDOT to consider the location and timing of pallid sturgeon hybrid captures in the same manner as pallid sturgeon captures.

The largest potential impact to pallid sturgeon would be an impact to the limited amount of available habitat outside the main navigation channel. This area appears to be used by both pallid sturgeon and their hybrids from November through May. It does not appear at this time that spawning habitat occurs within the Project Area. However, we are awaiting the final results of bathymetric surveys from the USGS - Columbia Environmental Research Center to examine substrates within the Project Area.

### *Recommendations to Avoid or Minimize Potential Impacts*

Within the Highway 19 Bridge Replacement Project Area wing dike fields are the only available areas of habitat diversity outside of the main navigation channel (Figure 5). These areas appear to be occupied by pallid sturgeon and their hybrids as overwintering habitat from November through May. All construction activities that would alter streamflow, modify depths, or impact sediment loading within the wing dike fields should be avoided during this time period.



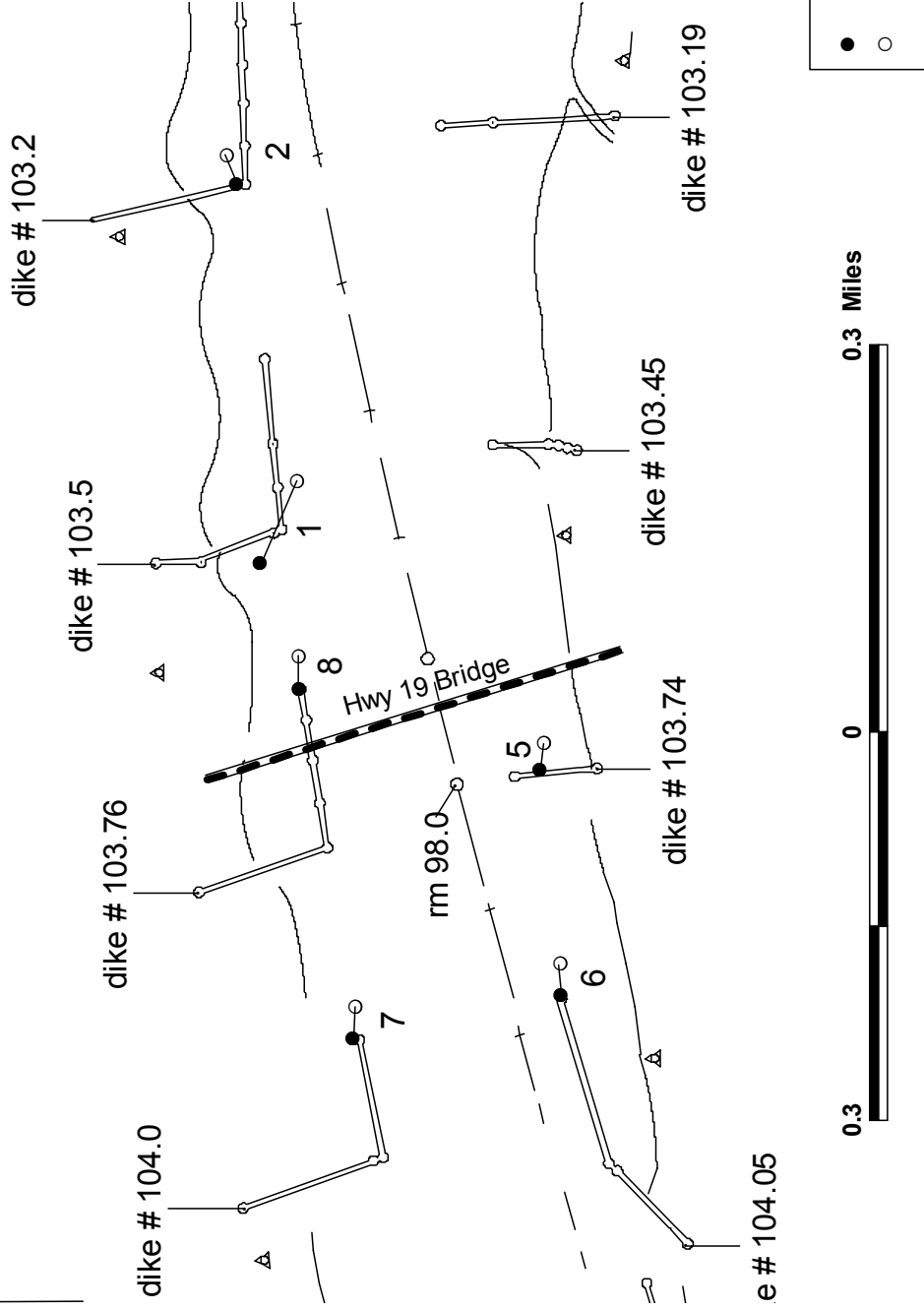
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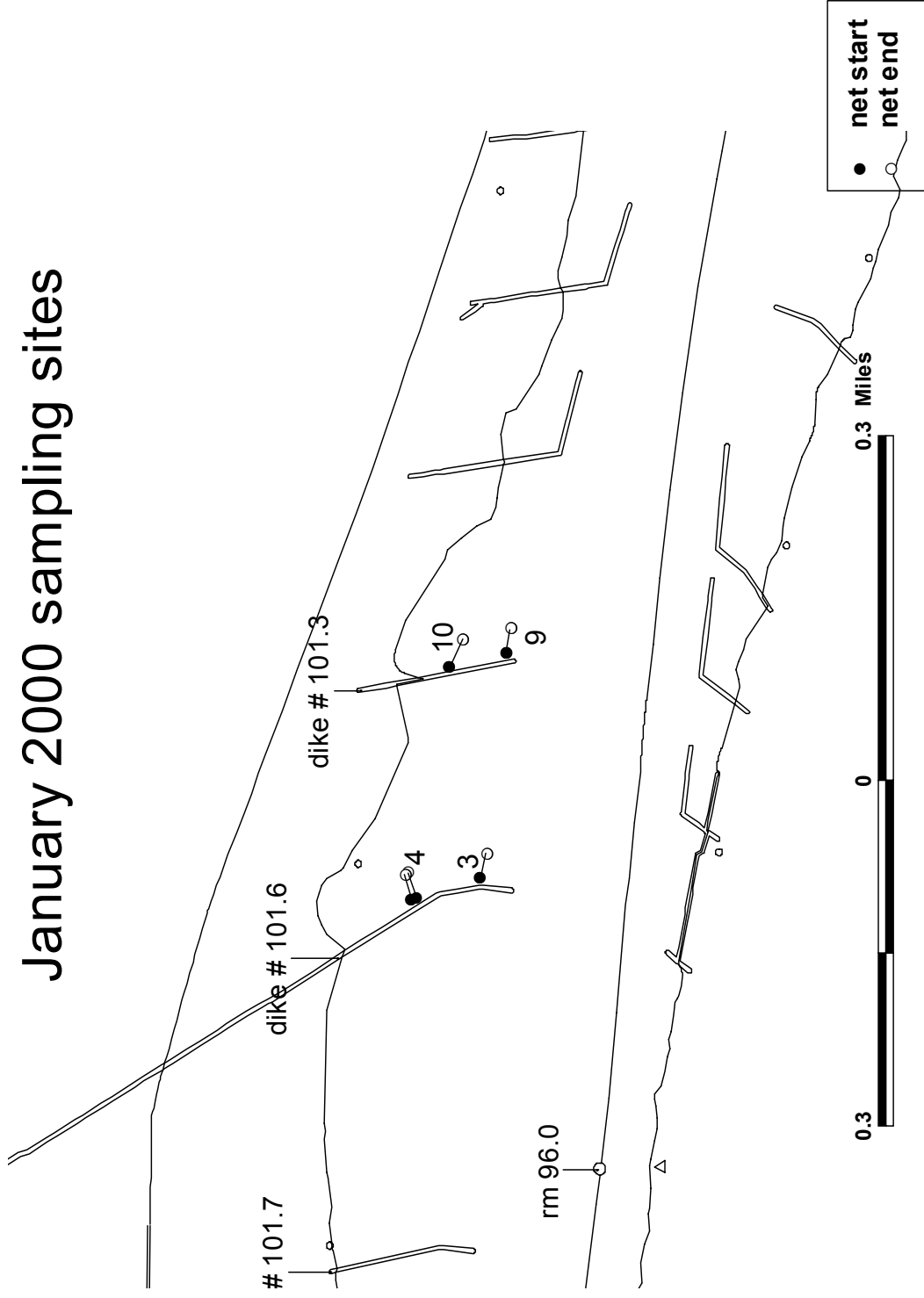
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**Appendix A.**  
**Maps of Netting Locations**

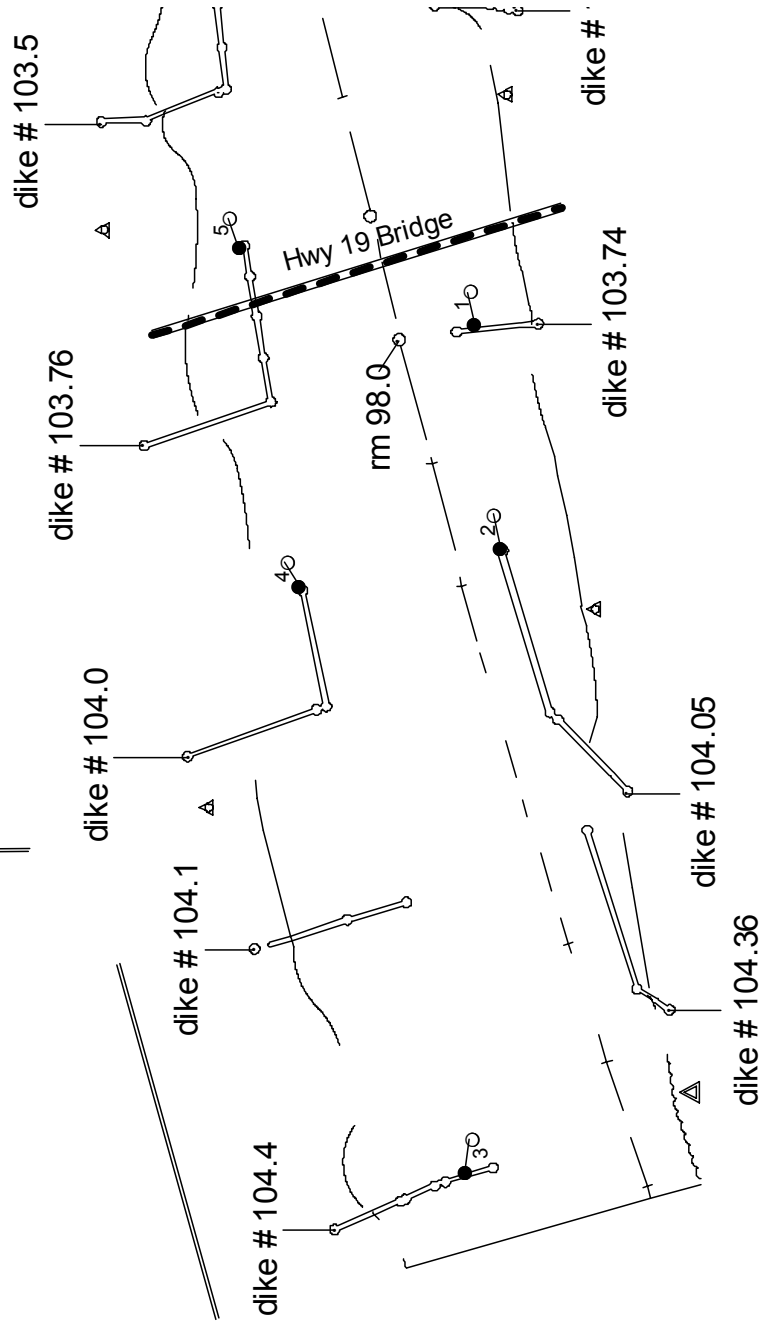
# January 2000 sampling sites



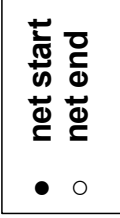
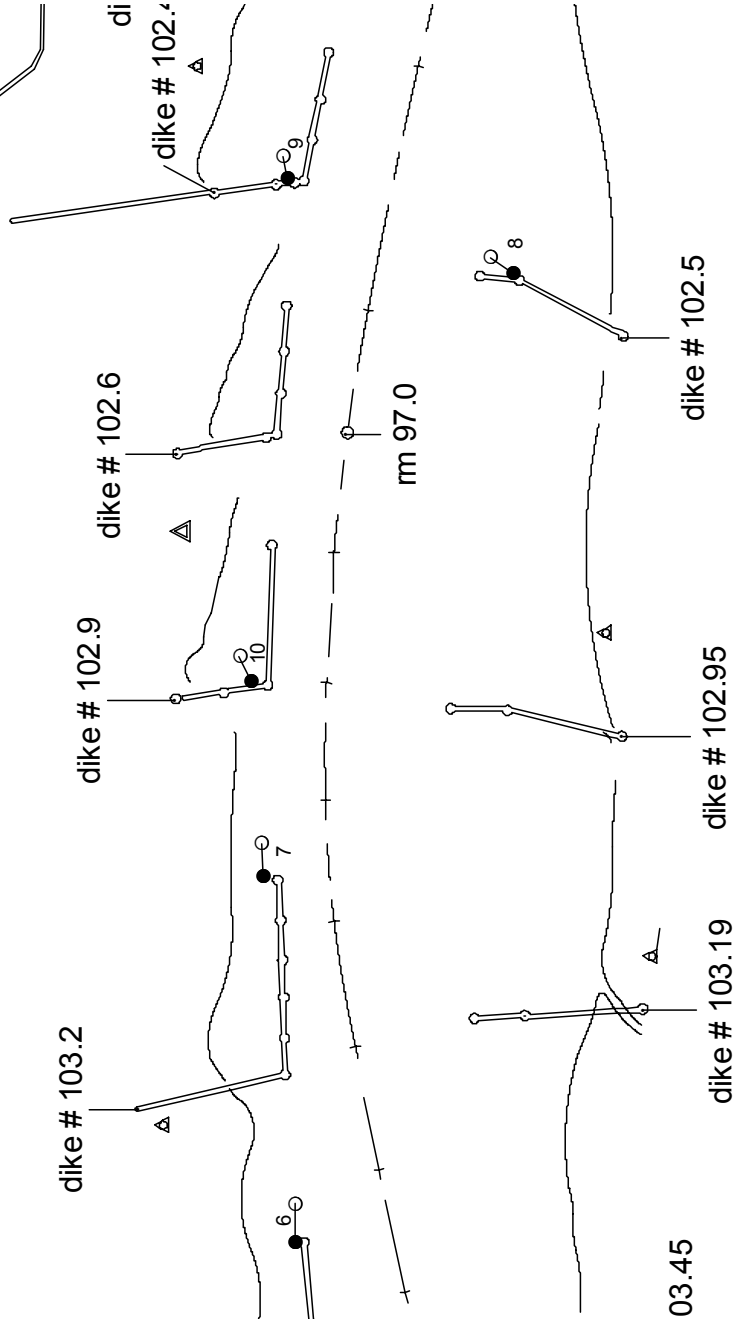
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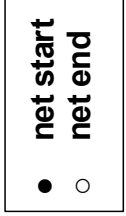
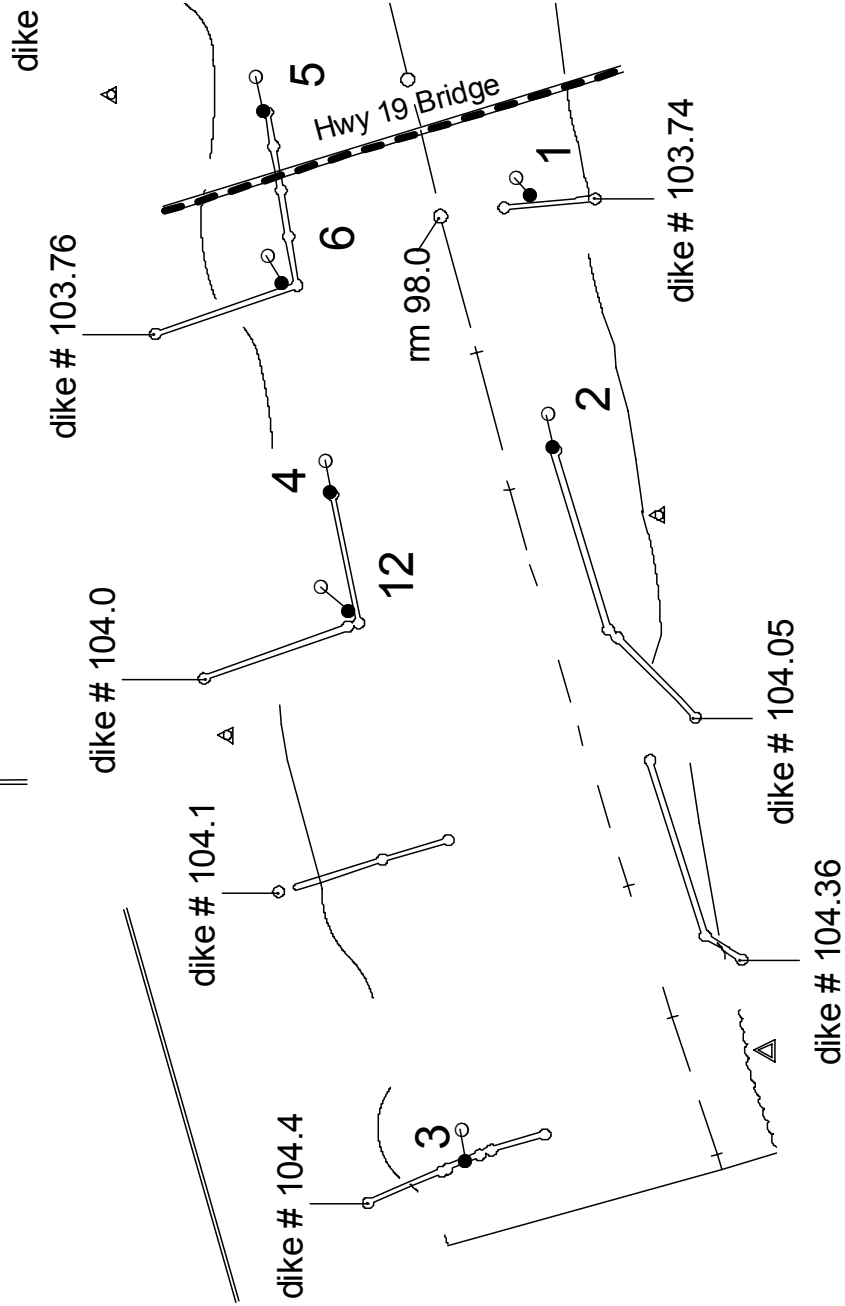
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# February 2000 sampling sites

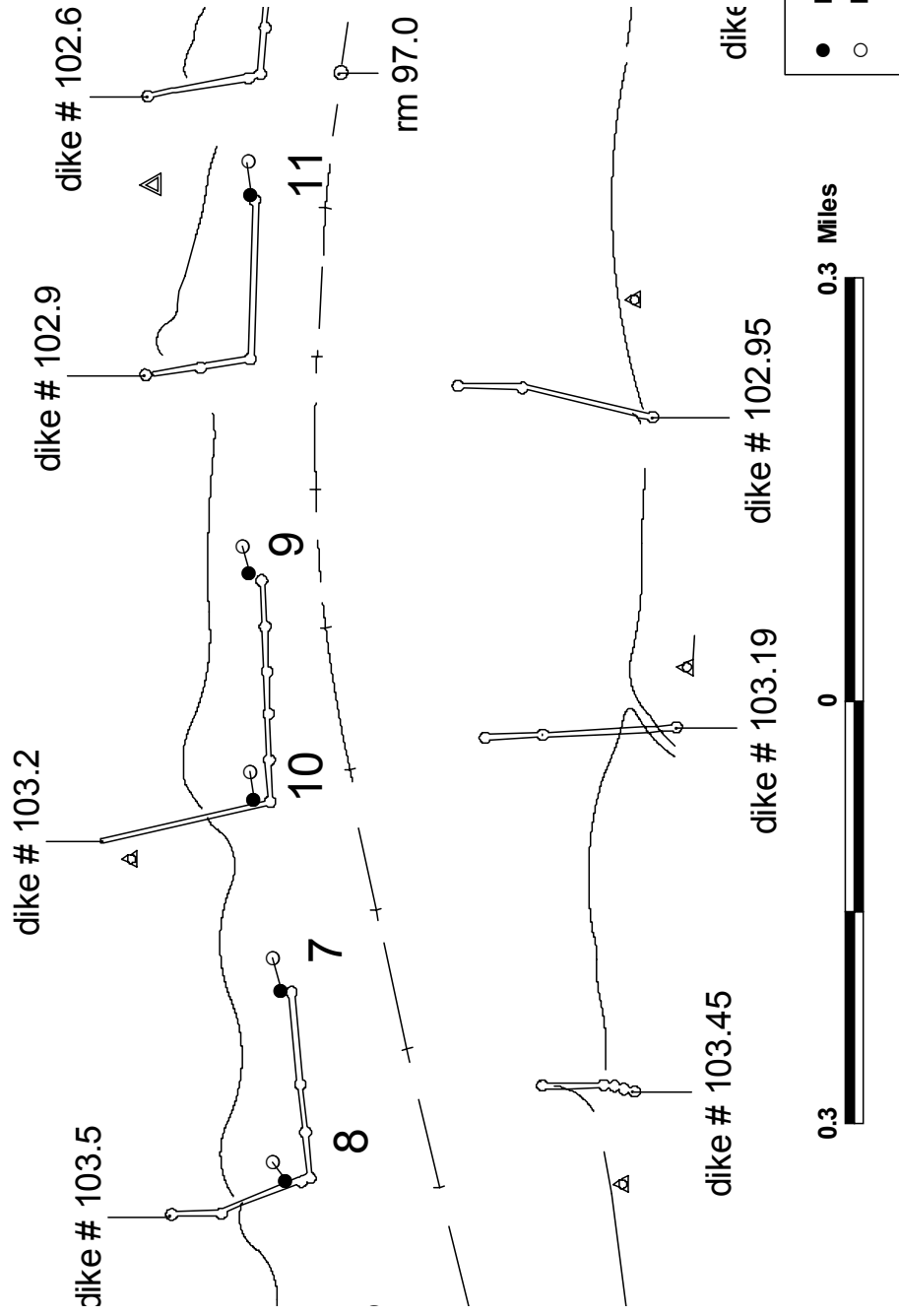


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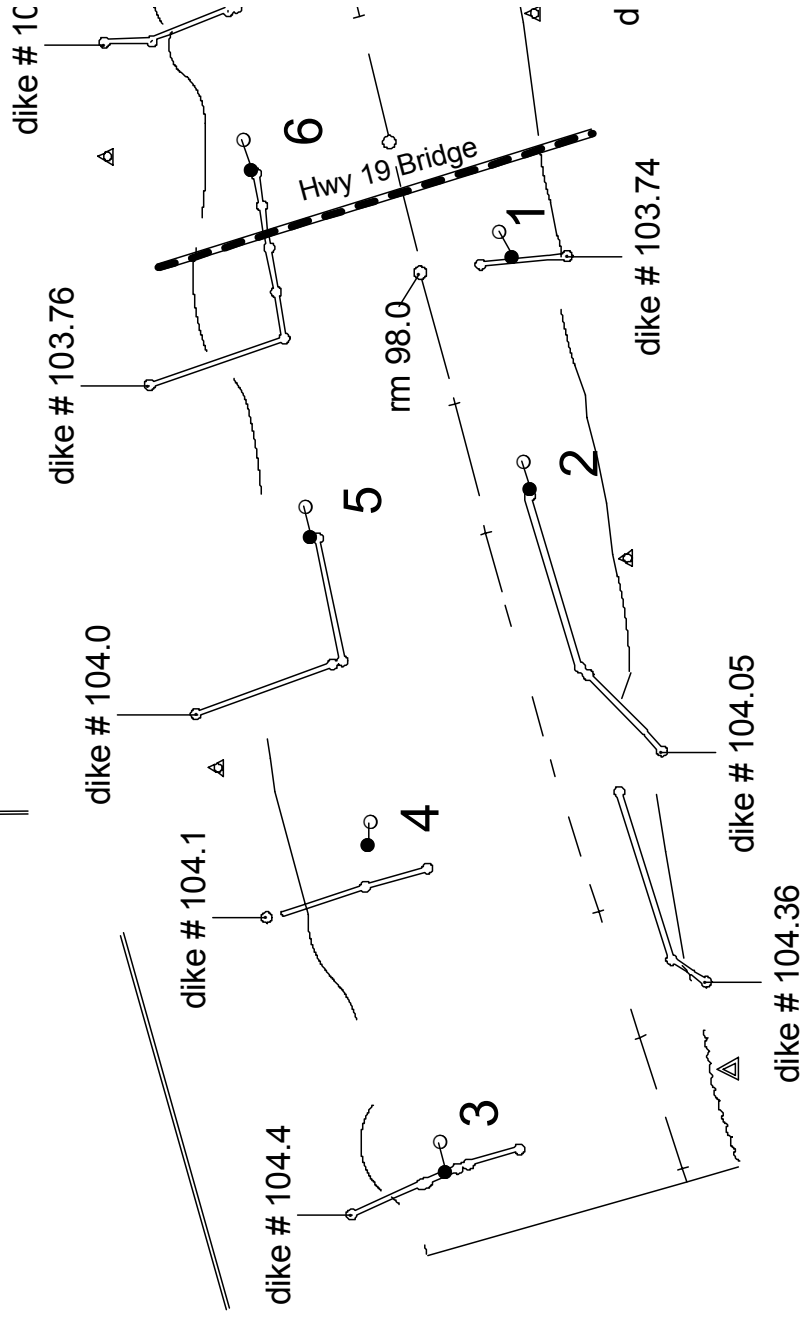




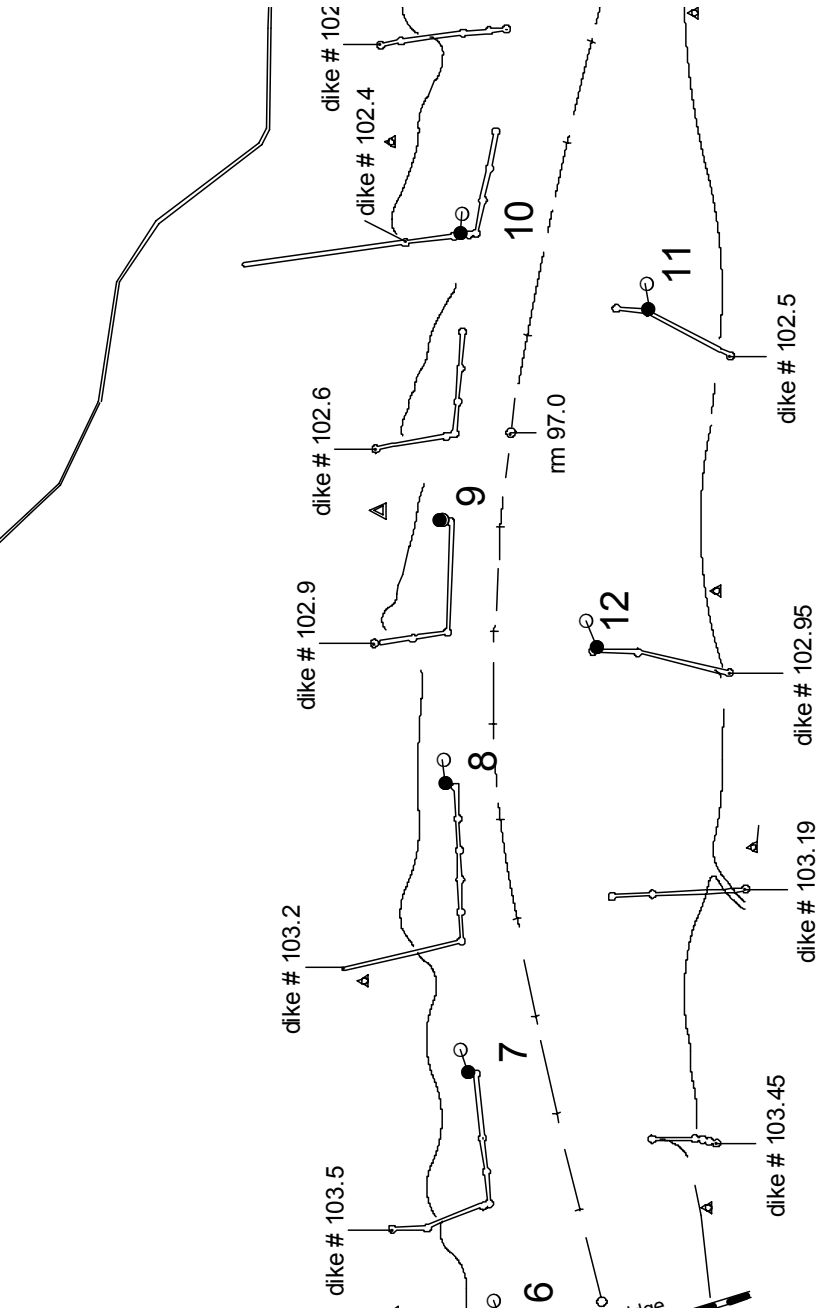
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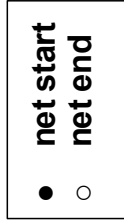
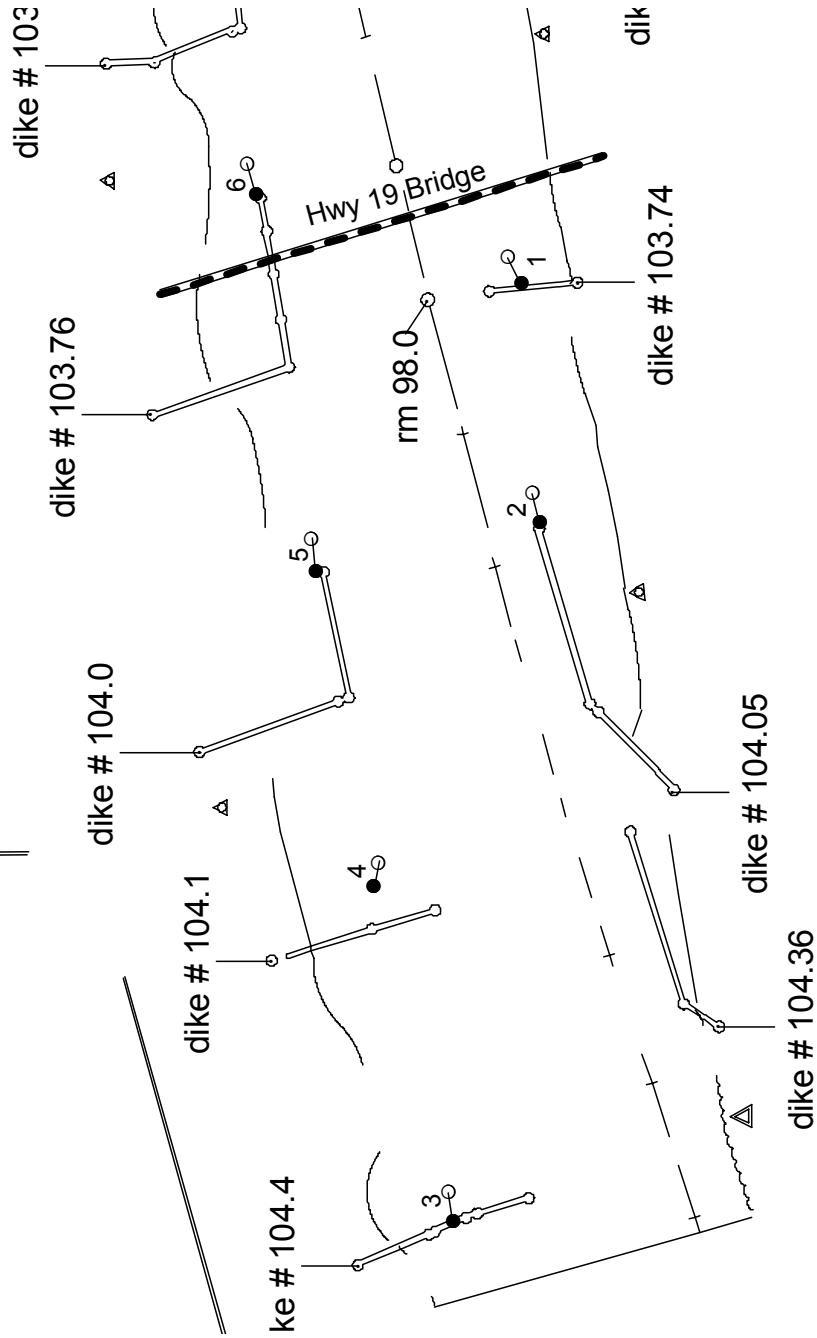
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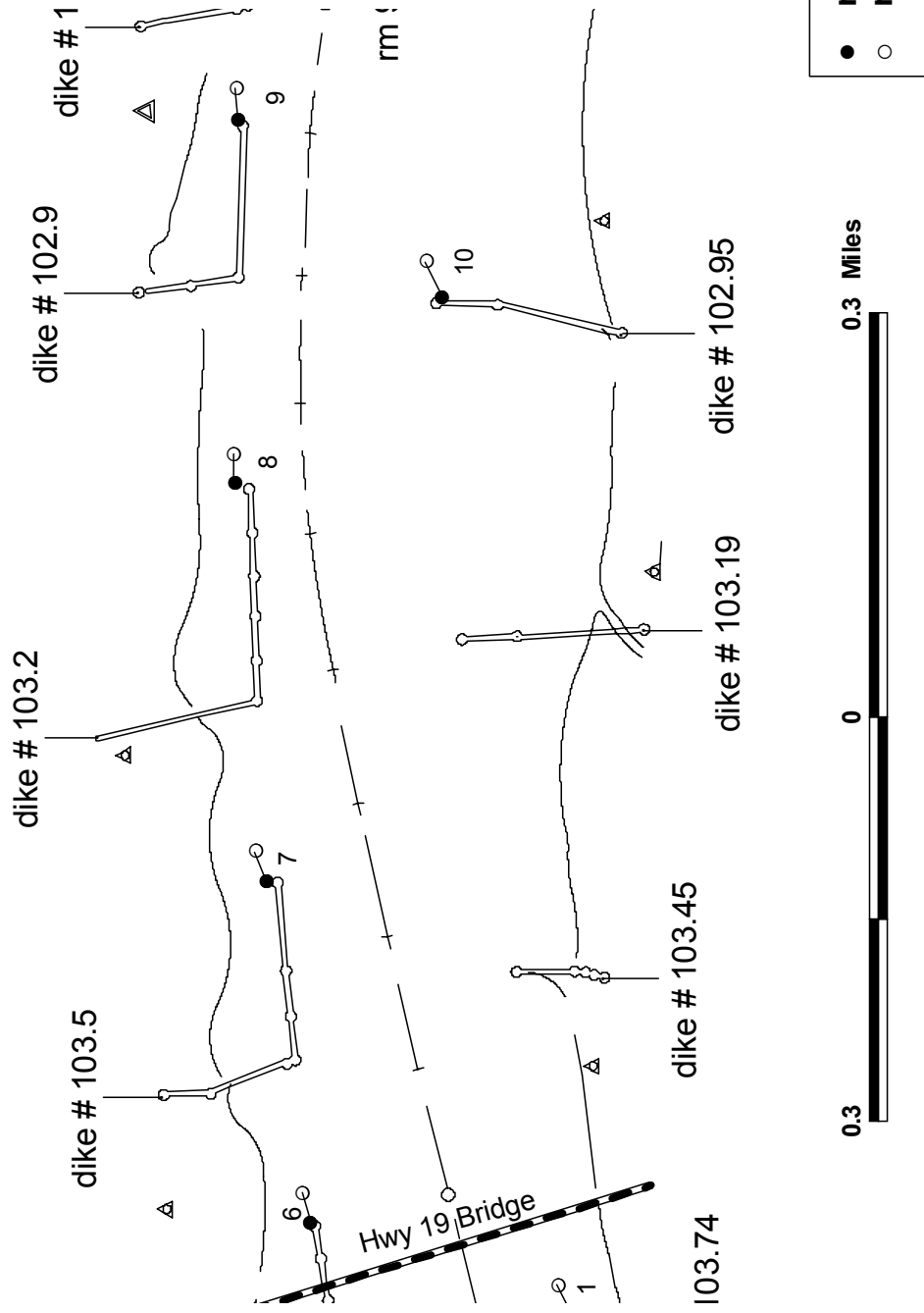
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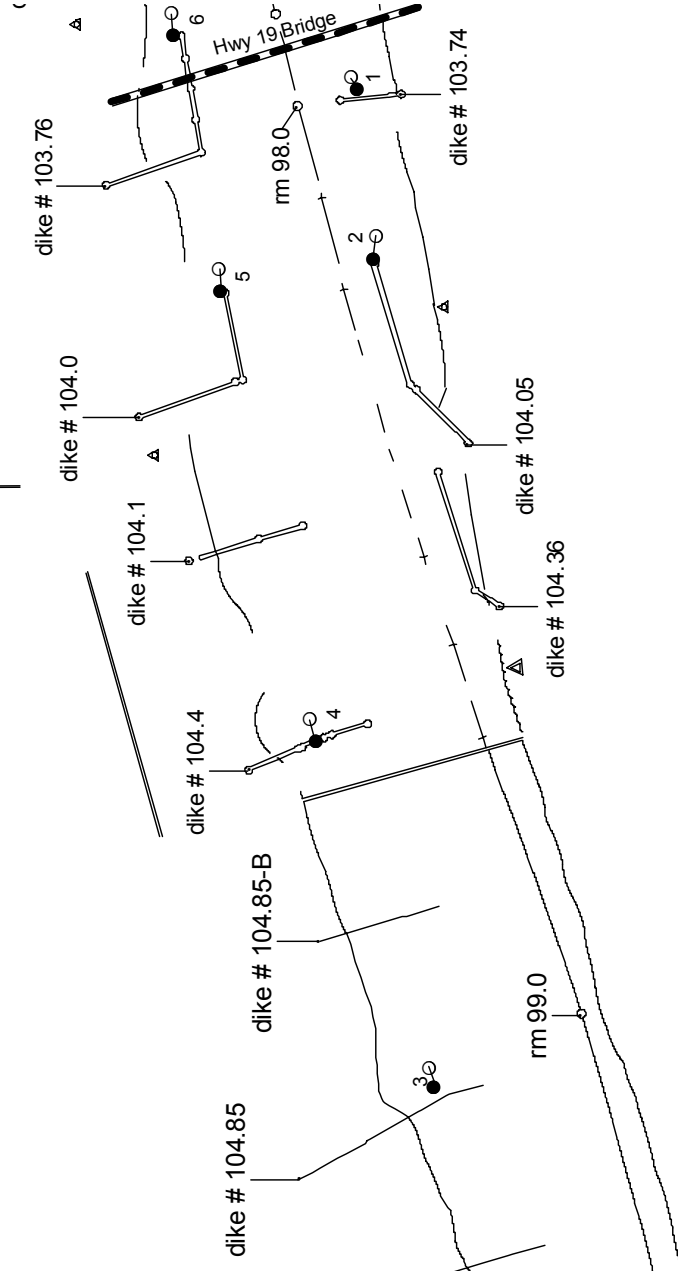
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# May 2000 sampling sites



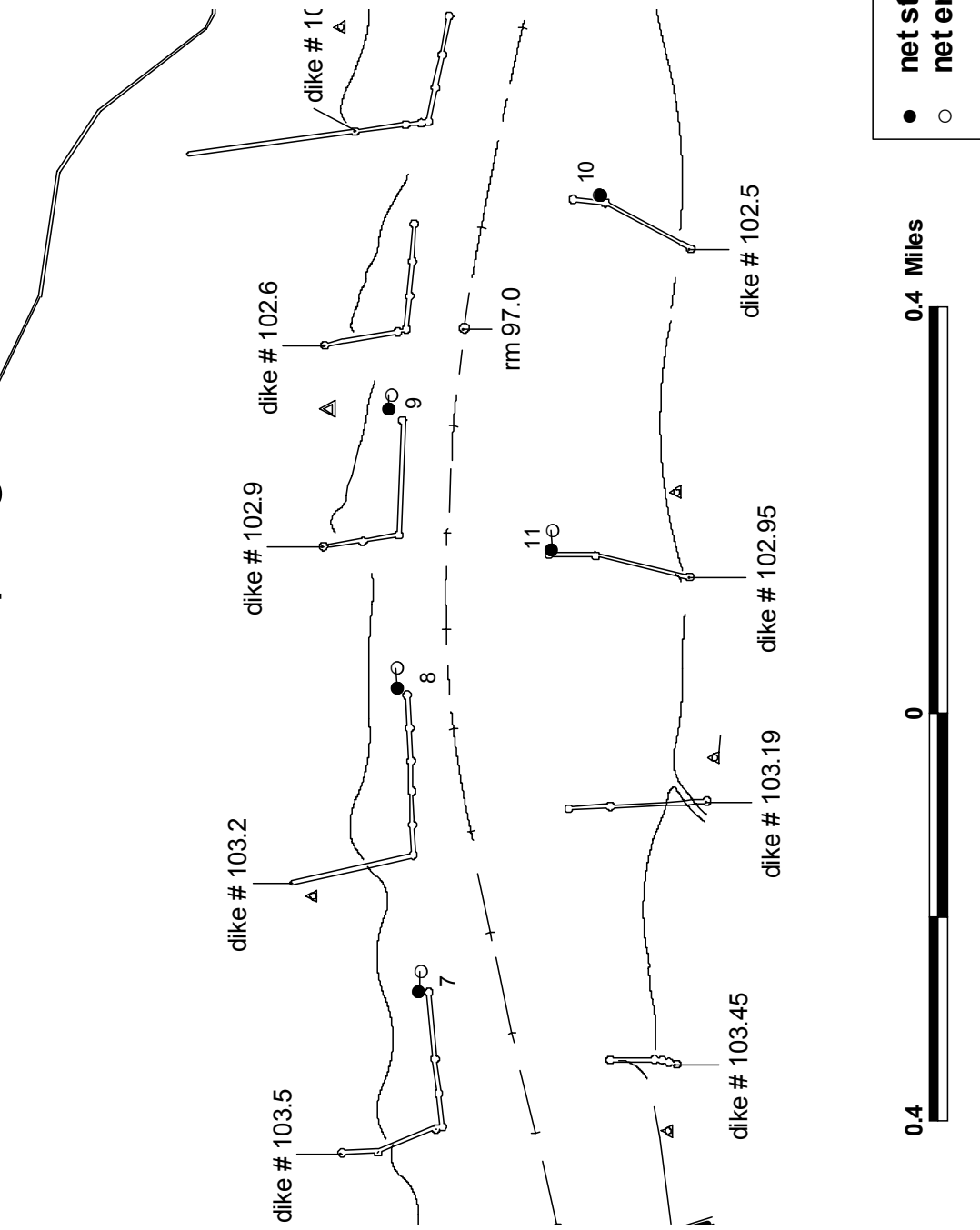
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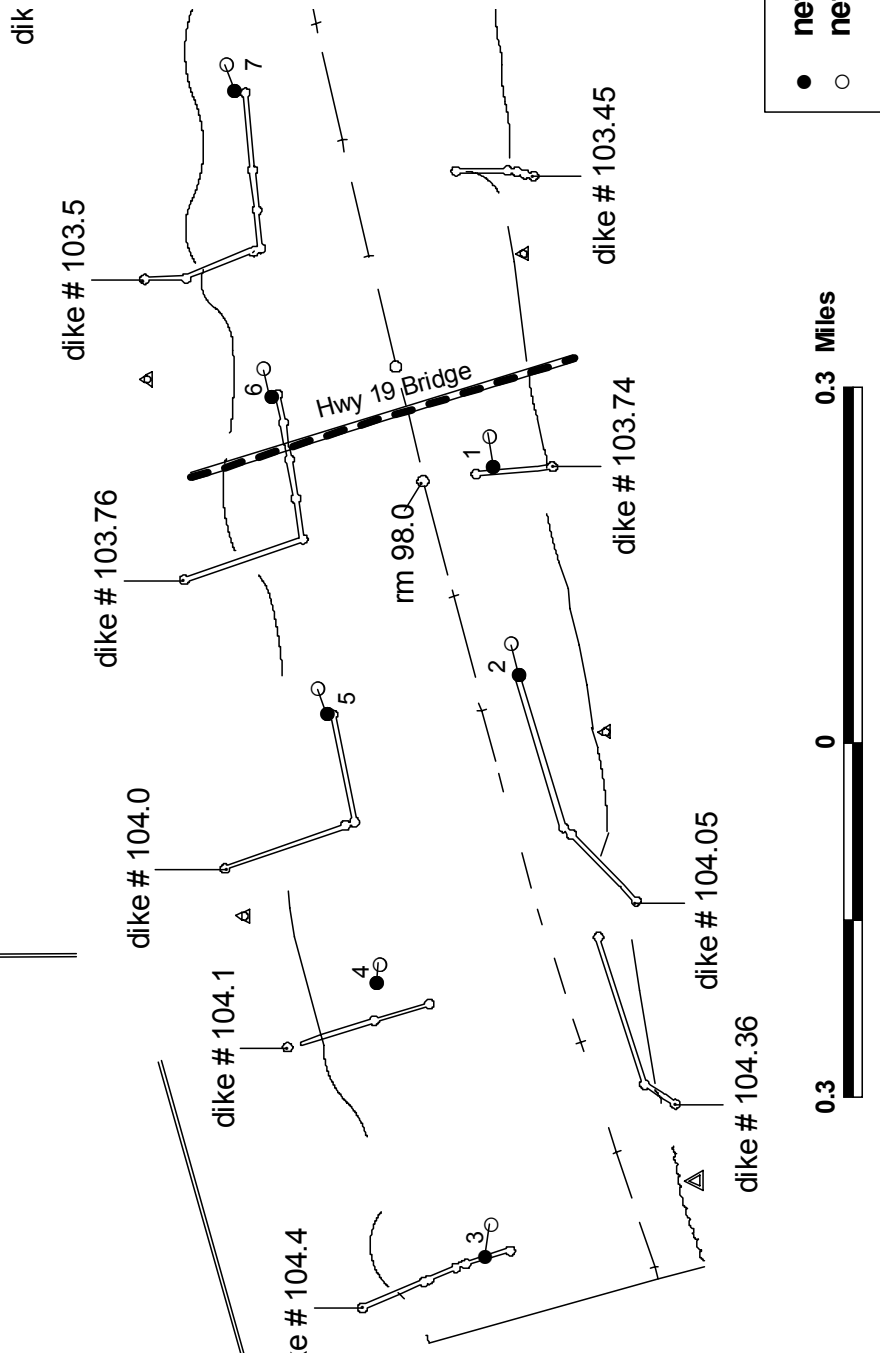
● net start  
○ net end

0 0.5 Miles

# June 2000 sampling sites

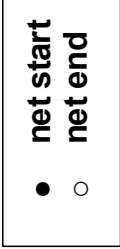
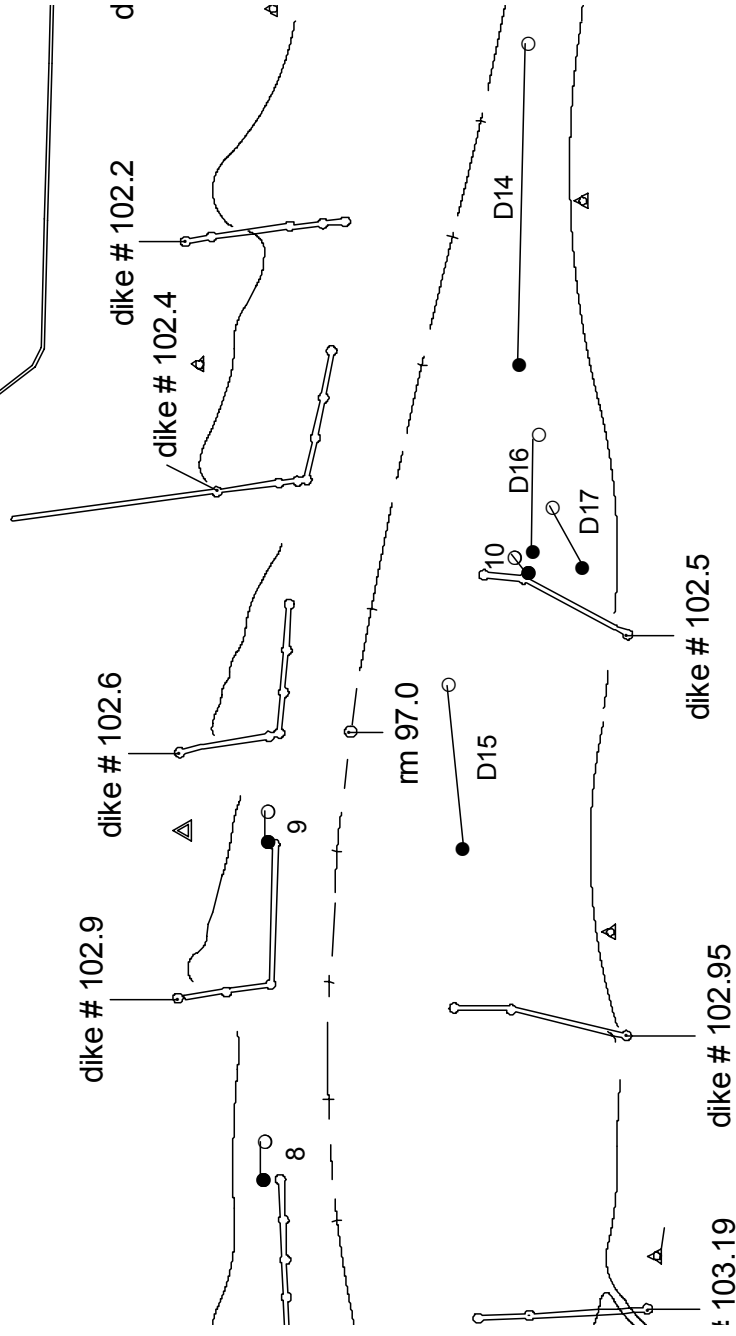


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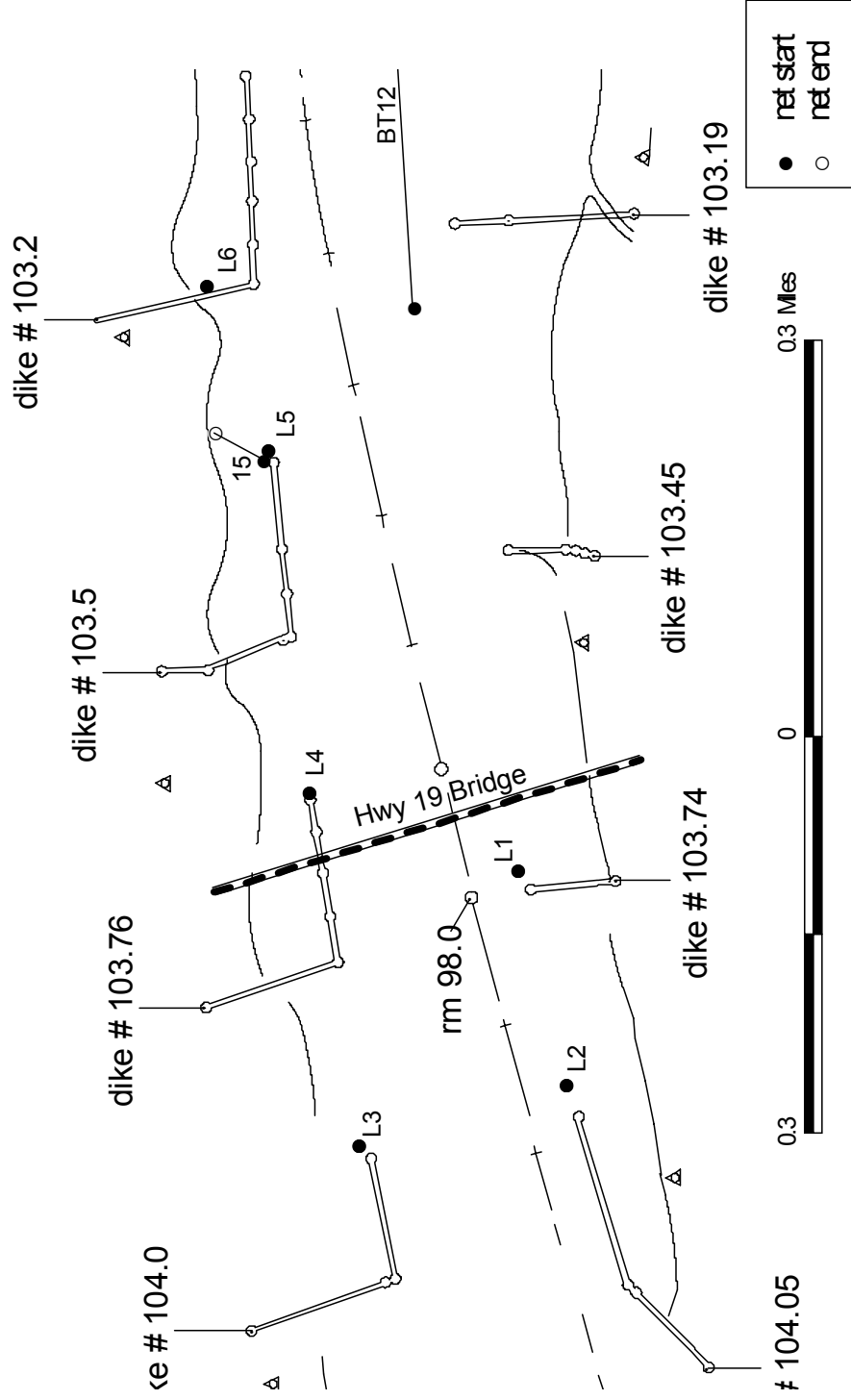




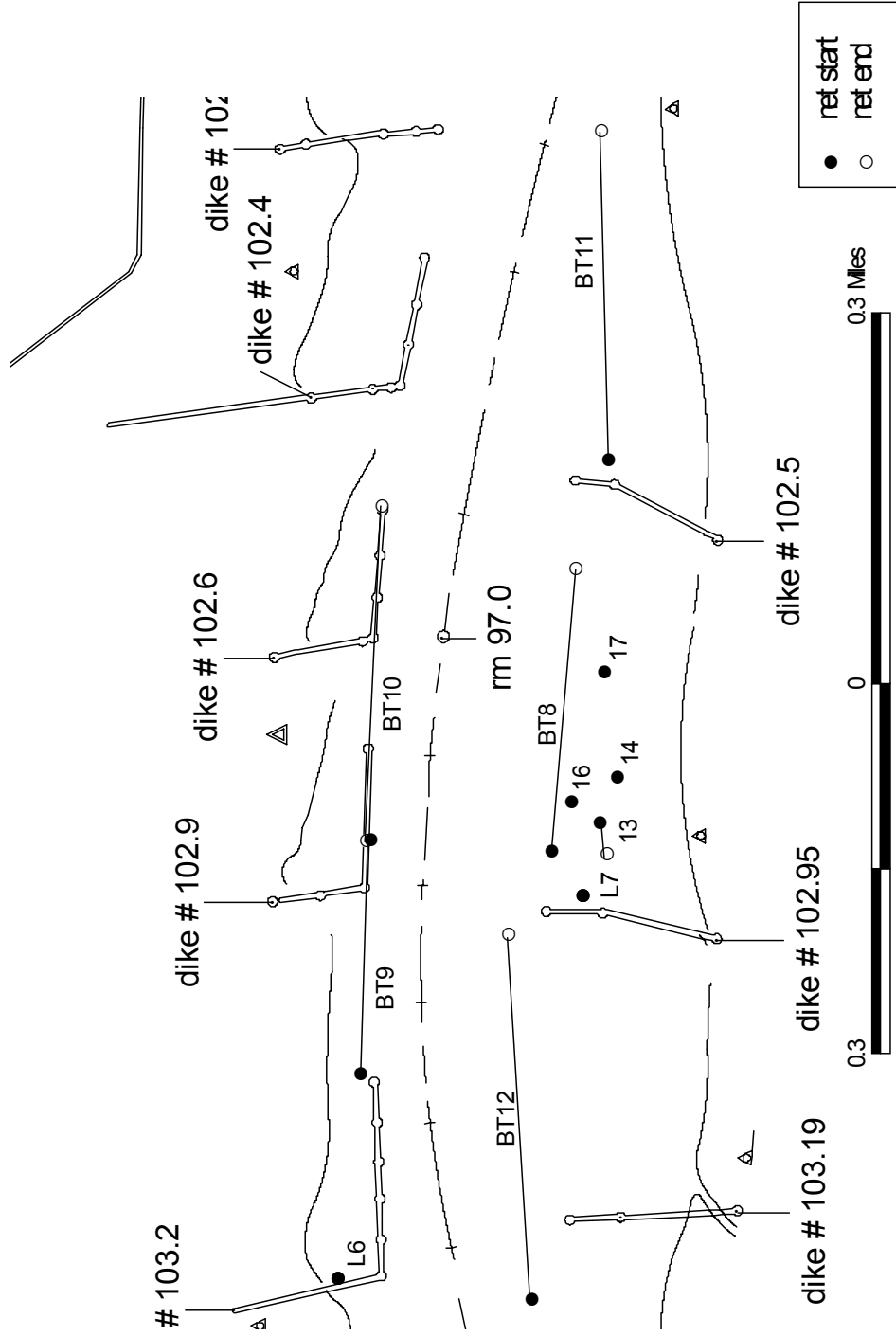
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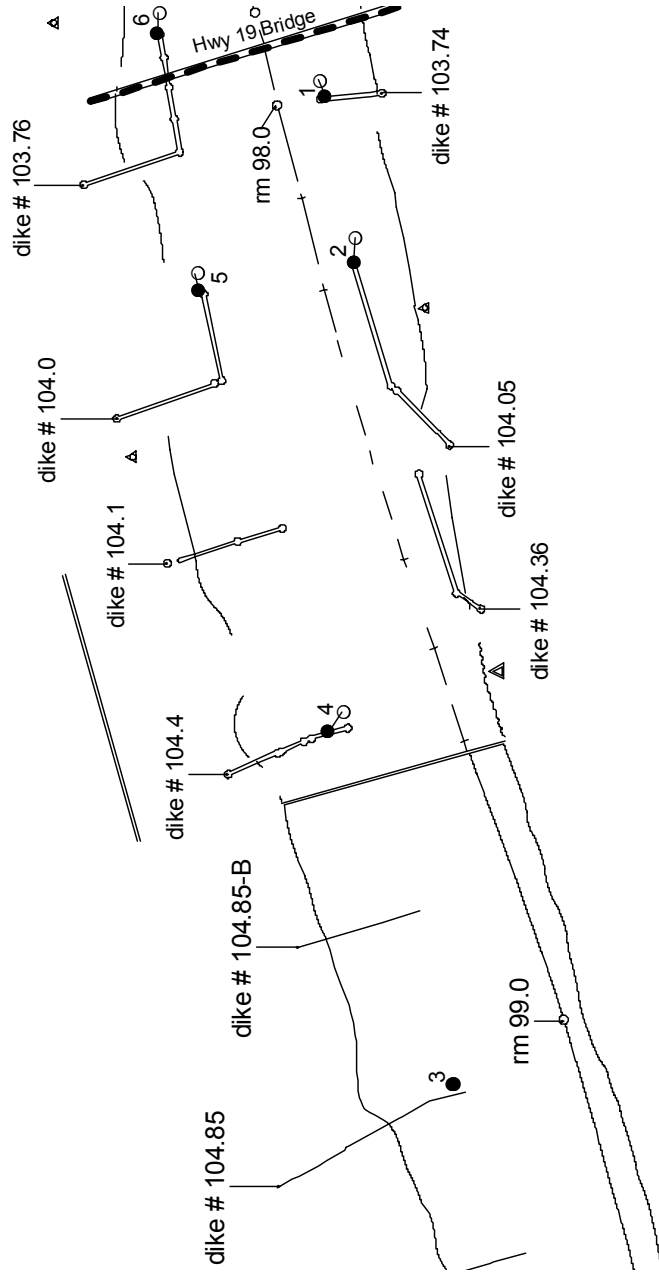
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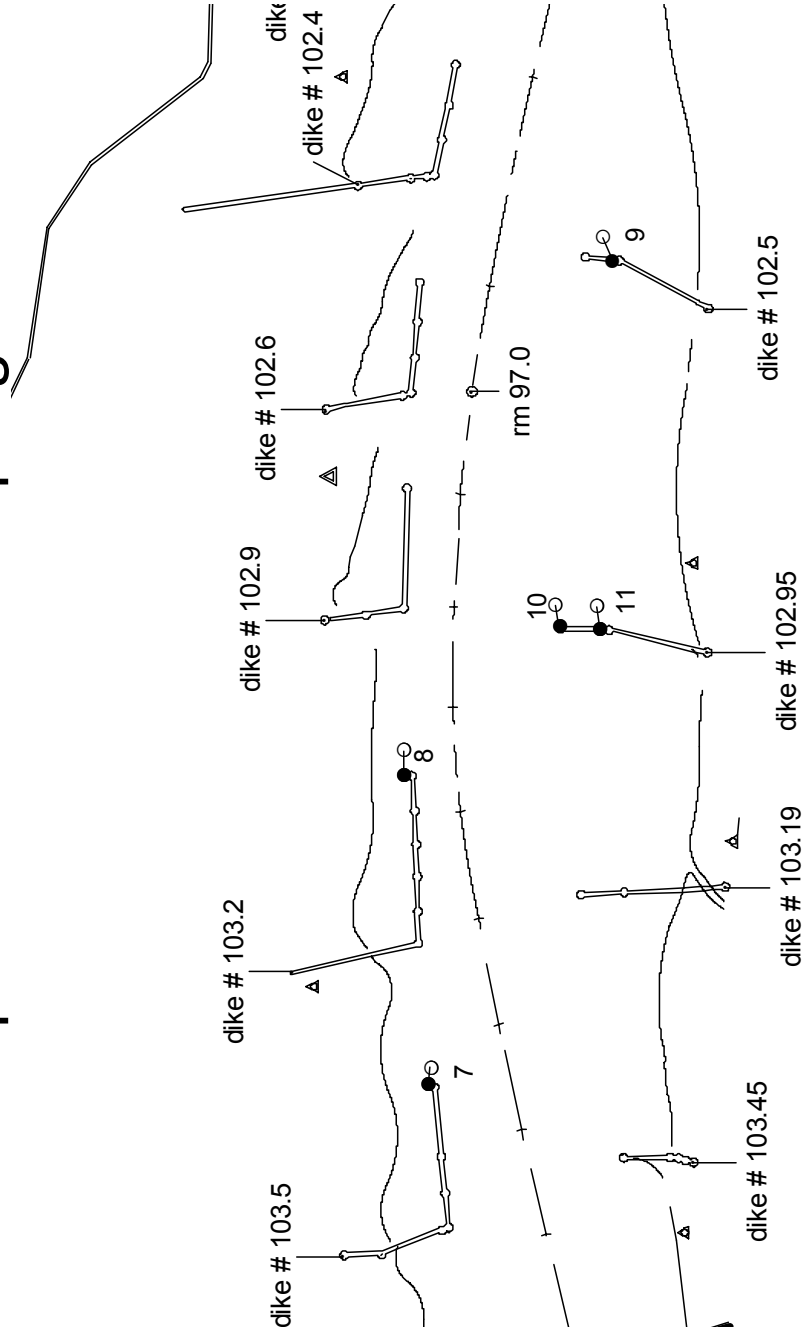
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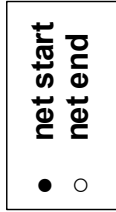
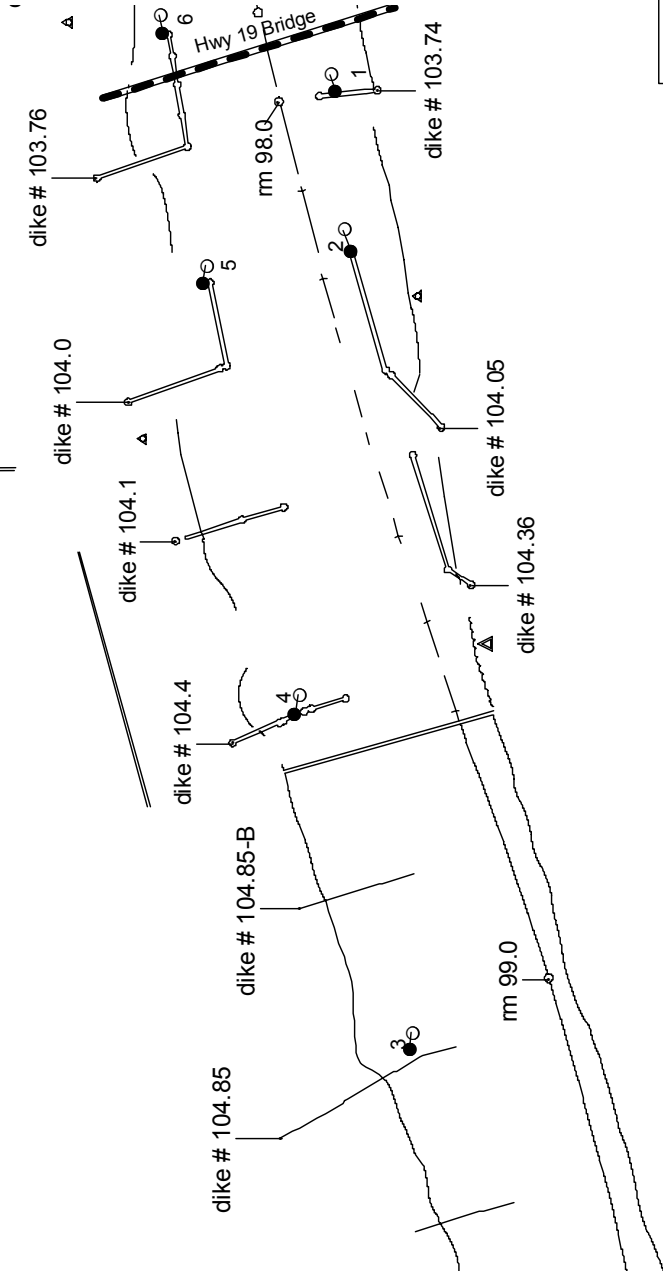
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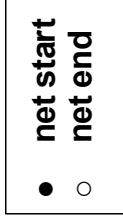
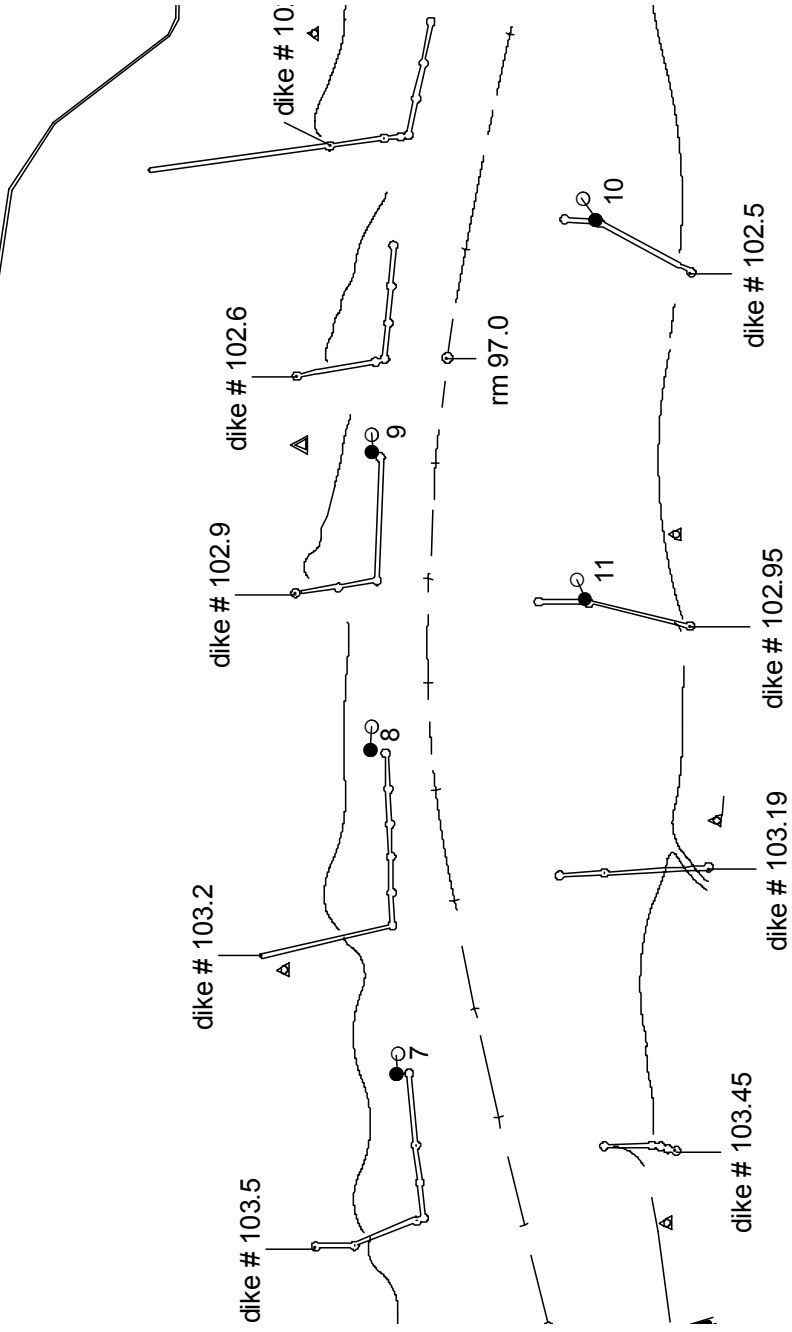
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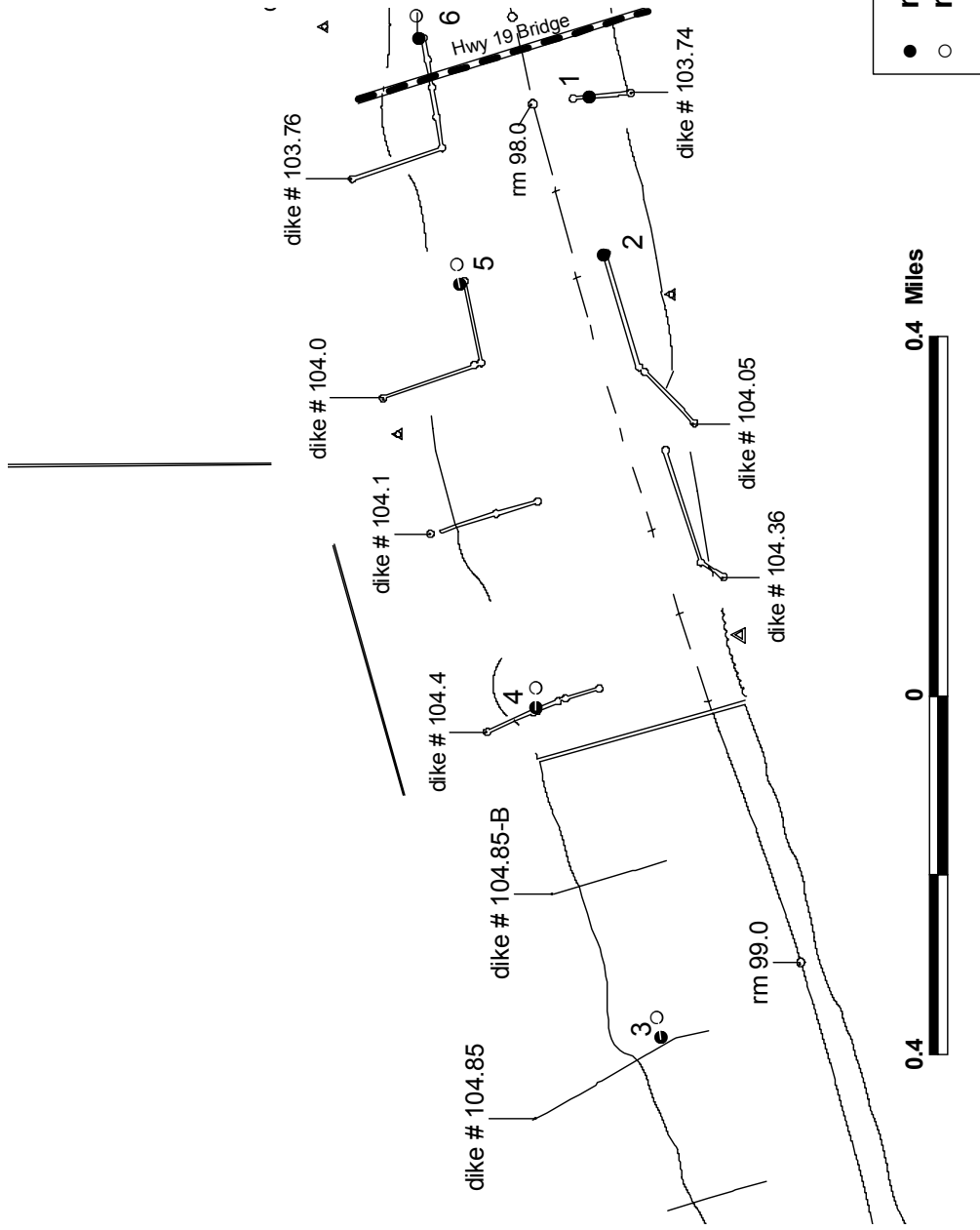
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# October 2000 sampling sites

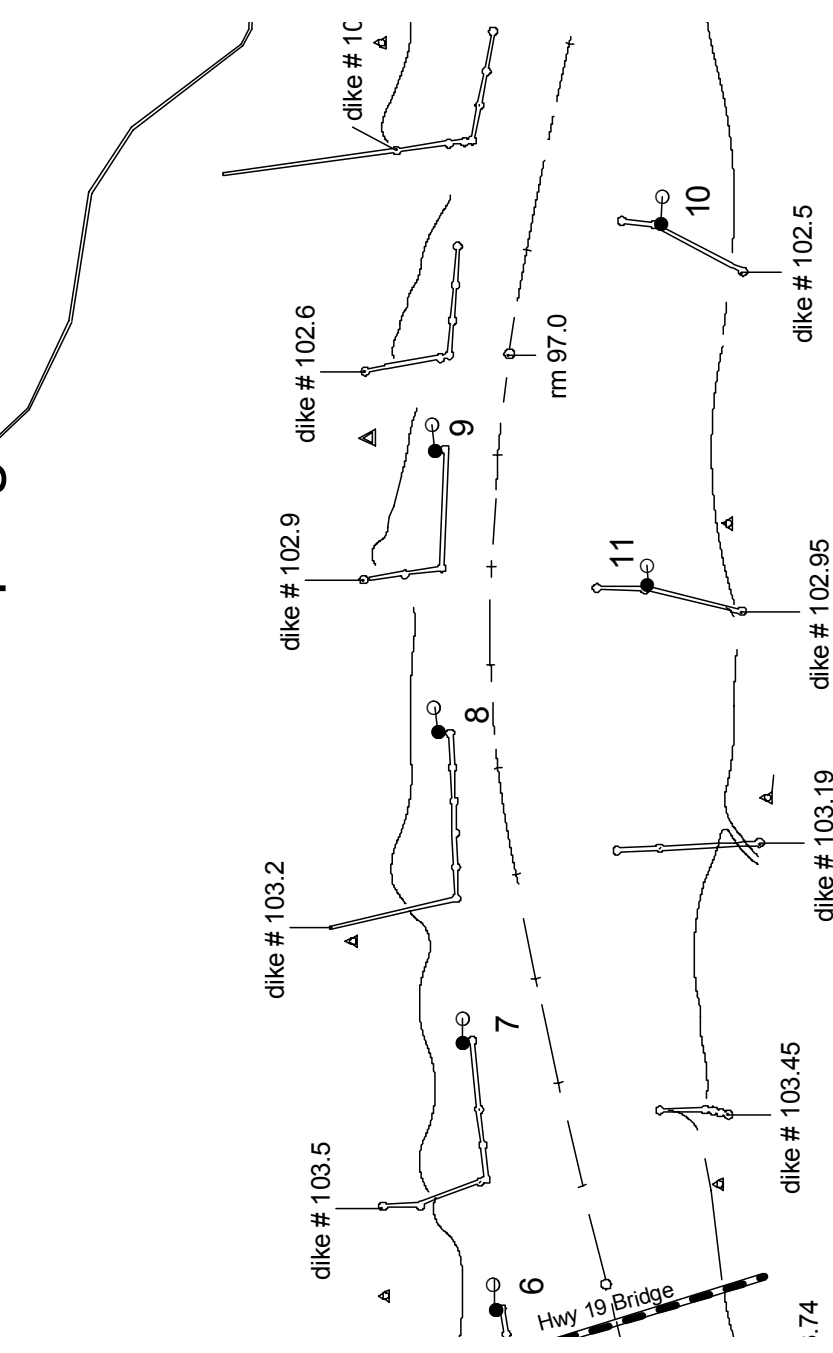


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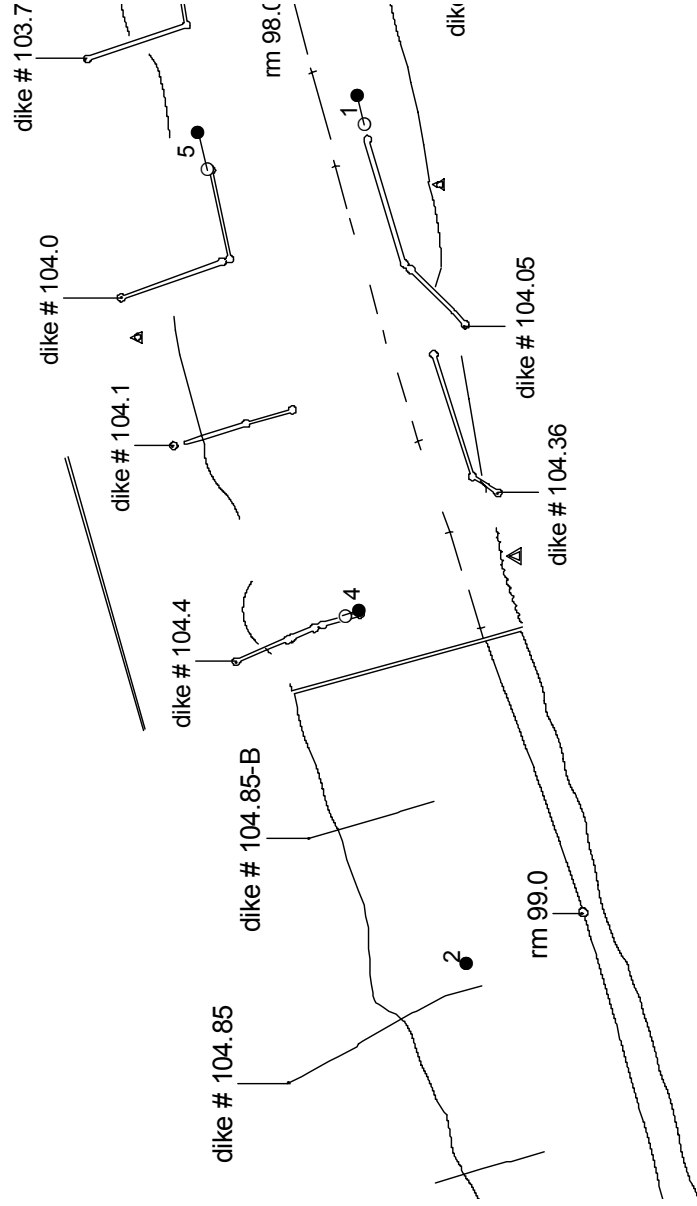
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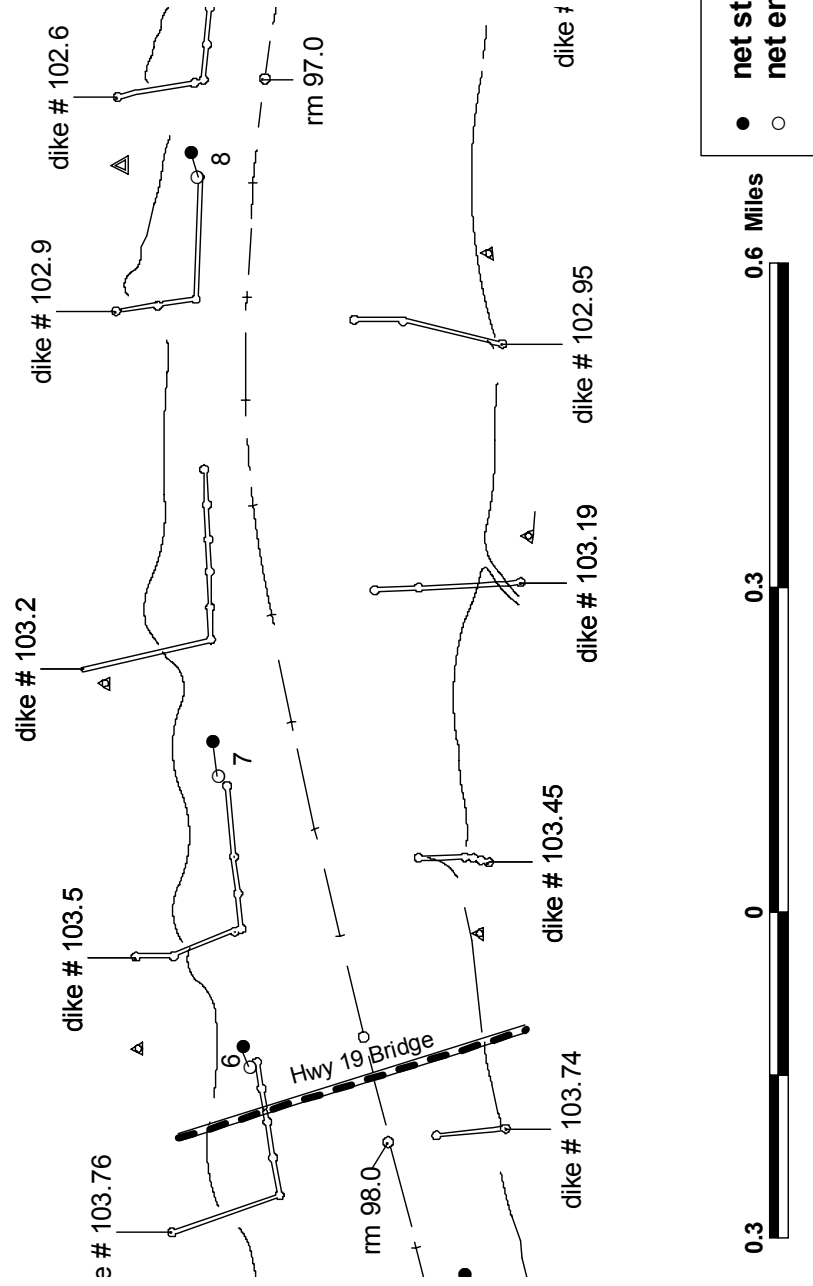
● net start  
○ net end



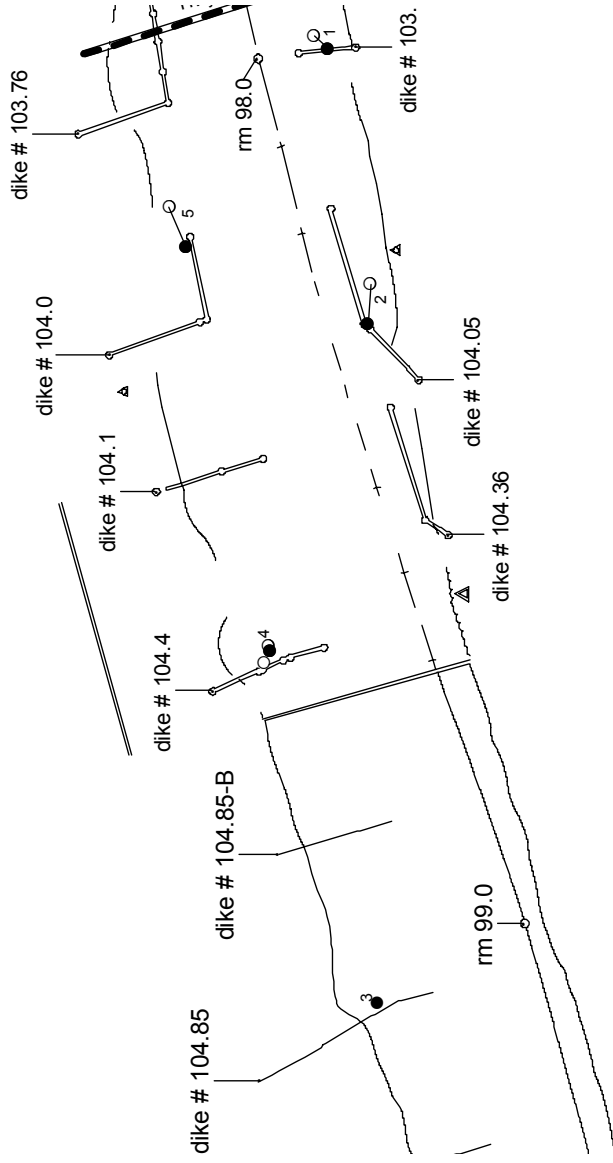
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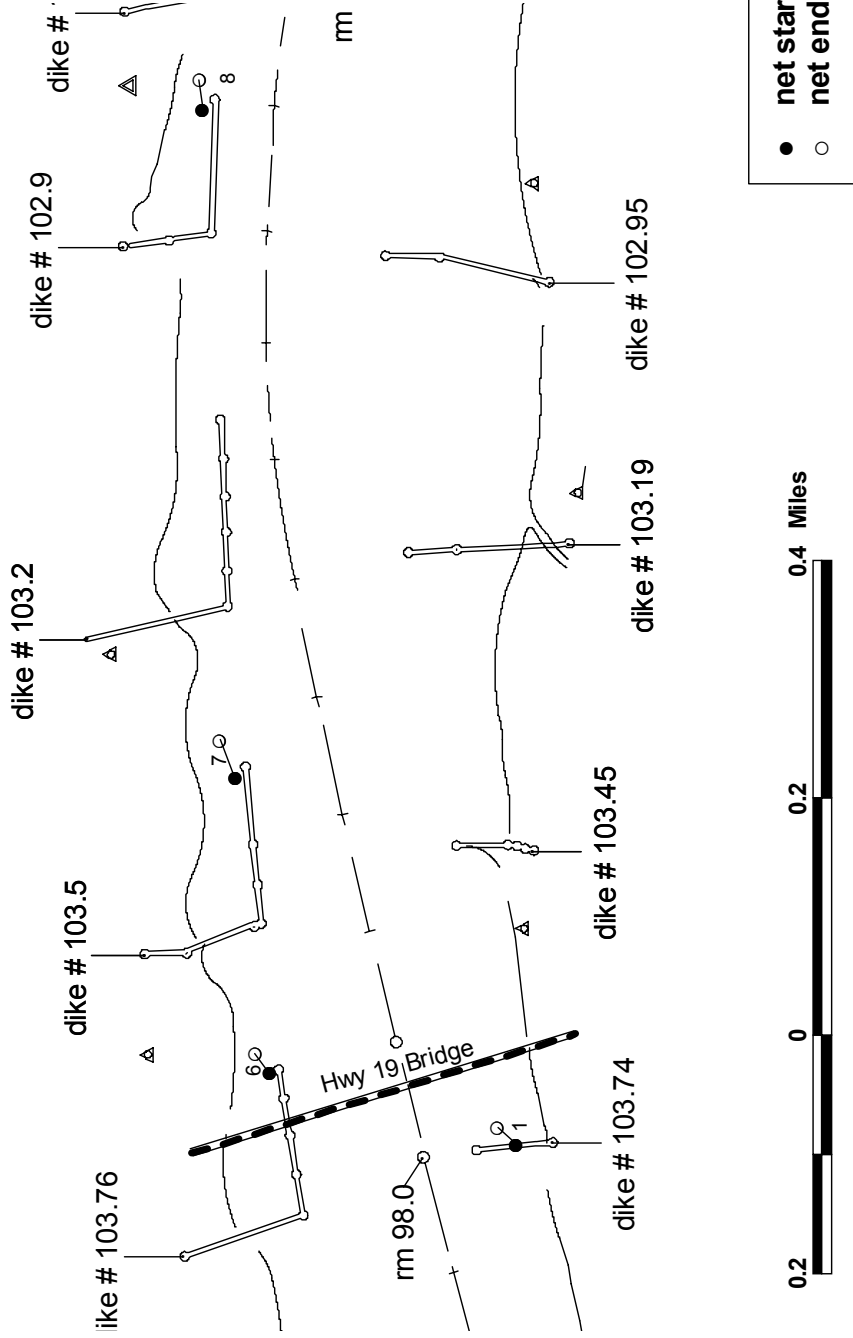
# February 2001 sampling sites



# March 2001 sampling sites



# March 2001 sampling sites



## Appendix B.

### Fish Catch by Month, Species and Net Number

#### Table Legend

**Gear Type:**

bt = benthic trawl  
lhn = large hoop net  
osgn = overnight stationary gill net  
ssgn = short-term stationary gill net

**Length (mm):**

Reported as an average for each net and species with the range in parentheses. Single number present when one fish was collected.

**CPUE (fish/hour):**

Catch Per Unit Effort

**Catch:**

number of fish collected in each net

**Weight (g):**

Reported as an average for each net and species with the range in parentheses. Single number present when one fish was collected. NA = Not Available - scale malfunction.

**Relative Abundance:**

Fish catch in each net reported as a percentage.

Table B1. Fish collected in the Route 19 Bridge Replacement Project Area in January 2000.

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.50	1	osgn	river carpsucker	2	354(353-	649(644-653)	0.03	33.3
			quillback carpsucker	1	314	455	0.01	16.7
			sauger	1	310	270	0.01	16.7
			freshwater drum	1	333	512	0.01	16.7
			mudpuppy	1	310	205	0.01	16.7
			Total	6		0.08		
103.20	2	osgn	shovelnose sturgeon	15	576(428-	787(343-1098)	0.21	65.2
			goldeye	2	251(249-	153(144-161)	0.03	8.7
			smallmouth buffalo	1	550	2575	0.01	4.4
			river carpsucker	4	458(400-	954(861-1044)	0.06	17.4
			freshwater drum	1	410	948	0.01	4.34
			Total	23		0.32		
101.60	3	osgn	shovelnose sturgeon	14	575(277-	751(83-1294)	0.15	100
			Total	14		0.15		
101.60	4	osgn	shovelnose sturgeon	98	581(295-	807(119-1432)	1.40	91.6
			pallid sturgeon hybrid	5	645(556-	968(596-1174)	0.07	4.7
			goldeye	2	221(188-	137(99-175)	0.03	1.9
			shorthead redhorse	1	254	160	0.01	0.9
			sauger	1	255	163	0.01	0.9
			Total	107		1.52		
103.74	5	osgn	shovelnose sturgeon	1	499	463	0.01	7.1
			pallid sturgeon hybrid	1	606	665	0.01	7.1
			river carpsucker	5	374(346-	701(543-972)	0.07	35.7
			river redhorse	1	193	85	0.01	7.1
			shorthead redhorse	4	295(218-	349(101-621)	0.05	28.6
			sauger	2	472(471-	1103(1044-	0.03	14.3
			Total	14		0.19		
104.05	6	osgn	shovelnose sturgeon	8	598(483-	836(434-1235)	0.11	61.5
			river carpsucker	1	394	754	0.01	7.7
			shorthead redhorse	1	471	632	0.01	7.7
			sauger	3	447(415-	1016(795-	0.04	23.1
			Total	13		0.19		

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
104.0	7	osgn	shovelnose sturgeon	20	591(473-	819(380-1518)	0.29	87.0
			pallid sturgeon hybrid	1	574	642	0.01	4.4
			river carpsucker	1	367	644	0.01	4.4
			shorthead redhorse	1	264	215	0.01	4.4
			Total	23			0.33	



Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.76	8	osgn	shovelnose sturgeon	15	562(477-	736(635-982)	0.21	68.2
			pallid sturgeon hybrid	1	552	599	0.01	4.6
			river carpsucker	3	381(352-	767(621-963)	0.04	13.6
			shorthead redhorse	1	375	640	0.01	4.6
			channel catfish	1	497	1031	0.01	4.6
			blue catfish	1	374	358	0.01	4.6
			Total	22			0.31	
101.3	9	osgn	shovelnose sturgeon	13	635(558-	914(622-1412)	0.18	86.7
			shorthead redhorse	2	414(397-	834(700-967)	0.03	13.3
			Total	15			0.21	
101.30	10	osgn	shovelnose sturgeon	28	586(485-	745(361-1139)	0.39	100
			Total	28			0.39	

Table B2. Fish collected in the Route 19 Bridge Replacement project area in February 2000.

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.74	1	osgn	shovelnose sturgeon	39	599(360-	824(164-1365)	0.55	84.8
			pallid sturgeon hybrid	1	591	777	0.01	2.2
			river carpsucker	2	358(353-	557(500-613)	0.03	4.4
			shorthead redhorse	1	213	113	0.01	2.2
			sauger	1	421	314	0.01	2.2
			freshwater drum	2	169(158-	62(48-75)	0.03	4.4
			Total	46			0.65	
104.05	2	osgn	shovelnose sturgeon	11	584(296-	809(110-1185)	0.16	73.3
			pallid sturgeon hybrid	1	655	1010	0.01	6.7
			river carpsucker	1	412	1047	0.01	6.7
			highfin carpsucker	1	332	489	0.01	6.7
			sauger	1	322	316	0.01	6.7
			Total	15			0.21	
104.40	3	osgn	shovelnose sturgeon	47	552(274-	707(98-1301)	0.67	100
			Total	47			0.67	
104.0	4	osgn	shovelnose sturgeon	32	606(320-	909(156-1477)	0.46	86.5
			river carpsucker	2	414(403-	957(864-1050)	0.03	5.4
			shorthead redhorse	2	234(233-	194(183-205)	0.03	5.4
			channel catfish	1	67	NA	0.01	2.7
			Total	37			0.53	
103.76	5	osgn	shovelnose sturgeon	14	562(417-	724(245-1156)	0.20	70.0
			pallid sturgeon hybrid	1	630	1090	0.01	5.0
			river carpsucker	1	430	1091	0.01	5.0
			shorthead redhorse	1	240	203	0.01	5.0
			blue catfish	1	460	832	0.01	5.0
			sauger	1	517	1520	0.01	5.0
			freshwater drum	1	316	455	0.01	5.0
			Total	20			0.28	
103.50	6	osgn	shovelnose sturgeon	17	586(511-	809(535-1009)	0.24	56.7
			smallmouth buffalo	1	405	890	0.01	3.3
			river carpsucker	4	414(394-	926(715-1070)	0.06	13.3
			shorthead redhorse	4	333(204-	664(96-1674)	0.06	13.3
			channel catfish	1	433	926	0.01	3.3

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
			sauger	2	430(420-	856(791-920)	0.03	6.7
			freshwater drum	1	363	623	0.01	3.3
			Total	30			0.42	

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.20	7	osgn	shovelnose sturgeon	10	547(350-	674(200-958)	0.14	66.7
			river carpsucker	3	399(377-	889(718-1019)	0.04	20.0
			shorthead redhorse	2	429(403-	1043(766-	0.03	13.3
			Total	15			0.21	
102.50	8	osgn	grass carp	1	595	3492	0.01	50.0
			blue catfish	1	235	NA	0.01	50.0
			Total	2			0.03	
102.4	9	osgn	shovelnose sturgeon	15	594(580-	861(554-1266)	0.21	62.5
			goldeye	2	311(270-	330(197-462)	0.03	8.3
			golden redhorse	1	204	104	0.01	4.2
			shorthead redhorse	6	342(220-	613(160-1029)	0.08	25.0
			Total	24			0.34	
102.90	10	osgn	shovelnose sturgeon	1	630	1007	0.01	9.1
			smallmouth buffalo	2	441(428-	1045(906-	0.03	18.2
			river carpsucker	6	396(372-	850(674-1036)	0.09	54.6
			channel catfish	1	430	780	0.01	9.1
			freshwater drum	1	338	492	0.01	9.1
			Total	11			0.16	

Table B3. Fish collected in the Route 19 Bridge Replacement project area in March 2000.

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.74	1	osgn	shovelnose sturgeon	11	546(315-	674(122-1165)	0.16	78.6
			gizzard shad	1	205	90	0.01	7.1
			river carpsucker	1	407	792	0.01	7.1
			freshwater drum	1	327	511	0.01	7.1
			Total	14		0.20		
104.05	2	osgn	shovelnose sturgeon	10	562(284-	780(75-1056)	0.14	25.6
			goldeye	10	250(222-	126(63-169)	0.14	25.6
			river carpsucker	11	406(368-	927(679-1231)	0.16	28.2
			golden redhorse	1	398	780	0.01	2.6
			shorthead redhorse	1	NA	NA	0.01	2.6
			black redhorse	1	205	120	0.01	2.6
			blue catfish	1	624	2838	0.01	2.6
			channel catfish	1	592	1900	0.01	2.6
			white bass	1	308	374	0.01	2.6
			sauger	1	259	139	0.01	2.6
			false map turtle	1	NA	NA	0.01	2.6
			Total	39		0.57		
104.40	3	osgn	shovelnose sturgeon	28	551(359-	664(132-1300)	0.40	96.6
			pallid sturgeon hybrid	1	701	1333	0.01	3.4
			Total	29		0.41		
104.0	4	osgn	shovelnose sturgeon	31	587(435-	830(309-1428)	0.44	51.7
			pallid sturgeon hybrid	1	630	1042	0.01	1.7
			goldeye	21	255(198-	145(90-481)	0.30	35.0
			river carpsucker	2	465(439-	1357(1258-	0.03	3.3
			shorthead redhorse	1	221	125	0.01	1.7
			blue catfish	2	414(368-	577(367-787)	0.03	3.3
			white bass	1	181	79	0.01	1.7
			sauger	1	325	NA	0.01	1.7
			Total	60		0.85		
103.76	5	osgn	shovelnose sturgeon	15	615(541-	945(651-1144)	0.21	65.2
			river carpsucker	8	406(335-	845(502-1130)	0.11	34.8
			Total	23		0.32		
103.76	6	osgn	shovelnose sturgeon	4	639(600-	932(798-1052)	0.06	25.0

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
			river carpsucker	10	389(320-	890(545-1357)	0.14	62.5
			shorthead redhorse	1	202	111	0.01	6.3
			channel catfish	1	682	1027	0.01	6.3
			Total	16			0.23	

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.50	7	osgn	shovelnose sturgeon	22	599(430-	820(228-1447)	0.31	91.7
			shorthead redhorse	1	300	227	0.01	4.2
			channel catfish	1	492	1053	0.01	4.2
			Total	24			0.34	
103.50	8	osgn	goldeye	2	224(205-	120(99-140)	0.03	14.3
			smallmouth buffalo	1	633	3733	0.01	7.1
			river carpsucker	6	440(418-	1130(942-	0.09	42.9
			white bass	1	174	103	0.01	7.1
			freshwater drum	4	335(320-	471(374-650)	0.06	28.6
			Total	14			0.20	
103.20	9	osgn	shovelnose sturgeon	13	541(284-	675(78-1046)	0.19	48.2
			goldeye	4	316(242-	346(121-559)	0.06	14.8
			river carpsucker	9	427(336-	1078(775-	0.13	33.3
			blue catfish	1	246	110	0.01	3.7
			Total	27			0.38	
103.20	10	osgn	shovelnose sturgeon	7	579(482-	759(418-940)	0.10	77.8
			blue catfish	1	467	756	0.01	11.1
			freshwater drum	1	364	692	0.01	11.1
			Total	9			0.13	
102.90	11	osgn	shovelnose sturgeon	6	608(515-	893(560-1325)	0.09	85.7
			river carpsucker	1	400	871	0.01	14.3
			Total	7			0.10	
104.0	12	osgn	river carpsucker	3	407(394-	932(804-1063)	1	37.5
			shorthead redhorse	1	210	94	0.01	12.5
			blue catfish	2	228(214-	82(68-95)	0.03	25.0
			sauger	2	247(241-	118(107-129)	0.03	25.0
			Total	8			0.11	

Table B4. Fish collected in the Route 19 Bridge Replacement project area in April 2000.

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.7 4	1	osgn	shovelnose	49	583(312-	790(113-1310)	0.71	87.5
			gizzard shad	1	367	460	0.01	1.8
			river carpsucker	5	414(391-	979(847-1085)	0.07	8.9
			freshwater drum	1	325	421	0.01	1.8
			Total	56		0.81		
104.0 5	2	osgn	chestnut lamprey	1	134	NA	0.01	3.3
			shovelnose	10	555(310-	667(67-1137)	0.14	33.3
			skipjack herring	2	401(395-	678(620-735)	0.03	6.7
			gizzard shad	1	328	377	0.01	3.3
			goldeye	1	250	78	0.01	3.3
			bigmouth buffalo	1	684	5315	0.01	3.3
			river carpsucker	11	404(350-	956(544-1296)	0.16	36.7
			blue catfish	1	682	3934	0.01	3.3
			white bass	2	368(313-	796(427-1165)	0.03	6.7
			Total	30		0.43		
104.4 0	3	osgn	shovelnose	11	551(340-	701(175-1483)	0.16	91.7
			smallmouth buffalo	1	625	3665	0.01	8.3
			Total	12		0.17		
104.1	4	osgn	shovelnose	6	485(340-	461(137-900)	0.09	60.0
			skipjack herring	1	436	813	0.01	10.0
			river carpsucker	1	400	768	0.01	10.0
			blue catfish	2	558(505-	1567(1102-	0.03	20.0
			Total	10		0.14		
104.0	5	osgn	shovelnose	45	604(497-	873(462-1230)	0.65	91.8
			river carpsucker	3	457(416-	1328(1054-	0.04	6.1
			smallmouth buffalo	1	627	4060	0.01	2.0
			Total	49		0.71		
103.7 6	6	osgn	shovelnose	16	573(434-	731(275-1013)	0.23	66.7
			common carp	1	628	4621	0.01	4.2
			river carpsucker	5	434(400-	1090(799-	0.07	20.8
			blue catfish	2	366(225-	607(88-1126)	0.03	8.3
			Total	24		0.35		



Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.5 0	7	osgn	shovelnose	29	615(478-	941(442-1445)	0.42	82.9
			river carpsucker	2	420(400-	1025(1010-	0.03	5.7
			blue catfish	1	243	112	0.01	2.9
			freshwater drum	3	329(325-	494(464-533)	0.04	8.6
			Total	35			0.50	
103.2 0	8	osgn	shovelnose	11	582(395-	799(182-1330)	0.16	61.1
			goldeye	1	370	544	0.01	5.6
			smallmouth buffalo	2	509(457-	2255(1352-	0.03	11.1
			river carpsucker	3	409(402-	990(912-1033)	0.04	16.7
			channel catfish	1	504	1244	0.01	5.6
			Total	18			0.26	
102.9 0	9	osgn	chestnut lamprey	1	NA	NA	0.01	2.4
			shovelnose	26	616(454-	1000(583-	0.38	61.9
			longnose gar	2	769(750-	1317(1299-	0.03	4.8
			goldeye	4	237(222-	120(100-142)	0.06	9.5
			river carpsucker	4	404(380-	982(751-1420)	0.06	9.5
			blue catfish	1	544	1388	0.01	2.4
			sauger	2	339(259-	431(145-716)	0.03	4.8
			false map turtle	2	NA	NA	0.03	4.8
			Total	42			0.61	
102.4 0	10	osgn	shovelnose	13	615(545-	960(615-1477)	0.19	68.4
			skipjack herring	2	420(412-	836(815-857)	0.03	10.5
			goldeye	2	432	884	0.03	10.5
			blue catfish	1	585	1780	0.01	5.3
			channel catfish	1	620	2452	0.01	5.3
			Total	19			0.27	
102.5 0	11	osgn	shovelnose	10	614(554-	839(657-1221)	0.14	71.4
			river carpsucker	2	393(384-	860(725-995)	0.03	14.3
			sauger	2	445(399-	902(663-1140)	0.03	14.3
			Total	14			0.20	
102.9 5	12	osgn	shovelnose	41	601(275-	908(142-2043)	0.60	89.1
			pallid sturgeon	1	785	1733	0.01	2.2
			blue sucker	1	440	884	0.01	2.2
			river carpsucker	1	404	1240	0.01	2.2
			blue catfish	1	248	163	0.01	2.2

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
			sauger	1	291	271	0.01	2.2
			Total	46			0.67	

Table B5. Fish collected in the Route 19 Bridge Replacement project area in May 2000.

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.74	1	osgn	shovelnose sturgeon	39	606(455-	861(375-1596)	0.55	60.9
			longnose gar	2	984(788-	3068(1128-	0.03	3.1
			common carp	1	478	1811	0.01	1.6
			river carpsucker	14	415(352-	1052(572-	0.20	21.9
			highfin carpsucker	1	420	946	0.01	1.6
			channel catfish	1	341	320	0.01	1.6
			flathead catfish	1	235	134	0.01	1.6
			striped bass	2	316(280-	403(222-584)	0.03	3.1
			white bass	1	196	120	0.01	1.6
			freshwater drum	2	293(192-	478(116-839)	0.03	3.1
			Total	64			0.90	
104.05	2	osgn	chestnut lamprey	1	122	NA	0.01	2.8
			shovelnose sturgeon	14	586(510-	737(483-1072)	0.20	38.9
			longnose gar	1	928	2208	0.01	2.8
			goldeye	1	323	410	0.01	2.8
			common carp	1	538	2427	0.01	2.8
			river carpsucker	9	401(360-	958(624-1463)	0.13	25.0
			channel catfish	1	590	2126	0.01	2.8
			white bass	1	412	956	0.01	2.8
			sauger	1	260	143	0.01	2.8
			freshwater drum	6	291(170-	411(72-716)	0.08	16.7
			Total	36			0.50	
104.85	3	osgn	shovelnose sturgeon	19	526(338-	588(102-1066)	0.27	36.5
			longnose gar	1	777	1219	0.01	1.9
			goldeye	2	333(332-	436	0.03	3.8
			common carp	1	490	1612	0.01	1.9
			river carpsucker	23	409(350-	964(307-2158)	0.32	44.2
			highfin carpsucker	1	337	437	0.01	1.9
			blue catfish	2	236(232-	108(99-116)	0.03	3.8
			channel catfish	1	500	1432	0.01	1.9
			sauger	1	450	827	0.01	1.9
			freshwater drum	1	357	620	0.01	1.9
			Total	52			0.73	

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
104.4	4	osgn	shovelnose sturgeon	13	516(385-	496(209-990)	0.18	68.4
			pallid sturgeon hybrid	1	487	400	0.01	5.3
			river carpsucker	3	418(395-	1053(846-	0.04	15.8
			blue catfish	1	570	1648	0.01	5.3
			freshwater drum	1	325	250	0.01	5.3
			Total	19			0.27	
104.0	5	osgn	shovelnose sturgeon	19	573(481-	772(378-1195)	0.26	50
			shortnose gar	2	644(641-	883(822-943)	0.03	5.3
			gizzard shad	1	336	438	0.01	2.6
			common carp	2	431(402-	1031(824-	0.03	5.3
			river carpsucker	6	413(379-	1049(721-	0.08	15.8
			blue catfish	1	511	1036	0.01	2.6
			freshwater drum	7	342(310-	535(414-768)	0.10	18.4
			Total	38			0.52	
103.76	6	osgn	shovelnose sturgeon	25	570(467-	752(463-1139)	0.35	54.3
			shortnose gar	1	743	1347	0.01	2.2
			common carp	3	564(525-	2871(2498-	0.04	6.5
			river carpsucker	6	378(348-	795(641-961)	0.08	13.0
			freshwater drum	11	369(292-	735(367-2235)	0.15	23.9
			Total	46			0.64	
103.5	7	osgn	shovelnose sturgeon	18	588(482-	848(423-1490)	0.25	54.5
			pallid sturgeon hybrid	1	640	1046	0.01	3.0
			longnose gar	2	917(902-	2090(1841-	0.03	6.1
			goldeye	2	317(313-	316(310-321)	0.03	6.1
			smallmouth buffalo	1	695	5660	0.01	3.0
			river carpsucker	3	424(379-	1135(828-	0.04	9.1
			blue catfish	2	390(237-	697(146-1248)	0.03	6.1
			sauger	1	385	543	0.01	3.0
			freshwater drum	3	385(283-	903(285-1770)	0.04	9.1
			Total	33			0.46	
103.2	8	osgn	shovelnose sturgeon	13	581(437-	861(580-1325)	0.18	48.1
			common carp	1	396	788	0.01	3.7
			river carpsucker	2	376(360-	789(705-873)	0.03	7.4
			channel catfish	2	440(320-	1001(318-	0.03	7.4

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
			blue catfish	2	551(531-	1521(1418-	0.03	7.4
			sauger	1	342	453	0.01	3.7
			freshwater drum	6	273(163-	349(80-572)	0.08	22.2
			Total	27			0.37	

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
102.9	9	osgn	shovelnose sturgeon	15	545(463-	649(328-1063)	0.21	41.7
			longnose gar	6	811(747-	1433(1022-	0.08	16.7
			common carp	2	615(425-	4811(1078-	0.03	5.6
			river carpsucker	7	411(347-	950(550-1258)	0.10	19.4
			channel catfish	1	616	2461	0.01	2.8
			blue catfish	1	455	832	0.01	2.8
			white bass	1	188	120	0.01	2.8
			bluegill	1	172	168	0.01	2.8
			freshwater drum	2	376(364-	740(616-864)	0.03	5.6
			Total	36			0.49	
102.95	10	osgn	shovelnose sturgeon	22	548(290-	764(65-1954)	0.30	66.7
			black buffalo	1	522	2515	0.01	3
			river carpsucker	7	389(350-	863(490-1159)	0.10	21.2
			shorthead redhorse	1	442	1235	0.01	3.0
			channel catfish	2	330(223-	577(194-960)	0.03	6.1
			Total	33			0.45	

Table B6. Fish collected in the Route 19 Bridge Replacement project area in June 2000.

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.74	1	osgn	shovelnose sturgeon	1	451	309	0.01	33.3
			smallmouth buffalo	1	505	2716	0.01	33.3
			freshwater drum	1	184	21	0.01	33.3
			Total	3			0.04	
104.05	2	osgn	shovelnose sturgeon	4	601(563-641)	732(583-943)	0.06	16.0
			longnose gar	3	1032(960-	3275(2459-	0.04	12.0
			gizzard shad	1	311	256	0.01	4.0
			goldeye	1	209	133	0.01	4.0
			common carp	1	572	2737	0.01	4.0
			river carpsucker	7	405(377-432)	904(708-1098)	0.10	28.0
			highfin carpsucker	1	361	609	0.01	4.0
			blue catfish	1	265	185	0.01	4.0
			white bass	1	346	531	0.01	4.0
			freshwater drum	5	302(190-354)	369(32-542)	0.07	20.0
Total	25			0.35				
104.85	3	osgn	shovelnose sturgeon	9	629(571-710)	1024(688-	0.13	56.3
			longnose gar	1	802	1333	0.01	6.3
			shortnose gar	1	734	1035	0.01	6.3
			gizzard shad	1	380	467	0.01	6.3
			blue catfish	2	623(578-667)	2694(2121-	0.03	12.5
			black crappie	1	192	87	0.01	6.3
			freshwater drum	1	365	513	0.01	6.3
			Total	16			0.22	
104.4	4	osgn	shovelnose sturgeon	6	507(415-677)	421(214-604)	0.08	66.7
			longnose gar	1	841	1484	0.01	11.1
			smallmouth buffalo	1	551	2882	0.01	11.1
			freshwater drum	1	357	648	0.01	11.1
			Total	9			0.13	
104.0	5	osgn	shovelnose sturgeon	17	601(458-665)	966(608-1495)	0.24	70.8
			shortnose gar	1	644	913	0.01	4.2
			smallmouth buffalo	2	611(579-643)	2160(1191-	0.03	8.3
			blue catfish	1	274	121	0.01	4.2
			sauger	1	322	265	0.01	4.2

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
			freshwater drum	2	171(165-177)	63(34-91)	0.03	8.3
			Total	24			0.34	



Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.76	6	osgn	shovelnose sturgeon	2	445(396-494)	310(191-428)	0.03	10.5
			common carp	3	474(446-504)	1313(1103-	0.04	15.8
			smallmouth buffalo	1	628	4728	0.01	5.3
			river carpsucker	9	400(357-442)	924(617-1383)	0.13	47.4
			freshwater drum	4	294(186-335)	396(64-554)	0.06	21.1
			Total	19			0.27	
103.5	7	osgn	shovelnose sturgeon	14	601(396-671)	896(424-1268)	0.20	46.7
			shortnose gar	1	631	810	0.01	3.3
			longnose gar	2	682(644-719)	772(617-927)	0.03	6.7
			goldeye	6	258(203-404)	124(88-218)	0.08	20.0
			common carp	2	527(513-541)	1922(1752-	0.03	6.7
			river carpsucker	3	419(392-449)	1085(857-	0.04	10.0
			channel catfish	1	247	118	0.01	3.3
			freshwater drum	1	306	394	0.01	3.3
Total	30			0.42				
103.2	8	osgn	shovelnose sturgeon	4	596(564-618)	857(734-1010)	0.06	33.3
			longnose gar	1	1132	6694	0.01	8.3
			river carpsucker	3	404(388-416)	843(798-881)	0.04	25.0
			blue catfish	1	334	304	0.01	8.3
			channel catfish	1	306	244	0.01	8.3
			freshwater drum	2	363(348-377)	655(593-716)	0.03	16.7
			Total	12			0.17	
102.9	9	osgn	shovelnose sturgeon	9	572(508-645)	742(535-1037)	0.13	56.3
			shortnose gar	2	755(736-774)	1596(1486-	0.03	12.5
			river carpsucker	3	417(412-422)	921(828-1056)	0.04	18.8
			freshwater drum	2	368(172-564)	1419(83-2755)	0.03	12.5
			Total	16			0.22	
102.5	10	lhn	longnose gar	1	876	1893	0.01	10.0
			gizzard shad	1	301	197	0.01	10.0
			common carp	3	428(344-529)	1269(529-	0.04	30.0
			river carpsucker	1	455	1283	0.01	10.0
			white bass	1	341	516	0.01	10.0
			white crappie	1	367	768	0.01	10.0
			black crappie	1	333	609	0.01	10.0
			freshwater drum	1	382	824	0.01	10.0

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
			Total	10			0.14	

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
102.95	11	osgn	shovelnose sturgeon	11	569(417-651)	711(202-1095)	0.15	61.1
			common carp	1	489	1341	0.01	5.6
			blue catfish	1	264	129	0.01	5.6
			channel catfish	2	548(452-644)	1021(984-	0.03	11.1
			flathead catfish	1	442	871	0.01	5.6
			freshwater drum	2	293(181-404)	429(32-826)	0.03	11.1
			Total	18			0.25	

Table B7. Fish collected in the Route 19 Bridge Replacement project area in July 2000.

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.74	1	ssgn	bigmouth buffalo	1	406	1080	0.04	100
			Total	1			0.04	
104.05	2	ssgn	shovelnose sturgeon	9	594(526-	800(548-1247)	0.39	82.0
			longnose gar	1	854	1671	0.04	9.1
			freshwater drum	1	202	92	0.04	9.1
			Total	11			0.47	
104.4	3	ssgn	shovelnose sturgeon	1	547	559	0.04	100
			Total	1			0.04	
104.1	4	ssgn	paddlefish	1	145	27	0.04	100
			Total	1			0.04	
104.0	5	ssgn	smallmouth buffalo	1	458	1517	0.04	20.0
			shortnose gar	1	529	406	0.04	20.0
			longnose gar	2	850(695-	1894(737-	0.09	40.0
			freshwater drum	1	174	52	0.04	20.0
			Total	5			0.22	
103.76	6	ssgn	shovelnose sturgeon	2	628(596-	889(679-1098)	0.09	100
			Total	2			0.09	
103.5	7	ssgn	shortnose gar	1	691	1193	0.09	33.3
			smallmouth buffalo	2	500(475-	1807(1384-	0.04	66.7
			Total	3			0.13	
103.2	8	ssgn	shovelnose sturgeon	2	709(708-	1556(1509-	0.09	66.7
			freshwater drum	1	341	563	0.04	33.3
			Total	3			0.13	
102.9	9	ssgn	shovelnose sturgeon	2	512(468-	495(358-632)	0.09	33.3
			smallmouth buffalo	1			0.04	66.7
			Total	3			0.13	
102.5	10	ssgn	shovelnose sturgeon	1	649	958	0.04	50.0
			blue catfish	1	214	87	0.04	50.0
			Total	2			0.09	
103.74	20	ssgn	freshwater drum	2	229(175-	185(67-303)	0.34	100
			Total	2			0.34	
104.05	21	ssgn	shovelnose sturgeon	2	627(561-	1002(743-	0.36	100
			Total	2			0.36	

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.5	25	ssgn	longnose gar	1	1113	3982	0.18	50.0
			smallmouth buffalo	1	414	1010	0.18	50.0
			Total	2			0.37	
102.9	27	ssgn	smallmouth buffalo	1	351	562	0.16	100
			Total	1			0.16	

Table B8. Fish collected in the Route 19 Bridge Replacement project area in August 2000.

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.74	1	lhn	flathead catfish	1	845	7252	0.01	100
			total	1			0.01	
104.05	2	lhn	river carpsucker	1	420	895	0.01	100
			total	1			0.01	
104.0	3	lhn	freshwater drum	1	299	318	0.01	100
			total	1			0.01	
103.2	6	lhn	channel catfish	1	609	2543	0.01	50.0
			freshwater drum	1	218	114	0.01	50.0
			total	2			0.03	
102.95	7	lhn	bighead carp	1	719	3700	0.01	50.0
			flathead catfish	1	615	2765	0.01	50.0
			total	2			0.03	
---	8	bt	chestnut lamprey	1	172	NA	---	2.0
			shovelnose sturgeon	1	438	245	---	2.0
			silver chub	1	33	NA	---	2.0
			channel catfish	5	83(50-133)	NA	---	10.2
			blue catfish	40	53(24-180)	NA	---	81.6
			freshwater drum	1	67	NA	---	2.0
			total	49			---	
---	9	bt	speckled chub	2	42(40-43)	NA	---	9.5
			sturgeon chub	3	43(33-49)	NA	---	14.3
			channel catfish	10	58(33-89)	13	---	47.6
			blue catfish	5	67(31-167)	31	---	23.8
			tadpole madtom	1	43	NA	---	4.8
			total	21			---	
---	10	bt	silver chub	1	35	NA	---	5.3

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
			sturgeon chub	3	45(43-49)	NA	---	15.8
			channel catfish	6	58(29-109)	NA	---	31.6
			blue catfish	9	58(44-65)	NA	---	47.4
			total	19			---	
---	11	bt	goldeye	2	69(66-71)	NA	---	13.3
			sturgeon chub	4	48(39-56)	NA	---	26.7
			channel catfish	3	50(38-58)	NA	---	20.0
			blue catfish	6	54(43-59)	NA	---	40.0
			total	15			---	
---	12	bt	channel catfish	3	50(47-53)	NA	---	50.0
			blue catfish	3	87(56-153)	NA	---	50.0
			total	6			---	
102.95	13	ssgn	gizzard shad	4	199(180-	43(21-83)	1.90	57.1
			goldeye	1	236	84	0.48	14.3
			longnose gar	2	710(668-	1034(775-	0.95	28.6
			Total	7			3.33	
102.95	14	ssgn	gizzard shad	1	209	92	0.44	9.1
			goldeye	8	251(219-	167(89-602)	3.56	72.7
			longnose gar	1	700	776	0.44	9.1
			shortnose gar	1	591	666	0.44	9.1
			Total	11			4.89	
103.5	15	ssgn	gizzard shad	1	366	435	NA	33.3
			river carpsucker	2	447(432-	1078(1043-	NA	66.7
			Total	3			NA	
----	16	ssgn	gizzard shad	1	208	105	0.41	33.3
			goldeye	2	235(233-	118(114-121)	0.82	66.7
			Total	3			1.22	

Table B9. Fish collected in the Route 19 Bridge Replacement project area in September 2000.

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.74	1	osgn	shovelnose sturgeon	1	624	893	0.01	12.5
			longnose gar	2	743(734-	1303(1153-	0.03	25.0
			shortnose gar	2	561(532-	717(534-900)	0.03	25.0
			gizzard shad	1	357	435	0.01	12.5
			river carpsucker	1	437	1030	0.01	12.5
			freshwater drum	1	445	1240	0.01	12.5
			Total	8			0.11	
104.05	2	osgn	shovelnose sturgeon	20	587(500-	711(517-1484)	0.28	66.7
			longnose gar	1	924	2072	0.01	3.3
			gizzard shad	5	343(334-	465(424-518)	0.07	16.7
			common carp	1	500	1685	0.01	3.3
			river carpsucker	1	464	1310	0.01	3.3
			blue catfish	1	340	323	0.01	3.3
			freshwater drum	1	180	90	0.01	3.3
Total	30			0.41				
104.85	3	osgn	shovelnose sturgeon	6	525(415-	556(211-830)	0.08	75.0
			gizzard shad	1	339	393	0.01	12.5
			freshwater drum	1	354	632	0.01	12.5
			Total	8			0.11	
104.4	4	osgn	shovelnose sturgeon	4	508(440-	502(279-819)	0.06	66.7
			longnose gar	1	775	1150	0.01	16.7
			river carpsucker	1	378	803	0.01	16.7
			Total	6			0.08	
104.0	5	osgn	shovelnose sturgeon	8	579(535-	738(560-1039)	0.11	53.3
			paddlefish	1	215	192	0.01	6.7
			smallmouth buffalo	2	437(319-	2591(2452-	0.03	13.3
			blue catfish	4	432(235-	840(95-1402)	0.06	26.7
			Total	15			0.21	
103.76	6	osgn	shovelnose sturgeon	7	564(432-	711(318-1017)	0.09	87.5
			smallmouth buffalo	1	463	1612	0.01	12.5
			Total	8			0.11	
103.5	7	osgn	shovelnose sturgeon	23	573(409-	733(235-1235)	0.31	100
			Total	23			0.31	

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.2	8	osgn	shovelnose sturgeon	5	575(530-	775(627-992)	0.07	55.6
			blue sucker	1	594	2118	0.01	11.1
			channel catfish	1	266	130	0.01	11.1
			flathead catfish	1	242	118	0.01	11.1
			freshwater drum	1	223	135	0.01	11.1
			Total	9			0.12	
102.5	9	osgn	shovelnose sturgeon	2	550(505-	588(530-645)	0.08	50.0
			shortnose gar	1	641	955	0.04	25.0
			channel catfish	1	107	NA	0.04	25.0
			Total	4			0.15	
102.95	10	osgn	shovelnose sturgeon	5	597(533-	867(720-1024)	0.10	62.5
			river carpsucker	2	438(420-	1052(1024-	0.04	25.0
			blue catfish	1	245	108	0.02	12.5
			Total	8			0.16	
102.95	11	osgn	shovelnose sturgeon	4	577(539-	743(668-851)	0.06	66.7
			flathead catfish	2	451(424-	1003(825-	0.03	33.3
			Total	6			0.08	



Table B10. Fish collected in the Route 19 Bridge Replacement project area in October 2000.

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.74	1	osgn	shovelnose sturgeon	24	551(360-	663(141-	0.34	94.4
			river carpsucker	1	415	947	0.01	5.6
			Total	25			0.35	
104.05	2	osgn	shovelnose sturgeon	26	563(297-	707(84-1080)	0.35	100
			Total	26			0.35	
104.85	3	osgn	shovelnose sturgeon	15	594(534-	749(503-	0.21	93.8
			blue catfish	1	511	1177	0.01	6.3
			Total	16			0.22	
104.4	4	osgn	shovelnose sturgeon	22	597(437-	771(215-	0.31	100
			Total	22			0.31	
104.0	5	osgn	shovelnose sturgeon	40	567(283-	773(85-1267)	0.56	93.0
			black redhorse	1	265	204	0.01	2.3
			river carpsucker	1	437	1104	0.01	2.3
			blue catfish	1	670	2637	0.01	2.3
			Total	43			0.60	
103.76	6	osgn	shovelnose sturgeon	23	588(463-	751(397-	0.32	100
			Total	23			0.32	
103.5	7	osgn	shovelnose sturgeon	19	577(382-	786(197-	0.26	100
			Total	19			0.26	
103.2	8	osgn	shovelnose sturgeon	10	571(433-	759(254-	0.14	100
			Total	10			0.14	
102.9	9	osgn	shovelnose sturgeon	53	549(318-	681(141-	0.73	100
			Total	53			0.73	
102.5	10	osgn	shovelnose sturgeon	6	531(405-	631(193-	0.08	54.5
			longnose gar	1	1060	3693	0.01	9.1
			gizzard shad	1	181	NA	0.01	9.1
			channel catfish	1	155	42	0.01	9.1
			river carpsucker	2	394(392-	893(854-932)	0.03	18.2
			Total	11			0.15	
102.95	11	osgn	shovelnose sturgeon	5	559(459-	662(391-970)	0.20	83.3
			longnose gar	1	1350	9800	0.04	16.7
			Total	6			0.24	



Table B11. Fish collected in the Route 19 Bridge Replacement project area in November 2000.

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.74	1	osgn	shovelnose sturgeon	64	559(276-	733(25-	0.90	84.2
			goldeye	8	198(174-	103(30-192)	0.11	10.5
			gizzard shad	1	182	49	0.01	1.3
			river carpsucker	1	455	NA	0.01	1.3
			blue catfish	1	246	144	0.01	1.3
			freshwater drum	1	163	NA	0.01	1.3
			Total	76			1.07	
104.05	2	osgn	shovelnose sturgeon	76	568(284-	767(299-	1.07	91.6
			goldeye	2	198(193-	NA	0.03	2.4
			shorthead redhorse	2	228(223-	NA	0.03	2.4
			channel catfish	1	210	89	0.01	1.2
			blue catfish	2	218(202-	NA	0.03	2.4
			Total	83			1.17	
104.85	3	osgn	shovelnose sturgeon	130	588(375-	780(352-	1.82	92.9
			goldeye	1	292	NA	0.01	0.7
			blue catfish	9	313(205-	590(573-	0.13	6.4
			Total	140			1.96	
104.4	4	osgn	shovelnose sturgeon	53	569(407-	781(307-	0.74	85.5
			paddlefish	1	760	5263	0.01	1.6
			goldeye	5	259(193-	159(56-201)	0.07	8.1
			blue catfish	3	336(232-	816(119-	0.04	4.8
			Total	62			0.87	
104.0	5	osgn	shovelnose sturgeon	23	555(327-	708(336-	0.32	85.2
			pallid sturgeon	1	761	NA	0.01	3.7
			goldeye	1	194	NA	0.01	3.7
			river carpsucker	1	418	965	0.01	3.7
			freshwater drum	1	168	NA	0.01	3.7
			Total	27			0.38	
103.76	6	osgn	shovelnose sturgeon	3	588(537-	781(591-	0.04	25.0
			gizzard shad	1	350	424	0.01	8.3
			goldeye	2	232(194-	66	0.03	16.7
			white sucker	1	400	672	0.01	8.3
			river carpsucker	1	373	NA	0.01	8.3

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
			shorthead redhorse	1	218	NA	0.01	8.3
			blue catfish	2	198(195-	NA	0.03	16.7
			sauger	1	330	NA	0.01	8.3
			Total	12			0.17	

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.5	7	osgn	shovelnose sturgeon	12	582(461-	784(356-	0.17	75.0
			goldeye	2	320(295-	NA	0.03	12.5
			smallmouth buffalo	1	501	1852	0.01	6.3
			river carpsucker	1	361	NA	0.01	6.3
			Total	16			0.22	
103.2	8	osgn	shovelnose sturgeon	3	523(470-	400(397-	0.04	8.1
			gizzard shad	2	160	NA	0.03	5.4
			goldeye	16	219(175-	113(66-201)	0.22	43.2
			common carp	1	463	1473	0.01	2.7
			white sucker	2	400	675	0.03	5.4
			river carpsucker	2	425	1043	0.03	5.4
			channel catfish	1	240	97	0.01	2.7
			blue catfish	1	233	NA	0.01	2.7
			white bass	2	333(315-	NA	0.03	5.4
			sauger	1	342	340	0.01	2.7
			freshwater drum	5	155-310	362	0.07	13.5
			map turtle	1	NA	NA	0.01	2.7
Total	37			0.52				
102.9	9	osgn	shovelnose sturgeon	29	557(423-	700(239-	0.40	87.9
			goldeye	3	259(188-	NA	0.04	9.1
			sauger	1	360	NA	0.01	3.0
			Total	33			0.46	
102.5	10	osgn	shovelnose sturgeon	12	528(169-	697(177-	0.23	60.0
			goldeye	2	234(194-	NA	0.04	10.0
			river carpsucker	1	354	NA	0.02	5.0
			black crappie	1	184	NA	0.02	5.0
			sauger	2	397(371-	NA	0.04	10.0
			freshwater drum	2	349(214-	NA	0.04	10.0
			Total	20			0.39	
102.95	11	osgn	shovelnose sturgeon	8	549(329-	NA	0.29	100
			Total	8			0.29	

Table B12. Fish collected in the Route 19 Bridge Replacement project area in February 2001.

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.74	1	osgn	shovelnose sturgeon	11	546(403-655)	732(263-1293)	0.24	44.0
			gizzard shad	1	195	92	0.02	4.0
			goldeye	2	186(185-186)	78(72-83)	0.04	8.0
			blue sucker	1	453	1355	0.02	4.0
			white sucker	1	435	1095	0.02	4.0
			shorthead redhorse	3	217(210-222)	115(87-143)	0.06	12.0
			river carpsucker	1	389	802	0.02	4.0
			blue catfish	1	535	1488	0.02	4.0
			sauger	4	446(398-493)	1002(700-1274)	0.09	16.0
			total	25			0.53	
104.05	2	osgn	smallmouth buffalo	1	550	2542	0.02	33.3
			river carpsucker	1	462	1383	0.02	33.3
			blue catfish	1	747	2556	0.02	33.3
			total	3			0.06	
104.85	3	osgn	shovelnose sturgeon	5	582(450-666)	878(445-1175)	0.11	27.8
			goldeye	7	222(180-353)	85(44-154)	0.15	38.9
			shorthead redhorse	2	324(227-421)	461(97-825)	0.04	11.1
			blue catfish	4	401(258-580)	663(114-1591)	0.09	22.2
			total	18			0.38	
104.4	4	osgn	shovelnose sturgeon	9	578(510-657)	877(566-1355)	0.19	90.0
			shorthead redhorse	1	222	118	0.02	10.0
			total	10			0.21	
104.0	5	osgn	shovelnose sturgeon	1	556	691	0.02	14.3
			gizzard shad	1	373	530	0.02	14.3
			smallmouth buffalo	4	546(505-594)	2608(1974-3465)	0.09	57.1
			river carpsucker	1	437	1125	0.02	14.3
			total	7			0.15	
103.76	6	osgn	shovelnose sturgeon	5	361(212-460)	204(20-365)	0.11	38.5
			river carpsucker	3	395(353-437)	792(606-977)	0.06	23.1
			shorthead redhorse	3	223(215-238)	98(88-112)	0.06	23.1
			channel catfish	1	458	1038	0.02	7.7
			freshwater drum	1	169	49	0.02	7.7
			total	13			0.27	

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.5	7	osgn	grass carp	1	672	3300	0.02	14.3
			smallmouth buffalo	1	570	3206	0.02	14.3
			river carpsucker	3	465(446-480)	1313(1177-1390)	0.06	42.9
			blue catfish	1	632	2212	0.02	14.3
			walleye	1	545	2271	0.02	14.3
			total	7			0.15	
102.9	8	osgn	shovelnose sturgeon	2	423(300-545)	391(92-690)	0.04	33.3
			goldeye	1	265	216	0.02	16.7
			shorthead redhorse	3	324(214-391)	509(131-739)	0.06	50.0
			total	6			0.13	

Table B13. Fish collected in the Route 19 Bridge Replacement project area in March 2001.

Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
103.74	1	osgn	paddlefish	1	504	1534	0.01	2.2
			shovelnose sturgeon	38	537(278-	744(15-1301)	0.53	84.4
			channel catfish	2	224(175-	149	0.03	4.4
			blue catfish	1	698	3257	0.01	2.2
			sauger	1	229	112	0.01	2.2
			freshwater drum	2	334(241-	1074	0.03	4.4
			Total	45			0.63	
104.05	2	osgn	shovelnose sturgeon	19	624(496-	1164(167-	0.27	70.4
			lake sturgeon	1	796	3576	0.01	3.7
			blue sucker	2	593(556-	2352(1644-	0.03	7.4
			blue catfish	4	617(590-	2267(1970-	0.06	14.8
			freshwater drum	1	585	2916	0.01	3.7
			Total	27			0.38	
104.85	3	osgn	shovelnose sturgeon	2	589(547-	961(714-1207)	0.08	40.0
			common carp	1	602	3677	0.04	20.0
			smallmouth buffalo	1	569	2756	0.04	20.0
			freshwater drum	1	475	NA	0.04	20.0
			Total	5			0.20	
104.4	4	osgn	shovelnose sturgeon	2	689(657-	1332(1048-	0.03	40.0
			channel catfish	2	127(75-178)	50	0.03	40.0
			freshwater drum	1	191	NA	0.01	20.0
			Total	5			0.07	
104.0	5	osgn	shovelnose sturgeon	23	581(297-	978(70-1800)	0.32	88.5
			blue sucker	1	718	4290	0.01	3.8
			smallmouth buffalo	2	557(531-	2957(2369-	0.03	7.7
			Total	26			0.36	
103.76	6	osgn	shovelnose sturgeon	19	550(230-	797(50-1311)	0.27	79.2
			river carpsucker	1	394	790	0.01	4.2
			blue catfish	2	241(232-	105(99-110)	0.03	8.3
			sauger	2	254(247-	118	0.03	8.3
			Total	24			0.34	
103.5	7	osgn	shovelnose sturgeon	3	633(608-	1047(958-	0.04	27.3
			blue sucker	3	718(664-	4605(3442-	0.04	27.3



Dike #	Net #	Gear Type	Species	Catch	Length (mm)	Weight (g)	CPUE (fish/hour)	Relative Abundance
			northern hogsucker	1	352	481	0.01	9.1
			river carpsucker	1	460	1313	0.01	9.1
			smallmouth buffalo	2	540(525-	2572(2356-	0.03	18.2
			blue catfish	1	229	NA	0.01	9.1
			Total	11			0.15	
102.9	8	osgn	paddlefish	1	720	6240	0.01	10.0
			shovelnose sturgeon	4	627(570-	1117(746-	0.06	40.0
			goldeye	1	191	NA	0.01	10.0
			blue catfish	1	609	2063	0.01	10.0
			smallmouth buffalo	1	515	2146	0.01	10.0
			sauger	1	438	NA	0.01	10.0
			freshwater drum	1	367	594	0.01	10.0
			Total	10			0.14	

## **Appendix C. Water Quality Parameters**

### **Table Legend**

#### **Gear Type:**

bt = benthic trawl

dtn = drifting trammel net

lhn = large hoop net

osgn = overnight stationary gill net

ssgn = short-term stationary gill net

sn = seine

Table C1. Water quality parameters at nets set in the Route 19 Bridge Replacement project area in January 2000.

Dike #	Net #	Gear Type	Minimum Depth (m)	Maximum Depth (m)	Turbidity (NTU)	Temperature (C)	Conductivity ( $\mu$ S)	Column Velocity (m/s)	Bottom Velocity (m/s)
103.50	1	osgn	1.7	3.5	7.0	6.0	504	NA	0.02
103.20	2	osgn	NA	4.2	20.7	5.2	500	0.07	0.04
101.60	3	osgn	2.3	3.7	22.0	4.6	491	0.24	0.15
101.60	4	osgn	3.1	8.0	16.3	5.0	498	0.06	0.07
103.74	5	osgn	3.1	4.8	20.0	4.7	463	0.02	0.05
104.05	6	osgn	1.8	10.1	25.3	5.0	470	0.36	0.20
104.0	7	osgn	2.4	6.7	23.3	4.8	496	0.17	0.04
103.76	8	osgn	2.7	6.1	24.0	4.9	496	0.28	0.03
101.3	9	osgn	1.7	6.4	21.0	4.9	497	0.15	0.07
101.30	10	osgn	3.6	11.3	22.7	5.2	500	0.11	0.08

Table C2. Water quality parameters at nets set in the Route 19 Bridge Replacement project area in February 2000.

Dike #	Net #	Gear Type	Minimum Depth (m)	Maximum Depth (m)	Turbidity (NTU)	Temperature (C)	Conductivity ( $\mu$ S)	Column Velocity (m/s)	Bottom Velocity (m/s)
103.74	1	osgn	2.3	4.9	14.3	6.0	453	0.20	0.28
104.05	2	osgn	1.9	3.8	13.3	5.4	454	0.29	0.29
104.40	3	osgn	1.7	4.3	13.7	5.5	516	0.16	0.16
104.0	4	osgn	3.6	7.0	14.7	5.2	515	0.06	-0.01
103.76	5	osgn	2.2	5.1	16.3	5.6	516	0.15	0.24
103.5	6	osgn	2.0	6.2	15.0	5.5	537	0.12	0.16
103.2	7	osgn	1.4	3.1	14.7	5.4	514	0.11	0.11
102.5	8	osgn	1.4	5.7	13.7	5.7	458	0.12	0.07
102.4	9	osgn	2.5	7.4	15	5.4	514	0.19	0.07
102.90	10	osgn	1.5	3.3	11.7	5.6	518	0.11	0.07

Table C3. Water quality parameters at nets set in the Route 19 Bridge Replacement project area in March 2000.

Dike #	Net #	Gear Type	Minimum Depth (m)	Maximum Depth (m)	Turbidity (NTU)	Temperature (C)	Conductivity ( $\mu$ S)	Column Velocity (m/s)	Bottom Velocity (m/s)
103.74	1	osgn	2.3	4.8	39.7	11.3	501	0.21	0.10
104.05	2	osgn	2.4	5.2	39.3	10.8	499	0.36	0.38
104.40	3	osgn	1.6	10.7	44.0	11.0	566	0.12	0.11
104.0	4	osgn	2.4	7.0	47.7	11.2	567	0.07	0.04
103.76	5	osgn	2.5	7.5	50.0	11.5	571	0.16	0.04
103.76	6	osgn	0.9	3.9	32.7	11.2	562	0.05	0.00
103.5	7	osgn	1.9	5.5	47.7	11.1	569	0.11	0.08
103.5	8	osgn	1.3	3.3	32.3	11.3	563	0.02	0.02
103.2	9	osgn	2.4	5.0	49.0	11.4	575	0.10	0.10
103.2	10	osgn	0.8	3.9	43.3	11.6	574	0.03	0.01
102.9	11	osgn	2.4	4.2	50.0	11.8	575	0.16	0.12
104.0	12	osgn	1.2	2.3	36.0	11.1	566	0.04	0.03

Table C4. Water quality parameters at nets set in the Route 19 Bridge Replacement project area in April 2000.

Dike #	Net #	Gear Type	Minimum Depth (m)	Maximum Depth (m)	Turbidity (NTU)	Temperature (C)	Conductivity ( $\mu$ S)	Column Velocity (m/s)	Bottom Velocity (m/s)
103.74	1	osgn	2.4	4.7	39.7	13.6	555	0.07	0.01
104.05	2	osgn	1.6	3.6	38.0	13.7	559	0.37	0.31
104.40	3	osgn	6.6	11.4	42.7	13.6	617	0.14	0.12
104.1	4	osgn	0.7	1.4	46.3	13.6	618	0.24	0.17
104.0	5	osgn	1.6	6.7	43.0	14.2	623	0.10	0.08
103.76	6	osgn	2.7	5.9	40.7	14.3	623	0.12	0.16
103.5	7	osgn	2.6	4.6	46.0	14.6	629	0.08	0.20
103.2	8	osgn	1.2	4.1	45.3	14.2	625	0.19	0.30
102.9	9	osgn	2.1	6.4	46.3	14.1	623	0.39	0.38
102.4	10	osgn	4.2	6.2	46.0	14.5	618	0.34	0.46
102.5	11	osgn	1.1	2.0	40.3	14.5	571	0.14	0.08
102.95	12	osgn	1.1	3.5	42.7	14.5	570	0.35	0.49

Table C5. Water quality parameters at nets set in the Route 19 Bridge Replacement project area in May 2000.

Dike #	Net #	Gear Type	Minimum Depth (m)	Maximum Depth (m)	Turbidity (NTU)	Temperature (C)	Conductivity (µS)	Column Velocity (m/s)	Bottom Velocity (m/s)
103.74	1	osgn	3.0	NA	30.1	21.4	712	0.29	0.29
104.05	2	osgn	3.5	NA	27.7	21.5	714	0.26	0.18
104.85	3	osgn	4.3	NA	26.3	21.4	735	0.10	0.02
104.4	4	osgn	3.2	NA	29.7	21.8	739	0.17	0.13
104.0	5	osgn	6.6	NA	29.0	21.6	737	0.11	0.01
103.76	6	osgn	5.7	NA	28.7	21.9	743	0.15	0.12
103.5	7	osgn	4.6	NA	27.7	22.2	746	0.12	0.10
103.2	8	osgn	4.0	NA	31.0	22.3	746	0.25	0.22
102.9	9	osgn	4.6	NA	28.3	22.5	751	0.06	0.06
102.95	10	osgn	3.1	NA	31.0	22.3	708	0.25	0.05

Table C6. Water quality parameters at nets set in the Route 19 Bridge Replacement project area in June 2000.

Dike #	Net #	Gear Type	Minimum Depth (m)	Maximum Depth (m)	Turbidity (NTU)	Temperature (C)	Conductivity (µS)	Column Velocity (m/s)	Bottom Velocity (m/s)
103.74	1	osgn	2.6	4.9	37.0	25.4	771	0.02	0.01
104.05	2	osgn	1.8	3.5	32.7	24.9	775	0.11	0.10
104.85	3	osgn	2.1	10.0	27.3	25.1	783	0.08	0.06
104.4	4	osgn	2.9	10.9	37.7	24.8	772	0.07	0.06
104.0	5	osgn	3.7	6.7	40.3	24.8	771	0.06	0.06
103.76	6	osgn	1.5	5.2	45.3	25.0	776	0.12	-0.02
103.5	7	osgn	1.4	5.2	41.0	25.0	773	0.11	0.10
103.2	8	osgn	1.4	3.5	38.7	25.2	781	0.03	-0.01
102.9	9	osgn	2.1	4.5	42.0	24.9	774	0.12	0.08
102.5	10	osgn	2.1	5.3	41.0	25.2	759	0.43	0.28
102.95	11	osgn	1.2	3.2	44.0	25.4	763	0.20	0.16

Table C7. Water quality parameters at nets set in the Route 19 Bridge Replacement project area in July 2000.

Dike #	Net #	Gear Type	Minimum Depth (m)	Maximum Depth (m)	Turbidity (NTU)	Temperature (C)	Conductivity ( $\mu$ S)	Column Velocity (m/s)	Bottom Velocity (m/s)
103.74	1	ssgn	2.5	4.9	142	30.2	658	0.10	-0.03
104.05	2	ssgn	2.3	4.3	229	30.3	650	-0.03	-0.08
104.40	3	ssgn	2.1	11.3	302	29.7	691	0.18	0.18
104.1	4	ssgn	NA	11.8	246	30.2	684	0.25	0.37
104.0	5	ssgn	1.2	3.7	310	30.1	684	0.03	0.08
103.76	6	ssgn	2.3	7.0	319	30.1	686	0.21	0.07
103.5	7	ssgn	2.6	5.5	319	30.2	686	0.07	0.13
103.2	8	ssgn	1.8	4.4	319	45.1	685	0.07	0.03
102.9	9	ssgn	1.8	5.5	274	29.8	682	0.14	0.07
102.5	10	ssgn	2.1	8.1	241	29.9	646	0.40	0.09
---	11	sn	0.0	1.0	174	33.5	735	NA	NA
---	12	sn	0.0	1.0	174	33.5	735	NA	NA
---	13	sn	0.0	1.0	174	33.5	735	NA	NA
---	14	dtm	NA	18.0	209	30.1	697	NA	NA
---	15	dtm	1.8	4.6	517	31.4	630	NA	NA
---	16	dtm	2.8	4.9	520	31.4	615	NA	NA
---	17	dtm	1.8	4.6	522	31.6	619	NA	NA
---	18	sn	0.0	0.03	456	31.5	653	NA	NA
---	19	sn	0.0	0.03	658	32.1	662	NA	NA
103.74	20	ssgn	2.8	4.6	227	69.4	601	NA	NA
104.05	21	ssgn	NA	4.0	531	29.9	603	NA	NA
104.1	22	ssgn	8.2	11.9	539	29.6	617	NA	NA
104	23	ssgn	2.1	4.6	443	30.0	653	NA	NA
103.76	24	ssgn	3.1	4.3	324	29.8	622	NA	NA
103.5	25	ssgn	1.2	6.1	437	29.9	620	NA	NA
103.2	26	ssgn	1.5	3.4	598	29.7	619	NA	NA
102.9	27	ssgn	1.8	6.1	606	29.6	620	NA	NA
102.5	28	ssgn	6.1	9.2	425	29.9	602	NA	NA

Table C8. Water quality parameters at nets set in the Route 19 Bridge Replacement project area in August 2000.

Dike #	Net #	Gear Type	Minimum Depth (m)	Maximum Depth (m)	Turbidity (NTU)	Temperature (C)	Conductivity ( $\mu$ S)	Column Velocity (m/s)	Bottom Velocity (m/s)
103.74	1	lhn	6.4	6.4	28	29.5	819	0.63	NA
104.05	2	lhn	4.1	4.1	29	29.6	820	0.52	NA
104.0	3	lhn	6.0	6.0	26	30.2	869	0.05	NA
130.76	4	lhn	4.5	4.5	30	29.6	840	0.62	NA
103.5	5	lhn	5.2	5.2	30	32.3	848	0.12	NA
103.2	6	lhn	1.53	5.2	34	29.9	869	0.15	NA
102.95	7	lhn	5.2	5.2	31	29.8	852	0.21	NA
---	8	bt	2.1	3.1	37	28.8	805	NA	NA
---	9	bt	3.1	3.7	47	30.0	873	NA	NA
---	10	bt	NA	4.0	29	NA	875	NA	NA
---	11	bt	0.9	2.4	29	30.1	828	NA	NA
---	12	bt	NA	2.4	29	30.1	NA	NA	NA
102.95	13	ssgn	NA	NA	24	30.2	876	0.04	NA
102.95	14	ssgn	NA	NA	30	30.5	876	0.27	NA
103.5	15	ssgn	NA	NA	26	30.6	811	0.19	NA
---	16	ssgn	NA	2.1	34	30.6	720	0.20	NA
---	17	ssgn	0.92	1.5	34	30.9	712	0.17	NA

Table C9. Water quality parameters at nets set in the Route 19 Bridge Replacement project area in September 2000.

Dike #	Net #	Gear Type	Minimum Depth (m)	Maximum Depth (m)	Turbidity (NTU)	Temperature (C)	Conductivity (µS)	Column Velocity (m/s)	Bottom Velocity (m/s)
103.74	1	osgn	NA	4.6	46	26.4	NA	0.15	0.18
104.05	2	osgn	NA	4.0	40	26.4	NA	0.06	0.07
104.85	3	osgn	NA	6.3	50	26.4	NA	0.19	0.31
104.4	4	osgn	NA	5.8	48	26.4	NA	0.21	0.20
104.0	5	osgn	NA	6.6	38	26.4	NA	0.05	0.06
103.76	6	osgn	NA	6.4	42	26.4	NA	0.11	0.14
103.5	7	osgn	NA	5.8	56	26.4	NA	0.27	0.17
103.2	8	osgn	NA	3.9	51	26.4	NA	0.10	0.07
102.5	9	osgn	NA	8.1	NA	NA	NA	0.39	0.17
102.95	10	osgn	NA	3.2	51	26.7	NA	0.13	0.14
102.95	11	osgn	NA	3.4	50	26.4	NA	0.19	0.19

Table C10. Water quality parameters at nets set in the Route 19 Bridge Replacement project area in October 2000.

Dike #	Net #	Gear Type	Minimum Depth (m)	Maximum Depth (m)	Turbidity (NTU)	Temperature (C)	Conductivity (µS)	Column Velocity (m/s)	Bottom Velocity (m/s)
103.74	1	osgn	NA	1.4	NA	15.7	726	0.15	0.10
104.05	2	osgn	NA	1.3	NA	16.0	729	0.27	0.24
104.85	3	osgn	NA	2.5	NA	16.0	728	0.19	0.11
104.4	4	osgn	NA	3.1	NA	15.9	726	0.15	0.22
104.0	5	osgn	NA	2.3	NA	16.1	725	0.10	0.06
103.76	6	osgn	NA	1.7	NA	16.1	726	0.24	0.13
103.5	7	osgn	NA	1.7	NA	16.4	728	0.15	0.10
103.2	8	osgn	NA	1.1	NA	16.8	726	0.11	0.08
102.9	9	osgn	NA	1.5	NA	16.6	726	0.18	0.14
102.5	10	osgn	NA	1.5	NA	16.7	724	0.15	0.12
102.95	11	osgn	NA	0.9	NA	15.7	749	0.09	0.30



Table C11. Water quality parameters at nets set in the Route 19 Bridge Replacement project area in November 2000.

Dike #	Net #	Gear Type	Minimum Depth (m)	Maximum Depth (m)	Turbidity (NTU)	Temperature (C)	Conductivity ( $\mu$ S)	Column Velocity (m/s)	Bottom Velocity (m/s)
103.74	1	osgn	3.1	4.7	52	6.7	687	0.03	0.03
104.05	2	osgn	1.5	9.1	45	6.9	687	0.42	0.30
104.85	3	osgn	4.7	9.7	33	7.1	713	0.06	0.04
104.4	4	osgn	6.9	11.4	33	7.6	711	0.10	0.10
104.0	5	osgn	3.7	6.7	33	7.2	713	0.23	0.14
103.76	6	osgn	4.1	10.4	37	7.4	714	0.20	0.35
103.5	7	osgn	2.4	7.5	33	6.9	716	0.18	0.21
103.2	8	osgn	2.3	5.2	30	7.0	716	0.17	0.04
102.9	9	osgn	3.4	6.2	31	6.9	717	0.29	0.11
102.5	10	osgn	0.9	4.3	33	7.3	682	0.36	-0.19
102.95	11	osgn	NA	0.9	24	6.9	673	NA	NA

Table C12. Water quality parameters at nets set in the Route 19 Bridge Replacement project area in February 2001.

Dike #	Net #	Gear Type	Minimum Depth (m)	Maximum Depth (m)	Turbidity (NTU)	Temperature (C)	Conductivity ( $\mu$ S)	Column Velocity (m/s)	Bottom Velocity (m/s)
103.74	1	osgn	1.5	3.6	55	3.1	558	0.28	0.26
104.05	2	osgn	1.5	3.4	49	3.2	553	0.73	0.72
104.85	3	osgn	2.0	7.9	NA	2.4	611	0.32	0.21
104.4	4	osgn	1.7	6.2	59	2.7	604	0.16	0.27
104.0	5	osgn	1.4	4.8	55	3.6	602	0.30	0.35
103.76	6	osgn	0.9	5.7	61	2.6	604	0.18	0.08
103.5	7	osgn	1.1	5.3	58	3.5	607	0.46	0.43
102.9	8	osgn	2.0	8.0	65	3.9	602	0.29	0.36

Table C13. Water quality parameters at nets set in the Route 19 Bridge Replacement project area in March 2001.

Dike #	Net #	Gear Type	Minimum Depth (m)	Maximum Depth (m)	Turbidity (NTU)	Temperature (C)	Conductivity ( $\mu$ S)	Column Velocity (m/s)	Bottom Velocity (m/s)
103.74	1	osgn	2.3	5.8	75	7.7	496	0.12	0.09
104.05	2	osgn	2.1	6.0	76	7.6	497	0.17	0.18
104.85	3	osgn	1.5	11.0	113	7.1	568	0.25	0.10
104.4	4	osgn	6.8	8.4	108	7.3	560	0.32	0.23
104.0	5	osgn	1.9	7.4	114	7.3	558	0.28	0.06
103.76	6	osgn	1.9	5.7	93	7.5	559	0.23	0.18
103.5	7	osgn	2.1	6.6	94	7.7	560	0.22	0.31
102.9	8	osgn	1.6	4.7	113	7.4	557	0.45	0.36