

PRE-CONSTRUCTION MONITORING OF AMERICAN SHAD, ATLANTIC STURGEON, AND STRIPED BASS PASSAGE AT LOCK AND DAM #1 ON THE CAPE FEAR RIVER, NORTH CAROLINA

DECEMBER 2002

\$20 REWARD
for
TAGGED FISH


AMERICAN SHAD


STRIPED BASS


ATLANTIC STURGEON

Prepared for:



U. S. ARMY CORPS OF ENGINEERS
WILMINGTON DISTRICT
Wilmington, North Carolina

Contract No DACW 54-97-D-0028
Delivery Order 32

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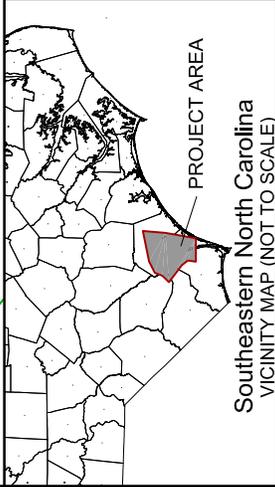
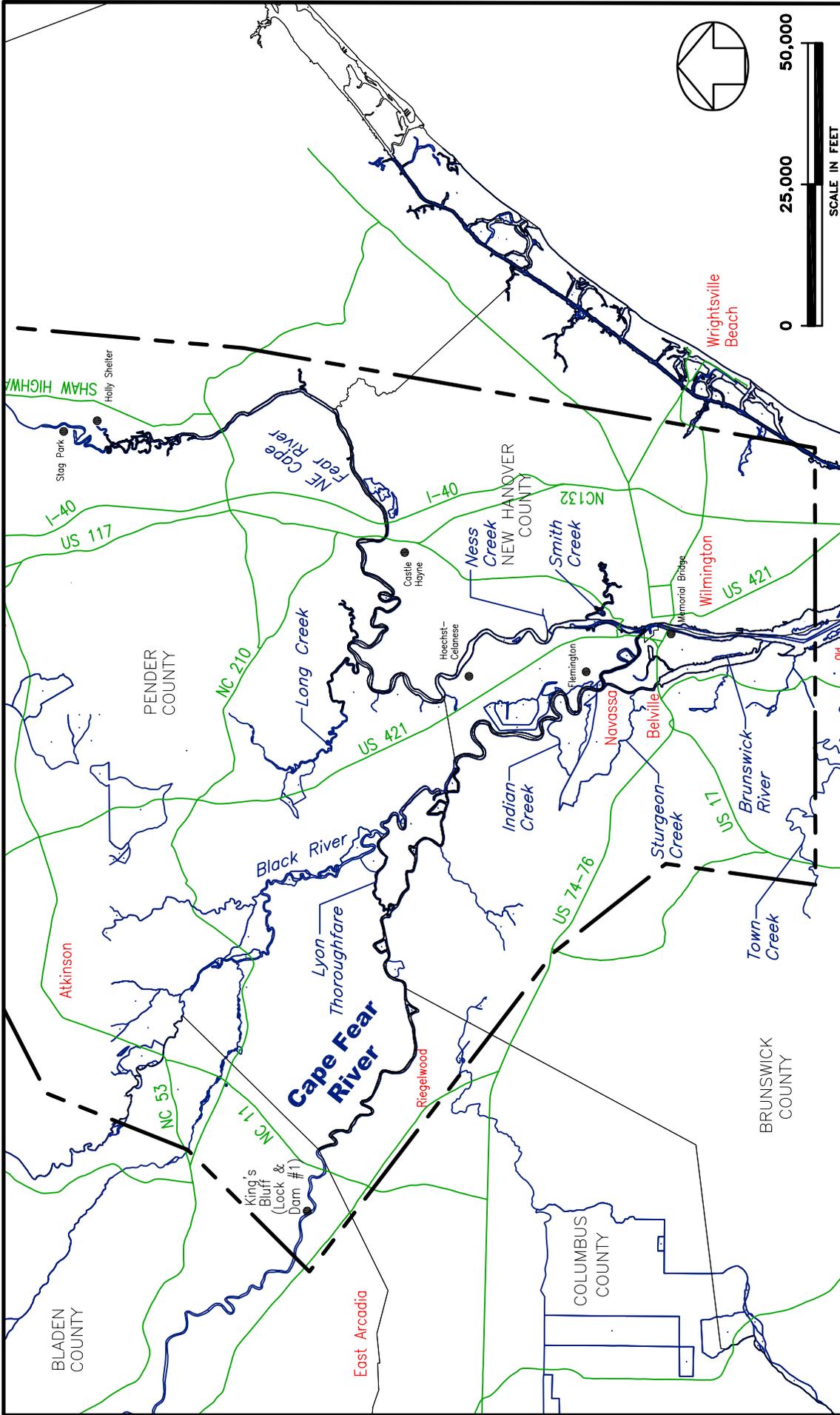
PRE-CONSTRUCTION MONITORING OF AMERICAN SHAD, ATLANTIC STURGEON, AND STRIPED BASS PASSAGE AT LOCK AND DAM #1 ON THE CAPE FEAR RIVER, NORTH CAROLINA

1.0 INTRODUCTION

Passage of anadromous fish on the Cape Fear River has been restricted since 1915 by the construction of low head dams. The U.S. Army Corps of Engineers (USACOE), Wilmington District (Corps), has proposed to improve the passage of anadromous fish by constructing a fish passage around Lock and Dam #1. This nature-like fish passage will be approximately 1 160 meters (3,800 feet) long and begin near the downstream base of the dam on the northeast bank and meander through the flood plain directly adjacent to the Cape Fear River. The upstream end of the passage will return to the upper pool above the dam thus allowing fish to bypass the dam and continue upriver to their traditional spawning grounds. As part of this proposed fish passage the Corps has contracted CZR Incorporated (CZR) to perform pre-construction monitoring of three anadromous fish species: striped bass (*Morone saxatilis*), Atlantic sturgeon (*Acipenser oxyrinchus*), and American shad (*Alosa sapidissima*). The purpose of pre-construction monitoring was to gather baseline data that can be compared to post-construction monitoring data in order to determine fish passage success. Movements of tagged fish were monitored by tracking ultrasonic transmitters with manual and fixed station receivers. Eight striped bass, one hybrid striped bass (*Morone saxatilis X chrysops*), one Atlantic sturgeon, and 30 American shad were tagged and monitored in the Cape Fear River between 13 February 2002 and 19 June 2002.

2.0 STUDY AREA

The project study area comprised of the Cape Fear River from its confluence with the Brunswick River south of Eagle Island to Lock and Dam #1, approximately 64 km (40 miles) upriver (Figure 1). Several sites on the Brunswick River were included within the project area as well. The lower portion of the study area is characterized as a drowned river valley with tidally driven river currents and high turbidity. Sediment ranges from soft mud to sand (Moser and Ross 1993^a). Once upriver of the confluence with the Black River the Cape Fear River becomes narrower and is fringed with bottomland hardwood forest and contains sediments ranging from soft mud and sand to limestone outcrops.



VICINITY MAP

WILMINGTON USACOE FISH PASSAGE	
SCALE: AS SHOWN	APPROVED BY:
DATE: 12/18/02	DRAWN BY: BFG
	FILE: 164532VIC
	CP#1645.32
 4709 COLLEGE ACRES DRIVE WILMINGTON, NORTH CAROLINA 28403 PHONE: 910/382-8733 FAX: 910/382-8738 ENVIRONMENTAL CONSULTANTS	
	FIGURE 1

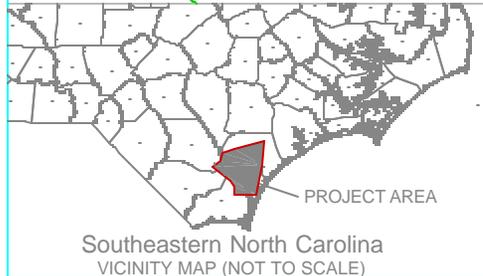
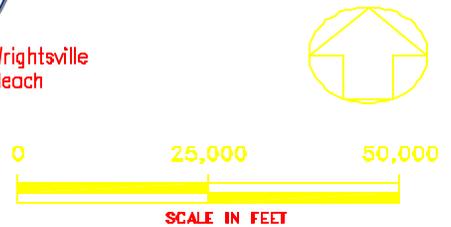
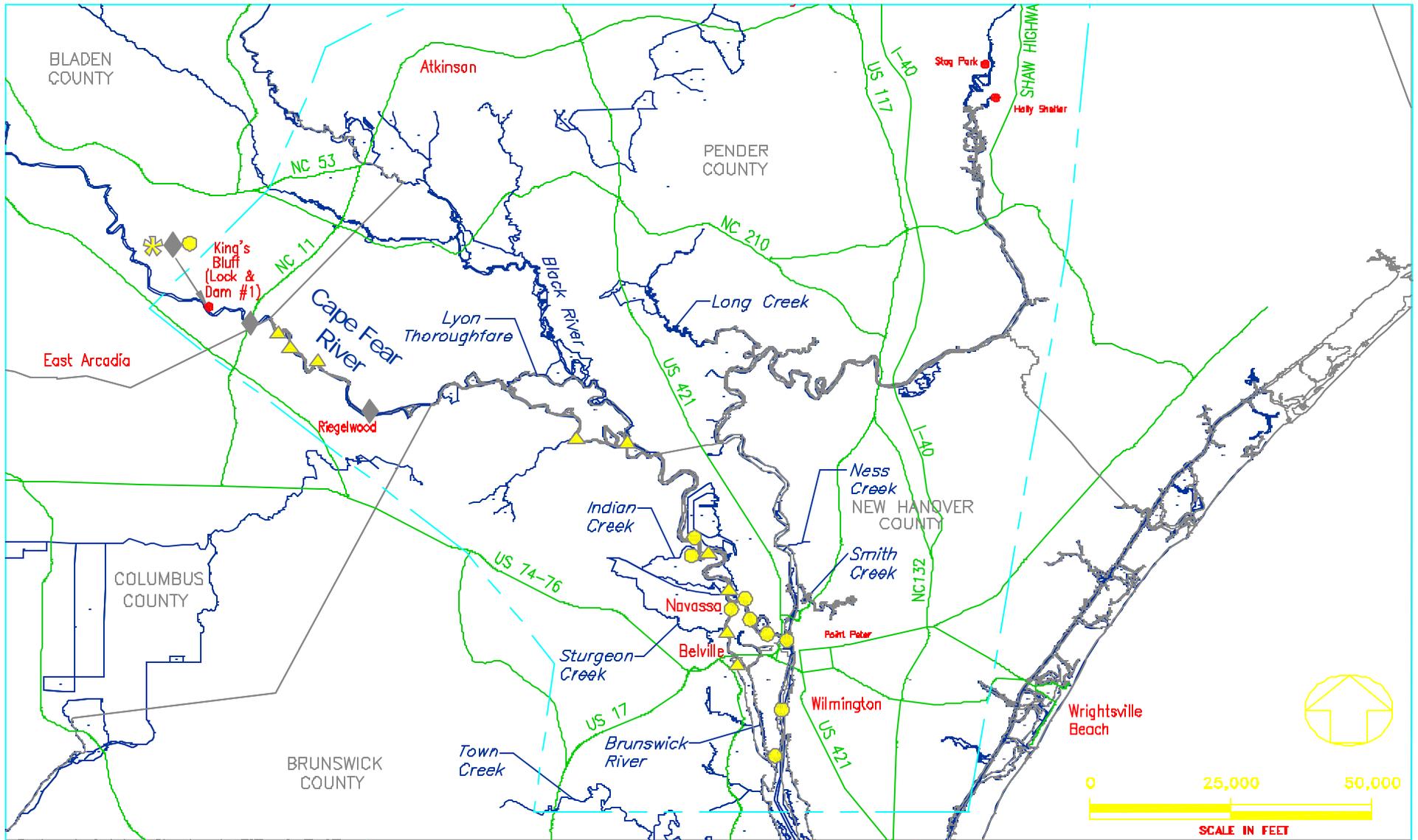
3.0 METHODS

3.1 Striped Bass

3.1.1 Hook and Line Collections. Attempts to catch striped bass and American shad were conducted using hook and line in addition to the gill-netting. A fishing charter guide was hired to attempt to catch striped bass in the lower portion of the study area on 13 and 14 February 2002. Areas with large structure such as bridge pilings and supports as well as creek mouths were targeted.

3.1.2 Gill-net Collections. CZR collected fish with sinking gill-nets between 18 February 2002 to 10 June 2002. Striped bass were targeted at eight sites in the lower portion of the Cape Fear River and two sites from the Brunswick River between 18 February 2002 and 4 April 2002 (Figure 2). Striped bass were captured using 50-yard and 25-yard, 8-foot deep, 5.5-inch stretch mesh monofilament sinking gill-nets. All gill nets were set from a mooring anchored to the shore and stretched perpendicular to the shoreline or at a forty-five degree angle depending on the site and river conditions. Spawning runs of striped bass generally begin late March and end in early May (Carmichael et al. 1998). Striped bass exhibit a strong downriver response following capture and release during the migration period (Carmichael et al. 1998). Efforts to catch striped bass were concentrated during the winter months prior to their upriver migration in order to minimize the downriver flight response. Gill-nets were deployed during most weeks for four days and three nights and checked in the morning and again in the afternoon. Nets were retrieved in the morning on the last sampling day.

Transmitters were surgically implanted in striped bass and hybrid striped bass using standardized sterile techniques established in similar studies (Moser and Ross 1993^a). Striped bass were anesthetized by placing fish in a holding tank and exposed to a 10% solution of tricaine methane sulfonate (MS-222). After five minutes of observation the tag was surgically implanted. The transmitters (Sonotronics CHP-87-L) operated on five frequencies (74, 75, 76, 77, and 78 kHz). Unique pulse intervals and “ping” codes within each frequency allowed identification of individual fish. The cylindrical transmitters for striped bass were 90 mm long and 18 mm in diameter, weighed 35.0 grams, and have a battery life of 18 months. Striped bass were also externally tagged with a Floy FT-2-94 type dart tag with a unique number and reward information printed on the streamer. For each fish tagged and released, total length, sex (if it could be determined), condition, time of release, and site of release (gps \pm 45 feet) were recorded. An initial minimum tagging size for striped bass was set at 533 mm (21 inches), but was lowered for striped bass males to 500 mm (19.5 inches) on 8 March 2002 after it was determined that larger fish were going to be difficult to catch.



LEGEND

- NET SET LOCATIONS FOR STRIPED BASS
- ▲ NET SET LOCATIONS FOR ATLANTIC STURGEON
- ✱ HOOK AND LINE/DRIFT NET SETS FOR AMERICAN SHAD
- ◆ FIXED MONITORING STATIONS

LOCATIONS OF NET SETS, HOOK AND LINE EFFORTS, AND FIXED MONITORING STATIONS

WILMINGTON

SCALE: AS SHOWN
DATE: 08/20/02

APPROV

DRAWN BY: BFG
FILE: 164532NET



4708 COLLEGE ADRES DRIVE
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CP#1645.32

FI

Tagging size for striped bass females remained 533 mm (21 inches). A decision to tag any hybrid striped bass meeting the 533 mm (21 inches) size criterion was approved on the same date.

Additional effort to capture striped bass with gill-nets was conducted between 4 June 2002 and 6 June 2002 inside the lock chamber (Figure 2). A sinking gill-net of the same dimensions mentioned above was placed in the lock chamber. All fish were removed and striped bass meeting the size criterion were tagged. An attempt to capture striped bass in the lock chamber with gill-nets was conducted the night of 10 June 2002 using the same protocol established for daylight sampling.

3.1.3 Seine Net Collections. A 60-foot long by 18-foot deep nylon seine net was used in an attempt to capture striped bass in the lock chamber between 4 June 2002 and 5 June 2002 (Figure 2). This net was lowered into the lock chamber and pulled approximately 45.7 meters (150 feet) by four people located on top of the lock chamber walls. A stop net was placed at the opposite end of the chamber and anchored to the lock chamber walls. A boat was located behind the stop net and the seine was slowly pulled toward the boat. The net was then quickly lifted to a horizontal position at the surface where the crew in the boat could determine the species of fish caught and retrieve any target species appropriate for tagging. This method was attempted six times over the course of two days.

3.2 Atlantic Sturgeon

3.2.1 Gill-net Collections. Atlantic sturgeon were targeted at seven sites in the Cape Fear River and two sites in the Brunswick River between 25 March 2002 and 11 June 2002 (Figure 2). Sturgeon were captured using 50-yard, 18-foot deep, 12-inch stretch multifilament nylon mesh sinking gill-nets. All efforts were made to survey sinking gill-nets for sturgeon as early in the morning as possible to avoid stresses associated with capture and warm water. One Atlantic sturgeon was surgically implanted with a transmitter using standardized techniques established in previous studies (Moser and Ross, 1993).

The transmitter (Sonotronics CHP-87-XL) operates on a frequency of 78 kHz with a unique pulse interval of 910 milliseconds and a "ping" code of 6, 11, 12. The cylindrical transmitter is a custom tag, 99 mm long, and varies in diameter from 18 mm to 33.5 mm. The tag has a battery life of 48 months. The fish was also externally tagged with two Floy FT-1-94 type dart tags, each with a unique number and reward information printed on each streamer. For the fish tagged and released, fork length, sex (if it could be determined), condition, time of release, site of release were recorded. A minimum tagging size of 1,524 mm (60 inches) was set to insure that only mature fish were being tagged and to preclude any possible misidentification with the endangered shortnose sturgeon (*Acipenser brevirostrum*) which reaches a maximum length between 60-100 cm (40 inches)(Menhenick 1991).

3.3 American Shad

3.3.1 Hook and Line Collections. American shad were targeted during the peak spawning migration between 15-22 April 2002 (Figure 2). Shad darts and “crappie jigs” were used with a spinning rod. The transmitter (Sonotronics CHP-87-S) operated on five frequencies (70, 71, 72, 73, and 74 kHz); unique pulse intervals and “ping” codes within each frequency allowed identification of individual fish. The cylindrical transmitters were 65 mm long and 18 mm in diameter, weighed 8.0 grams, and have a battery life of seven months. After capture, fish were placed in a holding tank containing river water and the transmitter was gently inserted into the esophagus to a point where the fish could not expel the tag. Care was taken not to force the transmitter too far down the throat and tear the tissue of the esophagus and stomach. Fish were also externally tagged with a Floy FT-2-94 type dart tag with a unique number and reward information printed on the streamer. Fish were released in a back eddy of slower current to prevent them from becoming disoriented. For each fish tagged and released, total length, sex (if it could be determined), condition, time of release, and site of release were recorded. Only fish that were determined to be in excellent condition were tagged due to the fragile nature of American shad. Handling time for each fish did not exceed more than five minutes.

3.3.2 Drift gill-net Collections. American shad were targeted at the peak of their migration between 15 - 22 April 2002 at Lock and Dam #1 on the Cape Fear River (Figure 2). Drift gill-nets were 30-yards long, 8-foot deep, and 5.5-inch stretch monofilament mesh. Four American shad were captured and tagged using a drifting gill-net. Sampling for American shad occurred after the commercial shad season closed to avoid any complications or competition with commercial drift net fishermen. The drift gill-net was deployed from a boat and allowed to drift for approximately 10 minutes or until several fish became entangled. Fish were cut from the net and tagged using the same protocol identified above in the “Hook and Line Collections” section.

3.4 Fish Monitoring

3.4.1 Manual Tracking. Before fish were implanted with a transmitter, the transmitter was activated and the pulse interval and code were verified with a manual tracking receiver (Sonotronics USR-96) and directional hydrophone (Sonotronics DH-4). Once the fish was implanted with a transmitter, externally tagged, and physiological data recorded, the fish was released. Tagged fish were then monitored with the manual tracking equipment for a short period to confirm position and movements. The release location for each fish tagged was recorded in latitude and longitude with a Magellan NAV DLX-10 handheld GPS (± 45 feet).

Fish were relocated during regular tracking efforts beginning at the most downstream location of a tagged fish. Stops were made at each bend in the river and approximately every 457 meters (1,500 feet). At each stop the outboard engine was turned off and the depth monitor disabled to eliminate interference. Ten pre-set frequencies were scanned upstream and downstream for a duration of approximately two minutes. Fish positions were determined by using signal strength and triangulation. Locations of all tagged fish were recorded in longitude and latitude using the Magellan handheld gps unit. Manual tracking continued upriver until all fish tagged were located or until Lock and Dam #1 was reached.

An additional two days of tracking were incorporated into the study to conduct manual tracking on the Black River (18 June 2002) and the Northeast Cape Fear River (19 June 2002). The goal was to track as far as possible up the Black and Northeast Cape Fear Rivers. This effort was done in an attempt to locate fish that may have been tagged on the Cape Fear River but relocated to positions outside of the study area. Approximately 24 km (15 miles) of the Black River and 58 km (36 miles) of the Northeast Cape Fear River were searched.

Range tests were performed prior to each manual tracking effort to determine the accuracy and reception of the manual tracking equipment since signal strength and reception can be affected by river conditions. This was accomplished by either placing a tag in the water or by using a relocated fish and measuring the greatest distance at which that tag could be identified. This was done to determine the maximum distance between stops for tracking days.

3.4.2 Fixed Monitoring Stations. Three fixed monitoring stations were placed along the upper portion of the study area (Figure 2). These stations were located at the International Paper Mill in Riegelwood, the NC 11 bridge approximately 11.3 km (7 miles) northwest of Riegelwood, and at Lock and Dam #1 near Kelly, NC. Each station consisted of a dual input scanning receiver (Sonotronics USR-90), Hewlett Packard 200LX palmtop computer (Sonotronics DL-95 data logger), one 12-volt marine deep cycle gel cell battery, and two directional hydrophones. Each receiver operated continuously, scanning the same preset frequencies as the manual tracking receiver. Output from the receiver was transmitted to the data logger and time and date recordings were stored on a 10MB PCM CIA flashcard. The flashcards were removed once a week and replaced with an empty flashcard and data were downloaded to a file folder for further analysis in the office. Batteries were exchanged every two weeks with fully charged batteries to ensure a constant power supply for the scanning receivers and palmtop data loggers. All electronic monitoring equipment were stored in an aluminum lock box to protect from the elements and vandalism. Reception tests were conducted on the fixed stations during several tracking efforts by activating a tag and drifting by the hydrophones to determine accurate reception and approximate distance at which a transmitter could be detected.

3.4.3 Water Quality. Water temperature (°C and °F) and dissolved oxygen (mg/l) were collected using an Oakton 300 dissolved oxygen meter. Turbidity (ntu) was measured using a LaMotte model 2020 portable turbidity meter. Air temperature was recorded in °C and °F. These parameters (including date and time) were measured at stations located upstream and downstream of Lock and Dam #1. Water quality data were collected during fixed weekly station data downloads, during shad fishing efforts, and when manual tracking events reached Lock and Dam #1.

3.4.4 Rewards. Reward posters were placed at the three Lock and Dam locations as well as at all other public boat ramps and fishing supply stores between Riegelwood and Lock and Dam #3. A twenty dollar reward was offered for recaptured tagged fish information and the return of the internal ultrasonic tag. For Atlantic sturgeon, only information pertaining to the recapture location and size of the fish were requested due to its threatened state in the Cape Fear River. Maintenance of posters occurred twice a month for the duration of the project.

4.0 RESULTS

A total of 439 fish representing 15 species (including one hybrid) were captured between 13 February 2002 and 11 June 2002 (Table 1). Individuals of anadromous species comprised 303 (69 percent) of the total catch, and were represented by the following species: American shad (80.3 percent), striped bass (9.5 percent), hybrid striped bass (9.2 percent) and Atlantic sturgeon (1 percent). Of the non-anadromous species, blue catfish (*Ictalurus furcatus*), longnose gar (*Lepisosteus osseus*), and gizzard shad (*Dorosoma cepedianum*) were the most abundant. Fish collection data (dates, techniques, effort, and catch) are summarized in Appendix A. Forty-two fish (30 American shad, 10 striped bass, 1 hybrid, and 1 Atlantic sturgeon) were internally implanted with a sonic transmitter and externally dart tagged. Movements of fish within the Cape Fear River were monitored using manual tracking units and dual input fixed station monitors. Maps and GPS data depicting positions of tagged fish located during manual tracking days are found in Appendix B and C, respectively.

Tag reception at distances of 608 meters (2,000 + feet) were normal and never less than 579 meters (1,900 feet). This reception distance proved to be more than adequate since stops were made at distances less than 457 meters (1,500 feet) apart in most cases.

4.1 American Shad. Hook and line and drift gill net collections were conducted during the peak of the spawning migration of American shad (shad) beginning on 15 April 2002 at Lock and Dam #1. Twenty six shad were caught using hook and line and four shad were captured using a drifting gill net. Fish were tagged and release at the base of Lock and Dam #1. Only fish considered in excellent condition were tagged. Of the 30 fish tagged four (13.3%) were male, 24 (80%) were female, and two (6.7%) were undetermined (Table 2). Total lengths ranged between 450 - 525 mm (17.7 - 20.7 inches) with an average total length of 488 mm (19.2 inches). More females were tagged due to their greater abundance compared to males caught at the dam, and because females tended to be in better condition after capture. Also, males tended to be smaller and less able to accommodate the size of the sonic transmitter.

Immediately after being tagged and released, all fish except one (shad #5060), exhibited varying degrees of the fall back response as confirmed through regular manual tracking efforts and fixed station data. A summary of shad behavior after tagging during 2002 can be found in Appendix D. Shad #5060 remained in the vicinity of the dam for approximately nine days and then slowly fell back to a position just downstream from the dam where it remained. Four fish (shad #s 5044, 5046, 5048, and 5057), 13.3%, successfully passed upstream of Lock and Dam #1 through the locking process. Shad #5046 fell back approximately 12.25 miles after tagging and passed through the lock eight days later. Shad #5044 fell back to the vicinity of

Table 1. Total numbers of fish collected at all sampling sites with all gear types used on the Cape Fear River in 2002.

Species	Number
<i>Alosa sapidissima</i>	244
<i>Morone saxatilis</i>	29
<i>Morone saxatilis</i> x <i>chrysops</i> (hybrid)	28
<i>Acipenser oxyrhynchus</i>	3
<i>Lepisosteus osseus</i>	43
<i>Dorosoma cepedianum</i>	19
<i>Ictalurus furcatus</i>	45
<i>Pylodictis olivaris</i>	6
<i>Ameiurus natalis</i>	1
<i>Amia calva</i>	15
<i>Paralichthys lethostigma</i>	3
<i>Ctenopharyngodon idella</i>	1
<i>Micropterus salmoides</i>	1
<i>Lepomis macrochirus</i>	1
<i>Archosargus probatocephalus</i>	1

Total Species = 15 (including one hybrid)

Total Number = 440

Table 2. Physical data collected from American shad tagged at Lock and Dam #1 during pre-construction monitoring for USACOE Fish Passage study during 2002.

Date	Tag #	PI ¹	TL (mm) ²	Sex	Time
15-Apr	CZR5041	855	490	F	1600
15-Apr	CZR5032	870	499	F	1600
15-Apr	CZR5033	878	499	F	1615
15-Apr	CZR5034	898	500	F	1745
16-Apr	CZR5035	915	468	F	0900
16-Apr	CZR5036	929	450	F	0907
16-Apr	CZR5037	944	505	F	0915
16-Apr	CZR5038	960	495	F	1000
16-Apr	CZR5039	974	469	U	1030
16-Apr	CZR5040	988	462	F	1151
16-Apr	CZR5031	1003	441	M	1335
16-Apr	CZR5042	1017	525	F	1425
17-Apr	CZR5043	1032	499	F	0818
17-Apr	CZR5044	1046	499	F	0836
17-Apr	CZR5045	854	498	F	0900
17-Apr	CZR5046	875	503	F	1041
17-Apr	CZR5047	890	470	M	1000
17-Apr	CZR5048	904	499	F	1248
17-Apr	CZR5049	918	462	F	1531
17-Apr	CZR5050	932	459	U	1600
22-Apr	CZR5051	945	493	M	1620
22-Apr	CZR5052	961	528	F	1625
22-Apr	CZR5053	975	481	M	1645
22-Apr	CZR5054	990	487	F	1700
23-Apr	CZR5055	1010	498	F	1315
23-Apr	CZR5056	1025	466	F	1415
24-Apr	CZR5057	1038	525	F	1045
24-Apr	CZR5058	863	499	F	1125
24-Apr	CZR5059	880	455	F	1245
24-Apr	CZR5060	893	500	F	1250

¹ Pulse interval for sonic transmitter

² Total length

NC 11 on 18 April 2002 until it passed upriver through the lock chamber on 23 April 2002. Shad #5048 fell back approximately 3.5 miles to a position downriver from the NC 11 bridge where it was located on 18 April 2002. This fish was found approximately 0.75 miles below the dam on 22 April 2002. This fish successfully passed upstream through the lock chamber on 23 April 2002. Shad # 5057 remained in the general vicinity of the dam and was relocated approximately 0.50 miles downstream of the dam on 29 April 2002. This fish remained in the same area until 1 May 2002 when it passed upstream through the lock chamber.

Of the remaining 25 shad, 16 fish fell back and remained between Lock and Dam #1 and the NC 11 bridge for the duration of the study. Six fish fell back and remained between the NC 11 bridge and Riegelwood. One of these fish, shad #5054, remained very close to the fixed monitor at Riegelwood. Shad #5052 retreated furthest downstream to approximately 1.0 mile upstream of the confluence of the Black River and the Cape Fear River. Two shad were located only once after tagging. Shad #5043 was relocated on 18 April 2002 and shad #5056 was found on 2 May 2002. These fish were most likely removed from the river by fishermen who neglected to return the tags. It is unlikely that these fish left the study area nor passed upstream since neither fish was recorded on any fixed monitoring stations.

4.2 Atlantic Sturgeon. Three Atlantic sturgeon were captured between 27 March 2002 and 11 June 2002. Two sturgeon were captured at the mouth of the Black River and one was captured in the upper Cape Fear River near the mouth of Weyman Creek at river mile 35.25. Sizes ranged from 1,230 - 1,980 mm (48.4 - 78.0 inches). Only one sturgeon met the minimum size criterion (1524 mm, 5 feet long) for tagging (Table 3). The fish was caught on 23 April 2002 and surgically implanted with a sonic transmitter and double tagged with two external dart tags (CZR5061 and CZR5071). This sturgeon was captured in a sharp bend in the river and in a portion of the net close to a steep cutbank directly adjacent to the mouth of Weyman Creek. The depth of the river at this position is approximately 16 feet deep. The fish was easily determined to be a male due to the large amount of semen present when the fish was squeezed. Water temperatures during this time were between 23.5°C and 24.0°C. The fish was held for approximately 15 minutes after surgery to insure recovery and was released in good condition. Two other sturgeon were not large enough to tag and one of these was found dead in the net. Both of these fish were captured in the same location at the mouth of the Black River in shallow water (<30 feet).

Manual tracking data indicate that the tagged sturgeon stayed in the same area after tagging and it was recaptured the following day, 24 April 2002. The fish was released and nets were not reset at that location until the fish had relocated. Manual tracking and the fixed station at NC11 located the fish a short distance downriver of the NC11 bridge on 25 April 2002. Later the same day the fish passed the fixed station at Riegelwood and was not relocated again during the study.

Table 3. Physical data collected from striped bass and Atlantic sturgeon tagged during pre-construction monitoring for USACOE Fish Passage Study 2002.

Species ¹	Date	Tag #	PI ²	TL (mm) ³	Tagging Location ⁴	Sex	Time
SB	26-Feb	CZR5001	845	597	34 14.46 / 77 57.31	M	0945
SB	7-Mar	CZR5006	865	510	34 14.80 / 77 58.35	M	0950
HSB	13-Mar	CZR5002	859	586	34 14.33 / 77 57.28	F	1200
SB	13-Mar	CZR5007	908	603	34 14.68 / 77 58.20	F	1530
SB	14-Mar	CZR5003	866	484	34 14.46 / 77 57.31	M	0930
SB	14-Mar	CZR5004	879	490	34 14.68/77 58.20	M	0900
SB	14-Mar	CZR5013	964	583	34 17.02 / 78 00.41	M	1145
SB	18-Mar	CZR5014 ⁵	978	509	34 15.65 / 77 58.94	M	1545
SB	19-Mar	CZR5014 ⁶	978	510	34 14.67 / 77 58.23	M	0915
SB	19-Mar	CZR5008	916	508	34 14.47 / 77 57.29	M	1530
SB	6-Jun	CZR5005 ⁷	886	587	34 24.14 / 78 17.19	M	1130
AS	23-Apr	CZR5061, 5071	906	1980 (FL)	34 23.45 / 78 15.13	M	1000

¹ SB = striped bass, HSB = hybrid striped bass, AS = Atlantic sturgeon

² PI = Pulse interval of sonic transmitter

³ TL = Total length in mm, FL = Fork Length (for sturgeon)

⁴ Latitude/longitude, WGS 84

⁵ Confirmed as dead on 19 March 2002

⁶ Bass #5014 was recaptured dead in a gill net on 19 March 2002. The same transmitter was reused in a different fish on 19 March 2002.

⁷ Confirmed as dead on 11 June 2002 between Lock and Dam #1 and the NC11 bridge.

A sonic tag detected during a manual tracking effort on 18 March 2002 was later determined to be an Atlantic sturgeon that was originally caught by Mike Williams and Mary Moser (UNCW researchers) in April 2000. This fish was tagged three miles south of the NC 117 bridge on the Northeast Cape Fear River (e-mail correspondence from Mike Williams 2002). The fish was 213 cm (83.9 inches) long at the time of tagging and determined to be an adult male. Efforts by CZR to capture this fish were unsuccessful and it was last recorded from near Riegelwood on 28 April 2002.

Each time this fish was relocated during manual tracking efforts it was making deliberate and directed movements either up or downstream. On 18 March 2002 it was moving downstream, and on 10 April 2002 it was above the NC 11 bridge and moving upstream. This sturgeon was located on 15 April 2002 a short distance down river from Lyon Thoroughfare moving rapidly downstream. The fish was relocated heading upstream on 18 April 2002 above NC11. The fixed stations at Riegelwood and the NC 11 bridge recorded multiple passes of this fish between 17 March 2002 and 28 April 2002. Although data gaps occurred at the Riegelwood (twice) and NC 11 (once) fixed monitoring stations, this fish passed the NC 11 station 15 times and passed Riegelwood at least five times. It appears that this fish made a series of runs up and down the river and was often in the vicinity of the NC 11 bridge. This fish was not recorded above the dam nor after 28 April 2002 when it was located below the Riegelwood site.

Manual tracking located a tag on 19 June 2002 on the Northeast Cape Fear River that was not tagged as part of this study. This tag was originally implanted in a sturgeon by UNCW and upon further inquiry has been determined to be an expelled tag.

4.3 Striped Bass. Twenty nine striped bass were captured and of these ten were implanted with a sonic transmitter. Of the ten striped bass tagged, eight survived. One striped bass, #5014, was found dead in a gill-net on 19 March 2002. The sonic transmitter and dart tag were removed from this fish and used to tag another striped bass captured later that morning. The other striped bass, #5005, was found dead and floating near the NC 11 bridge on 11 June 2002, six days after it was tagged at Lock and Dam #1. Of the eight fish that survived tagging, seven (87.5%) were males and one (12.5%) was a female. One hybrid striped bass was acquired from a recreational fisherman and was also internally tagged. Sizes ranged from 480 -680 mm (18.9 - 26.8 inches) with an average total length of 518 mm (20.4 inches) (Table 3). A total of 57 striped bass and hybrid striped bass were captured during the study period. Of these, 28 fish (49 percent) were hybrid striped bass. This supports earlier concerns (Patrick and Moser 2001) that the population of hybrids in the Cape Fear River is on the rise.

In general, the eight striped bass and a single hybrid striped bass tagged tended to remain faithful to their tagging locations. Eight of the nine fish tagged came from either nets set at Pt. Peter or Horseshoe Bend and remained in the general vicinity of these positions. The one fish tagged at Indian Creek, bass #5013, was never relocated after tagging. Bass #5001 remained at Pt. Peter for six days and then fell back to a position underneath the Henrietta III where it was located on 11 March 2002. On 14 March 2002, bass #5001 was located approximately one mile upriver of Horseshoe Bend in shallow water on the northeast side of the Cape Fear River. It then fell back to the mouth of the main stem of the Cape Fear River and remained in this general vicinity amongst old pilings and underneath the dredge pipes next to the NC 421 bridge.

Bass #5002, a hybrid striped bass, exhibited the same fidelity to positions in shallow water and sites containing structure similar to bass #5001. On 4 April 2002, bass #5002 was located at a position just upriver from Dollison's landing (near river mile 12). Bass #5002 fell back to a position where it was recorded for all remaining manual tracking efforts. Even though manual tracking of this fish located it in the same general vicinity each time, fixed station data indicate that this fish made a rapid upstream migration between manual tracking events. The fixed station at NC 11 located bass #5002 on the evening of 29 April 2002, and seven more times between 1 May 2002 and 9 May 2002. This fish returned to its downstream positions where it was located on 16 May 2002.

Bass #5003 was tagged at Pt. Peter and remained in the vicinity of Pt. Peter and the NC 421 bridge for approximately seven days after tagging and did not reappear until 20 days later. This fish was located on three subsequent manual tracking days in various positions upstream and downstream of the NC 421 bridge. After 22 April 2002 the fish was not manually located again until 19 June 2002 when it was found near the mouth of Prince George Creek on the Northeast Cape Fear River. During the time bass #5003 was missing, fixed station data at NC 11 recorded multiple visits by this fish. Beginning on 28 April 2002, bass #5003 was recorded in the vicinity of the NC 11 station each night and through the early morning hours when it moved upstream presumably to Lock and Dam #1 where it stayed until the next evening when it returned to the vicinity of the NC 11 bridge. This pattern was followed consistently until 9 May 2002 when the fish left the area and did not return.

Striped bass #5004 fell back to the same general vicinity of Pt. Peter and the NC 421 bridge after tagging and remained there until late April when it disappeared after 22 April 2002. Bass #5004 was not relocated again until 19 June 2002, approximately two miles up the Northeast Cape Fear River. Bass #5006 was tagged at Horseshoe Bend on 7 March 2002 and fell back to a position slightly north of Pt.

Peter in the Northeast Cape Fear River where it was located on 11 March 2002. This fish was not located again during the study period.

Bass #5007 fell back to the same pilings across from Pt. Peter after tagging. The fish remained in the general area between Pt. Peter and a boat harbor a short distance up the Northeast Cape Fear River until late May when it returned upriver to a position directly across from where it was originally captured. The fish remained here for the remainder of the study.

Striped bass #5008 disappeared after tagging on 19 March 2002 but was relocated at approximately river mile 13 on 27 March 2002. The fish disappeared for 32 days and returned to Pt. Peter where it was located during a manual tracking event on 2 May 2002. Bass #5008 vanished again for 48 days but reappeared on 19 June 2002 approximately one mile up the Northeast Cape Fear River across from the mouth of Smith Creek. Striped bass #5014 was tagged on 19 March at Horseshoe Bend. This fish vanished for 44 days until it was relocated downstream of the NC 421 bridge near some floating dredge pipes where it remained for the remainder of the study.

Seine attempts to catch striped bass in the lock chamber produce one striped bass. Striped bass #5005 was tagged on 6 June 2002 and release a short distance down river of Lock and Dam #1. The fish was found dead six days later on 11 June 2002 dead in the vicinity of the NC11 bridge.

4.4 Water Quality - Water temperature increased throughout the study period and ranged from 11.1 - 29.7°C downstream and 11.4 - 32.4°C upstream of the dam (Table 4). River discharge and water heights approached historic lows in 2002 as a result of an ongoing drought. At only one period (near 3 April 2002) did daily discharges approach the 32-year average (Figure 3). The remainder of the study period exhibited discharge values well below the daily mean. Turbidity measurements in the absence of any notable freshets remained low with ranges of 6.0 - 22.0 ntu's downstream and 5.1 - 17.0 ntu's upstream. The period between 27 March 2002 and 5 April 2002 exhibited the highest turbidity reading of 22.0 ntu's as a result of a rise in the river height from 15.6 feet to 16.5 feet. Dissolved oxygen ranged from a high of 10.49 mg/l recorded downstream of the dam on 8 March 2002 and a low of 4.80 mg/l recorded upstream of the dam on 10 June 2002.

4.5 Rewards - At the time of this report, no recaptures have been reported and no rewards have been paid.

Table 4. Summary of physicochemical measurements taken near Lock and Dam #1 in conjunction with fish sampling during 2002.

Location ¹	Date 2002	Time	Air Temp. °C / °F	Water Temp. °C / °F	D.O. (mg/l)	Turbidity (ntu's)	Water Height ²
Upstream	8 March	1300	17.2/63	11.4/53	7.94	12.5	16.6
Downstream	8 March	1300	17.2/63	11.1/52	10.49	14.9	16.6
Upstream	15 March	1145	23.3/74	18.9/66	9.45	11.0	15.8
Downstream	15 March	1145	23.3/74	17.6/64	8.35	22.0	15.8
Upstream	22 March	1000	10.1/50.3	16.3/61	7.77	10.0	16.4
Downstream	22 March	1000	10.1/50.3	14.9/59	8.73	12.0	16.4
Upstream	27 March	1745	20.6/69.4	18.3/65	7.96	11.0	16.0
Downstream	27 March	1745	20.6/69.4	17.4/63	9.24	11.0	16.0
Upstream	5 April	1200	15.7/60.5	22.1/72	5.62	14.0	15.6
Downstream	5 April	1200	15.7/60.5	21.1/70	6.44	22.0	15.6
Upstream	12 April	1200	24.4/76.3	19.8/68	6.25	17.0	16.6
Downstream	12 April	1200	24.4/76.3	19.6/67	6.67	14.0	16.6
Upstream	17 April	1630	31.6/89.4	24.4/76	6.20	12.0	16.9
Downstream	17 April	1630	31.6/89.4	27.8/82	5.50	14.0	16.9
Upstream	18 April	1730	32.2/90.6	27.4/81	6.04	11.0	16.5
Downstream	18 April	1730	32.2/90.6	27.0/81	6.54	12.0	16.5
Upstream	24 April	1430	23.5/74.8	23.3/74	6.32	11.0	15.0
Downstream	24 April	1430	23.5/74.8	22.8/73	6.84	12.0	15.0
Upstream	2 May	1730	33.3/92	24.0/75	5.42	11.1	14.8
Downstream	2 May	1730	33.3/92	24.7/77	6.41	10.2	14.8
Upstream	10 May	1730	33.3/92	32.4/90	6.85	7.8	14.9
Downstream	10 May	1730	33.3/92	29.7/86	6.07	9.4	14.9
Upstream	16 May	1530	26.1/79	28.5/83	7.02	8.4	14.5
Downstream	16 May	1530	26.1/79	27.4/81	6.90	9.0	14.5
Upstream	23 May	1430	20.0/68	28.2/83	5.46	7.9	14.8
Downstream	23 May	1430	20.0/68	23.1/74	7.09	9.5	14.8
Upstream	30 May	1500	27.8/82	29.7/86	7.05	7.7	15.0

Table 4. (concluded)

Location ¹	Date 2002	Time	Air Temp. °C / °F	Water Temp. °C / °F	D.O. (mg/l)	Turbidity (ntu's)	Water Height ²
Downstream	30 May	1500	27.8/82	26.9/80	6.82	8.8	15.0
Upstream	5 June	1430	33.9/93	31.8/89	6.41	5.1	14.7
Downstream	5 June	1430	33.9/93	27.5/82	7.11	6.0	14.7
Upstream	10 June	2000	32.2/90	27.3/81	4.80	5.2	14.9
Downstream	10 June	2000	32.2/90	25.8/78	6.22	6.0	14.9

¹ Position in reference to Lock and Dam #1

² Data from USGS gage at Lock and Dam #1

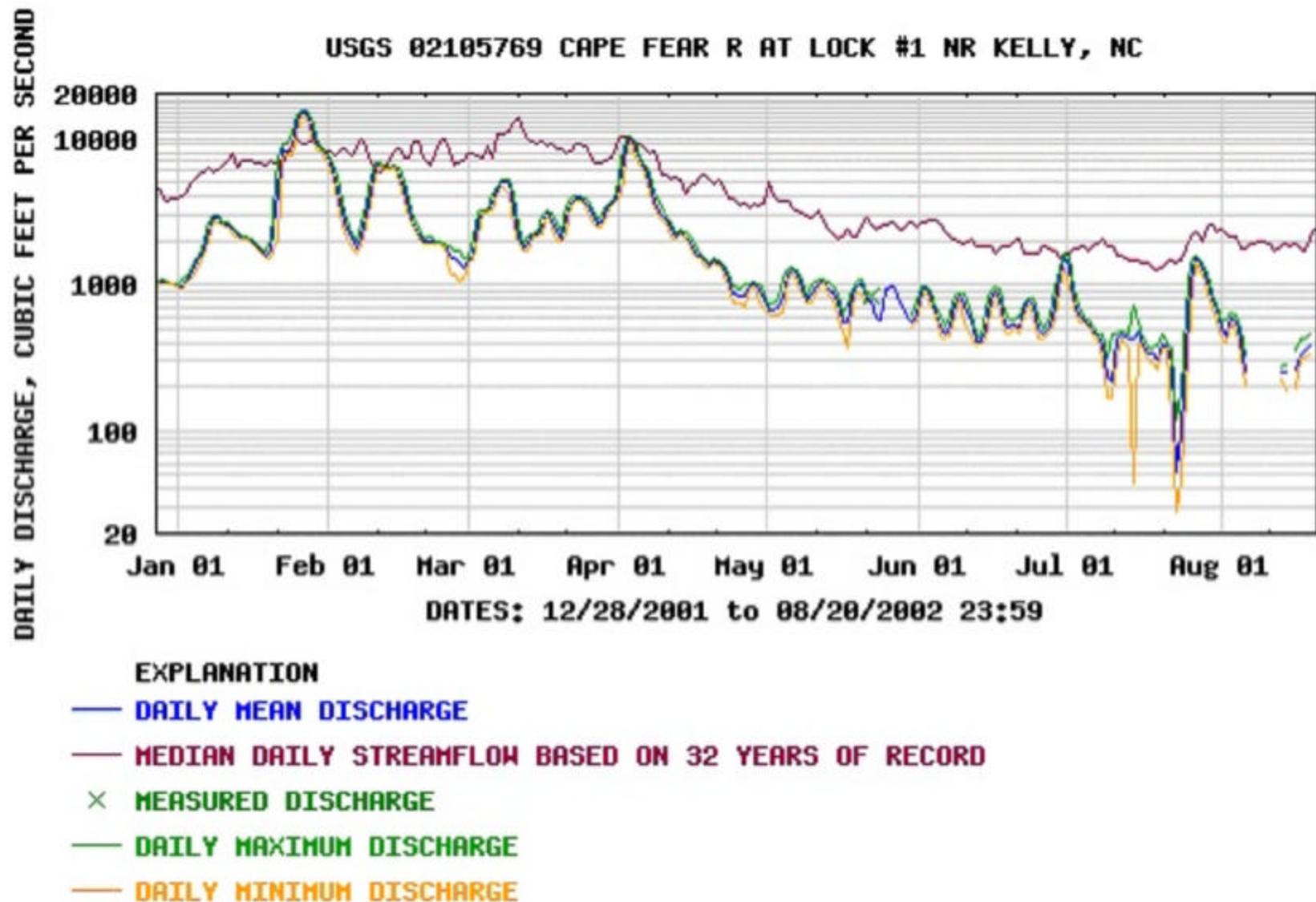


FIGURE 3. Daily river discharge from Lock and Dam #1 during the study period, 2002.
 (source: <http://waterdata.usgs.gov>)

5.0 DISCUSSION

Lock and Dam #1 remains an impediment to anadromous fish species' ability to continue upriver on their spawning migrations. Gill-net surveys indicate that striped bass and Atlantic sturgeon populations remain low in the main stem of the Cape Fear River (Moser and Ross 1995, Patrick and Moser 2001). Striped bass exhibited both fall back and an upriver responses after tagging. A high fidelity to sites was exhibited for striped bass as documented in previous similar studies (Moser and Ross 1993^a). Fixed station data indicate that two striped bass (CZR5002 and CZR5003) made daily upstream movements, possibly to the dam, between 28 April 2002 and 9 May 2002 and returned downstream each evening to the vicinity of the NC 11 bridge. The sturgeon tagged by CZR stayed in the vicinity of its tagging location for three days and then departed the study area. The sturgeon tagged by UNCW in 2000 exhibited a great range of mobility with regards to its original tagging location. It is believed that the sturgeon tagged by UNCW made many trips to the dam between 19 March 2002 and 28 April 2002 but was unsuccessful in passing the dam. It is assumed that these fish traveled to the dam since fixed station data indicate that the fish moved upstream. However, manual tracking never confirmed the presence of the fish at the dam itself. The turbulence created by the flow of water over the dam prevents the manual tracking of fish that reside just below it. It is possible that the striped bass and sturgeon could have been at the dam during our tracking events but the transmitters could not be detected due to the background noise created by the turbulence. No striped bass or Atlantic sturgeon passed Lock and Dam #1 during the study.

American shad occur in the Cape Fear River in large numbers. American shad consistently exhibited the fall back response to handling stress as documented in previous tracking studies (Moser and Ross 1993^a, Moser et al. 1998). Eight shad made return trips back to the dam after tagging and four shad (50 percent) passed upstream of the dam through the locking chamber. Shad were observed attempting to swim over the dam but in all cases failed and fell back to the base of the dam.

5.1 Difficulties Encountered. The original locations chosen for the two downstream fixed monitoring stations had to be moved due to background noise created by discharges both at the dam and at the Riegelwood (International Paper Mill) site. The monitor at the downstream side of the dam was relocated to the NC 11 bridge and the station originally place on the dissolved oxygen dock at the International Paper Mill was moved upstream approximately 152 meters (500 feet). The discharge at the International Paper Mill may have impaired the reception at this station during the times of heavy discharge. Discharges occurred twice daily in conjunction with the falling tide. This may explain how two striped bass and one American shad passed the station without being recorded. It is also possible that in addition to noise created by the discharge at the mill, rapid upstream swimming speeds and shoreline orientation

exhibited by striped bass (Moser and Ross 1993^b) may have made detection of these fish difficult at this station. A new location for this station should be considered for future studies.

Computer software compatibility problems in the office resulted in gaps in the fixed monitoring station data from the Riegelwood and NC 11 sites. Specifically, fixed station data from Riegelwood (22 March - 5 April 2002, 12 April - 18 April 2002) and NC 11 (5 April - 12 April 2002) were lost during data transfer from the flashcard to the hard drive of the office computer. It was later discovered that Windows 2000 operating system was not compatible with an older version of our flashcard reader software. This problem was remedied and no further data loss occurred.

Mobile tracking equipment performed well until more than two fish with transmitters of the same frequencies were encountered. The mobile tracking receiver could not differentiate more than two transmitters at a time when multiple fish were within close proximity to each other. The numbers of transmitters present could be determined but positive identification of more than two transmitters pulse intervals was impossible. This may have allowed some fish, such as the striped basses #5002 and #5003, to be heard but not identified when in close proximity to the dam and other fish of the same frequency. Future studies should consider the use of one frequency per fish or a very limited number of fish per frequency.

Tracking was conducted a maximum of twice a week where as previous similar studies conducted daily tracking of fish and even tracked single fish for an entire day. More data are collected with daily tracking allowing more confident predictions of mortality. Our tracking efforts recorded small movements within areas but only for a short period of time. Mortality of striped bass #5005 and #5014 were likely caused by stresses associated with capture and warm water. Otherwise, it is felt that all other striped bass and sturgeon tagged survived and that most shad survived throughout the study period. Transmitter size may have contributed to some stress and mortality on American shad. Based on tracking data an estimate of approximately 53 percent of the shad died during the course of the study period, however, only two individuals died within 48 hours after tagging. Although similar size transmitters have been used in previous studies (Moser and Ross 1993^a), smaller sized transmitters with a shorter battery life may be less stressful and suitable for future shad studies.

Overall abundance and availability of striped bass and Atlantic sturgeon were a problem. It was not surprising that only three Atlantic sturgeon were captured. Hybrid striped bass made up 49 percent of the overall number of fish captured during the striped bass fishing period. The number of striped bass utilizing the Cape Fear River has historically been low (Phone conversations with Keith Ashley of the North Carolina Wildlife Resource Commission/Inland Fisheries Department and Dr. Tom Lankford of the University of North Carolina at Wilmington on 15 August 2002) . The

WRC's attempts to collect striped bass downstream of Lock and Dam #1 during the winter and spring of 2002 only produced seven striped bass in three hours of shocking time. The average size striped bass captured was smaller than the required tagging length of 21 inches. Future studies may wish to re-evaluate the size criterion and also target hybrid striped bass of similar sizes. It is also possible low river conditions and low flow velocities caused by the extended drought conditions could have contributed to the low numbers of striped bass in the Cape Fear River in 2002.

6.0 REFERENCES

- Carmichael, J.T., S.L. Haeseker and J.E. Hightower. 1998. Spawning migration of telemetered striped bass in the Roanoke River, NC. *Transactions of the American Fisheries Society*. 127:286-297.
- Menhinick, E.F. 1991. *The Freshwater Fishes of North Carolina*. North Carolina Wildlife Resource Commission. Raleigh, North Carolina. 227 pp.
- Moser, M.L., and S.W. Ross^a. 1993. Distribution and movements of shortnose sturgeon (*Acipenser brevirostruna*) and other anadromous fishes of the lower Cape Fear River, North Carolina. Final Report to the U.S. Army Corps of Engineers, Wilmington District.
- Moser, M.L. and S.W. Ross. 1993^b. Effects of changing current regime and river discharge on the estuarine phase of anadromous fish migration. Off print from Changes in Fluxes in Estuaries International Symposium Series. Edited by K.R. Dyer and R.S. Orth.
- Moser, M.L., and S.W. Ross. 1995. Habitat use and movements of shortnose and Atlantic sturgeons in the Lower Cape Fear River, North Carolina. *Transactions of the American Fisheries Society*. 124:225-234.
- Moser, M.L., A.M. Darazdi, and J.R. Hall. 2000. Improving passage efficiency of adult American shad at low-elevation dams with navigation locks. *Journal of Fisheries Management*, 20:376-385.
- Patrick, W.S. and M.L. Moser. 2001. Potential competition between hybrid striped bass (*Morone saxatilis* X *M. Americana*) and striped bass (*M. saxatilis*) in the Cape Fear River Estuary, North Carolina. *Estuaries*, 24:425-429.

APPENDIX A

**FISH COLLECTION DATES, TECHNIQUES,
AND EFFORT**

Appendix A. Fish collection dates, techniques, effort, and fish caught associated with USACE Fish Passage Study for 2002.

Site ^a	Date	Gear	Level of Effort	Catch
PP	13 February	Hook and line	3 rod and reel, 3 hooks, 4 hrs.	0 fish
PP	14 February	Hook and line	3 rod and reel, 3 hooks, 4 hrs.	0 fish
PP	20 February	Gill net	1 gill net, 6 hrs.	1 Hybrid striped bass
PP	21 February	Gill net	1 gill net, 17.25 hrs	3 Hybrid striped bass
PP	25 February	Gill net	1 gill net, 7.25 hrs	1 Hybrid striped bass, 1 Longnose gar
PP	25-26 February	Gill net	1 gill net, 17.25 hrs	1 Striped bass(CZR5001), 1 Hybrid striped bass
PP	26 February	Gill net	1 gill net, 7 hrs	1 Longnose gar, 1 American shad
PP	26-27 February	Gill net	1 gill net, 18 hrs	1 Hybrid striped bass
PP	27 February	Gill net	1 gill net, 7.5 hrs	0 fish
PP	27-28 February	Gill net	1 gill net, 17.5 hrs	2 American shad, 1 Gizzard shad, 1 Longnose gar
PP	4 March	Gill net	1 gill net, 5.25 hrs.	0 fish
PP	4-5 March	Gill net	1 gill net, 18.25 hrs.	1 Hybrid striped bass, 1 Longnose gar
PP	5 March	Gill net	1 gill net, 7 hrs.	1 American shad, 1 Gizzard shad
PP	5-6 March	Gill net	1 gill net, 17.75 hrs.	1 American shad
PP	6 March	Gill net	1 gill net, 5.5 hrs.	1 American shad
PP	6-7 March	Gill net	1 gill net, 17.75 hrs.	1 Hybrid striped bass
PP	11 March	Gill net	1 gill net, 6.25 hrs.	0 fish
PP	11-12 March	Gill net	1 gill net, 17 hrs.	2 Longnose gar

Appendix A. (continued)

Site ^a	Date	Gear	Level of Effort	Catch
PP	12 March	Gill net	1 gill net, 6.25 hrs.	0 fish
PP	12-13 March	Gill net	1 gill net, 17.75 hrs.	1 Striped bass, 2 Gizzard shad
PP	13 March	Hook and line	1 rod and reel, 10 minutes, donated by recreational fisherman	1 Hybrid striped bass (CZR5002)
PP	13 March	Gill net	1 gill net, 6 hrs.	1 Hybrid striped bass
PP	13-14 March	Gill net	1 gill net, 17.75 hrs.	2 Striped bass(1 tagged CZR5003), 1 Blue catfish, 1 Bowfin
PP	14 March	Gill net	1 gill net, 5.75 hrs.	1 Striped bass, 1 Gizzard shad
PP	18 March	Gill net	1 gill net, 6.5 hrs.	1 American shad, 3 Longnose gar
PP	18-19 March	Gill net	1 gill net, 16.25 hrs.	2 Striped bass(recaptured CZR5014 dead), 4 Longnose gar
PP	19 March	Gill net	1 gill net, 6.25 hrs.	1 Striped bass (tagged CZR5008), 1 Hybrid striped bass
PP	19-20 March	Gill net	1 gill net, 17.25 hrs.	1 Longnose gar
PP	20 March	Gill net	1 gill net, 5.25 hrs.	0 fish
PP	20-21 March	Gill net	1 gill net, 17.5 hrs.	1 Longnose gar
PP	21 March	Gill net	1 gill net, 7.25 hrs.	0 fish
PP	29 March	Gill net	1 gill net, 22.5 hrs.	1 Striped bass
PP	4 April	Gill net	1 gill net, 17.5 hrs.	1 Sheepshead
HBS	20 February	Gill net	1 gill net, 6hrs.	5 Blue catfish

Appendix A. (continued)

Site ^a	Date	Gear	Level of Effort	Catch
HBS	21 February	Gill net	1 gill net, 17 hrs	1 Hybrid striped bass, 1 Longnose gar, 1 Gizzard shad
HBS	25 February	Gill net	1 gill net, 7.25 hrs	1 Hybrid striped bass, 4 Blue catfish, 1 American shad
HBS	25-26 February	Gill net	1 gill net, 17 hrs	0 fish
HBS	26 February	Gill net	1 gill net, 7 hrs	2 Hybrid striped bass
HBS	26-27 February	Gill net	1 gill net, 18.25 hrs	1 Hybrid striped bass
HBS	27 February	Gill net	1 gill net, 5 hrs	0 fish
HBS	27-28 February	Gill net	1 gill net, 17.5 hrs	1 American shad, 1 Blue catfish, 1 Southern flounder
HBS	4 March	Gill net	1 gill net, 5 hrs.	1 American shad, 1 Grass carp
HBS	4-5 March	Gill net	1 gill net, 17.5 hrs.	4 Hybrid striped bass
HBS	5 March	Gill net	1 gill net, 5.75 hrs.	0 fish
HBS	5-6 March	Gill net	1 gill net, 18 hrs.	2 Striped bass
HBS	6 March	Gill net	1 gill net, 5.75 hrs.	0 fish
HBS	6-7 March	Gill net	1 gill net, 17.75 hrs.	1 Largemouth bass
HBS	11 March	Gill net	1 gill net, 6.25 hrs.	1 Blue catfish
HBS	11-12 March	Gill net	1 gill net, 17 hrs.	2 Longnose gar, 1 Southern flounder
HBS	12 March	Gill net	1 gill net, 6.25 hrs.	0 fish
HBS	12-13 March	Gill net	1 gill net, 18 hrs.	1 Blue catfish, 2 Longnose gar
HBS	13 March	Gill net	1 gill net, 6.25 hrs.	1 Striped bass (tagged CZR5007)

Appendix A. (continued)

Site ^a	Date	Gear	Level of Effort	Catch
HBS	13-14 March	Gill net	1 gill net, 18.75 hrs.	2 Hybrid striped bass, 1 Blue catfish, 1 Longnose gar, 1 Gizzard shad
HBS	14 March	Gill net	1 gill net, 5.25 hrs.	1 Striped bass (tagged CZR5004)
HBS	18 March	Gill net	1 gill net, 6.5 hrs.	0 fish
HBS	18-19 March	Gill net	1 gill net, 16.75 hrs.	1 Striped bass(tagged CZR5014), 1 Blue catfish
HBS	19 March	Gill net	1 gill net, 6.5 hrs.	0 fish
HBS	19-20 March	Gill net	1 gill net, 17.5 hrs.	2 Longnose gar, 1 Flathead catfish, 1 Blue catfish, 1 Yellow bullhead
HBS	29 March	Gill net	1 gill net, 23 hrs.	2 Striped bass
HBS	2 April	Gill net	1 gill net, 16.5 hrs.	0 fish
HBS	4 April	Gill net	1 gill net, 18 hrs.	0 fish
HBN	6 March	Gill net	1 gill net, 6.25 hrs.	1 Striped bass, 1 Gizzard shad, 1 Blue catfish
HBN	6-7 March	Gill net	1 gill net, 17.75 hrs.	2 Striped bass (tagged CZR5006)
HBN	11 March	Gill net	1 gill net, 6 hrs.	0 fish
HBN	11-12 March	Gill net	1 gill net, 17.25 hrs.	0 fish
HBN	12 March	Gill net	1 gill net, 6 hrs.	1 Blue catfish
HBN	12-13 March	Gill net	1 gill net, 18 hrs.	1 American shad

Appendix A. (continued)

Site ^a	Date	Gear	Level of Effort	Catch
TC	25 February	Gill net	1 gill net, 4.75 hrs	2 Hybrid striped bass
TC	25-26 February	Gill net	1 gill net, 17 hrs	0 fish
TC	11 March	Gill net	1 gill net, 4.75 hrs.	1 Striped bass, 1 Hybrid striped bass, 1 Longnose gar, 1 Gizzard shad
TC	11-12 March	Gill net	1 gill net, 17 hrs.	1 Striped bass, 6 American shad, 1 Blue catfish, 1 Longnose gar
TC	12 March	Gill net	1 gill net, 5.75 hrs.	1 Blue catfish, 1 Gizzard shad
TC	12-13 March	Gill net	1 gill net, 18 hrs.	1 American shad
TC	13 March	Gill net	1 gill net, 6.5 hrs.	2 Gizzard shad
TC	13-14 March	Gill net	1 gill net, 18.75 hrs.	1 Striped bass, 2 Blue catfish, 1 Longnose gar, 1 Gizzard shad
TC	14 March	Gill net	1 gill net, 5.25 hrs.	2 Blue catfish
TC	18 March	Gill net	1 gill net, 6 hrs.	1 Striped bass (tagged CZR5014), 1 Blue catfish, 1 Longnose gar
TC	18-19 March	Gill net	1 gill net, 18 hrs.	1 American shad, 2 Blue catfish
TC	19 March	Gill net	1 gill net, 6 hrs.	1 American shad, 2 Longnose gar, 1 Bluegill
TC	19-20 March	Gill net	1 gill net, 17.5 hrs.	1 Striped bass, 2 American shad, 1 Blue catfish, 2 Longnose gar
TC	20 March	Gill net	1 gill net, 6 hrs.	2 American shad
TC	20-21 March	Gill net	1 gill net, 17.75 hrs.	1 Blue catfish, 2 Gizzard shad
TC	21 March	Gill net	1 gill net, 5 hrs.	1 American shad
NB	25 February	Gill net	1 gill net, 5.75 hrs	0 fish

Appendix A. (continued)

Site ^a	Date	Gear	Level of Effort	Catch
NB	25-26 February	Gill net	1 gill net, 17.5 hrs	0 fish
SB	4 March	Gill net	1 gill net, 5.25 hrs.	3 American shad
SB	4-5 March	Gill net	1 gill net, 17.5 hrs.	0 fish
SB	5 March	Gill net	1 gill net, 7 hrs.	0 fish
SB	5-6 March	Gill net	1 gill net, 15.25 hrs.	1 American shad, 1 Longnose gar
BB	28 March	Gill net	1 sturgeon net, 22.5 hrs.	0 fish
BB	29 March	Gill net	1 sturgeon net, 25 hrs.	0 fish
BB	2 April	Gill net	1 sturgeon net, 25 hrs.	0 fish
BB	4 April	Gill net	1 sturgeon net, 20.5 hrs.	0 fish
BB	9 April	Gill net	1 sturgeon net, 17.75 hrs.	1 Longnose gar
BB	10 April	Gill net	1 sturgeon net, 17.75 hrs.	0 fish
BB	16 May	Gill net	1 sturgeon net, 20.25 hrs.	0 fish
BB	17 May	Gill net	1 sturgeon net, 22.25 hrs.	3 Longnose gar
BB	22 May	Gill net	1 sturgeon net, 15.5 hrs.	4 Longnose gar
BB	23 May	Gill net	1 sturgeon net, 24 hrs.	0 fish
BB	24 May	Gill net	1 sturgeon net, 25.25 hrs.	0 fish

Appendix A. (continued)

Site ^a	Date	Gear	Level of Effort	Catch
NV	13 February	Hook and line	3 rod and reel, 3 hooks, 4 hrs.	0 fish
NV	14 February	Hook and line	3 rod and reel, 3 hooks, 4 hrs.	0 fish
NV	2 April	Gill net	1 sturgeon net, 22.25 hrs.	0 fish
NV	4 April	Gill net	1 sturgeon net, 19 hrs.	0 fish
NV	9 April	Gill net	1 sturgeon net, 17.5 hrs.	0 fish
NV	10 April	Gill net	1 sturgeon net, 17.75 hrs.	0 fish
NV	16 May	Gill net	1 sturgeon net, 20.25 hrs.	0 fish
NV	17 May	Gill net	1 sturgeon net, 22.25 hrs.	0 fish
NV	22 May	Gill net	1 sturgeon net, 16.75 hrs.	0 fish
NV	23 May	Gill net	1 sturgeon net, 24.5 hrs.	0 fish
NV	24 May	Gill net	1 sturgeon net, 24 hrs.	0 fish
NV	31 May	Gill net	1 sturgeon net, 16 hrs.	0 fish
NV	5 June	Gill net	1 sturgeon net, 16.25 hrs.	0 fish
BC	2 April	Gill net	1 sturgeon net, 23.5 hrs.	0 fish
BC	4 April	Gill net	1 sturgeon net, 20.25 hrs.	0 fish

Appendix A. (continued)

Site ^a	Date	Gear	Level of Effort	Catch
IC	26-27 February	Gill net	1 gill net, 18 hrs	0 fish
IC	27-28 February	Gill net	1 gill net, 23 hrs	1 American shad, 2 Bowfin
IC	4 March	Gill net	1 gill net, 4.75 hrs.	1 Hybrid striped bass
IC	4-5 March	Gill net	1 gill net, 18 hrs.	1 Flathead catfish, 1 Bowfin
IC	5 March	Gill net	1 gill net, 6.75 hrs.	1 Hybrid striped bass
IC	5-6 March	Gill net	1 gill net, 17.5 hrs.	0 fish
IC	6 March	Gill net	1 gill net, 6 hrs.	2 Bowfin
IC	6-7 March	Gill net	1 gill net, 17.75 hrs.	2 American shad
IC	11 March	Gill net	1 gill net, 6.25 hrs.	1 Bowfin, 1 turtle
IC	11-12 March	Gill net	1 gill net, 17 hrs.	1 American shad, 2 Blue catfish, 1 Gizzard shad, 1 Bowfin
IC	12 March	Gill net	1 gill net, 5.75 hrs.	1 Bowfin
IC	12-13 March	Gill net	1 gill net, 18.25 hrs.	2 American shad, 1 Bowfin
IC	13 March	Gill net	1 gill net, 6.25 hrs.	1 American shad, 1 Bowfin
IC	13-14 March	Gill net	1 gill net, 19 hrs.	2 Striped bass(1 tagged CZR5013), 1 American shad, 1 Bowfin
IC	14 March	Gill net	1 gill net, 4.5 hrs.	0 fish
IC	18 March	Gill net	1 gill net, 6.25 hrs.	0 fish
IC	18-19 March	Gill net	1 gill net, 18.75 hrs.	3 American shad, 2 Blue catfish, 1 Gizzard shad, 1 Southern flounder
IC	19 March	Gill net	1 gill net, 6 hrs.	2 American shad, 1 Blue catfish

Appendix A. (continued)

Site ^a	Date	Gear	Level of Effort	Catch
IC	19-20 March	Gill net	1 gill net, 17.75 hrs.	2 American shad, 3 Blue catfish, 1 Gizzard shad, 1 Bowfin
IC	20 March	Gill net	1 gill net, 5.25 hrs.	5 American shad
IC	20-21 March	Gill net	1 gill net, 18 hrs.	5 American shad, 4 Blue catfish
IC	21 March	Gill net	1 gill net, 4.25 hrs.	0 fish
IC	28 March	Gill net	1 sturgeon net, 22 hrs.	0 fish
IC	2 April	Gill net	1 sturgeon net, 24 hrs.	0 fish
IC	24 May	Gill net	1 sturgeon net, 17.5 hrs.	0 fish
IC	31 May	Gill net	1 sturgeon net, 17 hrs.	0 fish
IC	5 June	Gill net	1 sturgeon net, 16.75 hrs.	0 fish
CC	27-28 February	Gill net	1 gill net, 23 hrs	1 Hybrid striped bass, 1 Blue catfish, 2 Bowfin
CC	6 March	Gill net	1 gill net, 5.75 hrs.	0 fish
CC	6-7 March	Gill net	1 gill net, 18 hrs.	1 Flathead catfish
CC	11 March	Gill net	1 gill net, 6.25 hrs.	0 fish
CC	11-12 March	Gill net	1 gill net, 17 hrs.	1 American shad
CC	12 March	Gill net	1 gill net, 5.75 hrs.	1 Gizzard shad
CC	12-13 March	Gill net	1 gill net, 18.5 hrs.	1 American shad, 1 Bowfin
LCF	4 March	Gill net	1 gill net, 4.5 hrs.	0 fish

Appendix A. (continued)

Site ^a	Date	Gear	Level of Effort	Catch
LCF	4-5 March	Gill net	1 gill net, 18 hrs.	2 Blue catfish
LCF	5 March	Gill net	1 gill net, 6.25 hrs.	0 fish
LCF	5-6 March	Gill net	1 gill net, 15.5 hrs.	0 fish
CP	20 March	Gill net	1 gill net, 6 hrs.	1 Striped bass, 3 Blue catfish, 3 Longnose gar
CP	20-21 March	Gill net	1 gill net, 17.75 hrs.	2 Blue catfish, 1 Bowfin
CP	21 March	Gill net	1 gill net, 5.25 hrs.	0 fish
LD1	15 April	Rod and Reel	2 Rods, 4 hooks, 1.5 hrs	4 American shad (CZR 5005, CZR5032-5034)
LD1	16 April	Rod and Reel	2 Rods, 4 hooks, 8 hrs	8 American shad (CZR 5035-5040, CZR5031, CZR5042)
LD1	17 April	Rod and Reel	3 Rods, 6 hooks, 8 hrs	8 American shad (CZR 5043-5050)
LD1	22 April	Rod and Reel	2 Rods, 4 hooks, 1.5 hrs	4 American shad (CZR 5051-5054)
LD1	23 April	Gill net	1 gill net, 2 hrs	2 American shad (CZR 5055-5056)
LD1	24 April	Rod and Reel	2 Rods, 4 hooks, 1.5 hrs	2 American shad (CZR5057-5058)
LD1	24 April	Gill net	1 gill net, 1 hrs	2 American shad (CZR 5059-5060)
LD1	4 June	Seine net	1 seine, 3 hrs.	50 American shad, 50 catfish sp., many juvenile gizzard shad
LD1	4 June	Gill net	1 gill net, 2 hrs	1 Striped bass (CZR 5005)
LD1	4 June	Shocking boat	1 boat, .50 hrs (WRC)	Many non target fish were raised but no fish were tagged during this effort.

Appendix A. (continued)

Site ^a	Date	Gear	Level of Effort	Catch
LD1	5 June	Seine net	1 seine, 3 hrs	50 American shad, 50 catfish sp., many juvenile gizzard shad
LD1	5 June	Gill net	1 gill net, 2 hrs	5 American shad
LD1	6 June	Seine net	1 seine, 3 hrs	50 American shad, 50 catfish sp., many juvenile gizzard shad
LD1	6 June	Gill net	1 gill net, 2 hrs	3 American shad
LD1	6 June	Gill net	1 shad net, 2 hrs	5 American shad
LD1	10 June	Gill net	1 net, 5.5 hrs	0 fish
WC	23 April	Gill net	1 Sturgeon net, 16.25 hrs	1 Atlantic Sturgeon (CZR5061 and CZR5071)
WC	24 April	Gill net	1 Sturgeon net, 22.5 hrs	1 Atlantic Sturgeon (recapture of CZR5061 and CZR5071)
WC	30 April	Gill net	1 Sturgeon net, 18 hrs	0 fish
WC	30 April	Gill net	1 Sturgeon net, 18 hrs	0 fish
WC	16 May	Gill net	1 Sturgeon net, 22 hrs.	0 fish
WC	6 June	Gill net	1 Sturgeon net, 16.5 hrs.	0 fish
WC	11 June	Gill net	1 Sturgeon net, 22 hrs.	0 fish
UCF1	24 April	Gill net	1 Sturgeon net, 17 hrs.	0 fish
UCF1	25 April	Gill net	1 Sturgeon net, 22 hrs.	0 fish
UCF1	16 May	Gill net	1 Sturgeon net, 22 hrs.	1 Flathead catfish

Appendix A. (concluded)

Site ^a	Date	Gear	Level of Effort	Catch
UCF1	6 June	Gill net	1 Sturgeon net, 16.5 hrs.	0 fish
UCF1	11 June	Gill net	1 Sturgeon net, 22 hrs.	0 fish
UCF2	25 April	Gill net	1 Sturgeon net, 22.5 hrs.	1 Flathead catfish
UCF2	30 April	Gill net	1 Sturgeon net, 17 hrs.	1 Flathead catfish
UCF2	3 May	Gill net	1 Sturgeon net, 17.75 hrs.	0 fish
UCF2	16 May	Gill net	1 Sturgeon net, 22.5 hrs.	0 fish
BR1	30 April	Gill net	1 Sturgeon net, 20.25 hrs.	1 Atlantic sturgeon
BR1	3 May	Gill net	1 Sturgeon net, 17.25 hrs.	0 fish
BR1	22 May	Gill net	1 Sturgeon net, 23.75 hrs.	0 fish
BR1	23 May	Gill net	1 Sturgeon net, 23.75 hrs.	0 fish
BR1	24 May	Gill net	1 Sturgeon net, 23.75 hrs.	1 Atlantic sturgeon
BR2	22 May	Gill net	1 Sturgeon net, 23.25 hrs.	0 fish
BR2	23 May	Gill net	1 Sturgeon net, 25 hrs.	0 fish
BR2	24 May	Gill net	1 Sturgeon net, 23.5 hrs.	0 fish
BR2	31 May	Gill net	1 Sturgeon net, 18 hrs.	0 fish
HC	3 May	Gill net	1 Sturgeon net, 17.25 hrs.	0 fish

^a Sites: PP - Pt. Peter

Appendix A. (continued)

HBS - Horseshoe Bend South

HBN - Horseshoe Bend North

TC - Toomer's Creek

NV - Navassa Train Bridge

NB - North Brunswick River

SB - South Brunswick River

BB - Brunswick River at NC 74/76 Bridge

BC - Bypass Creek on Brunswick River south of Sturgeon Creek

IC - Indian Creek

CC - Catfish Creek

LCF - Lower Cape Fear River

LD1 - Lock and Dam #1

CP - Cypress Point

UCF1 - Upper Cape Fear River at mile marker 34.5

UCF2 - Upper Cape Fear River at mile marker 32.75

WC - Waymans Creek

BR1 - Black River at the Cape Fear River

BR2 - Black River at the Cape Fear River

HC - Hood Creek

APPENDIX B

MAPS



LEGEND

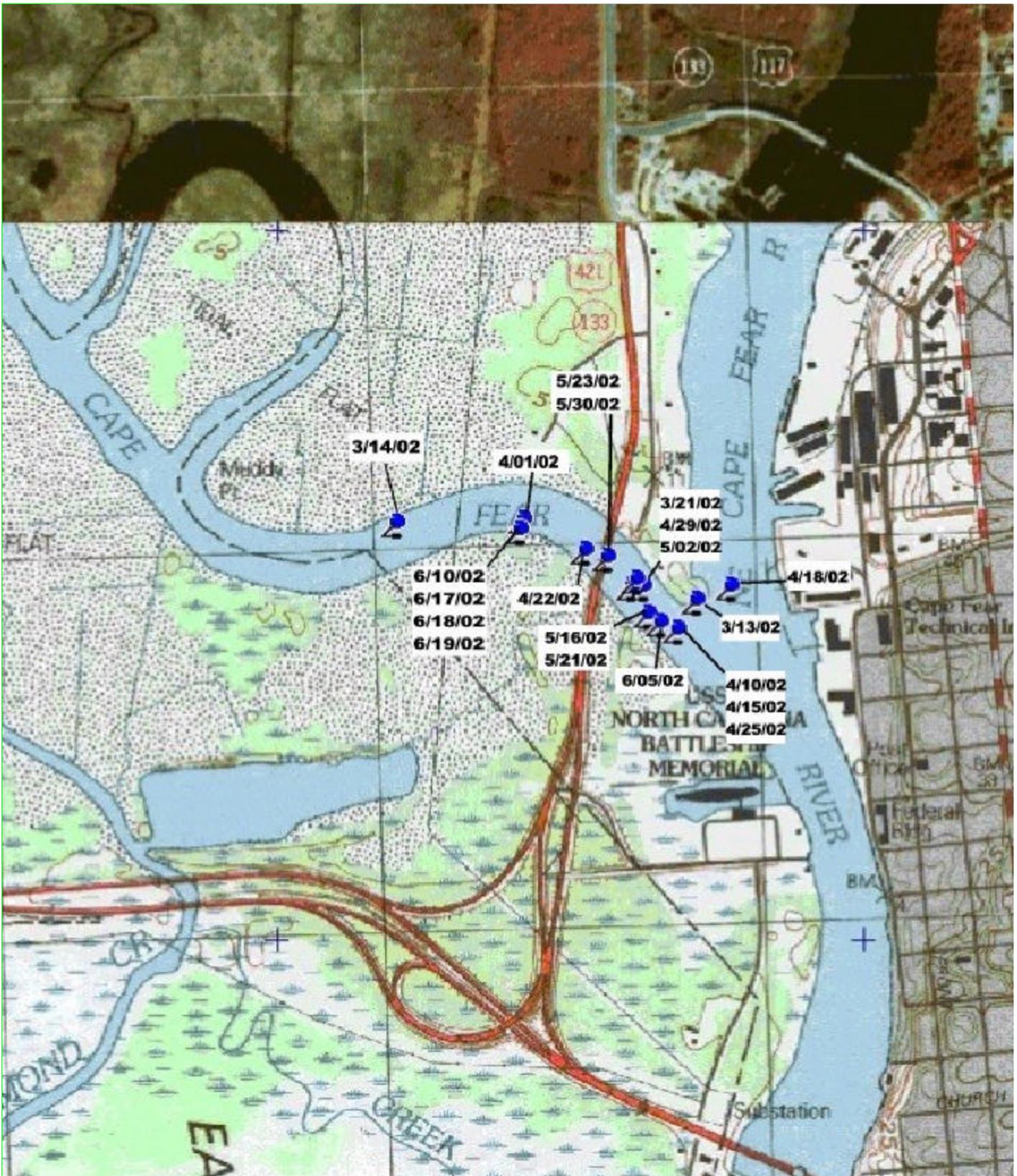
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SITE OF RELOCATED STRIPED BASS
CZR5001

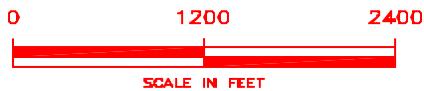
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WILMINGTON USACOE FISH PASSAGE

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		CP#1645.32
4708 COLLEGE ACRES DRIVE SUITE 2 WILMINGTON, NORTH CAROLINA 28403 TEL 810/392-9253 FAX 810/392-9139		APPENDIX B1



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 3/13/02



**SITE OF RELOCATED STRIPED BASS
CZR5002**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: TLJ
DATE: 08/13/02		FILE: CZR5002
		CP#1645.32
4708 COLLEGE ACRES DRIVE SUITE 2 WILMINGTON, NORTH CAROLINA 28403 TEL 810/202-0253 FAX 810/392-9139		APPENDIX B2



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 3/13/02



SITE OF RELOCATED STRIPED BASS
CZR5002

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

SCALE: AS SHOWN
DATE: 08/19/02

APPROVED BY:

DRAWN BY: TLJ
FILE: CZR5002B



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APPENDIX B3



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 3/14/02



SITE OF RELOCATED STRIPED BASS
CZR5003

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: TLJ
DATE: 08/13/02		FILE: CZR5003



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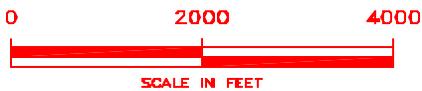
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APPENDIX B4



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 3/14/02



**SITE OF RELOCATED STRIPED BASS
CZR5003**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

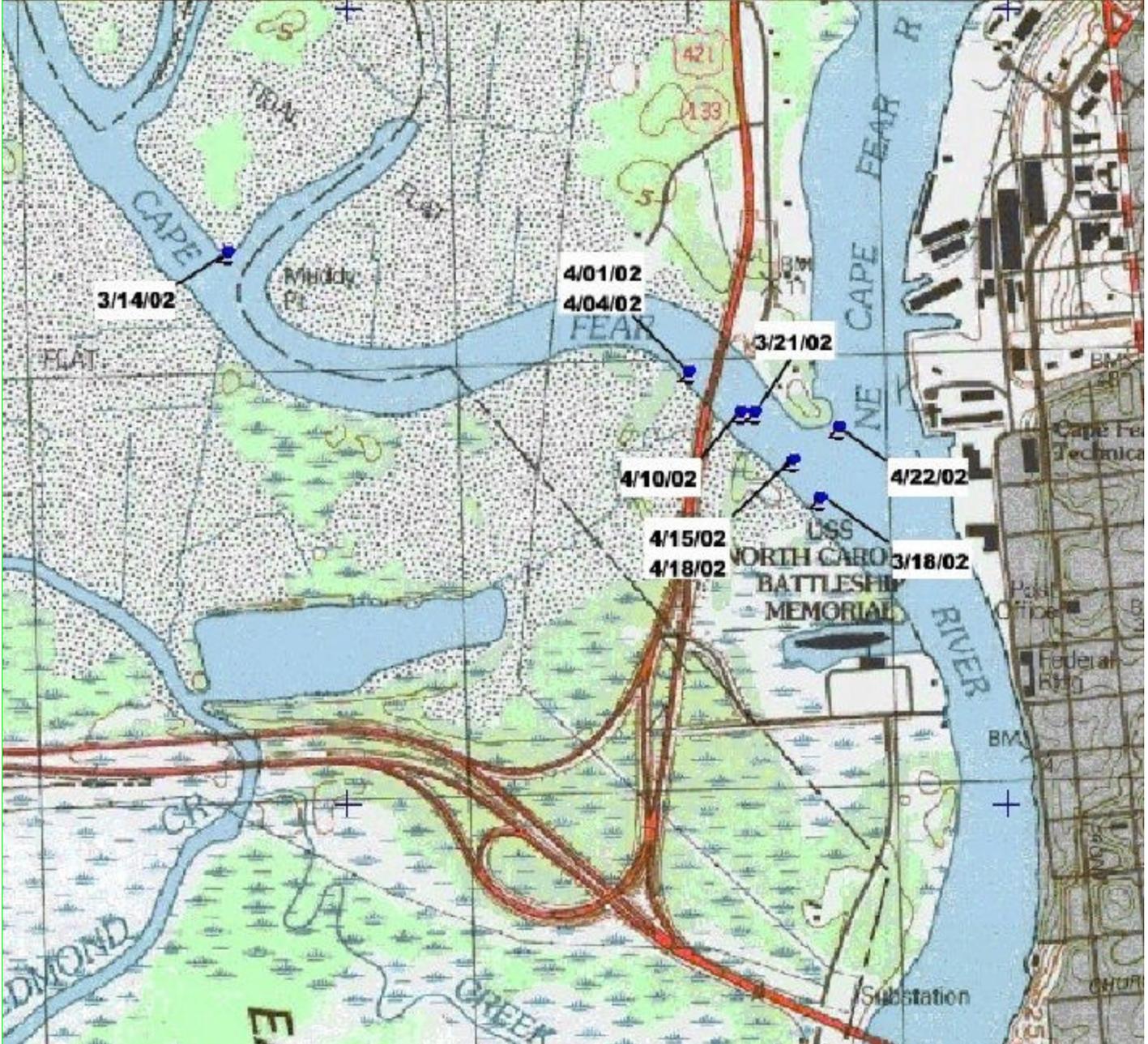
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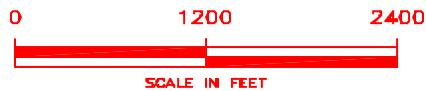
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APPENDIX B6



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 3/14/02



SITE OF RELOCATED STRIPED BASS
CZR5004

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

SCALE: AS SHOWN
DATE: 08/13/02

APPROVED BY:

DRAWN BY: TLJ
FILE: CZR5004



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APPENDIX B7



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 3/14/02



SITE OF RELOCATED STRIPED BASS
CZR5004

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: TLJ
DATE: 08/19/02		FILE: CZR5004B



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APPENDIX B8



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 3/07/02



SITE OF RELOCATED STRIPED BASS
CZR5006

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

SCALE: AS SHOWN
DATE: 08/13/02

APPROVED BY:

DRAWN BY: TLJ
FILE: CZR5006



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APPENDIX B9



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 3/13/02



**SITE OF RELOCATED STRIPED BASS
CZR5007**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

SCALE: AS SHOWN
DATE: 08/13/02

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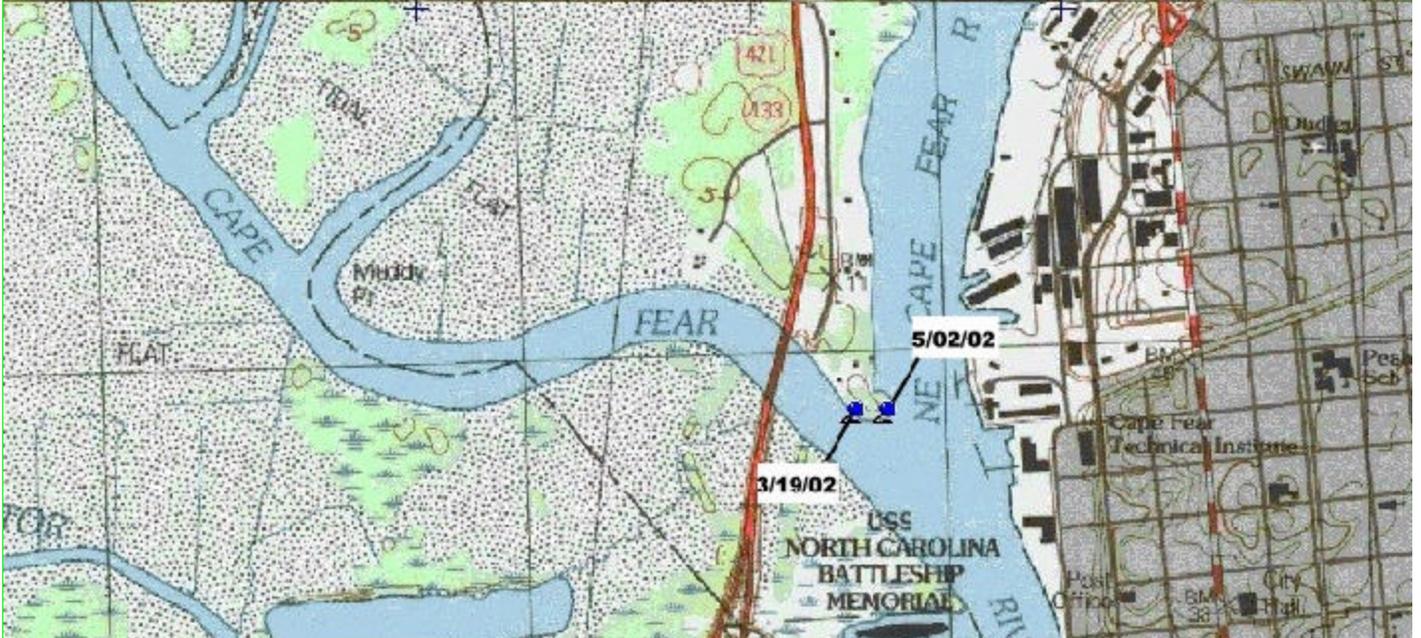
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APPENDIX B10



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 3/19/02



SITE OF RELOCATED STRIPED BASS
CZR5008

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

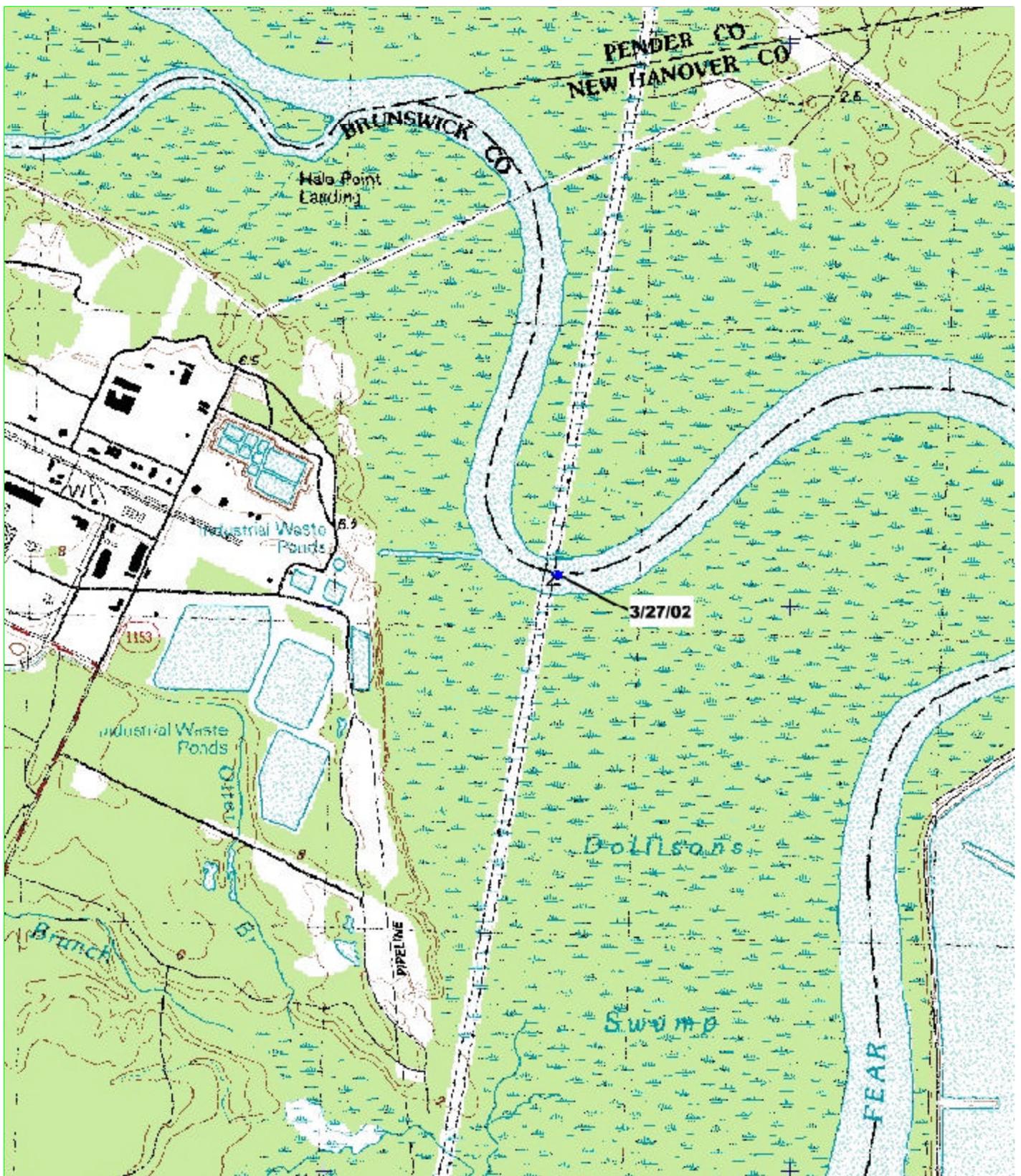
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CP#1645.32

APPENDIX B11



LEGEND

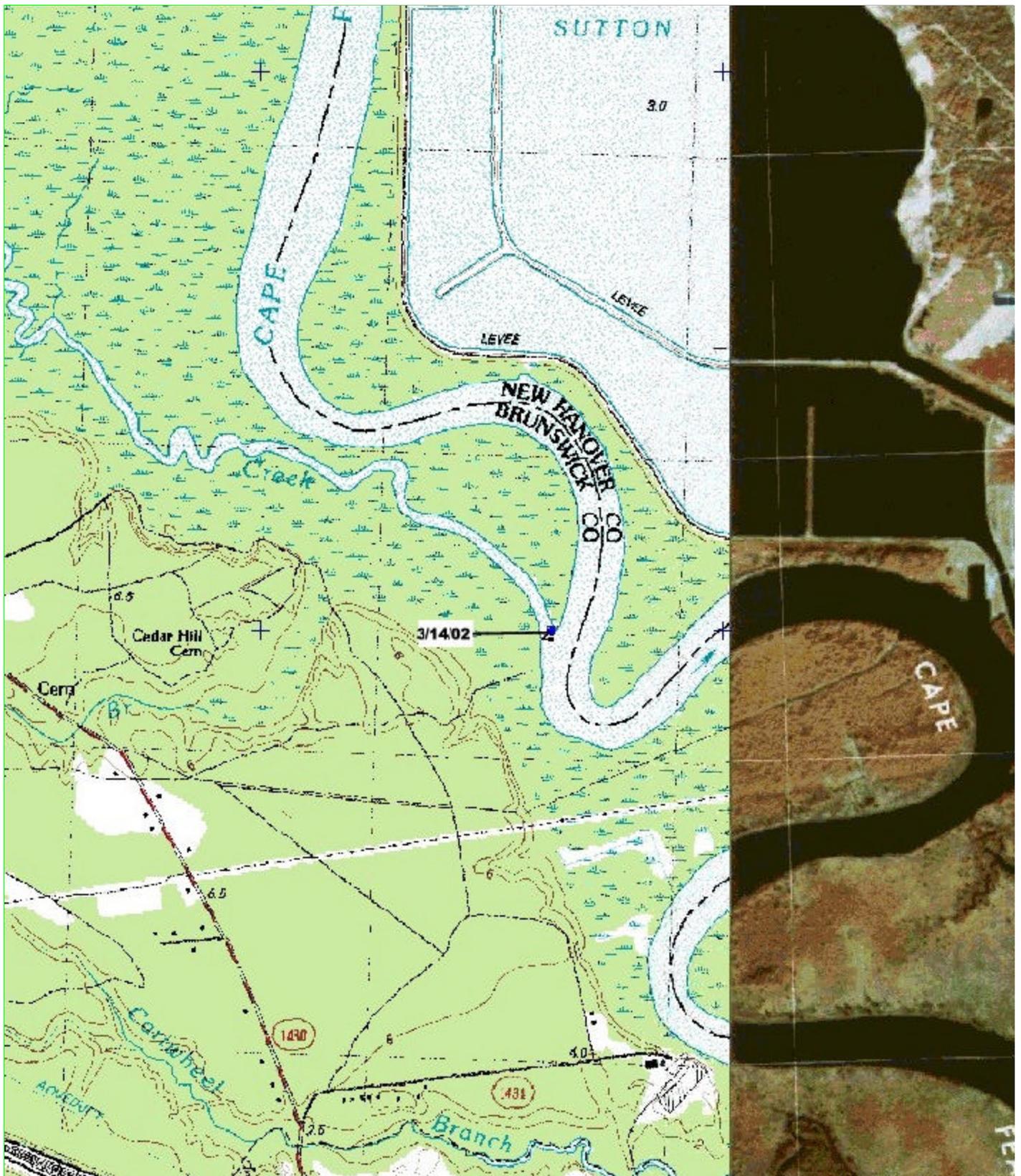
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**SITE OF RELOCATED STRIPED BASS
CZR5008**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

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		CP#1645.32
4708 COLLEGE ACRES DRIVE SUITE 2 WILMINGTON, NORTH CAROLINA 28403 TEL 810/282-9253 FAX 810/392-9139		APPENDIX B12



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 3/14/02



SITE OF RELOCATED STRIPED BASS
CZR5013

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: TLJ
DATE: 08/13/02		FILE: CZR5013



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APPENDIX B13



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 3/19/02



**SITE OF RELOCATED STRIPED BASS
CZR5014**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

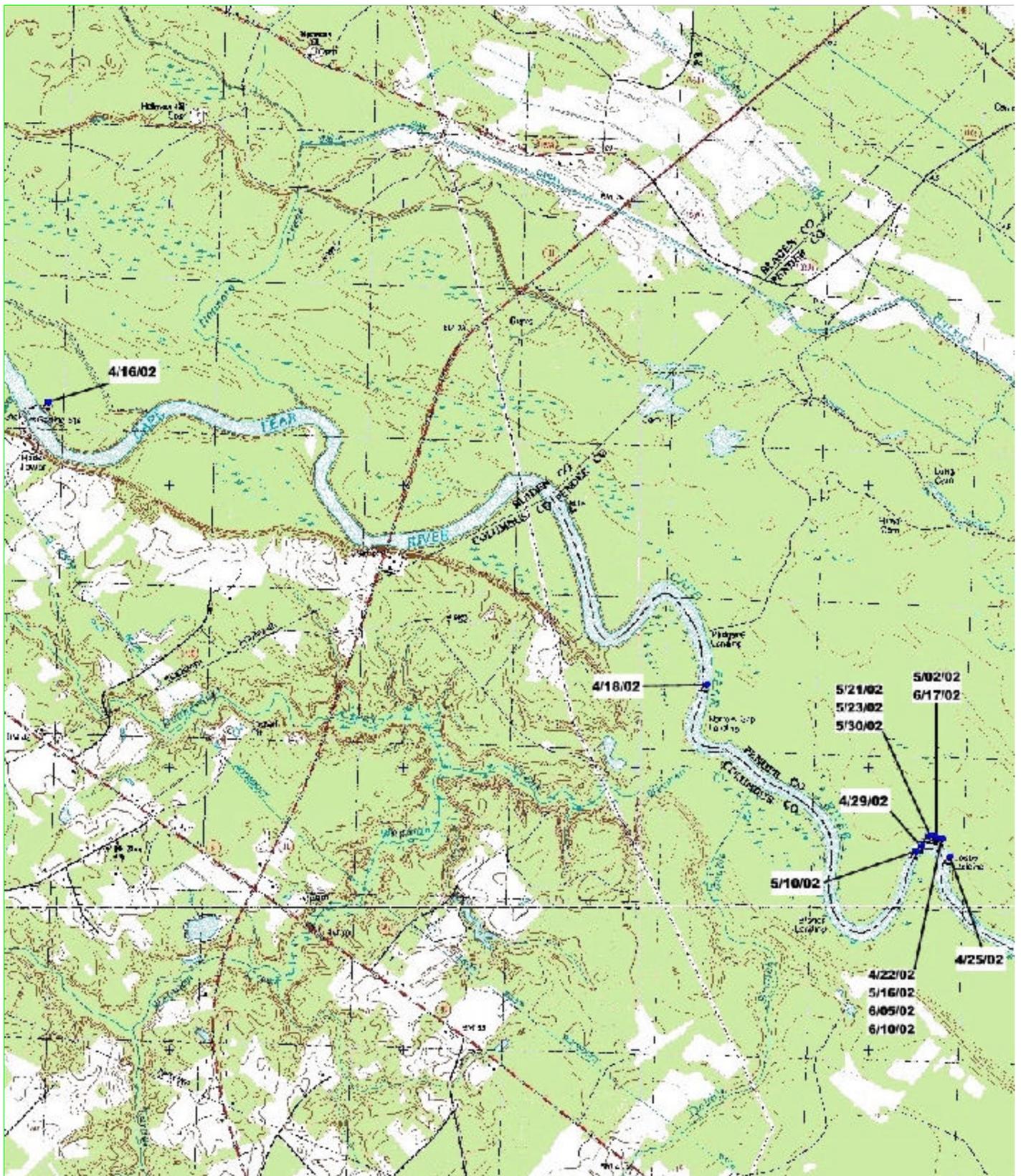
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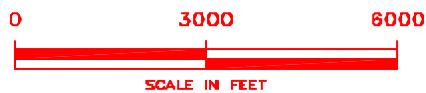
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APPENDIX B14



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/16/02



**SITE OF RELOCATED AMERICAN SHAD
CZR5031**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

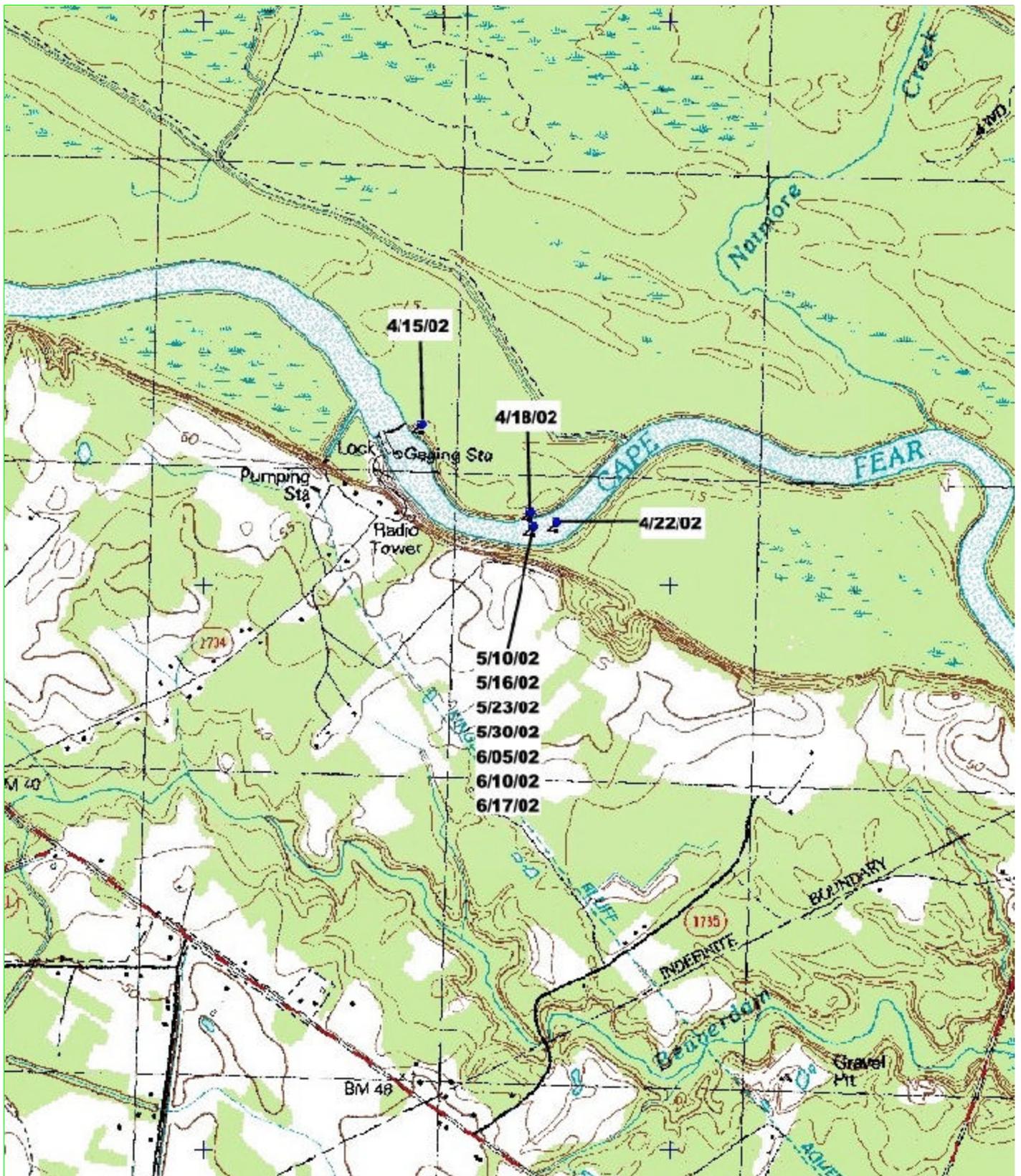
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APPENDIX B15



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/15/02



SITE OF RELOCATED AMERICAN SHAD
CZR5032

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

SCALE: AS SHOWN
DATE: 08/13/02

APPROVED BY:

DRAWN BY: TLJ

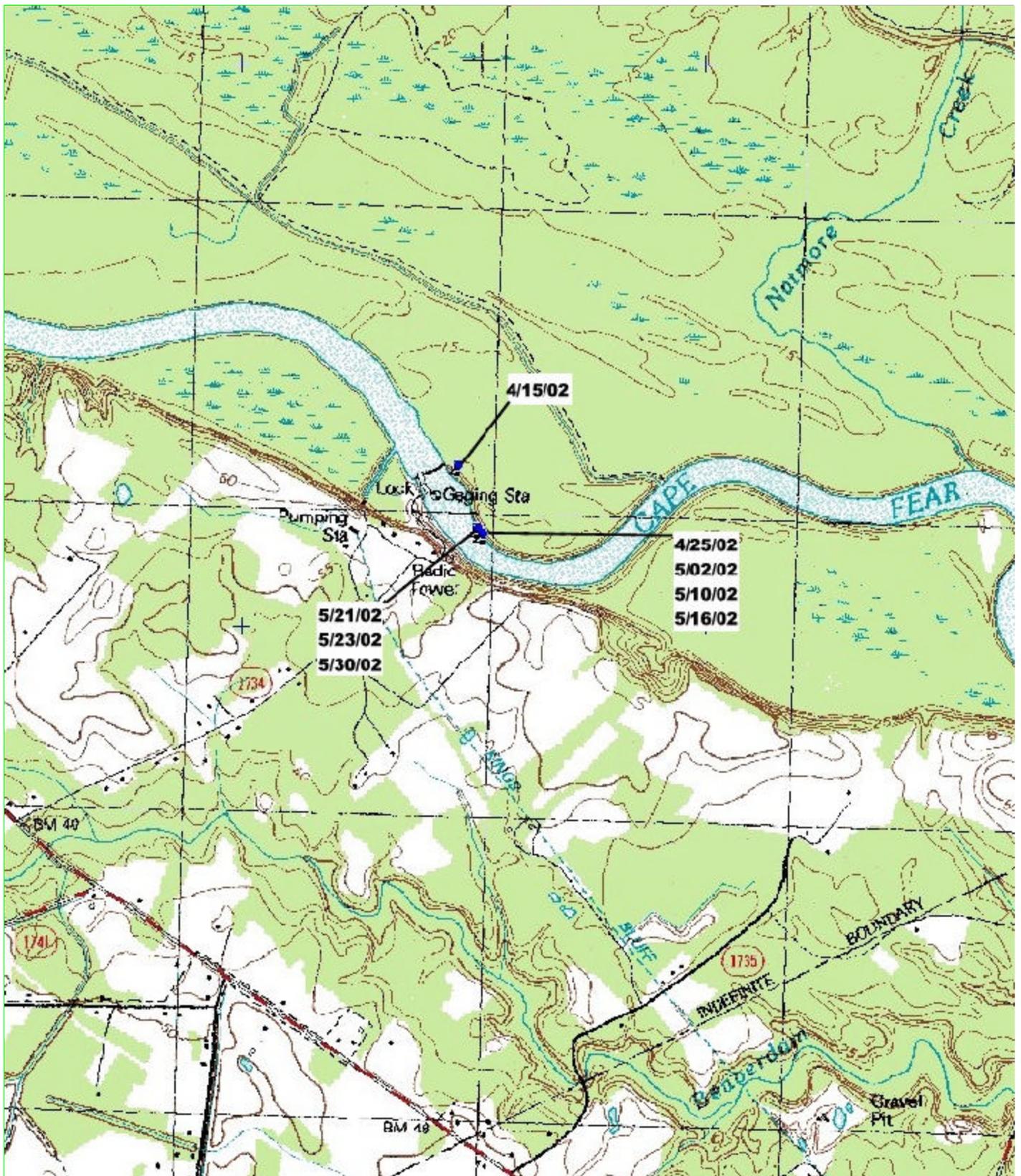
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CP#1645.32

APPENDIX B16



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/15/02



SITE OF RELOCATED AMERICAN SHAD
CZR5033

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

SCALE: AS SHOWN
DATE: 08/13/02

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DRAWN BY: TLJ

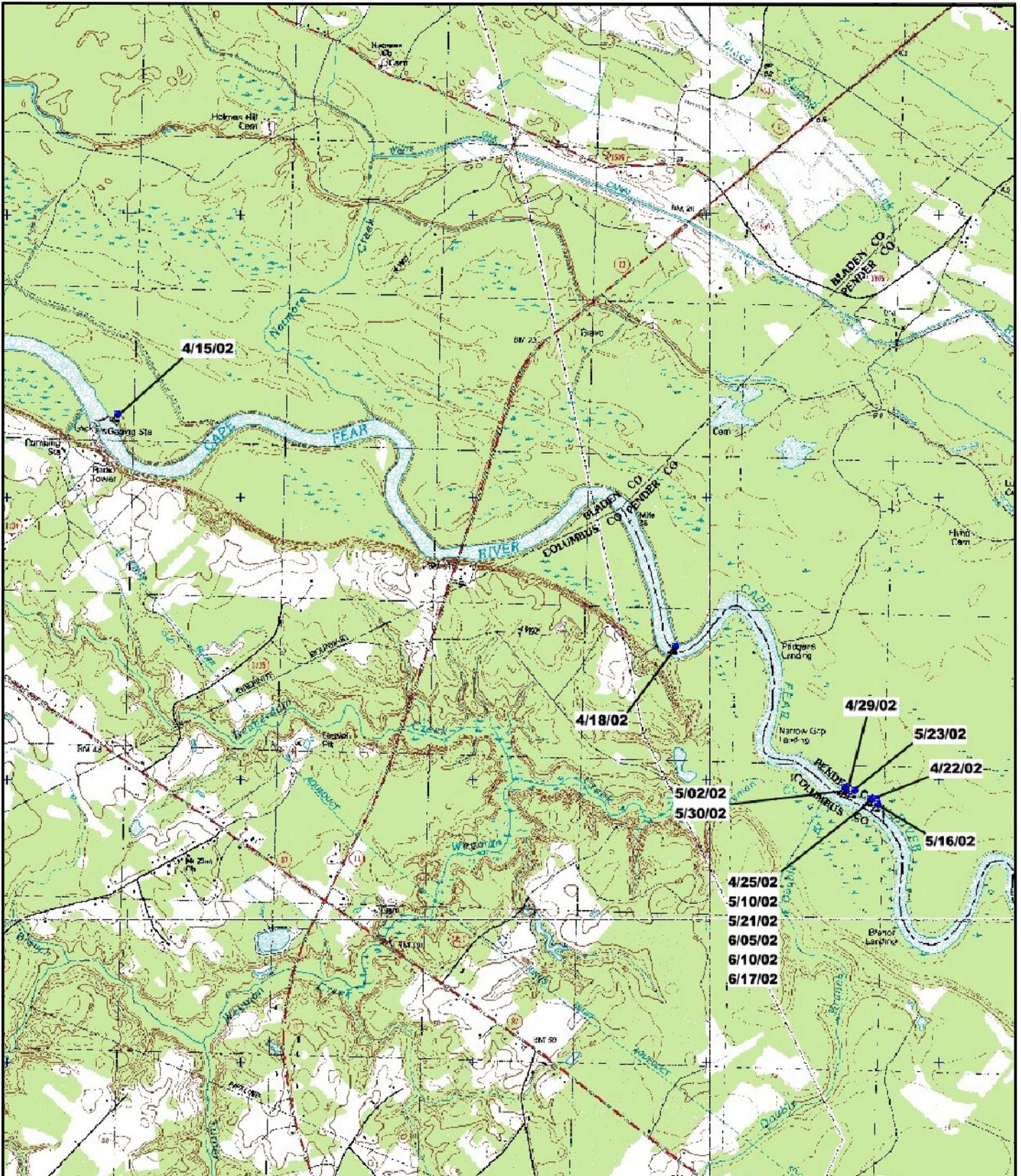
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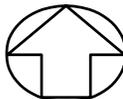
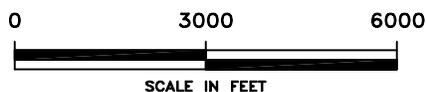
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APPENDIX B17



LEGEND

- **SITE OF RELOCATED FISH TAGGED ON 4/15/02**



SITE OF RELOCATED AMERICAN SHAD
CZR5034

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

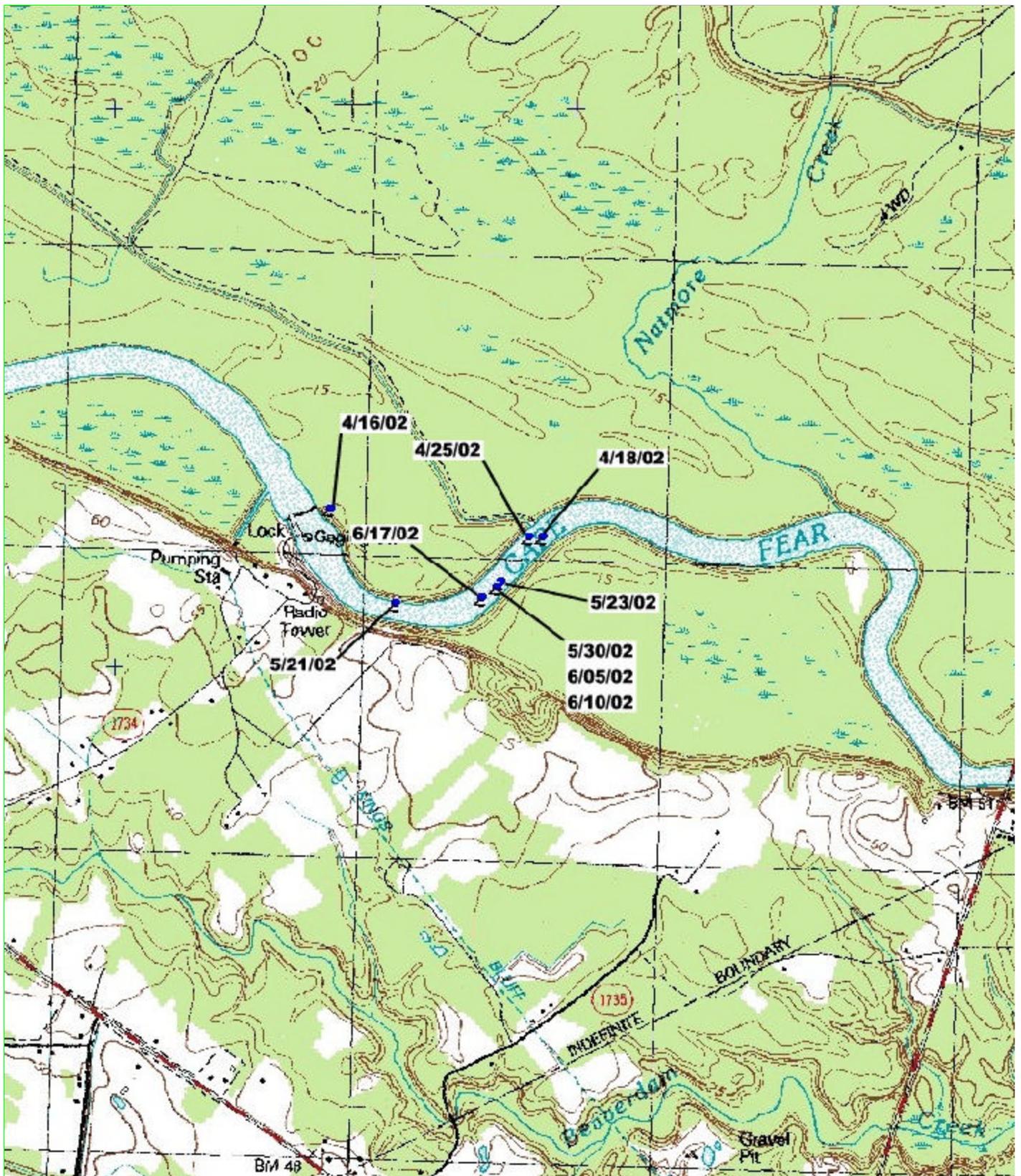
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CP#1645.32

APPENDIX B18



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/16/02



SITE OF RELOCATED AMERICAN SHAD
CZR5036

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

SCALE: AS SHOWN
DATE: 08/13/02

APPROVED BY:

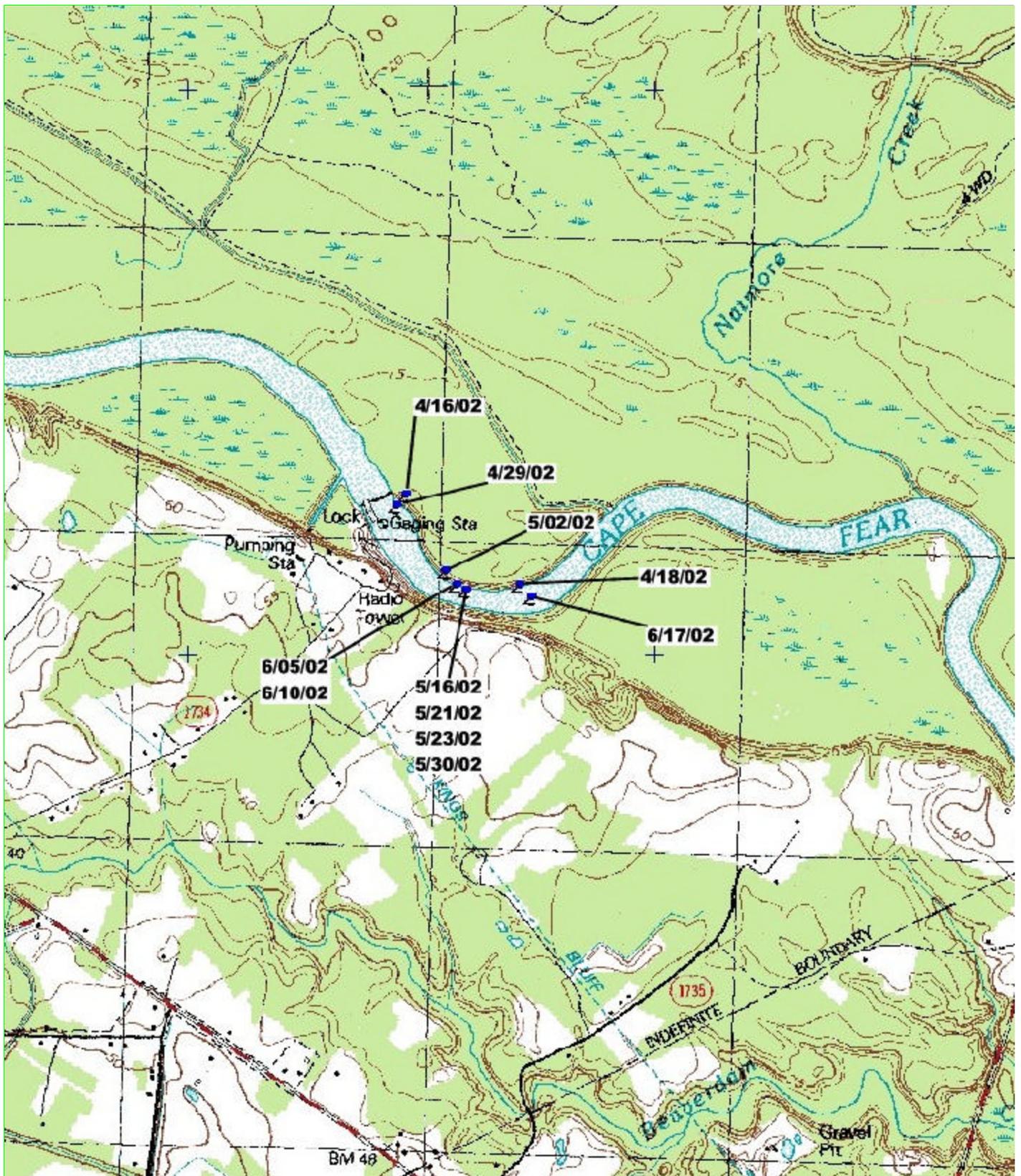
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CP#1645.32

APPENDIX B20



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/16/02



**SITE OF RELOCATED AMERICAN SHAD
CZR5037**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

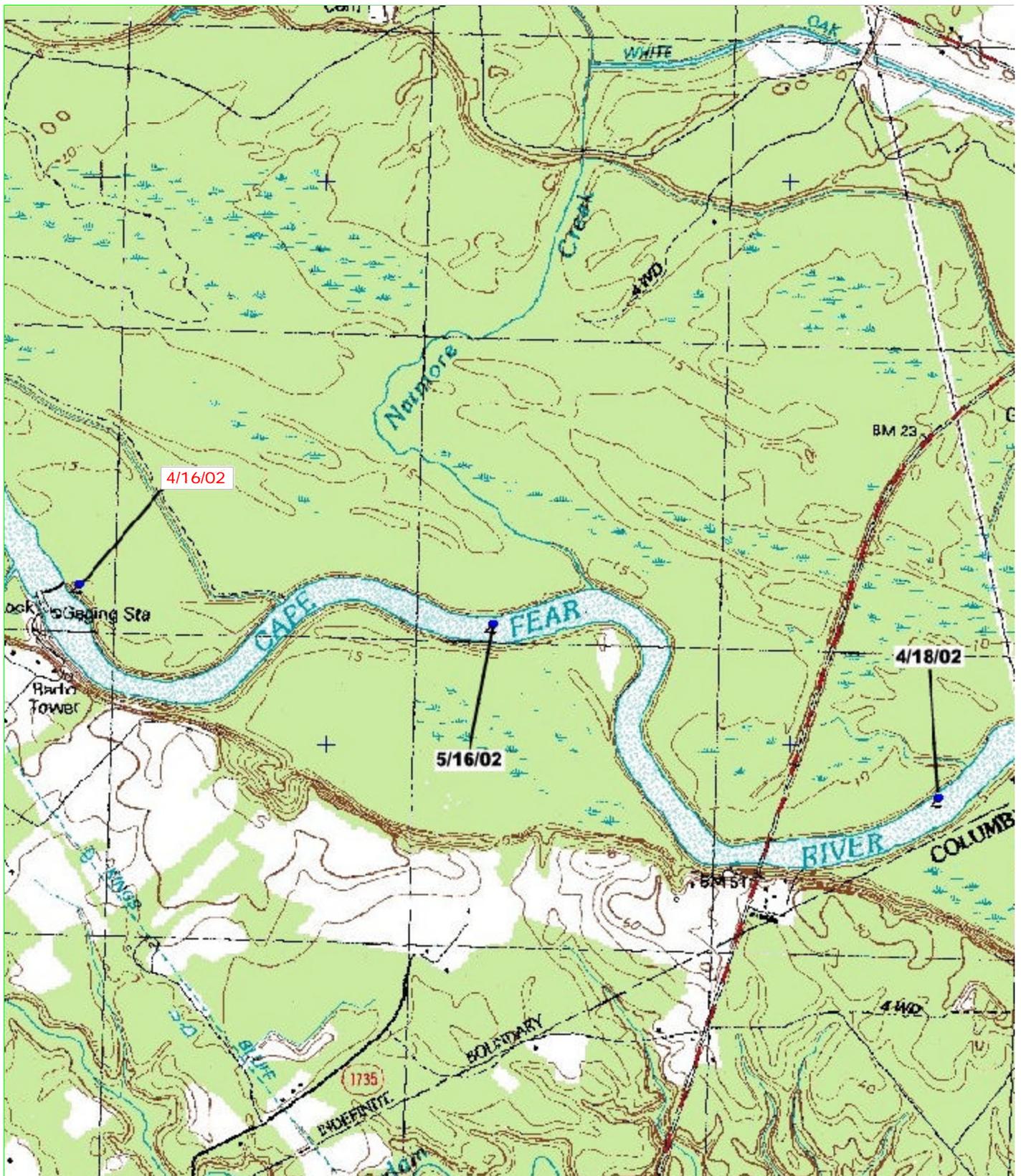
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TEL 810/282-0253
FAX 810/392-9139

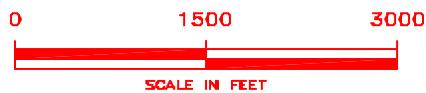
CP#1645.32

APPENDIX B21



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/16/02



SITE OF RELOCATED AMERICAN SHAD
CZR5038

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

SCALE: AS SHOWN
DATE: 08/13/02

APPROVED BY:

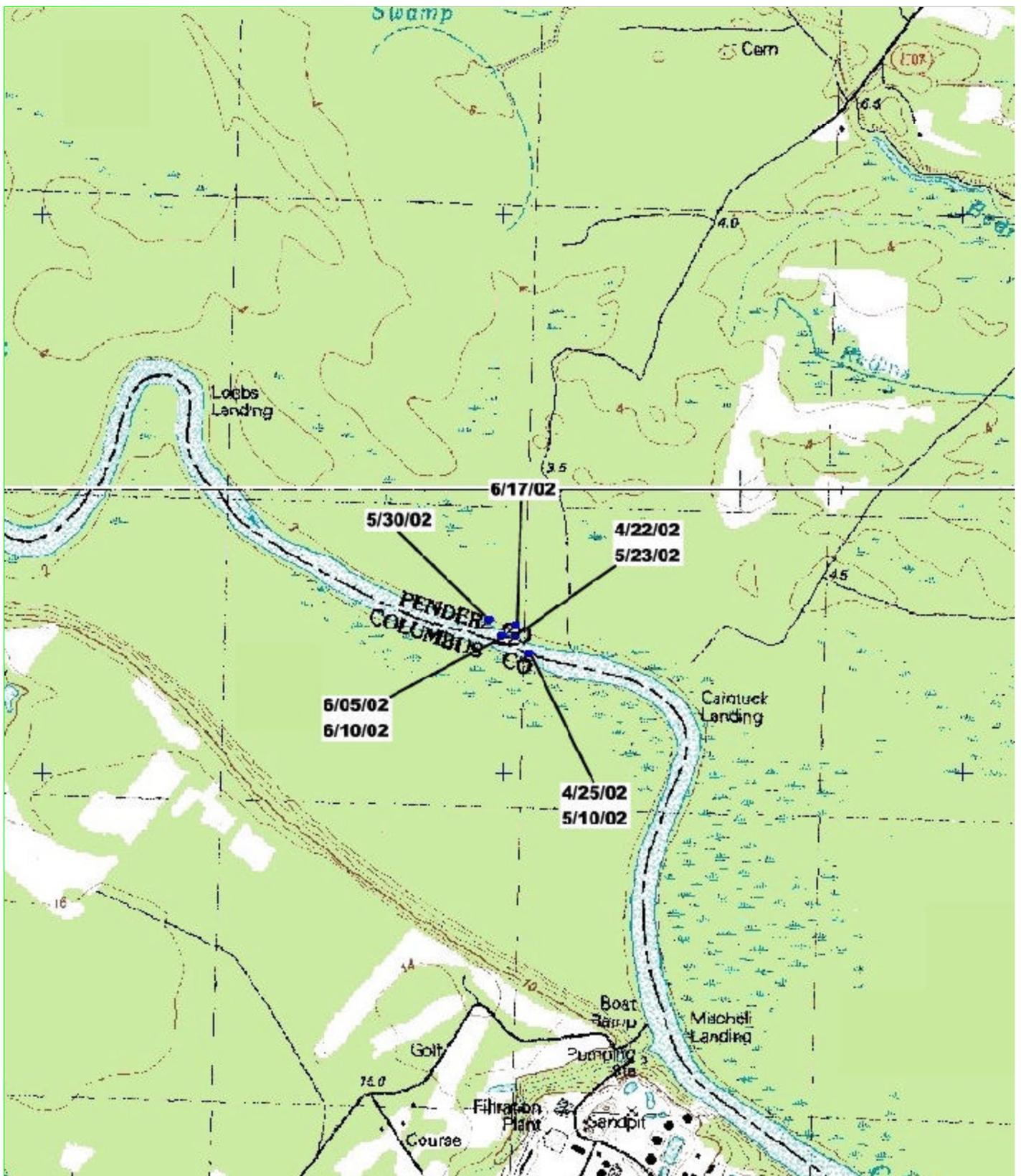
DRAWN BY: TLJ
FILE: CZR5038



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-0253
FAX 810/392-9139

CP#1645.32

APPENDIX B22



SITE OF RELOCATED AMERICAN SHAD
CZR5038

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: TLJ
DATE: 08/19/02		FILE: CZR5038B



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-0253
FAX 810/392-9139

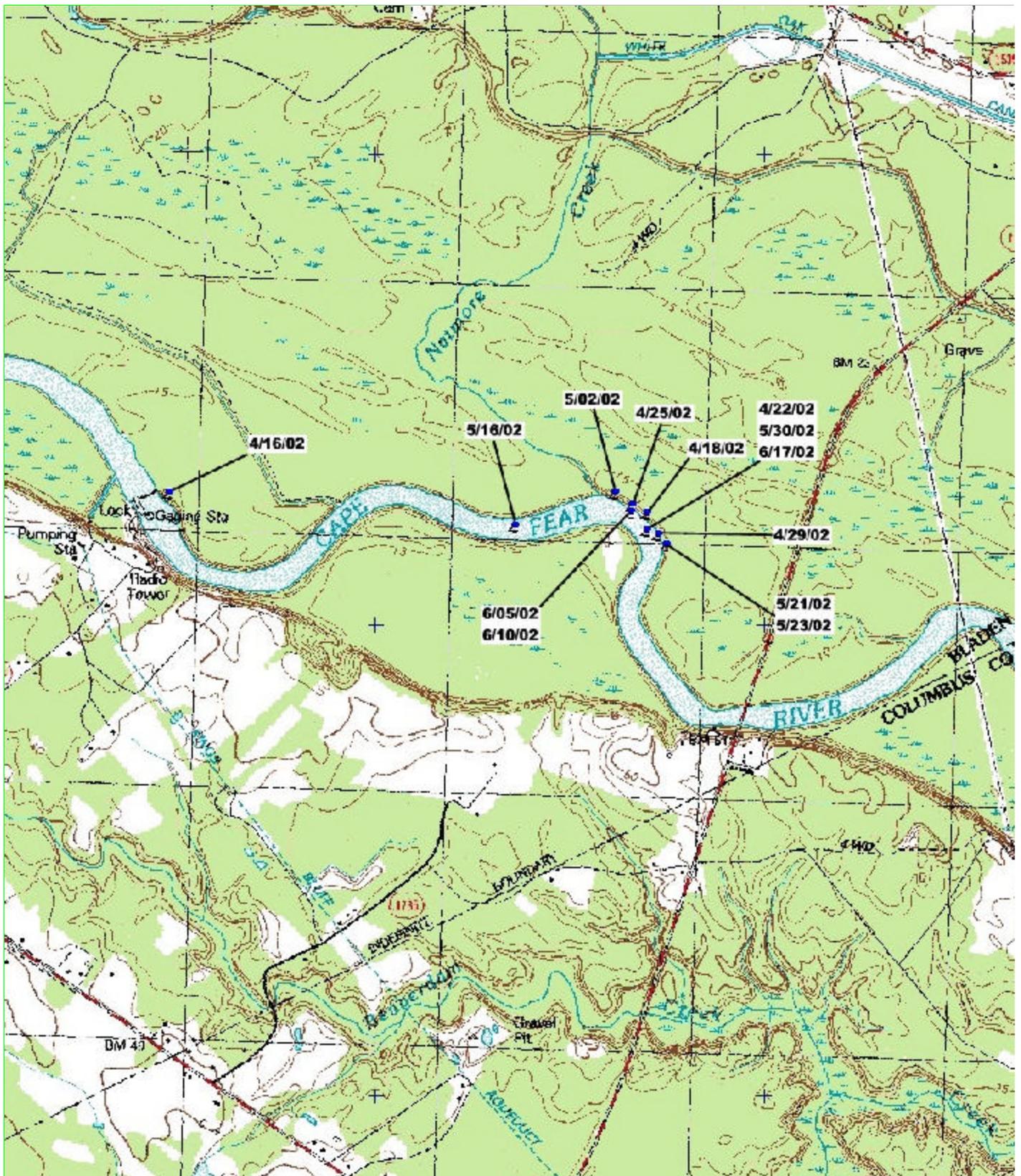
CP#1645.32

APPENDIX B23

LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/16/02





LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/16/02



**SITE OF RELOCATED AMERICAN SHAD
CZR5039**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

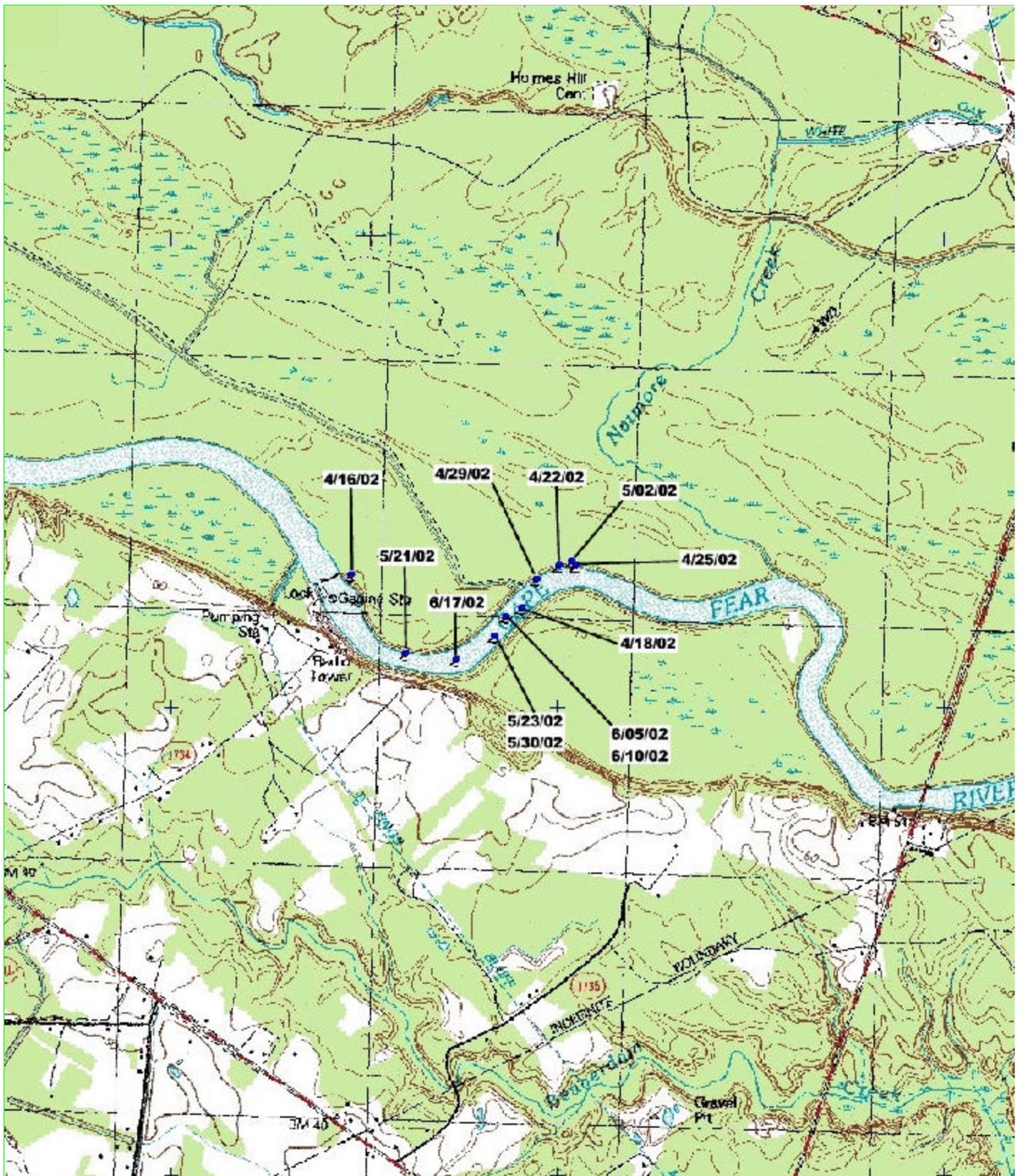
SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: TLJ
DATE: 08/13/02		FILE: CZR5039



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-0253
FAX 810/282-9139

CP#1645.32

APPENDIX B24



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/16/02



**SITE OF RELOCATED AMERICAN SHAD
CZR5040**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

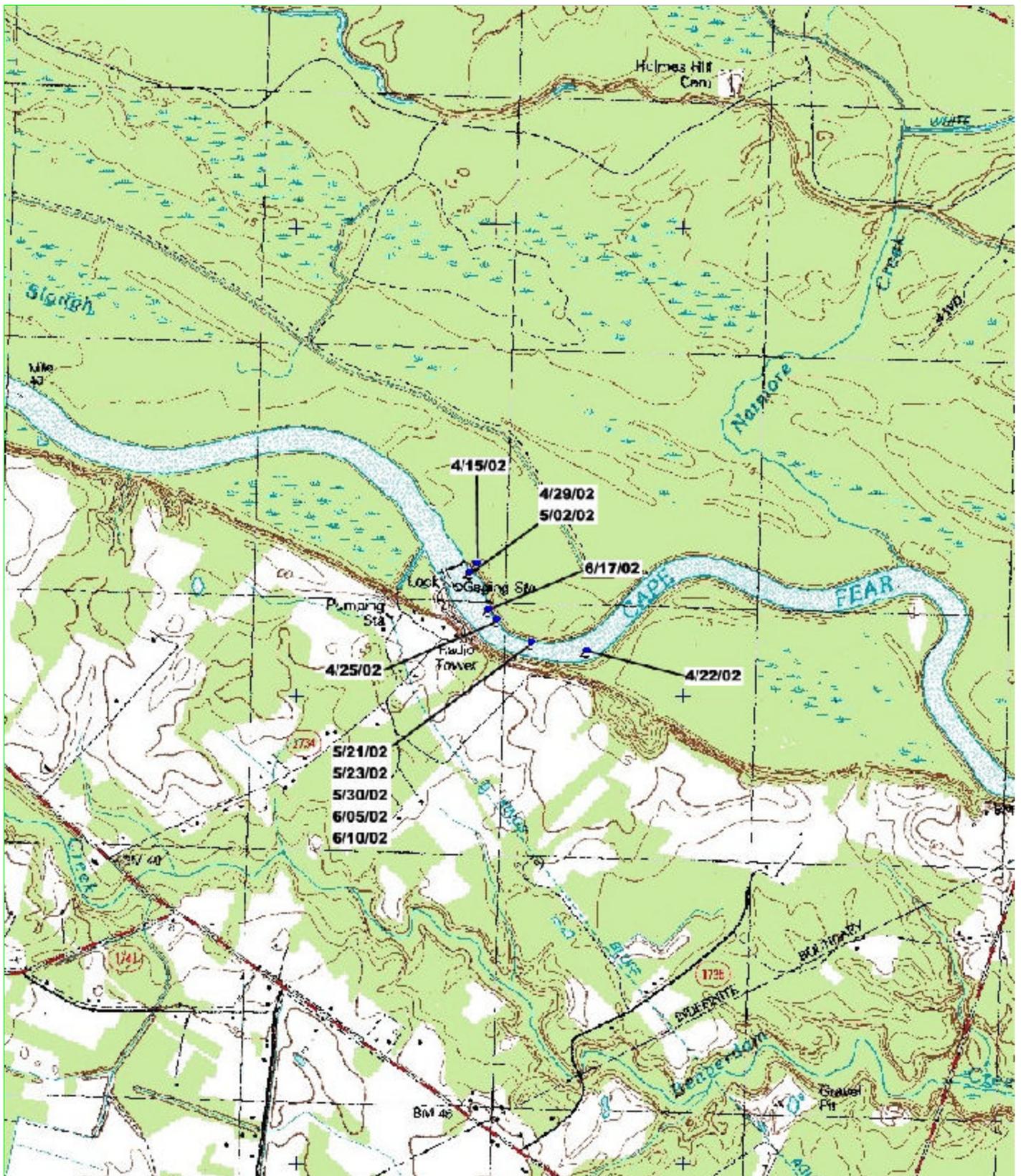
SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: TLJ
DATE: 08/13/02		FILE: CZR5040



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-0253
FAX 810/392-9139

CP#1645.32

APPENDIX B25



SITE OF RELOCATED AMERICAN SHAD
CZR5041

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

SCALE: AS SHOWN
DATE: 08/13/02

APPROVED BY:

DRAWN BY: TLJ

FILE: CZR5041



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/202-0253
FAX 810/202-9139

CP#1645.32

APPENDIX B26

LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/15/02





LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/16/02



SITE OF RELOCATED AMERICAN SHAD
CZR5042

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

SCALE: AS SHOWN
DATE: 08/13/02

APPROVED BY:

DRAWN BY: TLJ

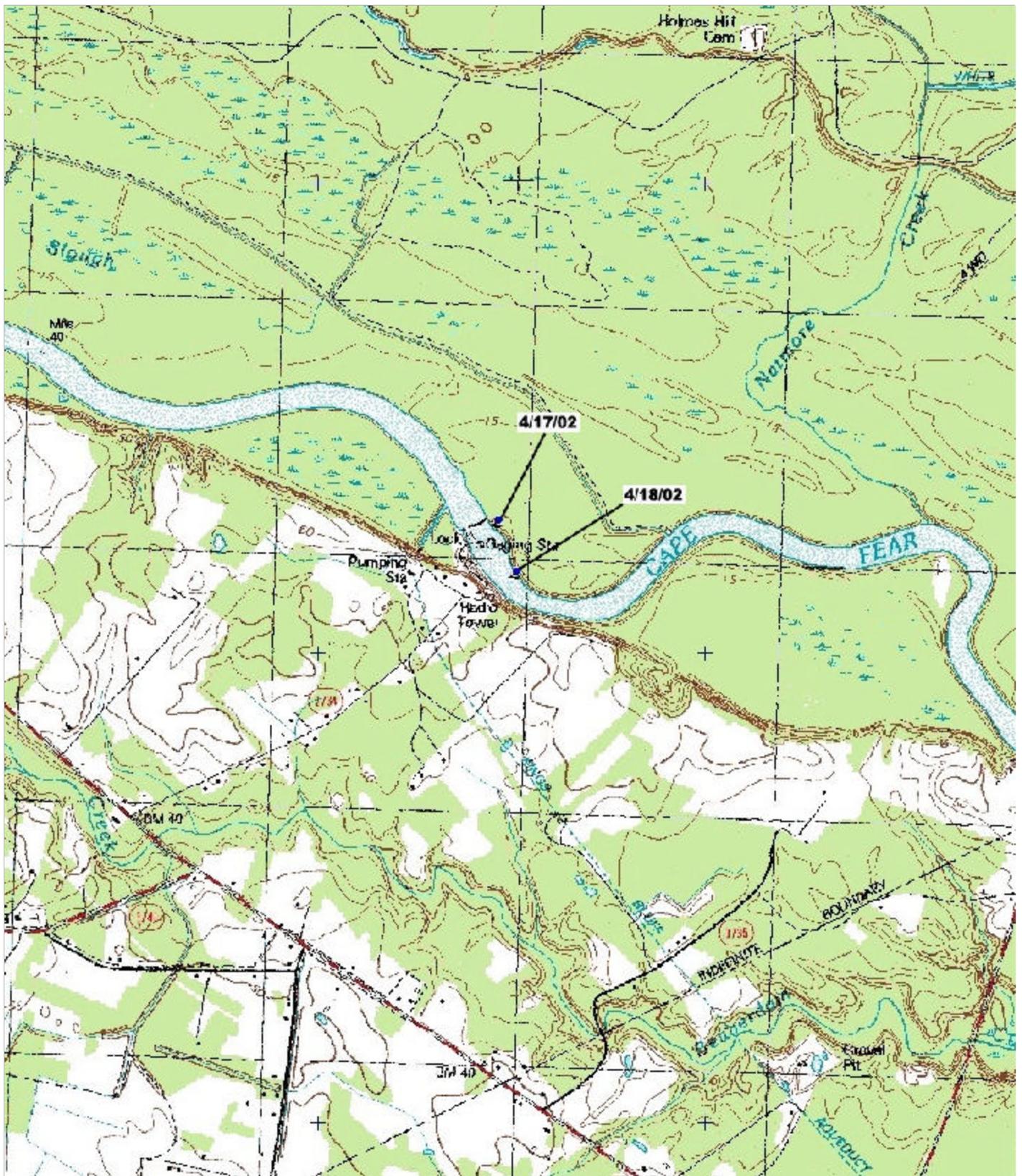
FILE: CZR5042



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/262-0253
FAX 810/392-9139

CP#1645.32

APPENDIX B27



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/17/02



**SITE OF RELOCATED AMERICAN SHAD
CZR5043**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: TLJ/BFG
DATE: 08/12/02		FILE: CZR5043



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-9253
FAX 810/392-9139

CP#1645.32

APPENDIX B28



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/17/02



**SITE OF RELOCATED AMERICAN SHAD
CZR5044**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

SCALE: AS SHOWN
DATE: 08/12/02

APPROVED BY:

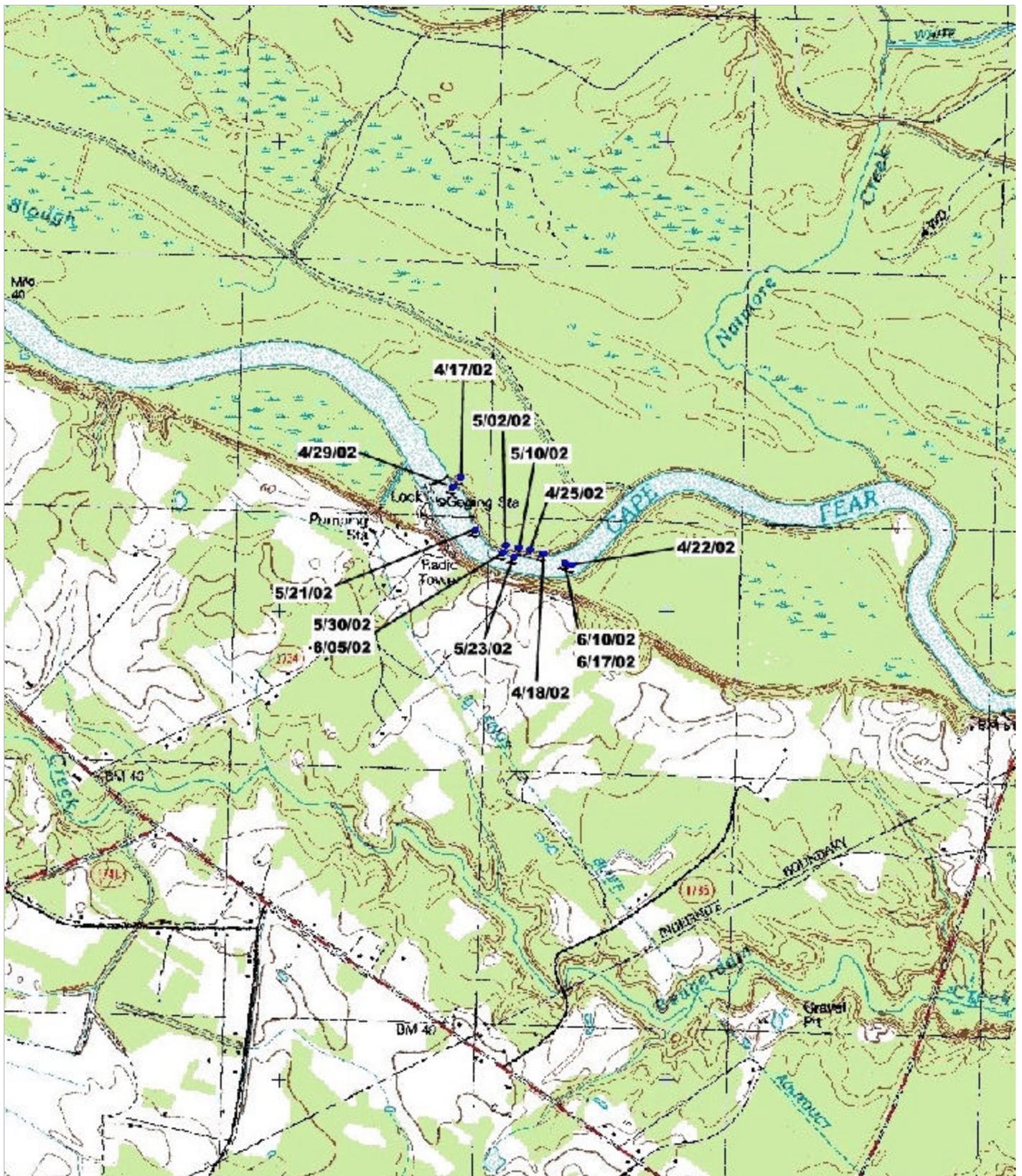
DRAWN BY: TLJ/BFG
FILE: CZR5044



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-0253
FAX 810/392-9139

CP#1645.32

APPENDIX B29



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/17/02



**SITE OF RELOCATED AMERICAN SHAD
CZR5045**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

SCALE: AS SHOWN
DATE: 08/12/02

APPROVED BY:

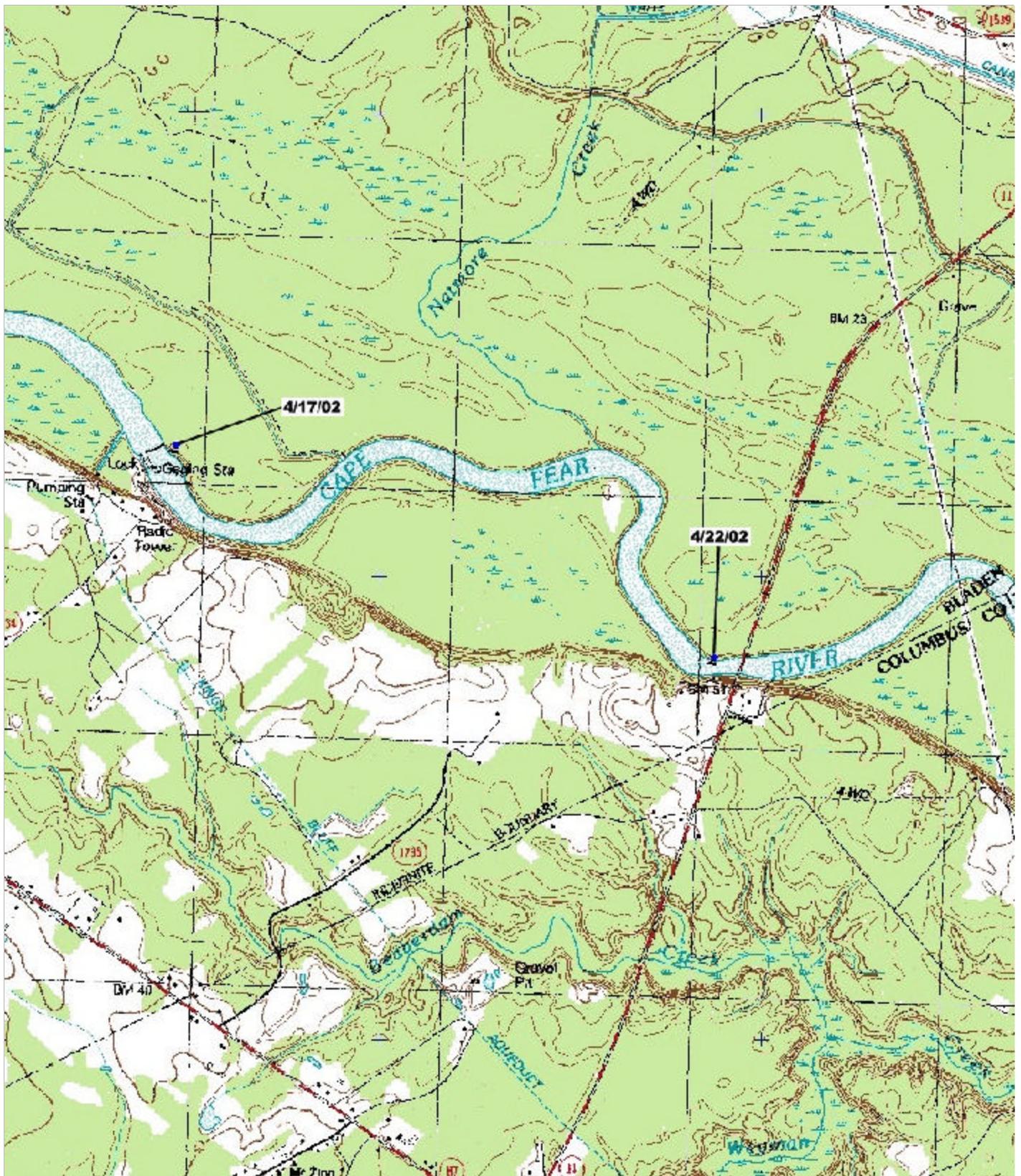
DRAWN BY: TLJ/BFG
FILE: CZR5045



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-0253
FAX 810/392-9139

CP#1645.32

APPENDIX B30



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/17/02



**SITE OF RELOCATED AMERICAN SHAD
CZR5046**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

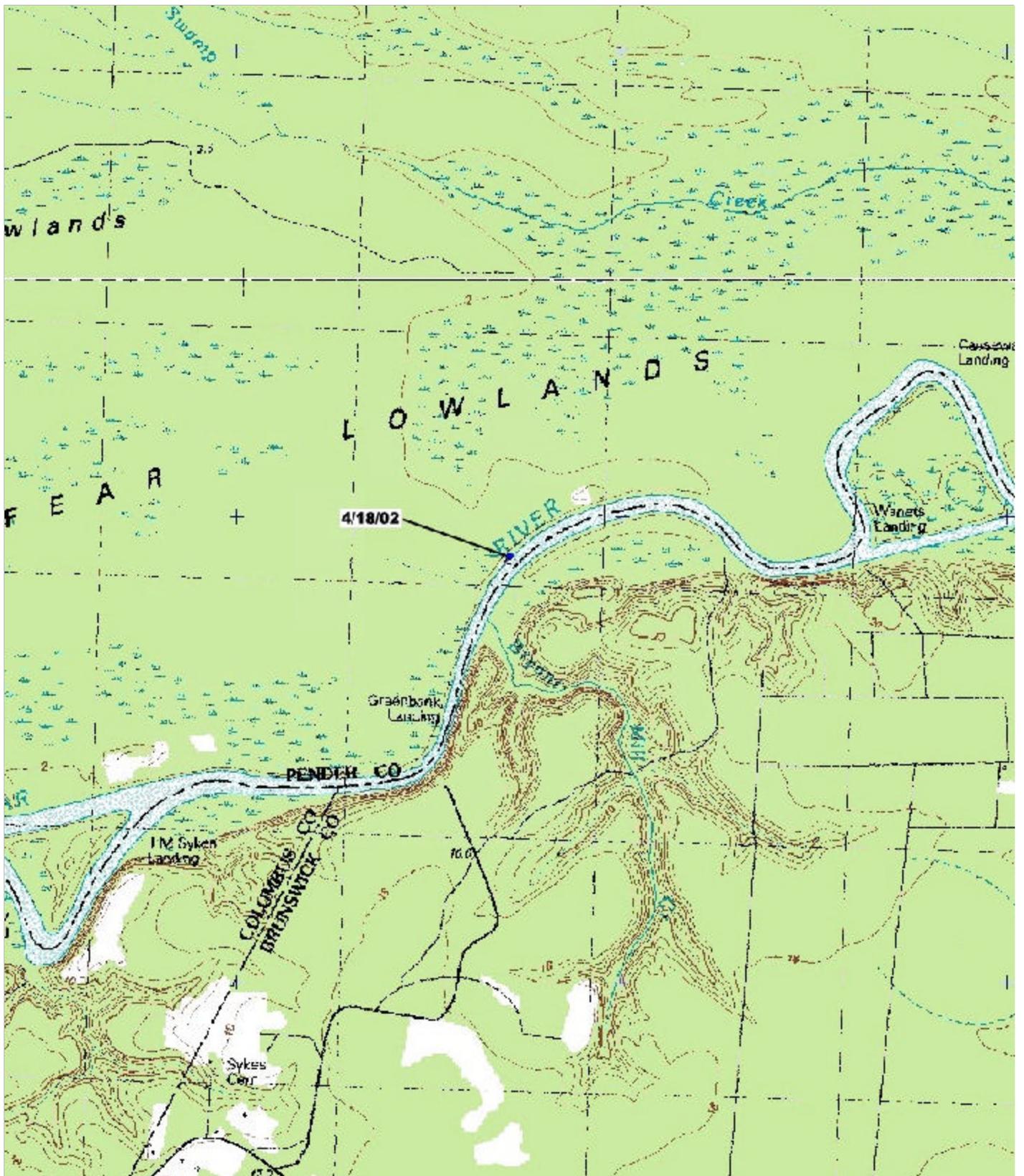
SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: TLJ/BFG
DATE: 08/12/02		FILE: CZR5046



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-0253
FAX 810/392-9139

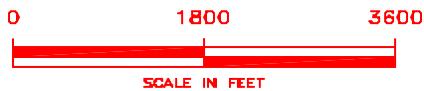
CP/1645.32

APPENDIX B31



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/17/02



SITE OF RELOCATED AMERICAN SHAD
CZR5046

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

SCALE: AS SHOWN
DATE: 08/23/02

APPROVED BY:

DRAWN BY: TLJ/BFG
FILE: CZR5046B



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-0253
FAX 810/392-9139

CP#1645.32

APPENDIX B31a



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/17/02



SITE OF RELOCATED AMERICAN SHAD
CZR5047

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

SCALE: AS SHOWN

APPROVED BY:

DRAWN BY: TLJ/BFG

DATE: 08/12/02

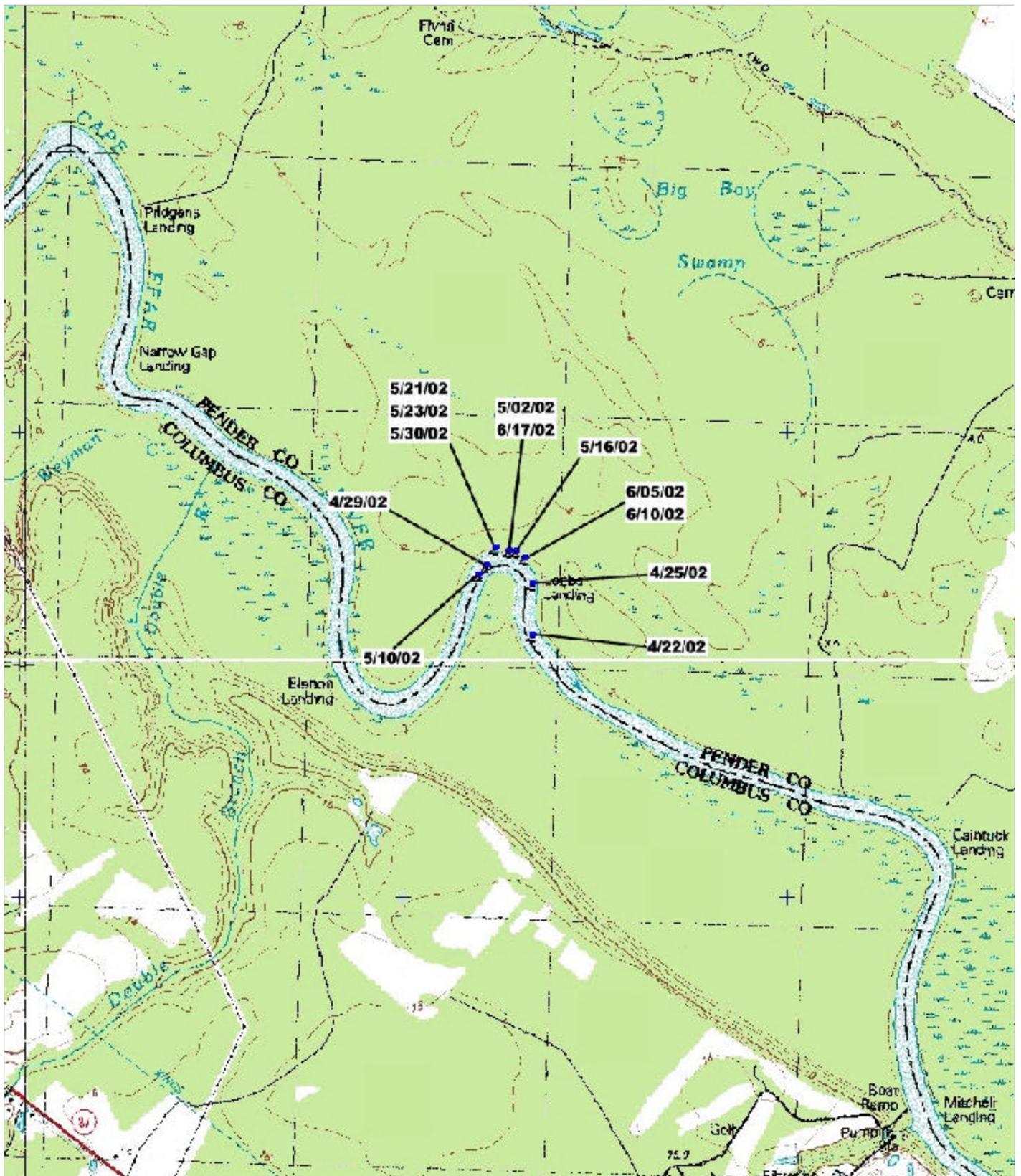
FILE: CZR5047



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-0253
FAX 810/282-9139

CP#1645.32

APPENDIX B32



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/17/02



**SITE OF RELOCATED AMERICAN SHAD
CZR5047**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

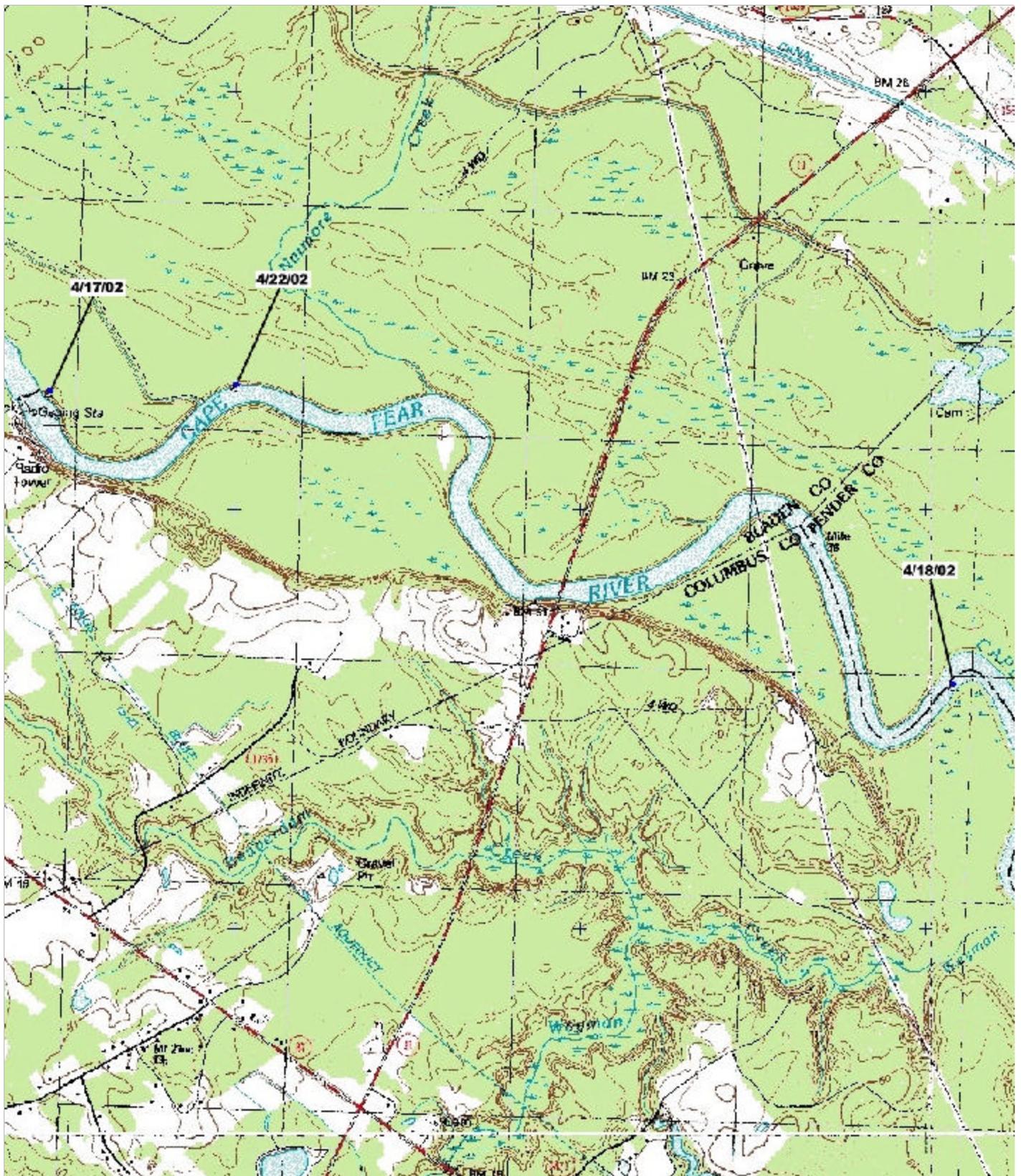
SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: TLJ/BFG
DATE: 08/20/02		FILE: CZR5047B



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-9253
FAX 810/292-9139

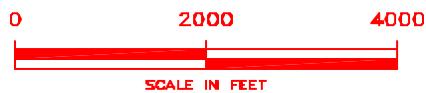
CP#1645.32

APPENDIX B33



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/17/02



**SITE OF RELOCATED AMERICAN SHAD
CZR5048**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

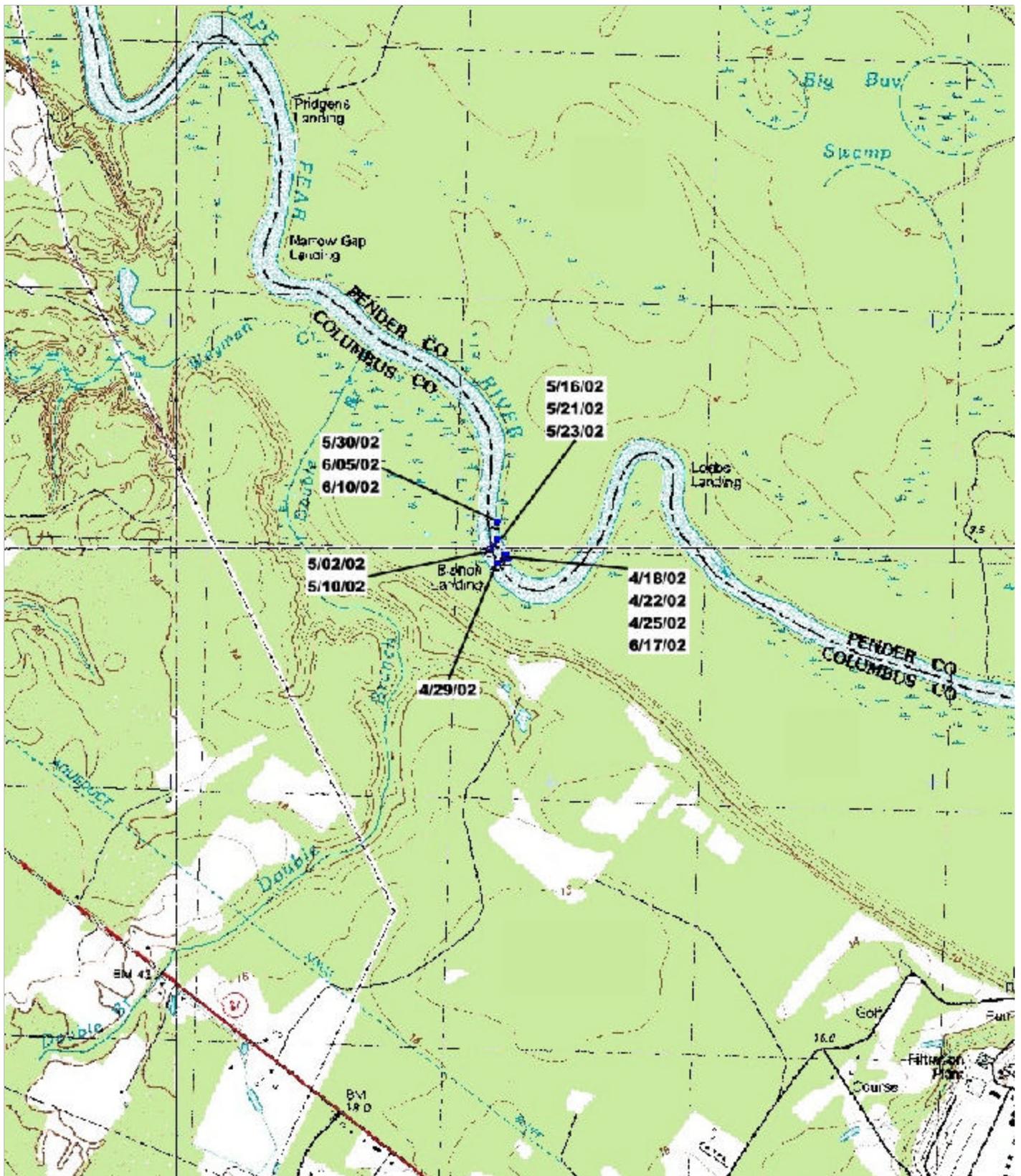
SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: TLJ/BFG
DATE: 08/12/02		FILE: CZR5048



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-0253
FAX 810/282-9139

CP#1645.32

APPENDIX B34



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/17/02



**SITE OF RELOCATED AMERICAN SHAD
CZR5049**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

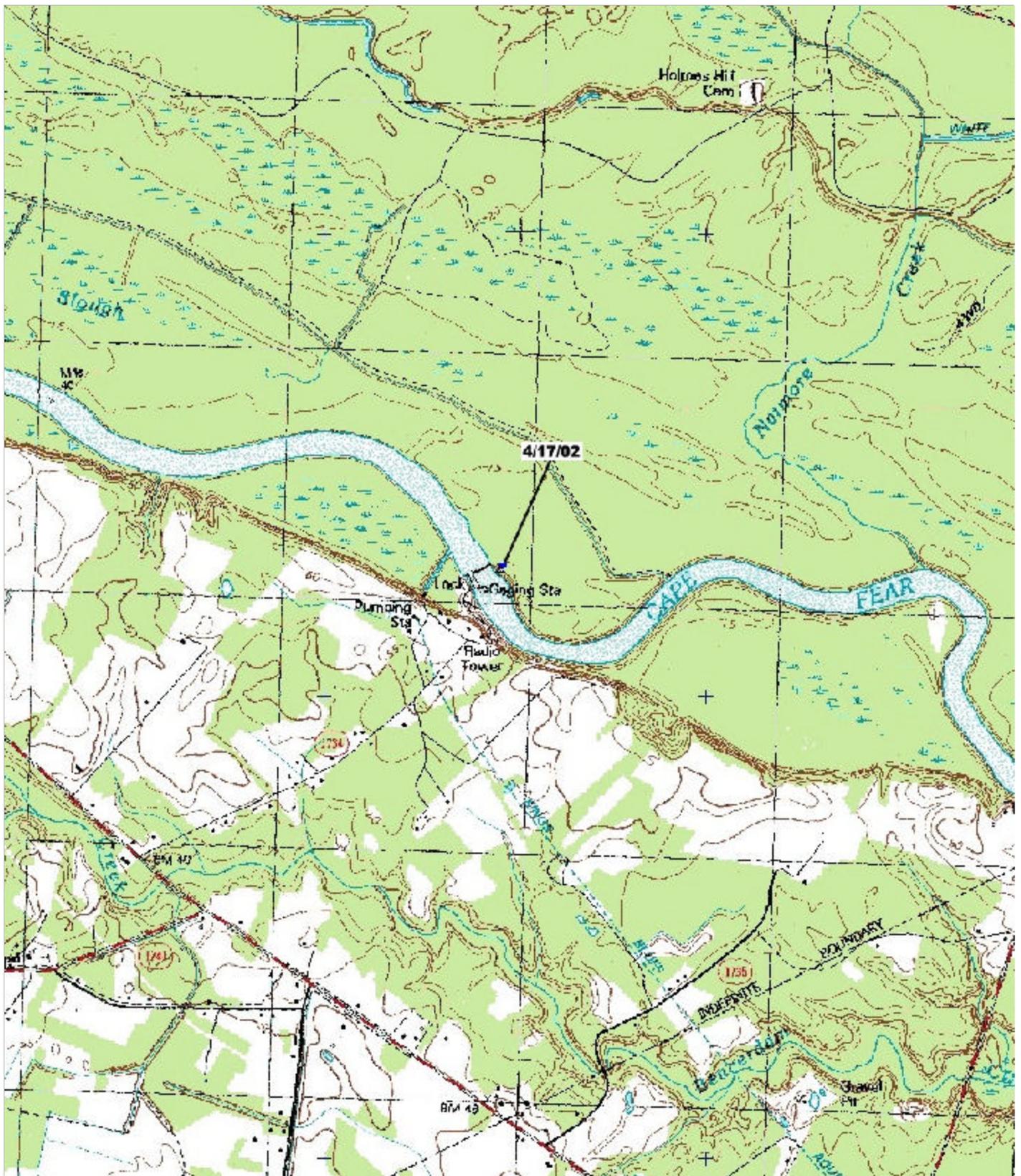
SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: TLJ/BFG
DATE: 08/23/02		FILE: CZR5049



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/392-0253
FAX 810/392-9139

CP#1645.32

APPENDIX B35



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/17/02



SITE OF RELOCATED AMERICAN SHAD
CZR5049

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

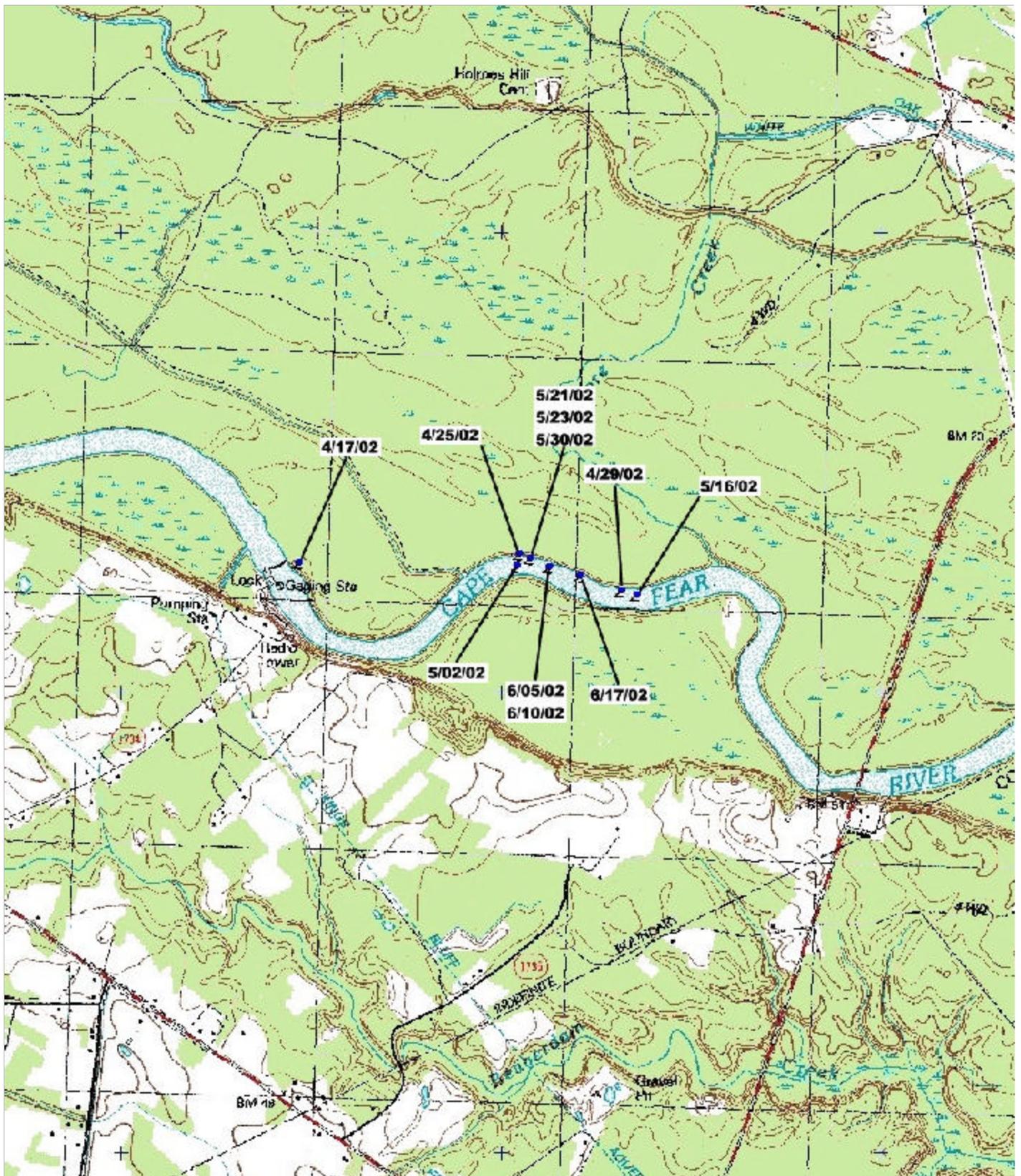
SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: TLJ/BFG
DATE: 08/20/02		FILE: CZR5049B



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-9253
FAX 810/282-9139

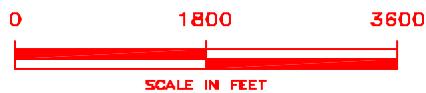
CP#1645.32

APPENDIX B36



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/17/02



**SITE OF RELOCATED AMERICAN SHAD
CZR5050**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

SCALE: AS SHOWN
DATE: 08/12/02

APPROVED BY:

DRAWN BY: TLJ/BFG

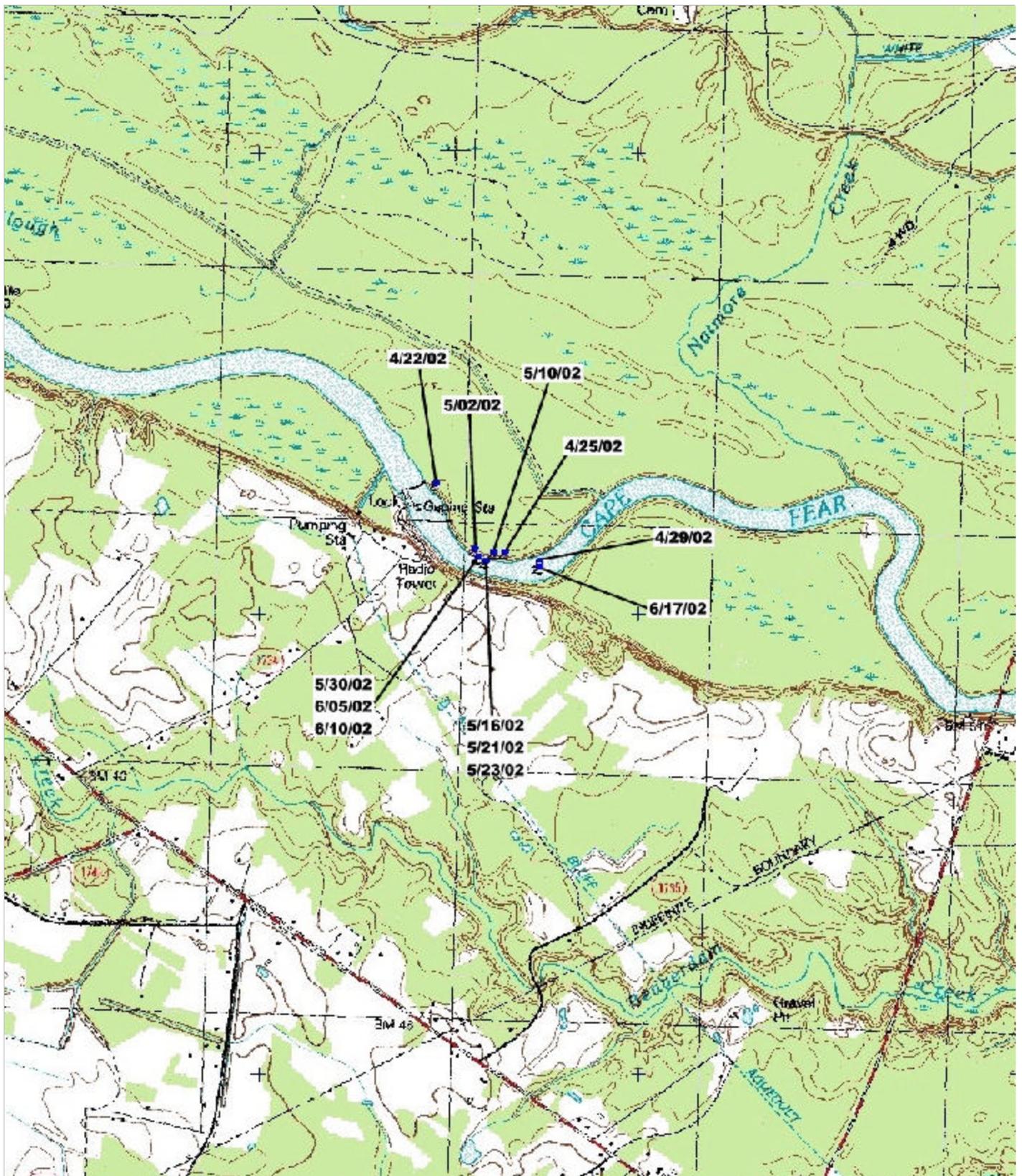
FILE: CZR5050



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/262-0253
FAX 810/392-9139

CP#1645.32

APPENDIX B37



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/22/02



**SITE OF RELOCATED AMERICAN SHAD
CZR5051**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

SCALE: AS SHOWN
DATE: 08/12/02

APPROVED BY:

DRAWN BY: TLJ/BFG

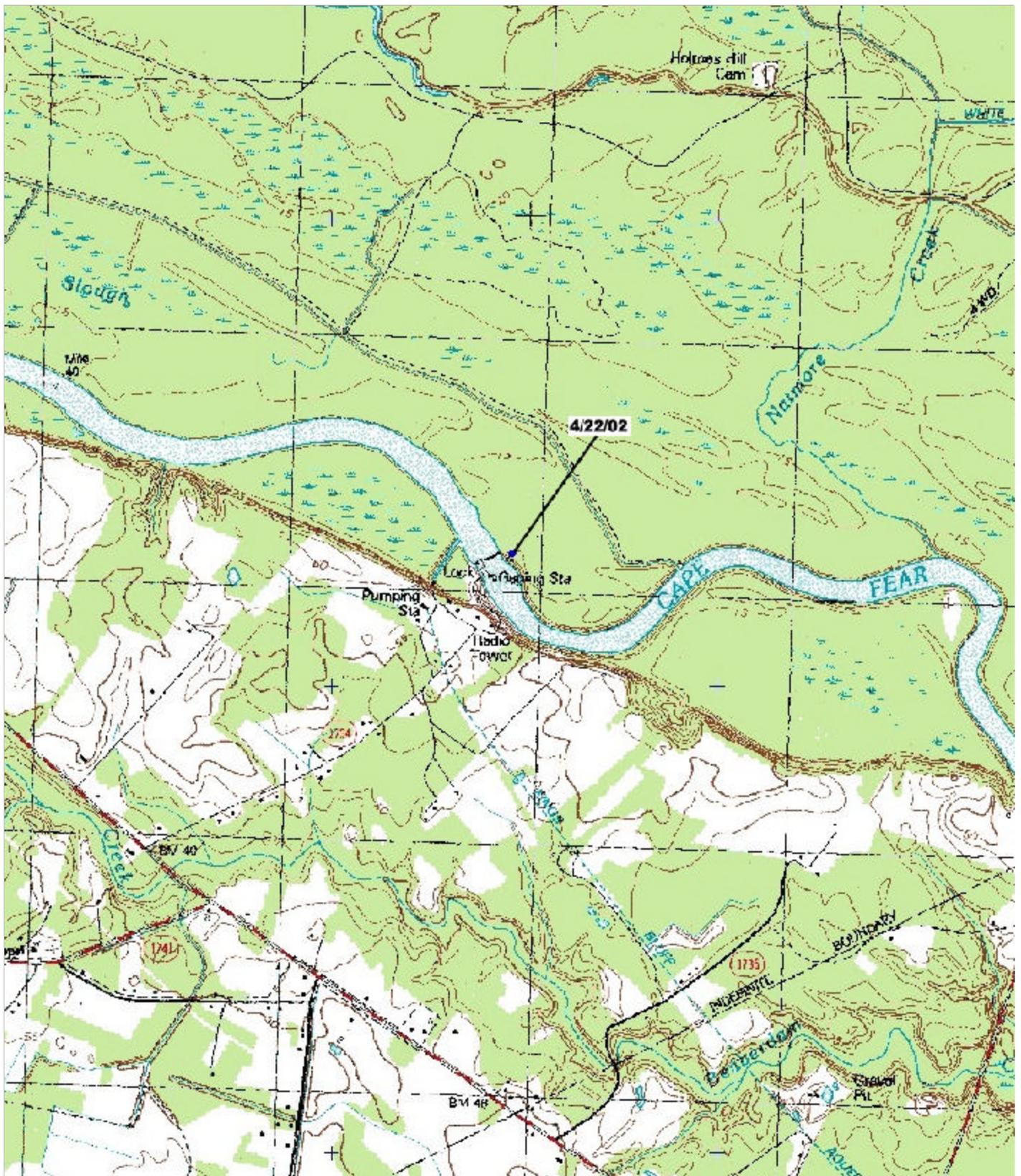
FILE: CZR5051



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-0253
FAX 810/392-9139

CP#1645.32

APPENDIX B38



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/22/02



**SITE OF RELOCATED AMERICAN SHAD
CZR5052**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

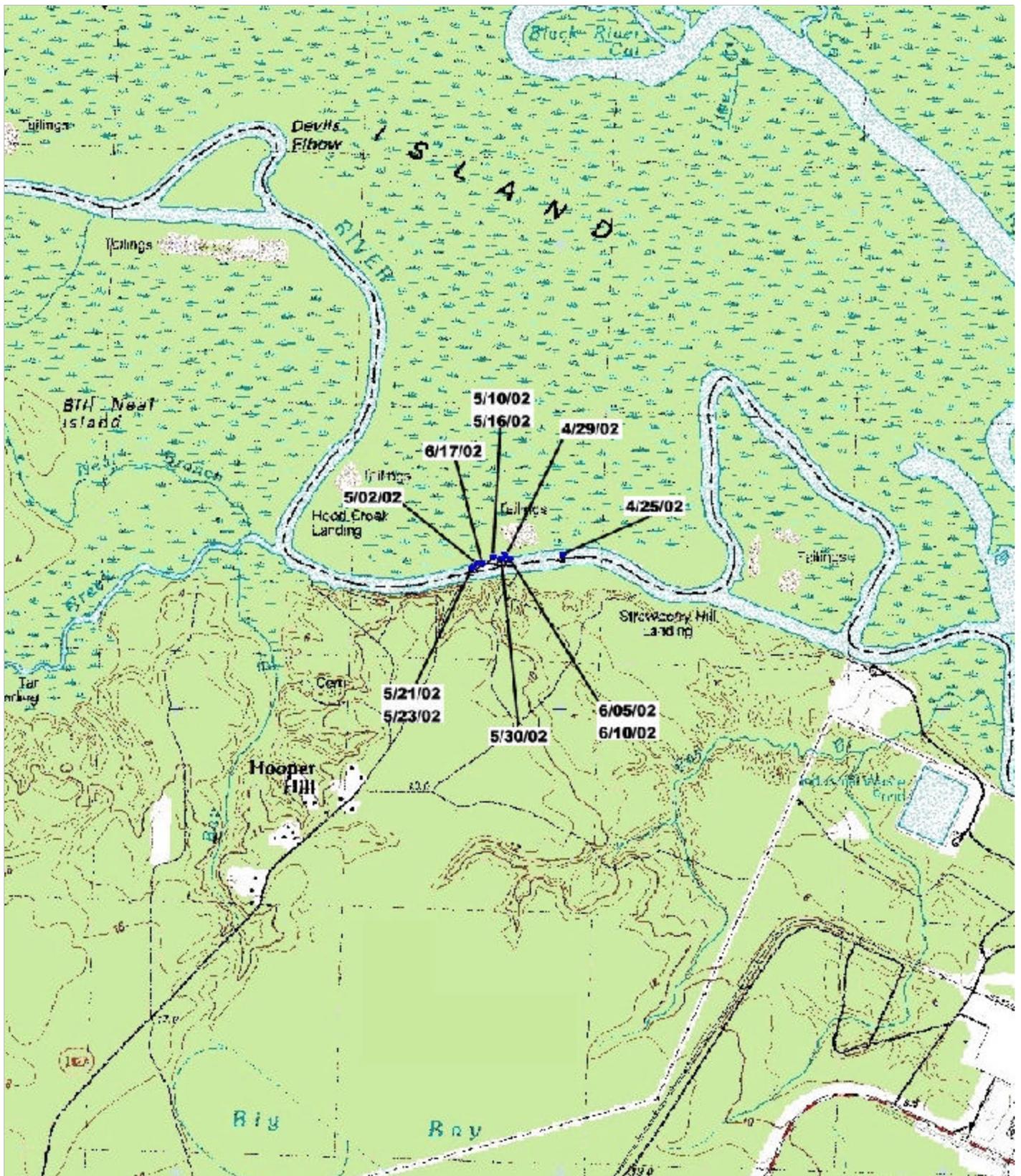
SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: TLJ/BFG
DATE: 08/12/02		FILE: CZR5052



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-9253
FAX 810/392-9139

CP#1645.32

APPENDIX B39



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/22/02



**SITE OF RELOCATED AMERICAN SHAD
CZR5052**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

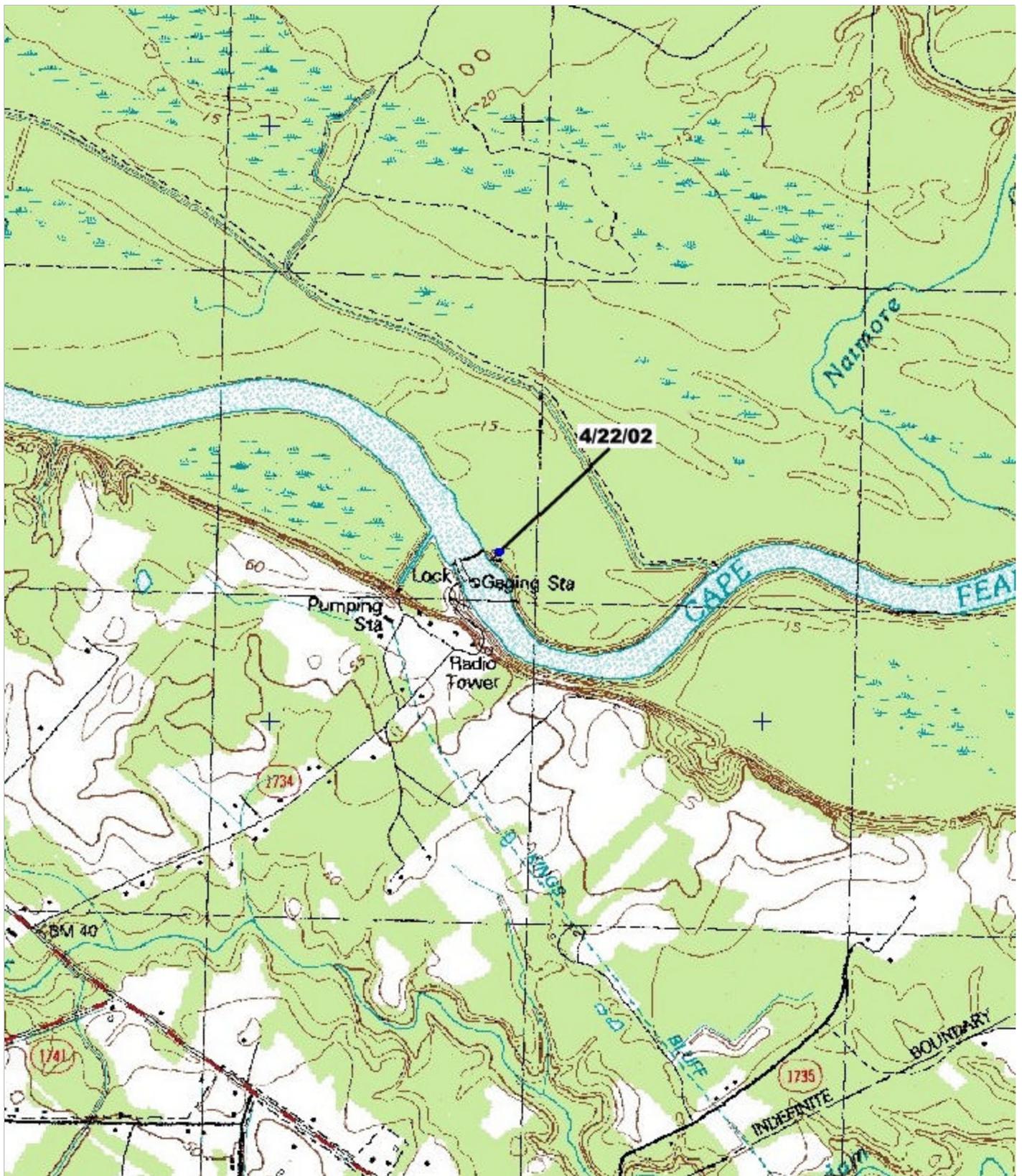
SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: TLJ/BFG
DATE: 08/20/02		FILE: CZR5052B



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/262-0253
FAX 810/262-9139

CP#1645.32

APPENDIX B40



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/22/02



SITE OF RELOCATED AMERICAN SHAD
CZR5054

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

SCALE: AS SHOWN
DATE: 08/12/02

APPROVED BY:

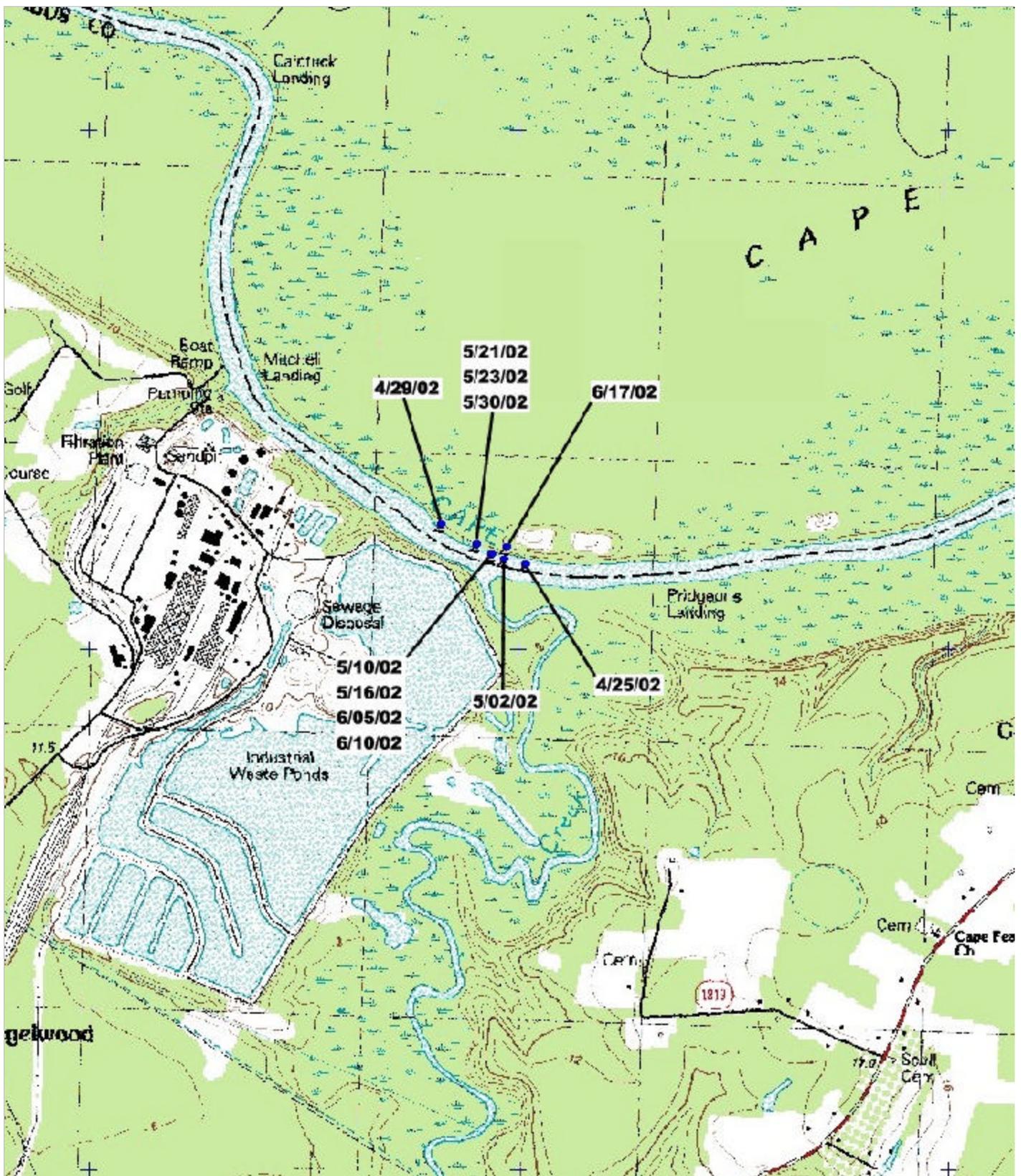
DRAWN BY: TLJ/BFG
FILE: CZR5054



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-0253
FAX 810/282-9139

CP#1645.32

APPENDIX B42



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/22/02



**SITE OF RELOCATED AMERICAN SHAD
CZR5054**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

SCALE: AS SHOWN
DATE: 08/20/02

APPROVED BY:

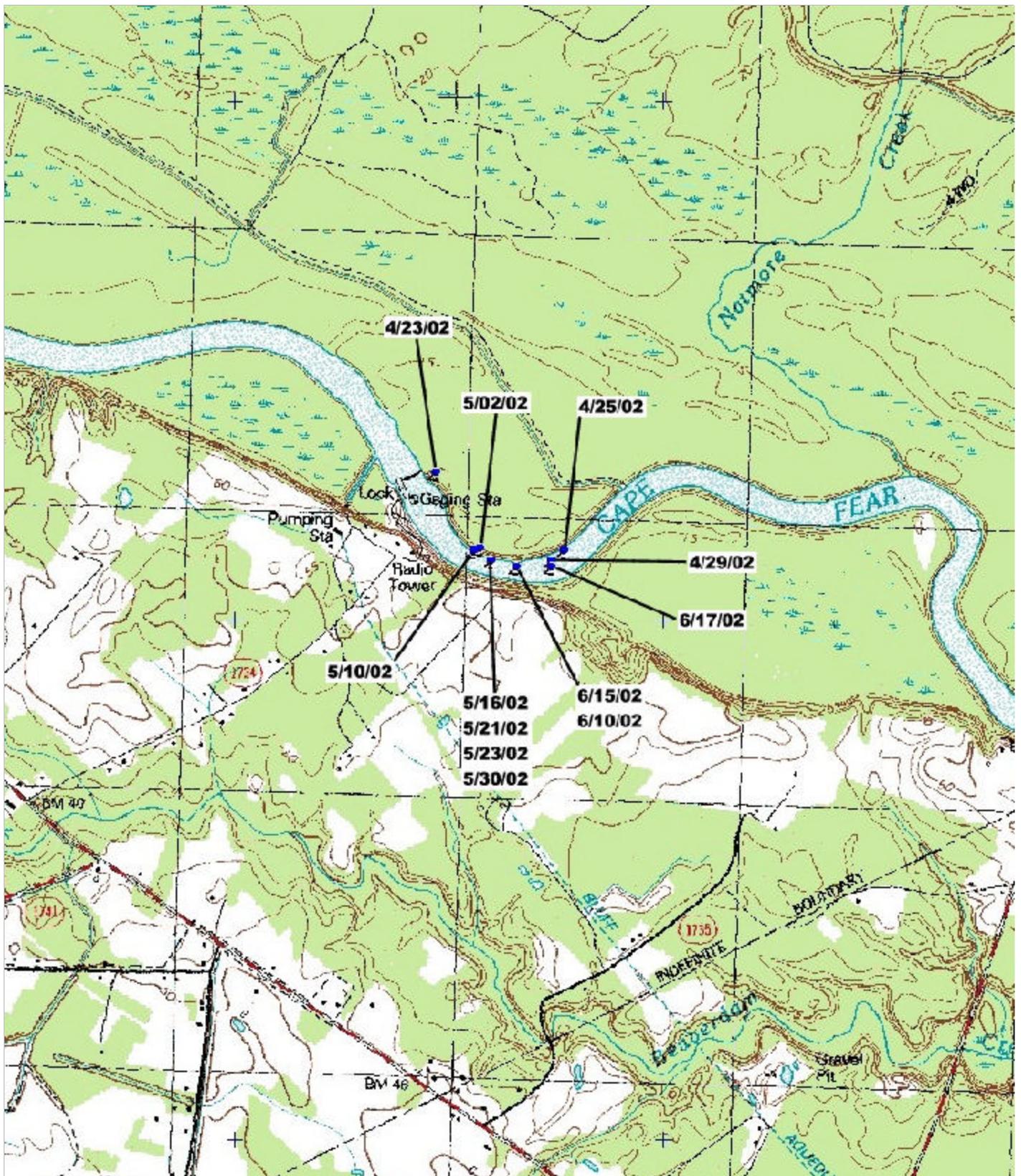
DRAWN BY: TLJ/BFG
FILE: CZR5054B



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-0253
FAX 810/392-9139

CP#1645.32

APPENDIX B43



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/23/02



SITE OF RELOCATED AMERICAN SHAD
CZR5055

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

SCALE: AS SHOWN
DATE: 08/12/02

APPROVED BY:

DRAWN BY: TLJ/BFG

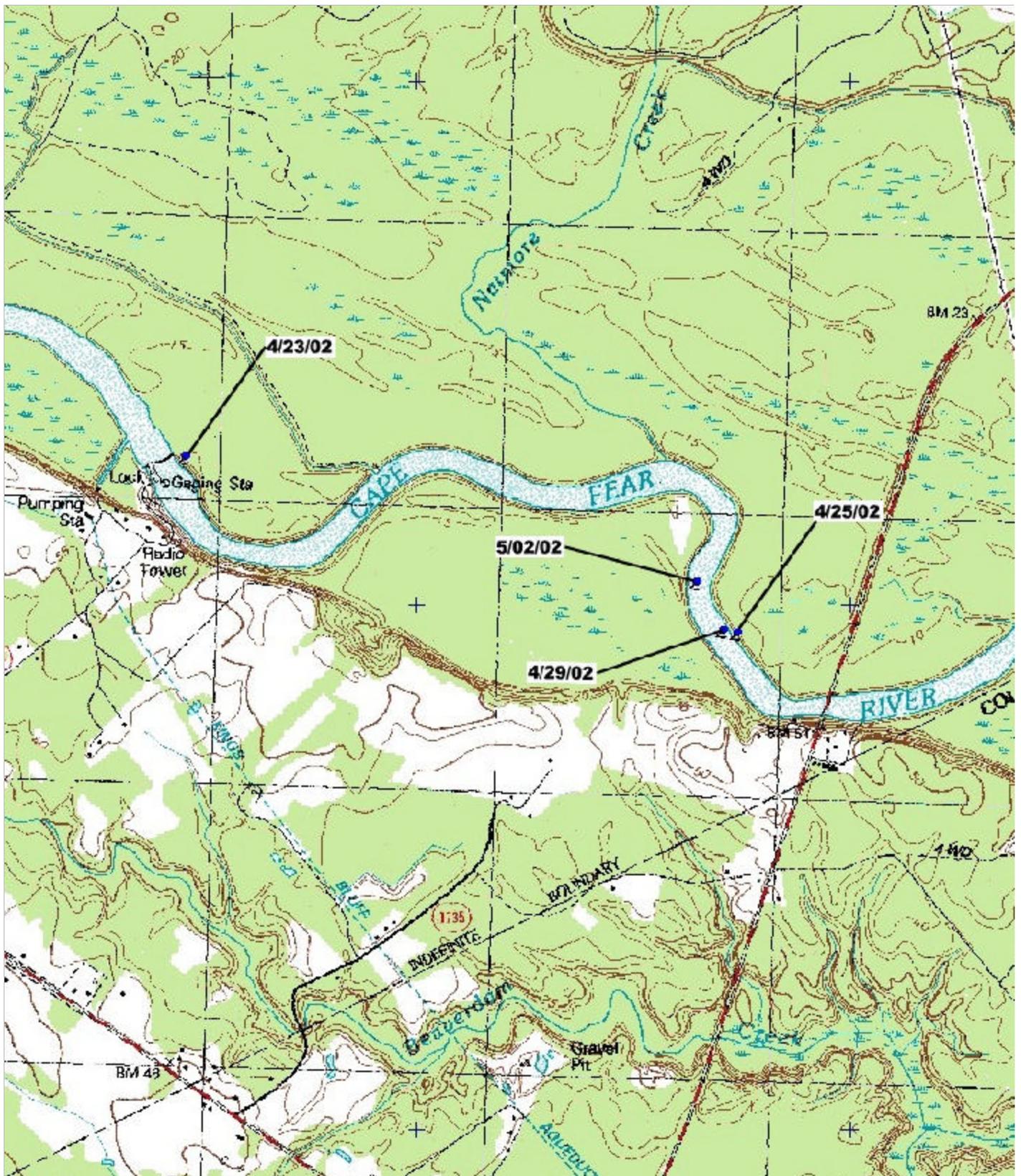
FILE: CZR5055



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-0253
FAX 810/392-9139

CP#1645.32

APPENDIX B44



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/23/02



**SITE OF RELOCATED AMERICAN SHAD
CZR5056**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

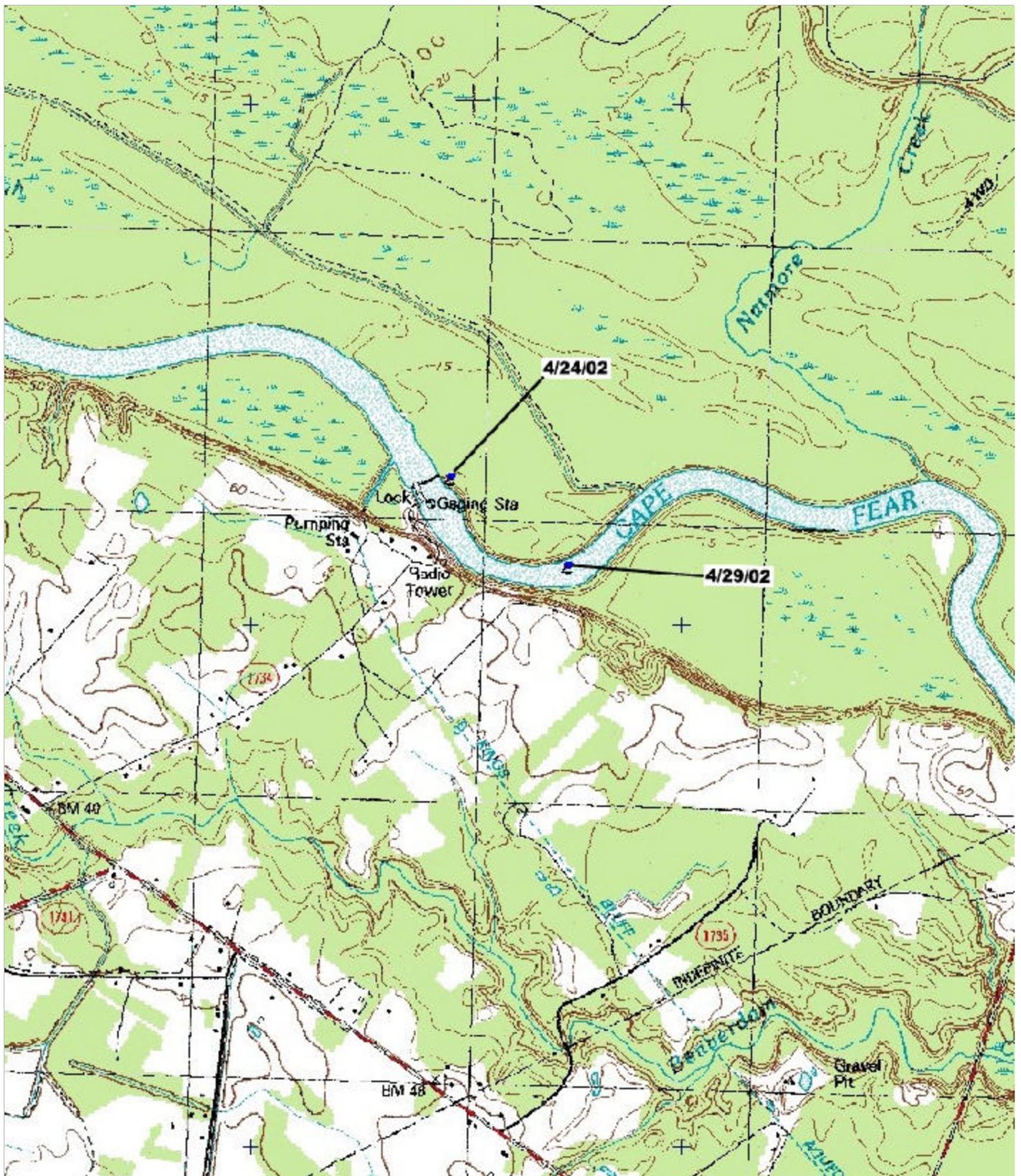
SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: TLJ/BFG
DATE: 08/12/02		FILE: CZR5056



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-9253
FAX 810/282-9139

CP#1645.32

APPENDIX B45



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/24/02



SITE OF RELOCATED AMERICAN SHAD
CZR5057

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

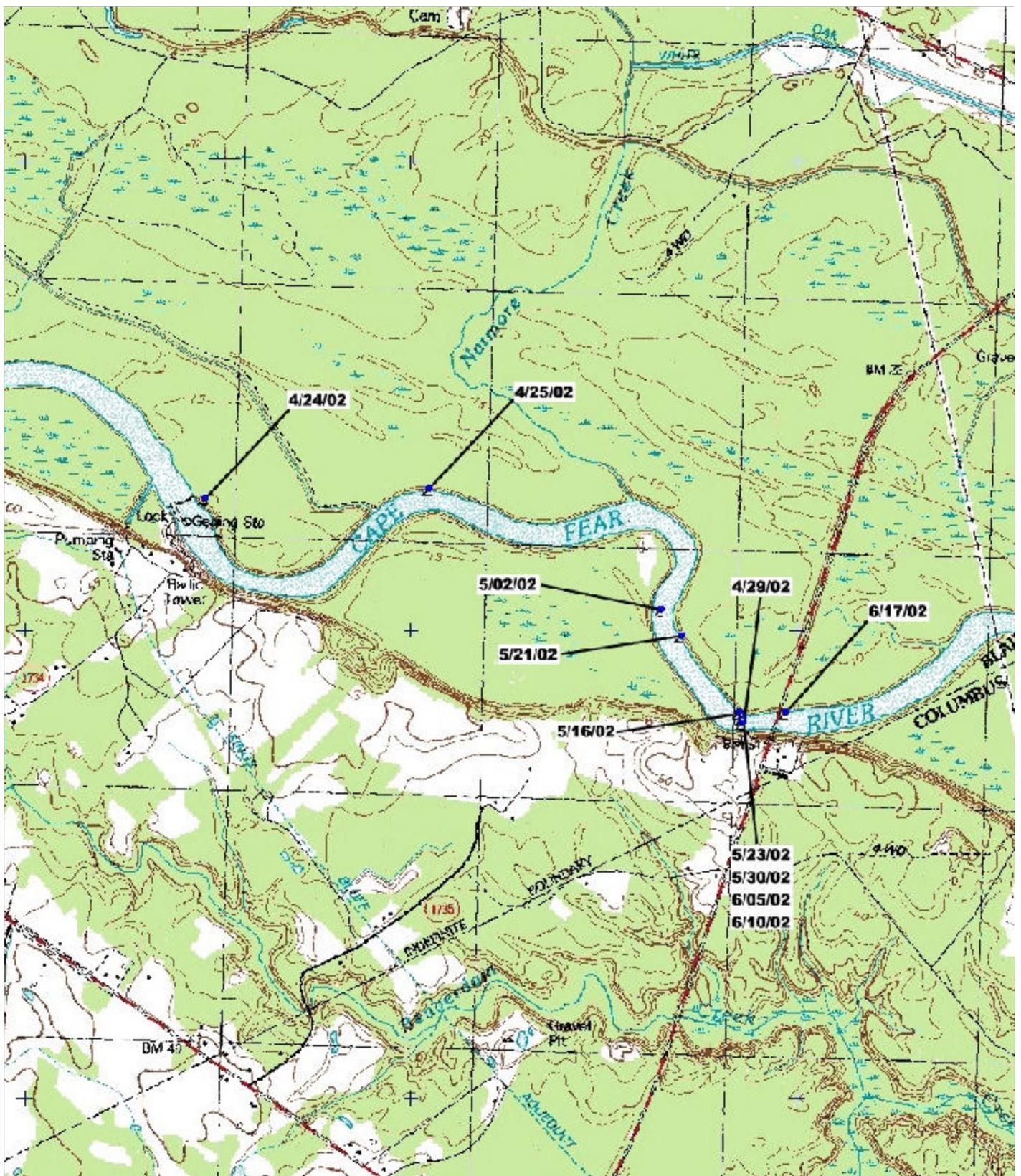
SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: TLJ/BFG
DATE: 08/12/02		FILE: CZR5057



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-9253
FAX 810/392-9139

CP#1645.32

APPENDIX B46



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/24/02



**SITE OF RELOCATED AMERICAN SHAD
CZR5058**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

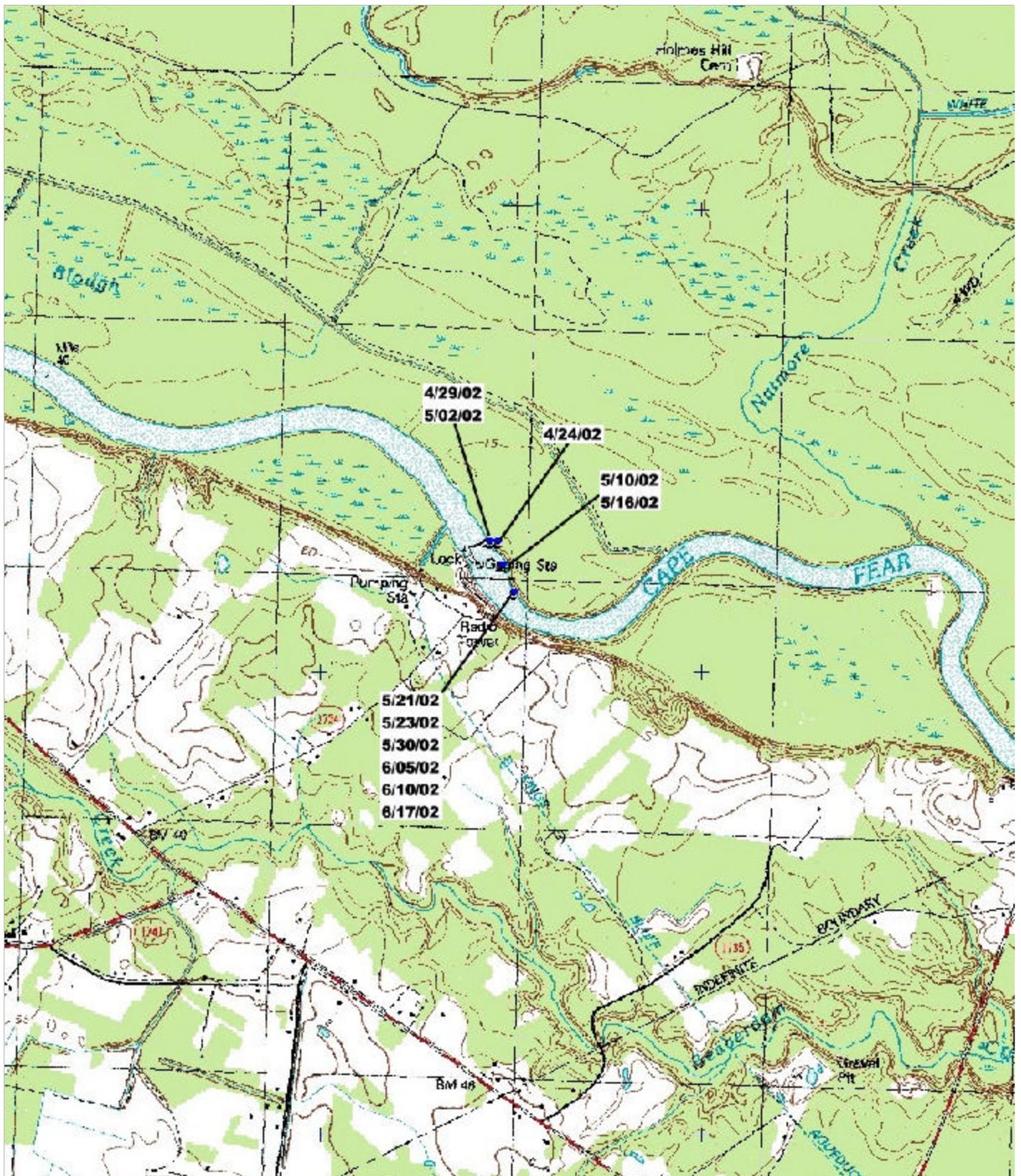
SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: TLJ/BFG
DATE: 08/12/02		FILE: CZR5058



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-0253
FAX 810/392-9139

CP#1645.32

APPENDIX B47



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/24/02



**SITE OF RELOCATED AMERICAN SHAD
CZR5060**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

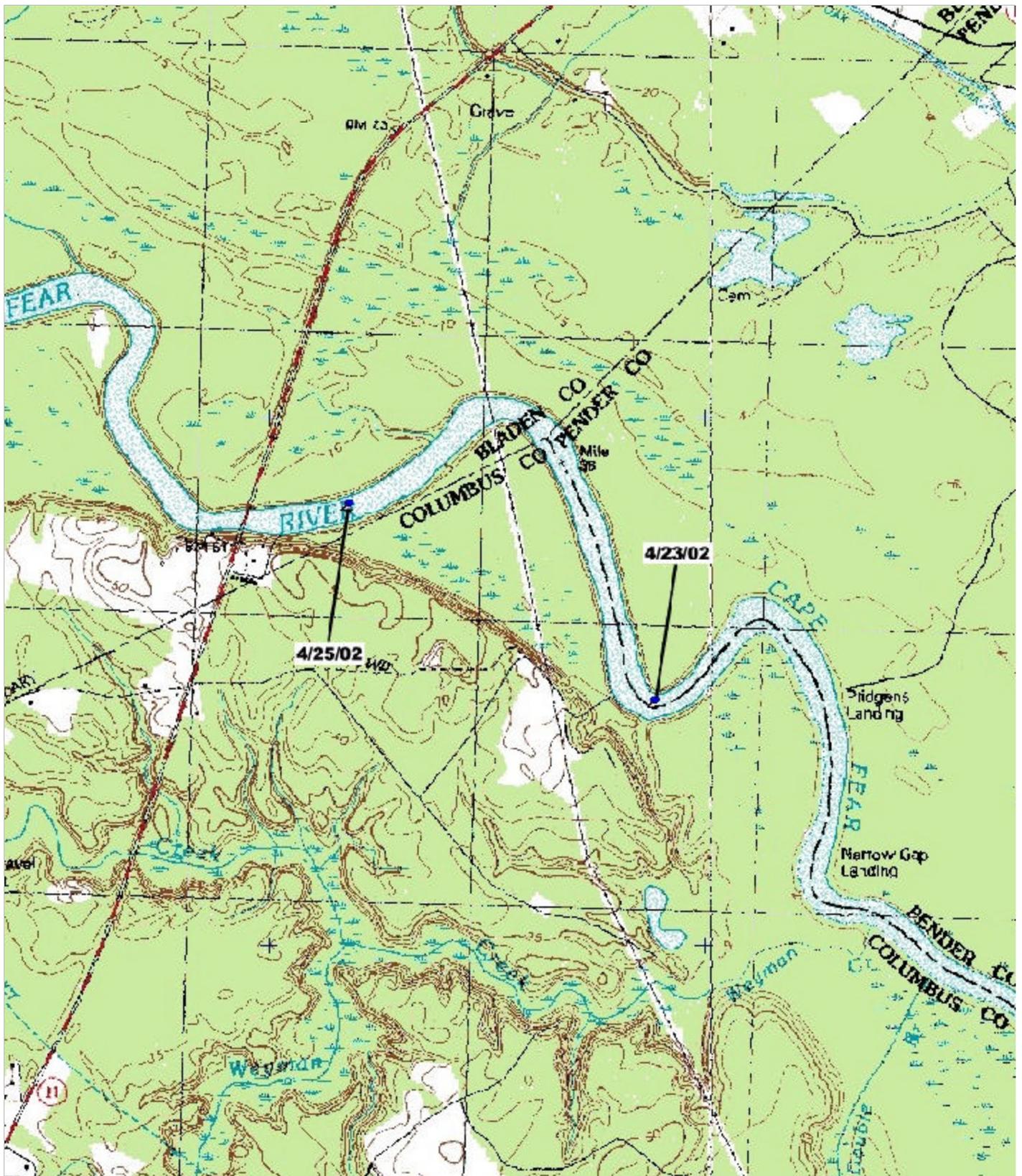
SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: TLJ/BFG
DATE: 08/12/02		FILE: CZR5060



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/262-0253
FAX 810/262-9139

CP#1645.32

APPENDIX B49



LEGEND

- SITE OF RELOCATED FISH TAGGED ON 4/23/02



**SITE OF RELOCATED ATLANTIC STURGEON
CZR5061**

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

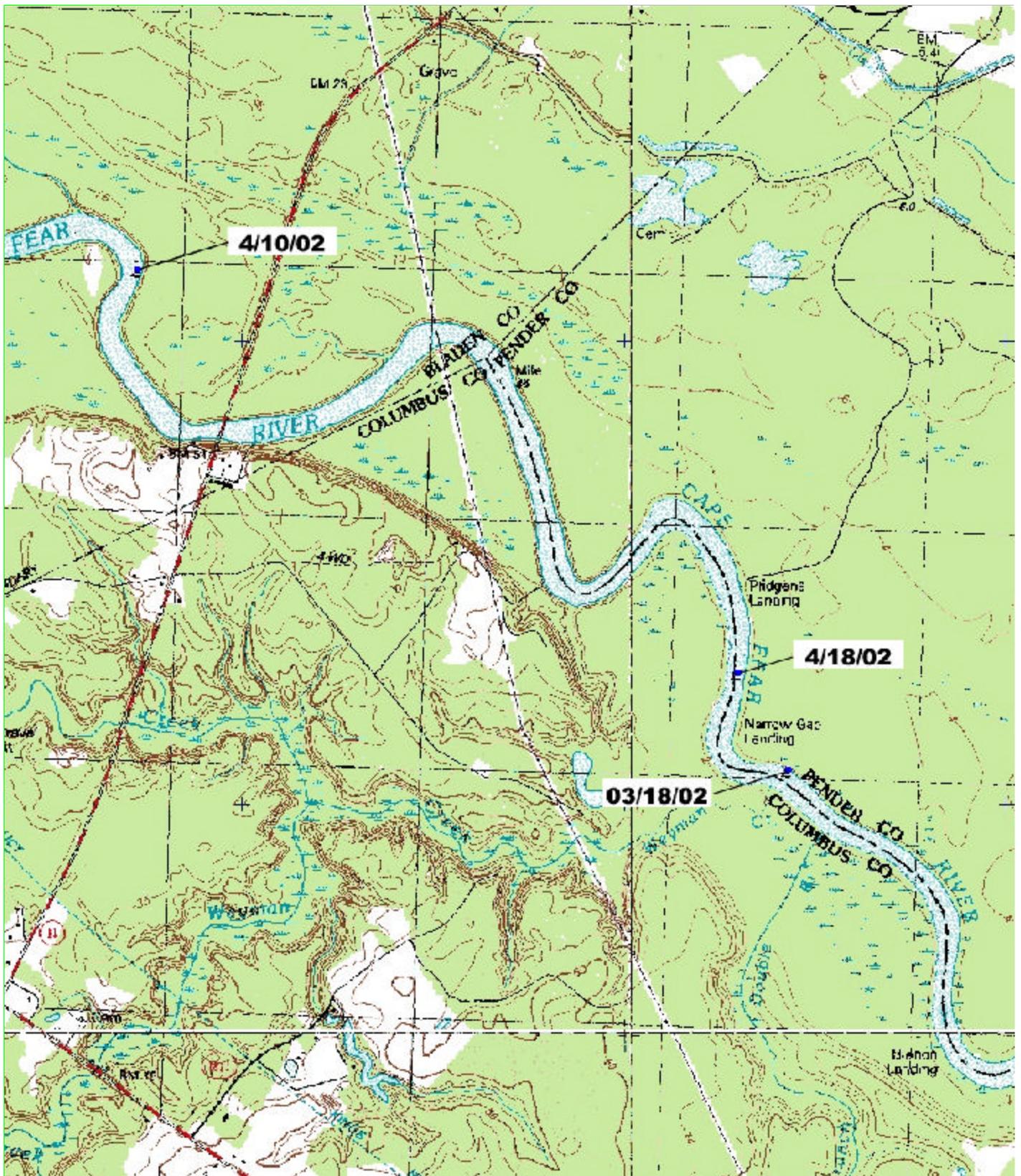
SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: TLJ/BFG
DATE: 08/12/02		FILE: CZR5061



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-0253
FAX 810/392-9139

CP#1645.32

APPENDIX B50



LEGEND

- SITE OF LOCATED ATLANTIC STURGEON 'MOSER'



SITE OF LOCATED ATLANTIC STURGEON MOSER

**MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE**

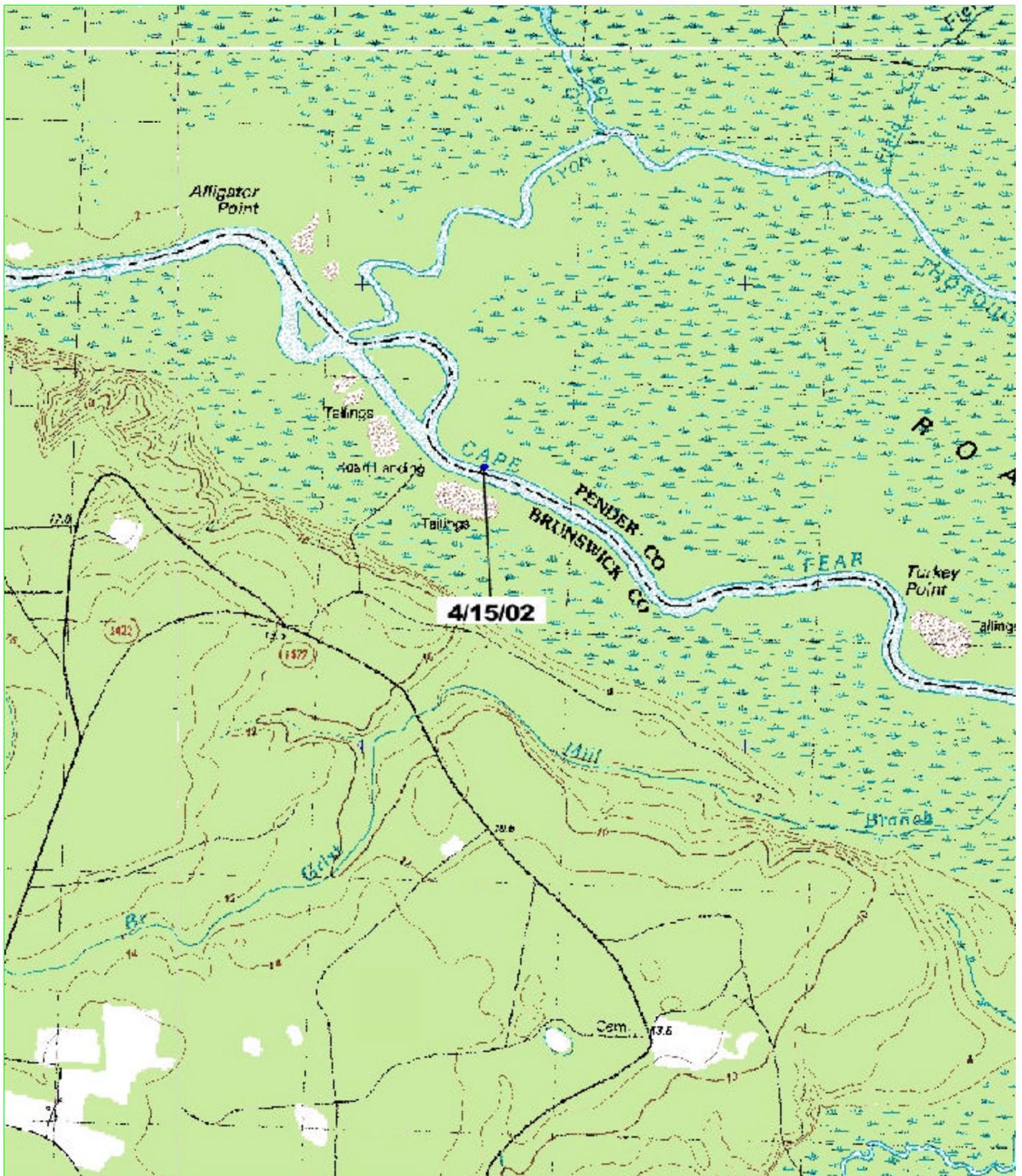
SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: BFG
DATE: 08/19/02		FILE: CZRMOSER



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-9253
FAX 810/392-9139

CP#1645.32

APPENDIX B51



LEGEND

- SITE OF LOCATED ATLANTIC STURGEON "MOSER"



SITE OF LOCATED ATLANTIC STURGEON
MOSER

MANUAL FISH TRACKING DATA
WILMINGTON USACOE FISH PASSAGE

SCALE: AS SHOWN	APPROVED BY:	DRAWN BY: BFG
DATE: 08/19/02		FILE: CZRM0SR2



4708 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 810/282-0253
FAX 810/392-9139

CP#1645.32

APPENDIX B52

APPENDIX C

LIST OF COORDINATES COLLECTED DURING TAGGING AND MANUAL TRACKING

Appendix C. List of coordinates collected during tagging and manual tracking.

TAG #	DATE	LATITUDE	LONGITUDE
CZR5001	2/26/02	341446	775731
	3/4/02	341446	775731
	3/7/02	341450	775729
	3/11/02	341404	775699
	3/14/02	341530	775859
	3/18/02	341437	775730
	3/21/02	341448	775740
	4/1/02	341453	775750
	4/4/02	341453	775750
	4/10/02	341442	775734
	4/15/02	341442	775735
	4/18/02	341442	775735
	4/22/02	341443	775737
	4/25/02	341453	775750
	4/29/02	341448	775742
	5/2/02	341449	775741
	5/10/02	341447	775739
	5/16/02	341448	775726
	5/21/02	341448	775726
	5/23/02	341452	775746
	5/30/02	341452	775746
	6/5/02	341443	775737
	6/10/02	341443	775737
6/17/02	341443	775737	
6/18/02	341443	775737	
6/19/02	341443	775737	
CZR5002	3/13/02	341446	775731
	3/14/02	341457	775782
	3/21/02	341448	775740
	4/1/02	341456	775761
	4/4/02	341889	780056
	4/10/02	341442	775734
	4/15/02	341442	775734
	4/18/02	341448	775725
	4/22/02	341453	775750
	4/25/02	341442	775734
	4/29/02	341448	775742
	5/2/02	341449	775741
	5/16/02	341444	775739
	5/21/02	341444	775739
	5/23/02	341452	775746
	5/30/02	341452	775746
	6/5/02	341443	775737
	6/10/02	341456	775761
6/17/02	341456	775761	
6/18/02	341456	775761	
6/19/02	341456	775761	

Appendix C. (continued)

TAG #	DATE	LATITUDE	LONGITUDE
CZR5003	3/14/02	341446	775731
	3/21/02	341448	775740
	4/10/02	341448	775740
	4/15/02	341442	775734
	4/22/02	341453	775750
	6/19/02	342187	775713
CZR5004	3/14/02	341468	775820
	3/18/02	341437	775730
	3/21/02	341448	775740
	4/1/02	341453	775750
	4/4/02	341453	775750
	4/10/02	341448	775742
	4/15/02	341442	775734
	4/18/02	341442	775734
	4/22/02	341446	775727
6/19/02	341696	775711	
CZR5006	3/7/02	341480	775835
	3/11/02	341448	775726
CZR5007	3/13/02	341468	775820
	3/14/02	341433	775728
	3/18/02	341437	775730
	3/21/02	341437	775731
	4/1/02	341437	775731
	4/4/02	341437	775731
	4/10/02	341437	775731
	4/15/02	341446	775731
	4/18/02	341446	775731
	4/22/02	341446	775727
	4/25/02	341437	775731
	4/29/02	341440	775731
	5/2/02	341447	775725
	5/10/02	341449	775729
	5/16/02	341448	775726
	5/21/02	341451	775730
	5/23/02	341466	775827
	5/30/02	341466	775827
	6/5/02	341465	775824
	6/10/02	341465	775824
6/17/02	341465	775824	
6/18/02	341465	775824	
6/19/02	341465	775824	
CZR5008	3/19/02	341447	775729
	5/2/02	341444	775734

Appendix C. (continued)

TAG #	DATE	LATITUDE	LONGITUDE
	6/19/02	341416	775711
CZR5013	3/14/02	341702	780041
CZR5014	3/19/02	341467	775823
	5/2/02	341449	775741
	5/10/02	341447	775739
	5/16/02	341449	775741
	5/21/02	341449	775741
	5/23/02	341452	775746
	5/30/02	341440	775731
	6/5/02	341455	775737
	6/10/02	341455	775737
	6/17/02	341455	775737
	6/18/02	341455	775737
	6/19/02	341455	775737
CZR5031	4/16/02	342427	781755
	4/18/02	342319	781472
	4/22/02	342272	781368
	4/25/02	342266	781368
	4/29/02	342270	781380
	5/2/02	342273	781374
	5/10/02	342268	781382
	5/16/02	342274	781371
	5/21/02	342275	781377
	5/23/02	342275	781377
	5/30/02	342275	781377
	6/5/02	342273	781369
	6/10/02	342273	781369
	6/17/02	342275	781373
CZR5032	4/15/02	342427	781755
	4/18/02	342412	781733
	4/22/02	342406	781727
	5/10/02	342409	781731
	5/16/02	342409	781731
	5/21/02	342409	781731
	5/23/02	342409	781731
	5/30/02	342409	781731
	6/5/02	342409	781731
	6/10/02	342409	781731
	6/17/02	342409	781731
CZR5033	4/15/02	342427	781755
	4/25/02	342415	781750
	5/2/02	342415	781750
	5/10/02	342415	781750

Appendix C. (continued)

TAG #	DATE	LATITUDE	LONGITUDE
	5/16/02	342415	781750
	5/21/02	342416	781751
	5/23/02	342416	781751
	5/30/02	342416	781751
CZR5034	4/15/02	342427	781755
	4/18/02	342345	781516
	4/22/02	342291	781430
	4/25/02	342291	781432
	4/29/02	342294	781442
	5/2/02	342295	781443
	5/10/02	342291	781433
	5/16/02	342289	781429
	5/21/02	342291	781435
	5/23/02	342294	781439
	5/30/02	342296	781444
	6/5/02	342292	781436
	6/10/02	342292	781436
	6/17/02	342294	781437
CZR5035	4/16/02	342427	781755
	4/18/02	342387	781618
	4/22/02	342389	781622
	4/25/02	342393	781623
	4/29/02	342394	781631
	5/2/02	342403	781637
	5/16/02	342398	781633
	5/21/02	342398	781626
	5/23/02	342379	781616
	5/30/02	342398	781635
	6/5/02	342394	781632
	6/10/02	342394	781632
	6/17/02	342391	781629
CZR5036	4/16/02	342427	781755
	4/18/02	342422	781709
	4/25/02	342422	781712
	5/21/02	342410	781741
	5/23/02	342414	781718
	5/30/02	342413	781719
	6/5/02	342413	781719
	6/10/02	342413	781719
	6/17/02	342411	781722
CZR5037	4/16/02	342427	781755
	4/18/02	342412	781733
	4/29/02	342425	781757
	5/2/02	342414	781742

Appendix C. (continued)

TAG #	DATE	LATITUDE	LONGITUDE
	5/16/02	342410	781742
	5/21/02	342410	781741
	5/23/02	342410	781741
	5/30/02	342410	781741
	6/5/02	342411	781744
	6/10/02	342411	781744
	6/17/02	342409	781728
CZR5038	4/16/02	342427	781755
	4/18/02	342389	781570
	4/22/02	342223	781299
	4/25/02	342220	781296
	5/10/02	342220	781295
	5/16/02	342420	781666
	5/23/02	342224	781299
	5/30/02	342223	781302
	6/5/02	342226	781305
	6/10/02	342226	781305
	6/17/02	342225	781299
CZR5039	4/16/02	342427	781755
	4/18/02	342422	781627
	4/22/02	342419	781632
	4/25/02	342427	781631
	4/29/02	342418	781629
	5/2/02	342427	781640
	5/16/02	342420	781666
	5/21/02	342416	781627
	5/23/02	342416	781627
	5/30/02	342421	781632
	6/5/02	342423	781636
	6/10/02	342423	781636
	6/17/02	342419	781633
CZR5040	4/16/02	342427	781755
	4/18/02	342420	781711
	4/22/02	342432	781701
	4/25/02	342429	781697
	4/29/02	342426	781707
	5/2/02	342430	781698
	5/21/02	342410	781741
	5/23/02	342414	781718
	5/30/02	342413	781719
	6/5/02	342418	781715
	6/10/02	342418	781715
	6/17/02	342409	781728
CZR5041	4/15/02	342427	781755

Appendix C. (continued)

TAG #	DATE	LATITUDE	LONGITUDE
	4/22/02	342406	781727
	4/25/02	342415	781750
	4/29/02	342425	781757
	5/2/02	342425	781757
	5/21/02	342410	781741
	5/23/02	342410	781741
	5/30/02	342410	781741
	6/5/02	342410	781741
	6/10/02	342410	781741
	6/17/02	342417	781752
CZR5042	4/16/02	342427	781755
	4/18/02	342404	781633
	4/22/02	342406	781631
	4/25/02	342408	781635
	4/29/02	342418	781629
	5/2/02	342403	781637
	5/10/02	342412	781634
	5/21/02	342416	781627
	5/23/02	342416	781627
	5/30/02	342421	781632
	6/5/02	342414	781629
	6/10/02	342414	781629
	6/17/02	342409	781633
CZR5043	4/17/02	342427	781755
	4/18/02	342418	781745
CZR5044	4/17/02	342427	781755
	4/18/02	342423	781649
	4/22/02	342413	781750
CZR5045	4/17/02	342427	781755
	4/18/02	342413	781734
	4/22/02	342406	781727
	4/25/02	342412	781737
	4/29/02	342425	781757
	5/2/02	342414	781742
	5/10/02	342412	781740
	5/16/02	342412	781740
	5/21/02	342416	781751
	5/23/02	342410	781741
	5/30/02	342411	781744
	6/5/02	342411	781744
	6/10/02	342409	781728
	6/17/02	342409	781728
CZR5046	4/17/02	342427	781755

Appendix C. (continued)

TAG #	DATE	LATITUDE	LONGITUDE
	4/18/02	342190	780931
	4/22/02	342381	781614
CZR5047	4/17/02	342427	781755
	4/18/02	342389	781570
	4/22/02	342255	781368
	4/25/02	342266	781368
	4/29/02	342270	781380
	5/2/02	342273	781374
	5/10/02	342268	781382
	5/16/02	342274	781371
	5/21/02	342275	781377
	5/23/02	342275	781377
	5/30/02	342275	781377
	6/5/02	342273	781369
	6/10/02	342273	781369
	6/17/02	342275	781373
CZR5048	4/17/02	342427	781755
	4/18/02	342357	781494
	4/22/02	342431	781701
CZR5049	4/17/02	342427	781755
	4/18/02	342247	781413
	4/22/02	342247	781414
	4/25/02	342247	781414
	4/29/02	342246	781416
	5/2/02	342249	781418
	5/10/02	342250	781417
	5/16/02	342231	781416
	5/21/02	342251	781416
	5/23/02	342251	781416
	5/30/02	342214	781412
	6/5/02	342214	781412
	6/10/02	342214	781412
	6/17/02	342248	781414
CZR5050	4/17/02	342427	781755
	4/25/02	342429	781697
	4/29/02	342421	781670
	5/2/02	342423	781698
	5/16/02	342420	781666
	5/21/02	342428	781694
	5/23/02	342428	781694
	5/30/02	342428	781694
	6/5/02	342426	781689
	6/10/02	342426	781689
	6/17/02	342424	781681

Appendix C. (continued)

TAG #	DATE	LATITUDE	LONGITUDE
CZR5051	4/22/02	342427	781755
	4/25/02	342412	781737
	4/29/02	342410	781728
	5/2/02	342414	781742
	5/10/02	342412	781740
	5/16/02	342410	781742
	5/21/02	342410	781741
	5/23/02	342410	781741
	5/30/02	342411	781744
	6/5/02	342411	781744
	6/10/02	342411	781744
	6/17/02	342409	781728
CZR5052	4/22/02	342427	781755
	4/25/02	342032	780401
	4/29/02	342027	780417
	5/2/02	342030	780423
	5/10/02	342033	780420
	5/16/02	342033	780421
	5/21/02	342021	780422
	5/23/02	342021	780422
	5/30/02	342032	780416
	6/5/02	342017	780431
	6/10/02	342017	780431
	6/17/02	342030	780422
CZR5053	4/22/02	342427	781755
	4/25/02	342429	781697
	4/29/02	342428	781690
	5/2/02	342430	781698
	5/16/02	342427	781696
	5/21/02	342428	781694
	5/23/02	342428	781694
	5/30/02	342428	781694
	6/5/02	342428	781690
	6/10/02	342428	781690
	6/17/02	342427	781691
	CZR5054	4/22/02	342427
4/25/02		342115	781200
4/29/02		342124	781219
5/2/02		342116	781205
5/10/02		342117	781208
5/16/02		342120	781206
5/21/02		342120	781211
5/23/02		342120	781211
5/30/02		342120	781211

Appendix C. (continued)

TAG #	DATE	LATITUDE	LONGITUDE
	6/5/02	342118	781208
	6/10/02	342118	781208
	6/17/02	342120	781203
CZR5055	4/23/02	342427	781755
	4/25/02	342412	781725
	4/29/02	342410	781728
	5/2/02	342414	781742
	5/10/02	342412	781746
	5/16/02	342410	781742
	5/21/02	342410	781741
	5/23/02	342410	781741
	5/30/02	342410	781741
	6/5/02	342409	781736
	6/10/02	342409	781736
	6/17/02	342409	781728
CZR5056	4/23/02	342427	781755
	4/25/02	342393	781623
	4/29/02	342394	781631
	5/2/02	342403	781637
CZR5057	4/24/02	342427	781755
	4/29/02	342410	781728
CZR5058	4/24/02	342427	781755
	4/25/02	342429	781697
	4/29/02	342380	781616
	5/2/02	342403	781637
	5/16/02	342381	781617
	5/21/02	342399	781628
	5/23/02	342379	781616
	5/30/02	342379	781616
	6/5/02	342379	781616
	6/10/02	342379	781616
	6/17/02	342381	781605
CZR5059	4/24/02	342427	781755
	4/25/02	342415	781750
	4/29/02	342428	781690
	5/2/02	342423	781669
	5/16/02	342427	781696
	5/21/02	342428	781694
	5/23/02	342428	781694
	5/30/02	342428	781694
	6/5/02	342427	781690
	6/10/02	342427	781690
	6/17/02	342427	781691

Appendix C. (concluded)

TAG #	DATE	LATITUDE	LONGITUDE
CZR5060	4/24/02	342427	781755
	4/29/02	342425	781757
	5/2/02	342425	781757
	5/10/02	342422	781754
	5/16/02	342422	781754
	5/21/02	342416	781751
	5/23/02	342416	781751
	5/30/02	342416	781751
	6/5/02	342416	781751
	6/10/02	342416	781751
	6/17/02	342417	781752
CZR5061	4/23/02	342345	781513
CZR5071	4/25/02	342385	781591

APPENDIX D

**SUMMARY OF AMERICAN SHAD BEHAVIOR FROM FISH TAGGED
AND RELEASED AT LOCK AND DAM #1 DURING 2002**

Appendix D. Summary of American Shad behavior from fish tagged and released at Lock and Dam #1 during 2002.

Tag #	Collection method	Passed upstream ¹	Comments
5031	hook & line	no	Passed NC11 on 4/17 but never passed Reiglewood (IP).
5032	hook & line	no	Remained in vicinity of Lock and Dam #1 (L&D#1).
5033	hook & line	no	Passed NC11 on 4/17 and possibly again on 4/22, then remained in the vicinity of L&D#1.
5034	hook & line	no	Passed NC11 on 4/16 and remained between NC11 and IP.
5035	hook & line	no	Fell downstream and stayed within vicinity of NC11, manual tracking never found fish below NC11.
5036	hook & line	no	Remained in vicinity of L&D#1, manual tracking never found fish below NC11. Possibly entered lock chamber on 5/15 (only 1 hit on L&D station).
5037	hook & line	no	Remained in vicinity of L&D#1. Manual tracking never found fish below NC11.
5038	hook & line	no	Fell back to position just upstream of IP, then moved upstream of NC11 bridge and then fell back to previous position above IP and remained.
5039	hook & line	no	Remained between L&D#1 and NC11, never passed either station. Manual tracking found fish in same general vicinity near mouth of Natmore Creek.
5040	hook & line	no	Remained between L&D#1 and NC11 but never passed either station. Manual tracking never located fish below NC11. NC11 station did pick-up tag two times on 4/17 so it is possible fish swam near stations but then proceeded back upriver and stayed.
5041	hook & line	no	Remained in the vicinity of L&D#1. Manual tracking never found fish below NC11. Possibly swam to NC11 between 5/2-5/21 (1 hit on NC11 station on 5/4, 5/6 & 5/7) and returned to L&D #1 but never passed either station.
5042	hook & line	no	Remained between L&D#1 and NC11 but never passed either station. Manual tracking found fish in a variety of locations but within same general vicinity.
5043	hook & line	no	Remained in the vicinity of L&D#1 for 2 days then was never found again. Possibly passed NC 11 on 4/18 at 18:00 but did not pass IP. Possibly removed from the river by fisherman or predation.

Appendix D. (continued)

Tag #	Collection method	Passed upstream ¹	Comments
5044	hook & line	yes	Fell down river to NC11 vicinity on 4/18, stayed near NC11 until 4/19 and then proceeded back upstream to L&D#1 where it passed the lock on 4/23. Fish was never relocated by manual tracking after 4/22.
5045	hook & line	no	Remained in the vicinity of L&D#1. Fixed station at NC11 recorded fish passing on 4/22 and 4/23 when it went back up to L&D#1 then returned to NC11 on 5/1 and returned to L&D#1 between 5/1 and 5/2 where it remained. Manual tracking never found fish below NC11.
5046	hook & line	yes	Fell downstream of Greenbank landing but was not pick-up by IP fixed station. Manual tracking located fish on 4/18. Fish passed NC11 on 4/22 and remained in the vicinity of NC11 until 4/23. Fish passed the lock on 4/25 in the afternoon.
5047	hook & line	no	Fell downstream of NC11 on 4/18 and remained between NC11 and IP. Manual tracking never found fish below IP and fish never went back upstream past NC11.
5048	hook & line	yes	Fell downstream past NC11 between 4/17 and 4/18. Returned up river and was manually tracked on 4/22 below L&D#1. Retreated back to the vicinity of NC11 and returned to L&D#1 between 4/22 and 4/23, when it passed through lock chamber.
5049	hook & line	no	Passed NC11 on 4/17 and remained between NC11 & IP.
5050	hook & line	no	Remained between L&D#1 and NC11 bridge.
5051	hook & line	no	Remained in the vicinity of L&D#1. Never recorded at the 3 stations, nor was it manually located below NC11.
5052	hook & line	no	Retreated down river past NC11 on 4/22 and passed IP on 4/23. Remained in the vicinity of Hood Creek and Strawberry Hill Landing throughout the rest of the study. Fish did not return upriver again. Sites of this relocated fish represent the greatest distance (to river-mile 18) documented for fall back during this study.
5053	hook & line	no	Remained between L&D#1 and NC11. Fish did not pass NC11 or IP. Tag was recorded from IP for April, May, and June. These data are not consistent manual tracking data. It is possibly that this false detect is a result of noise from the IP site that resembled the same frequency as this fish. Manual tracking never located this fish below NC11.

Appendix D. (concluded)

Tag #	Collection method	Passed upstream ¹	Comments
5054	hook & line	no	Passed NC11 station on 4/23 and remained in the vicinity of IP for the remainder of the study. The fish never returned upstream nor did manual tracking locate the fish anywhere other than adjacent to IP.
5055	drift gill net	no	Remained a short distance down river from L&D#1. Fish never passed NC11 or IP, manual tracking did not locate fish below NC11.
5056	drift gill net	no	Remained in the vicinity (just upstream of) NC11 until 5/2 and was never relocated. Fish possibly removed from river by fisherman, otherwise it is unknown what happened to this fish since it did not get recorded on any stations.
5057	hook & line	yes	Remained in the vicinity of L&D#1 until 5/1 and passed through the lock that morning. Fish was never located again during manual tracking nor did it appear at NC11 or IP fixed stations.
5058	hook & line	no	Retreated downstream to NC11 vicinity where it remained between the bridge and approximately 1 mile upstream. Manual tracking never located fish below NC11 bridge.
5059	drift gill net	no	Remained between L&D#1 and NC11. Fish was recorded at NC11 from 6/10 through 6/24. Manual tracking positions indicate the fish was very mobile.
5060	drift gill net	no	Remained within close proximity of L&D#1. Fish never passed any of the 3 stations and was never manually tracked below NC11. Tag was recorded from the fixed station between 6/20 - 6/24, but these data are inconsistent with tracking data and are disregarded.

¹ "Yes" indicates tag was recorded above Lock and Dam #1 from the fixed monitoring receiver.