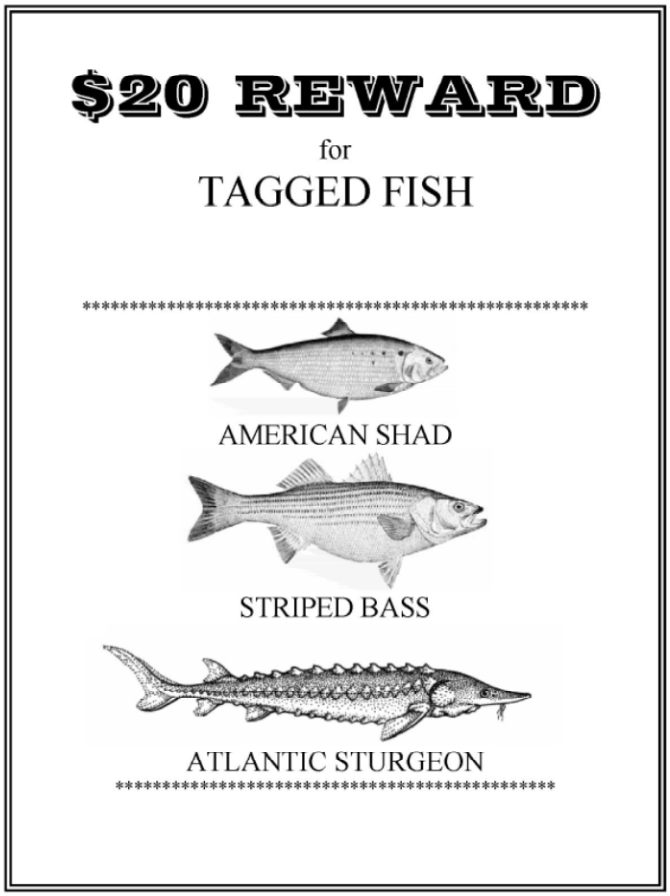
# PRE-CONSTRUCTION MONITORING OF AMERICAN SHAD, ATLANTIC STURGEON, AND STRIPED BASS PASSAGE AT LOCK AND DAM #1 ON THE CAPE FEAR RIVER, NORTH CAROLINA

DECEMBER 2003




Prepared for:

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

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

Prepared by:

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## EXECUTIVE SUMMARY

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 contracted CZR Incorporated (CZR) to perform pre-construction monitoring of three anadromous fish species: striped bass (*Morone saxatilis*), Atlantic sturgeon (*Acipenser oxyrhynchus*), 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. Thirty-eight striped bass, three hybrid striped bass (*Morone saxatilis X chrysops*), and 53 American shad were tagged and monitored in the Cape Fear River between 22 January 2003 and 22 July 2003.

Striped bass were collected with the assistance of electro-fishing boats provided by the North Carolina Wildlife Resource Commission (NCWRC) and North Carolina Division of Marine Fisheries (NCDMF). The University of North Carolina at Wilmington (UNCW) also provided striped bass to be tagged through their regular gill net and electro-fishing sampling efforts for the Lower Cape Fear River Program. American shad were collected using monofilament drift gill nets and electro-fishing boats provided by the NCWRC and NCDMF. Atlantic sturgeon were targeted with large nylon sinking gill nets but none were captured in 2003. Fish were implanted, either orally (American shad) or surgically (striped bass), with a sonic transmitter and externally tagged with a nylon dart tag bearing reward information. Fish were relocated with a mobile tracking receiver during regular tracking efforts beginning at the Castle Street public boat landing in Wilmington, NC. Stops were made at each bend in the river and approximately every 457 meters (1,500 feet). Locations of all tagged fish were recorded in UTMs using a Magellan handheld gps unit. In addition to mobile tracking efforts, three fixed monitoring stations were placed along the upper portion of the study area. 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 just upstream of Lock and Dam #1 near Kelly, NC.

Results of pre-construction monitoring of fish tagged in both 2002 and 2003 are summarized in the following table.

Summary of fish passage success for pre-construction monitoring at Lock and Dam #1, Cape Fear River, Wilmington, North Carolina in 2002 and 2003.

| Monitoring Year | Species Tagged | Number Tagged | Number Returned to Dam | Number Passed | % | Maximum Distance after Tagging Observed Upstream |
|---|---|---|---|---|---|---|
| 2002 | American shad | 30 | 8 | 4 | 50 | N/A[a] |
| | Striped bass | 9 | 2 | 0 | 0 | 30 miles[a] |
| | Atlantic sturgeon | 1 | 0 | 0 | 0 | N/A[a] |
| 2003 | American shad | 53 | 12 | 4 | 33 | 100 miles[b] |
| | Striped bass | 41 | 22 | 5 | 23 | 102 miles[c] |

[a] No tracking above Lock and Dam #1 was conducted in 2002.
[b] Distance measured in miles from Lock and Dam #1, North Carolina.
[c] Distance measured in miles from Wilmington, North Carolina.

Overall, the data suggests that Lock and Dam #1 remains an impediment to anadromous fish species' ability to continue upriver on their spawning migrations.

Fixed station data and manual tracking efforts indicate that 20 striped bass and two hybrid striped bass made deliberate and directed movements upstream in an attempt to reach spawning grounds. Of these 22 fish, five (23%) successfully passed upstream of Lock and Dam #1. One (5%) of these striped bass (#5011) was confirmed to have been passed upstream through the locking process. The other four fish are believed to have passed over the top of the dam during high flow events when the water level on either side of the dam was equal. Eight striped bass were recorded by the Lock and Dam #1 fixed station entering the lock chamber but were not passed through the locking process to the upper pool.

Twelve shad made return trips back to the dam after tagging and four shad (33.3%) passed upstream of the dam. Two (16.7%) were passed through the locking chamber and two (16.6%) apparently swam over the top of dam during high water events.

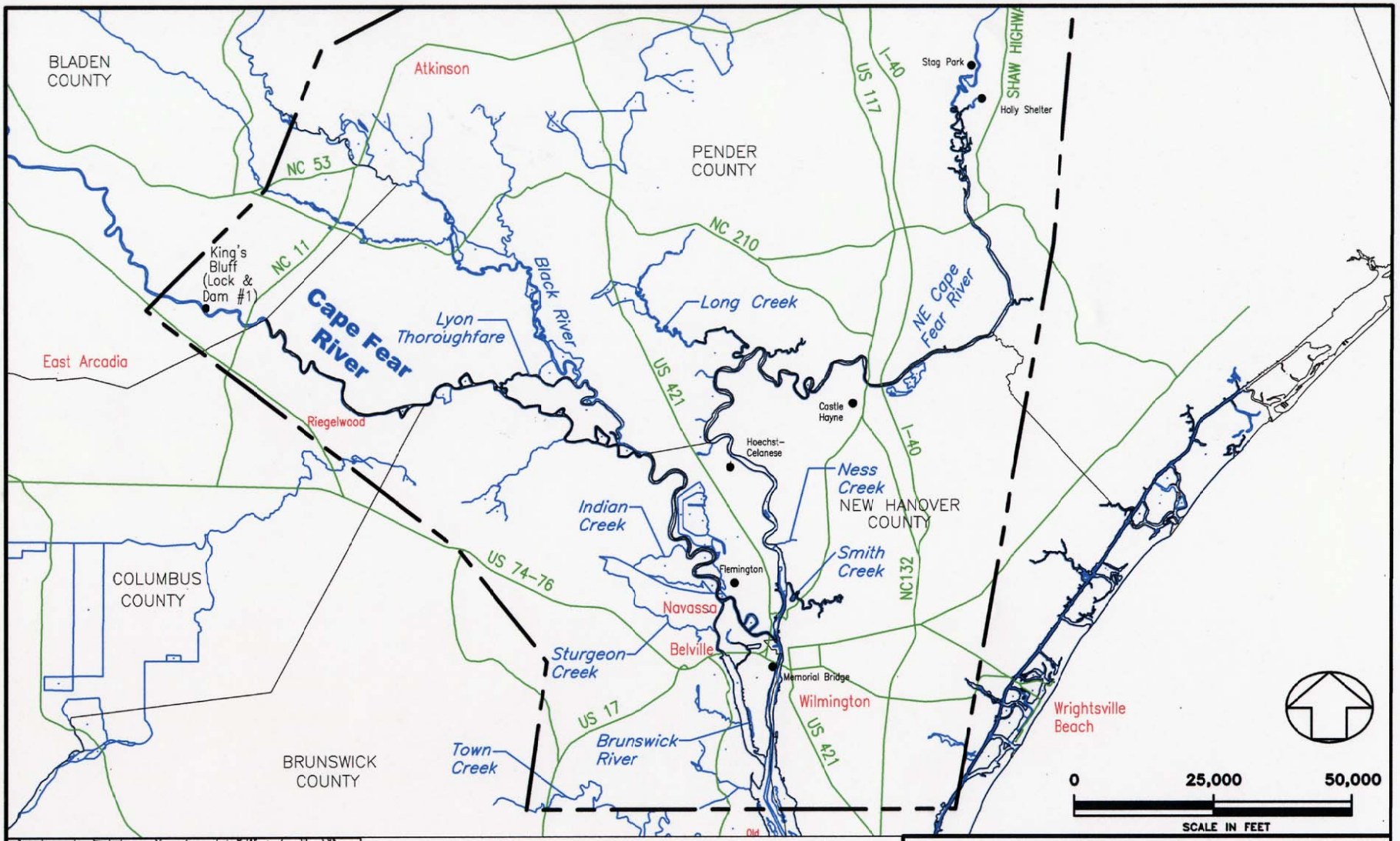
# PRE-CONSTRUCTION MONITORING OF AMERICAN SHAD, ATLANTIC STURGEON, AND STRIPED BASS PASSAGE AT LOCK AND DAM #1 ON THE CAPE FEAR RIVER, NORTH CAROLINA 2003

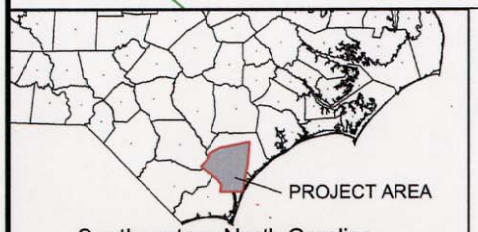
## 1.0 INTRODUCTION

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 contracted CZR Incorporated (CZR) to perform pre-construction monitoring of three anadromous fish species: striped bass (*Morone saxatilis*), Atlantic sturgeon (*Acipenser oxyrhynchus*), 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. Thirty-eight striped bass, three hybrid striped bass (*Morone saxatilis X chrysops*), and 53 American shad were tagged and monitored in the Cape Fear River between 22 January 2003 and 22 July 2003.

## 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). 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.




Southeastern North Carolina
VICINITY MAP (NOT TO SCALE)

VICINITY MAP

**WILMINGTON USACOE FISH PASSAGE**

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: BFG |
| DATE: 12/18/02 | | FILE: 164532VIC |
| | | CP#1645.32 |
| | | FIGURE 1 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

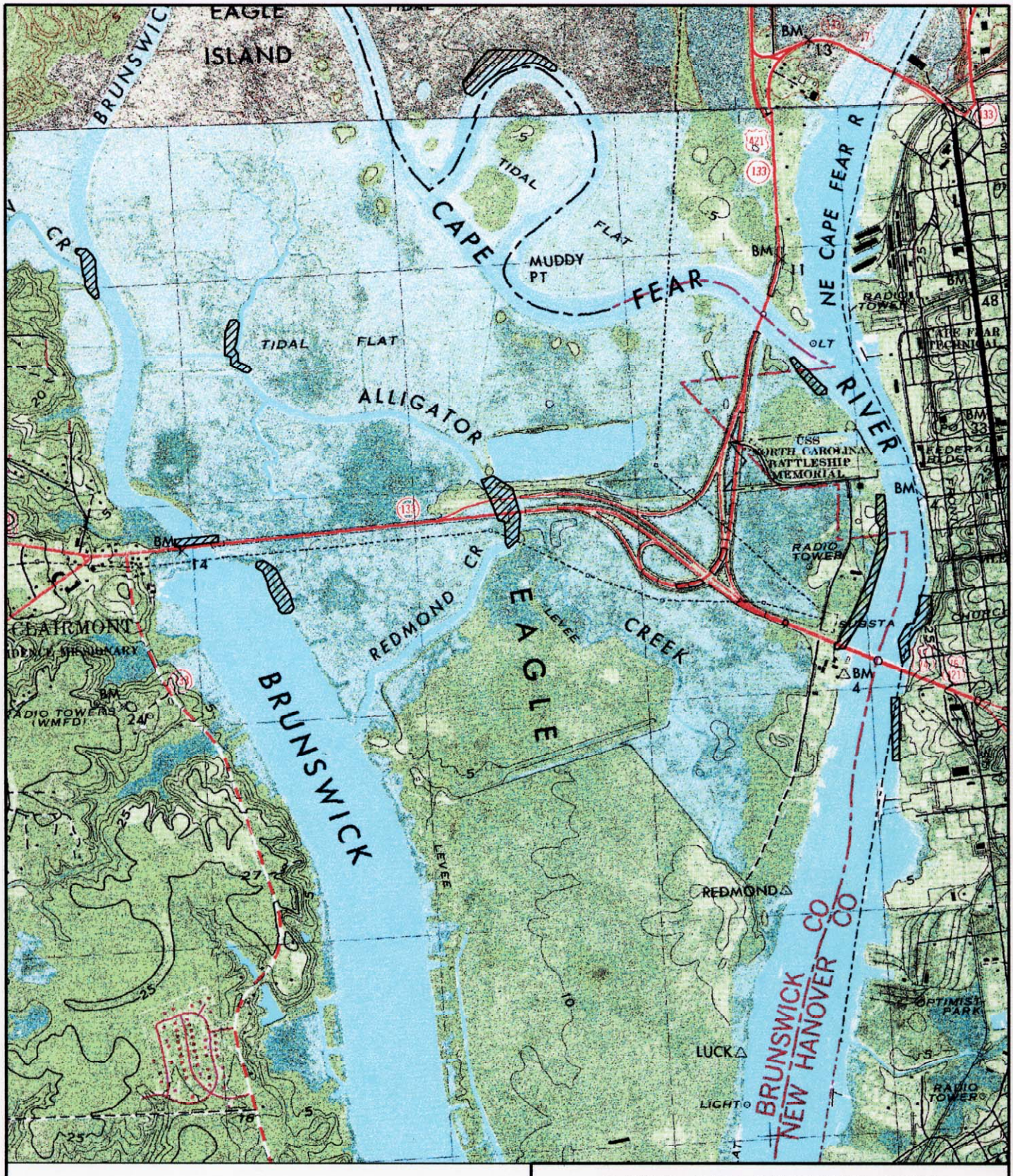
## 3.0 METHODS

### 3.1 Striped Bass

3.1.1 Electro-fishing Collections. CZR, with the assistance of electro-fishing boats provided by the North Carolina Division of Marine Fisheries (NCDMF),the North Carolina Wildlife Resource Commission (NCWRC) (see photos in Appendix A), and the University of North Carolina at Wilmington (UNCW) targeted striped bass in the lower portion of the Cape Fear River near Wilmington and from the Brunswick River between 22 January 2003 and 26 March 2003 (Figure 2). 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.

3.1.2 Gill Net Collections. CZR conducted sinking gill net surveys for striped bass between 10 February 2003 to 13 February 2003. Striped bass were targeted at five sites in the lower portion of the Cape Fear River and two sites from the Brunswick River (Figure 3). 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. Gill nets were deployed for four days and three nights and checked each morning and re-deployed. Nets were retrieved in the morning on the last sampling day of the week.

Transmitters were surgically implanted in striped bass and hybrid striped bass using standardized sterile techniques established in similar studies (Moser and Ross 1993) and photographs of these techniques can be found in Appendix 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 nine frequencies (70-78 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), date and time of release, site of release (gps ± 45 feet), depth, water temperature, and conductivity were recorded. A minimum tagging size for striped bass was set at 533 mm (21 inches) for females and 500 mm (19 inches) for males, and for hybrid striped bass, 500 mm for females and 450 mm (18 inches) for males.




LEGEND

STRIPED BASS COLLECTION AREAS

0 2000 4000

SCALE IN FEET

STRIPED BASS COLLECTION AREAS

**WILMINGTON USACOE FISH PASSAGE**

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/27/03 | | FILE: 1645STRBAS |
| | | CP#1645.32 |
| | | FIGURE 2 |

CZR INCORPORATED ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
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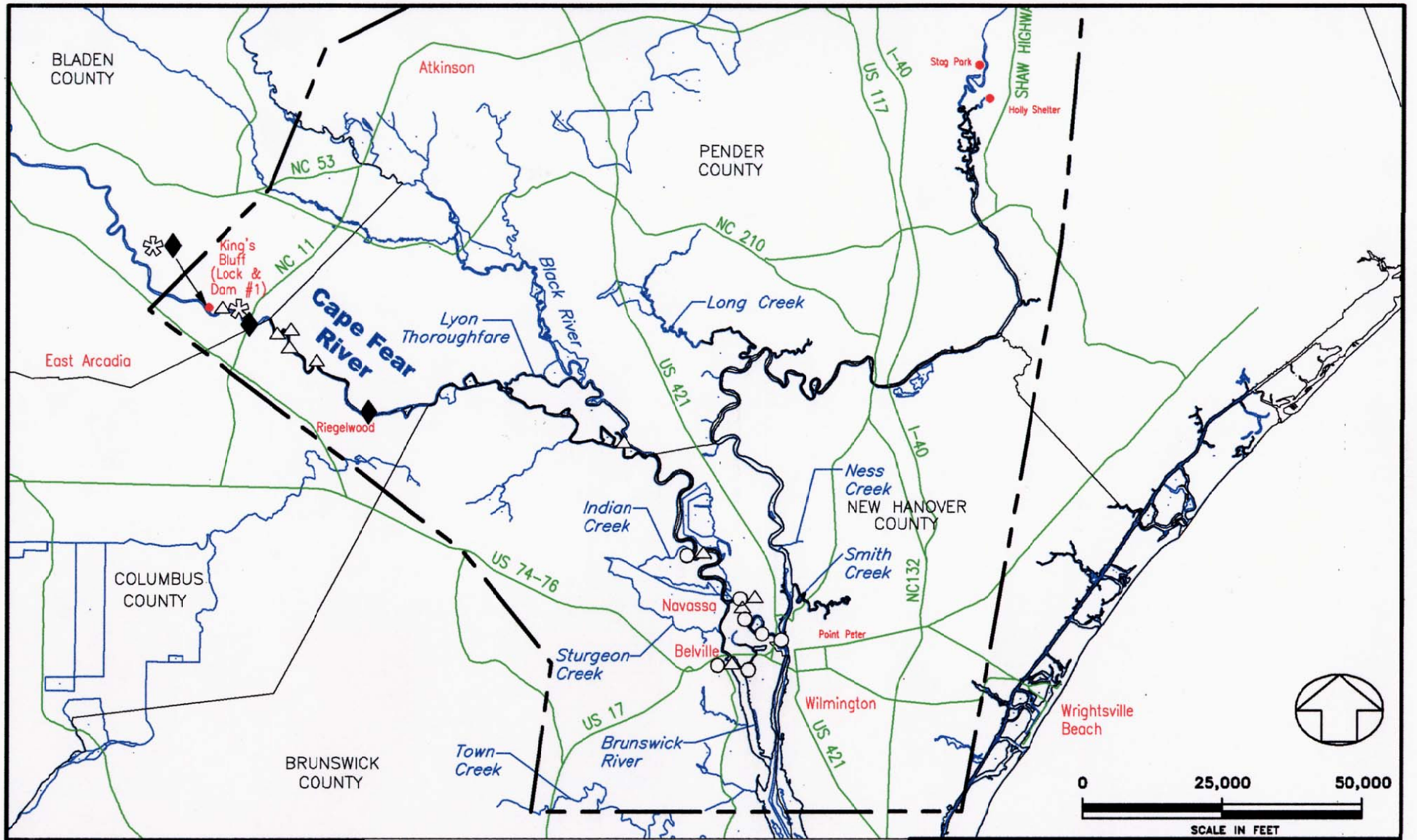


LEGEND

- ○ NET SET LOCATIONS FOR STRIPED BASS
- △ NET SET LOCATIONS FOR ATLANTIC STURGEON
- ✲ DRIFT NET SETS FOR AMERICAN SHAD
- ◆ FIXED MONITORING STATIONS

LOCATIONS OF GILL NET SETS AND FIXED MONITORING STATIONS

**WILMINGTON USACOE FISH PASSAGE**

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: BFG |
| DATE: 08/25/03 | | FILE: 164532NET |
| | | CP#1645.32 |
| | | FIGURE 3 |

CZR INCORPORATED ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE SUITE 2
WILMINGTON, NORTH CAROLINA 28403
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## 3.2 Atlantic Sturgeon

3.2.1 Gill Net Collections. Atlantic sturgeon were targeted at nine sites in the Cape Fear River and one site in the Brunswick River between 20 March 2003 and 28 May 2003 (Figure 3). Custom made sturgeon nets consisted of a 50-yard long, 18-foot deep,12-inch stretch multifilament nylon mesh sinking gill nets. All efforts were made to check sinking gill nets for as early in the morning as possible to avoid stresses associated with capture and warm water.

Although no sturgeon were caught and tagged in 2003, custom-made transmitters (CHP-87-XL) were obtained from Sonotronics that operated on a frequency of 78 and 79 kHz. Unique pulse intervals and "ping" codes within each frequency allowed identification of individual fish. The cylindrical transmitter was, 99 mm long, and varied in diameter from 18 mm to 33.5 mm. The tags have a battery life of 48 months. The fish would have been externally tagged with two Floy FT-1-94 type dart tags, each with a unique number and reward information printed on each streamer. For each fish tagged and released, total length, sex (if it could be determined), date and time of release, site of release (gps ± 45 feet), depth, water temperature, and conductivity were to have been recorded. A minimum tagging size of 1,219 mm (48 inches) was established 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 Drift Gill Net Collections. American shad were targeted at the peak of their migration between 18 March 2003 and 17 April 2003 in the vicinity of Lock and Dam #1 on the Cape Fear River (Figure 3). Drift gill nets were 30-yards long, 8-foot deep, and 5.5-inch stretch monofilament mesh. Transmitters were surgically implanted in American shad using standardized sterile techniques established in similar studies (Moser and Ross 1993) and photographs of these techniques can be found in Appendix A. The transmitter (Sonotronics IBT-96-5) operated on ten frequencies (70-79 kHz); unique pulse intervals and "ping" codes within each frequency allowed identification of individual fish. The cylindrical transmitters were 28 mm long and 8 mm in diameter, weighed 2.5 grams, and have a battery life of five months. After capture, fish were placed in a holding tank containing river water and a glycerin-coated 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 slower current to prevent them from becoming disoriented. For each fish tagged and released, total length, sex (if it could be

determined), date and time of release, site of release (gps ± 45 feet), depth, water temperature, and conductivity 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 Electro-fishing Collections. CZR, with the assistance of electro-fishing boats provided by the NCDMF and the NCWRC, targeted American shad during the peak of their migration on 18 March 2003 and 9 April 2003 in the vicinity of Lock and Dam #1 on the Cape Fear River (Figure 3). American shad were collected and tagged using the same protocol identified above in the "Drift Gill Net 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 (see photos in Appendix A). The release location for each fish tagged was recorded in Universal Transverse Mercator (UTMs) with a Magellan NAV DLX-10 handheld GPS (± 45 feet).

Fish were relocated during regular tracking efforts beginning at the Castle Street public boat landing in Wilmington, NC. 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 UTMs using the Magellan handheld gps unit. Manual tracking continued upriver until all tagged fish were located or until Lock and Dam #1 was reached.

Additional tracking efforts were incorporated into the study near the end of the monitoring period to locate tagged fish in the Black River (16 June 2003), the Northeast Cape Fear River (17 June 2003), and the Cape Fear River (between Ft. Caswell and Wilmington [18 June 2003], and from Buckhorn Dam near Sanford, N.C., to Lock and Dam #1 [30 June - 3 July]). The goal was to survey as far as possible up the Black, Cape Fear, and Northeast Cape Fear Rivers in an attempt to locate fish that may have been tagged on the Cape Fear River but relocated to positions outside of the regularly monitored area. Approximately 51.2 km (31.8 miles) of the Black River, 71.8 km (44.6 miles) of the Northeast Cape Fear River, 41.8 km (26.0 miles)

of the Cape Fear River from Wilmington to Ft. Caswell were searched. In addition to these river sections, approximately 202.9 km (126.1 miles) of the upper Cape Fear River from Buckhorn Dam to Lock and Dam #1 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 while tracking.

3.4.2 Fixed Monitoring Stations. Three fixed monitoring stations were placed along the upper portion of the study area (Figure 3). 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 just upstream of 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 three 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 periodically during 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), dissolved oxygen (mg/l), salinity (ppt), and conductivity (µs) were collected using a YSI 85 water quality 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 weekly fixed station data downloads and after each fish was tagged.

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 once a month for the duration of the project.

## 4.0 RESULTS

A total of 107 fish representing 6 species (including one hybrid) were captured between 28 January 2003 and 3 July 2003 (Table 1). Individuals of anadromous species comprised 98 (91.6%) of the total catch, and were represented by the following species: American shad (55.1%), striped bass (40.8%), and hybrid striped bass (4.1%). All the non-anadromous fish were caught in gill nets and longnose gar (*Lepisosteus osseus*), blue catfish (*Ictalurus furcatus*), and flathead catfish (*Pylodictis olivaris*) were the most abundant. Fish collection data (dates, techniques, effort, and catch) are summarized in Appendix B. Ninety-four fish (53 American shad, 38 striped bass, and 3 hybrid striped bass) 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 C and D, respectively.

Tag reception at distances of 608 meters (2,000+ feet) were common in the section of the Cape Fear River from Wilmington to the mouth of the Black River and in the remainder of the river when discharges were 8,000 cubic feet per second (cfs) or less. However, during periods of elevated discharges, (i.e. greater than 8,000 cfs) tag reception varied in the upper river depending on the location of the range test, orientation of the hydrophone (pointed upriver or downriver), and the type of sonic tag used for the test. The "noise" created by large volumes of water flowing through the narrow channel of the Cape Fear River inhibited tag reception at the fixed stations and their ability to register passing fish during increased discharges.

The three fixed monitoring stations were installed and tested in January 2003 when discharge was between 2,500 and 3,000 cfs (Figure 4). Reception distance was measured using one high powered (striped bass and Atlantic sturgeon) and one medium powered (shad) tag. Due to the orientation of the hydrophones at the Lock and Dam #1 station, maximum range on either tag at any given river condition was approximately 300 feet. At the International Paper (IP) and NC 11 stations, the high powered tags could be heard and successfully registered on the data loggers at a distance of 1,000 feet. The tags to be implanted in American shad were heard and successfully registered at approximately 800 feet. A range test performed on the manual tracking equipment at the same time was approximately double the fixed station distances except for the shad tags which could be detected at 1,000 feet. The difference in range between the fixed stations and manual tracking equipment is due

Table 1. Total numbers of fish collected at all sampling sites with all gear types used on the Cape Fear River in 2003.

| Species | Number |
|---|---|
| Alosa sapidissima | 54 |
| Morone saxatilis | 40 |
| Morone saxatilis x chrysops (hybrid) | 4 |
| Lepisosteus osseus | 5 |
| Ictalurus furcatus | 3 |
| Pylodictis olivaris | 1 |
| Total Species = 6 (including one hybrid) | Total Number = 107 |

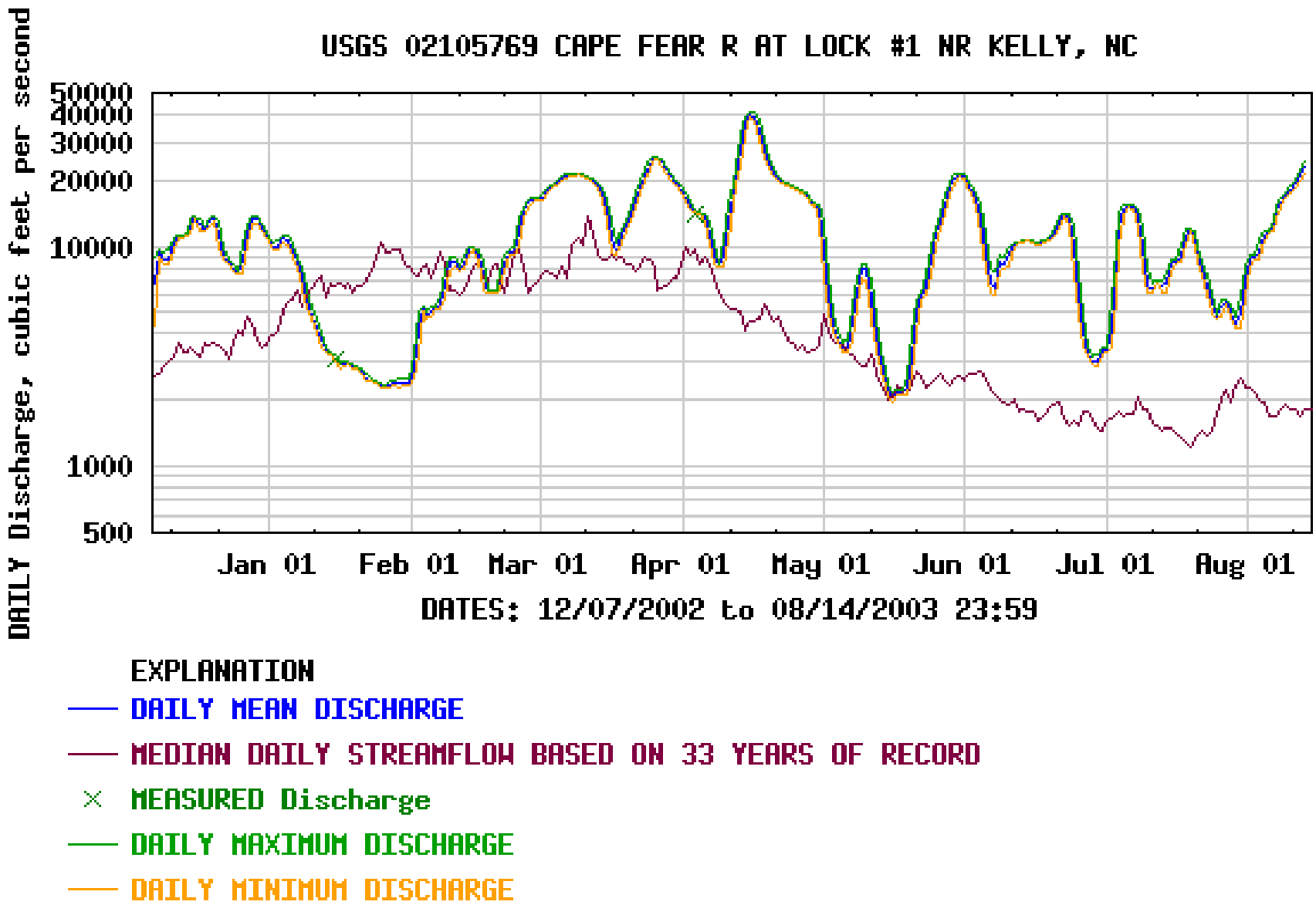


FIGURE 4. Daily River discharge from Lock and Dam #1 during the study period, 2003. (source: http://waterdata.usgs.gov)

to the static orientation of the fixed station hydrophones compared to the mobility of the manual tracking unit.

On 17 March 2003, river discharge was approximately 10,000 cfs and the fixed station range on the striped bass and sturgeon tags was reduced to 600 feet and to 300 feet for the shad tags. Manual tracking reception was measured at 900 and 600 feet for the same tags. On 27 March 2003, discharge was 26,000 cfs and fixed station ranges were less than 300 feet at the IP and NC 11 and 600 feet for the manual tracking equipment. This variation in tag reception and range produced gaps in the fixed station data for those periods when river conditions exceeded 8,000 cfs.

### 4.1 American Shad

Electro-fishing and drift gill net collections were conducted during the three weeks prior to and two days after the peak of the spawning migration of American shad (shad) beginning on 18 March 2003 and ending on 17 April 2003. Fifty-four shad were collected, and of these, 53 were tagged and released in the vicinity of Lock and Dam #1. Thirty-six shad were captured using a drifting gill net and 21 shad were collected through the use of an electro-fishing boat provided by the NCDMF or the NCWRC. One shad died while tagging and was not released. Only fish considered in excellent condition were tagged. Of the 53 fish tagged 21(39.6%) were male and 32 (60.4%) were female (Table 2). Total lengths ranged between 398 -597 mm (11.2 - 23.5 inches) with an average total length of 500 mm (19.7 inches).

A summary of shad behavior after tagging during 2003 can be found in Appendix E. Immediately after being tagged and released, all fish except one (shad #5161), exhibited varying degrees of the fall back response as confirmed through regular manual tracking efforts and fixed station data. Shad #5161 moved upstream after tagging. This fish was manually tracked on three separate occasions between the NC 11 bridge and Lock and Dam #1.

Four fish (7.6%), shad #s 5132, 5137, 5138, and 5163, successfully passed upstream of Lock and Dam #1. Shad #5132 was successfully locked through to the upper pool on 4 May 2003; however, it was not manually tracked upstream and it was later located at the fixed station at the NC 11 bridge on 19 June 2003. It is believed that this fish continued upstream with the intent to spawn and then fell back over the dam before manual tracking efforts were conducted upstream of the dam in late June and early July. Shad #5138 was successfully locked upstream on 2 May 2003 since it was both registered on the Lock and Dam fixed station and manually tracked upstream of the dam near Lock and Dam #2 on 3 July 2003. Shad #5137 and 5163 likely swam over the dam during periods of high water. These fish were not registered on the Lock and Dam station either because of the interference created by the large volume of water flowing over the dam or they passed the dam when the monitor was removed because of flood levels. Shad #5163 was manually tracked on 1 July 2003

Table 2. Physical data collected from American shad tagged near Lock and Dam #1 during pre-construction monitoring for USACOE Fish Passage study during 2003.

| Tag # | Date | Pl[1] | TL (mm)[2] | Sex | Time |
|---|---|---|---|---|---|
| 5131 | 18-Mar | 827 | 551 | F | 1500 |
| 5168 | 18-Mar | 1011 | 491 | F | 1700 |
| 5151 | 18-Mar | 817 | 429 | M | 1600 |
| 5160 | 18-Mar | 1045 | 449 | M | 1600 |
| 5163 | 18-Mar | 923 | 461 | M | 1600 |
| 5164 | 18-Mar | 930 | 445 | M | 1600 |
| 5165 | 18-Mar | 944 | 439 | M | 1600 |
| 5166 | 18-Mar | 964 | 461 | M | 1700 |
| 5169 | 18-Mar | 1038 | 493 | M | 1700 |
| 5140 | 1-Apr | 837 | 575 | F | 1200 |
| 5143 | 1-Apr | 875 | 549 | F | 1135 |
| 5145 | 1-Apr | 897 | 542 | F | 1335 |
| 5152 | 1-Apr | 927 | 520 | F | 1300 |
| 5153 | 1-Apr | 810 | 575 | F | 1100 |
| 5154 | 1-Apr | 913 | 571 | F | 1225 |
| 5156 | 1-Apr | 881 | 575 | F | 1345 |
| 5167 | 1-Apr | 991 | 492 | F | 1400 |
| 5172 | 1-Apr | 814 | 492 | F | 1405 |
| 5175 | 1-Apr | 867 | 501 | F | 1215 |
| 5158 | 1-Apr | 1018 | 473 | M | 1245 |
| 5162 | 1-Apr | 856 | 398 | M | 1130 |
| 5133 | 8-Apr | 974 | 538 | F | 1215 |
| 5135 | 8-Apr | 1003 | 578 | F | 1230 |
| 5146 | 8-Apr | 996 | 525 | F | 1245 |
| 5148 | 8-Apr | 1031 | 554 | F | 1300 |
| 5150 | 8-Apr | 1053 | 543 | F | 1430 |
| 5155 | 8-Apr | 789 | 511 | F | 1000 |
| 5159 | 8-Apr | 1024 | 513 | F | 1300 |
| 5161 | 8-Apr | 951 | 515 | F | 1100 |
| 5170 | 8-Apr | 844 | 546 | F | 1400 |
| 5179 | 8-Apr | 1024 | 495 | M | 1115 |
| 5180 | 8-Apr | 927 | 439 | M | 1130 |
| 5134 | 9-Apr | 988 | 551 | F | 1300 |
| 5137 | 9-Apr | 960 | 545 | F | 1300 |
| 5141 | 9-Apr | 847 | 522 | F | 1520 |
| 5149 | 9-Apr | 1039 | 472 | F | 1525 |
| 5173 | 9-Apr | 821 | 540 | F | 1350 |
| 5132 | 9-Apr | 893 | 475 | M | 1545 |
| 5136 | 9-Apr | 938 | 450 | M | 1515 |
| 5138 | 9-Apr | 916 | 476 | M | 1520 |
| 5142 | 9-Apr | 1010 | 431 | M | 1545 |
| 5144 | 9-Apr | 861 | 412 | M | 1550 |

Table 2. (concluded)

| Tag # | Date | PI[1] | TL (mm)[2] | Sex | Time |
|---|---|---|---|---|---|
| 5157 | 9-Apr | 976 | 452 | M | 1345 |
| 5174 | 9-Apr | 834 | 461 | M | 1512 |
| 5177 | 9-Apr | 953 | 435 | M | 1530 |
| 5178 | 9-Apr | 979 | 440 | M | 1342 |
| 5139 | 17-Apr | 902 | 455 | F | 1400 |
| 5140B | 17-Apr | 837 | 491 | F | 1330 |
| 5147 | 17-Apr | 1060 | 525 | F | 1400 |
| 5169B | 17-Apr | 1038 | 546 | F | 1330 |
| 5171 | 17-Apr | 794 | 505 | F | 1330 |
| 5176 | 17-Apr | 597 | 597 | F | 1330 |
| 5152B | 17-Apr | 927 | 490 | M | 1330 |

[1] Pulse interval for sonic transmitter
[2] Total length in mm

approximately one mile upstream of the NC 217 bridge at Erwin, or approximately 100 miles upstream from Lock and Dam #1. This fish represents the furthest upstream location of any shad located during the study period. Shad #5137 was manually located a short distance downstream of Lock and Dam #2 on 3 July 2003.

Fixed station data and manual tracking efforts indicate that twelve shad (22.6%) returned to the vicinity of the dam after tagging. Two shad, #5171 and 5165, were registered by the fixed station located at Lock and Dam #1. Shad #5165 was registered in the vicinity of the Lock and Dam fixed station on 2 April 2003. It is believed that this fish swam over the top of the dam during a period when locking procedures were suspended due to above average discharge. This fish then remained within close proximity to the upstream side of the lock chamber for several hours after which shad #5165 was not located again above or below Lock and Dam #1 during subsequent tracking efforts. Shad #5171 entered the lock chamber two times on 25 May 2003 but was not passed upstream during that days locking procedures.

Of the remaining 46 shad, 22 fish fell back and were tracked at least once during the course of the study. Of these 22 shad, eight were tracked more than once. Shad # 5142 was manually located five times after tagging in the same general vicinity of its original tagging location and is believed to have died shortly after it was released. This fish represents the only shad mortality associated with tagging. The remaining 24 shad were never manually located or registered by any of the fixed stations after tagging. It is believed that these fish exited the study area after tagging and did not return during the remainder of the study.

Fourteen tags from American shad implanted in 2002 were manually located during the 2003 pre-construction monitoring period. In all cases, the location of these tags were in the same vicinity as noted at the end of the 2002 monitoring period. Therefore, it is believed that these are active tags still "pinging" from shad that died during the previous study.

### 4.2 Atlantic Sturgeon

Intensive gill net surveys were conducted from nine sites in the upper and lower Cape Fear River and one site in the Brunswick River. No Atlantic sturgeon were captured in 2003.

### 4.3 Striped Bass

Forty striped bass and four hybrid striped bass were captured and, of these, 38 striped bass and three hybrids were implanted with a sonic transmitter. Two striped bass and one hybrid striped bass were captured in gill nets but were not tagged

because they were either dead or in poor condition. It is believed that all bass tagged in 2003 survived. Of the 41 tagged bass, 28 (68.3%) were females and 13 (31.7%) were males. Sizes ranged from 480 - 889 mm (18.9 - 35.0 inches) with an average total length of 650 mm (25.6 inches) (Table 3). In addition to the 41 fish tagged in 2003, five striped bass (5001, 5002, 5004, 5007, and 5014) tagged in 2002 were also located. Of these five fish, two (5004 and 5014) were confirmed to be alive and will be included in the tracking data presented in 2003.

A total of 1,366 minutes (22.8 hours) were spent electro-fishing with the NCWRC and NCDMF in the Cape Fear River around Wilmington harbor and the Brunswick River. A map depicting areas where striped bass were collected during electro-fishing efforts in 2003 can be found in Figure 2. One attempt was made to shock an area of the Cape Fear River below Lock and Dam #1 but this only produced one hybrid striped bass (#5118). A total of 80 fish were collected using two electro-fishing boats. Of these, 37 (46.3%) fulfilled the size criterion for tagging. Electro-fishing for striped bass was concentrated in areas containing underwater structure. These areas were typically around bridge supports, old dock pilings, ship wrecks and cypress stumps. The mouths of creeks and small tributaries were also targeted. Four striped bass (#5009 - #5012) were provided by Mike Williams of UNCW. These fish were captured during UNCW's regular gill net and electro-fishing sampling efforts for the Lower Cape Fear River Program.

In general, the 38 striped bass and three hybrid striped bass tagged in 2003 tended to very mobile compared to the fish tracked in 2002. A summary of striped bass behavior after tagging during 2003 can be found in Appendix F.

Of the 41 fish tagged in 2003, five striped bass (#'s 5011, 5015, 5023, 5106, and 5116), or 12.2%, successfully passed upstream of Lock and Dam #1. Striped bass #5110 may have also successfully passed upstream through the lock chamber on 9 May 2003 but this cannot be confirmed since it was not located during upstream tracking efforts nor was it located again below the dam by fixed stations or subsequent manual tracking runs. Of the five striped bass that passed Lock and Dam #1, only #5011 can be confirmed to have passed through the lock chamber to the upper pool. The remaining four fish were never registered by the fixed station and it is assumed that these fish passed over the dam during high flow events when the upper and lower pools were equal.

Striped bass #5015 was tagged at Pt. Peter on 25 February 2003 and was manually tracked seven times between the US 74-76 Bridge and Horseshoe Bend. This fish then disappeared after 7 April 2003 and was not located again until 3 July 2003 when it was found approximately 7 miles above Lock and Dam #3 or 102 miles upstream from Wilmington. This fish represents the furthest upstream location of any striped bass located during the study.

Table 3. Physical data collected from striped bass and hybrid striped bass tagged during pre-construction monitoring for USACOE Fish Passage Study 2003.

| Species[1] | Date | Tag # | PI[2] | TL (mm)[3] | Sex | Time |
|---|---|---|---|---|---|---|
| SB | 30-Jan | 5009 | 929 | 645 | F | 1630 |
| SB | 30-Jan | 5010 | 936 | 691 | F | 1630 |
| SB | 30-Jan | 5011 | 950 | 661 | M | 1630 |
| SB | 10-Feb | 5012 | 957 | 568 | M | 1425 |
| SB | 25-Feb | 5015 | 984 | 668 | F | 945 |
| SB | 25-Feb | 5016 | 998 | 614 | F | 945 |
| SB | 25-Feb | 5017 | 1004 | 742 | M | 1030 |
| SB | 25-Feb | 5018 | 1018 | 666 | F | 1030 |
| SB | 25-Feb | 5019 | 1024 | 694 | F | 1030 |
| SB | 25-Feb | 5020 | 1038 | 839 | F | 1030 |
| SB | 25-Feb | 5021 | 1044 | 699 | F | 1030 |
| SB | 25-Feb | 5022 | 852 | 709 | M | 1030 |
| SB | 25-Feb | 5023 | 865 | 550 | M | 1030 |
| SB | 25-Feb | 5024 | 873 | 561 | F | 1030 |
| SB | 26-Feb | 5025 | 885 | 762 | M | 1330 |
| SB | 26-Feb | 5026 | 892 | 550 | M | 1330 |
| SB | 26-Feb | 5027 | 900 | 577 | F | 1330 |
| SB | 26-Feb | 5028 | 914 | 601 | F | 1330 |
| SB | 26-Feb | 5029 | 920 | 578 | F | 1330 |
| SB | 26-Feb | 5030 | 932 | 787 | F | 1330 |
| SB | 26-Feb | 5101 | 849 | 592 | M | 1330 |
| SB | 4-Mar | 5102 | 864 | 815 | F | 930 |
| SB | 4-Mar | 5103 | 886 | 667 | F | 1245 |
| SB | 4-Mar | 5104 | 908 | 635 | F | 1245 |
| SB | 4-Mar | 5105 | 930 | 619 | F | 1245 |
| SB | 4-Mar | 5106 | 945 | 558 | M | 1245 |
| SB | 4-Mar | 5107 | 966 | 710 | F | 1400 |
| SB | 7-Mar | 5108 | 989 | 576 | F | 930 |
| SB | 11-Mar | 5109 | 1010 | 889 | F | 1100 |
| HSB | 11-Mar | 5110 | 1025 | 589 | F | 1100 |
| SB | 12-Mar | 5111 | 1047 | 823 | F | 1130 |
| SB | 12-Mar | 5112 | 859 | 605 | F | 1130 |
| SB | 12-Mar | 5113 | 880 | 609 | M | 1130 |
| SB | 12-Mar | 5114 | 895 | 603 | F | 1130 |
| SB | 13-Mar | 5115 | 918 | 615 | F | 1000 |
| SB | 13-Mar | 5116 | 939 | 610 | M | 1000 |
| SB | 13-Mar | 5117 | 960 | 724 | F | 1300 |
| HSB | 18-Mar | 5118 | 975 | 576 | F | 1500 |
| SB | 26-Mar | 5119 | 996 | 625 | M | 1300 |
| SB | 26-Mar | 5120 | 1018 | 660 | M | 1300 |
| HSB | 26-Mar | 5121 | 1039 | 480 | F | 1300 |

[1] SB = striped bass, HSB = hybrid striped bass
[2] PI = Pulse interval of sonic transmitter
[3] TL = Total length in mm

Striped bass #5011was tagged on 30 January 2003 at the Castle St. boat landing. On 6 February 2003 this fish was found in the Brunswick River south of the Navassa train trestle. This fish moved south again and was located underneath the US 74-76 bridge where it crosses the Brunswick River on 20 and 24 February 2003. Bass #5011 then returned to the Cape Fear River and was located on 10 March 2003 a short distance upstream from the NC 421 bridge. This fish was next located upstream from Hood Creek on 3 April 2003 and again on 10 April 2003 approximately 32 miles upstream from Wilmington. Bass #5011 was not located again until 14 May 2003 when it was picked up by the fixed station at IP. On 15 May 2003, this fish was manually located near the mouth of Natmore Creek above the NC 11 bridge. The fish then fell back to a location a short distance upstream of the NC 11 bridge where it was manually tracked on 19 May 2003. This fish then fell back again to a position downstream from the IP fixed station where it was registered on 20 May 2003. Bass #5011 then turned back upstream and passed the NC 11fixed station at 6:30 pm the same day. This fish was registered on the Lock and Dam #1 fixed station at 8:45 am and again at 4:00 pm on 21 May 2003 at which time it was successfully passed upstream through the locking process. On 3 July 2003, bass #5011 was manually located approximately 3/4 of a mile downstream from Lock and Dam #3 or 94 miles upstream from Wilmington.

Striped bass #5116 was tagged on 13 March 2003 near the US 74-76 bridge and was located the next day in Horseshoe Bend. This fish was manually located on 7 April 2003 near the Navassa train trestle and again on 9 April 2003 when the fixed station at IP recorded it as it passed the station heading upstream at 6:30 am. The fish was located again on 10 April 2003 during a manual tracking run upstream of IP. Bass #5116 was not found again until 3 July 2003 when it was located approximately 500 feet upstream of Lock and Dam #2 or 72 miles upstream from Wilmington.

Striped bass #5023 was tagged on 25 February 2003 at Pt. Peter and was not located until 15 May 2003 when it was found to be a short distance from its original tagging position. This fish vanished again and was not located until the fixed station at NC 11 recorded it moving upstream on 26 June 2003. On 3 July 2003, bass #5023 was manually located approximately 1,200 feet downstream from Lock and Dam #2 or 70 miles upstream from Wilmington.

Striped bass #5106 was tagged on 4 March 2003 in the Brunswick River near the US 74-76 bridge. This fish was manually located on 10 April 2003 at the mouth of the Northeast Cape Fear River near Pt. Peter. This fish was not located again until 3 July 2003 when it was found approximately 1.5 miles downstream from Lock and Dam #2 or 69.5 miles upstream from Wilmington.

Of the remaining 36 fish tagged in 2003, four (9.8%) were never manually tracked or located by any of the fixed stations. Six (14.6%) fish were relocated only one time. Fixed station data and manual tracking efforts indicate that twenty-two striped bass made deliberate and directed movements upstream in an attempt to reach spawning grounds. Eight of these fish were recorded on the fixed station at Lock and Dam #1 but were never found upstream of the dam and subsequently were located by the downstream fixed stations and or by manual tracking efforts. This indicates that these fish entered the lock chamber but were not passed through the locking process to the upper pool.

### 4.4 Water Quality

Water temperature increased throughout the study period and ranged from 6.8 - 25.1° C downstream and 7.0-25.5° C upstream of the dam (Table 4). River discharge and water heights were well above the 33- year average in 2003 as a result of consistent heavy rains in the upper basin in March and April. Between 10 February and 1 July 2003, daily discharges approached the 33-year average on five occasions (Figure 4). Discharges remained near the average for less than four days before returning to above average conditions. The remainder of the study period exhibited discharge values well above the average daily mean. A discharge of 43,200 cfs was measured on 15 April 2003 and represents the maximum discharge value measured during the study period. The 33-year average discharge for 16 April 2003 is 4,700 cfs. Turbidity measurements ranged from 11.4- 65.3 ntu's downstream and 11.4 - 64.5 ntu's upstream. The highest turbidity reading of 65.3 ntu's was recorded on 26 May 2003 during a period of the highest river elevations. Dissolved oxygen ranged from a high of 12.80 mg/l recorded downstream of the dam on 20 February 2003, and a low of 5.32 mg/l recorded upstream of the dam on 19 May 2003.

### 4.5 Rewards

At the time of this report, ten recaptures had been reported and $200.00 in rewards had been paid. Seven returns were reported from American shad captured by commercial shad fishermen in either drift gill nets fished near Lock and Dam #1 or set nets located in the vicinity of Riegelwood. Three tag returns were from striped bass caught by recreational fisherman at Pt. Peter, the mouth of Mallory Creek, and Marker 55 near Town Creek.

## 5.0 DISCUSSION

Although less than ideal gill netting conditions were encountered during the study period, the absence of any captured sturgeon suggests that Atlantic sturgeon populations remain low in the Cape Fear River (Moser and Ross 1995, Patrick and

Table 4. Summary of physicochemical measurements taken near Lock and Dam #1 in conjunction with fish sampling during 2003.

| Location[1] | Date 2003 | Time | Air Temp. °C / °F | Water Temp. °C / °F | D.O. (mg/l) | Turbidity (ntu's) | Water Height[2] |
|---|---|---|---|---|---|---|---|
| Upstream | 17 Feb. | 1430 | 4.44/40 | 7.2/45 | 10.10 | 14.5 | 17.3 |
| Downstream | 17 Feb. | 1430 | 4.44/40 | 6.8/44 | 11.05 | 15.9 | 17.3 |
| Upstream | 20 Feb. | 1545 | 12.8/55 | 7.0/45 | 12.33 | 15.3 | 17.7 |
| Downstream | 20 Feb. | 1545 | 12.8/55 | 7.1/45 | 12.80 | 15.3 | 17.7 |
| Upstream | 24 Feb. | 1500 | 14.4/58 | 8.6/48 | 11.48 | 21.8 | 19.0 |
| Downstream | 24 Feb. | 1500 | 14.4/58 | 8.4/47 | 12.70 | 28.3 | 19.0 |
| Upstream | 3 March | 1500 | 12.8/55 | 7.9/46 | 12.21 | 49.3 | 20.4 |
| Downstream | 3 March | 1500 | 12.8/55 | 8.0/46 | 12.40 | 47.7 | 20.4 |
| Upstream | 10 March | 1530 | 15.5/60 | 11.3/52 | 10.87 | 55.1 | 20.85 |
| Downstream | 10 March | 1530 | 15.5/60 | 11.3/52 | 10.98 | 53.5 | 20.85 |
| Upstream | 24 March | 1400 | 23.0/73 | 14.0/57 | 6.53 | 15.1 | 21.25 |
| Downstream | 24 March | 1400 | 23.0/73 | 13.2/56 | 7.32 | 17.4 | 21.25 |
| Upstream | 1 April | 1500 | 22.2/72 | 14.4/58 | 8.53 | 26.3 | 20.1 |
| Downstream | 1 April | 1500 | 22.2/72 | 14.8/59 | 8.79 | 27.4 | 20.1 |
| Upstream | 8 April | 1430 | 13.9/57 | 14.9/59 | 8.07 | 20.4 | 17.9 |
| Downstream | 8 April | 1430 | 13.9/57 | 15.2/59 | 8.34 | 20.8 | 17.9 |
| Upstream | 17 April | 1400 | 22.2/72 | 14.4/58 | 7.13 | 24.5 | 22.7 |
| Downstream | 17 April | 1400 | 22.2/72 | 14.3/58 | 7.45 | 25.3 | 22.7 |
| Upstream | 28 April | 1515 | 25.5/78 | 16.4/62 | 9.23 | 23.9 | 19.9 |
| Downstream | 28 April | 1515 | 25.5/78 | 16.4/62 | 10.03 | 24.5 | 19.9 |
| Upstream | 5 May | 1500 | 29.4/85 | 20.7/69 | 7.57 | 14.2 | 16.2 |
| Downstream | 5 May | 1500 | 29.4/85 | 22.0/72 | 7.98 | 16.2 | 16.2 |
| Upstream | 12 May | 1430 | 26.6/80 | 23.3/74 | 6.23 | 11.4 | 16.5 |
| Downstream | 12 May | 1430 | 26.6/80 | 23.7/75 | 7.84 | 11.4 | 16.5 |
| Upstream | 19 May | 1400 | 19.9/68 | 22.2/72 | 5.32 | 14.1 | 15.5 |
| Downstream | 19 May | 1400 | 19.9/68 | 22.2/72 | 6.48 | 15.3 | 15.5 |
| Upstream | 26 May | 1430 | 26.6/80 | ** | ** | 64.5 | 19.2 |
| Downstream | 26 May | 1430 | 26.6/80 | ** | ** | 65.3 | 19.2 |

Table 4. (concluded)

| Location[1] | Date 2003 | Time | Air Temp. °C / °F | Water Temp. °C / °F | D.O. (mg/l) | Turbidity (ntu's) | Water Height[2] |
|---|---|---|---|---|---|---|---|
| Upstream | 2 June | 1445 | 27.8/82 | 20.9/70 | 7.59 | 26.6 | 20.25 |
| Downstream | 2 June | 1445 | 27.8/82 | 20.7/69 | 7.40 | 28.1 | 20.25 |
| Upstream | 10 June | 1415 | 31.1/88 | 24.0/75 | 6.30 | 25.7 | 18.2 |
| Downstream | 10 June | 1415 | 31.1/88 | 23.7/75 | 7.60 | 27.2 | 18.2 |
| Upstream | 19 June | 1400 | 32.2/90 | 25.2/77 | 9.37 | 17.7 | 18.7 |
| Downstream | 19 June | 1400 | 32.2/90 | 25.1/77 | 10.25 | 35.4 | 18.7 |
| Upstream | 26 June | 1315 | 32.2/90 | 25.5/78 | 7.91 | 14.0 | 16.5 |
| Downstream | 26 June | 1315 | 32.2/90 | 25.0/77 | 8.97 | 14.5 | 16.5 |

[1] Position in reference to Lock and Dam #1
[2] Data from USGS gage at Lock and Dam #1
** Water Quality meter malfunction

Moser 2001). Intensive gill net surveys were conducted in May 2003 but no Atlantic sturgeon were captured.

Striped bass exhibited both fall back and upriver responses after tagging. A high degree of mobility was exhibited for striped bass in 2003 compared to the fish tagged in 2002. Fixed station data and manual tracking efforts indicate that 20 striped bass and two hybrid striped bass made deliberate and directed movements upstream in an attempt to reach spawning grounds. Of these 22 fish, five (23%) successfully passed upstream of Lock and Dam #1. One (5%) of these striped bass (#5011) was confirmed to have been passed upstream through the locking process. The other four fish are believed to have passed over the top of the dam during high flow events when the water level on either side of the dam was equal. Eight striped bass were recorded by the Lock and Dam #1 fixed station entering the lock chamber but were not passed through the locking process to the upper pool.

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, Moser et al. 2000). Twelve shad made return trips back to the dam after tagging and four shad (33.3%) passed upstream of the dam. Two (16.7%) were passed through the locking chamber and two (16.6%) apparently swam over the top of dam during high water events.

Overall, the data suggest that Lock and Dam #1 remains an impediment to anadromous fish species' ability to continue upriver on their spawning migrations. A summary of passage success by species for 2002 and 2003 can be found in Table 5.

Table 5. Summary of fish passage success for pre-construction monitoring at Lock and Dam #1, Cape Fear River, Wilmington, North Carolina in 2002 and 2003.

| Monitoring Year | Species Tagged | Number Tagged | Number Returned to Dam | Number Passed | % | Maximum Distance after Tagging Observed Upstream |
|---|---|---|---|---|---|---|
| 2002 | American shad | 30 | 8 | 4 | 50 | N/A[a] |
| | Striped bass | 9 | 2 | 0 | 0 | 30 miles[a] |
| | Atlantic sturgeon | 1 | 0 | 0 | 0 | N/A[a] |
| 2003 | American shad | 53 | 12 | 4 | 33 | 100 miles[b] |
| | Striped bass | 41 | 22 | 5 | 23 | 102 miles[c] |

[a] No tracking above Lock and Dam #1 was conducted in 2002.
[b] Distance measured in miles from Lock and Dam #1, North Carolina.
[c] Distance measured in miles from Wilmington, North Carolina.

### 5.1 Difficulties Encountered

The biggest difficulty encountered in 2003 was the above average discharge in the Cape Fear River (see photos in Appendix A). Above average rainfall amounts in both the upper drainage basin and in eastern North Carolina combined to create flooding conditions for the majority of the study period. The increase in river discharge created "noise" levels that interfered with and impeded reception of the sonic tags at all fixed stations and on the manual tracking receiver. Discharges ranged from 2,000 to 43,000 cfs with an average of 12,450 cfs for the study period. When river discharge exceeded 8,000 cfs, tag reception was greatly reduced. In addition, flooding downstream of Lock and Dam #1 necessitated the removal of the fixed stations at the NC 11 bridge and IP sites from 20 March to 31 March 2003 and from 12 April to 28 April 2003. These periods equate to a total of 29 days that the downstream fixed stations were absent. The fixed station at Lock and Dam #1 was removed from 14 April to 17 April 2003 when river levels nearly reached the official flood stage of 24 feet at the dam. During these periods when the fixed stations were absent, manual tracking was the only method to collect tracking data on striped bass and American shad.

According to Robert Campbell of Sonotronics, the only solution to this "noise" interference is to move the fixed stations to areas of the river that do not experience this problem. This essentially would require the fixed stations to be located downstream of the Black River. This is not likely to be a viable solution. A second solution would be to convert to radio transmitter technology which is not affected by river conditions. However, the use of radio transmitters is limited to areas where salinity levels are minimal. This would greatly restrict tracking efforts in the lower Cape Fear River upstream to the upper limit of the saltwater wedge. Radio transmitters are also greatly affected by depth making it nearly impossible to effectively track a fish deeper than twenty feet.

The high water levels and discharges also greatly restricted the timing and effectiveness of gill net fishing. Attempts were made to deploy sturgeon nets in April 2003 at a variety of sites both in the upper and lower Cape Fear River, but increased discharge created a constant raft of debris that fouled the nets. The increased flow also caused the sturgeon nets to relocate after being set, entangling them in trees and underwater hazards. CZR was then forced to wait until river conditions improved which was not until May 2003.

It was decided in 2003 to change the type of tag to be implanted in American shad in an attempt to improve survival. The tags, a Sonotronics IBT-96-5, were 28 mm long and 8 mm in diameter. These tags have a battery life of approximately five months. The smaller size greatly increase survival of shad and it is believed that only one fish, CZR 5142, died immediately after tagging. Handling time was reduced as well, decreasing the stress associated with capture. However, the smaller transmitter has a decreased signal strength. The tag is described in the Sonotronics products listing to have a range "up to 1,000 meters". In the field, however, this was not experienced except for the few fish that were manually located below the Black River. The "noise" levels created by the increased volume of water flowing downriver greatly affected these tags. It is not recommended that these types of tags be changed for future studies in the hope that river conditions experienced in 2003 would not be repeated.

## 6.0 REFERENCES


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# APPENDIX A

# PHOTOGRAPHS

CZR 5004 tagged in 2002, recaptured during during shocking effort in 2003.

CZR 5004 tagged in 2002, recaptured during during shocking effort in 2003.

Hybrid striped bass CZR 5118.

Recaptured striped bass tagged in 2003.

Hybrid striped bass CZR 5118.

Recaptured striped bass tagged one week prior with healing tag incision.

**Striped bass tagging sequence - #1.**

**Striped bass tagging sequence - #2.**

**Striped bass tagging sequence - #3.**

**Striped bass tagging sequence - #4.**

**Striped bass tagging sequence - #5.**

**Striped bass tagging sequence - #6.**

American shad tagging sequence - #1.

American shad tagging sequence - #2.

American shad tagging sequence - #3.

American shad tagging sequence - #4.

American shad tagging sequence - #5.

Sonic tag types.

**Cape Fear River levels in 2003 at Riegelwood Landing.**

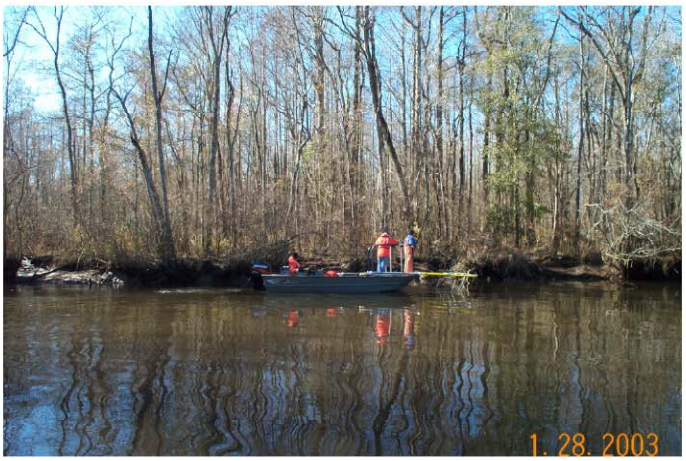
**Cape Fear River levels in 2002 at Lock & Dam #1.**

**Cape Fear River levels in 2003 at Lock & Dam #1.**

**Cape Fear River levels in 2003 at Lock & Dam #1.**

**Cape Fear River levels in 2003 at Lock & Dam #1.**

**Cape Fear River levels in 2003 at Lock & Dam #1.**




DMF electroshocking boat.

WRC electroshocking boat.

Manual tracking.

Manual tracking.

Components of a fixed station with scanning receiver, data logger, 12-volt gell cell battery and coaxial cables.

# APPENDIX B

# FISH COLLECTION DATES, TECHNIQUES, AND EFFORT

Appendix B. Fish collection dates, techniques, effort, and fish caught associated with USACOE Fish Passage Study for 2003.

| Site[a] | Date | Gear | Level of Effort | Catch |
|---|---|---|---|---|
| CFR | 22 January | Electroshocking | 71 minutes | 0 fish |
| CFR | 28 January | Electroshocking | 105 minutes | 0 fish |
| CFR | 25 February | Electroshocking | 79 minutes | 10 Striped bass |
| CFR | 25 February | Electroshocking | 186 minutes | 7 Striped bass |
| CFR | 11 March | Electroshocking | 55 minutes | 1 Striped bass and 1 Hybrid striped bass |
| CFR | 13 March | Electroshocking | 54 minutes | 1 Striped bass |
| CFR | 26 March | Electroshocking | 90 minutes | 2 Striped bass and 1 hybrid striped bass |
| PP | 11 February | Gill net | 1 gill net, 17.0 hrs | 0 fish |
| PP | 12 February | Gill net | 1 gill net, 24.0 hrs | 1 Striped bass (female-514mm) |
| PP | 13 February | Gill net | 1 gill net, 23.75 hrs | 0 fish |
| HBS | 11 February | Gill net | 1 gill net, 17.25 hrs. | 0 fish |
| HBS | 12 February | Gill net | 1 gill net, 24.0 hrs | 0 fish |
| HBS | 13 February | Gill net | 1 gill net, 23.75 hrs | 0 fish |
| HBN | 13 March | Electroshocking | 100 minutes | 2 Striped bass |
| TC | 11 February | Gill net | 1 gill net, 17.5 hrs | 2 Longnose gar, 1 blue catfish |
| TC | 12 February | Gill net | 1 gill net, 24.0 hrs | 0 fish |
| TC | 13 February | Gill net | 1 gill net, 23.75 hrs. | 1 Hybrid striped bass (dead) |
| TC | 20 March | Gill net | 1 Sturgeon gill net, 18.0 hrs. | 0 fish |

Appendix B. (continued)

| Site[a] | Date | Gear | Level of Effort | Catch |
|---|---|---|---|---|
| BB | 11 February | Gill net | 1 gill net, 18.0 hrs. | 0 fish |
| BB | 12 February | Gill net | 1 gill net, 23.5 hrs. | 1 Striped bass (dead) |
| BB | 13 February | Gill net | 1 gill net, 24.5 hrs. | 1 American shad, 1 blue catfish, 1 longnose gar |
| BB | 4 March | Electroshocking | 223 minutes | 6 Striped bass |
| BB | 7 March | Electroshocking | 46 minutes | 1 Striped bass |
| BB | 12 March | Electroshocking | 76 minutes | 4 Striped bass |
| BB | 20 March | Gill net | 1 Sturgeon gill net, 18.0 hrs. | 0 fish |
| BB | 29 April | Gill net | 1 Sturgeon net, 15.0 hrs. | 0 fish |
| BB | 30 April | Gill net | 1 Sturgeon net, 24.0 hrs. | 0 fish |
| BB | 1 May | Gill net | 1 Sturgeon net, 22.25 hrs. | 0 fish |
| BB | 6 May | Gill net | 1 Sturgeon net, 24.5 hrs. | 0 fish |
| BB | 7 May | Gill net | 1 Sturgeon net, 23.0 hrs. | 0 fish |
| BB | 8 May | Gill net | 1 Sturgeon net, 23.5 hrs. | 0 fish |
| BB | 9 May | Gill net | 1 Sturgeon net, 24.5 hrs. | 0 fish |
| IC | 29 April | Gill net | 1 Sturgeon net, 16.5 hrs. | 0 fish |
| IC | 30 April | Gill net | 1 Sturgeon net, 25.5 hrs. | 0 fish |
| IC | 1 May | Gill net | 1 Sturgeon net, 20.5 hrs. | 0 fish |
| IC | 6 May | Gill net | 1 Sturgeon net, 24.0 hrs. | 0 fish |
| IC | 8 May | Gill net | 1 Sturgeon net, 22.25 hrs. | 0 fish |

Appendix B. (continued)

| Site[a] | Date | Gear | Level of Effort | Catch |
|---|---|---|---|---|
| IC | 9 May | Gill net | 1 Sturgeon net, 25.5 hrs. | 0 fish |
| IC | 28 May | Gill net | 1 Sturgeon net, 16.25 hrs. | 0 fish |
| LD1 | 29 January | Electroshocking | 79 minutes | 0 fish |
| LD1 | 18 March | Electroshocking | 210 minutes | 1 Hybrid striped bass and 10 American shad |
| LD1 | 1 April | Gill net | 1 gill net, 3.0 hrs | 12 American shad |
| LD1 | 8 April | Gill net | 1 gill net, 3.5 hrs | 11 American shad |
| LD1 | 9 April | Electroshocking | 26 minutes | 8 American shad |
| LD1 | 9 April | Gill net | 1 gill net, .75 hrs | 5 American shad |
| LD1 | 17 April | Gill net | 1 gill net, 1.25 hrs | 7 American shad |
| LD1 | 13 May | Gill net | 1 Sturgeon net, 18.0 hrs. | 0 fish |
| LD1 | 14 May | Gill net | 1 Sturgeon net, 23.75 hrs. | 0 fish |
| LD1 | 15 May | Gill net | 1 Sturgeon net, 26.0 hrs. | 2 Longnose gar |
| LD1 | 16 May | Gill net | 1 Sturgeon net, 20.5 hrs. | 0 fish |
| LD1 | 21 May | Gill net | 1 Sturgeon net, 22.75 hrs. | 1 Flathead catfish |
| WC | 2 April | Gill net | 1 Sturgeon net, 17.5 hrs. | 0 fish |
| WC | 13 May | Gill net | 1 Sturgeon net, 17.25 hrs. | 0 fish |
| WC | 14 May | Gill net | 1 Sturgeon net, 24.0 hrs. | 0 fish |
| WC | 15 May | Gill net | 1 Sturgeon net, 26.75 hrs. | 0 fish |
| WC | 16 May | Gill net | 1 Sturgeon net, 21.5 hrs. | 0 fish |

Appendix B. (continued)

| Site[a] | Date | Gear | Level of Effort | Catch |
|---|---|---|---|---|
| WC | 20 May | Gill net | 1 Sturgeon net, 18.75 hrs. | 0 fish |
| WC | 21 May | Gill net | 1 Sturgeon net, 23.75 hrs. | 1 Blue catfish |
| UCF1 | 13 May | Gill net | 1 Sturgeon net, 17.75 hrs. | 0 fish |
| UCF2 | 13 May | Gill net | 1 Sturgeon net, 17.5 hrs. | 0 fish |
| UCF2 | 14 May | Gill net | 1 Sturgeon net, 23.25 hrs. | 0 fish |
| UCF2 | 15 May | Gill net | 1 Sturgeon net, 25.5 hrs. | 0 fish |
| UCF2 | 16 May | Gill net | 1 Sturgeon net, 23.0 hrs. | 0 fish |
| UCF2 | 20 May | Gill net | 1 Sturgeon net, 18.75 hrs. | 0 fish |
| UCF2 | 21 May | Gill net | 1 Sturgeon net, 24.25 hrs. | 0 fish |
| UCF 3 | 15 May | Gill net | 1 Sturgeon net, 25.25 hrs. | 0 fish |
| UCF 3 | 16 May | Gill net | 1 Sturgeon net, 23.0 hrs. | 0 fish |
| UCF 3 | 20 May | Gill net | 1 Sturgeon net, 19.0 hrs. | 0 fish |
| UCF 3 | 21 May | Gill net | 1 Sturgeon net, 24.5 hrs. | 0 fish |
| BR1 | 30 April | Gill net | 1 Sturgeon net, 21.5 hrs. | 0 fish |
| BR1 | 1 May | Gill net | 1 Sturgeon net, 23.0 hrs. | 0 fish |
| BR1 | 6 May | Gill net | 1 Sturgeon net, 23.75 hrs. | 0 fish |
| BR1 | 7 May | Gill net | 1 Sturgeon net, 22.75 hrs. | 0 fish |
| BR1 | 8 May | Gill net | 1 Sturgeon net, 24.25 hrs. | 0 fish |

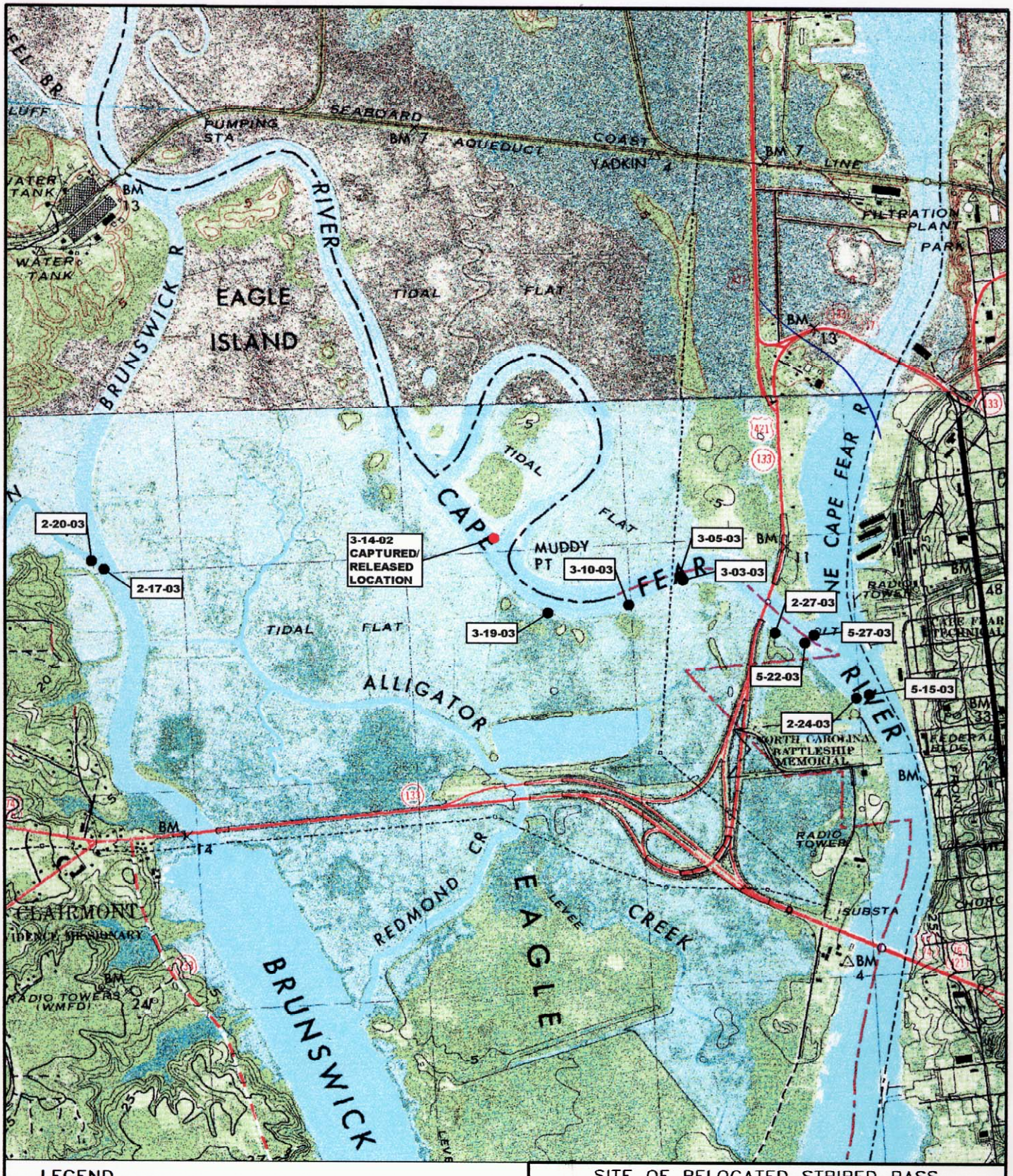
Appendix B. (concluded)

| Site[a] | Date | Gear | Level of Effort | Catch |
|---|---|---|---|---|
| BR1 | 9 May | Gill net | 1 Sturgeon net, 24.0 hrs. | 0 fish |
| BR1 | 28 May | Gill net | 1 Sturgeon net, 17.5 hrs. | 0 fish |
| BR2 | 29 April | Gill net | 1 Sturgeon net, 19.25 hrs. | 0 fish |
| INC | 13 February | Gill net | 1 gill net, 22.75 hrs. | 0 fish |
| INC | 29 May | Gill net | 1 Sturgeon net, 22.75 hrs. | 0 fish |
| CS | 30 January | UNCW Gill net | overnight | 3 Striped bass caught in Brunswick River and tagged at Castle Street. |
| CS | 10 February | UNCW electroshocking | 3 hours | 1 Striped bass caught at Horseshoe Bend and tagged at Castle Street. |

[a] Sites: PP - Pt. Peter
HBS - Horseshoe Bend South
HBN - Horseshoe Bend North
TC - Toomer's Creek
BB - Brunswick River at NC 74/76 Bridge
IC - Indian Creek
CS - Castle Street boat landing
CFR - Cape Fear River near Wilmington Harbor
UCF1 - Upper Cape Fear River at mile marker 34.5
UCF2 - Upper Cape Fear River at mile marker 32.75
UCF3 - Upper Cape Fear River at mile marker 35.0
WC - Weyman's Creek
BR1 - Black River at the Cape Fear River
BR2 - Black River at the Cape Fear River
INC - Inland Creek
LD1 - Downstream of Lock and Dam #1 at mile marker 38.0

# APPENDIX C

# MAPS




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-14-02
- SITE OF RELOCATED FISH

0 2000 4000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5004

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

| | | |
|---|---|---|
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| DATE: 8/28/03 | | FILE: CZR5004-03 |
| | | CP#1645.32 |

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4709 COLLEGE ACRES DRIVE
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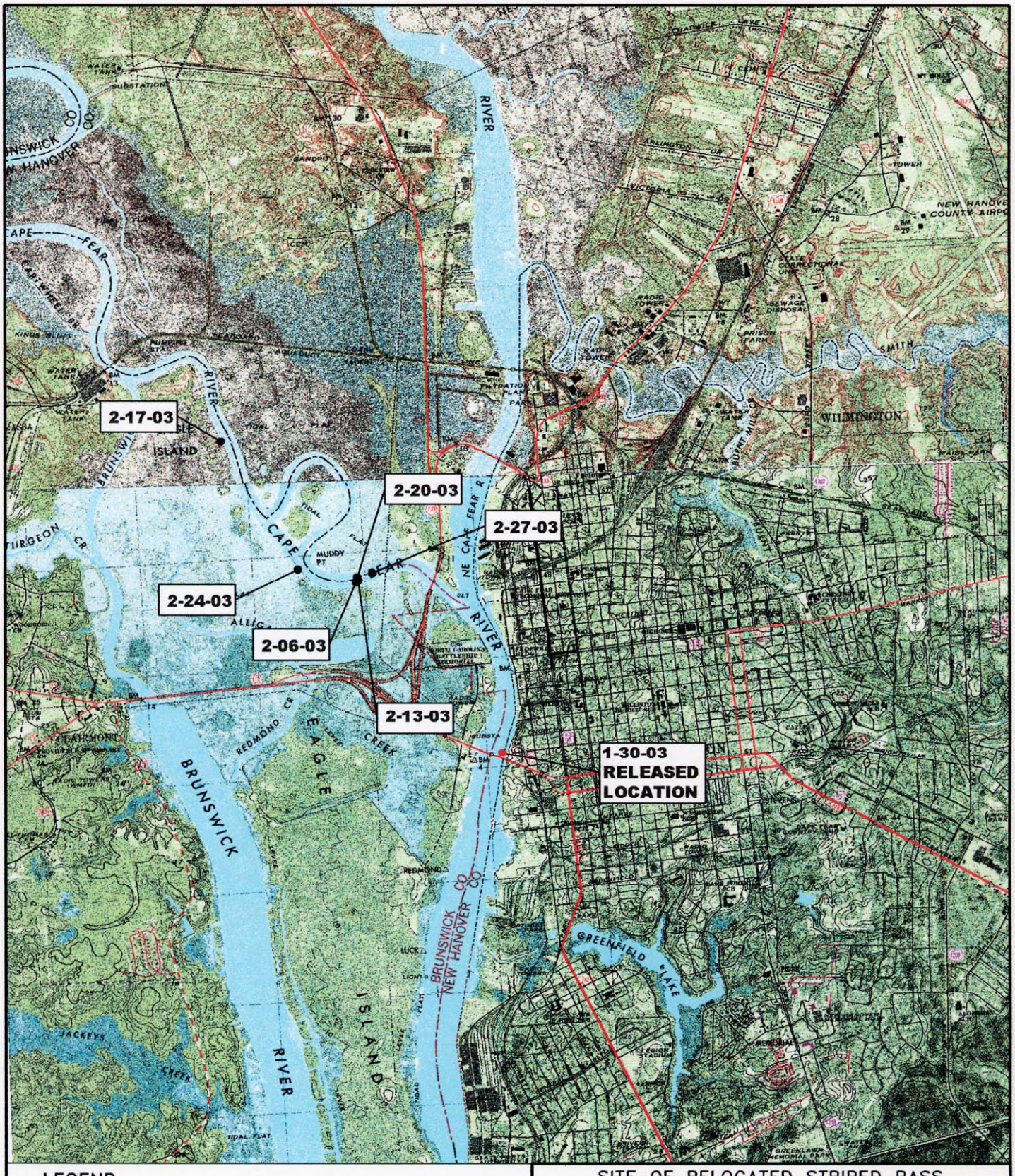
FAX 910/392-9139




## LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 1-30-03
- SITE OF RELOCATED FISH

0 4000 8000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5009

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

| | | |
|---|---|---|
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| | | CP#1645.32 |
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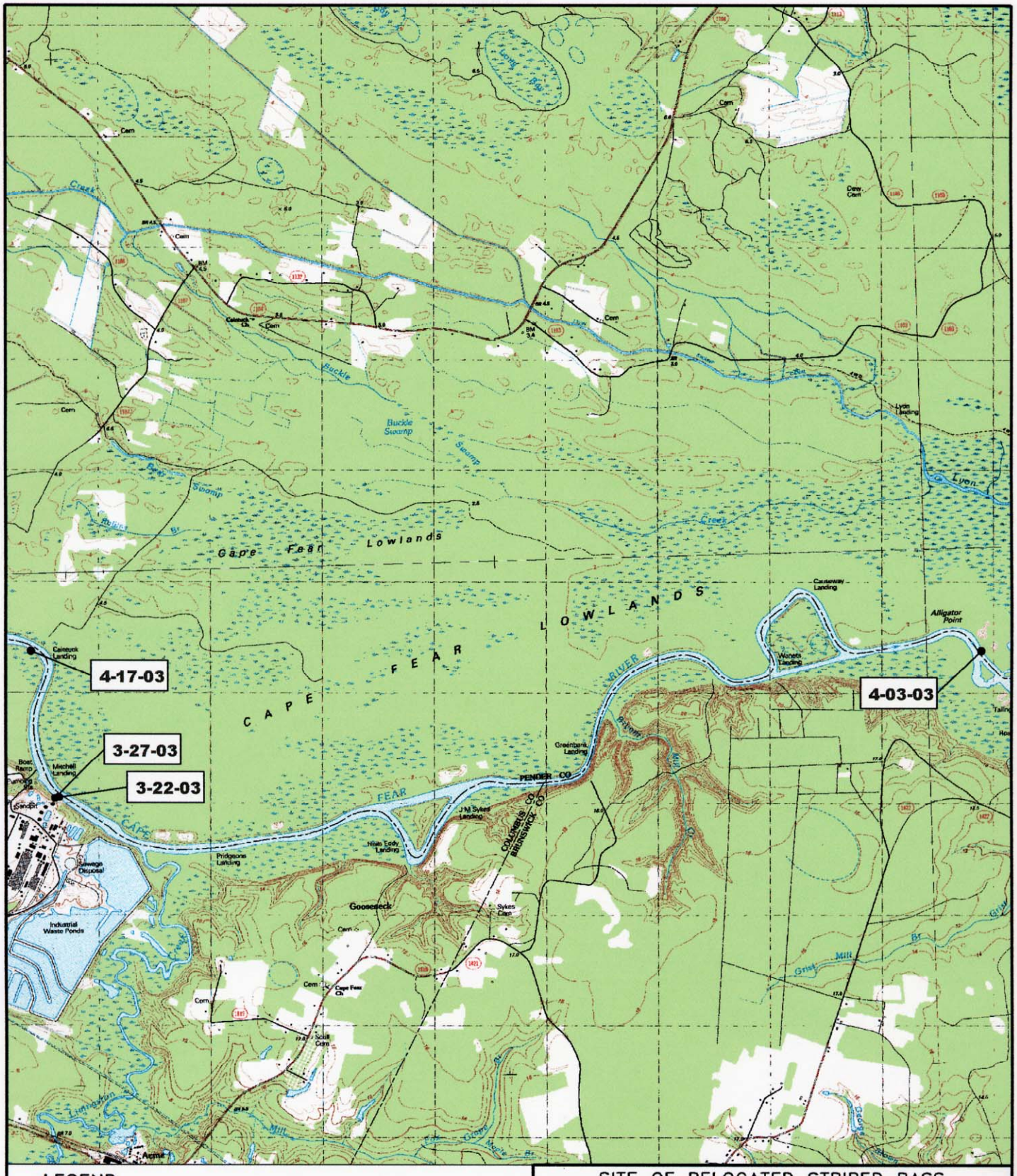


## LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 1-30-03
- SITE OF RELOCATED FISH

0 4000 8000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5009

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

| | | |
|---|---|---|
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| | | CP#1645.32 |
| | | 2 OF 3 |

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## LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 1-30-03
- SITE OF RELOCATED FISH

0 4000 8000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5009

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

| | | |
|---|---|---|
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| | | CP#1645.32 |
| | | 3 OF 3 |

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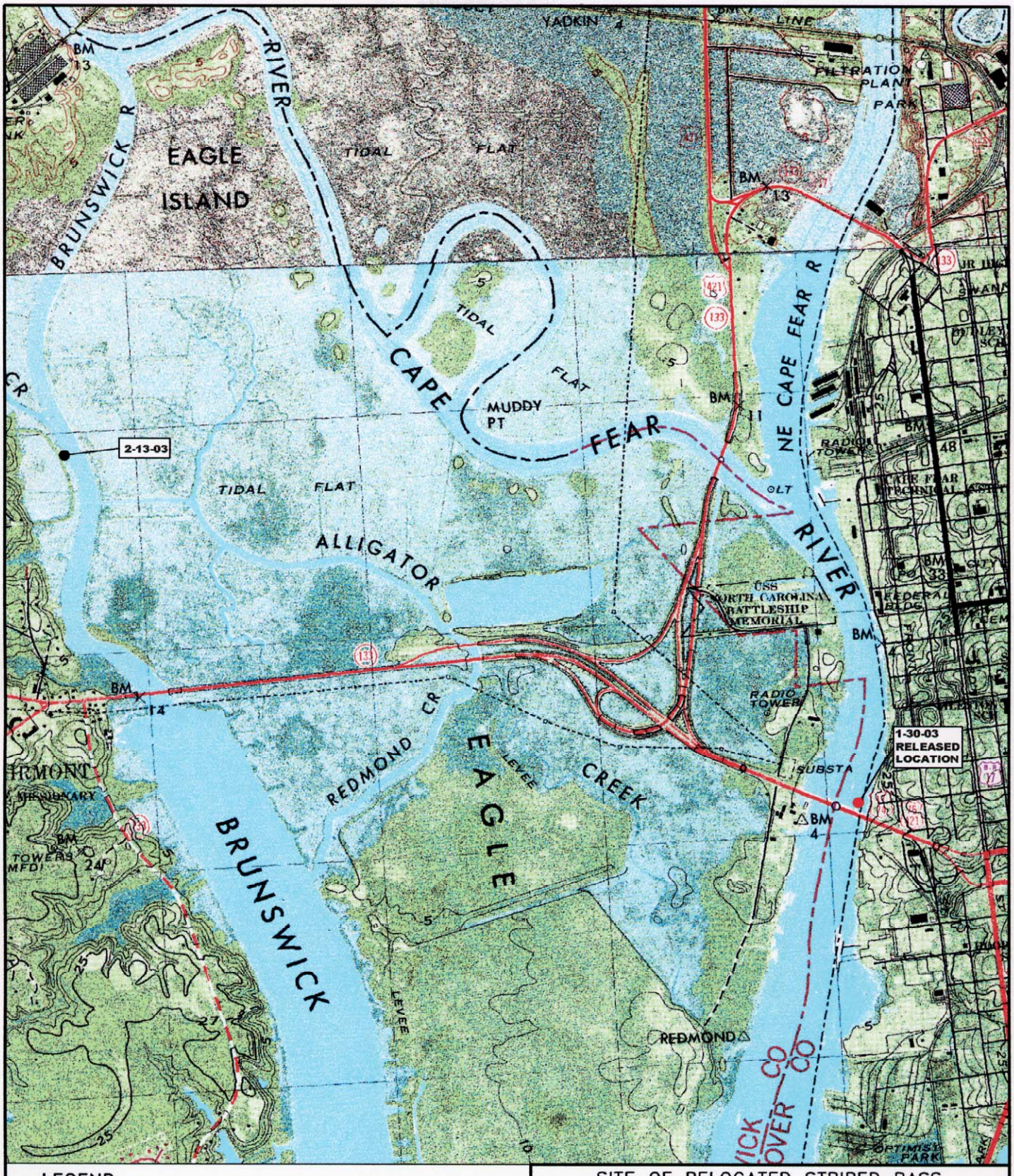


LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 1-30-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5010

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5010-03 |
| | | CP#1645.32 |

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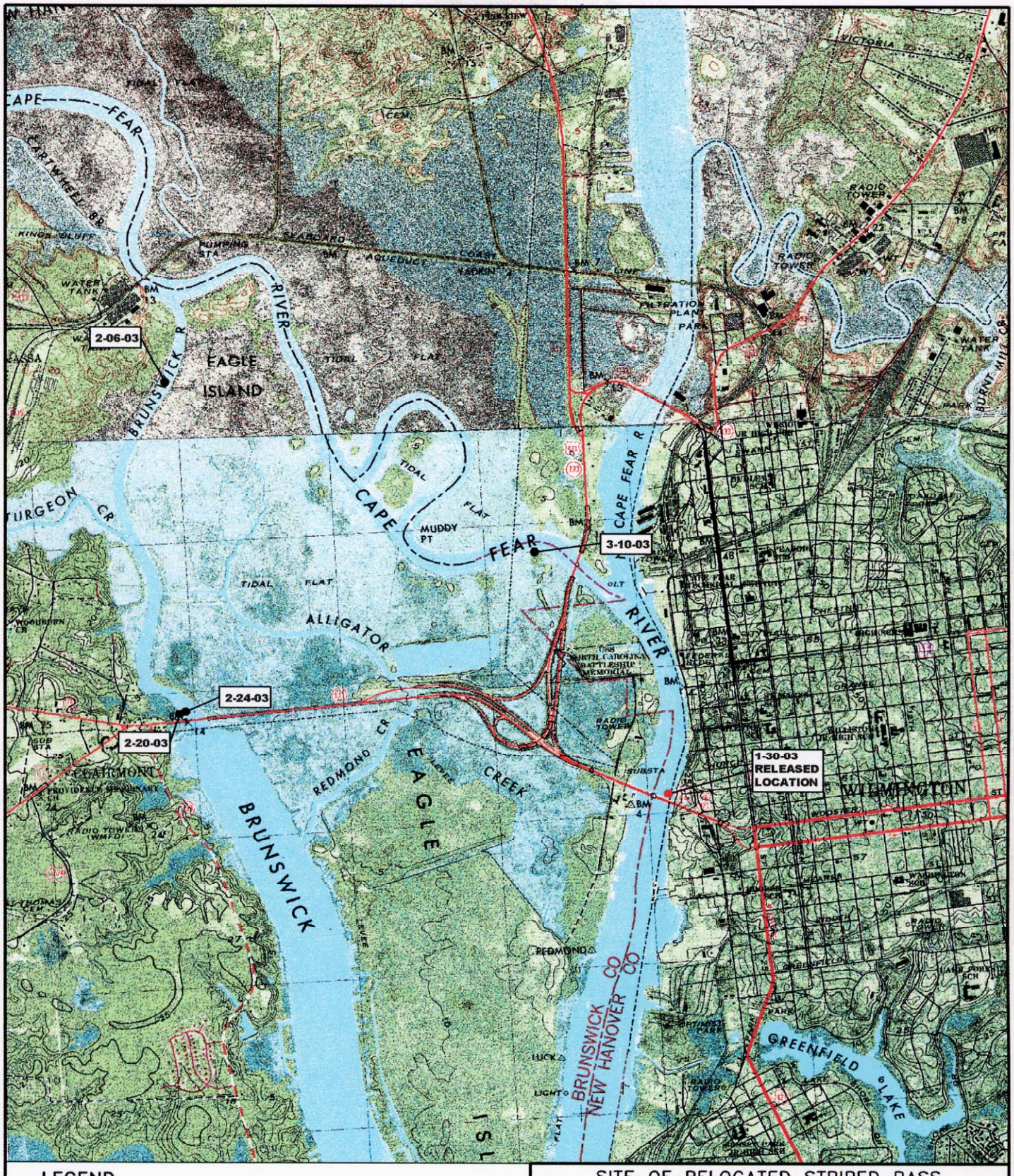


LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 1-30-03
- SITE OF RELOCATED FISH

0 3000 6000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5011

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5011-03 |
| | | CP#1645.32 |
| | | 1 OF 4 |

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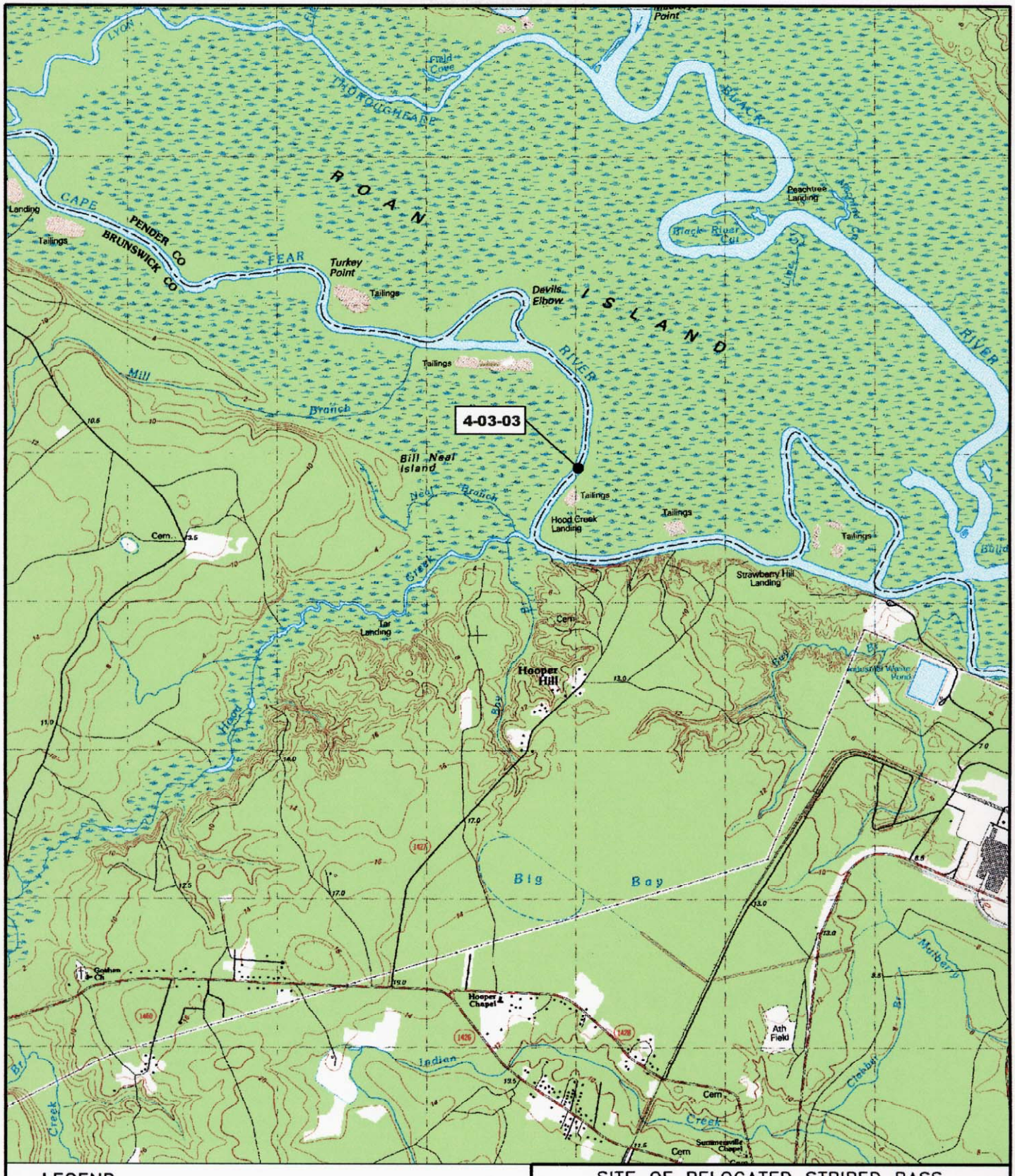


## LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 1-30-03
- SITE OF RELOCATED FISH

0 3000 6000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5011

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

| | | |
|---|---|---|
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| DATE: 8/28/03 | | FILE: CZR5011-03 |
| | | CP#1645.32 |
| | | 2 OF 4 |

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## LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 1-30-03
- SITE OF RELOCATED FISH

0 3000 6000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5011

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

| | | |
|---|---|---|
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| DATE: 8/28/03 | | FILE: CZR5011-03 |
| | | CP#1645.32 |
| | | 3 OF 4 |

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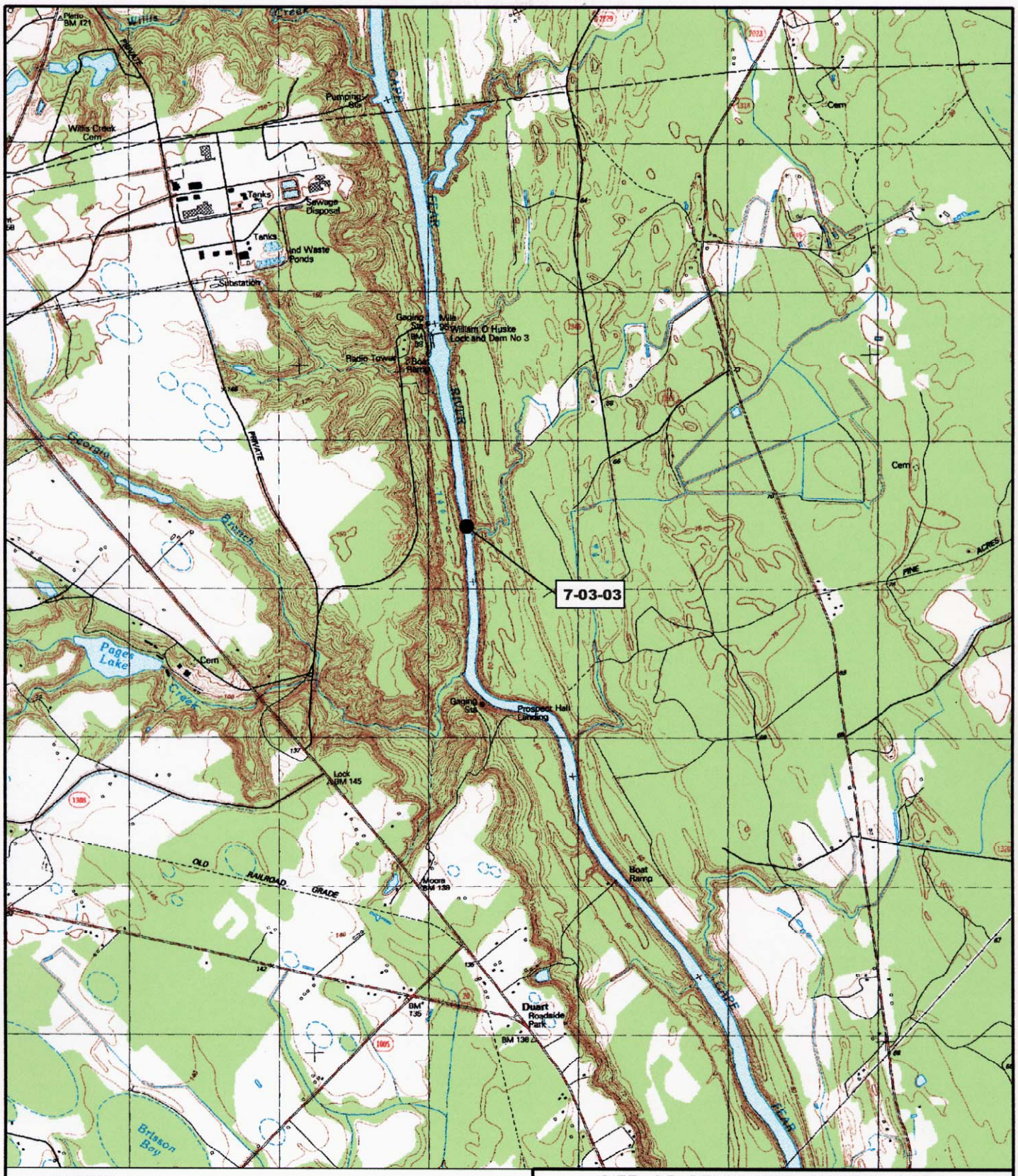


## LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 1-30-03
- SITE OF RELOCATED FISH

0 3000 6000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5011

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5011-03 |
| | | CP#1645.32 |
| | | 4 OF 4 |

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ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
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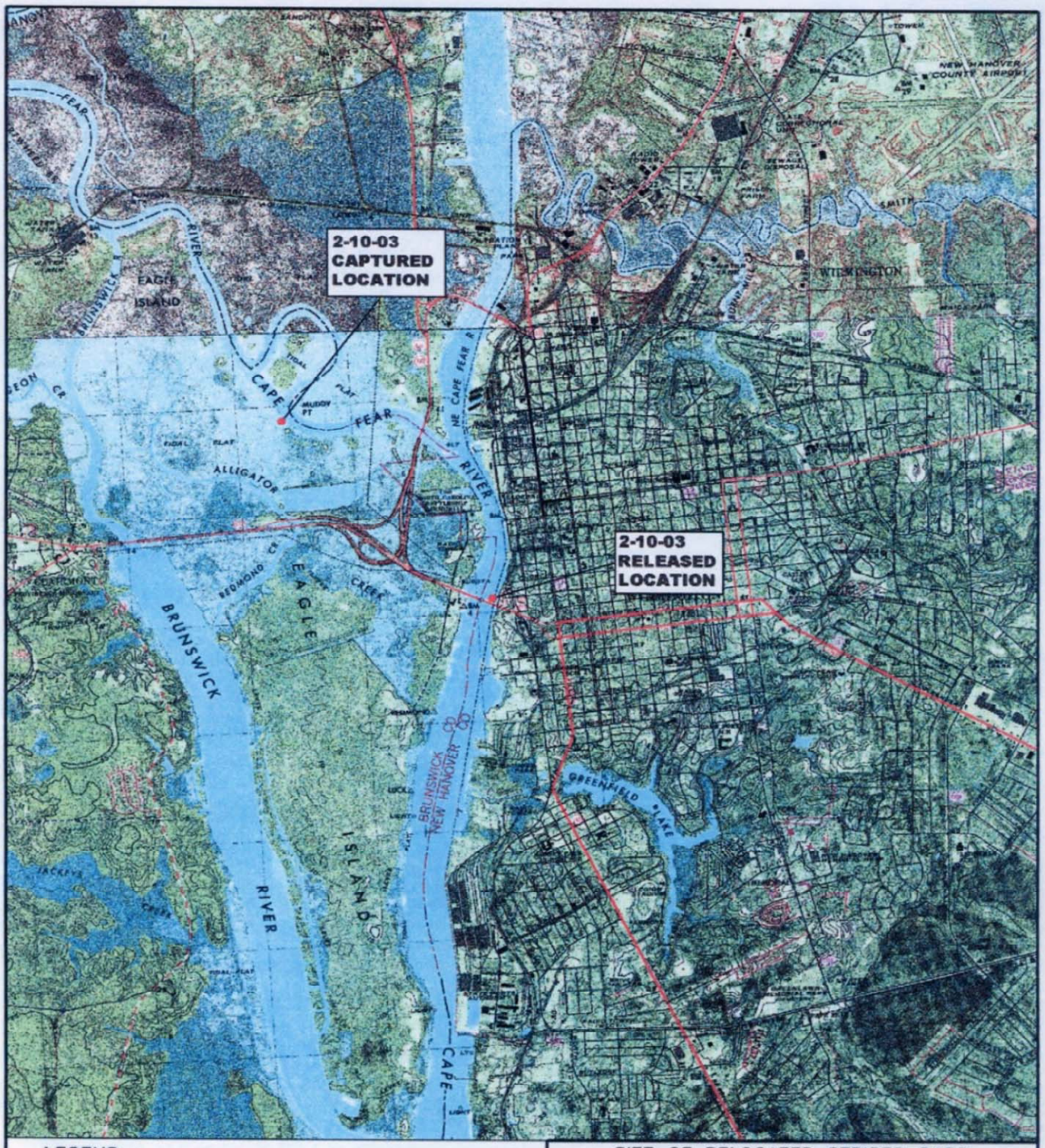
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-10-03
- SITE OF RELOCATED FISH

0 4000 8000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5012

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 12/03/03 | | FILE: CZR5012-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

CZR INCORPORATED
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4709 COLLEGE ACRES DRIVE
SUITE 3
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TEL 910/392-0253
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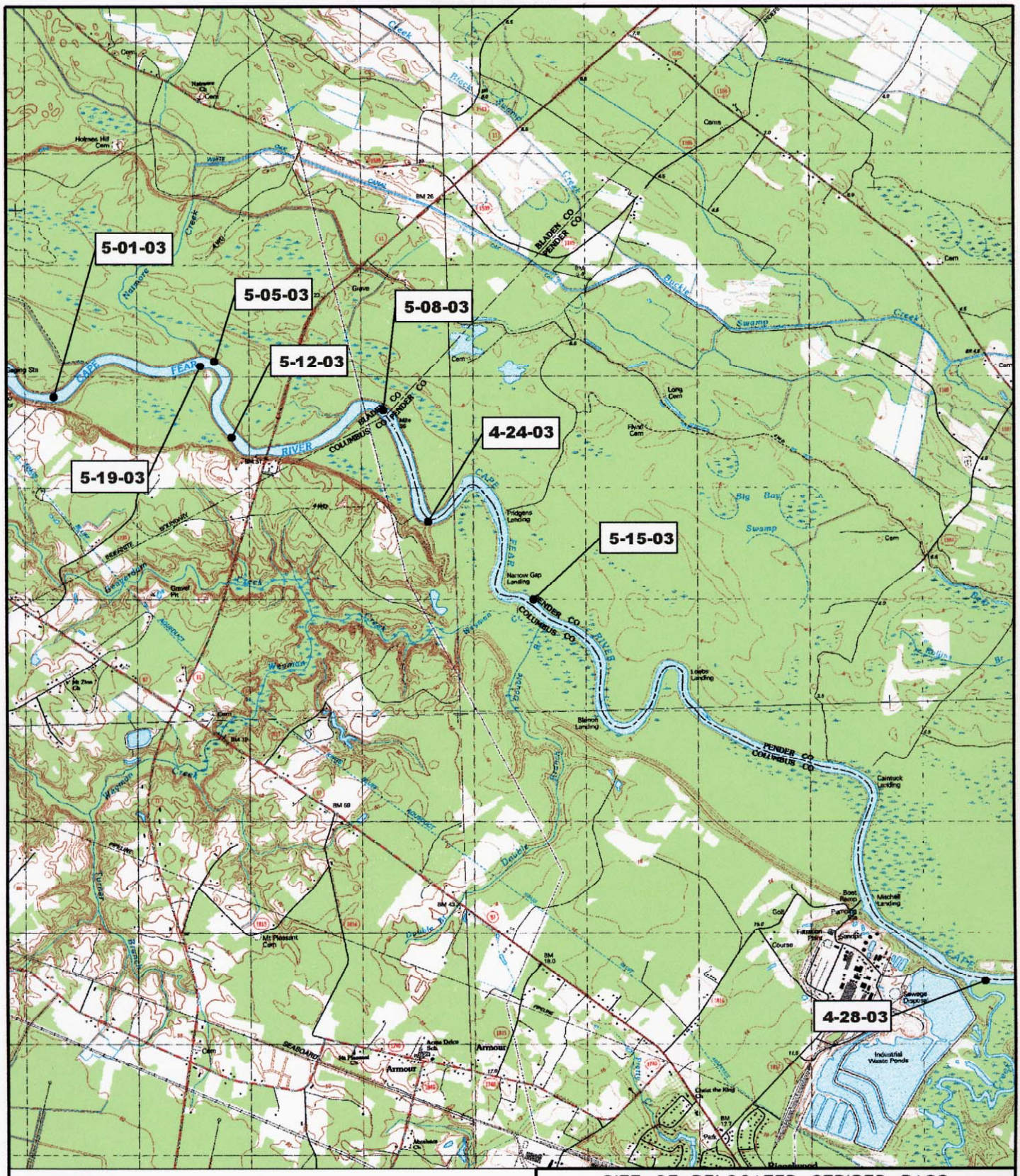


LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-10-03
- SITE OF RELOCATED FISH

0 4000 8000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5012

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5012-03 |
| | | CP#1645.32 |
| | | 2 OF 2 |

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4709 COLLEGE ACRES DRIVE
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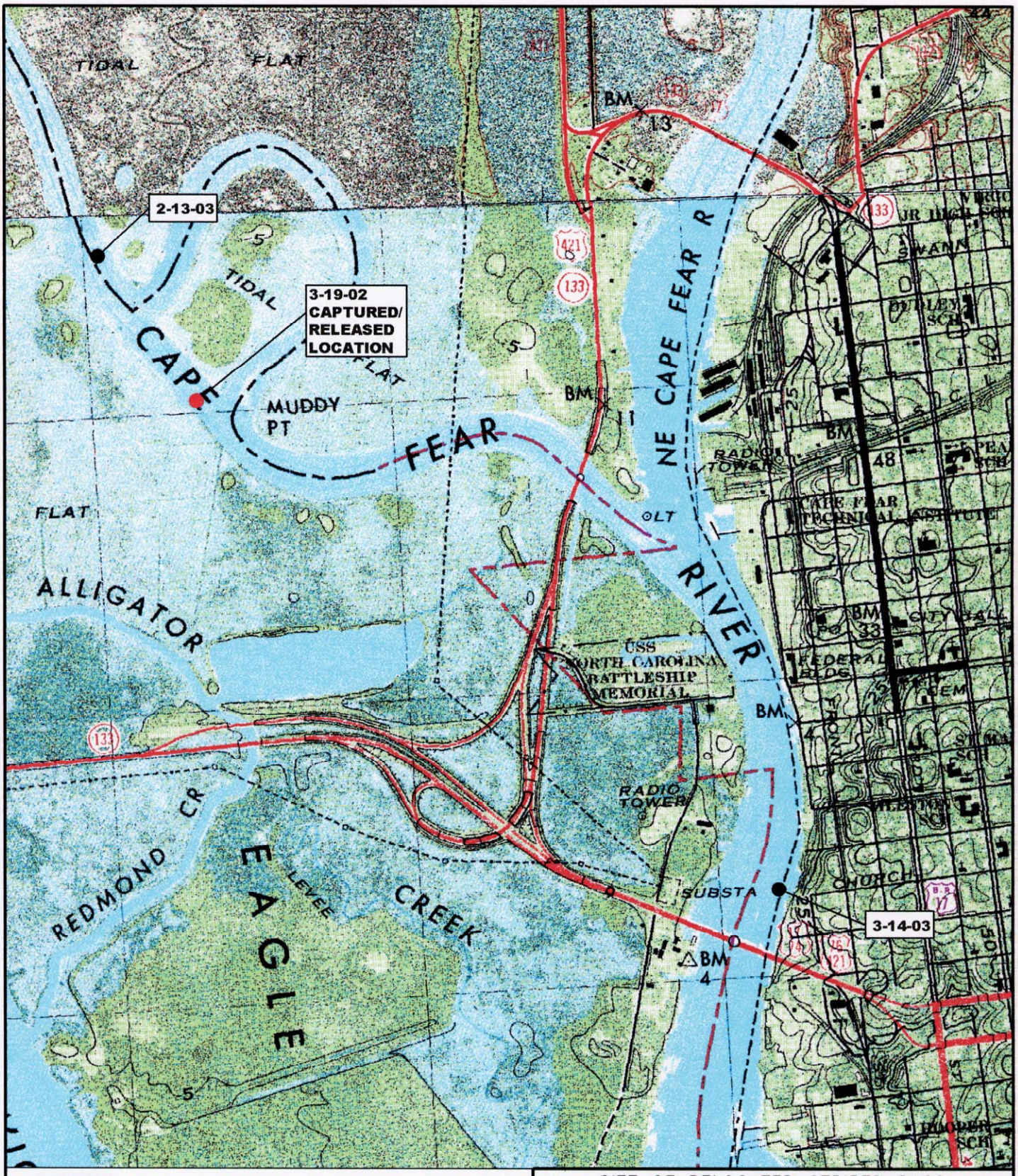
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-19-02
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5014

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 9/2/03 | | FILE: CZR5014-03 |
| | | CP#1645.32 |

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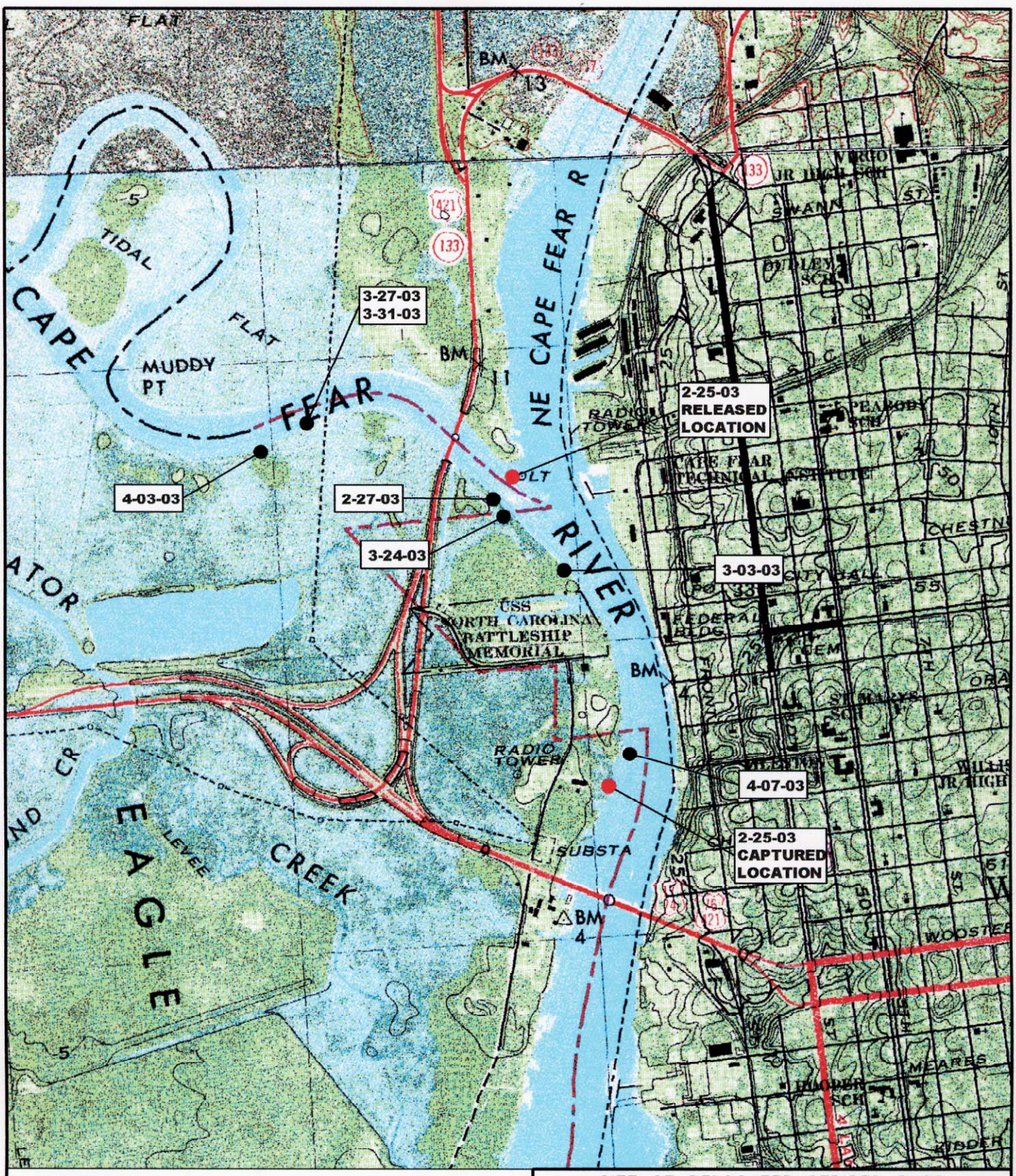



LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-25-03
- SITE OF RELOCATED FISH

0 1500 3000

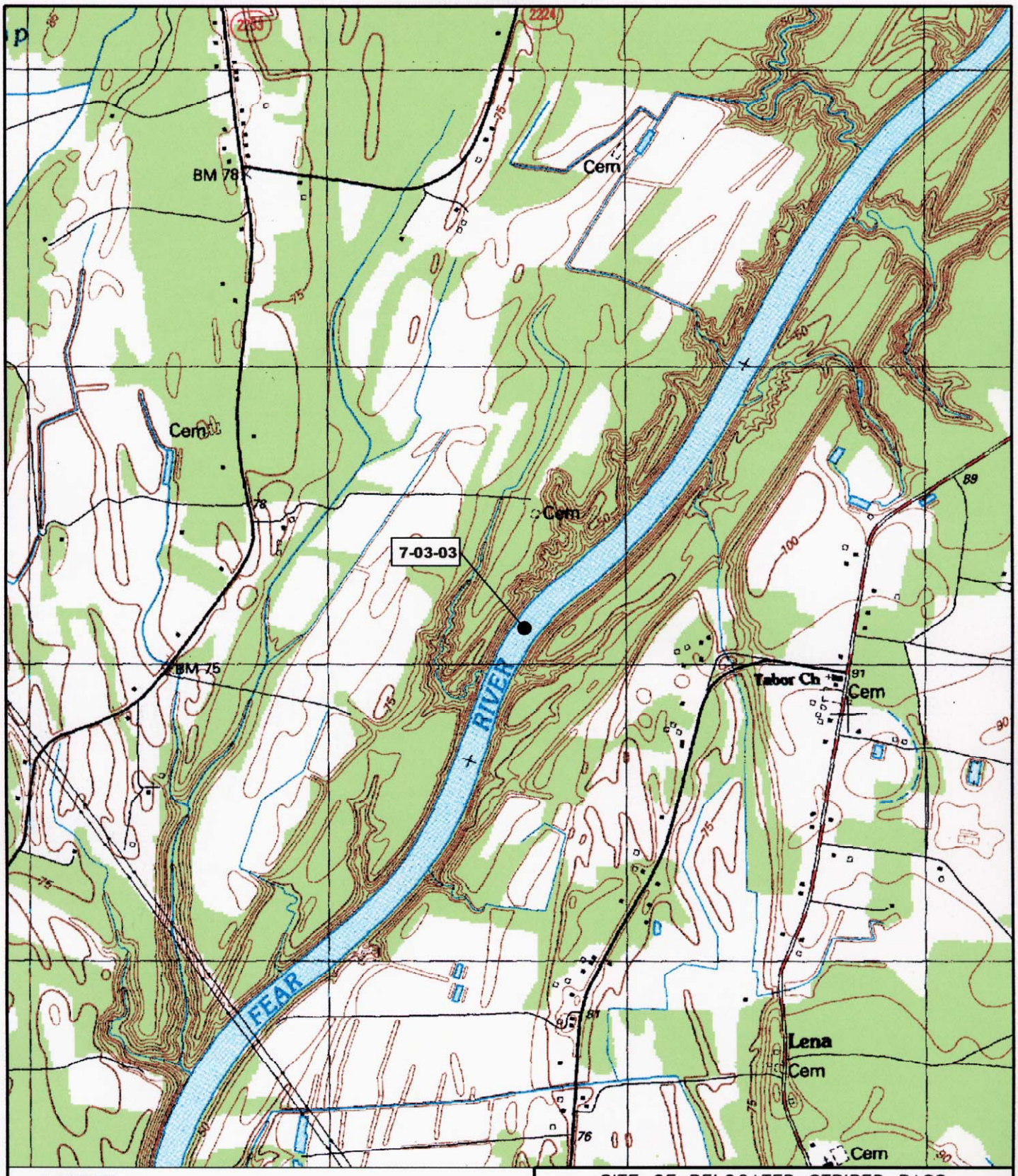
SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5015

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5015-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-25-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5015

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5015-03 |
| | | CP#1645.32 |
| | | 2 OF 2 |

CZR INCORPORATED
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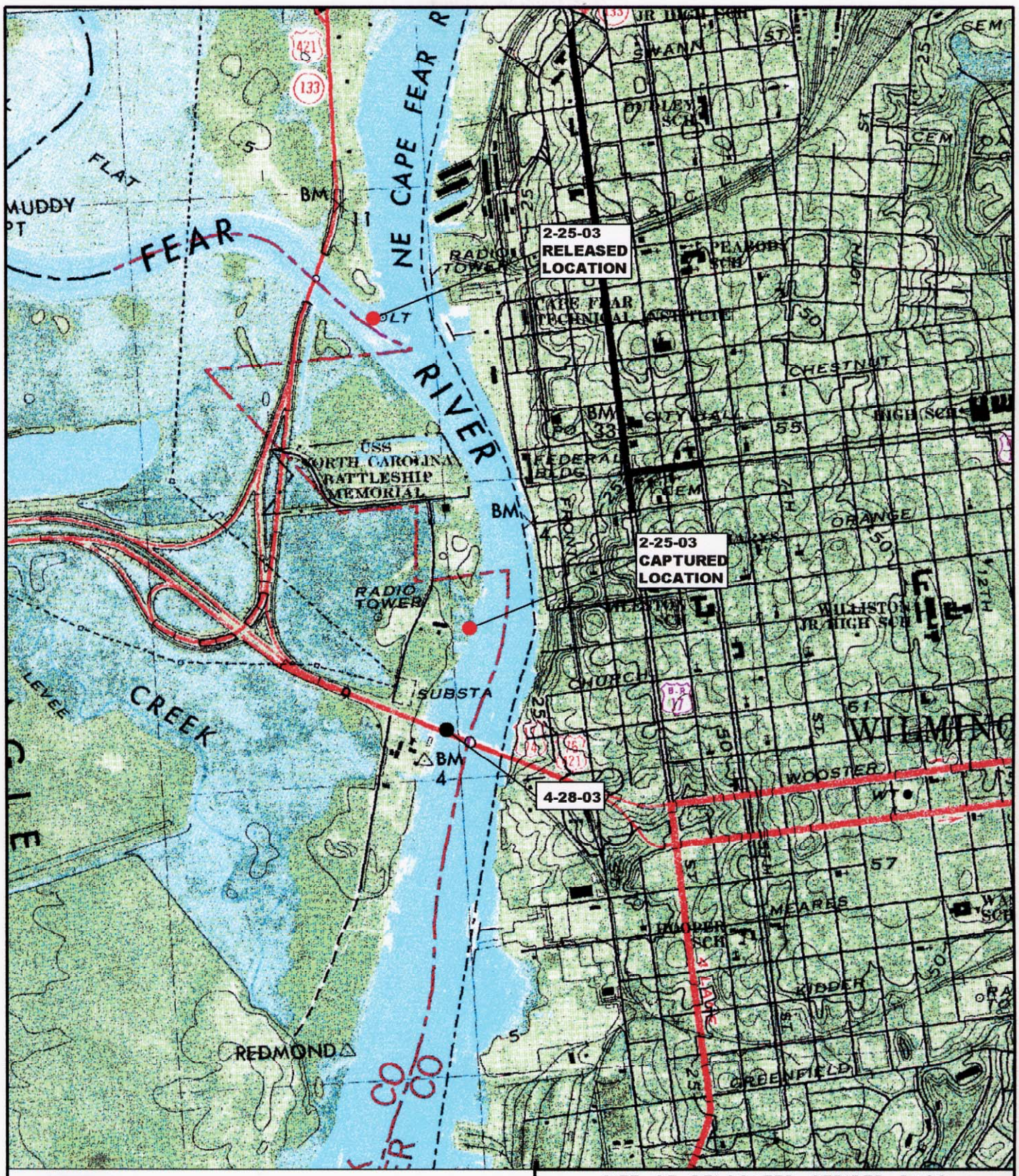
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-25-03
- SITE OF RELOCATED FISH

0 1500 3000

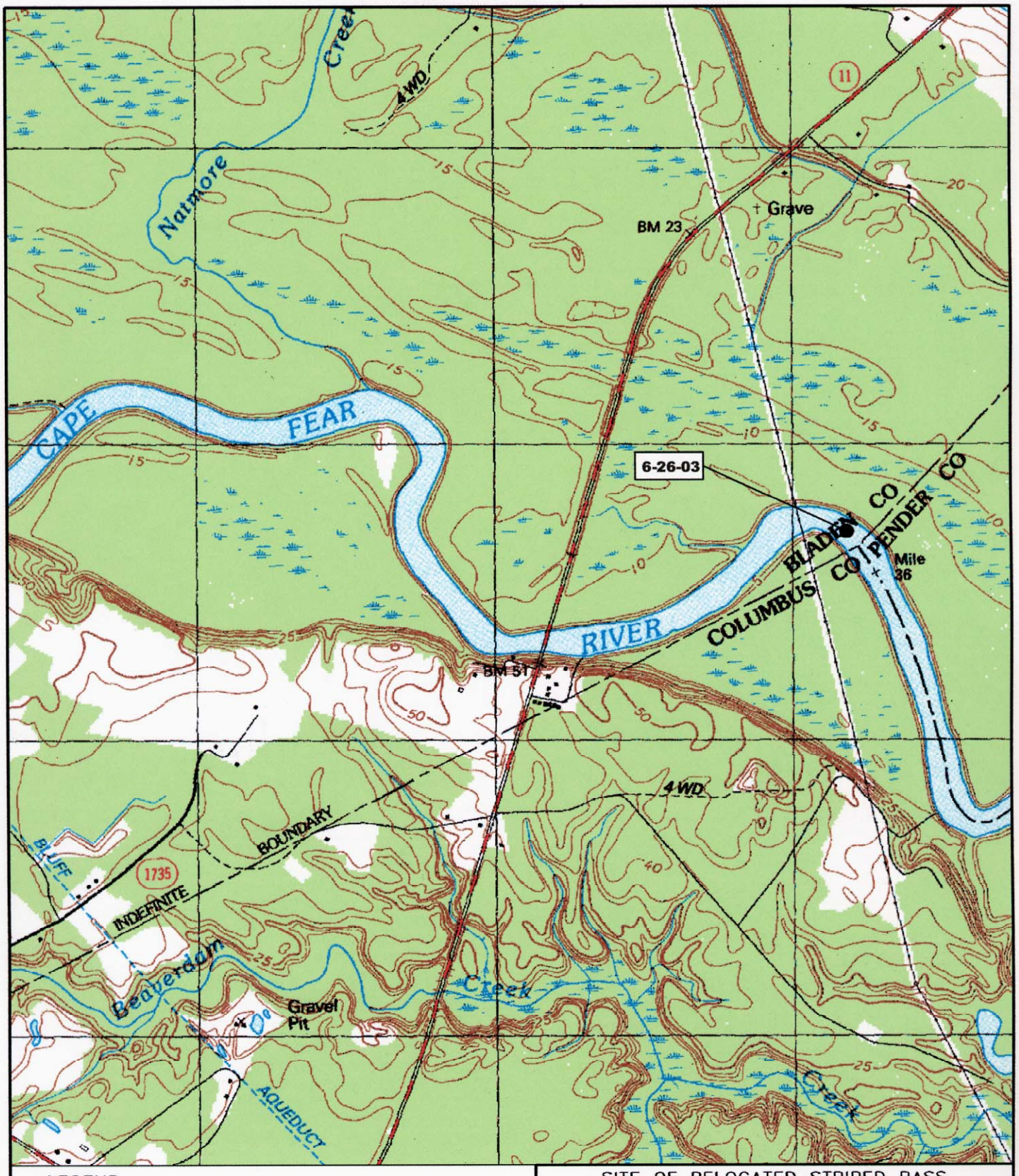
SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5016

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5016-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-25-03
- SITE OF RELOCATED FISH

0 1500 3000

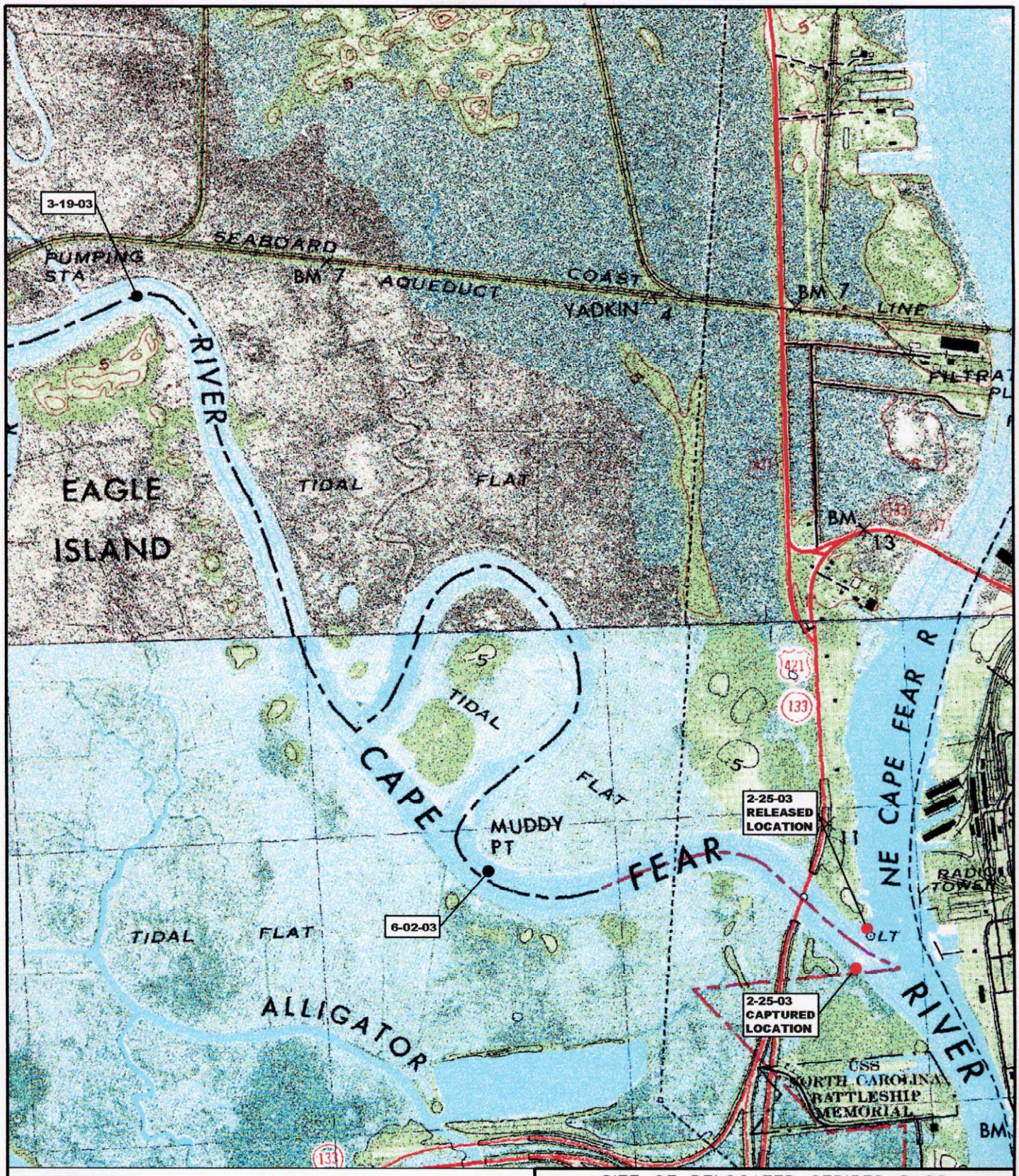
SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5016

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5016-03 |
| | | CP#1645.32 |
| | | 2 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-25-03
- SITE OF RELOCATED FISH

0 1500 3000

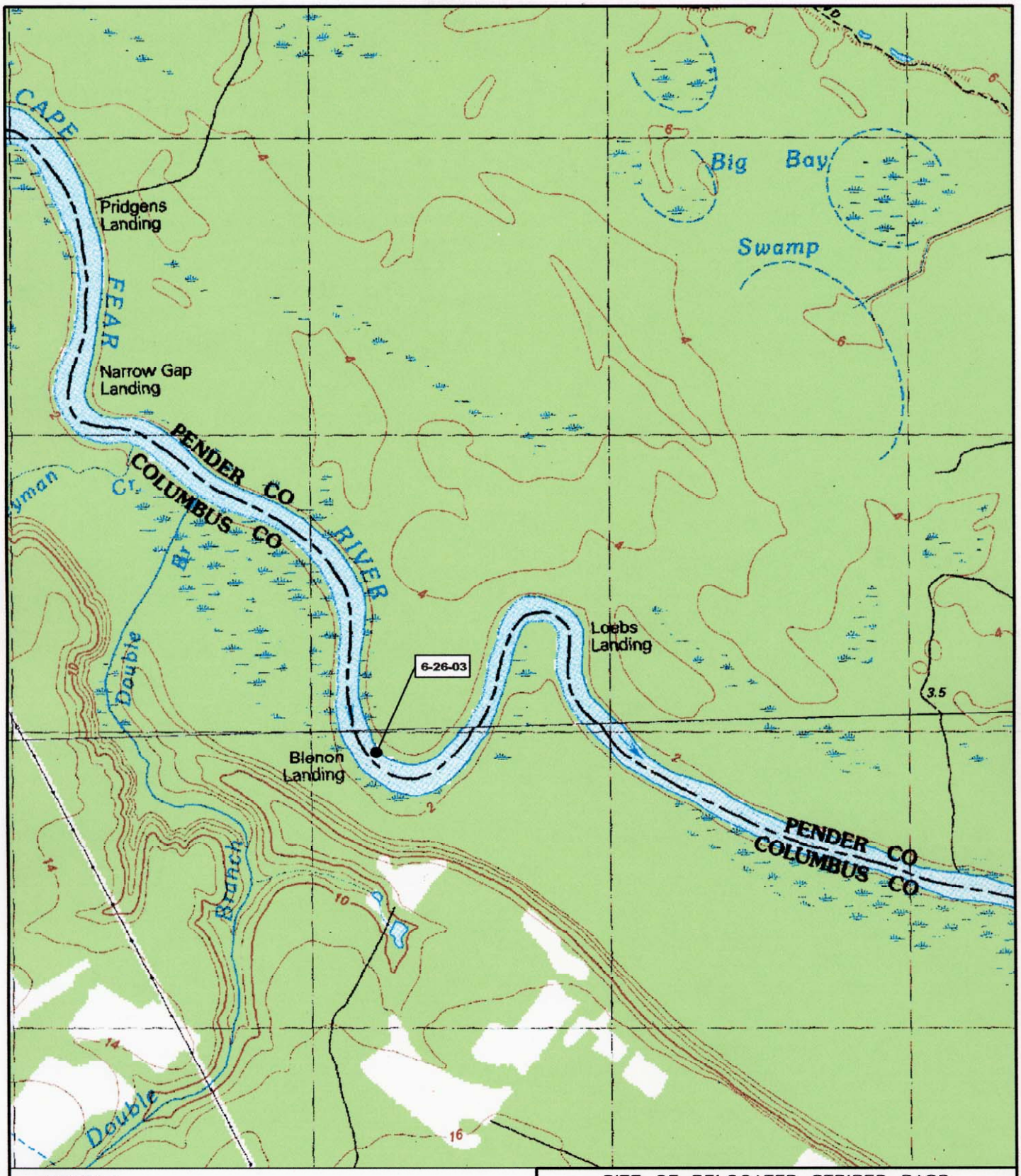
SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5017

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5017-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-25-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5017

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5017-03 |
| | | CP#1645.32 |
| | | 2 OF 2 |

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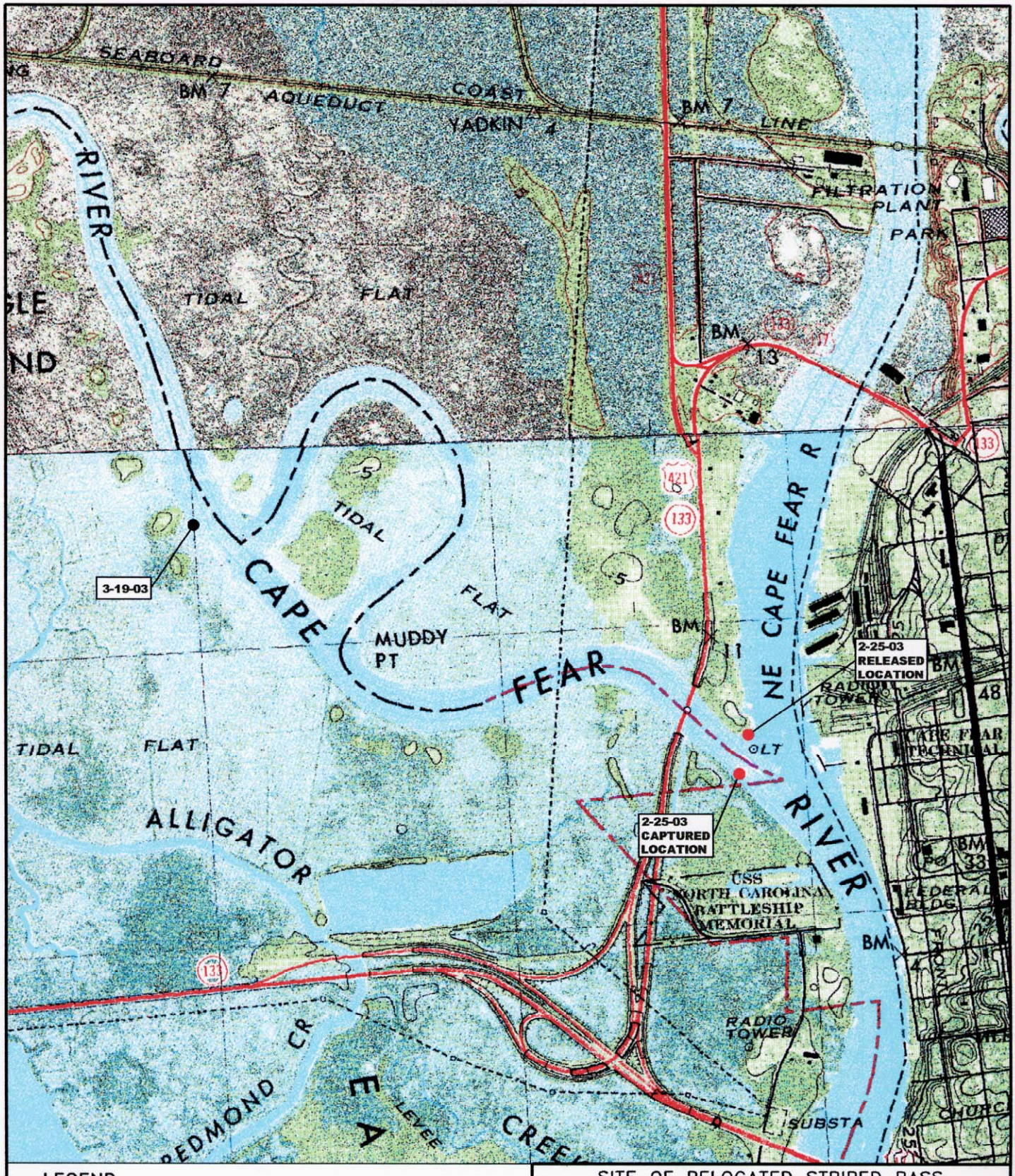
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




**LEGEND**

- ● CAPTURE AND RELEASE OF TAGGED FISH ON 2-25-03
- ● SITE OF RELOCATED FISH

0 1500 3000

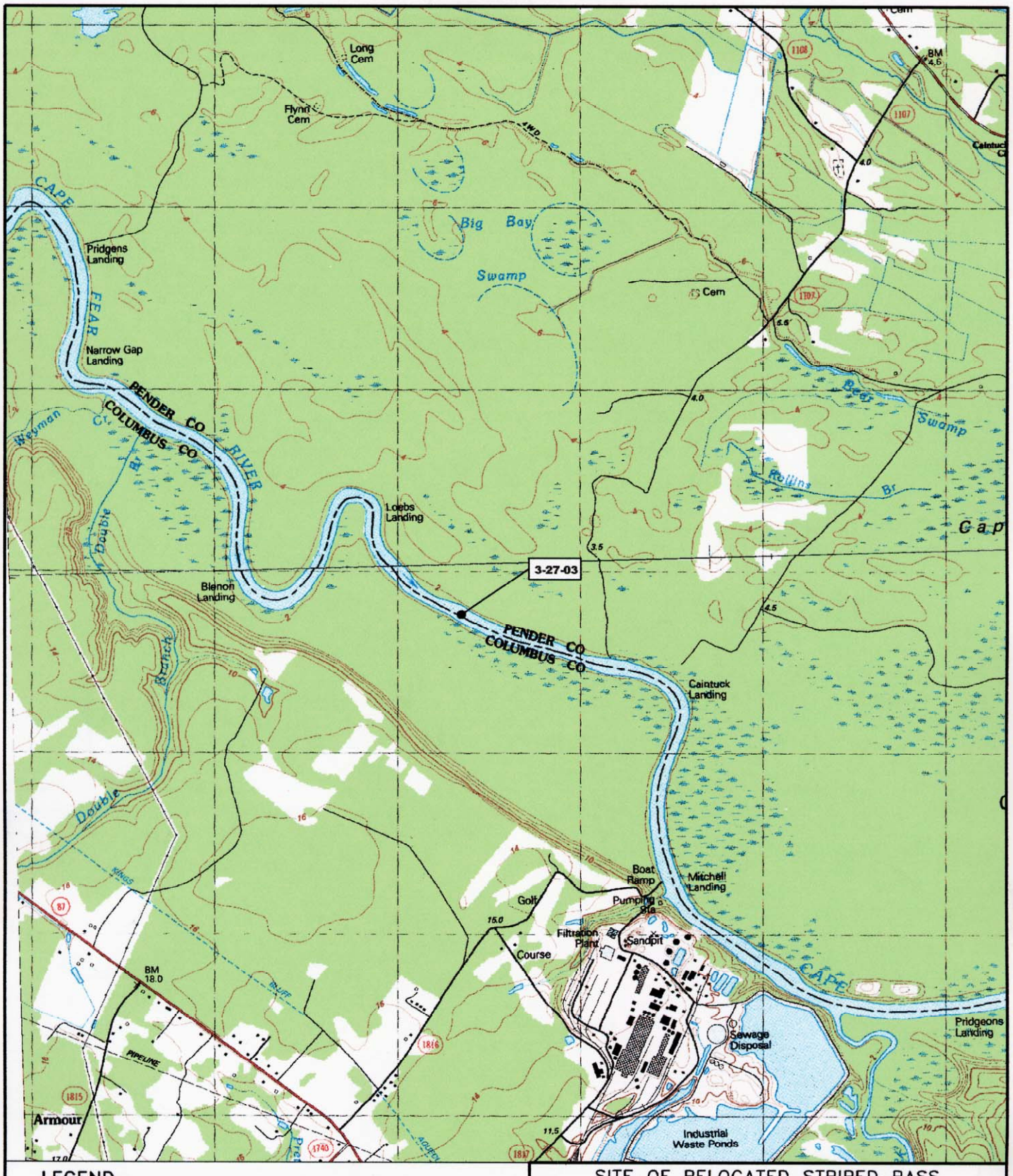
SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5018

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5018-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-25-03
- SITE OF RELOCATED FISH

0 1500 3000

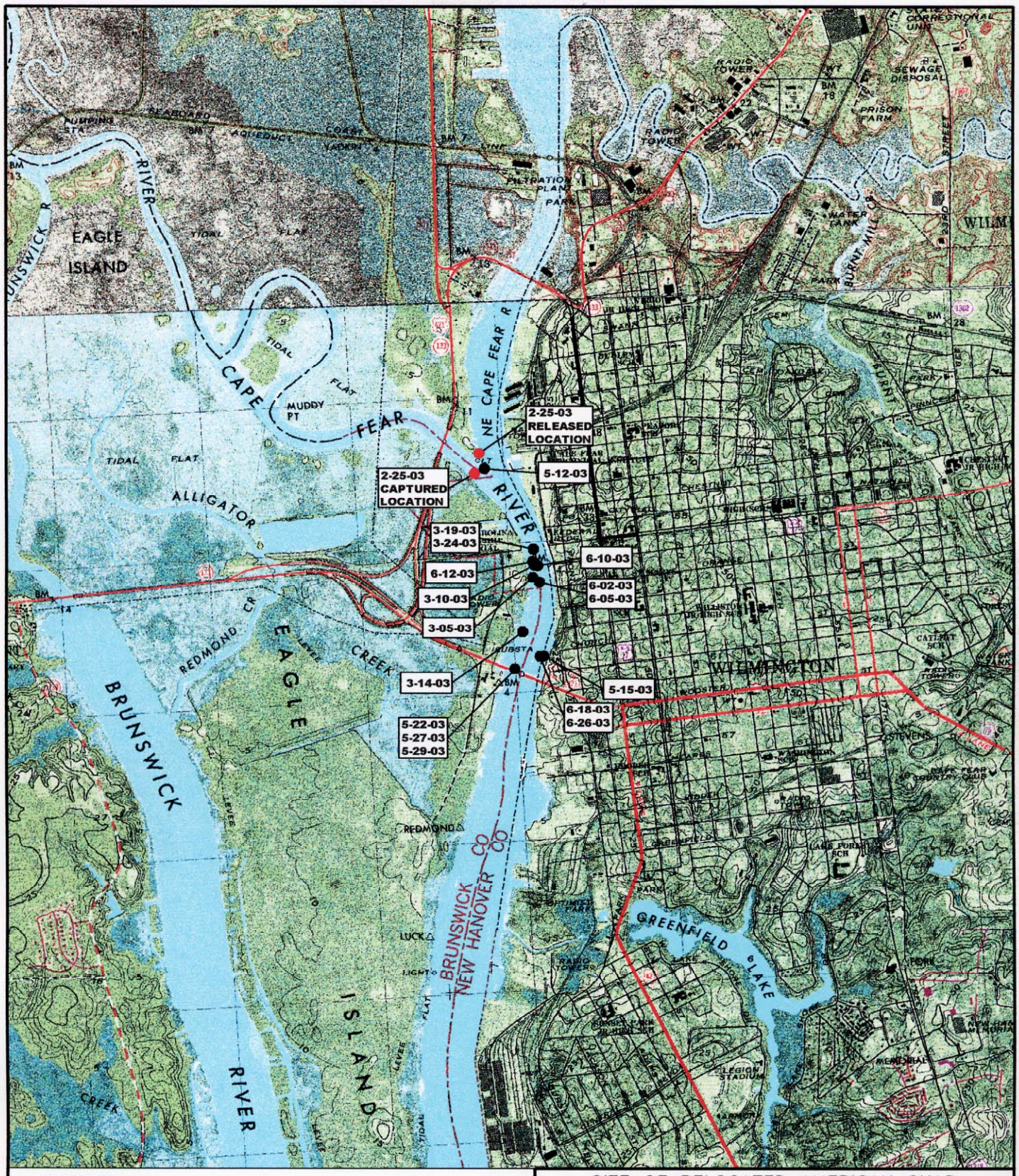
SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5018

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5018-03 |
| | | CP#1645.32 |
| | | 2 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-25-03
- SITE OF RELOCATED FISH

0 3000 6000

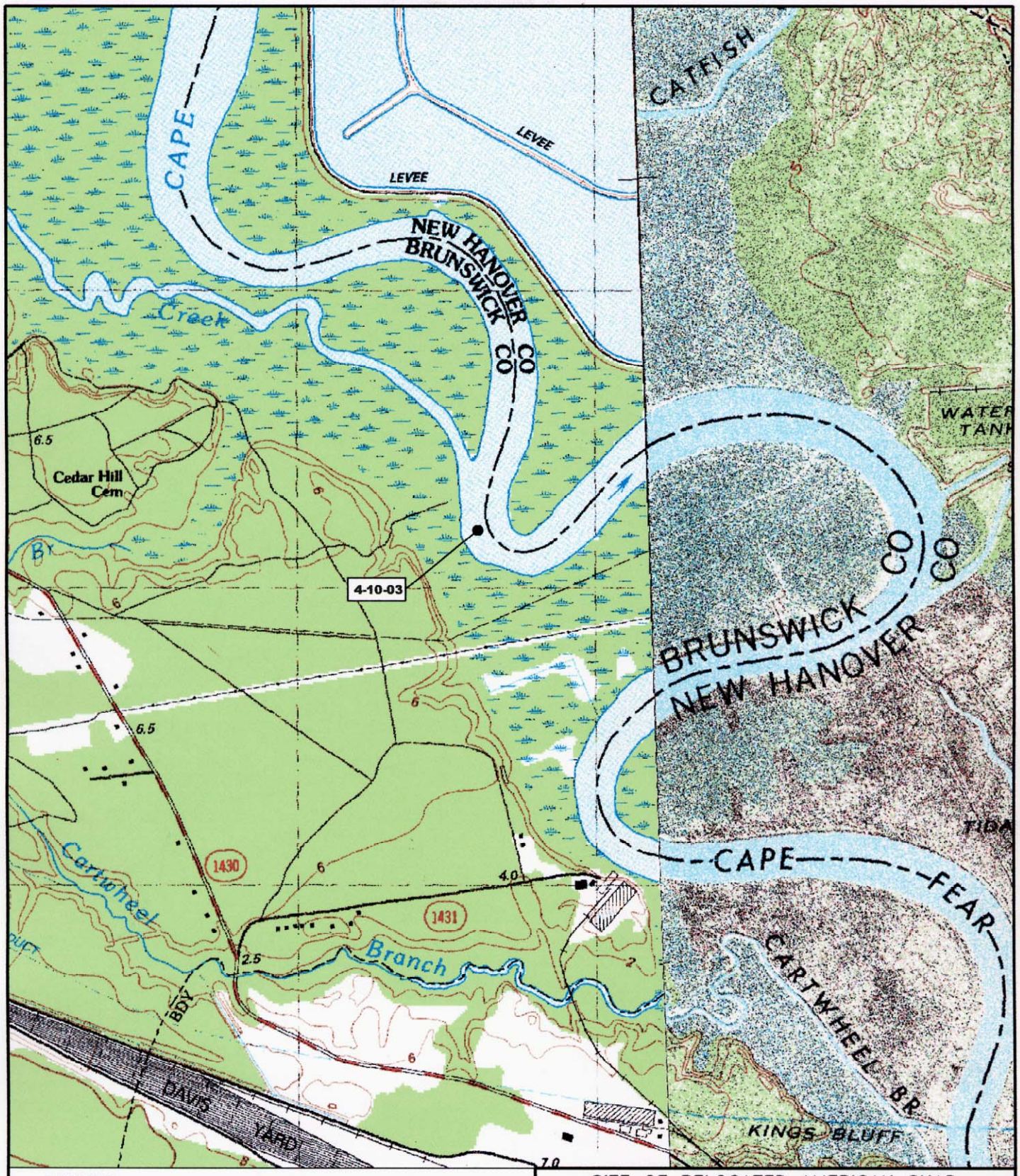
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5019

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5019-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-25-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5019

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5019-03 |
| CZR INCORPORATED ENVIRONMENTAL CONSULTANTS | 4709 COLLEGE ACRES DRIVE SUITE 2 WILMINGTON, NORTH CAROLINA 28403 TEL 910/392-9253 FAX 910/392-9139 | CP#1645.32 |
| | | 2 OF 2 |

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-25-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5020

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5020-03 |
| | | CP#1645.32 |

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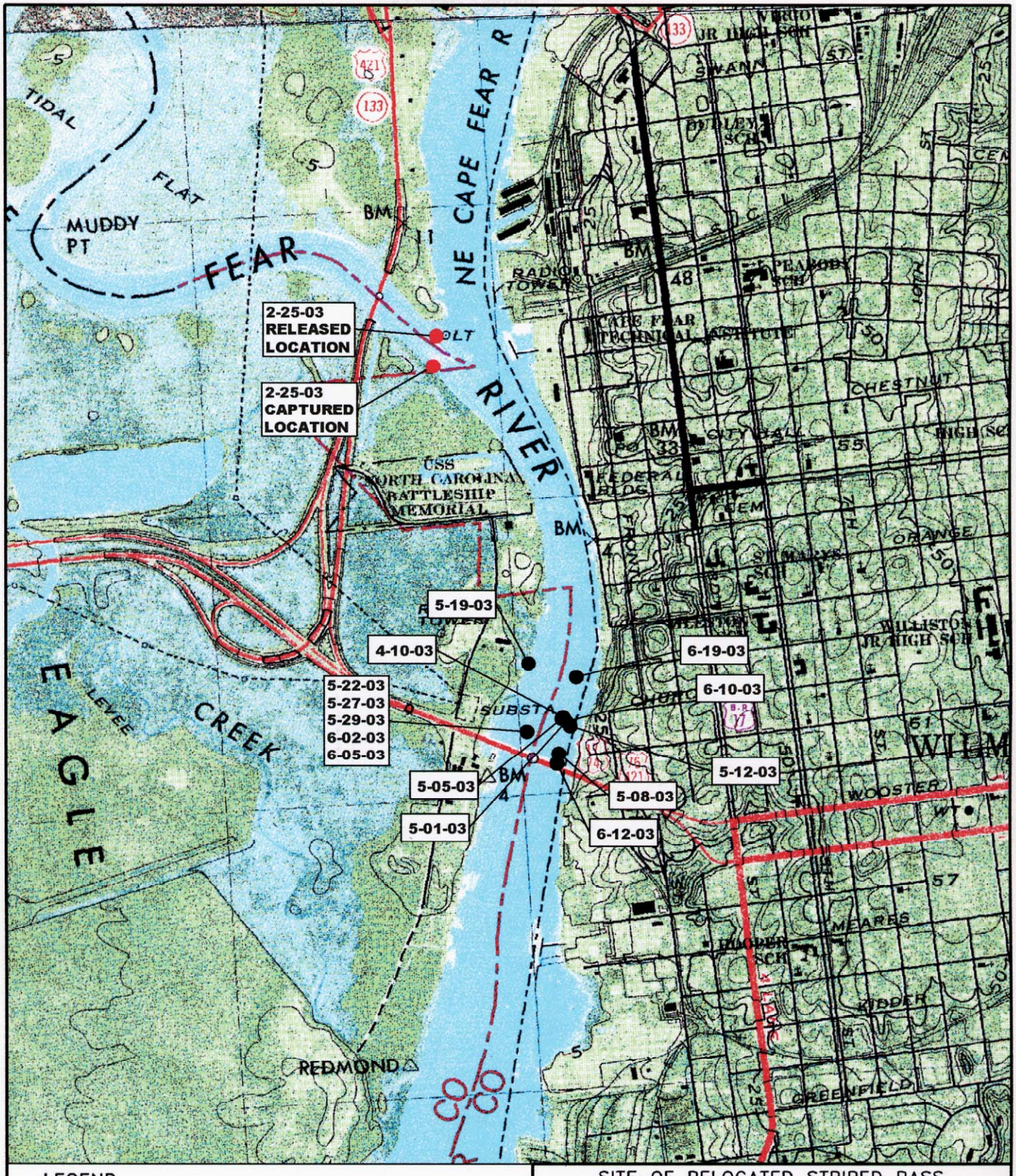
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-25-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5021

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5021-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-25-03
- SITE OF RELOCATED FISH

0 1500 3000

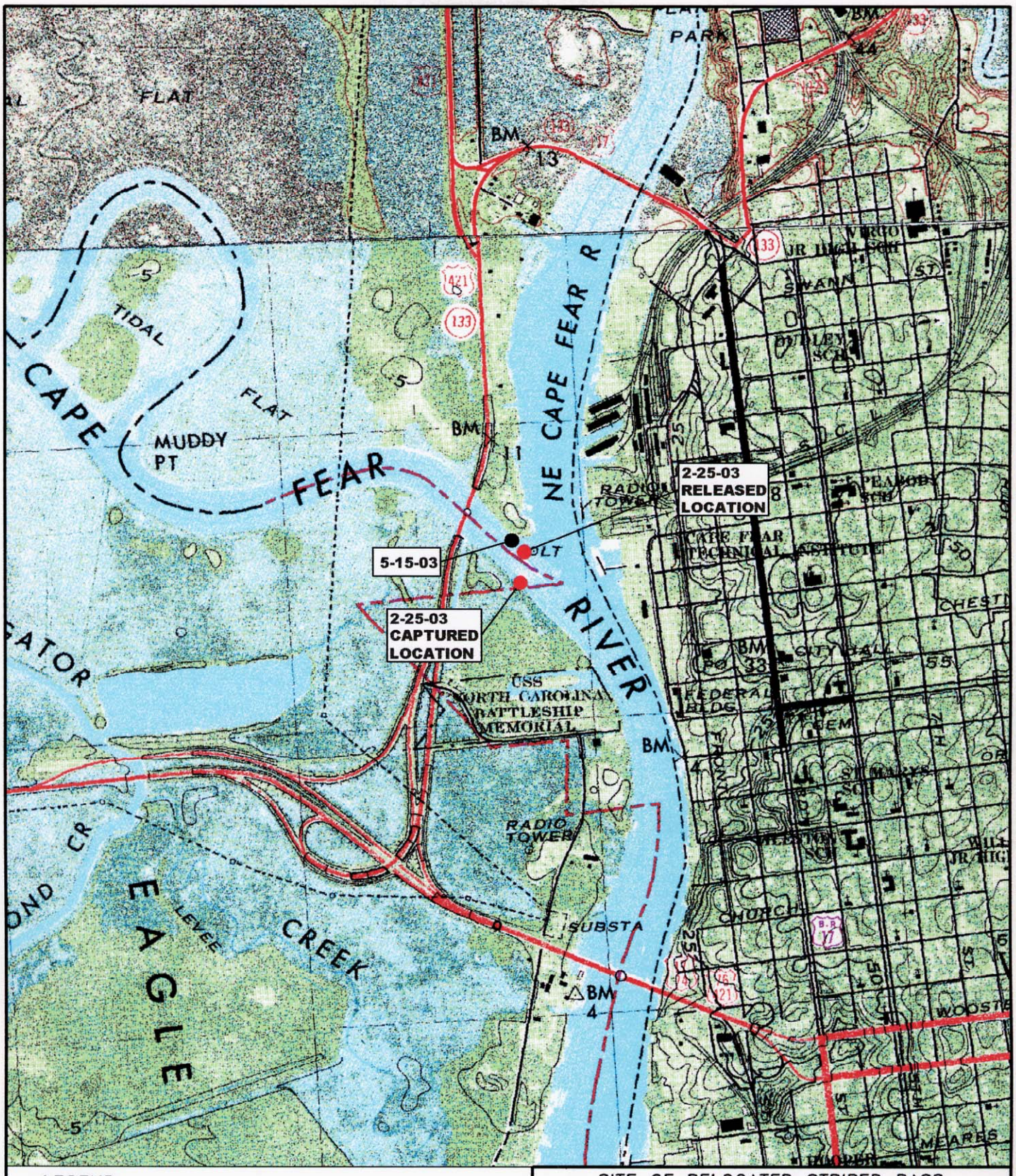
SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5022

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 08/28/03 | | FILE: CZR5022-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-25-03
- SITE OF RELOCATED FISH

0 1500 3000

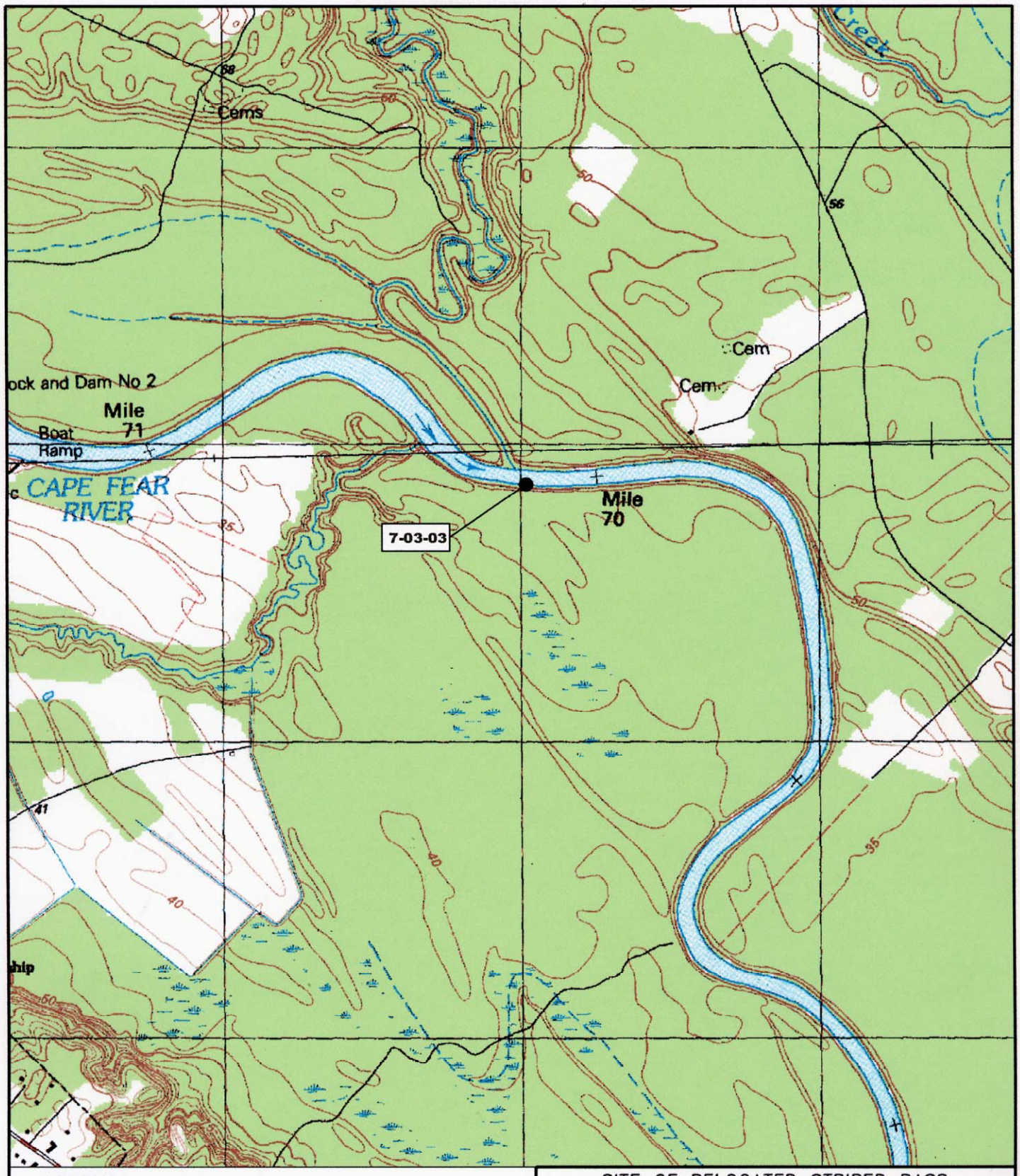
SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5023

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5023-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-25-03
- SITE OF RELOCATED FISH

0 1500 3000

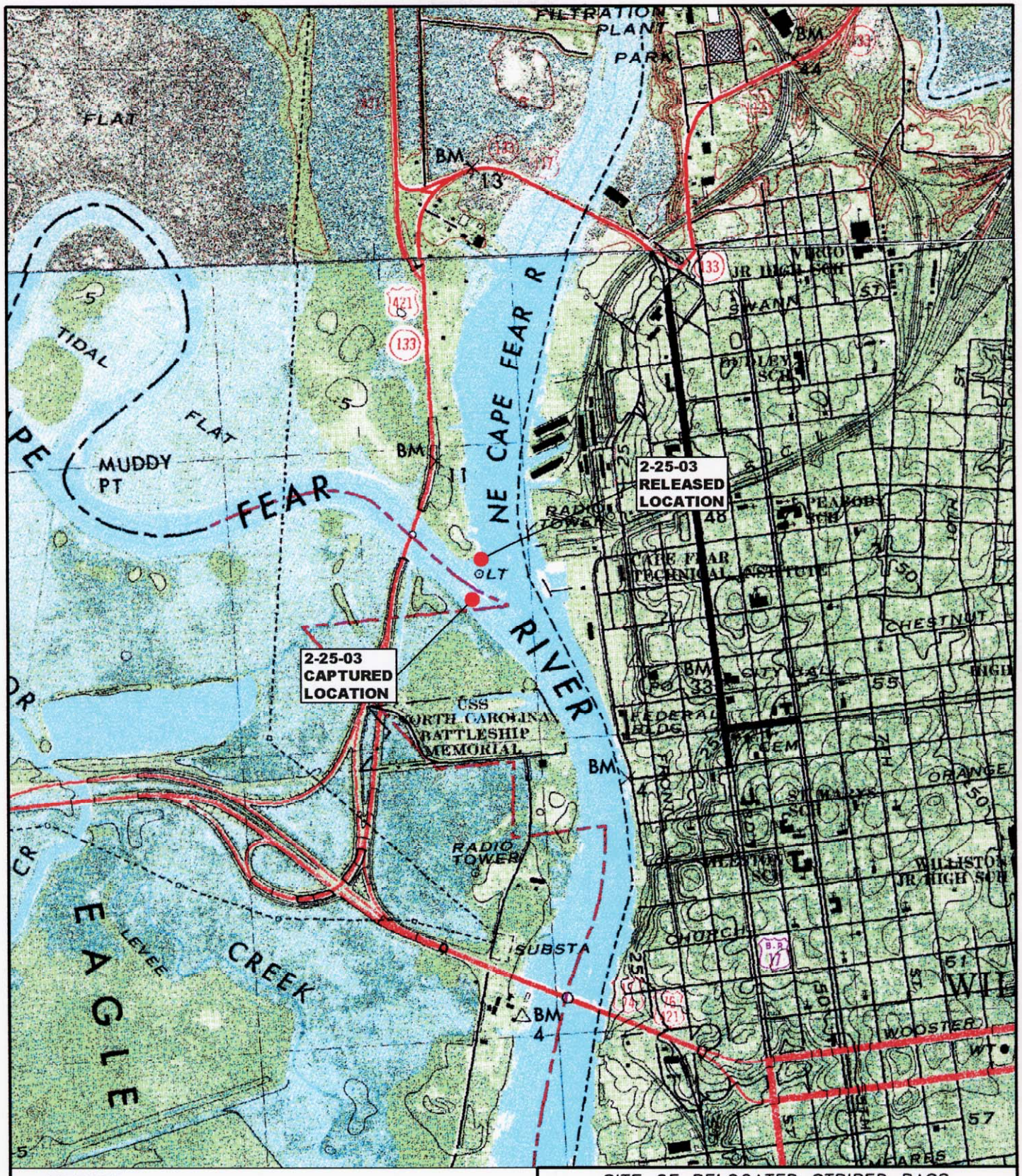
SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5023

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5023-03 |
| | | CP#1645.32 |
| | | 2 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-25-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5024

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5024-03 |
| | | CP#1645.32 |

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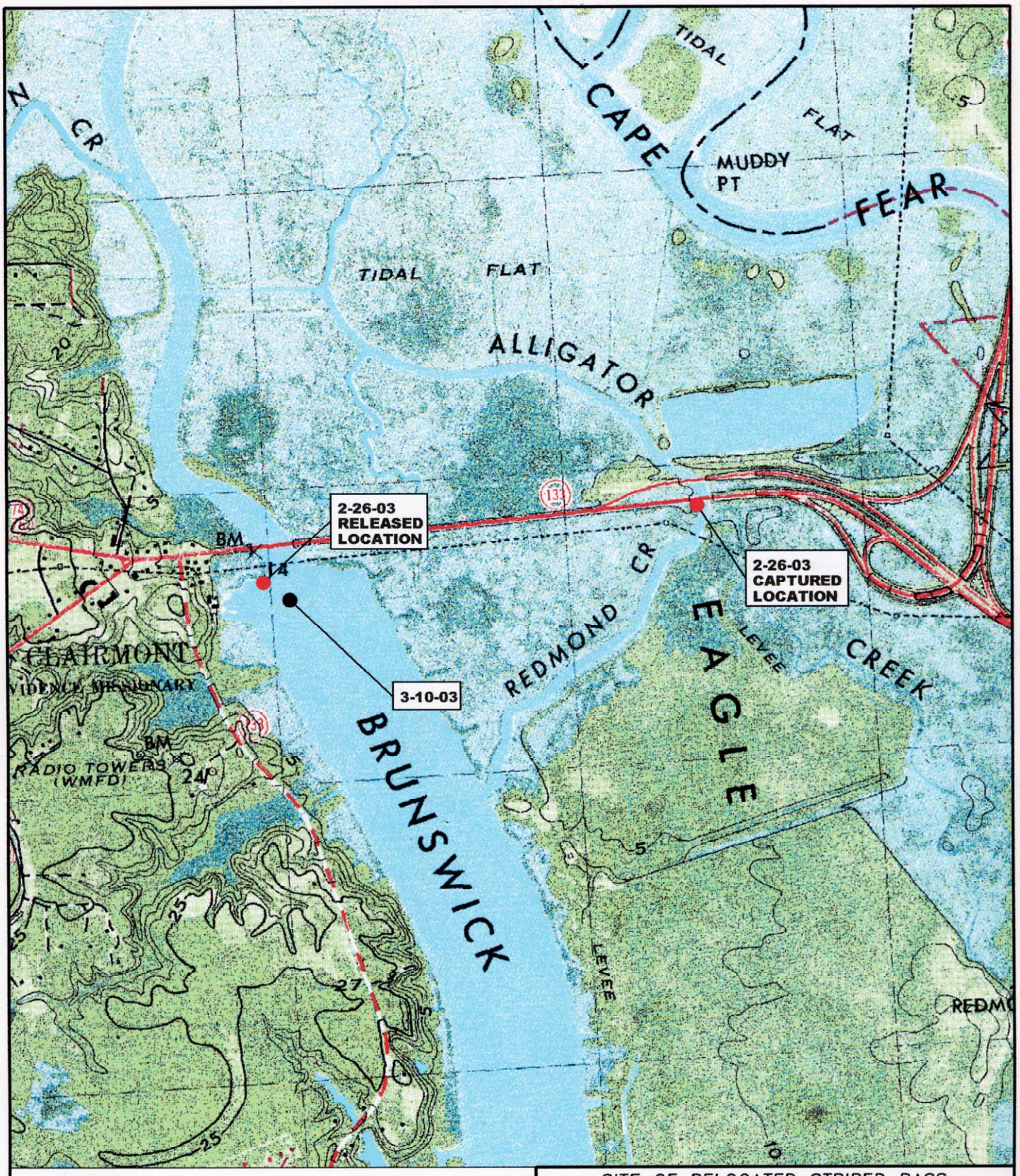
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-26-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5025

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5025-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
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LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-26-03
- SITE OF RELOCATED FISH

0 1500 3000

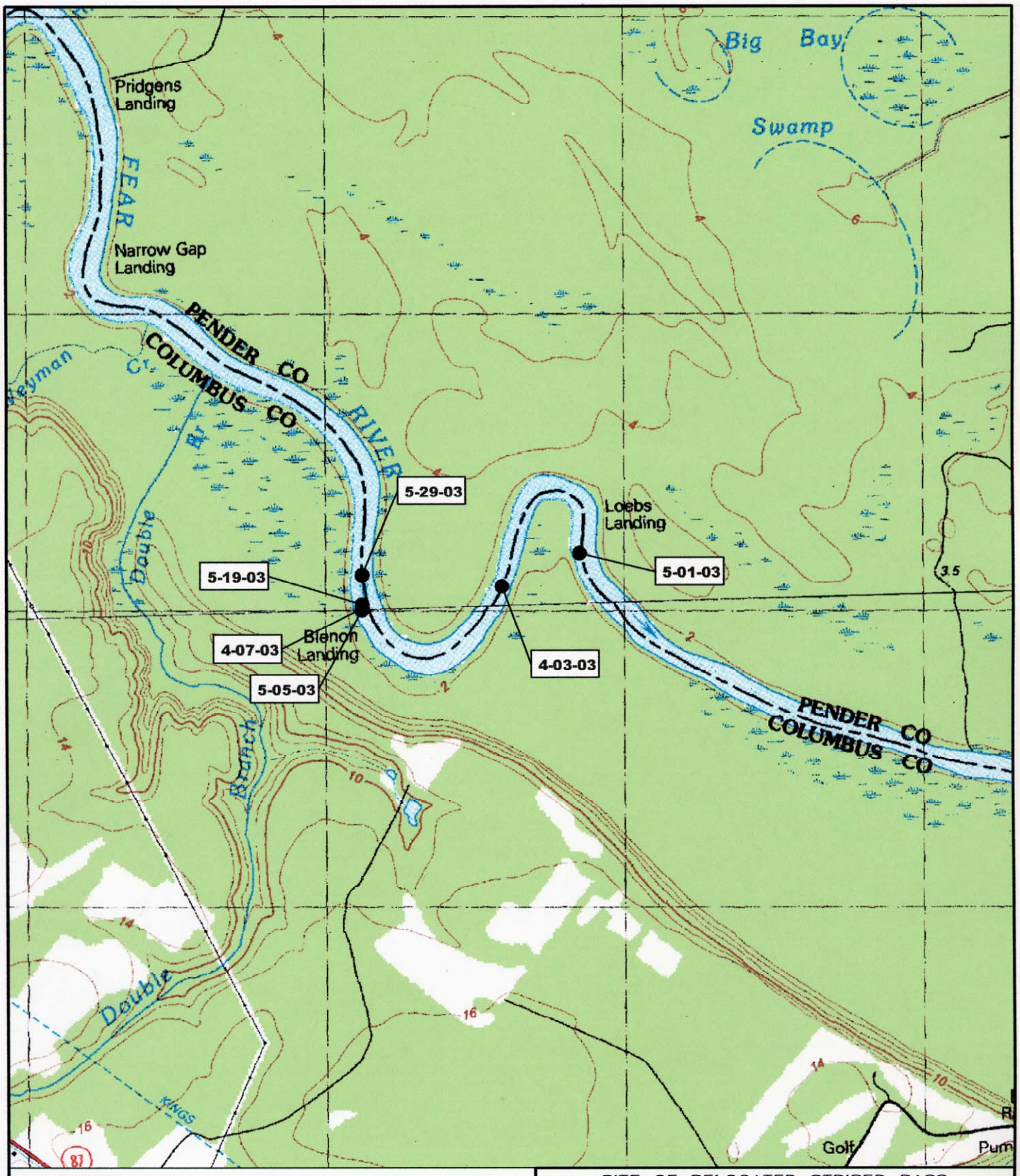
SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5026

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5026-03 |
| | | CP#1645.32 |
| | | 1 OF 3 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




**LEGEND**

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-26-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5026

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5026-03 |
| | | CP#1645.32 |
| | | 2 OF 3 |

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4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
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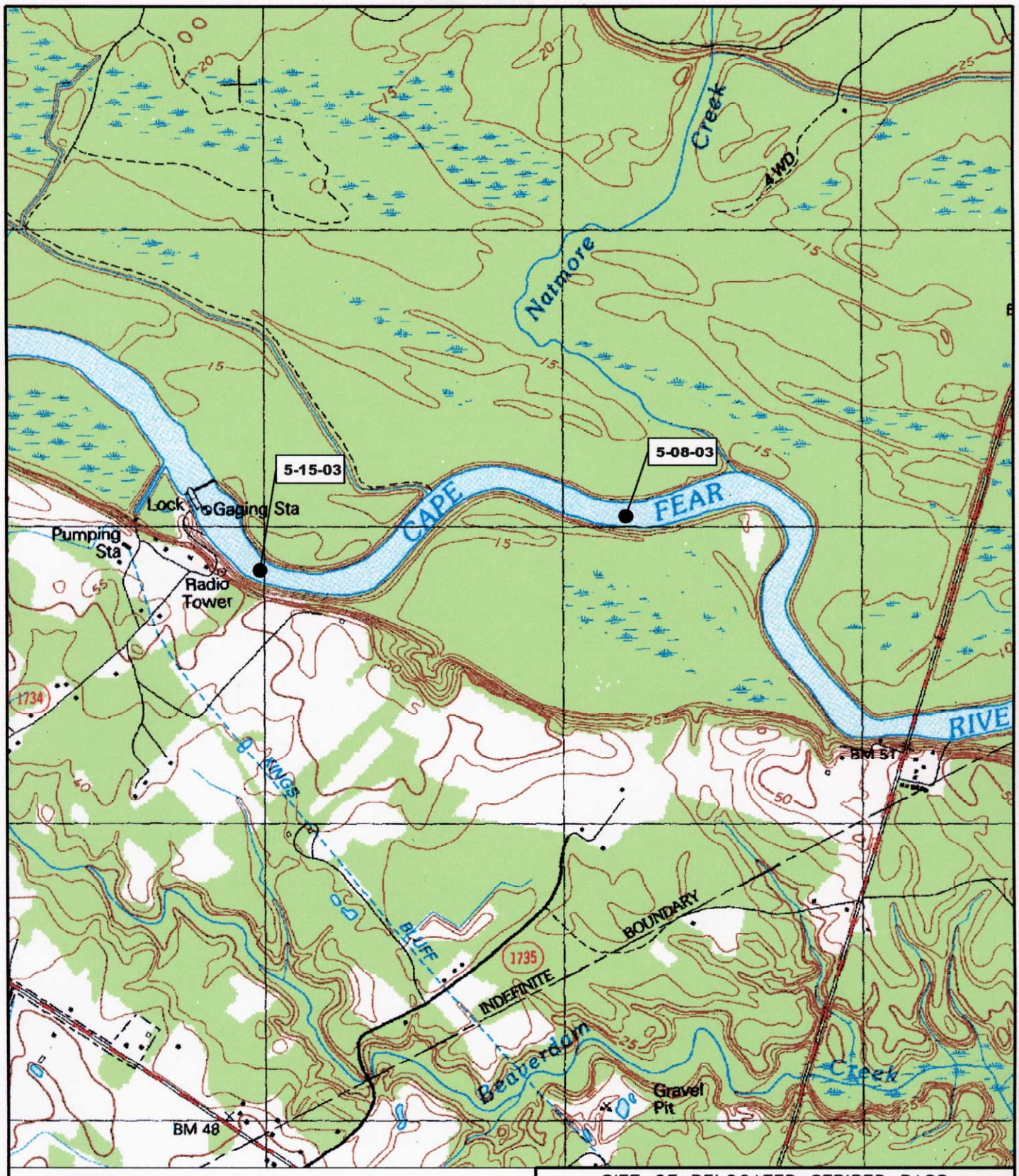



LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-26-03
- SITE OF RELOCATED FISH

0 1500 3000

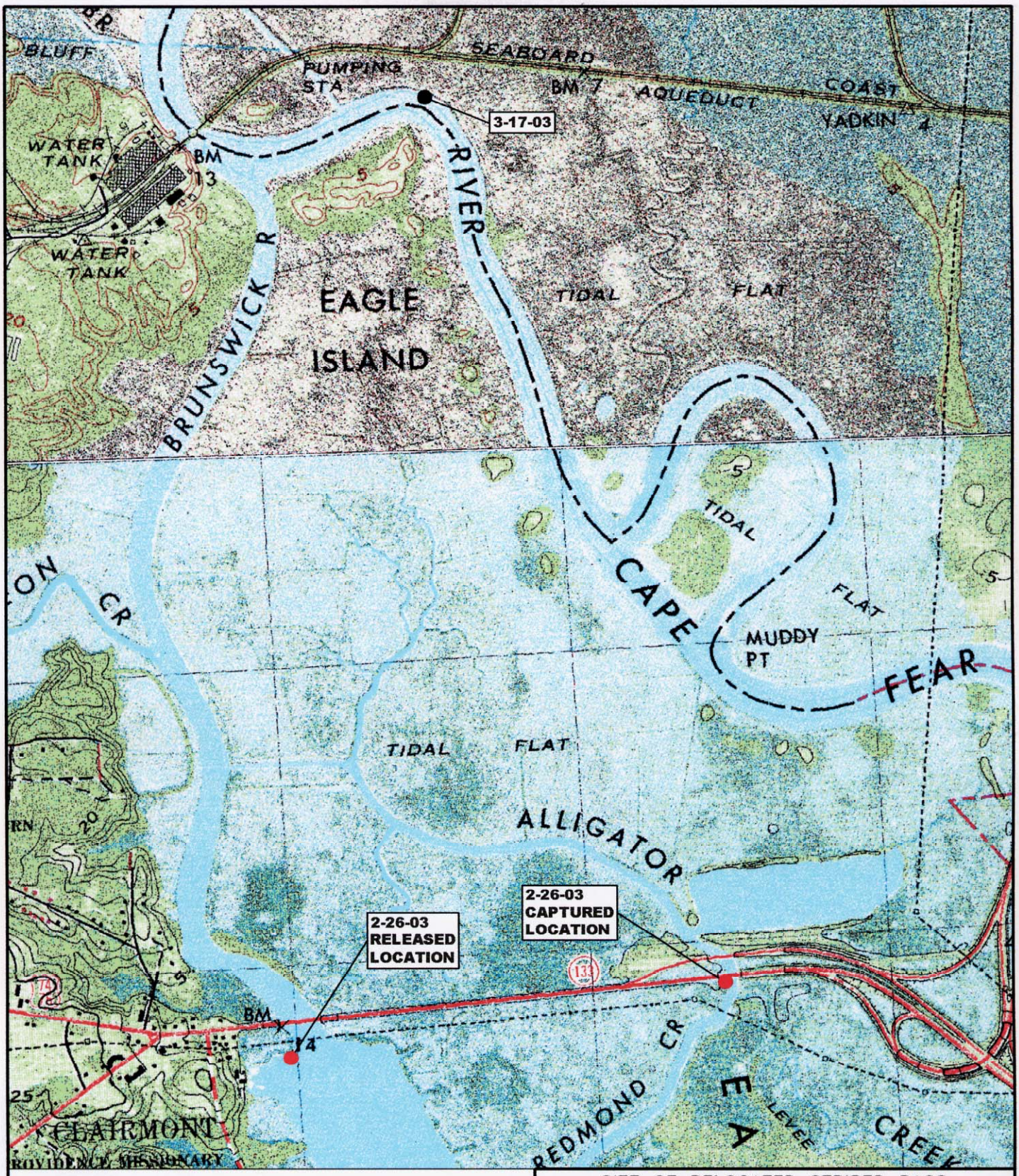
SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5026

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5026-03 |
| | | CP#1645.32 |
| | | 3 OF 3 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-26-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5027

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5027-03 |
| | | CP#1645.32 |

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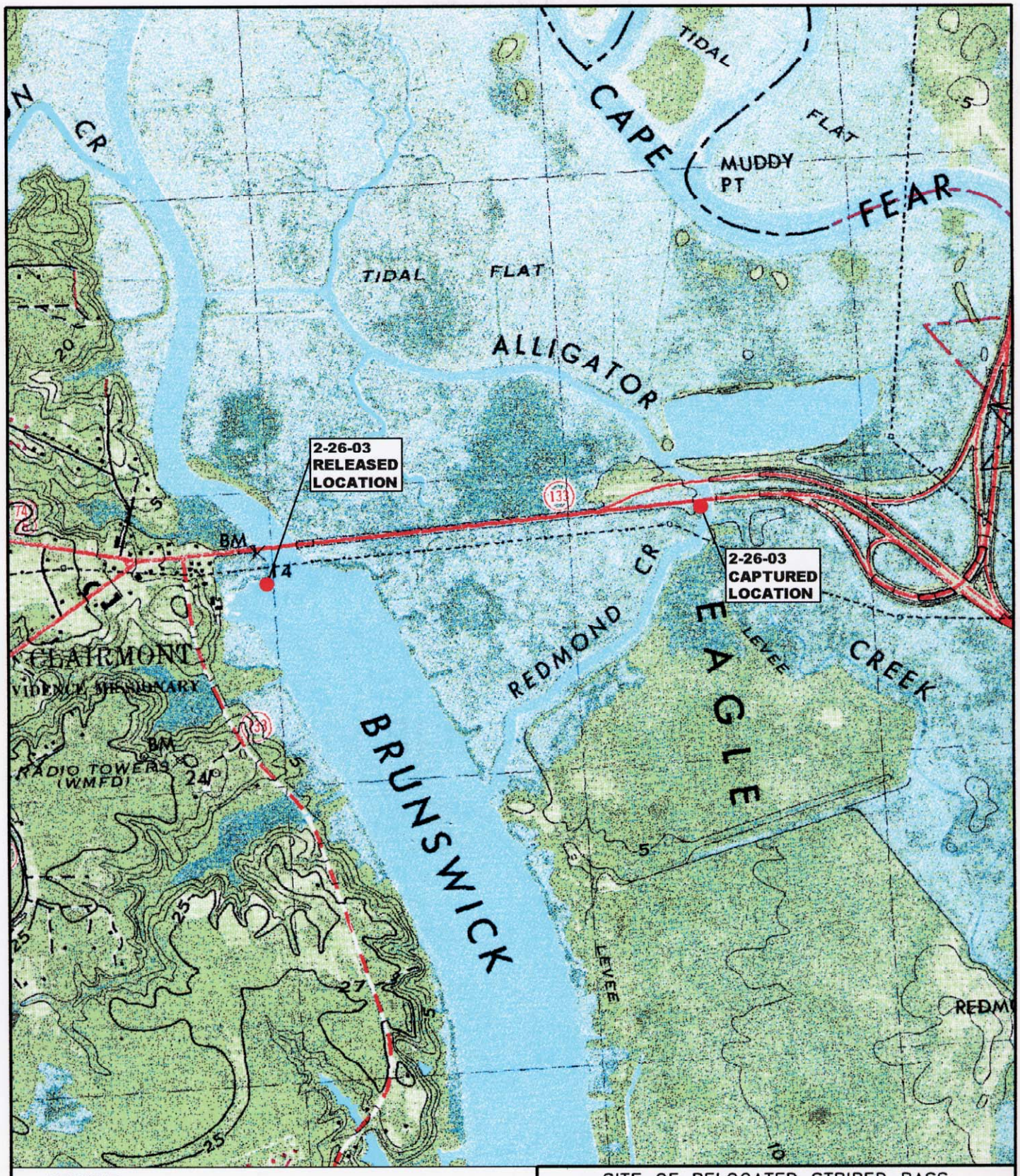
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-26-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5028

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5028-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
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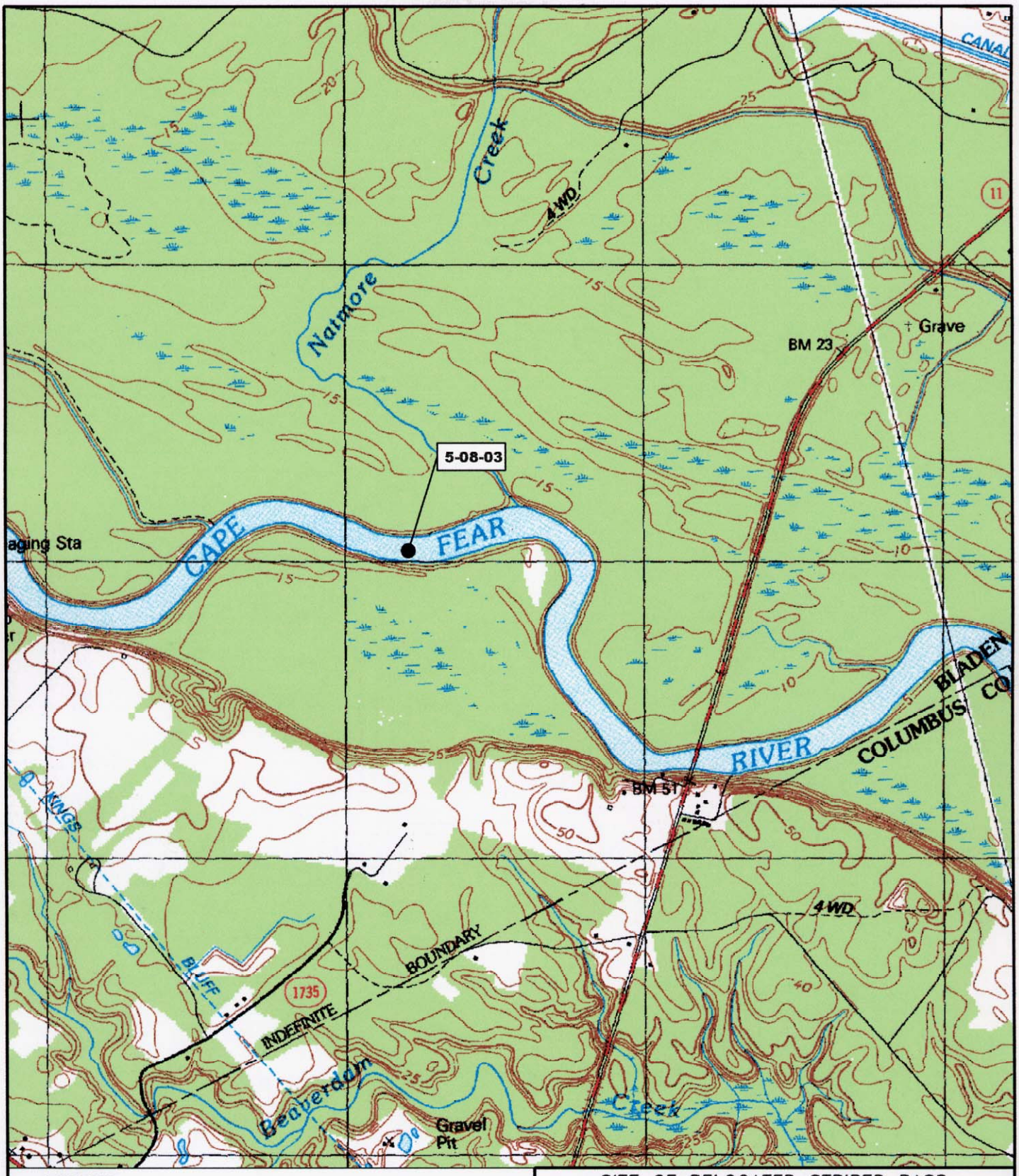
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-26-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5028

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5028-03 |
| | | CP#1645.32 |
| | | 2 OF 2 |

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ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
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TEL 910/392-9253
FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-26-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5029

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5029-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-26-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5030

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5030-03 |
| | | CP#1645.32 |

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SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-26-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5101

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5101-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

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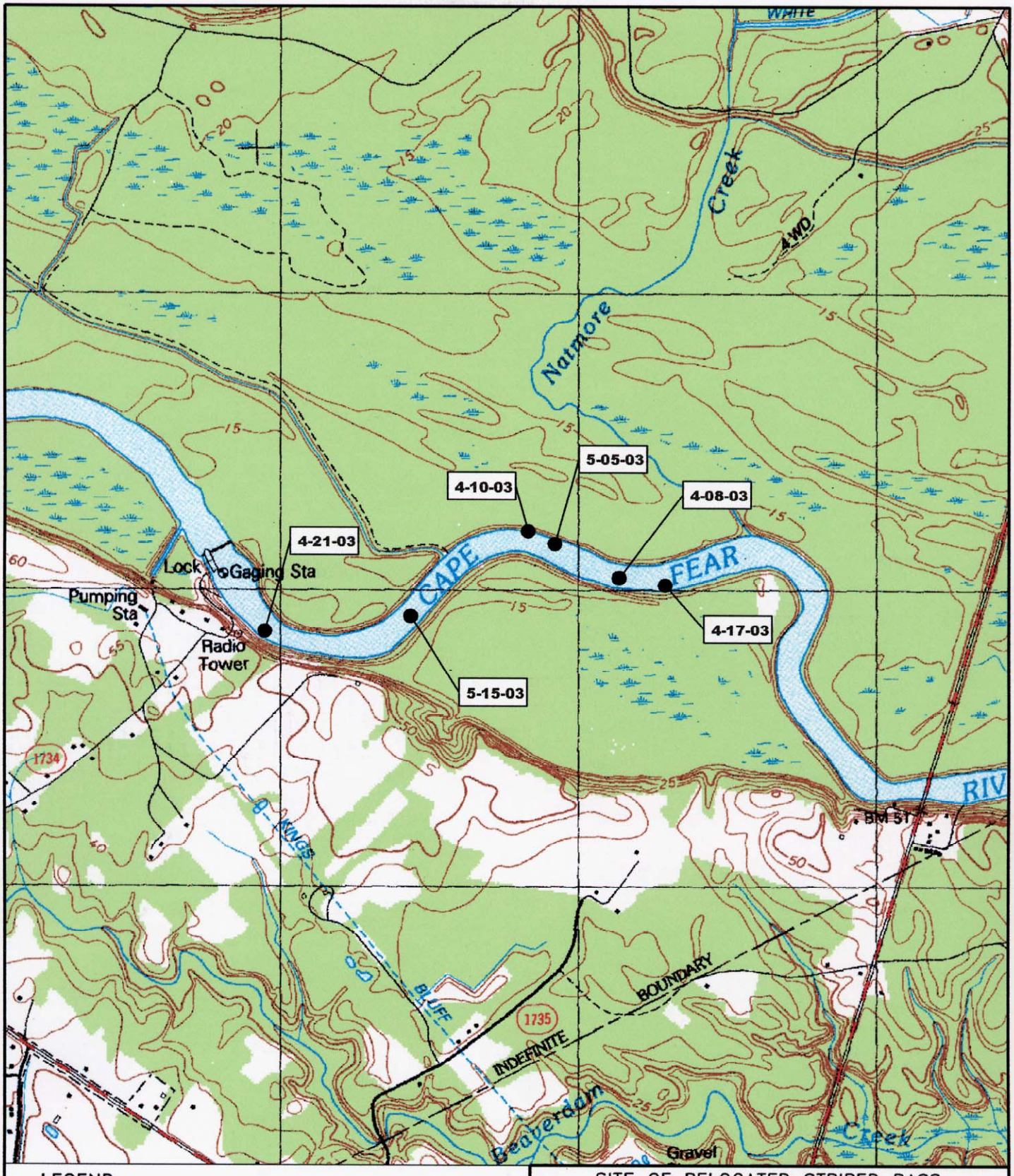
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 2-26-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5101

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/28/03 | | FILE: CZR5101-03 |
| | | CP#1645.32 |
| | | 2 OF 2 |

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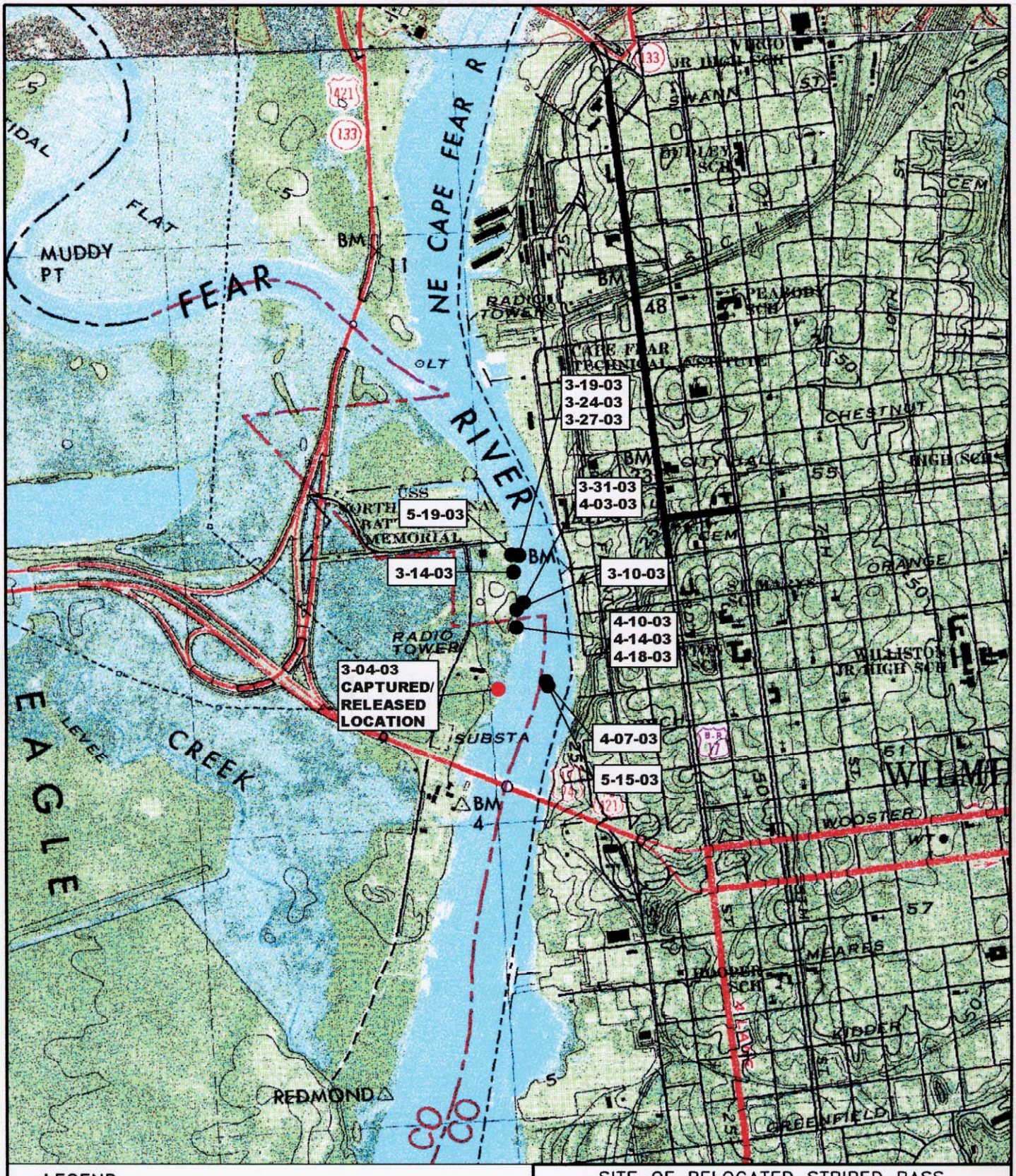
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-04-03
- SITE OF RELOCATED FISH

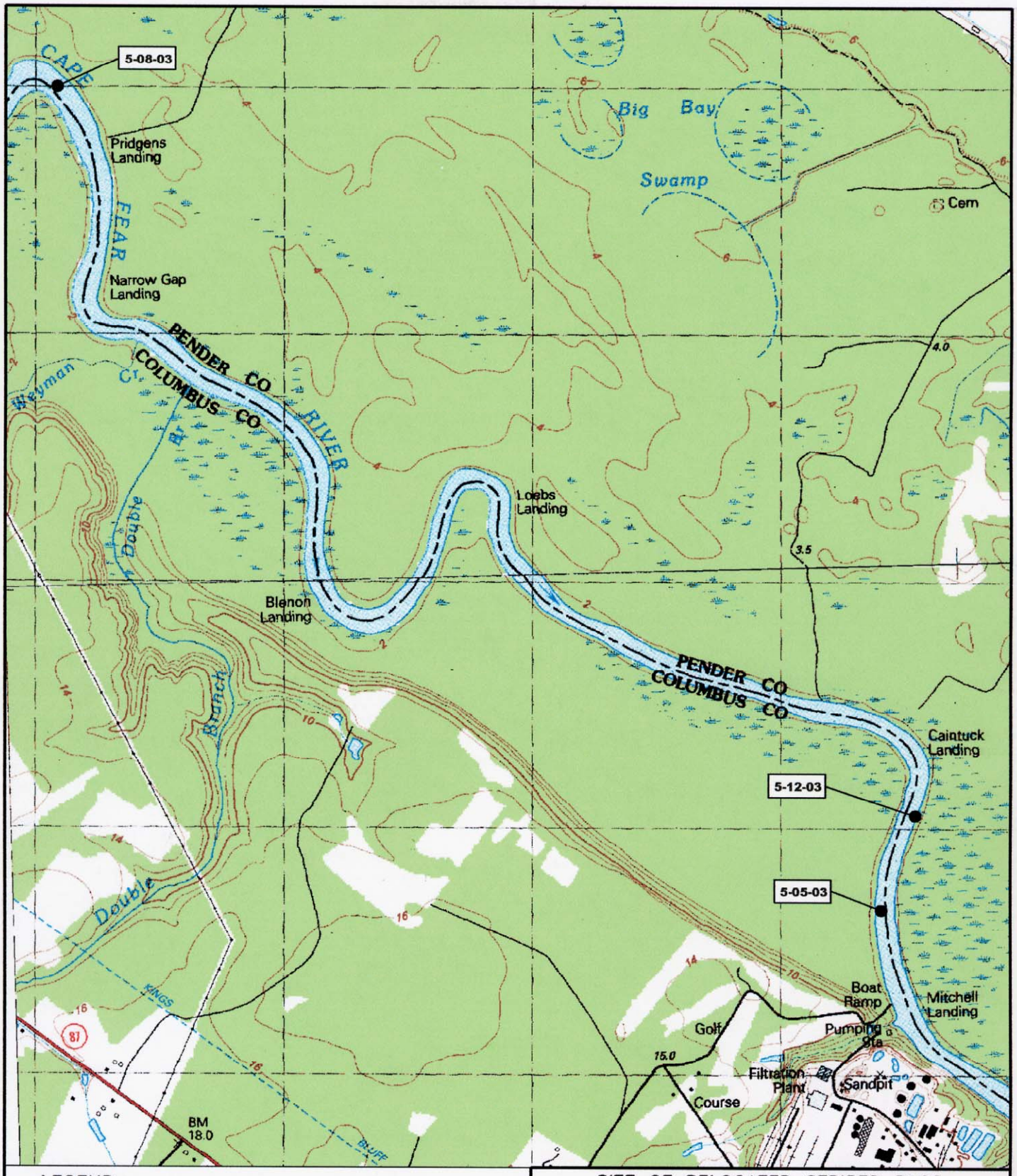
0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5102

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5102-03 |
| CZR INCORPORATED ENVIRONMENTAL CONSULTANTS | 4709 COLLEGE ACRES DRIVE SUITE 2 WILMINGTON, NORTH CAROLINA 28403 TEL 910/392-9253 FAX 910/392-9139 | CP#1645.32 |
| | | 1 OF 2 |




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-04-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5102

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5102-03 |
| | | CP#1645.32 |
| | | 2 OF 2 |

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ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
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TEL 910/392-9253
FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-04-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5103

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5103-03 |
| | | CP#1645.32 |
| | | 1 OF 3 |

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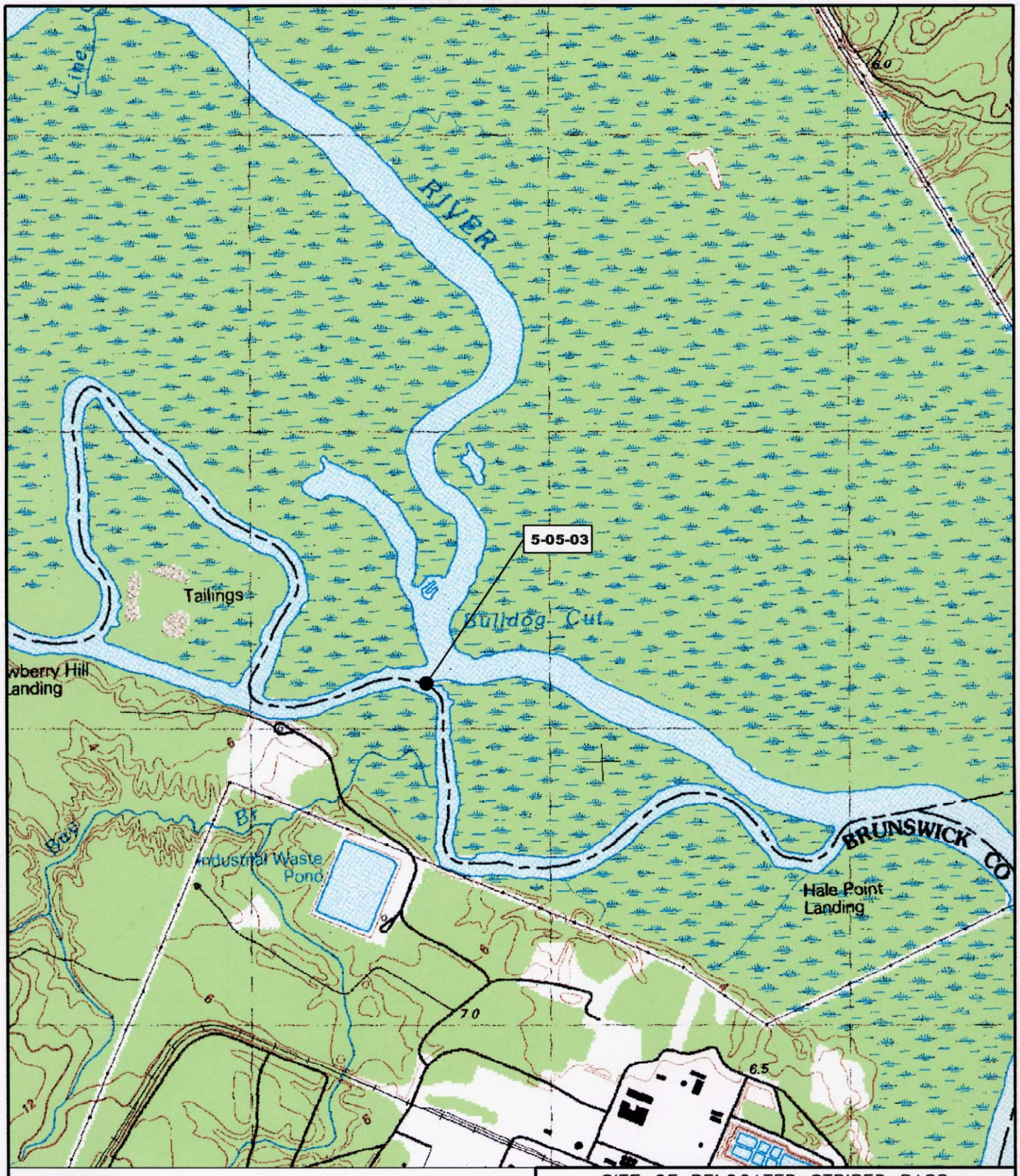
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-04-03
- SITE OF RELOCATED FISH

0 1500 3000

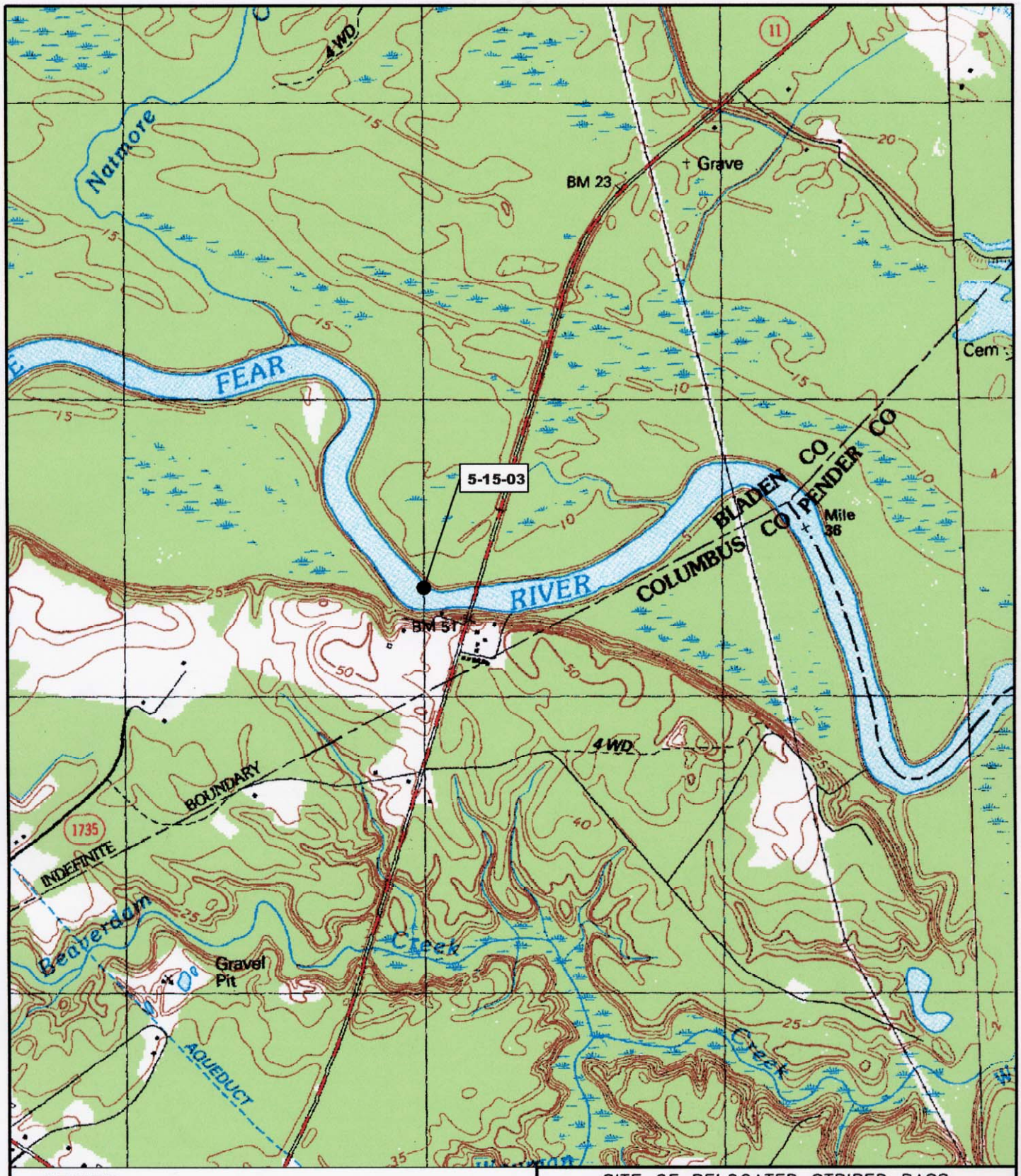
SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5103

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5103-03 |
| | | CP#1645.32 |
| | | 2 OF 3 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-04-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5103

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5103-03 |
| | | CP#1645.32 |
| | | 3 OF 3 |

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ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

**LEGEND**

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-04-03
- SITE OF RELOCATED FISH

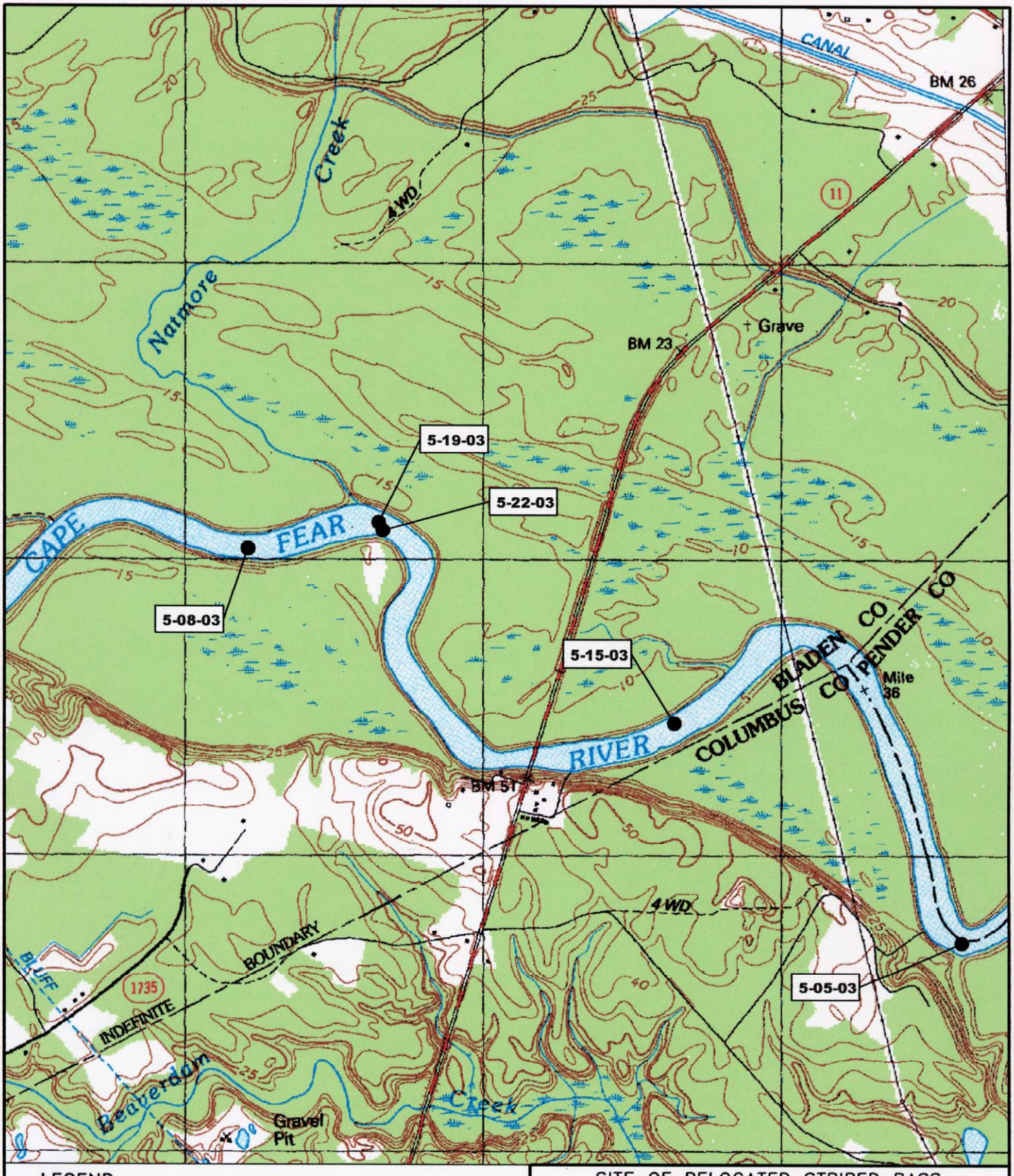
0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5104

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5104-03 |
| CZR INCORPORATED ENVIRONMENTAL CONSULTANTS | 4709 COLLEGE ACRES DRIVE SUITE 2 WILMINGTON, NORTH CAROLINA 28403 TEL 910/392-9253 FAX 910/392-9139 | CP#1645.32 |
| | | 1 OF 2 |




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-04-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5104

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 9/2/03 | | FILE: CZR5104-03 |
| | | CP#1645.32 |
| | | 2 OF 2 |

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ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
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FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-04-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5105

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5105-03 |
| | | CP#1645.32 |

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SUITE 2
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FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-04-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5106

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5106-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

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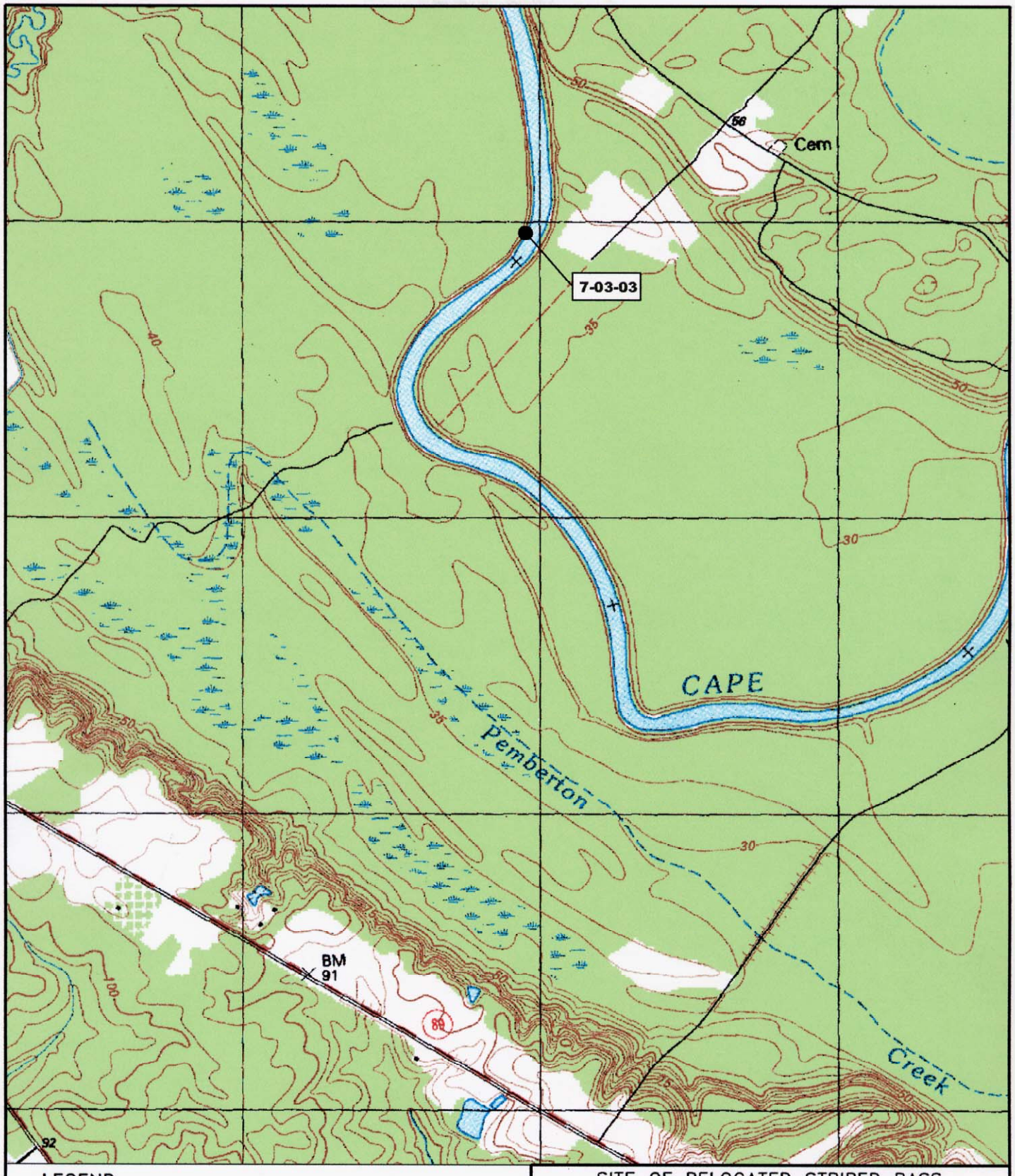
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-04-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5106

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5106-03 |
| | | CP#1645.32 |
| | | 2 OF 2 |

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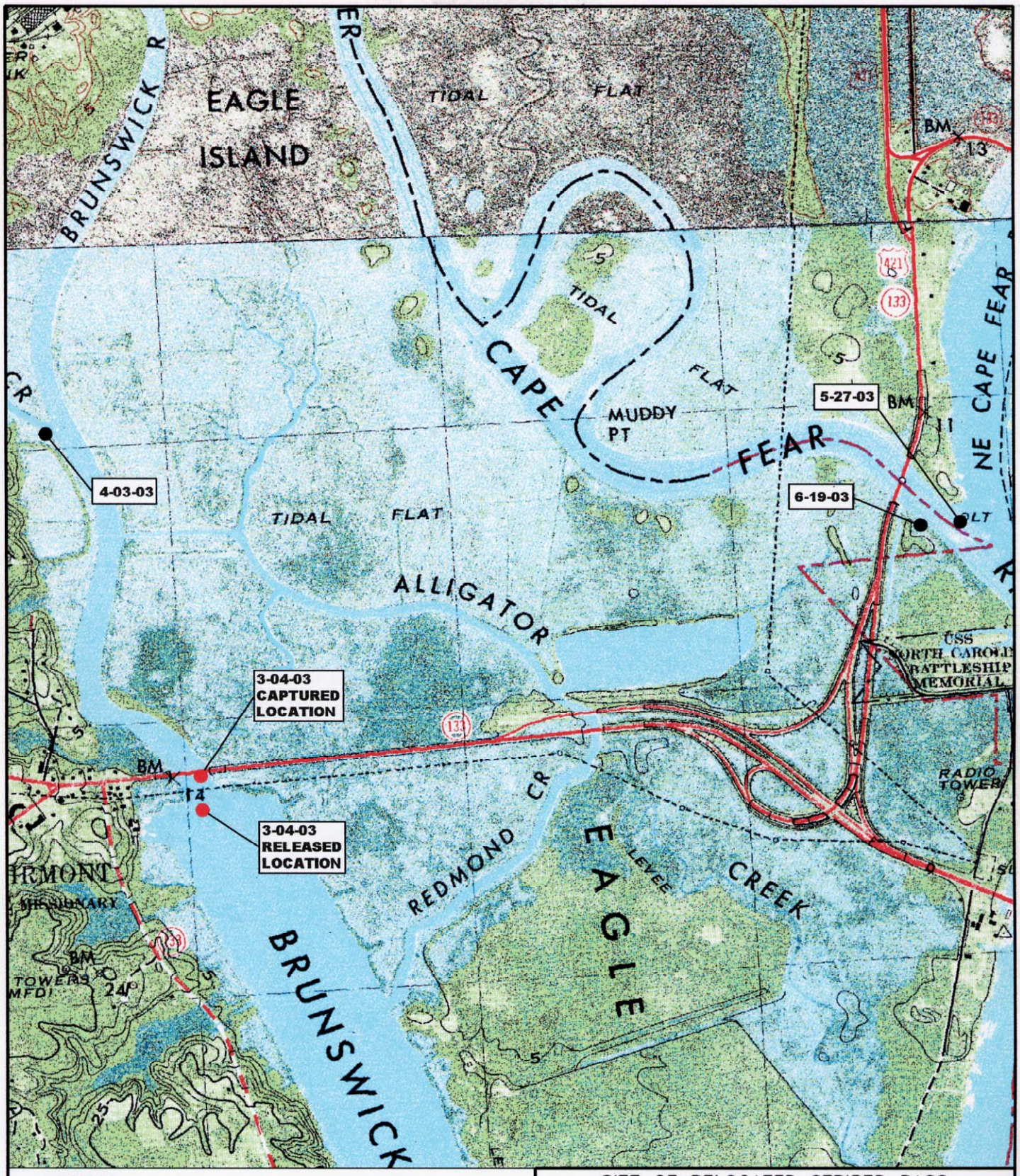
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-04-03
- SITE OF RELOCATED FISH

0 1600 3200

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5107

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5107-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS

4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-07-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5108

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5108-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-11-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5109

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5109-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

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ENVIRONMENTAL CONSULTANTS
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SUITE 2
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TEL 910/392-9253
FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-11-03
- SITE OF RELOCATED FISH

0 1500 3000

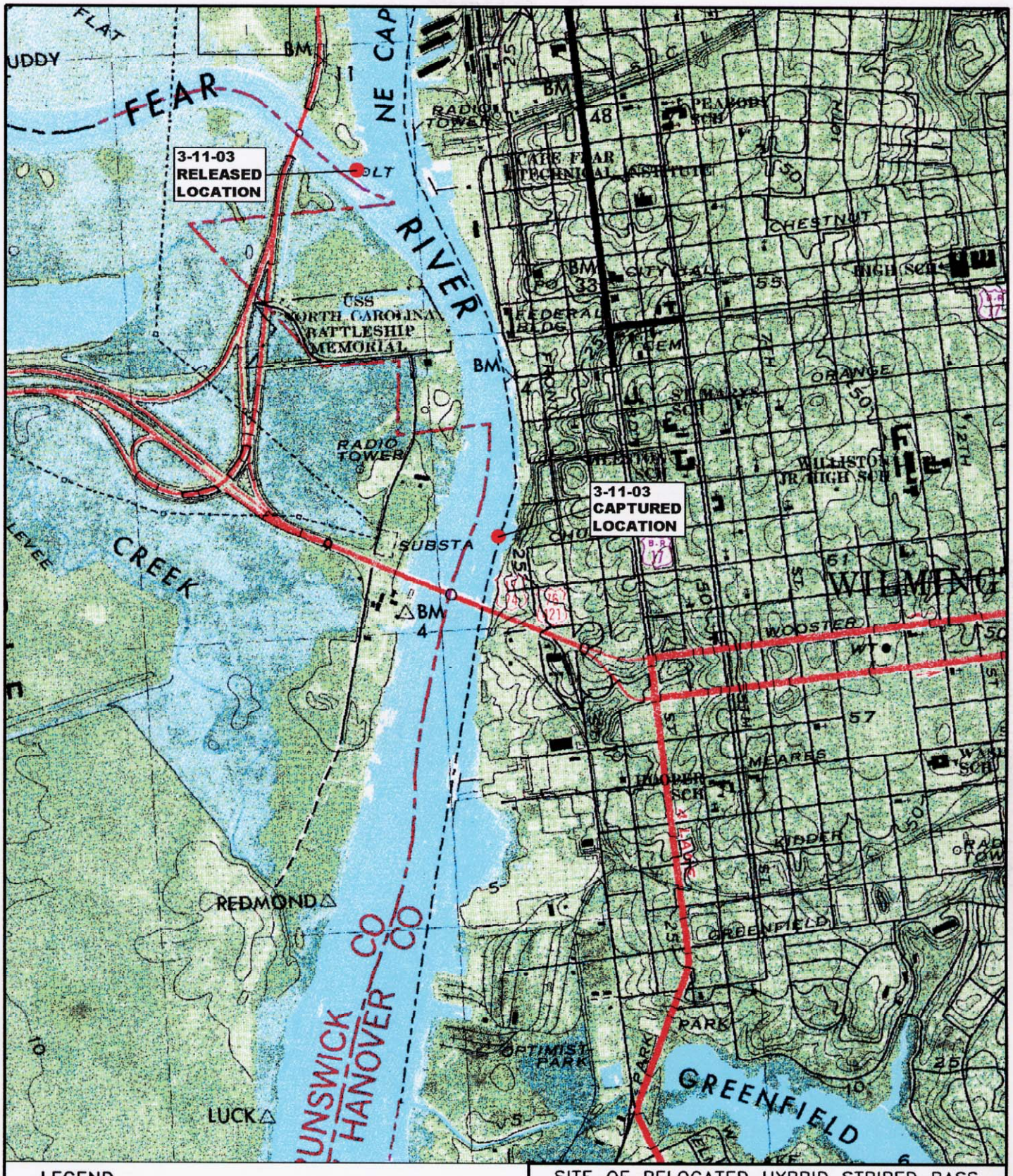
SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5109

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5109-03 |
| | | CP#1645.32 |
| | | 2 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-3139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-11-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED HYBRID STRIPED BASS
CZR5110

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5110-03 |
| | | CP#1645.32 |

CZR INCORPORATED
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4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-12-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5111

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 9/2/03 | | FILE: CZR5111-03 |
| | | CP#1645.32 |

CZR INCORPORATED ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-12-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5112

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 9/2/03 | | FILE: CZR5112-03 |
| | | CP#1645.32 |

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SUITE 2
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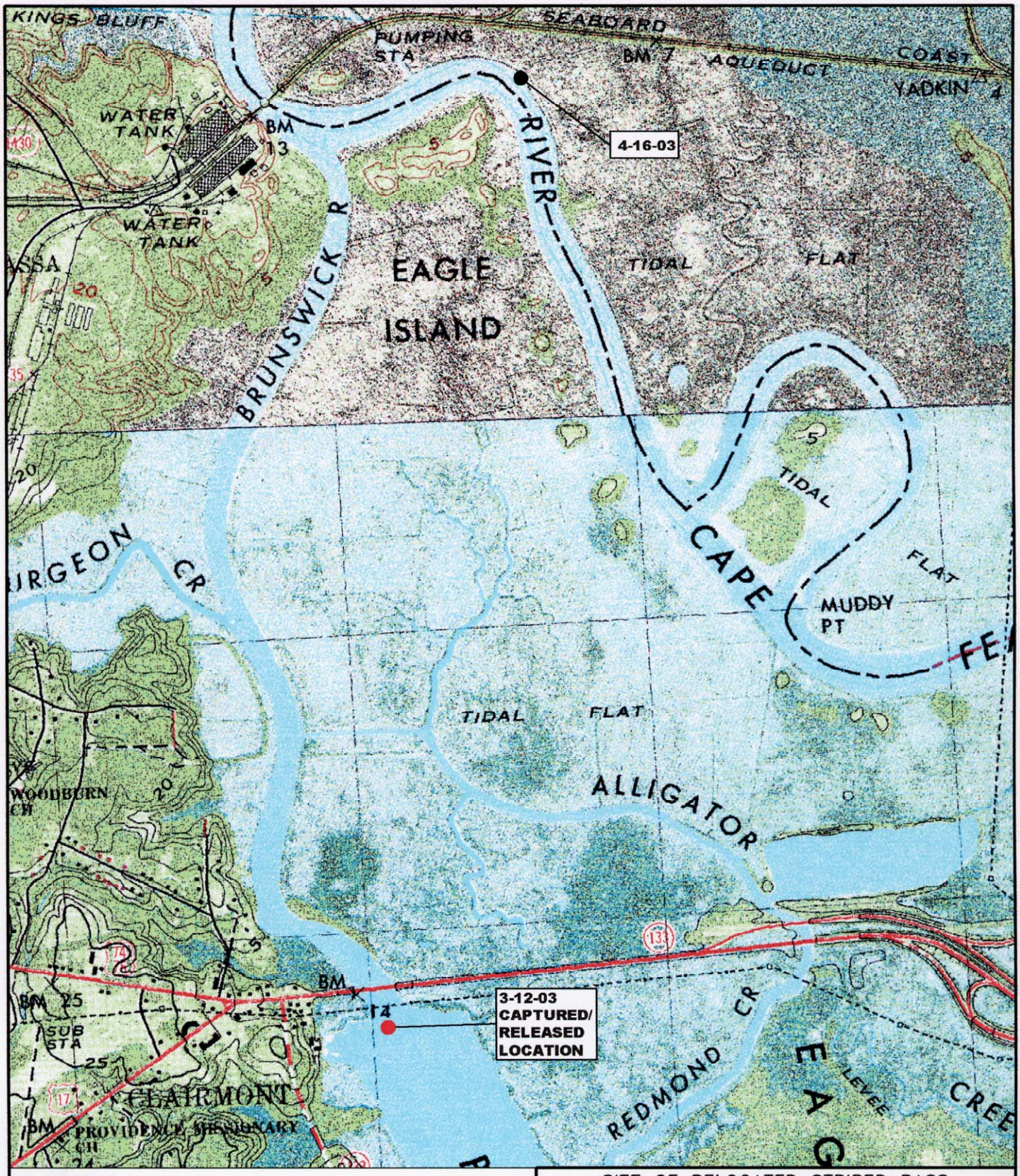


LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-12-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5113

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5113-03 |
| | | CP#1645.32 |

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ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
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TEL 910/392-9253
FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-12-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5114

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5114-03 |
| | | CP#1645.32 |

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ENVIRONMENTAL CONSULTANTS

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SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-13-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5115

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5115-03 |
| | | CP#1645.32 |

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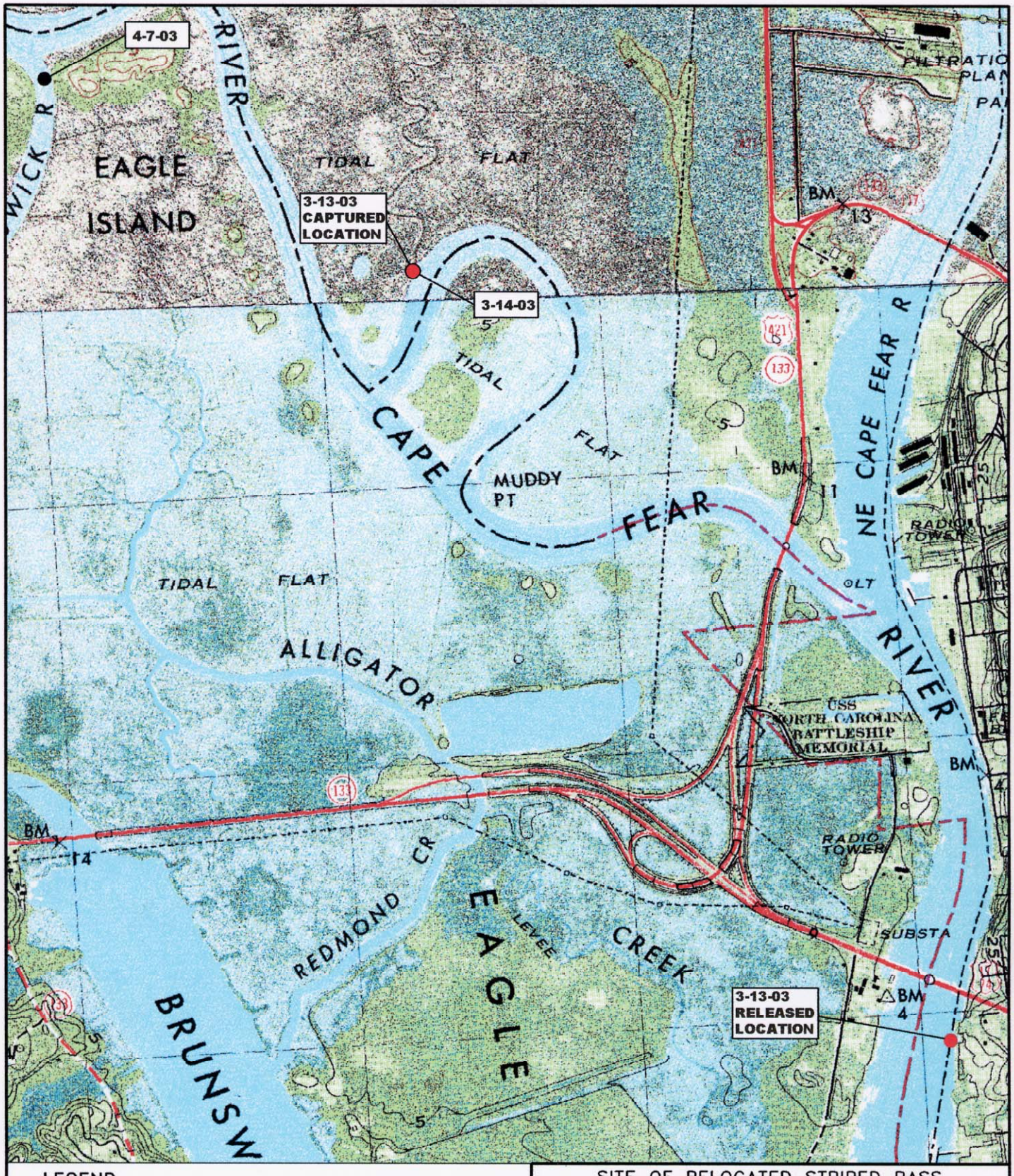
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-13-03
- SITE OF RELOCATED FISH

0 1600 3200

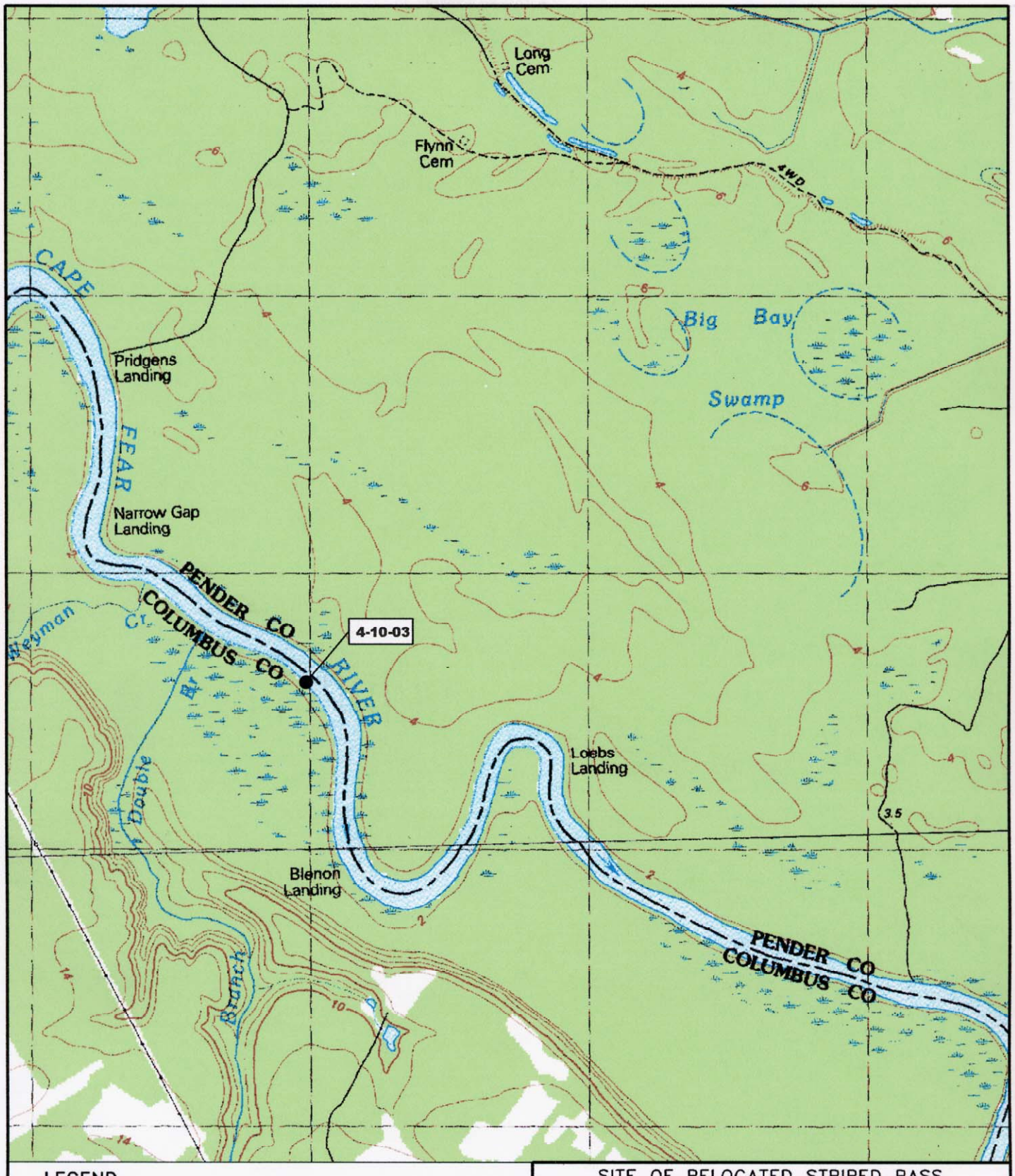
SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5116

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5116-03 |
| | | CP#1645.32 |
| | | 1 OF 3 |

CZR INCORPORATED ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-13-03
- SITE OF RELOCATED FISH

0 1600 3200

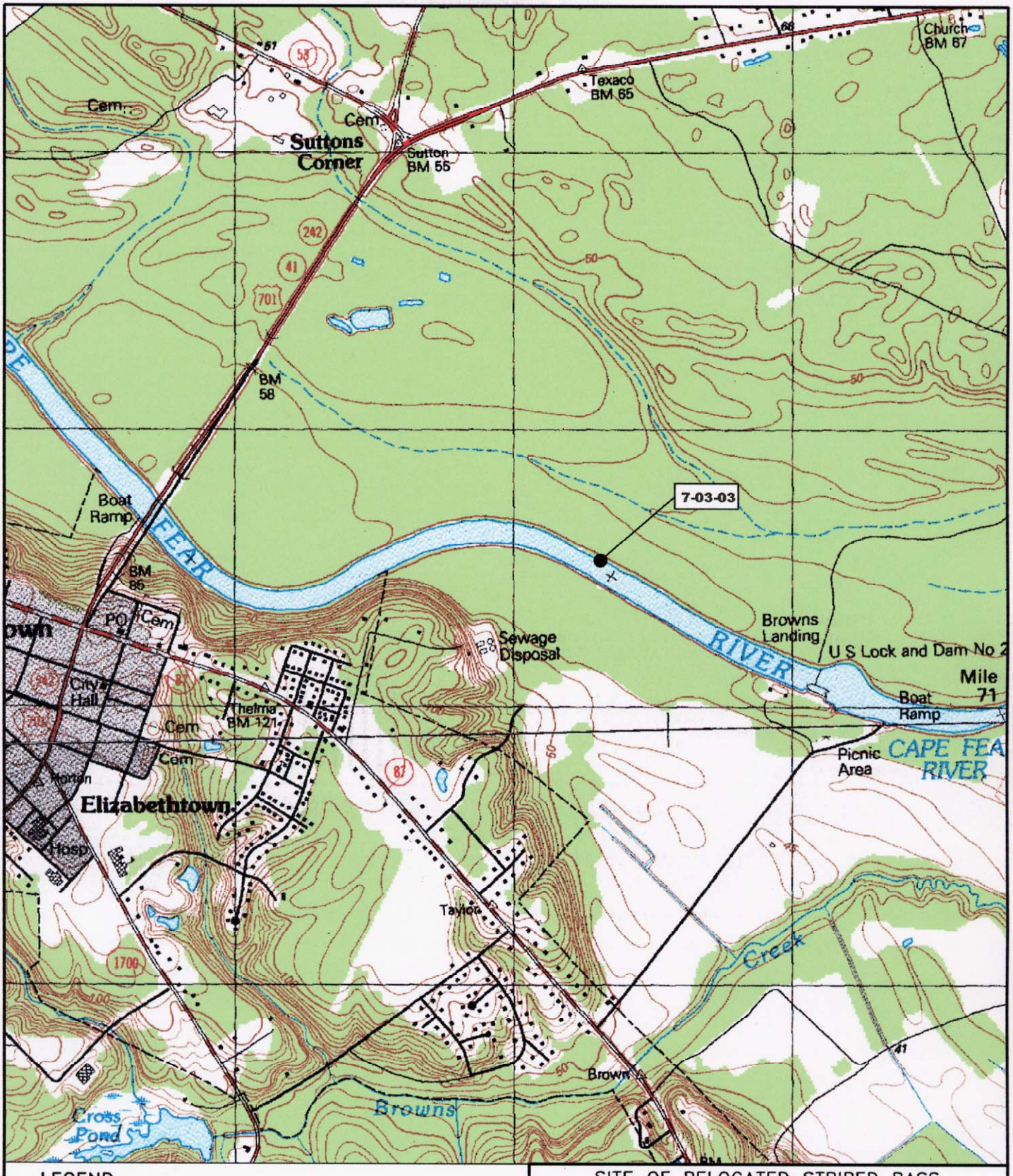
SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5116

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5116-03 |
| | | CP#1645.32 |
| | | 2 OF 3 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-13-03
- SITE OF RELOCATED FISH

0 1600 3200

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5116

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5116-03 |
| | | CP#1645.32 |
| | | 3 OF 3 |

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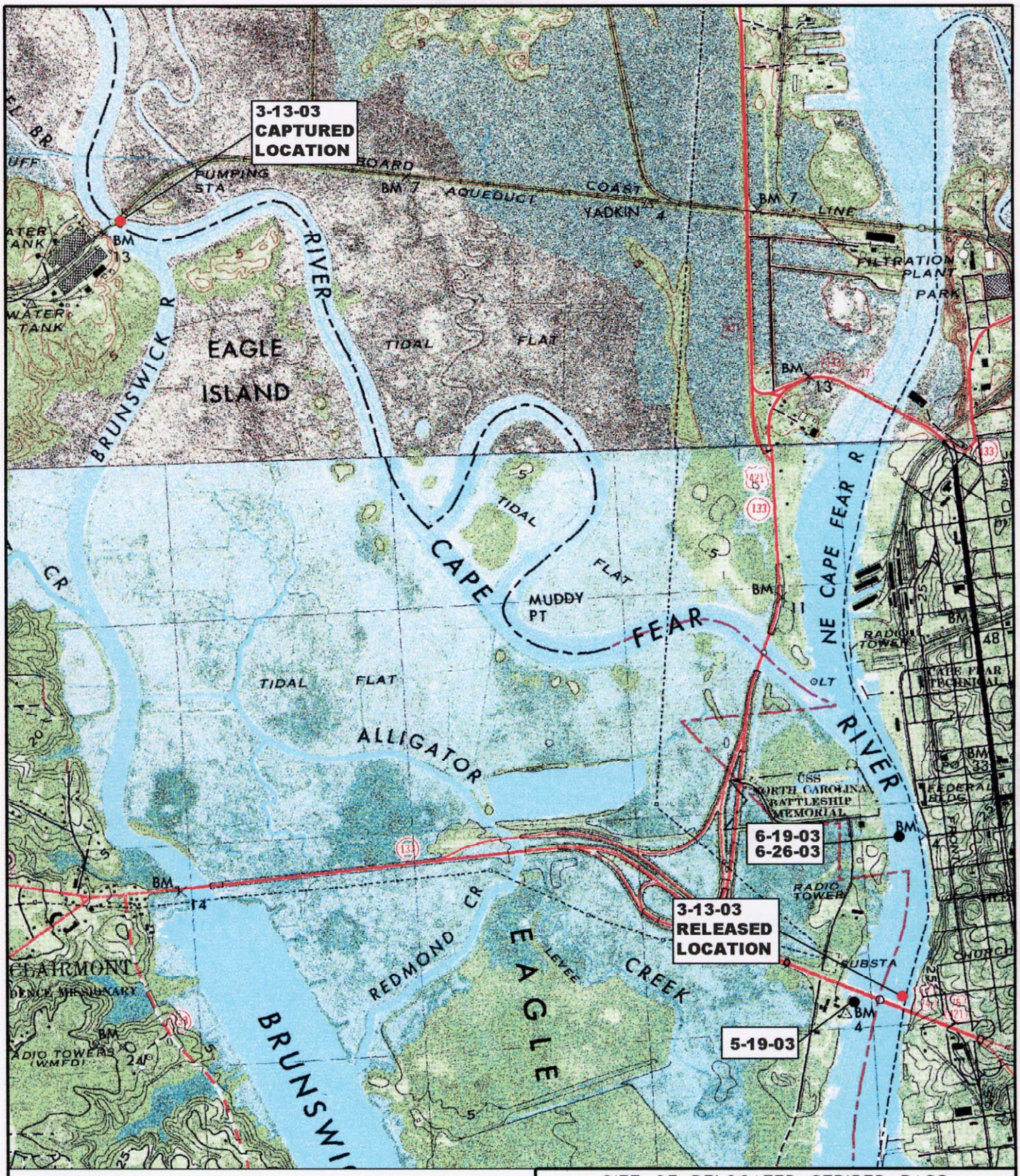
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-13-03
- SITE OF RELOCATED FISH

0 2000 4000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5117

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5117-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-18-03
- SITE OF RELOCATED FISH

0 3000 6000

SCALE IN FEET

SITE OF RELOCATED HYBRID STRIPED BASS
CZR5118

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5118-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

**LEGEND**

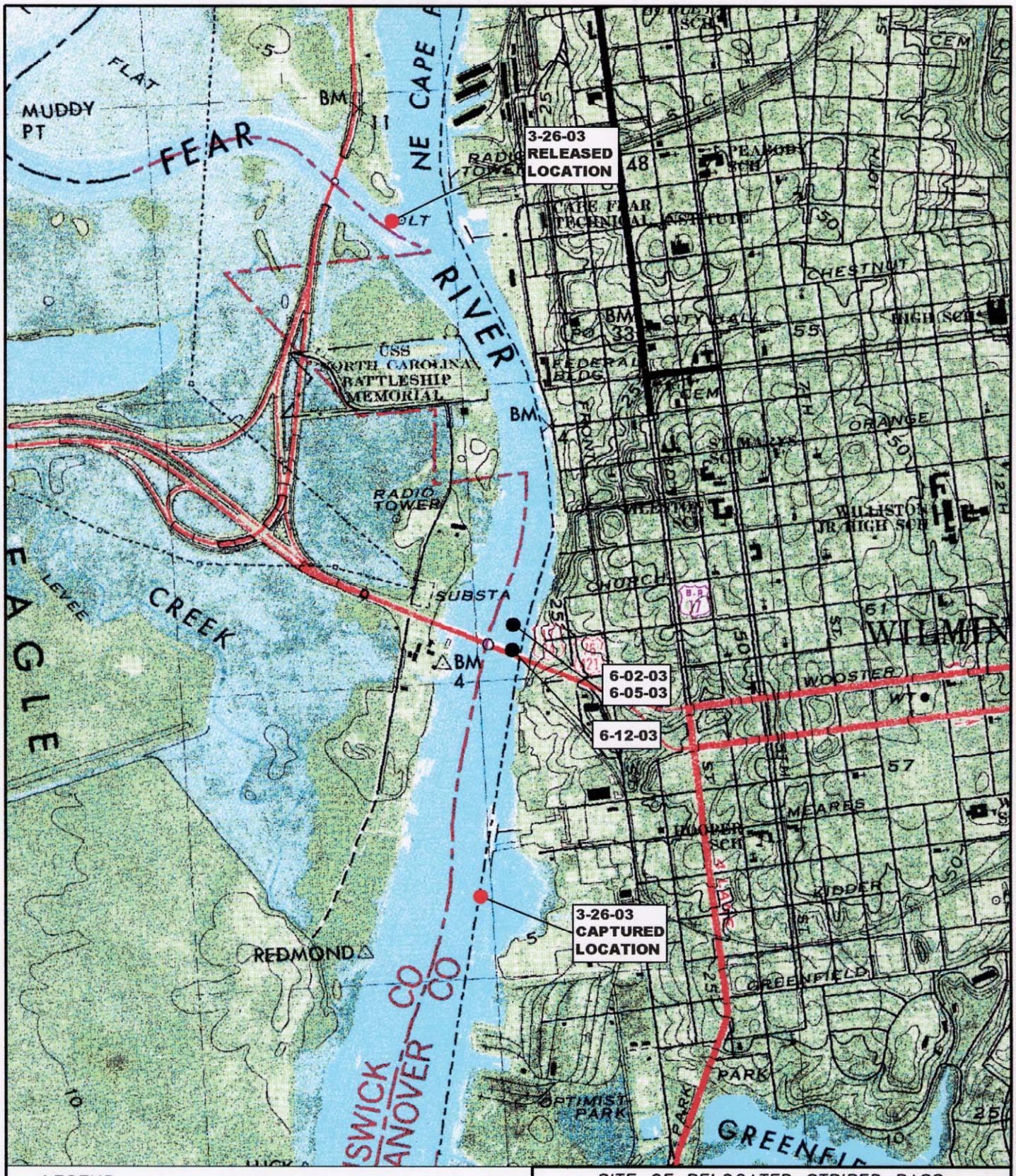
- **CAPTURE AND RELEASE OF TAGGED FISH ON 3-18-03**
- **SITE OF RELOCATED FISH**

0 3000 6000

SITE OF RELOCATED HYBRID STRIPED BASS
CZR5118

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5118-03 |
| CZR INCORPORATED ENVIRONMENTAL CONSULTANTS | 4709 COLLEGE ACRES DRIVE SUITE 2 WILMINGTON, NORTH CAROLINA 28403 TEL 910/392-9253 FAX 910/392-9139 | CP#1645.32 |
| | | 2 OF 2 |




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-26-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5119

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5119-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS

4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-26-03
- SITE OF RELOCATED FISH

0 1500 3000

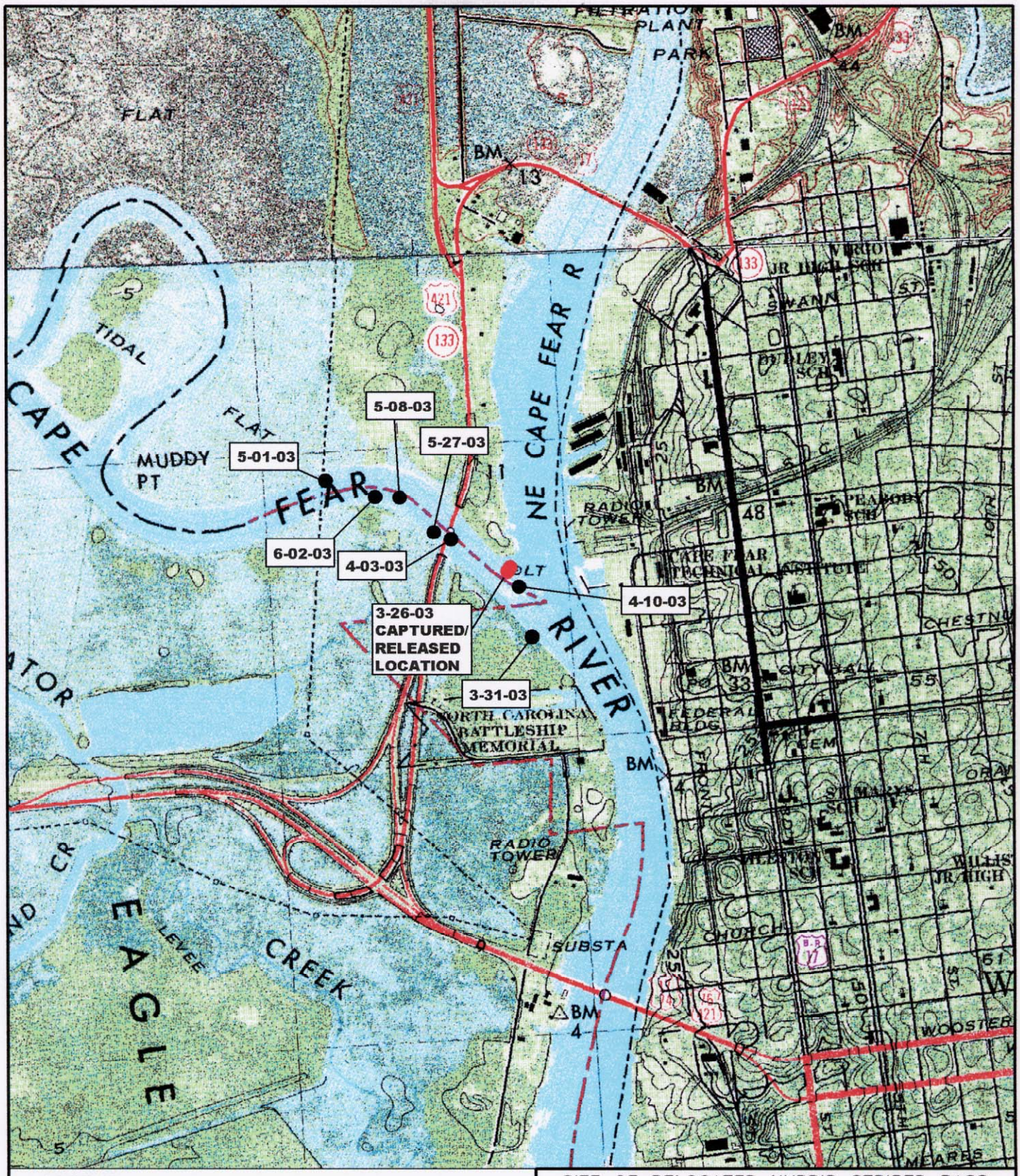
SCALE IN FEET

SITE OF RELOCATED STRIPED BASS
CZR5120

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5120-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




**LEGEND**

- ● CAPTURE AND RELEASE OF TAGGED FISH ON 3-26-03
- ● SITE OF RELOCATED FISH

0 1500 3000

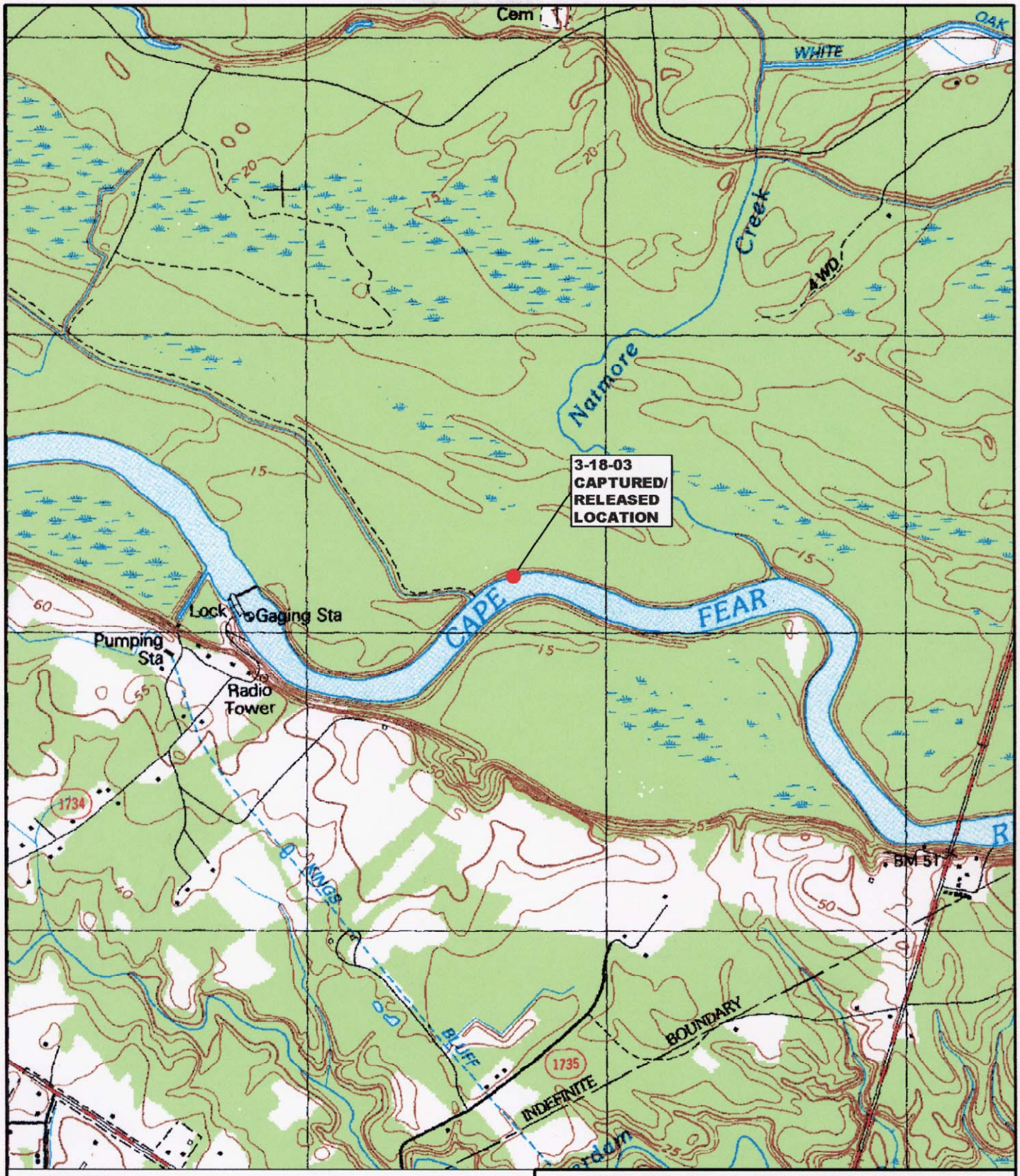
SCALE IN FEET

SITE OF RELOCATED HYBRID STRIPED BASS
CZR5121

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5121-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-18-03
- SITE OF RELOCATED FISH

0 1500 3000

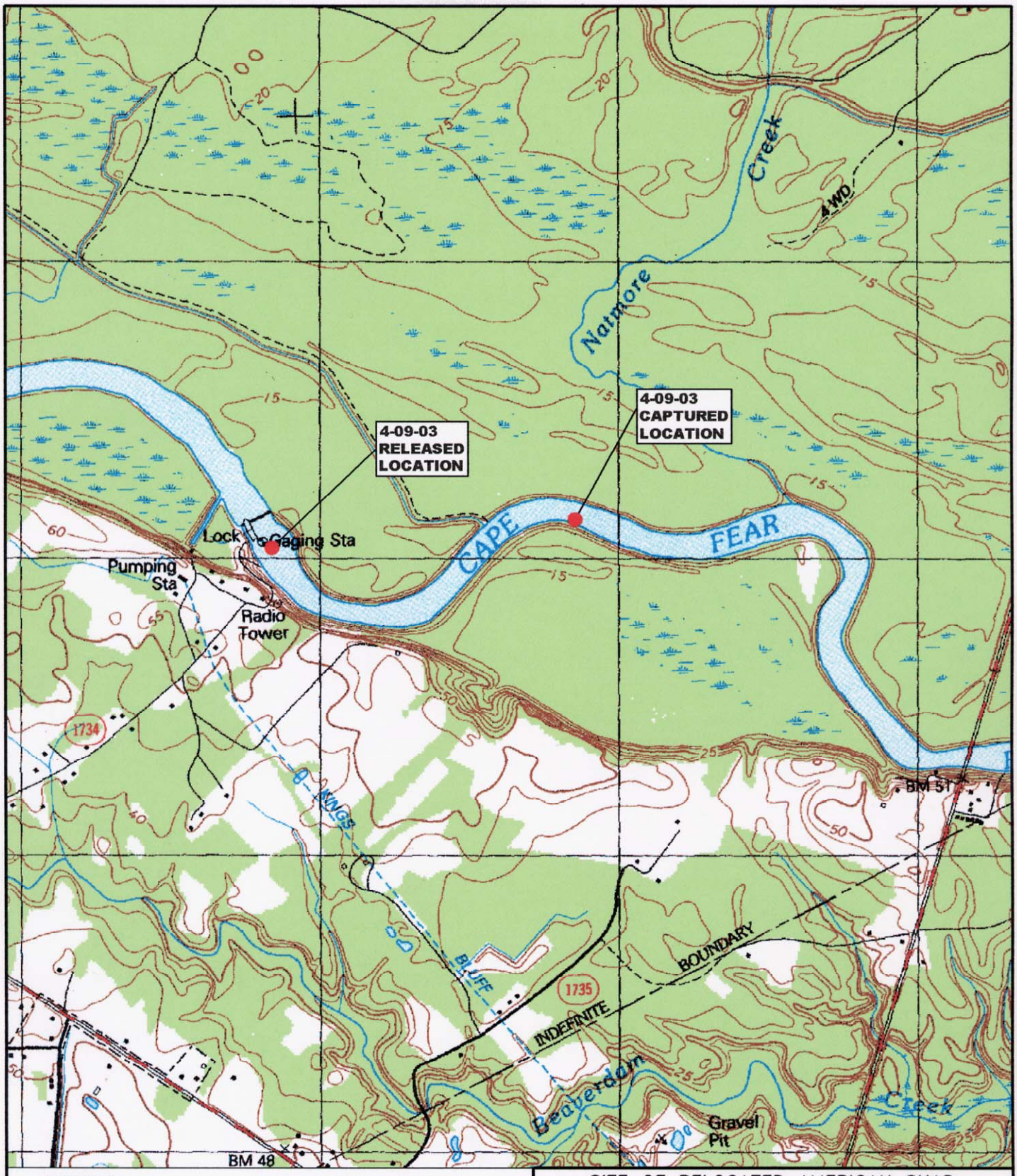
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5131

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5131-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9136




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-09-03
- SITE OF RELOCATED FISH

0 1500 3000

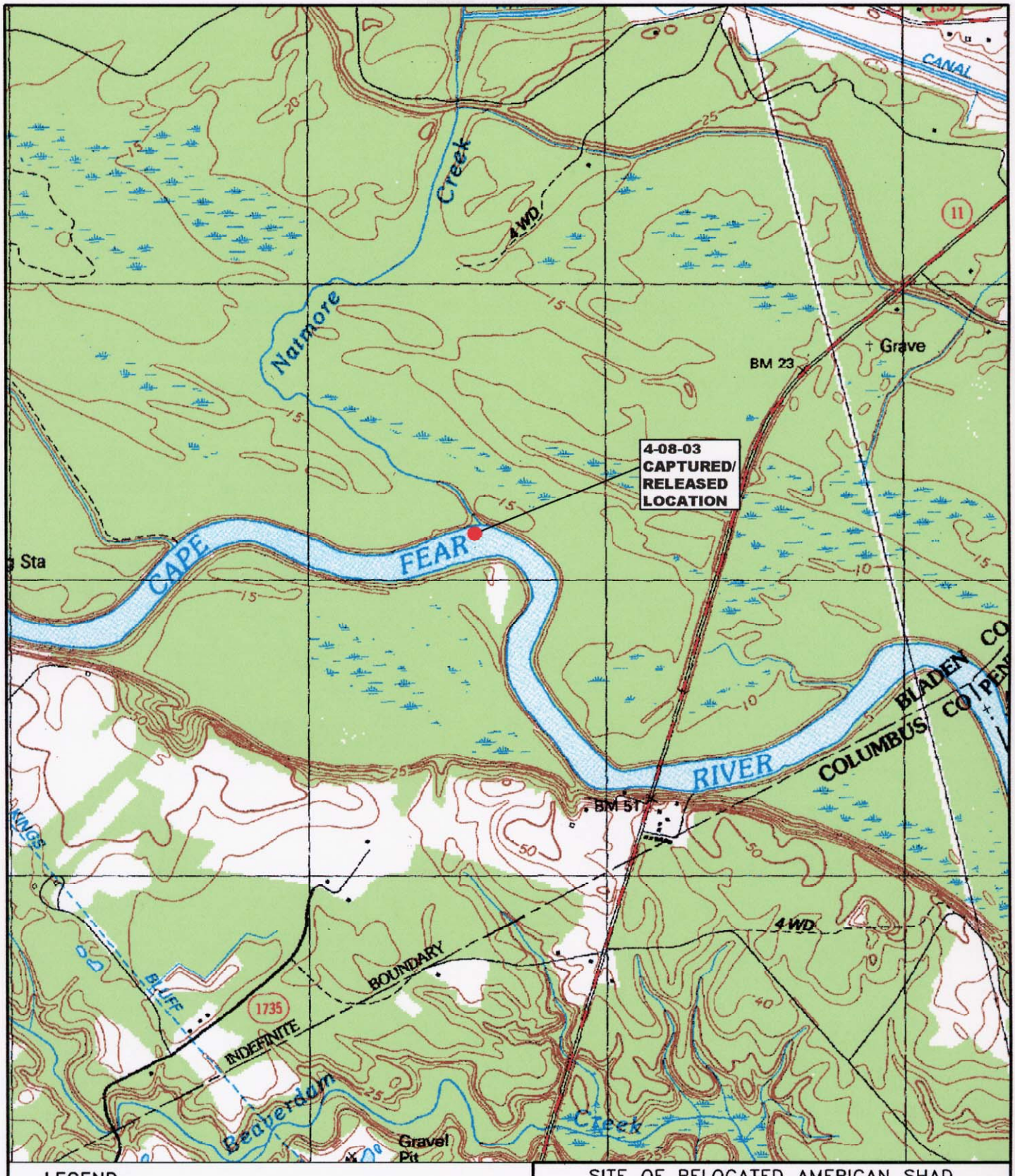
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5132

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5132-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-08-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5133

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5133-03 |
| | | CP#1645.32 |

CZR INCORPORATED
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4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-09-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

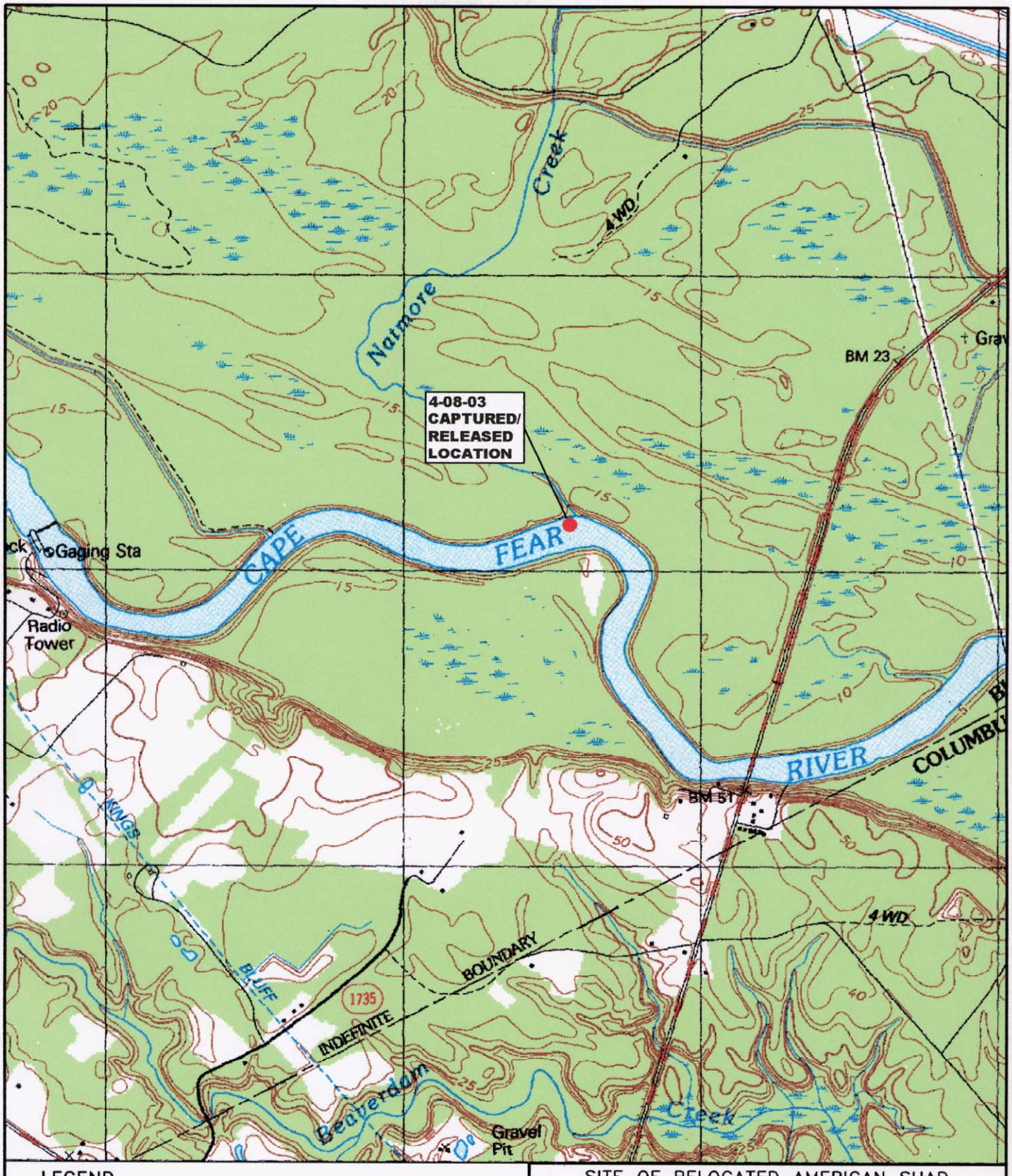
SITE OF RELOCATED AMERICAN SHAD
CZR5134

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5134-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS

4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-08-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5135

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5135-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS

4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-09-03
- SITE OF RELOCATED FISH

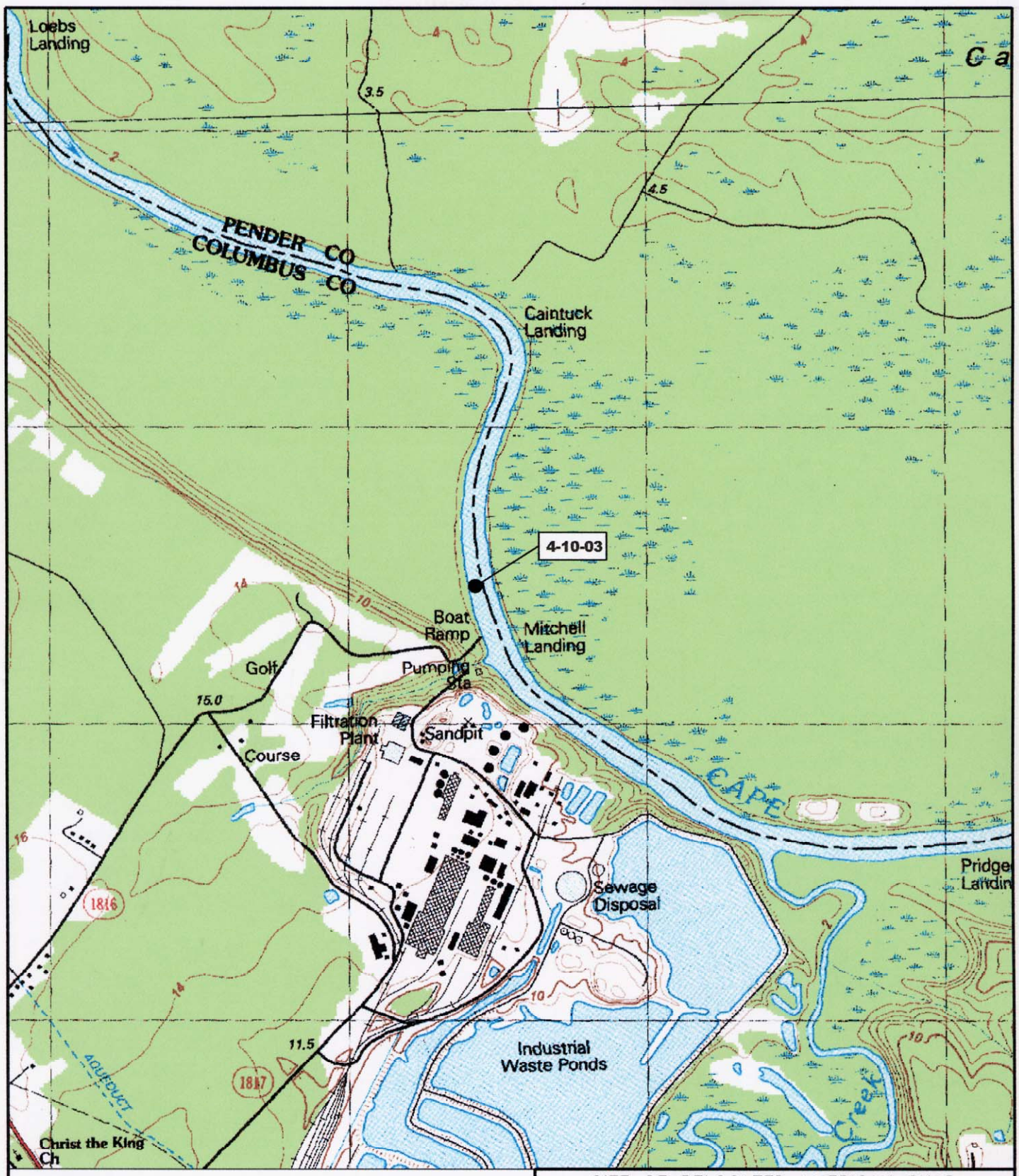
0 1500 3000

SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5136

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5136-03 |
| CZR INCORPORATED ENVIRONMENTAL CONSULTANTS | 4709 COLLEGE ACRES DRIVE SUITE 2 WILMINGTON, NORTH CAROLINA 28403 TEL 910/392-9253 FAX 910/392-9139 | CP#1645.32 |
| | | 1 OF 2 |




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-09-03
- SITE OF RELOCATED FISH

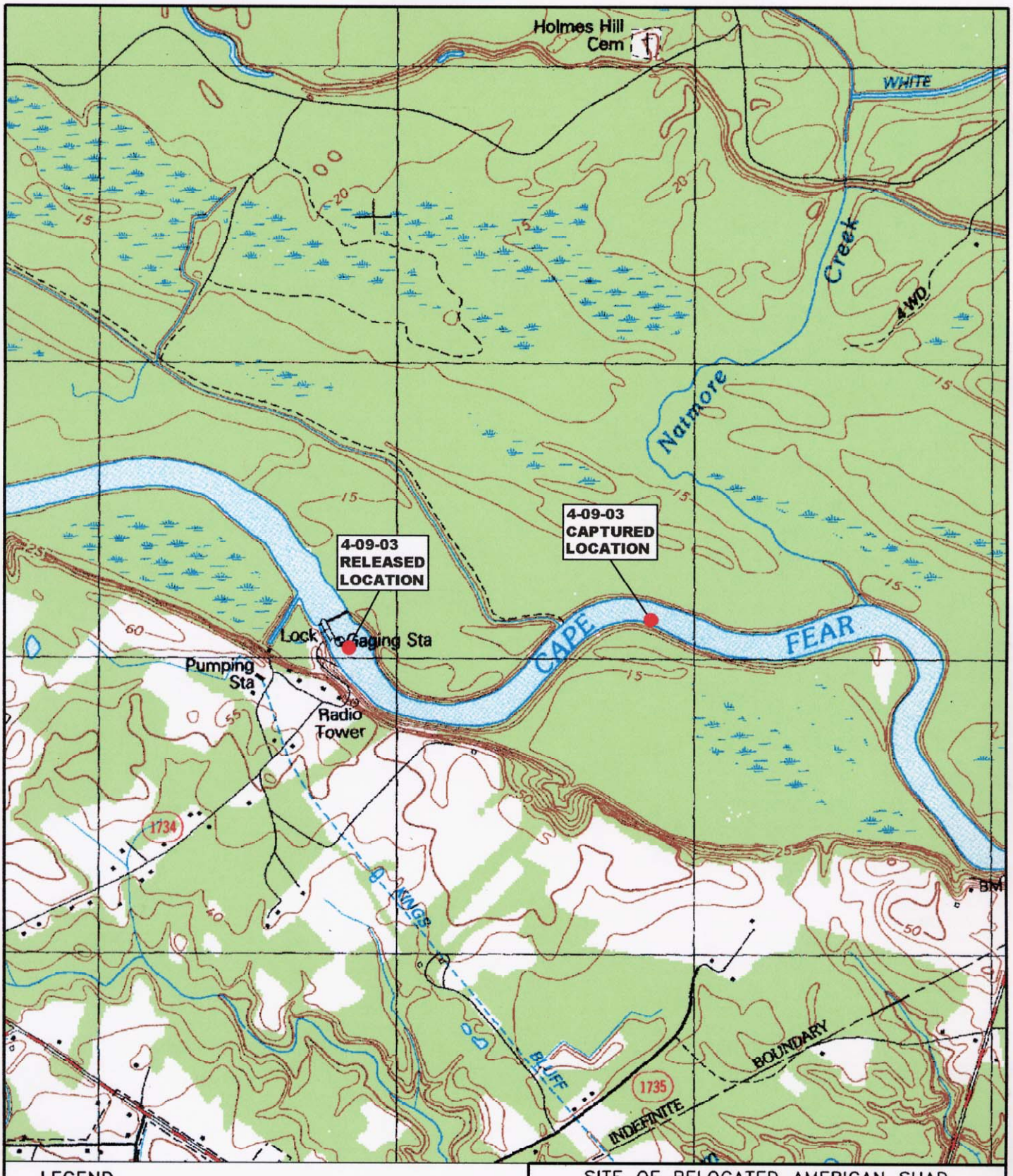
0 1500 3000

SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5136

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5136-03 |
| CZR INCORPORATED ENVIRONMENTAL CONSULTANTS | 4709 COLLEGE ACRES DRIVE SUITE 2 WILMINGTON, NORTH CAROLINA 28403 TEL 910/392-9253 FAX 910/392-9139 | CP#1645.32 |
| | | 2 OF 2 |




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-09-03
- SITE OF RELOCATED FISH

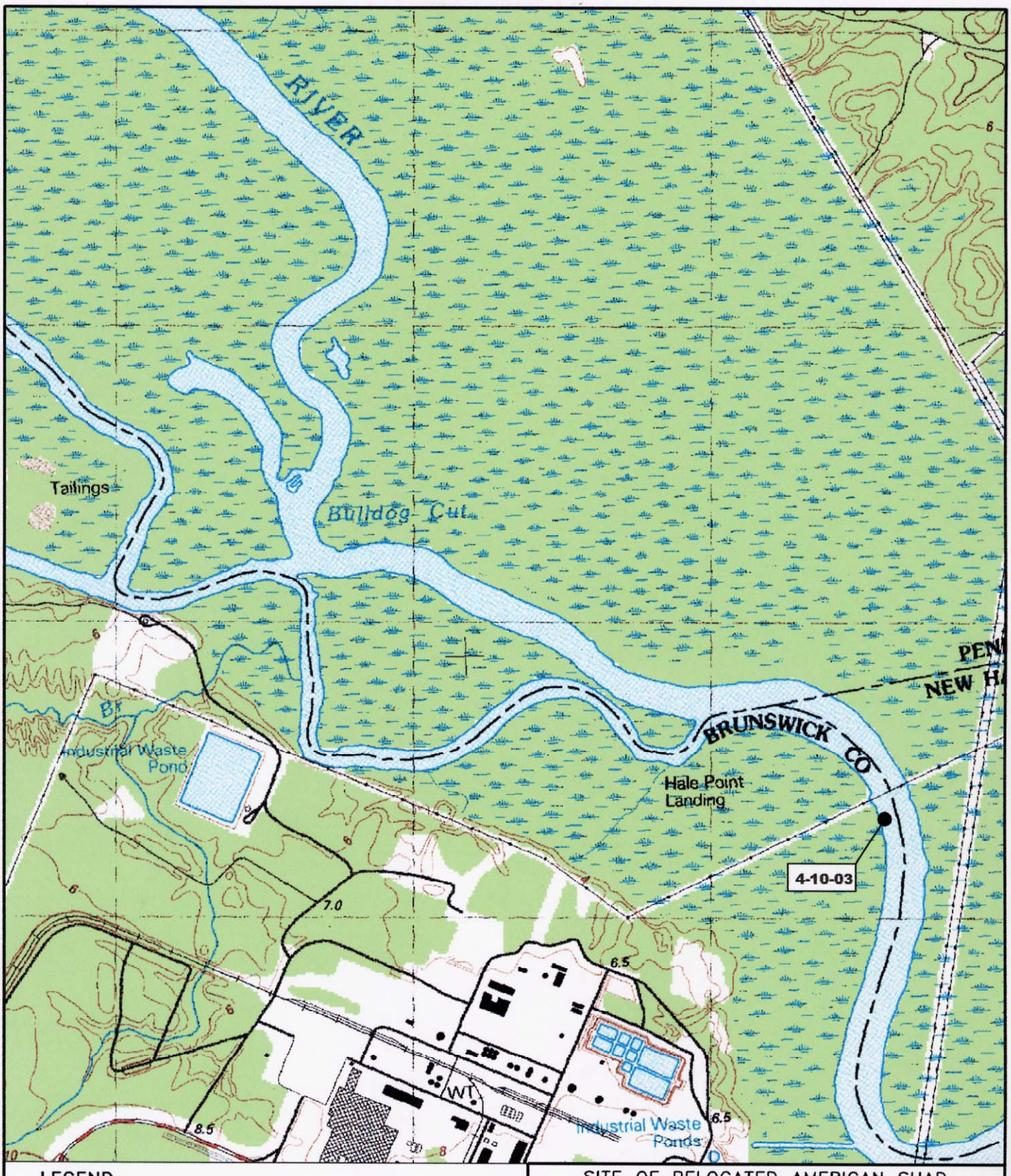
0 1500 3000

SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5137

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5137-03 |
| CZR INCORPORATED ENVIRONMENTAL CONSULTANTS | 4709 COLLEGE ACRES DRIVE SUITE 2 WILMINGTON, NORTH CAROLINA 28403 TEL 910/392-9253 FAX 910/392-9139 | CP#1645.32 |
| | | 1 OF 3 |




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-09-03
- SITE OF RELOCATED FISH

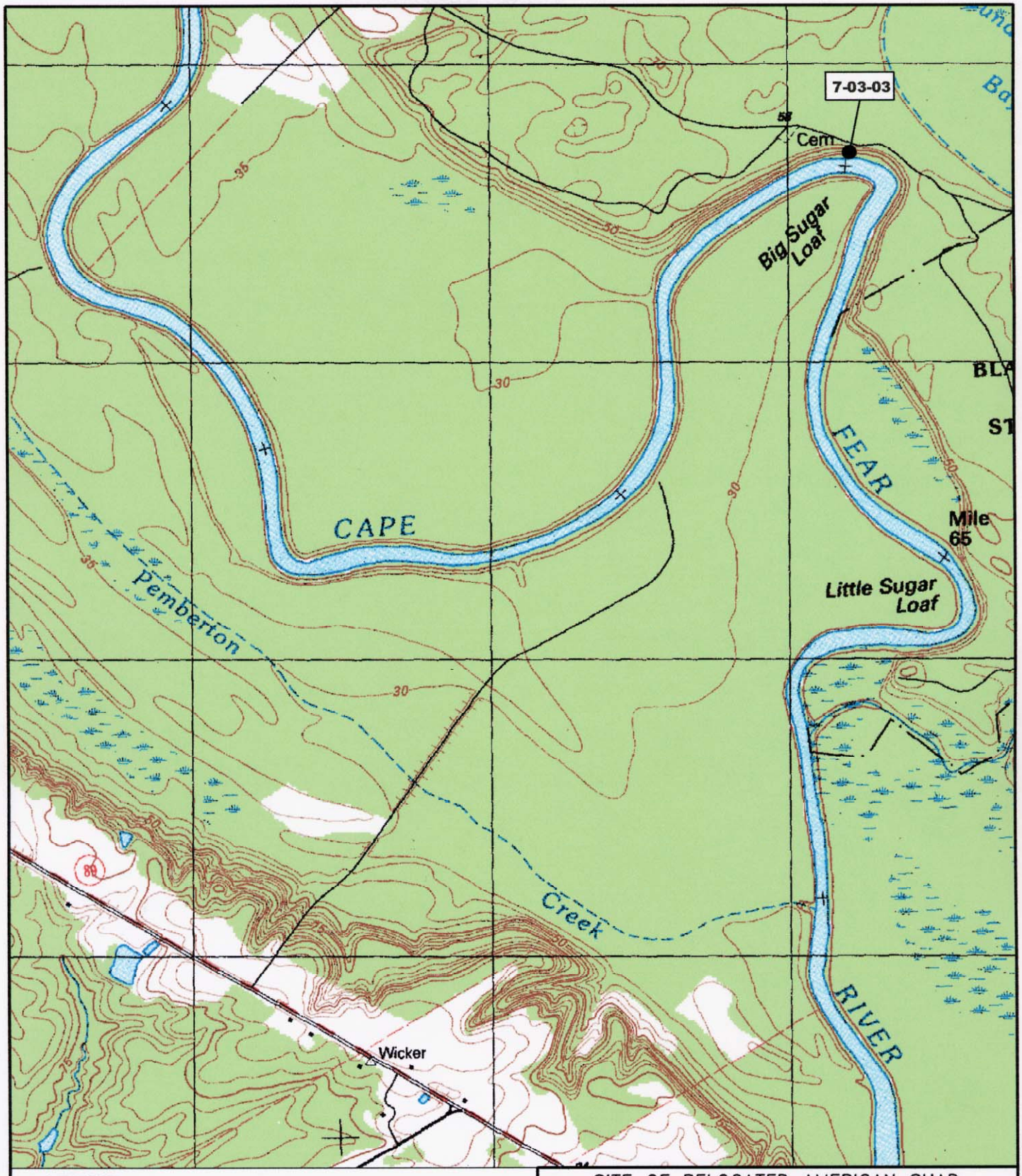
0 1500 3000

SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5137

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5137-03 |
| CZR INCORPORATED ENVIRONMENTAL CONSULTANTS | 4709 COLLEGE ACRES DRIVE SUITE 2 WILMINGTON, NORTH CAROLINA 28403 TEL 910/392-9253 FAX 910/392-9139 | CP#1645.32 |
| | | 2 OF 3 |




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-09-03
- SITE OF RELOCATED FISH

0 1500 3000

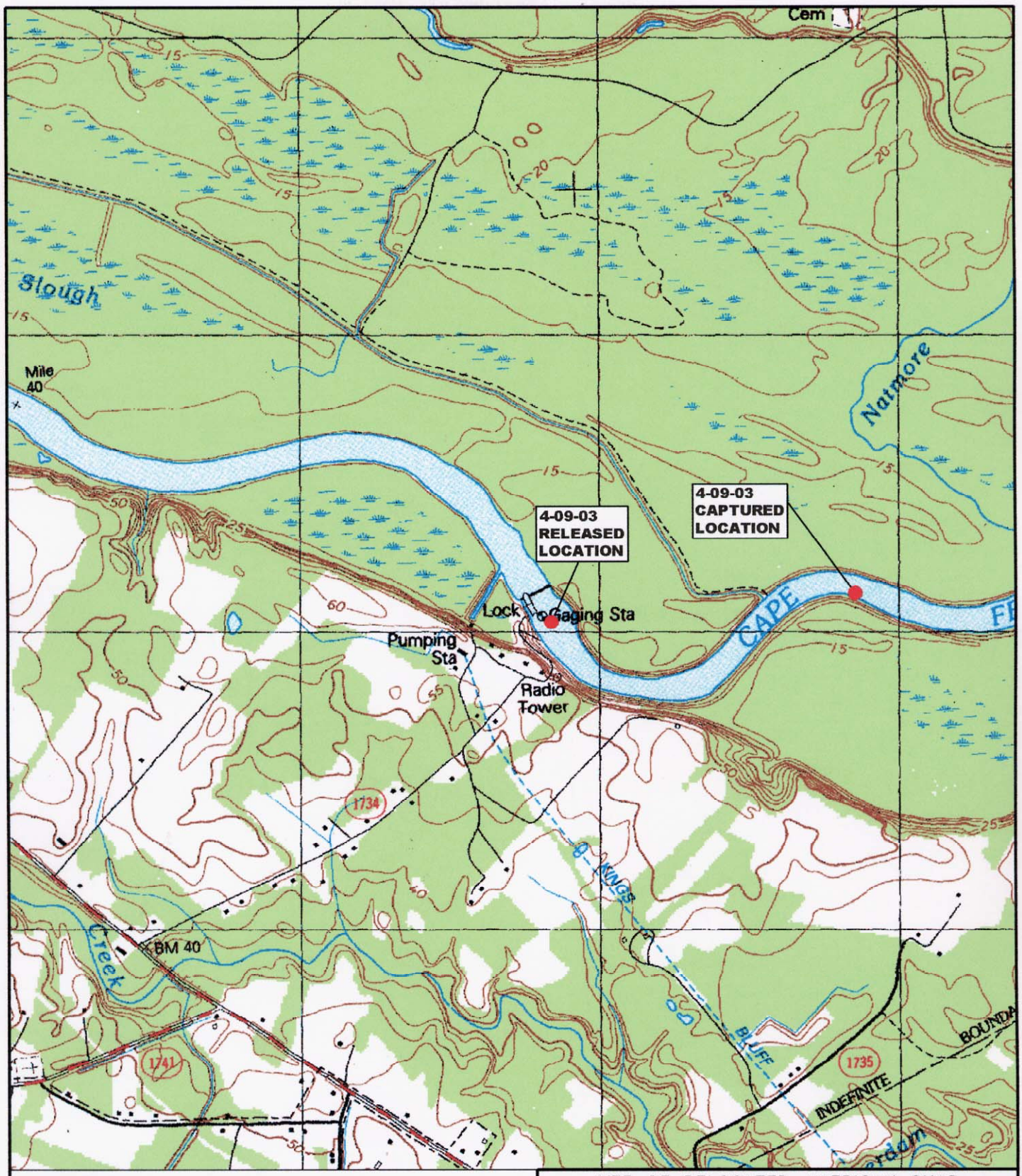
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5137

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5137-03 |
| | | CP#1645.32 |
| | | 3 OF 3 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-09-03
- SITE OF RELOCATED FISH

0 1500 3000

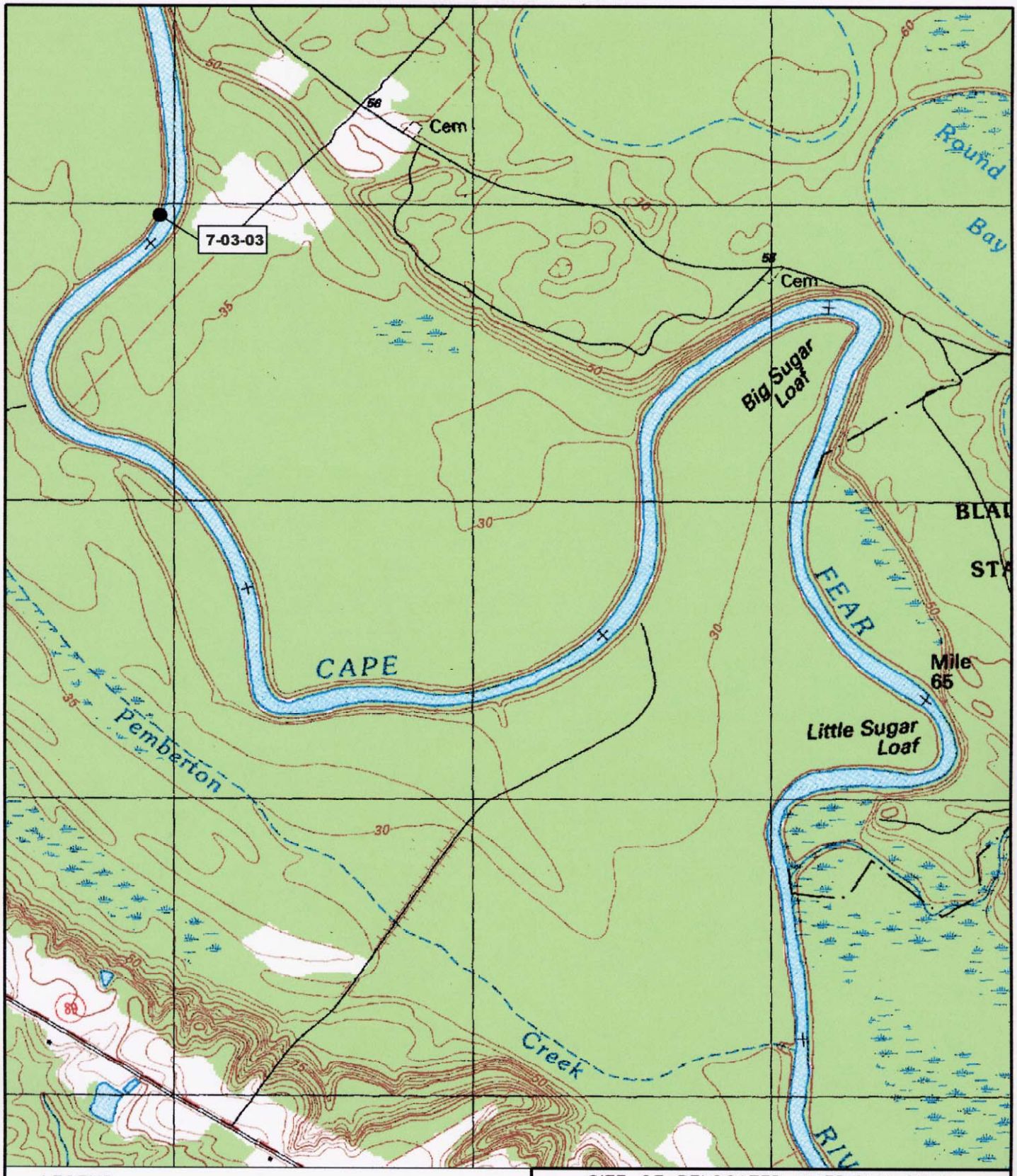
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5138

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5138-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-09-03
- SITE OF RELOCATED FISH

0 1500 3000

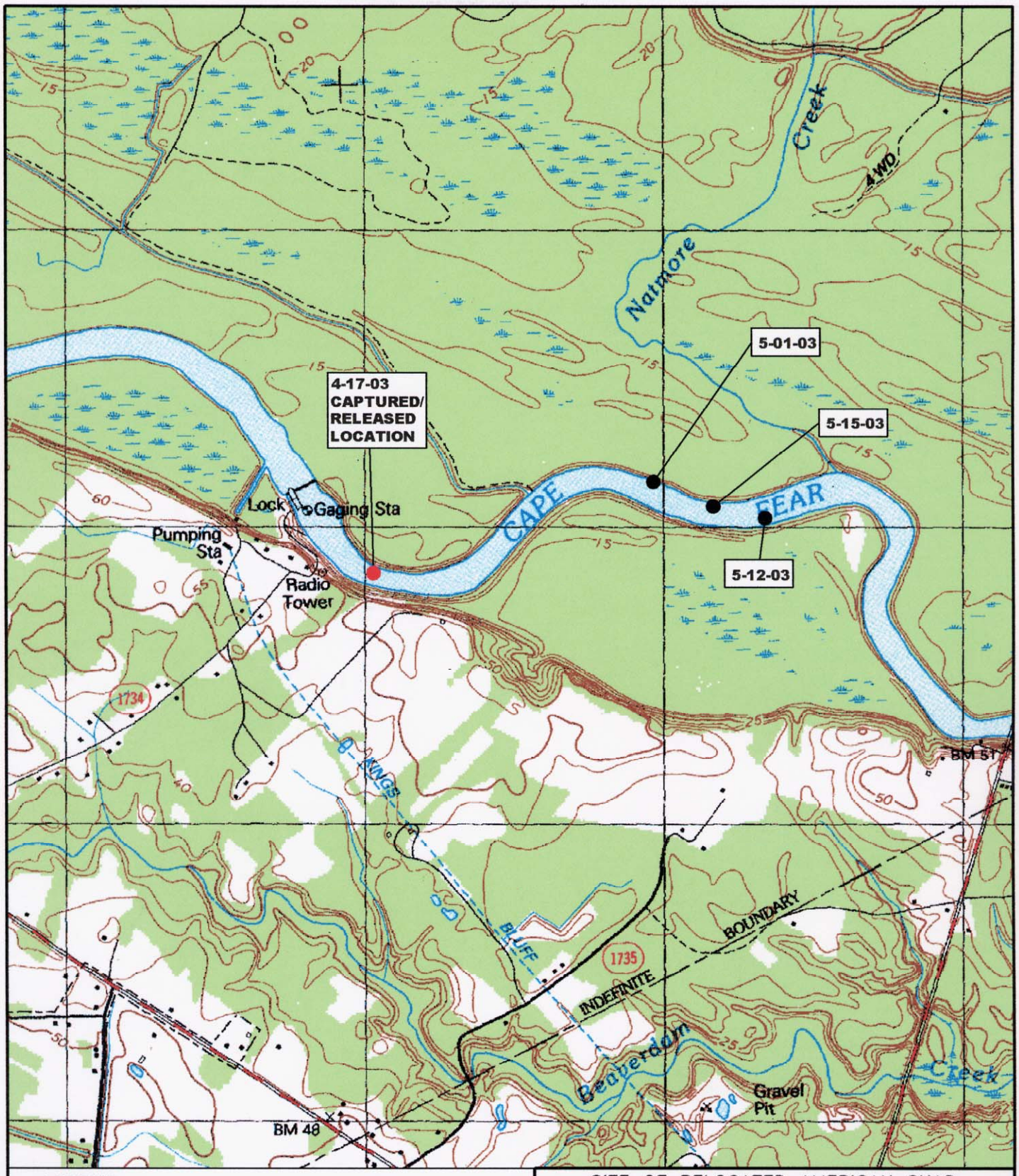
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5138

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5138-03 |
| | | CP#1645.32 |
| | | 2 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-17-03
- SITE OF RELOCATED FISH

0 1500 1000

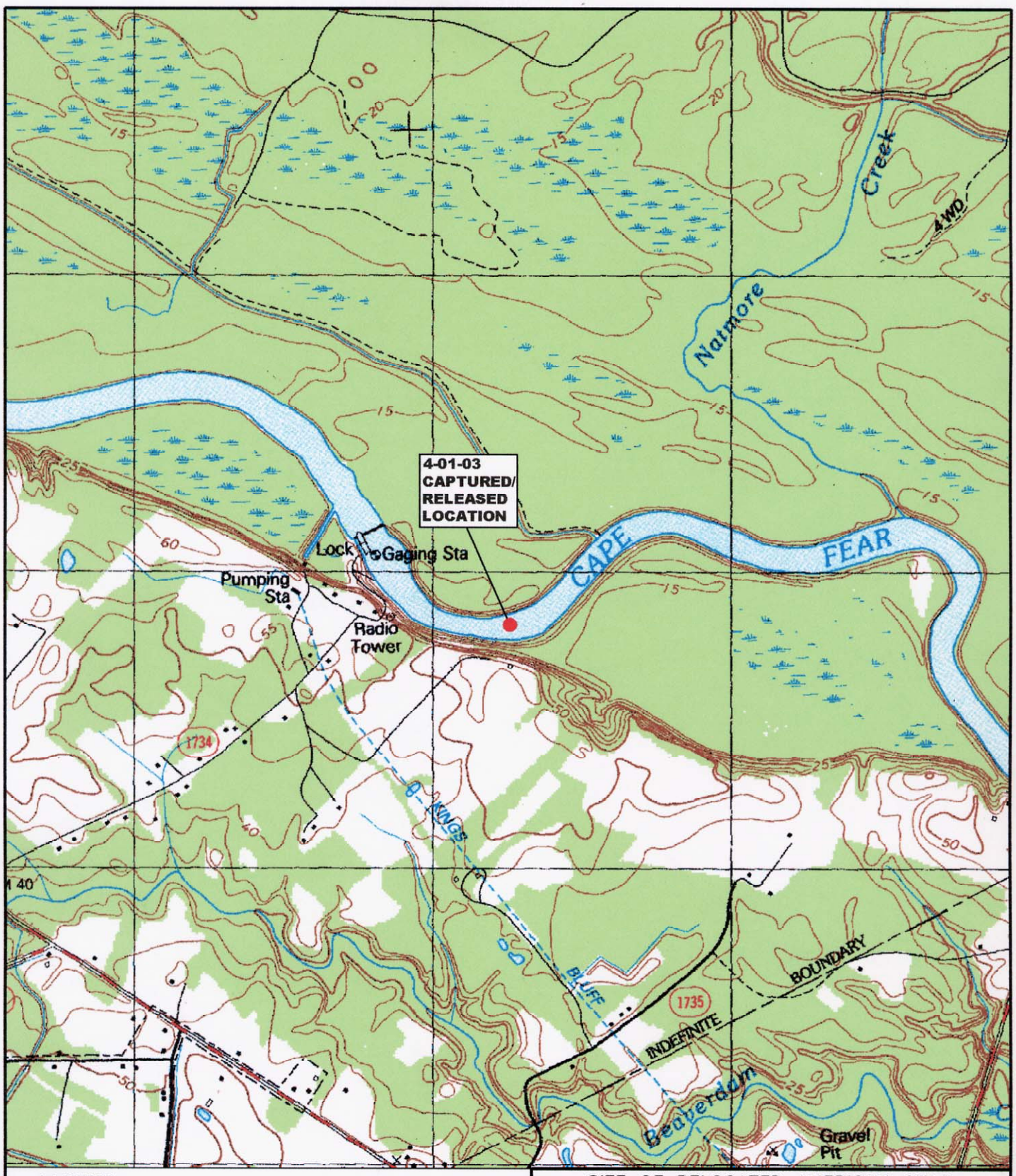
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5139

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5139-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-01-03
- SITE OF RELOCATED FISH

0 1500 3000

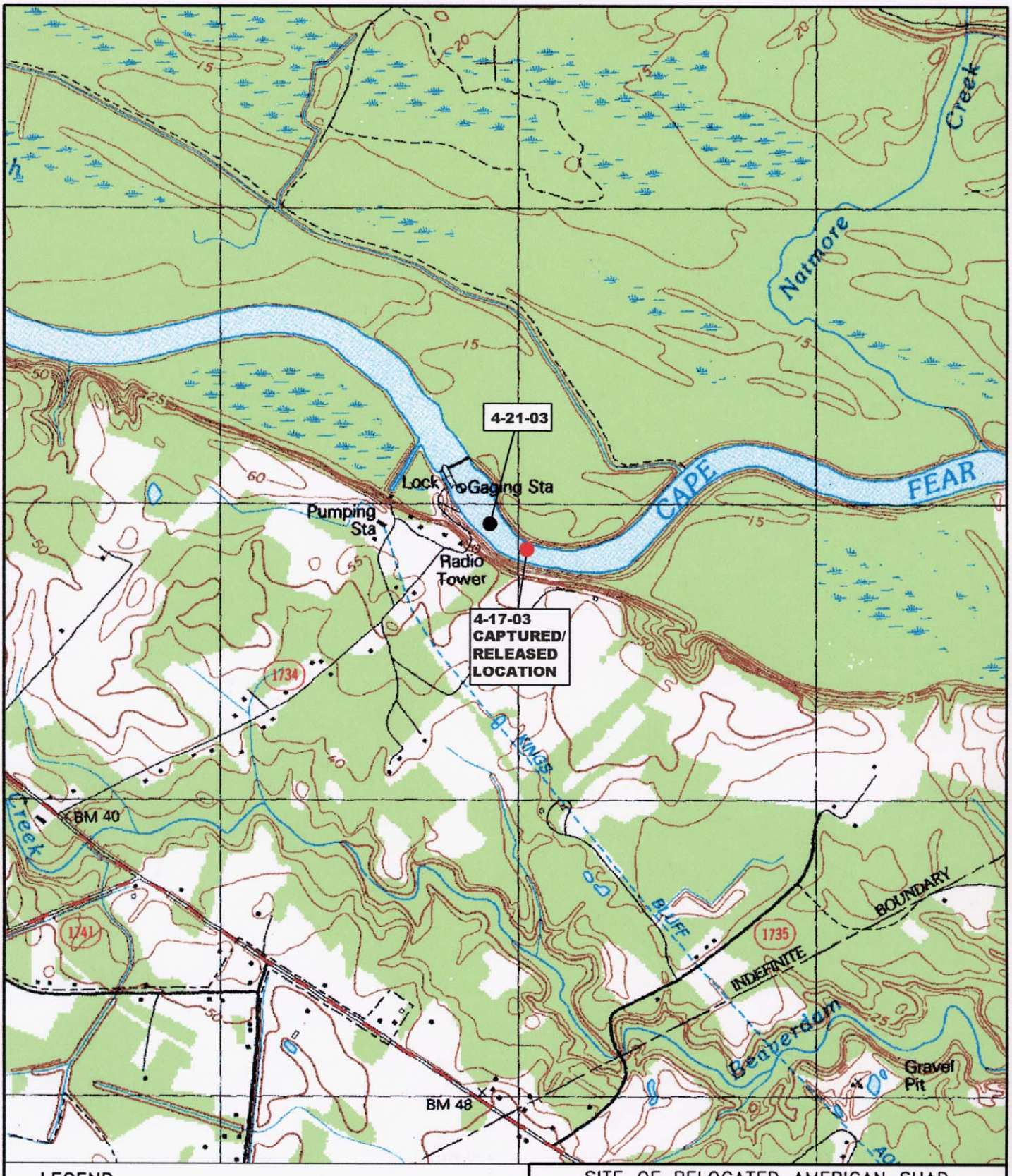
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5140

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5140-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-17-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

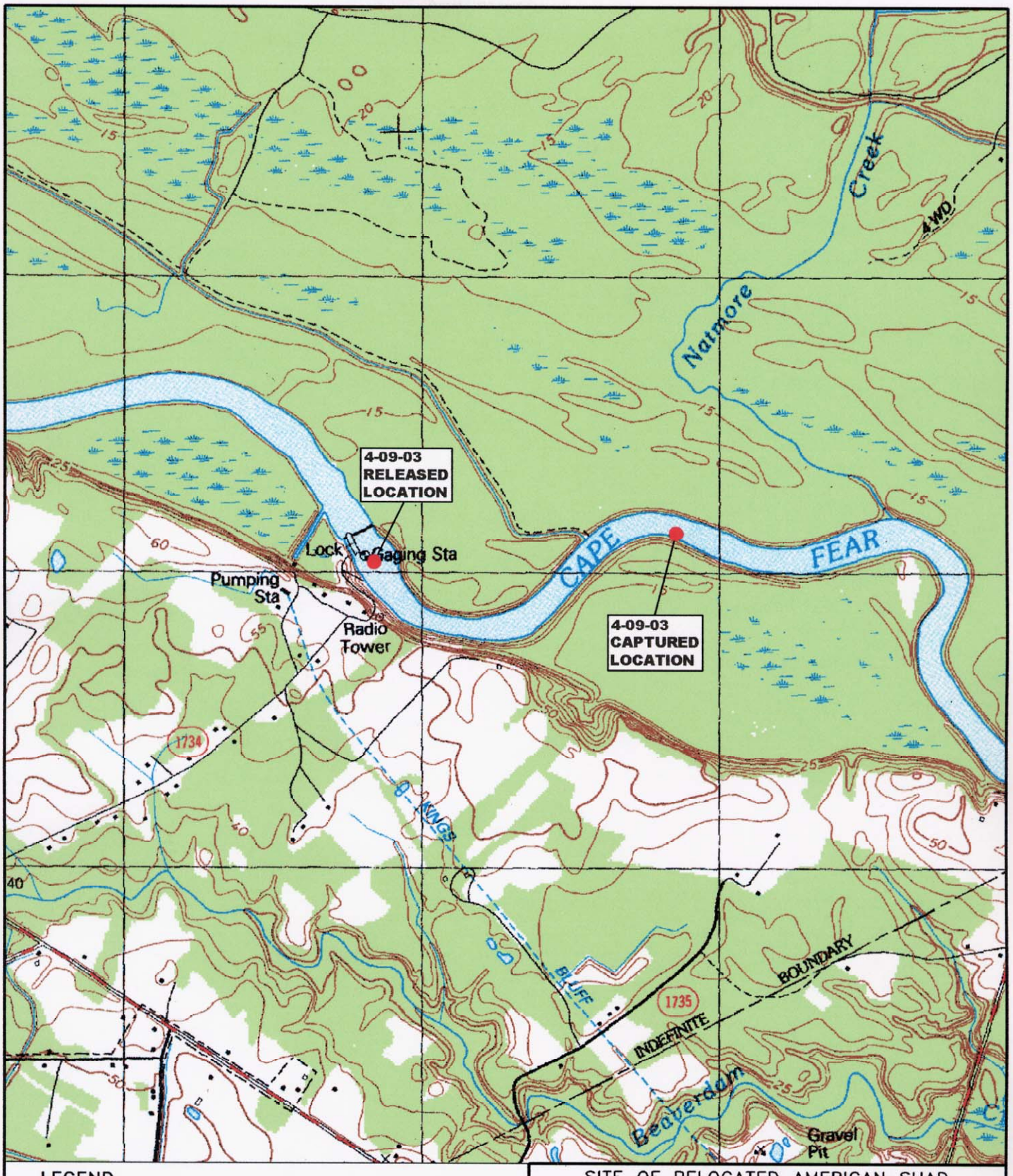
SITE OF RELOCATED AMERICAN SHAD
CZR5140B

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5140B-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS

4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-09-03
- SITE OF RELOCATED FISH

0 1500 3000

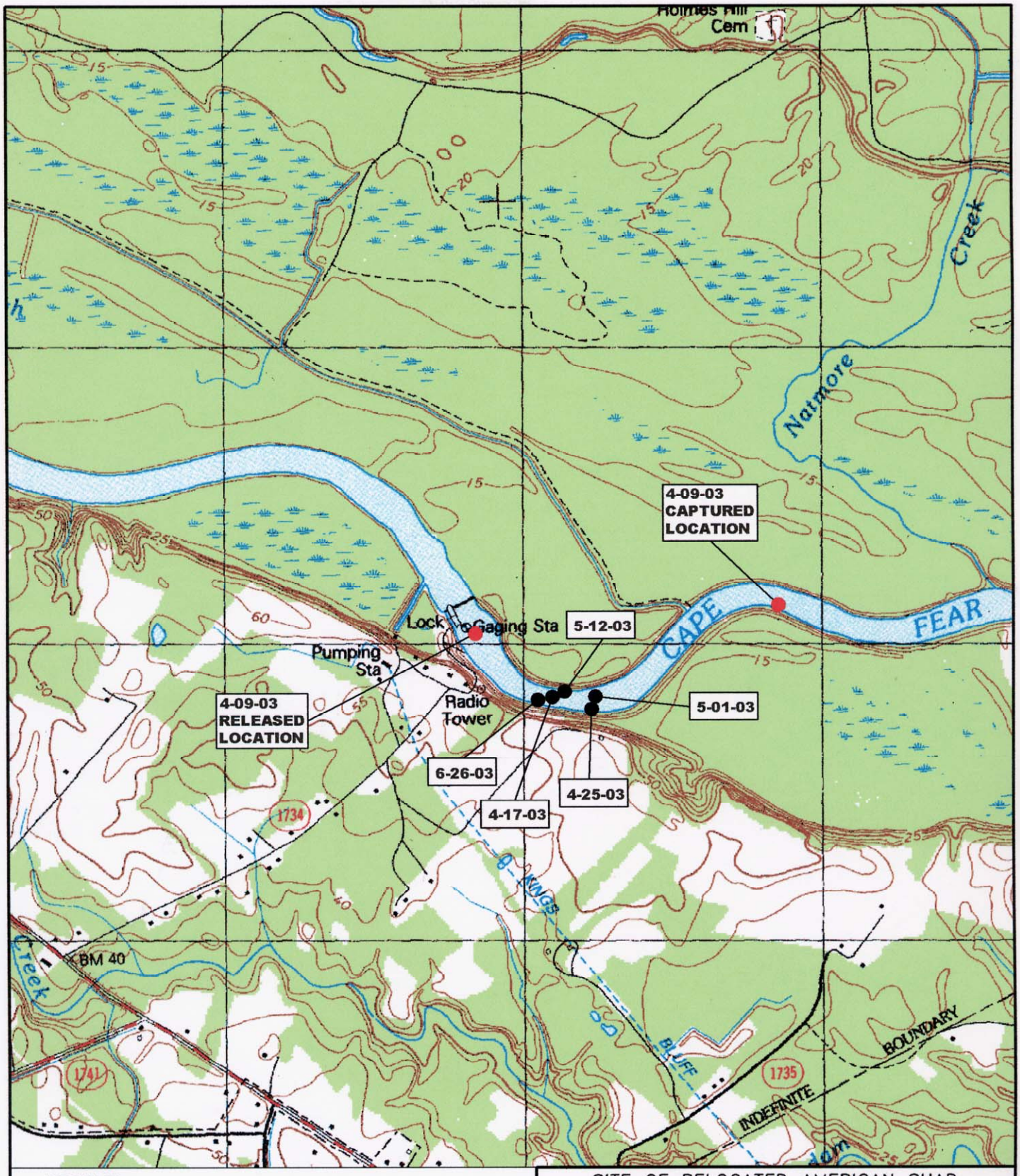
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5141

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5141-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-09-03
- SITE OF RELOCATED FISH

0 1500 3000

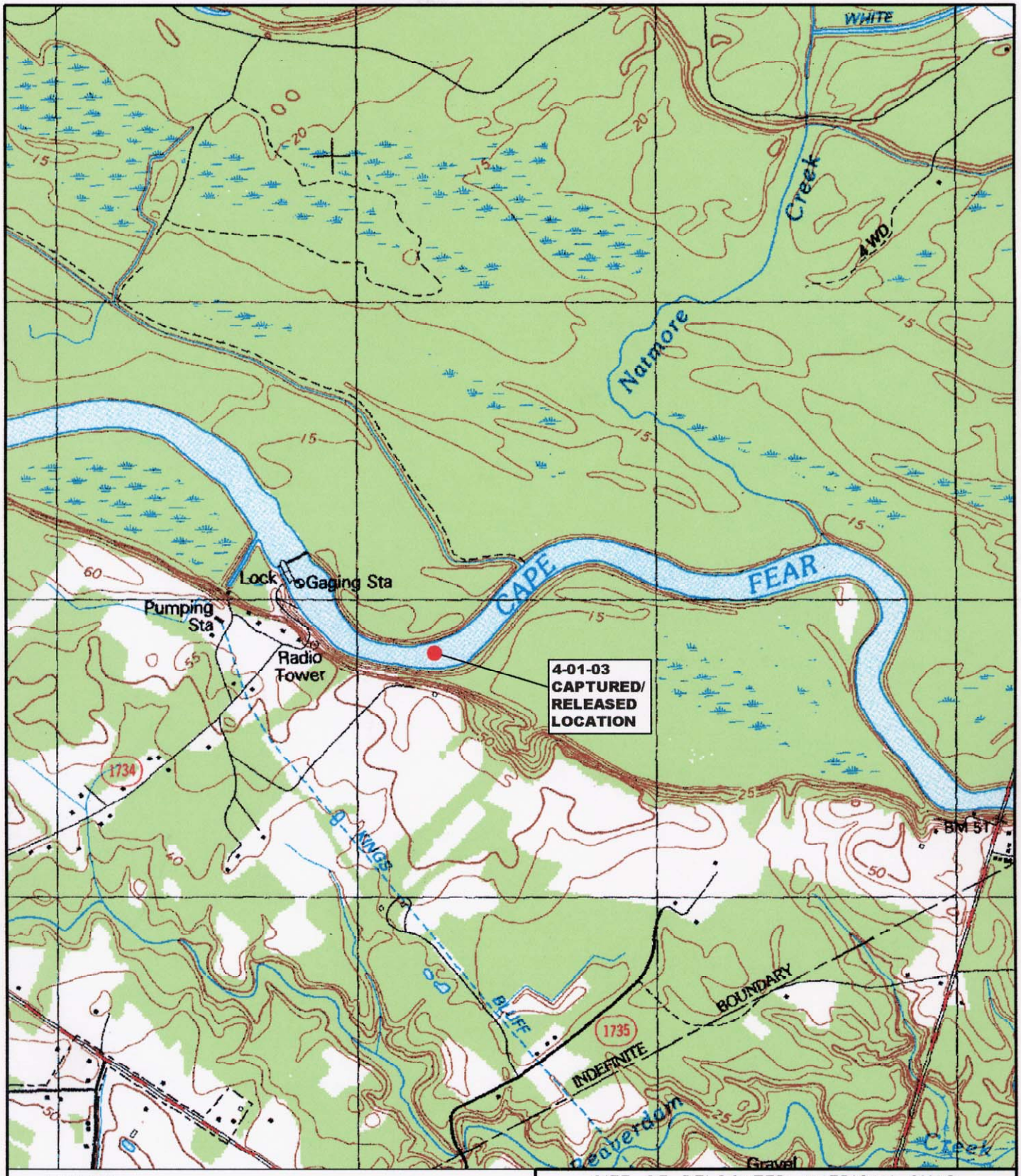
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5142

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5142-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-01-03
- SITE OF RELOCATED FISH

0 1500 3000

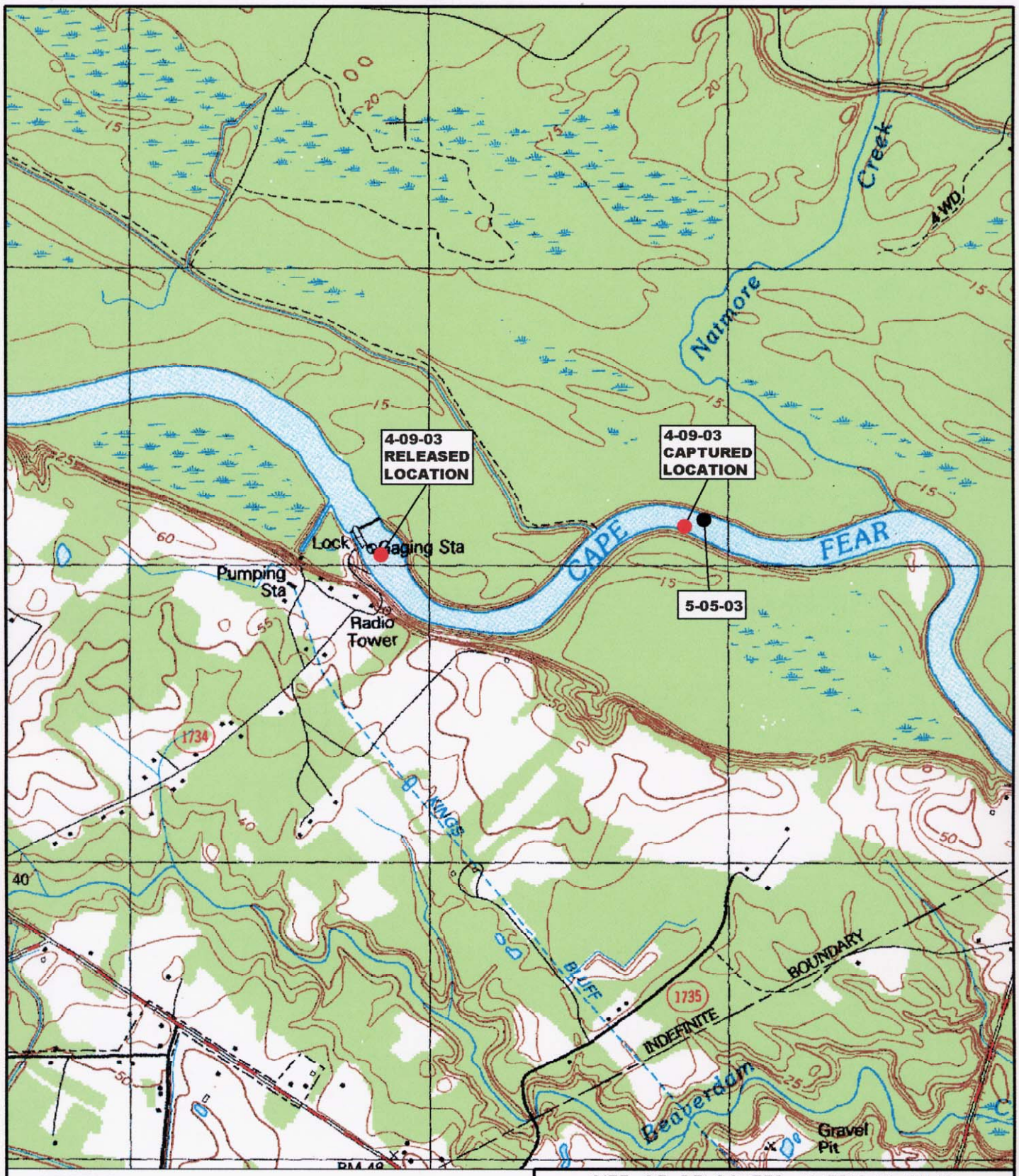
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5143

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5143-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-09-03
- SITE OF RELOCATED FISH

0 1500 3000

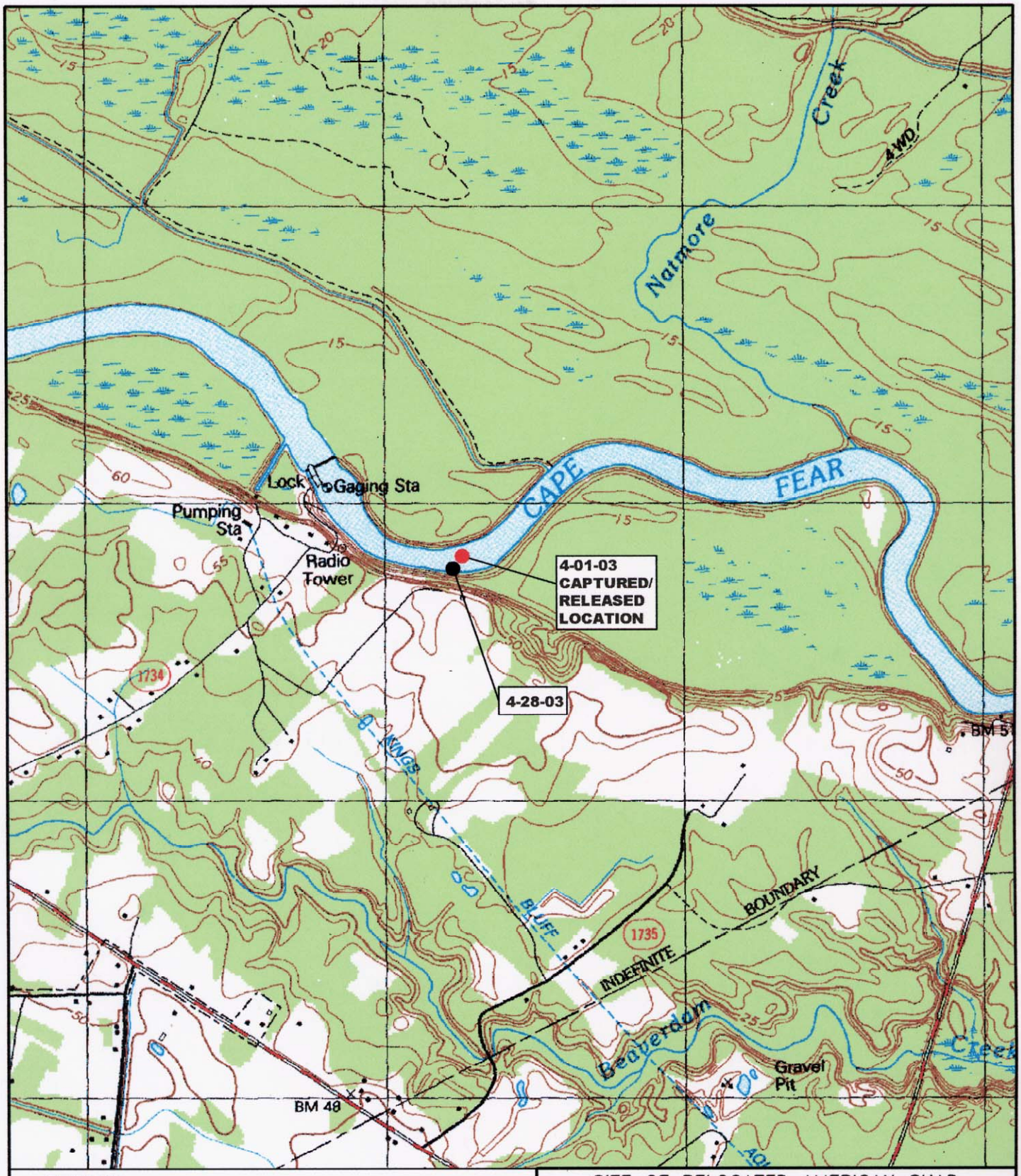
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5144

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5144-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-01-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5145

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5145-03 |
| | | CP#1645.32 |

CZR INCORPORATED ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

## LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-08-03
- SITE OF RELOCATED FISH

0 3000 6000

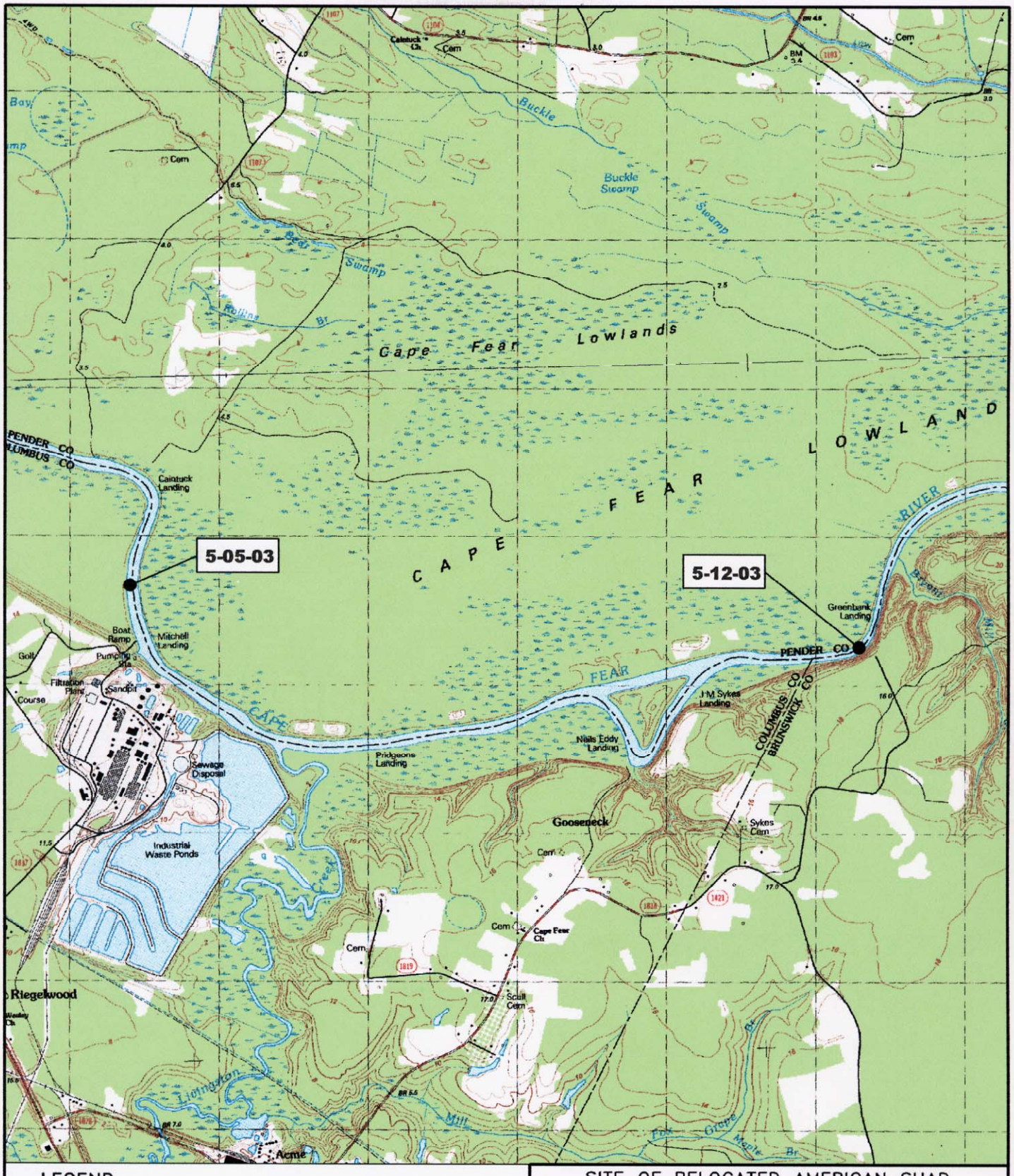
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5146

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5146-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-08-03
- SITE OF RELOCATED FISH

0 3000 6000

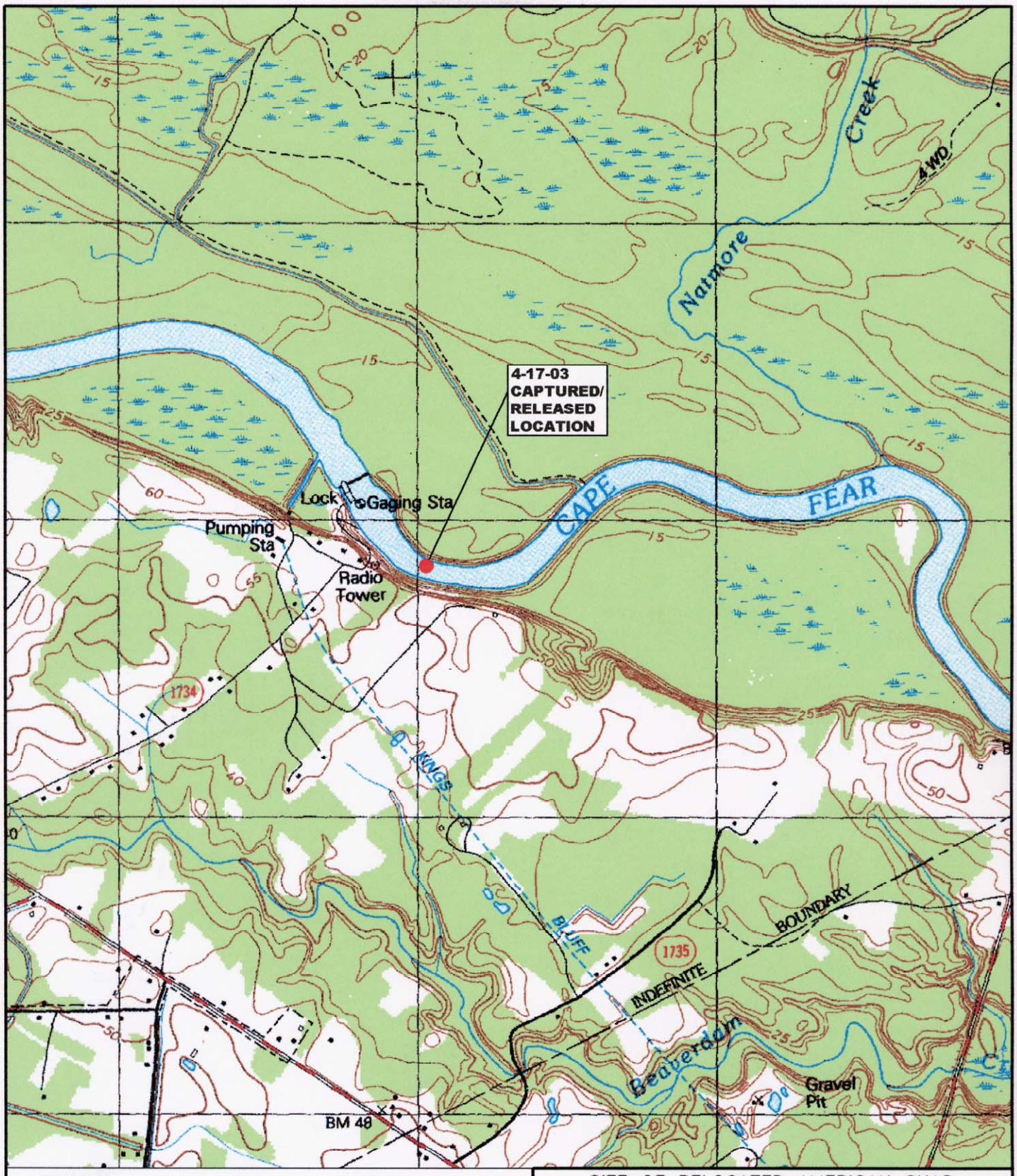
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5146

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5146-03 |
| | | CP#1645.32 |
| | | 2 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-17-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

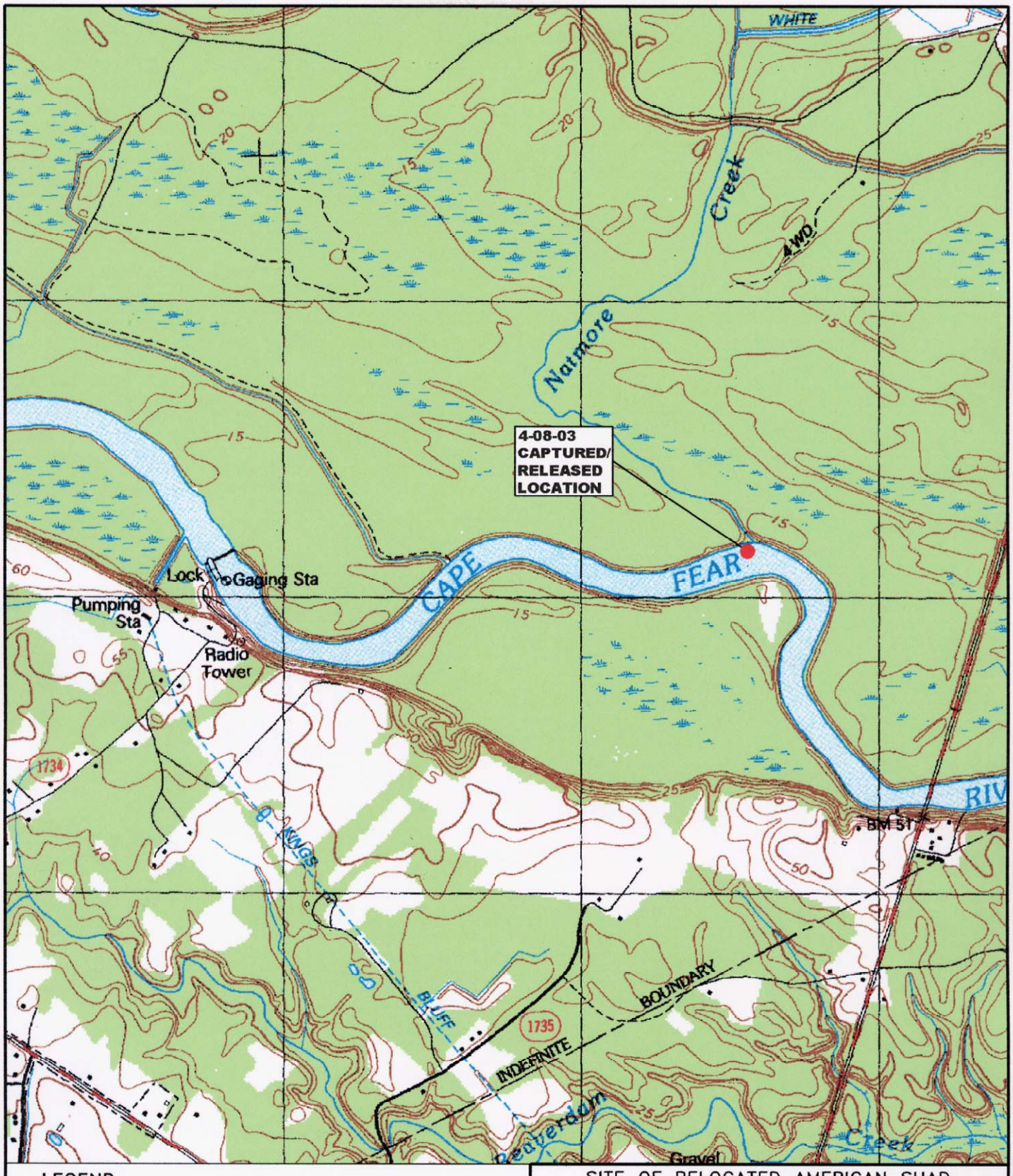
SITE OF RELOCATED AMERICAN SHAD
CZR5147

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5147-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS

4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-08-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

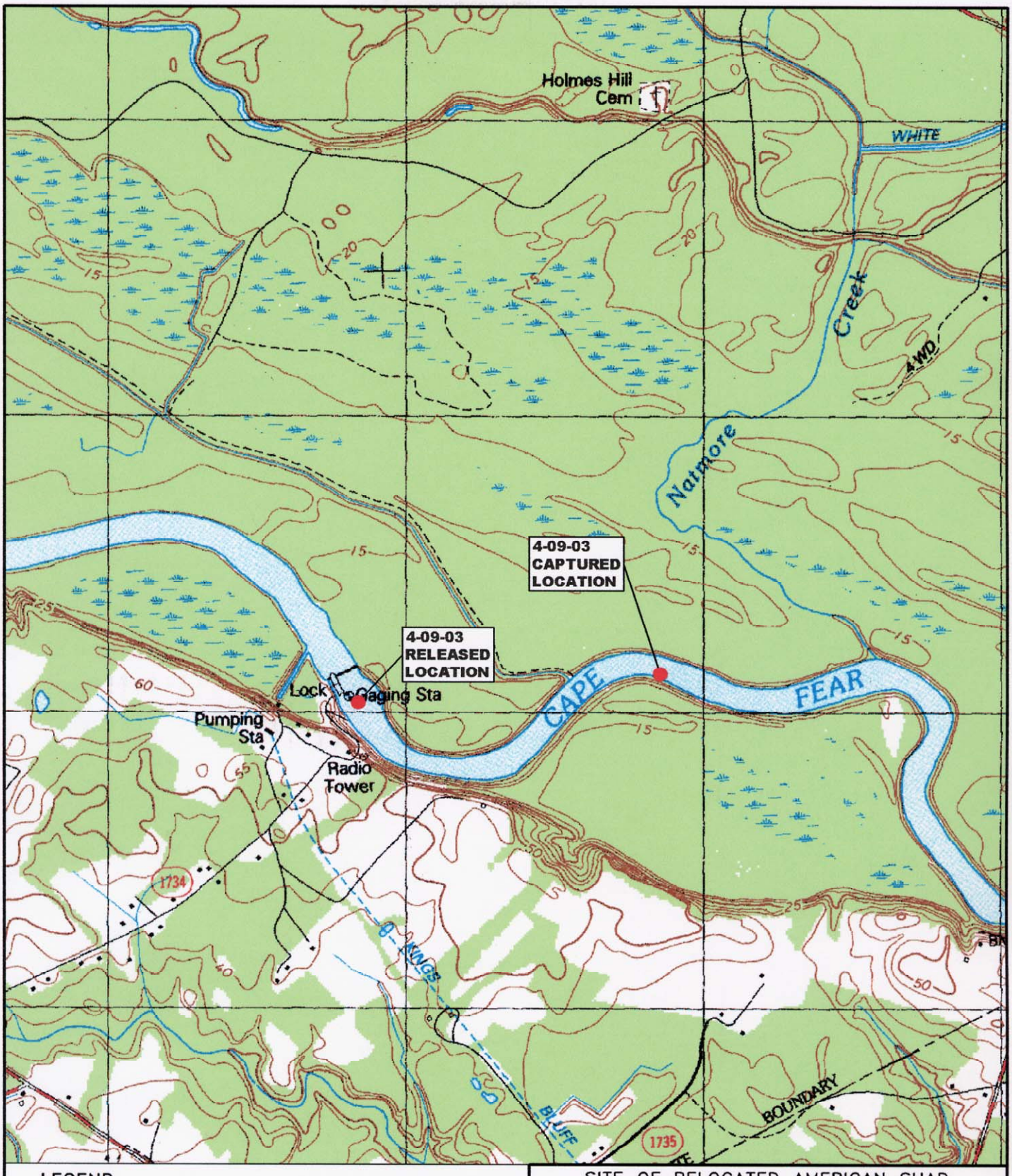
SITE OF RELOCATED AMERICAN SHAD
CZR5148

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5148-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS

4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-09-03
- SITE OF RELOCATED FISH

0 1500 3000

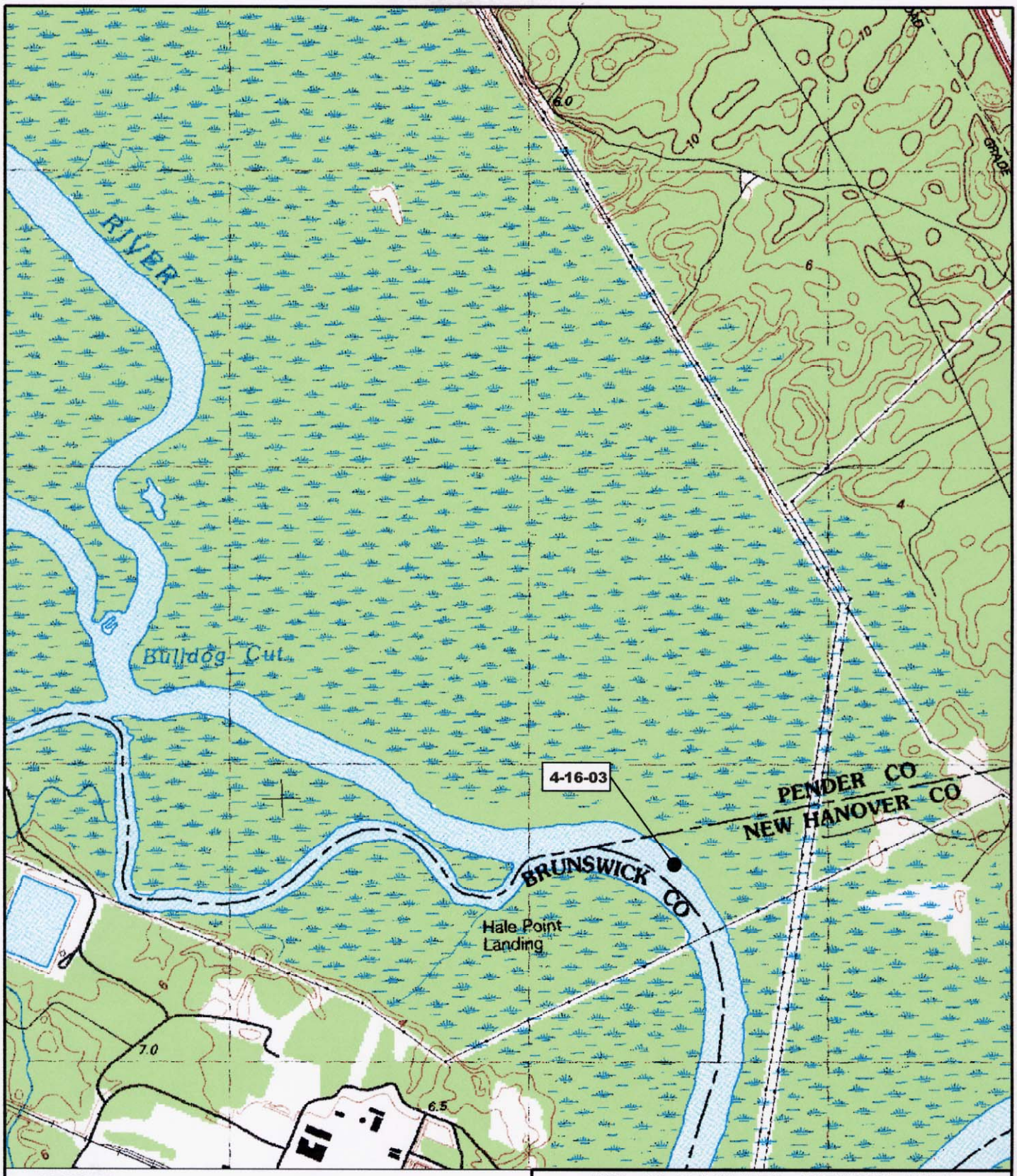
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5149

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5149-03 |
| | | CP#1645.32 |
| | | 1 of 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




**LEGEND**

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-09-03
- SITE OF RELOCATED FISH

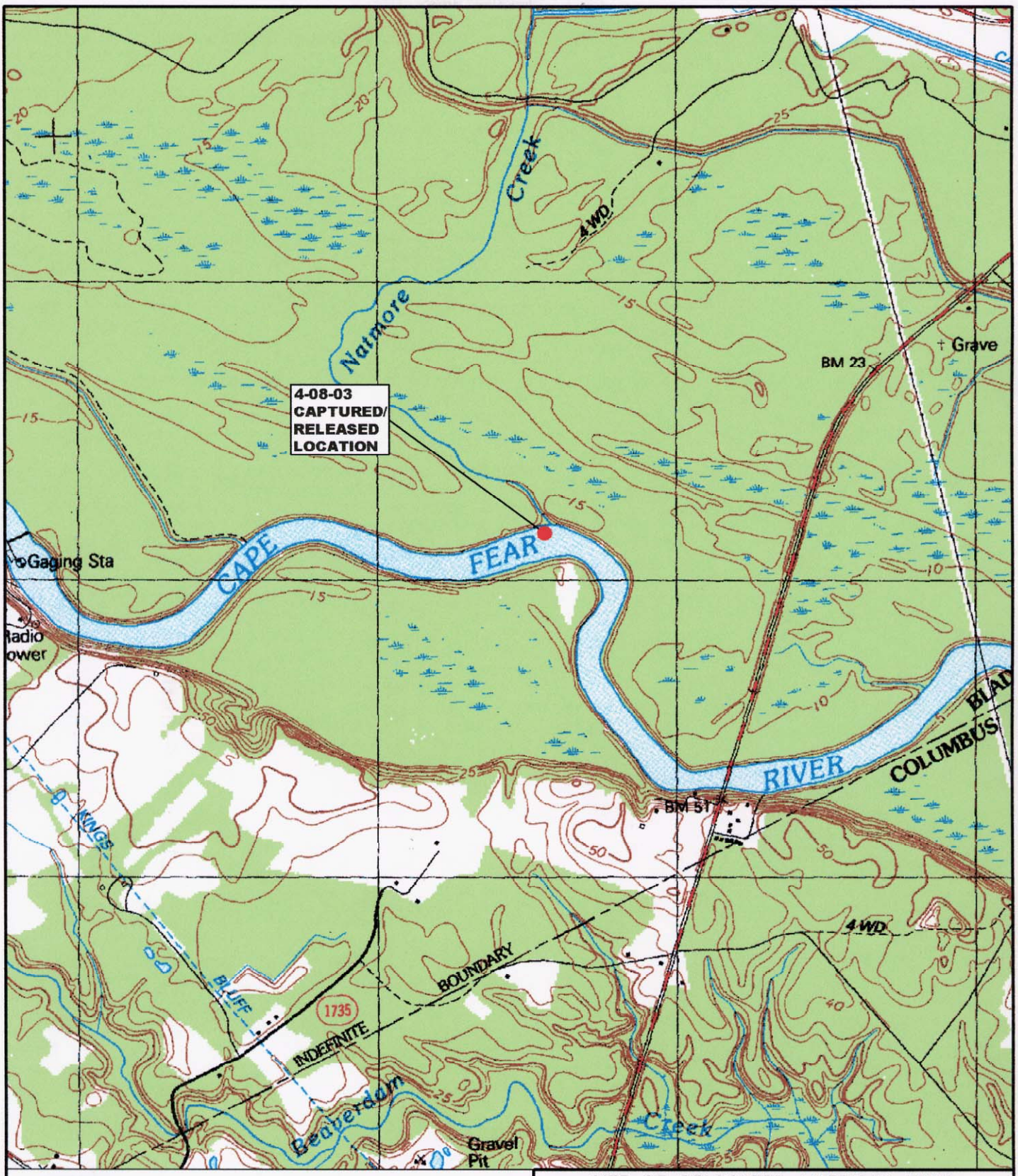
0 1500 3000

SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5149

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5149-03 |
| CZR INCORPORATED ENVIRONMENTAL CONSULTANTS | 4709 COLLEGE ACRES DRIVE SUITE 2 WILMINGTON, NORTH CAROLINA 28403 TEL 910/392-9253 FAX 910/392-9139 | CP#1645.32 |
| | | 2 of 2 |




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-08-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

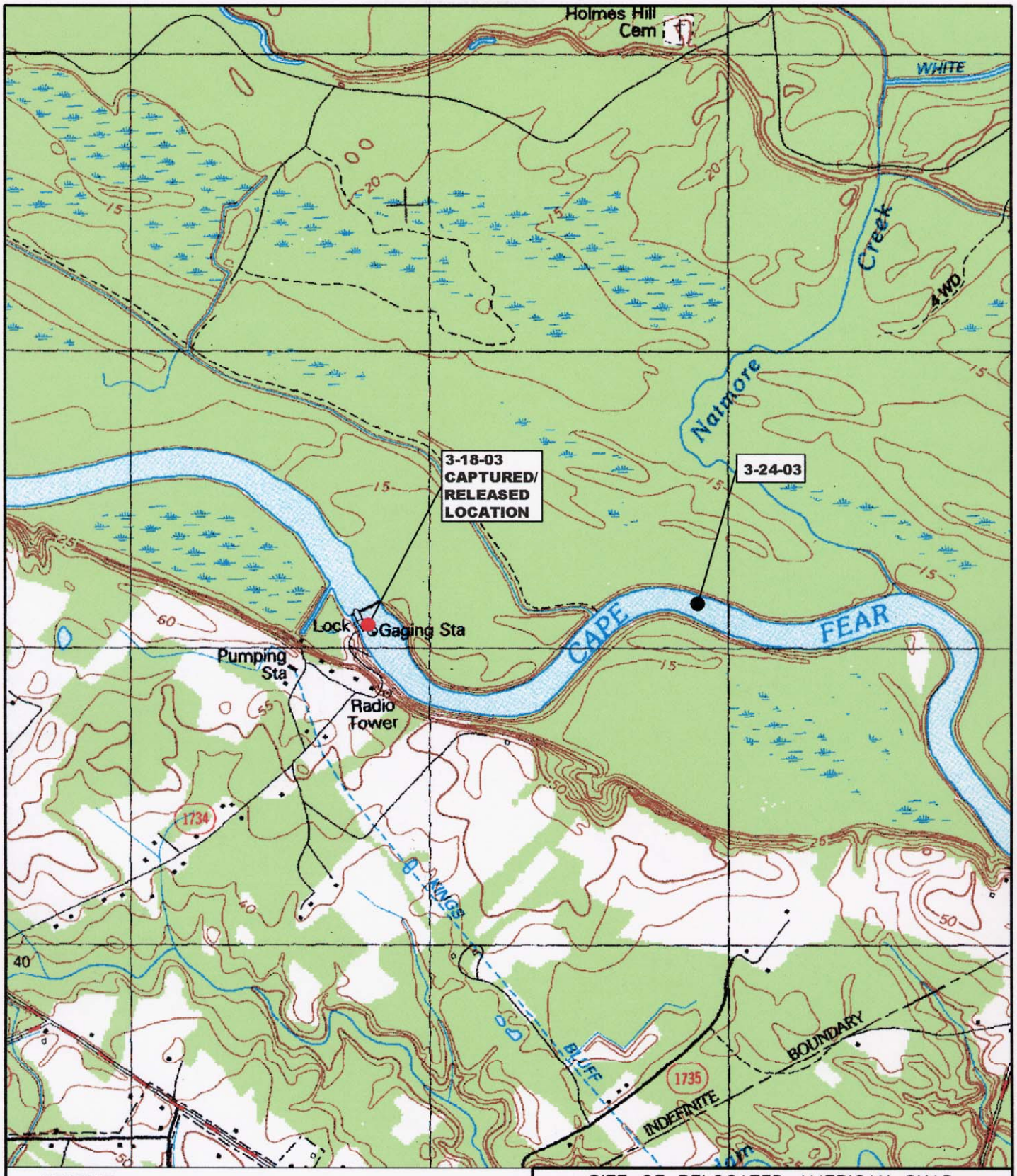
SITE OF RELOCATED AMERICAN SHAD
CZR5150

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5150-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS

4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-18-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

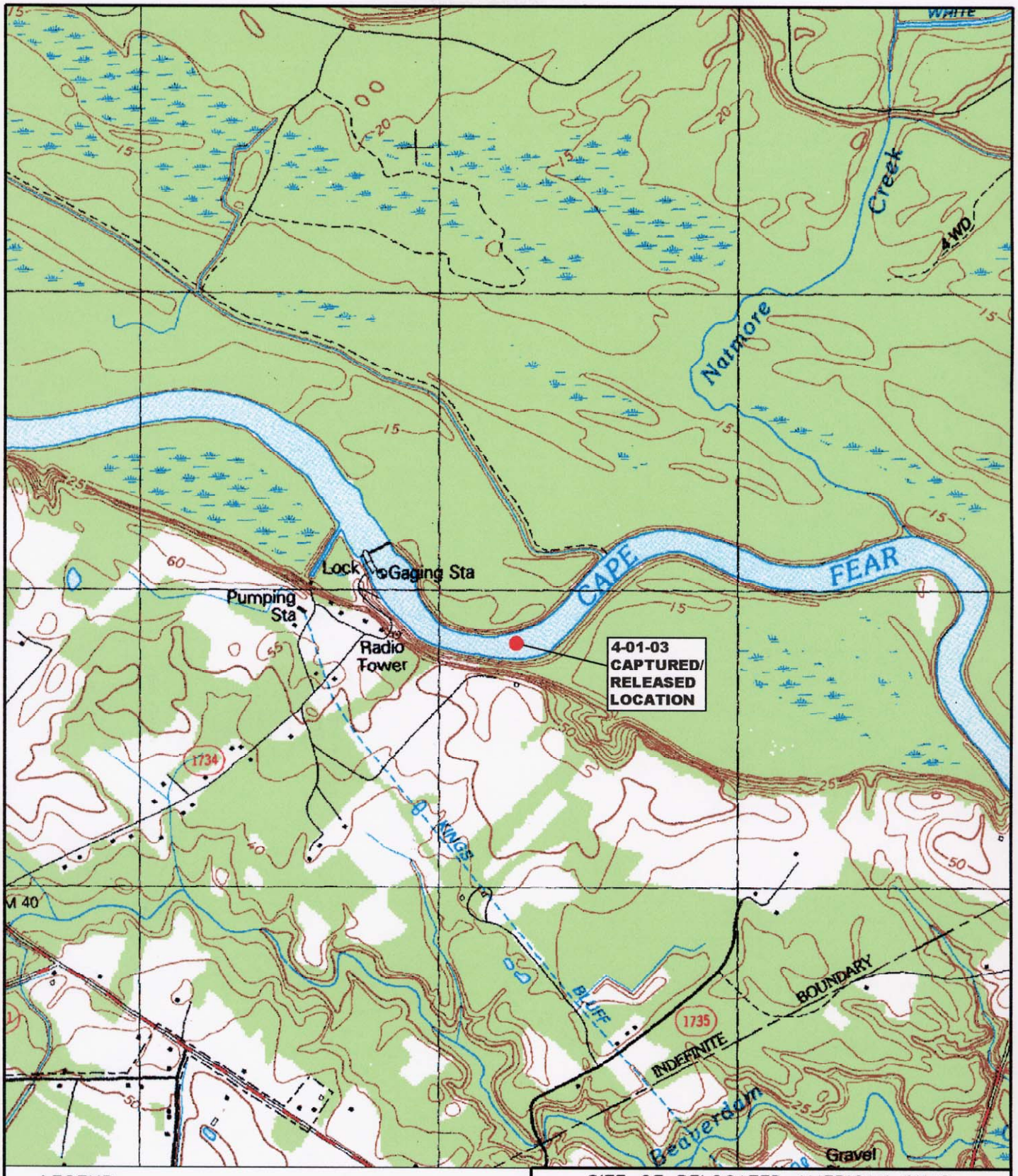
SITE OF RELOCATED AMERICAN SHAD
CZR5151

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5151-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS

4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-01-03
- SITE OF RELOCATED FISH

0 1500 3000

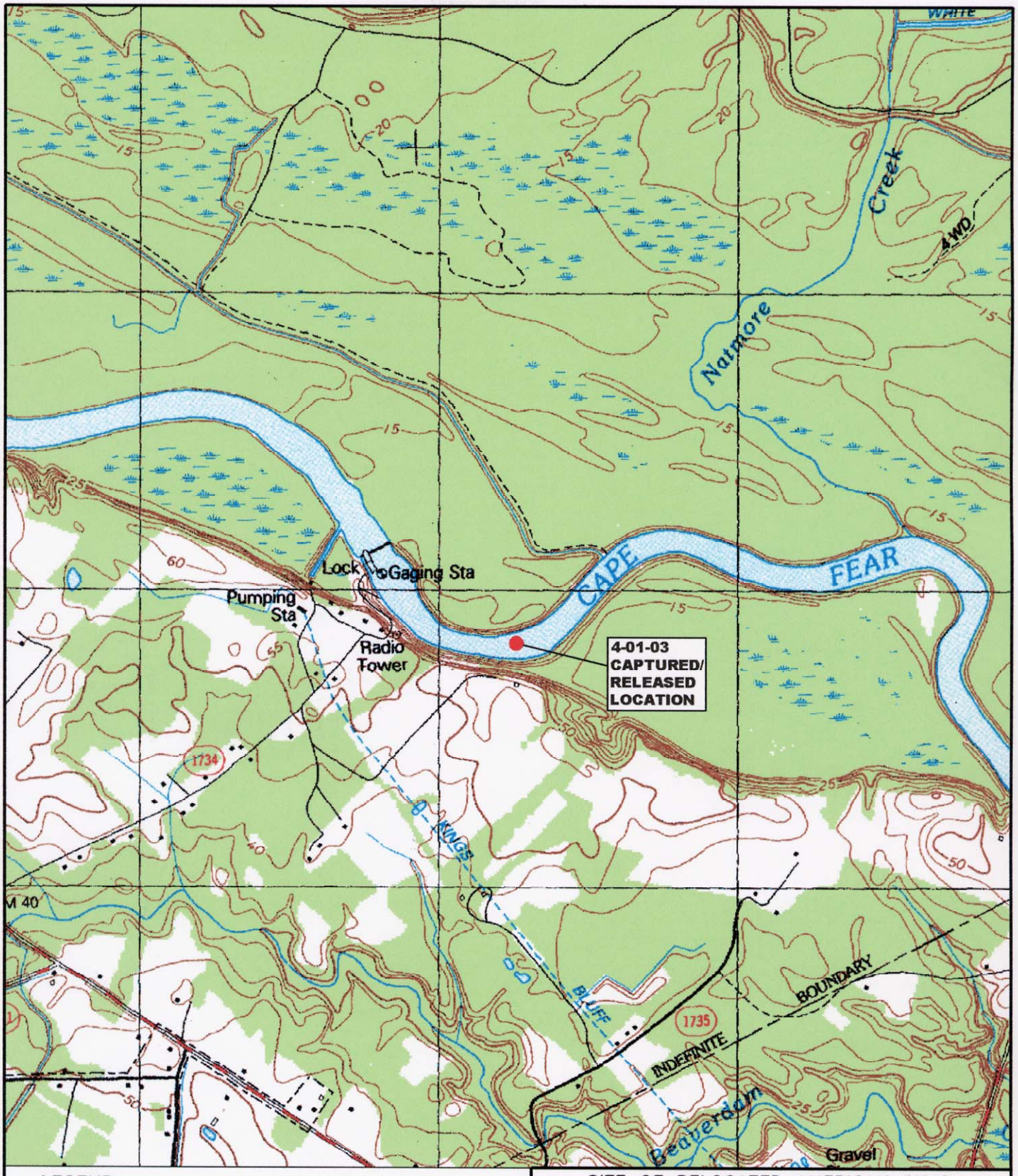
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5152

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5152-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

CZR INCORPORATED ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-01-03
- SITE OF RELOCATED FISH

0 1500 3000

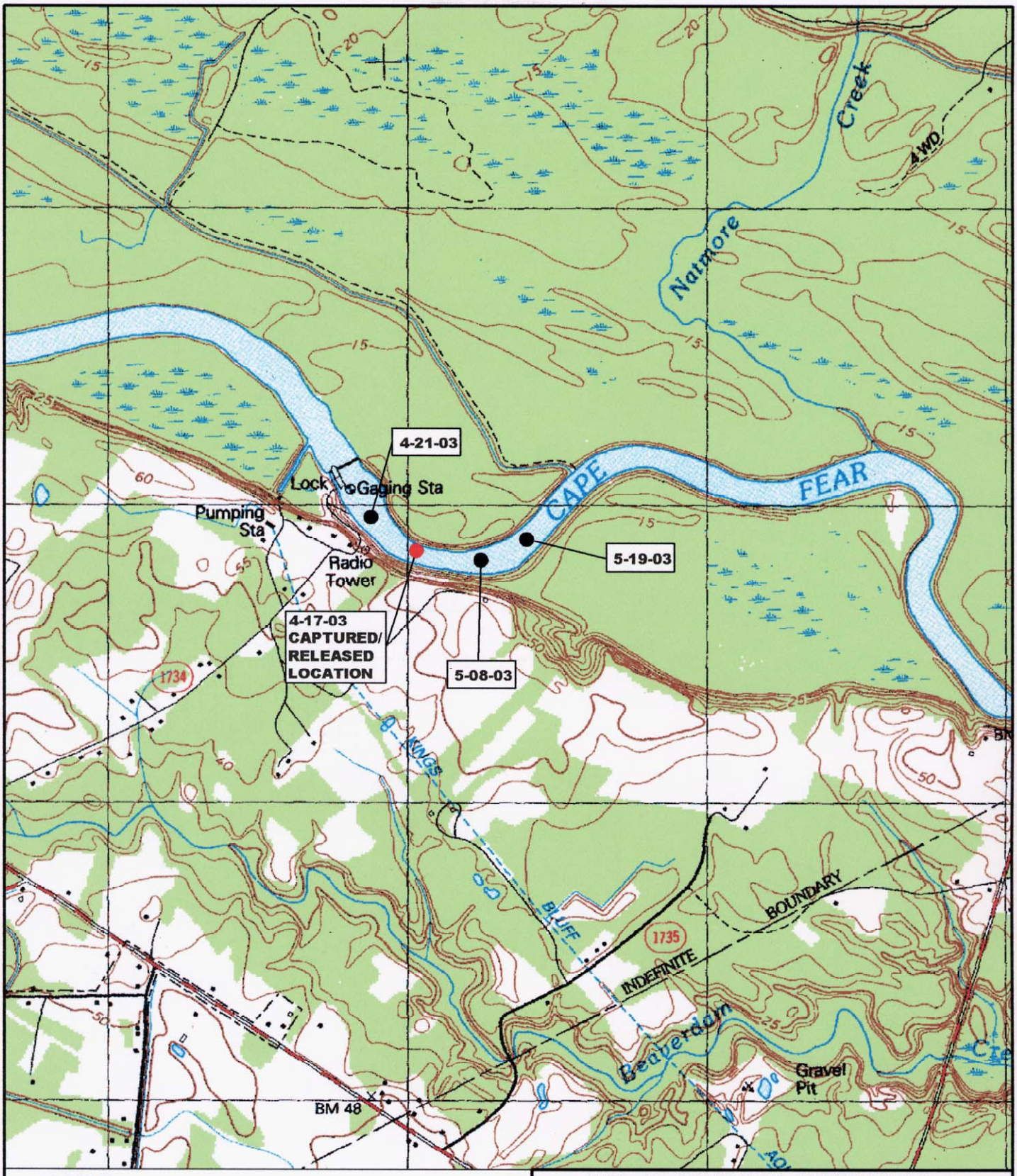
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5152

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5152-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

CZR INCORPORATED ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-17-03
- SITE OF RELOCATED FISH

0 1500 3000

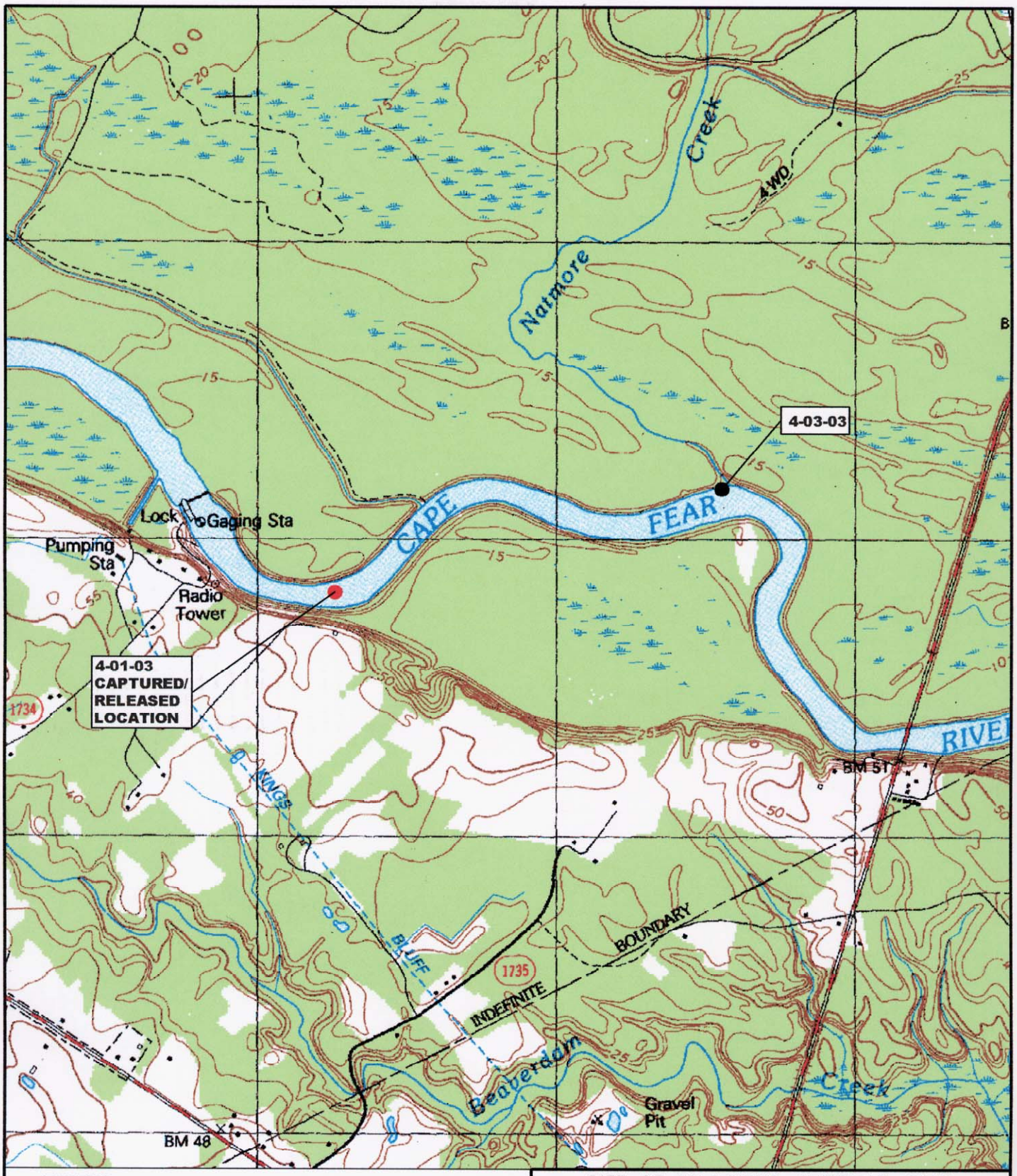
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5152B

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5152B-03 |
| | | CP#1645.32 |

CZR INCORPORATED ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-01-03
- SITE OF RELOCATED FISH

0 1500 3000

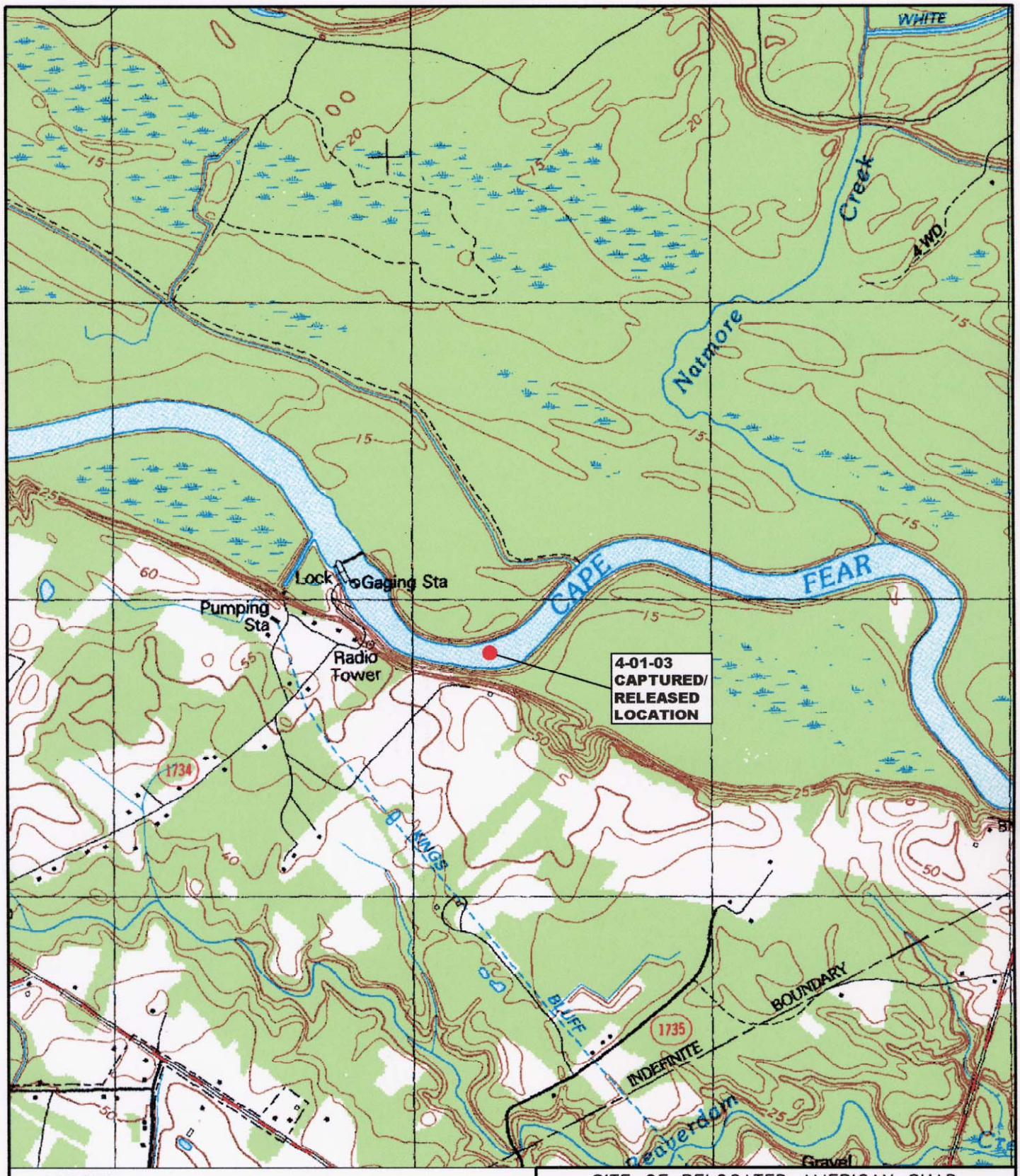
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5153

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5153-03 |
| | | CP#1645.32 |

CZR INCORPORATED ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-01-03
- SITE OF RELOCATED FISH

0 1500 3000

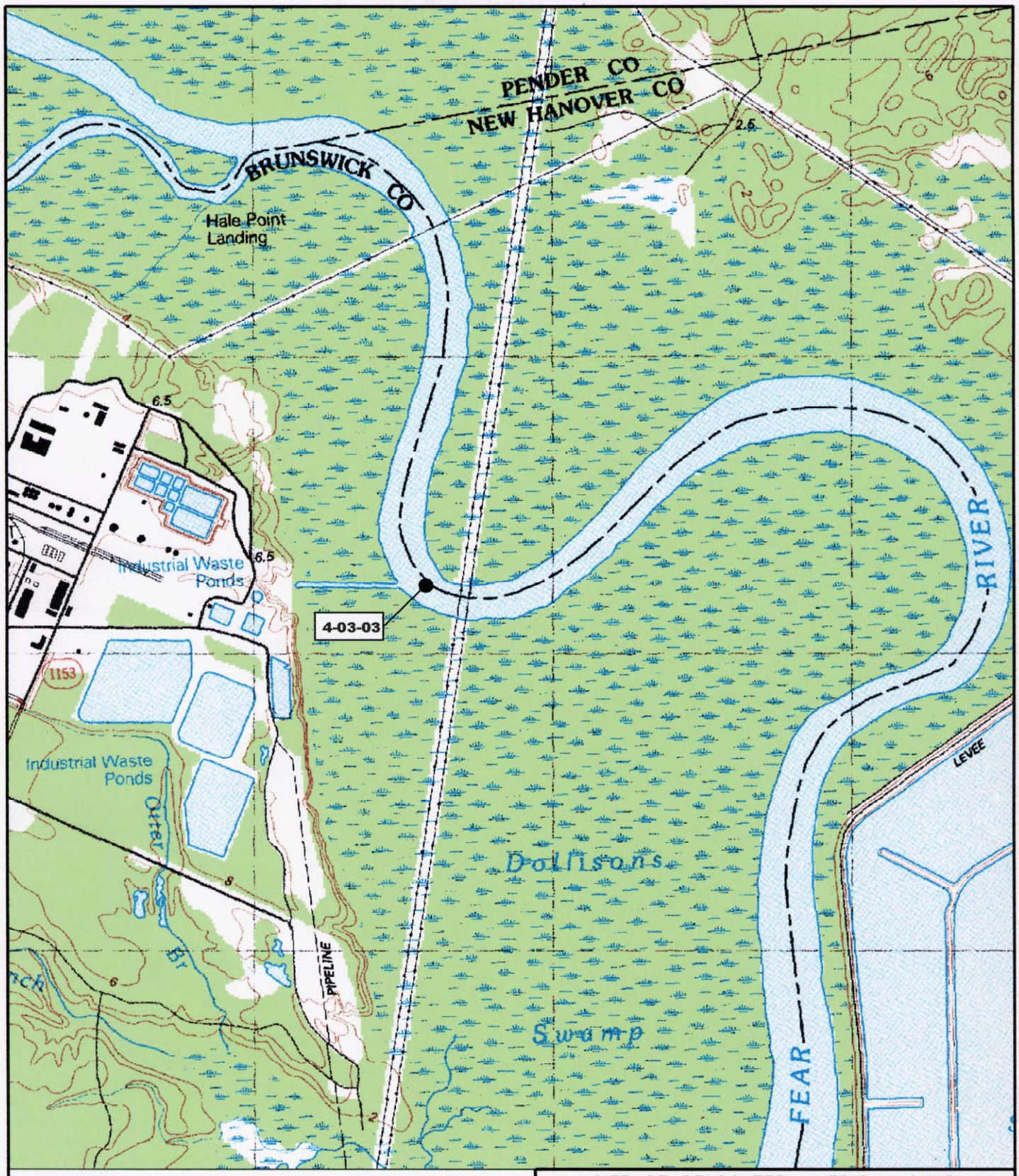
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5154

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5154-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-01-03
- SITE OF RELOCATED FISH

0 1500 3000

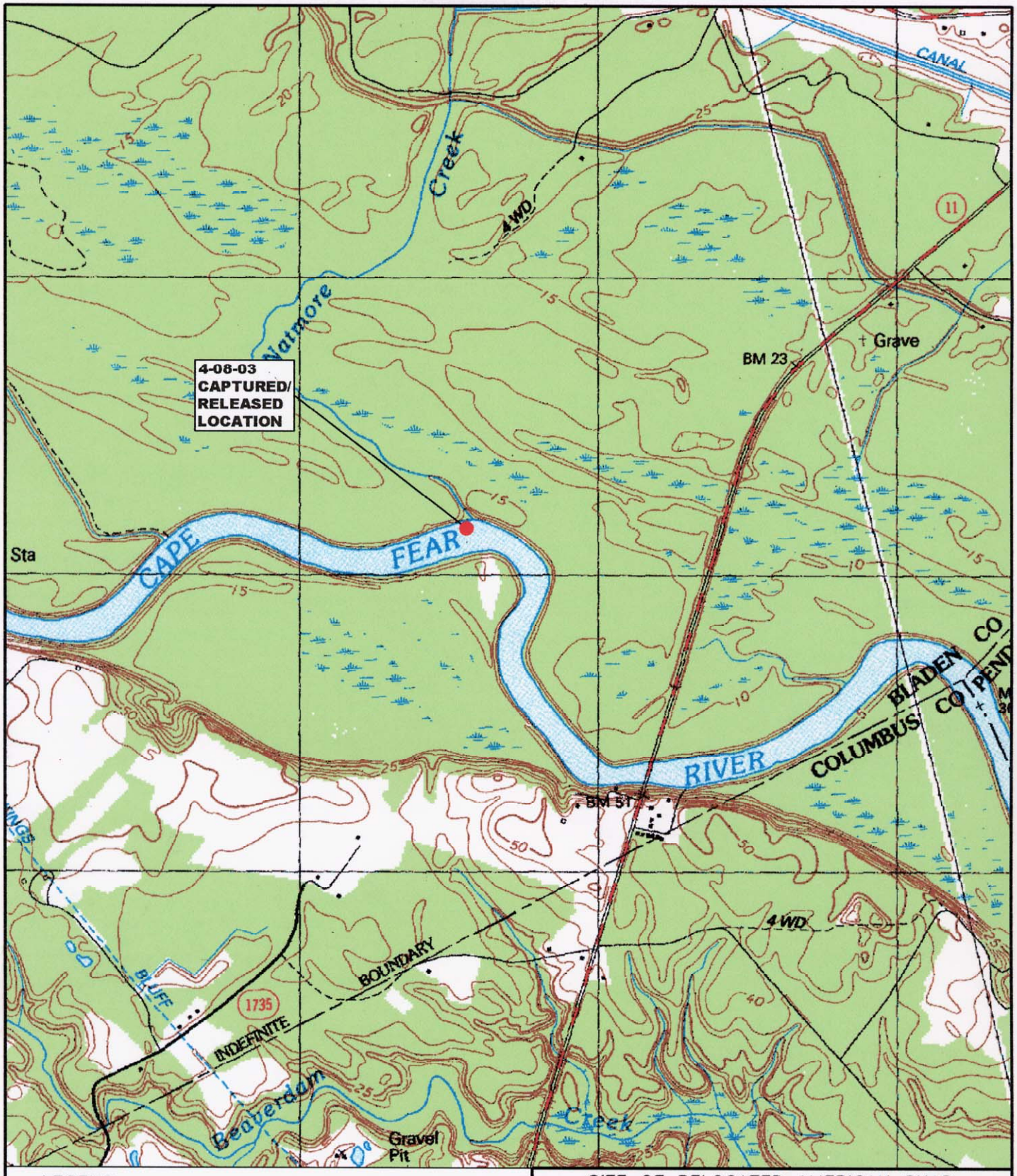
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5154

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5154-03 |
| | | CP#1645.32 |
| | | 2 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-08-03
- SITE OF RELOCATED FISH

0 1500 3000

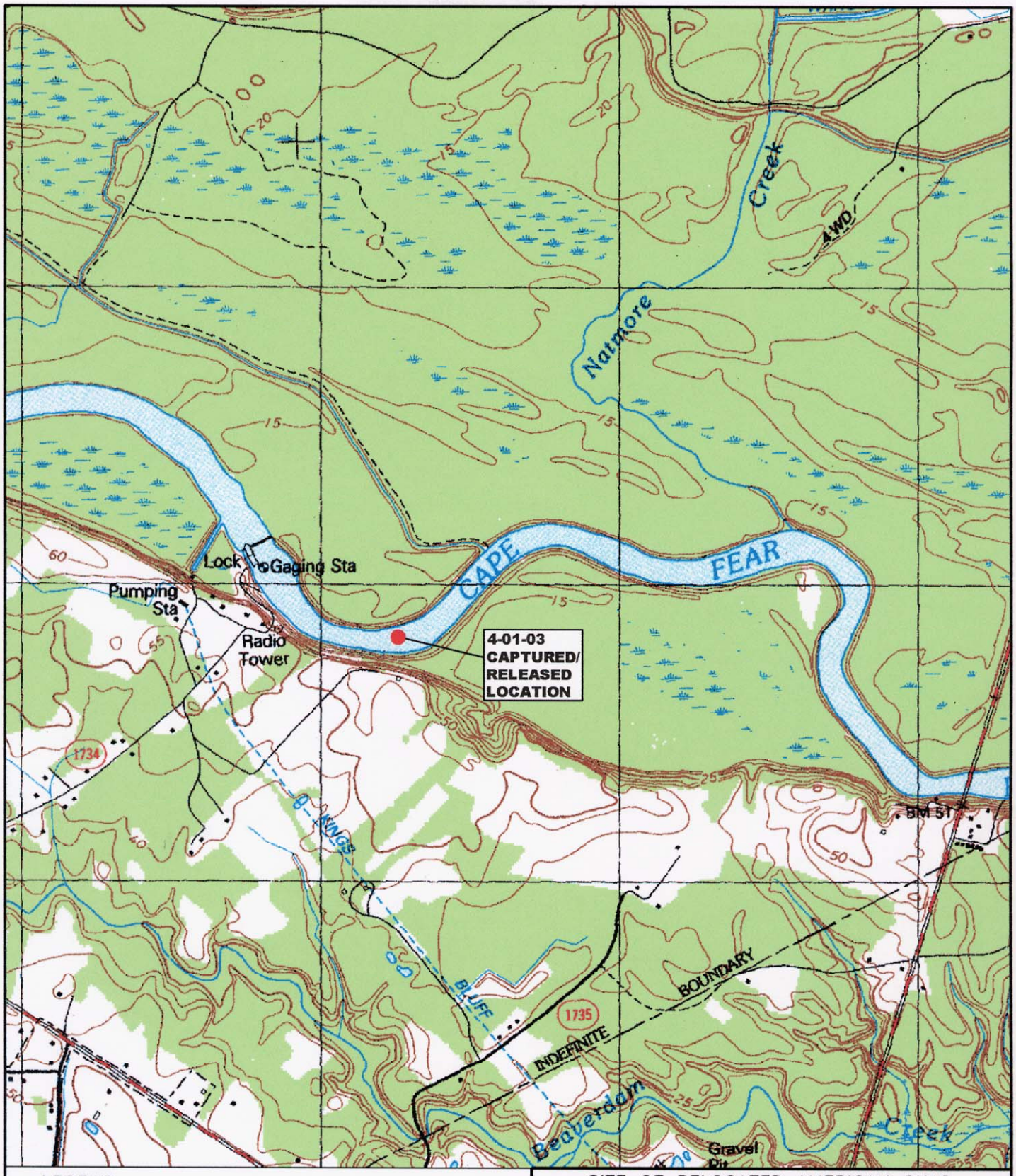
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5155

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5155-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-01-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5156

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5156-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

## LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-09-03
- SITE OF RELOCATED FISH

0 3000 6000

SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5157

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5157-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-01-03
- SITE OF RELOCATED FISH

0 1500 3000

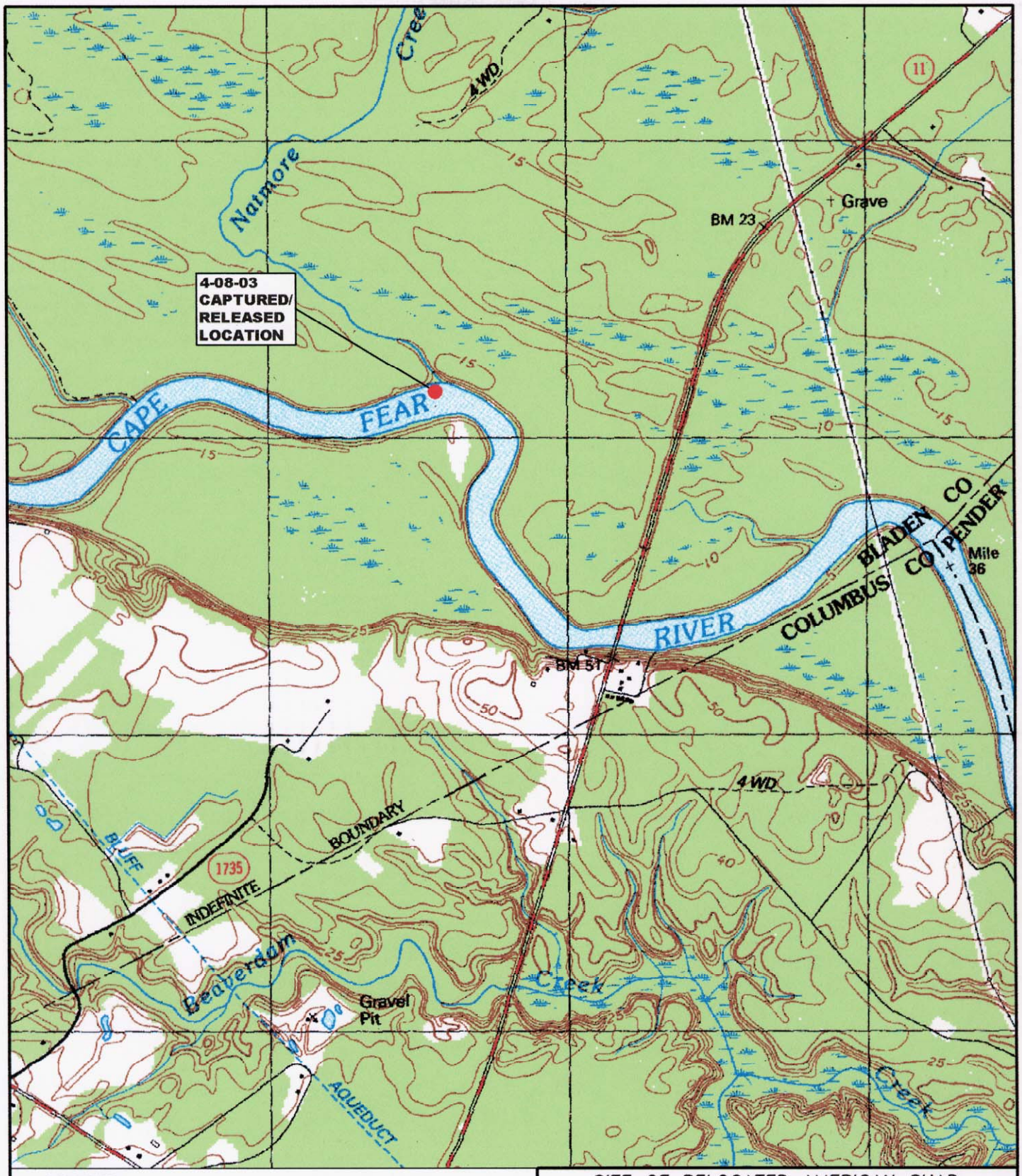
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5158

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5158-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-08-03
- SITE OF RELOCATED FISH

0 1500 3000

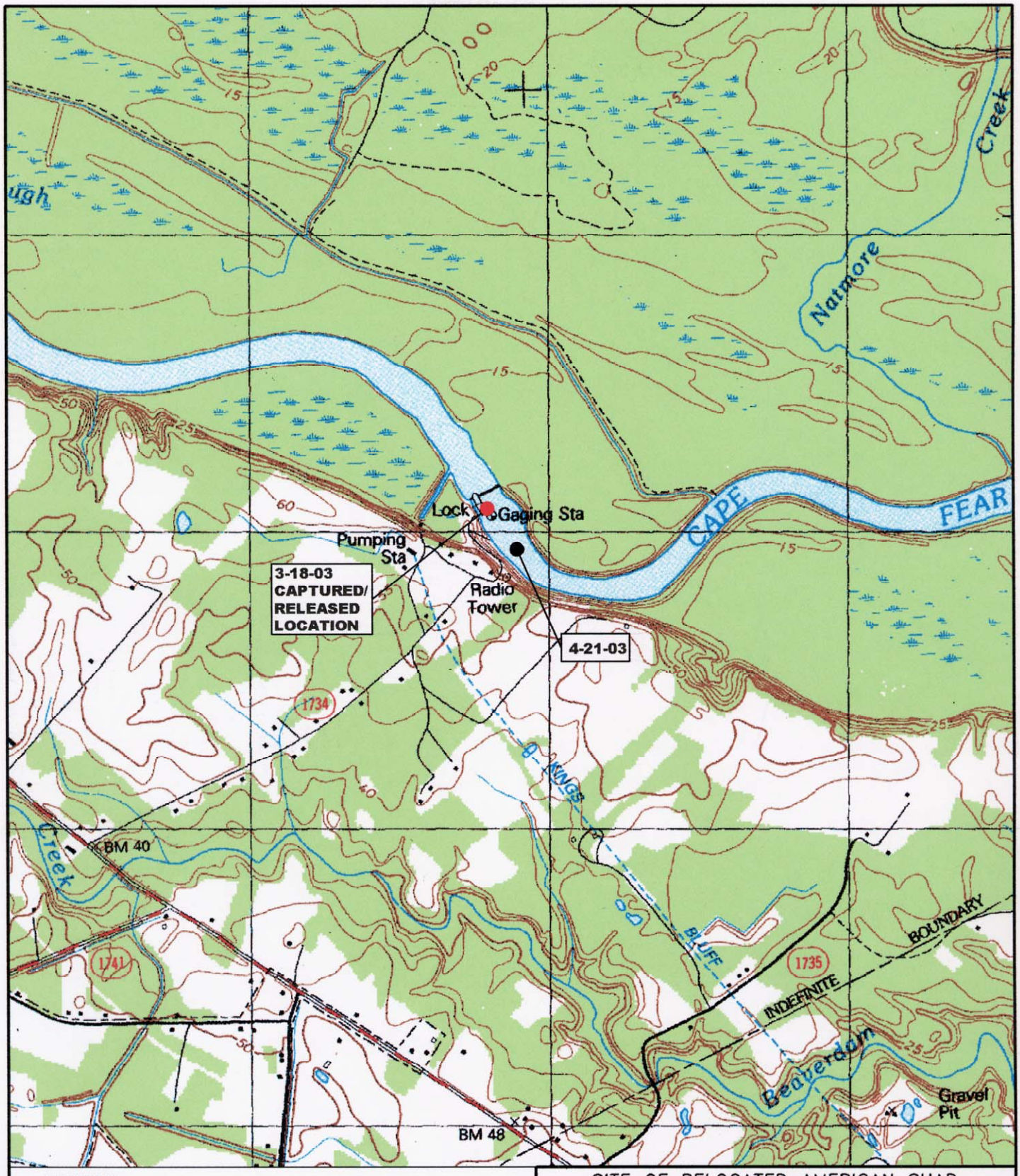
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5159

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5159-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-18-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5160

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5160-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-08-03
- SITE OF RELOCATED FISH

0 1500 3000

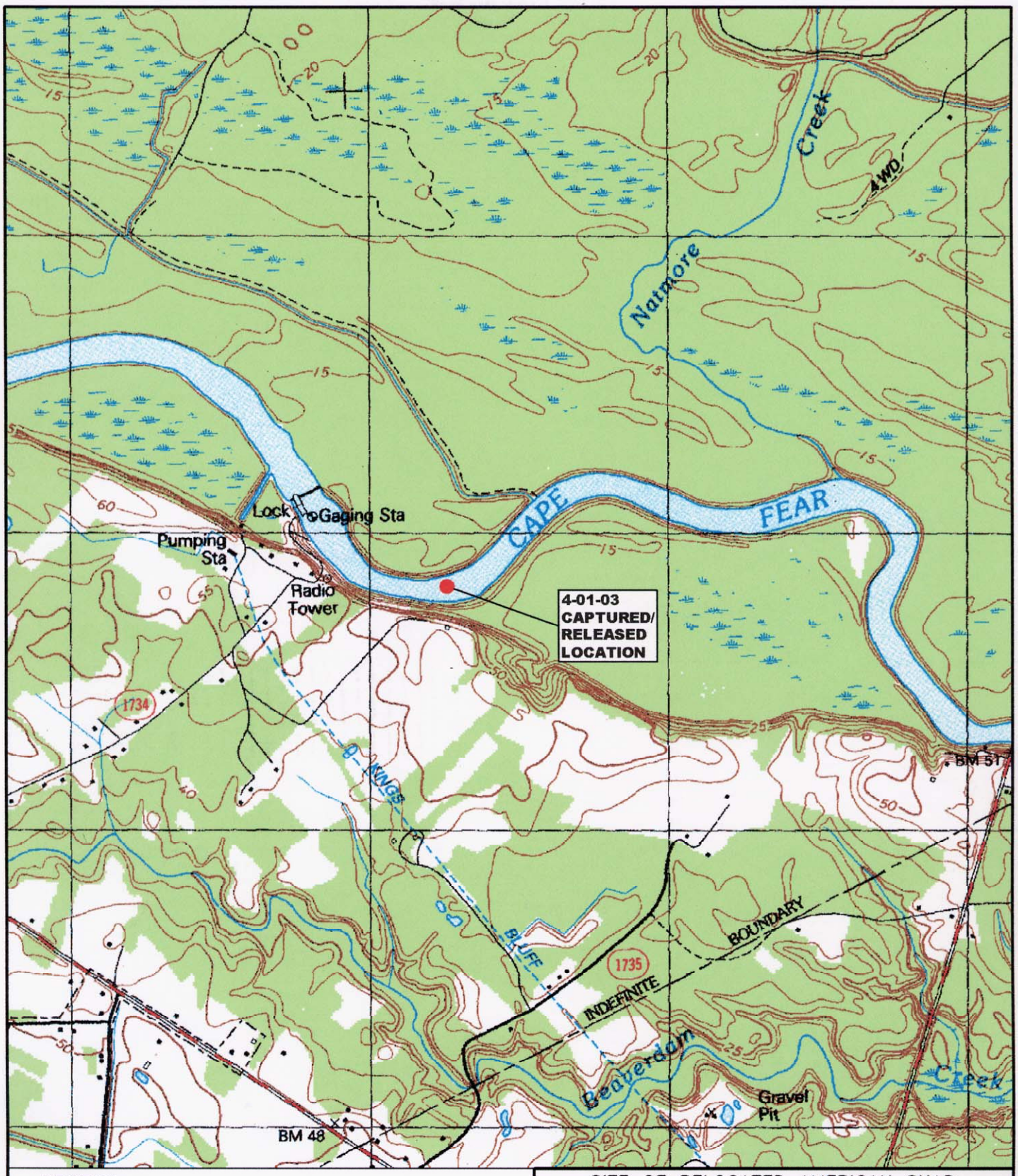
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5161

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5161-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-01-03
- SITE OF RELOCATED FISH

0 1500 3000

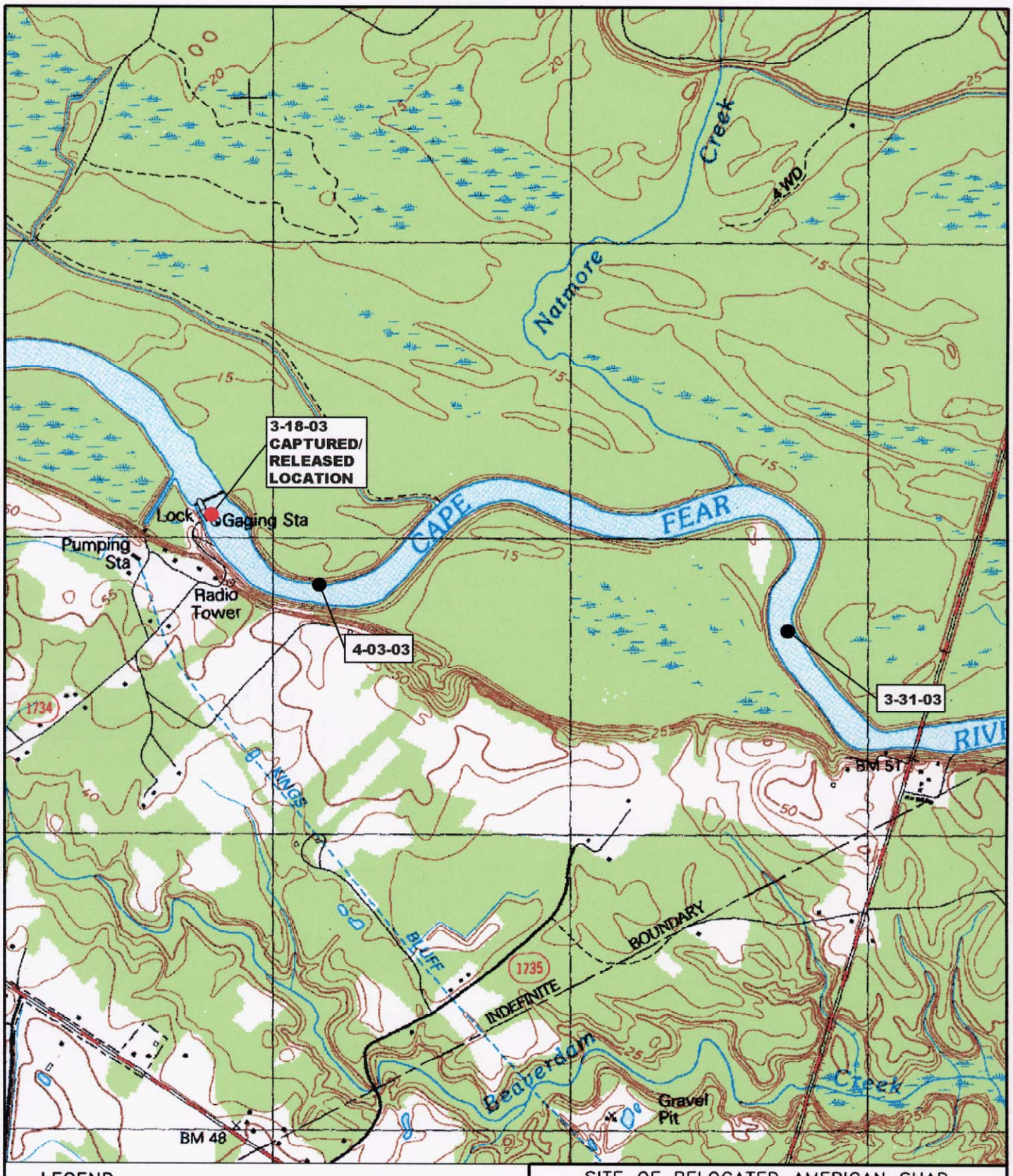
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5162

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5162-03 |
| | | CP#1645.32 |

CZR INCORPORATED ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-18-03
- SITE OF RELOCATED FISH

0 1500 3000

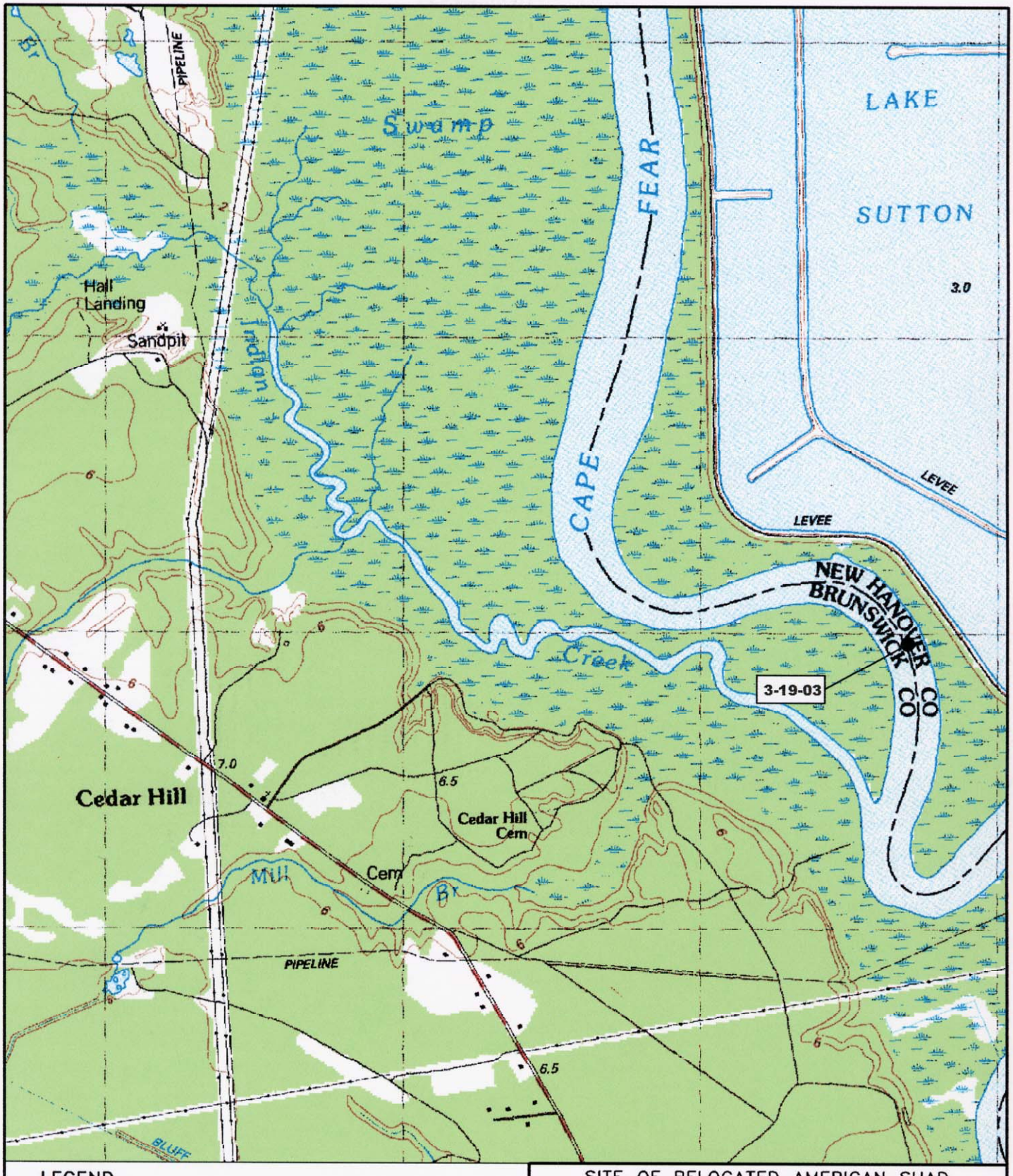
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5163

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5163-03 |
| | | CP#1645.32 |
| | | 1 OF 3 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-18-03
- SITE OF RELOCATED FISH

0 1500 3000

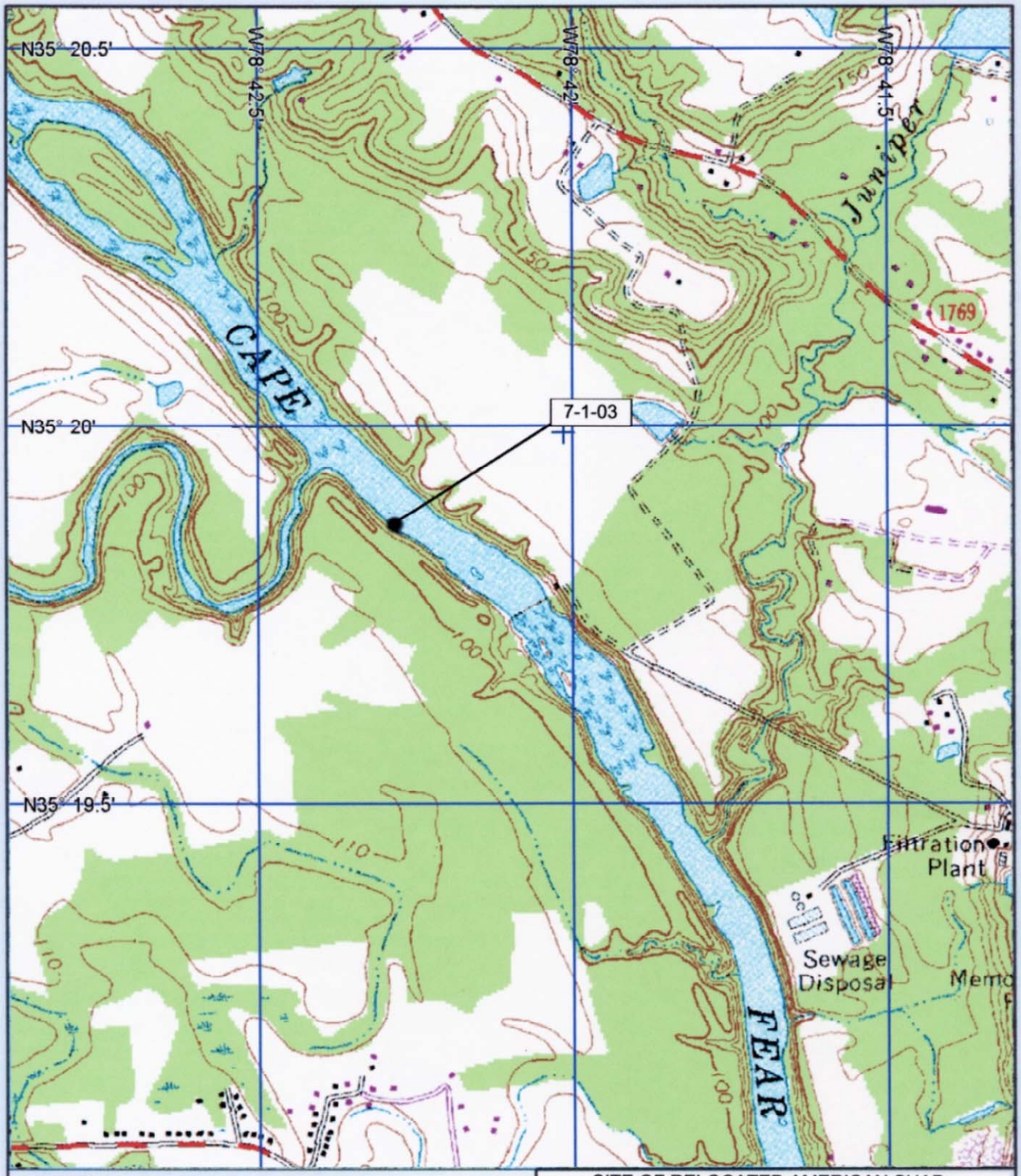
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5163

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5163-03 |
| | | CP#1645.32 |
| | | 2 OF 3 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-18-03
- SITE OF RELOCATED FISH

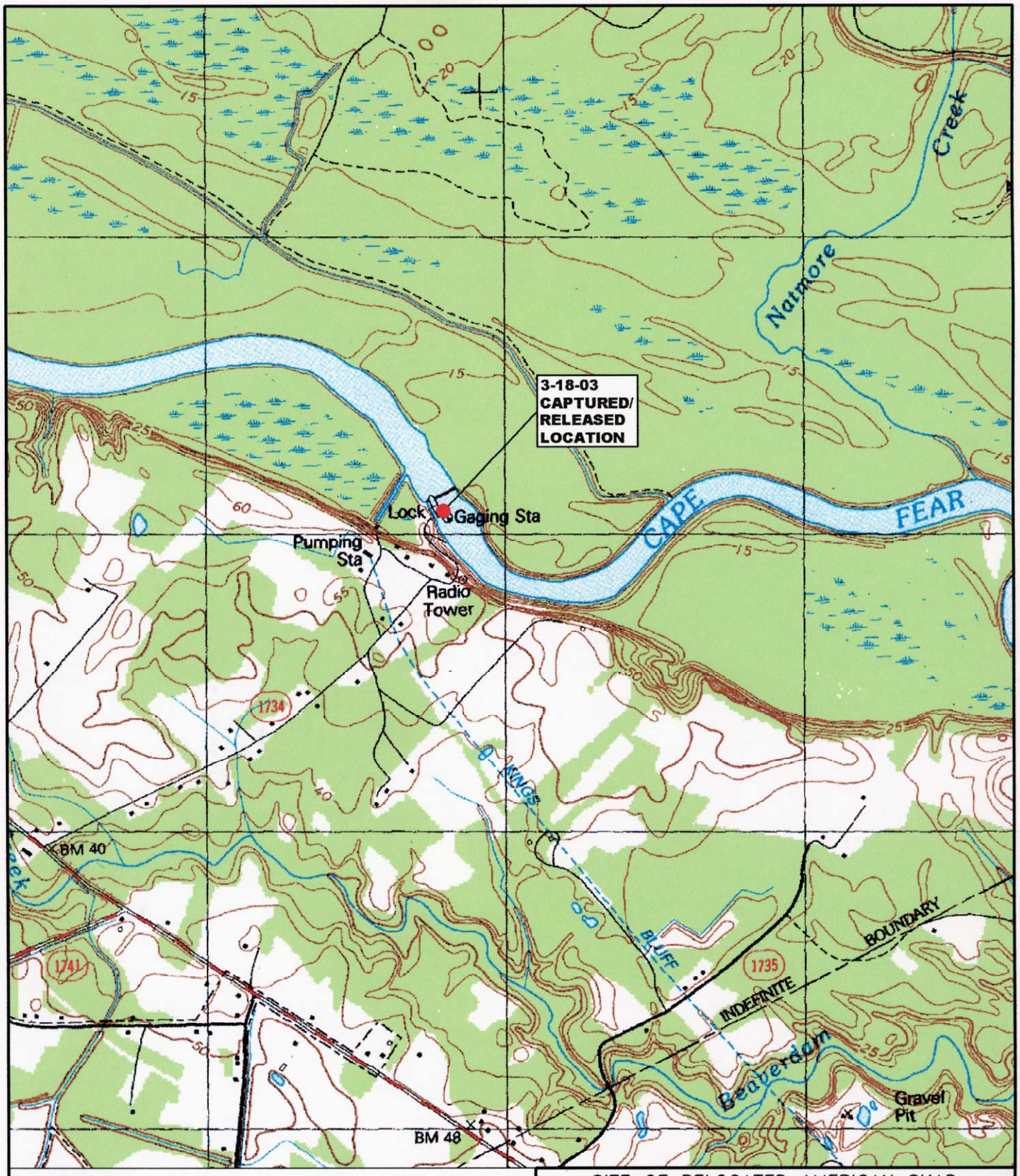
0 1500 3000

SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5163

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 9/2/03 | | FILE: CZR5163-03 |
| CZR INCORPORATED ENVIRONMENTAL CONSULTANTS | 4709 COLLEGE ACRES DRIVE SUITE 2 WILMINGTON, NORTH CAROLINA 28403 TEL 910/392-9253 FAX 910/392-9138 | CP#1645.32 |
| | | 3 OF 3 |




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-18-03
- SITE OF RELOCATED FISH

0 1500 3000

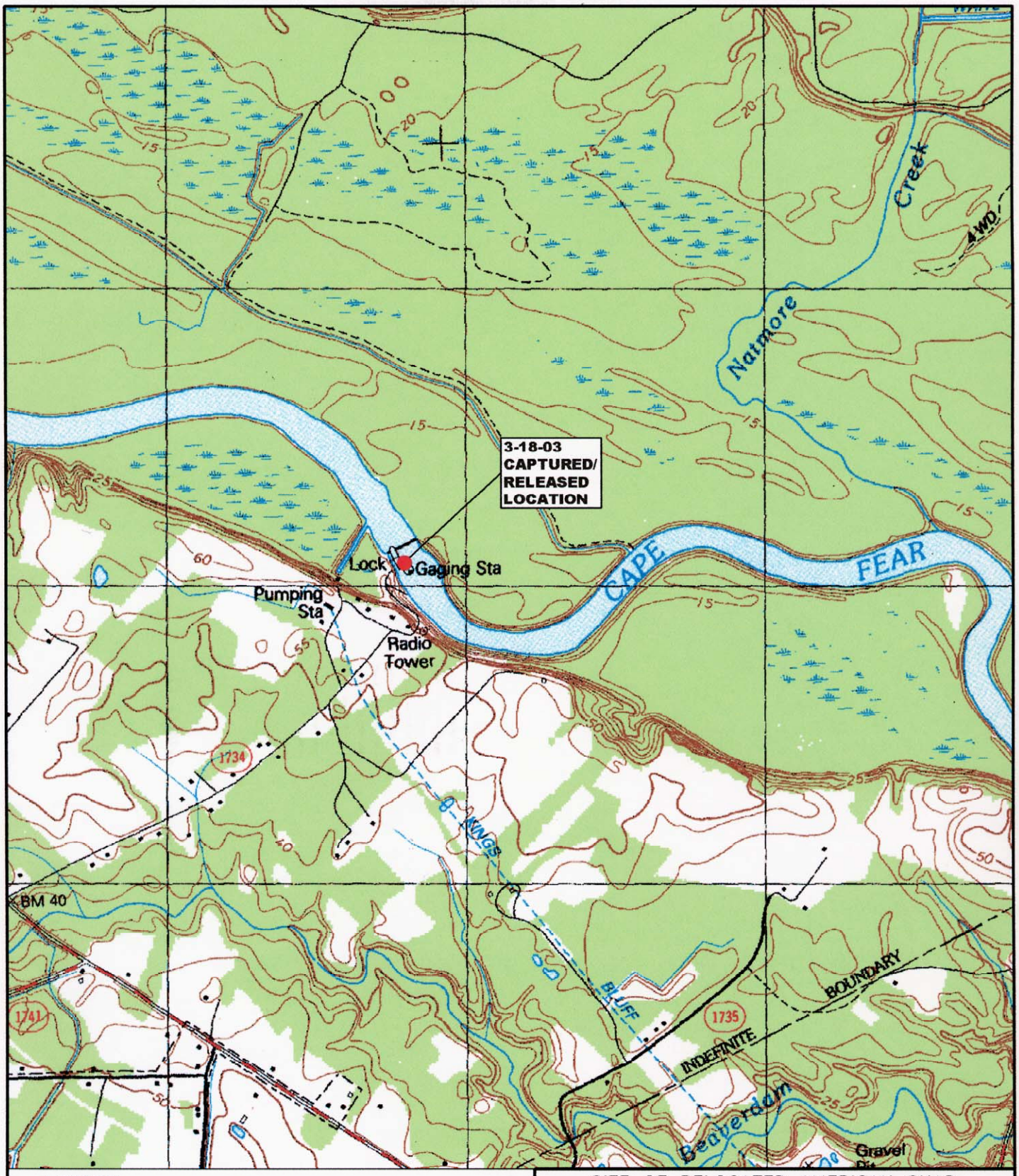
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5164

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5164-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-18-03
- SITE OF RELOCATED FISH

0 1500 3000

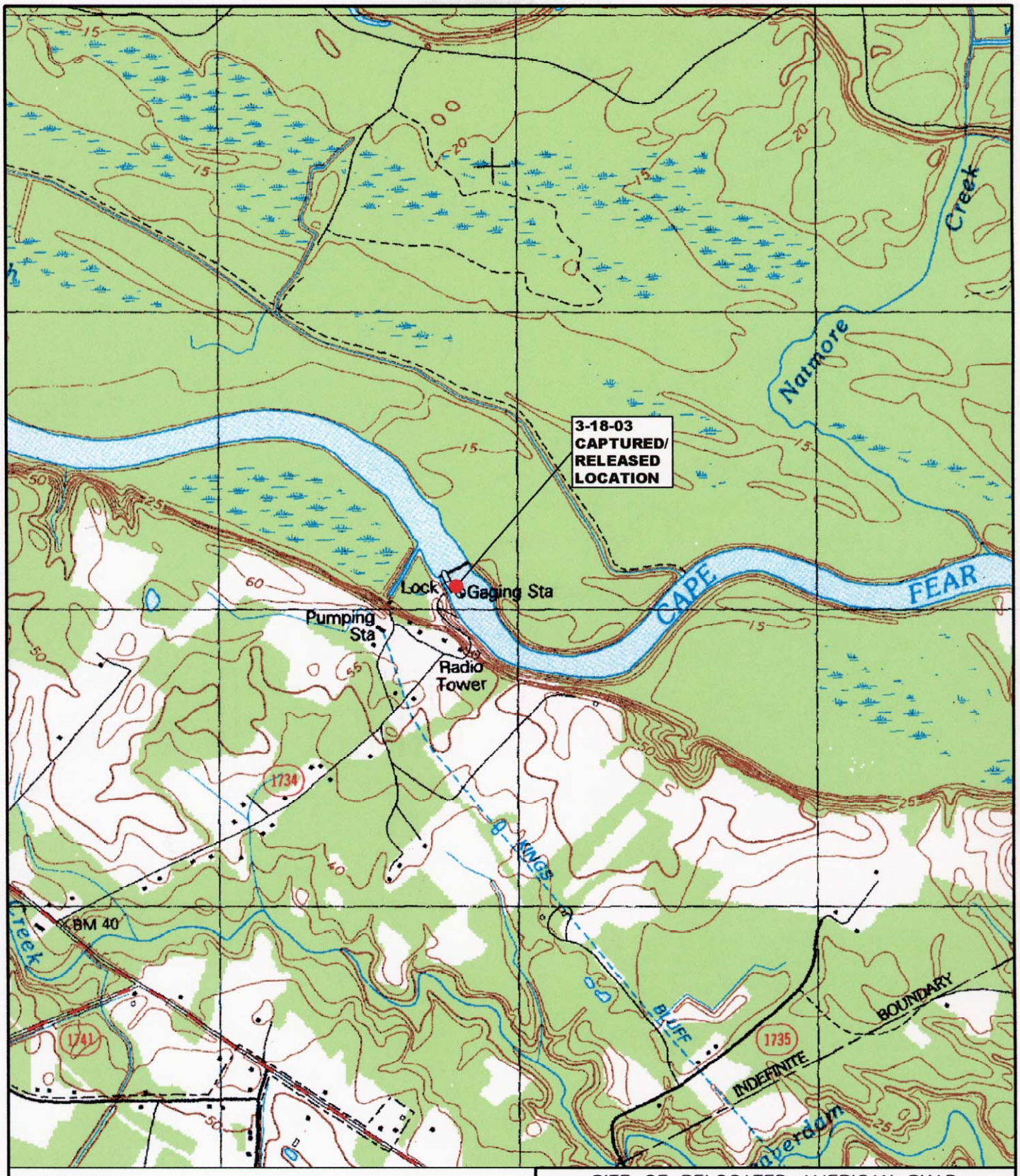
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5165

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5165-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-18-03
- SITE OF RELOCATED FISH

0 1500 3000

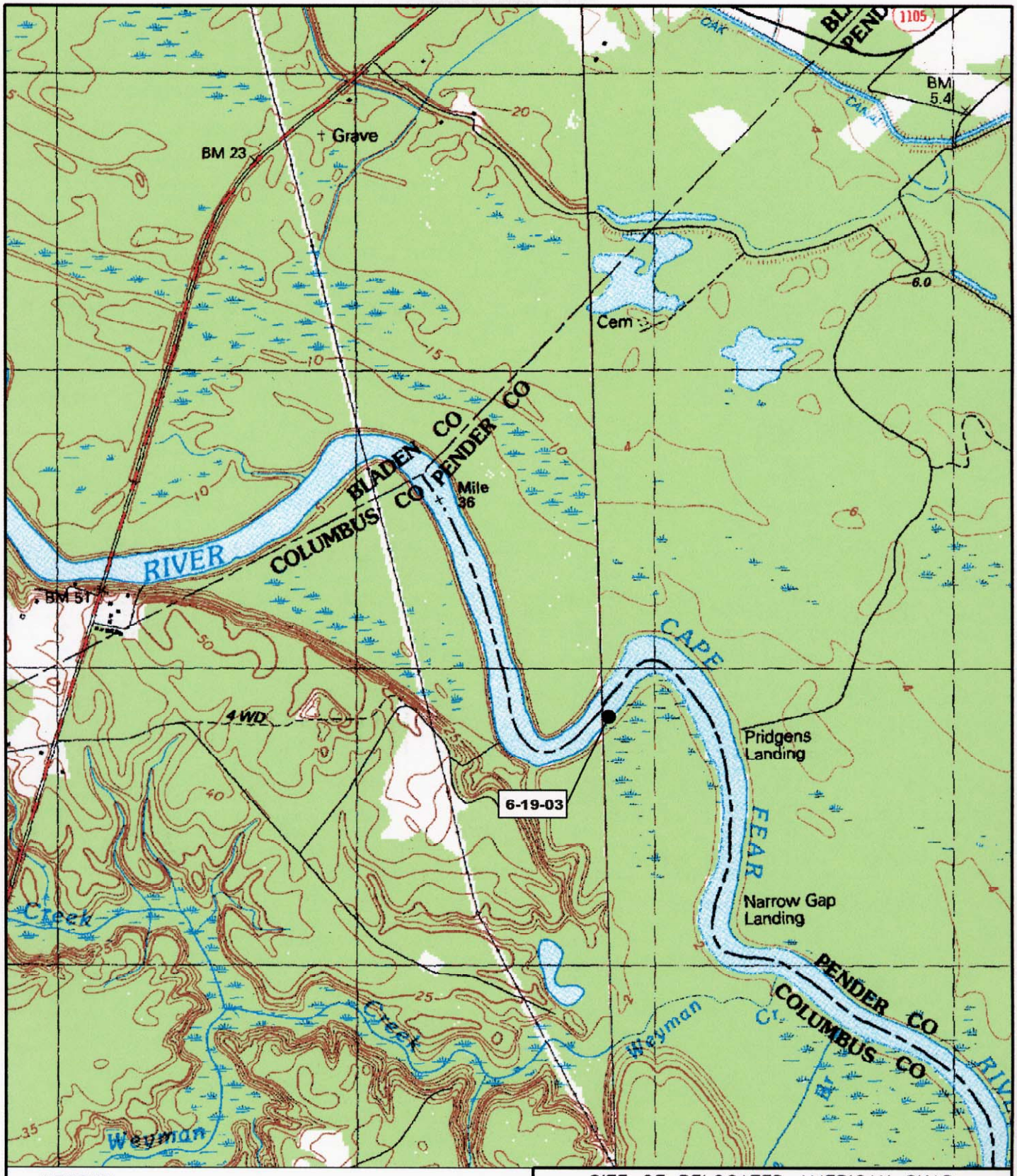
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5166

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5166-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-18-03
- SITE OF RELOCATED FISH

0 1500 3000

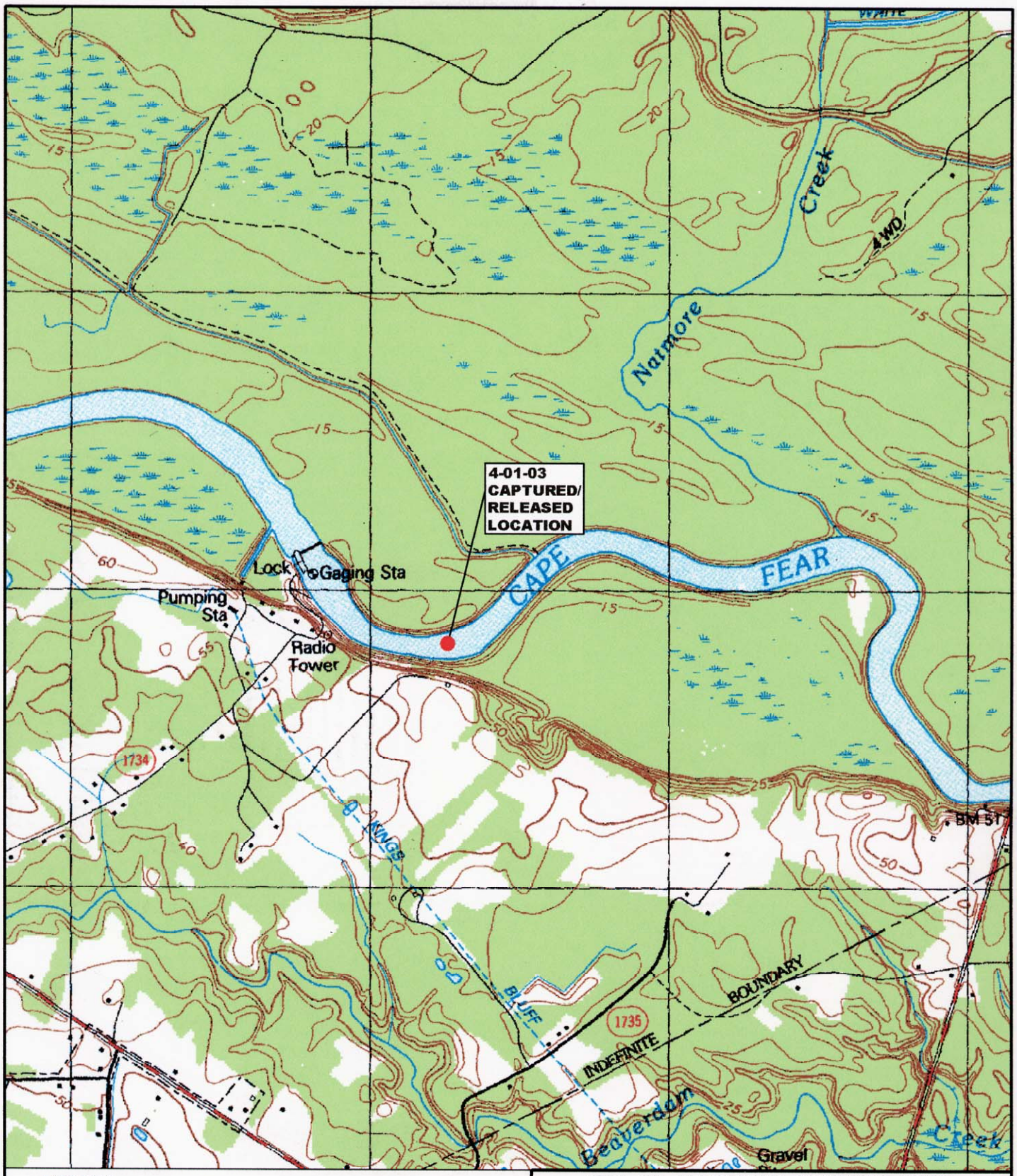
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5166

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5166-03 |
| | | CP#1645.32 |
| | | 2 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-01-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

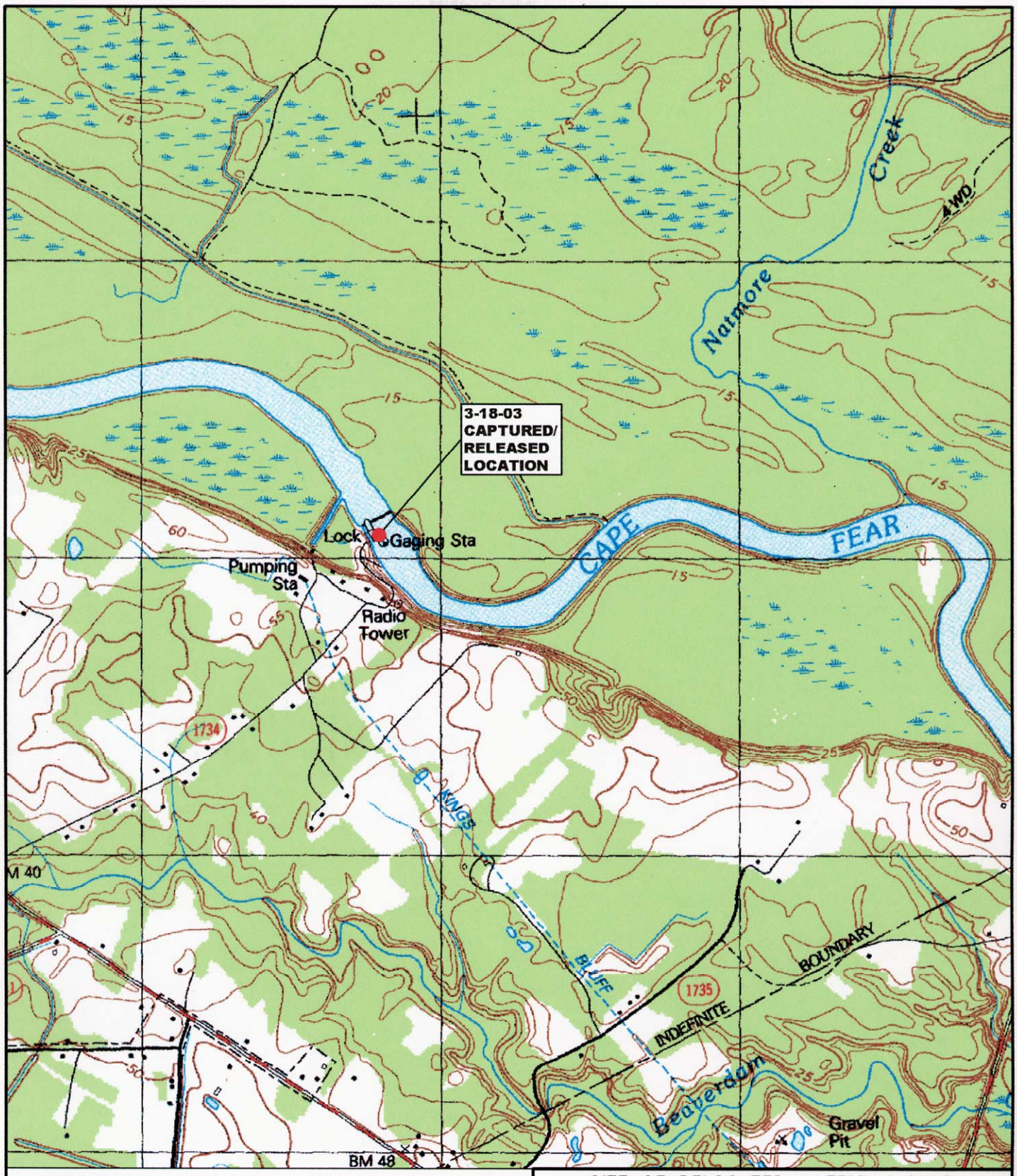
SITE OF RELOCATED AMERICAN SHAD
CZR5167

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5167-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS

4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-18-03
- SITE OF RELOCATED FISH

0 1500 3000

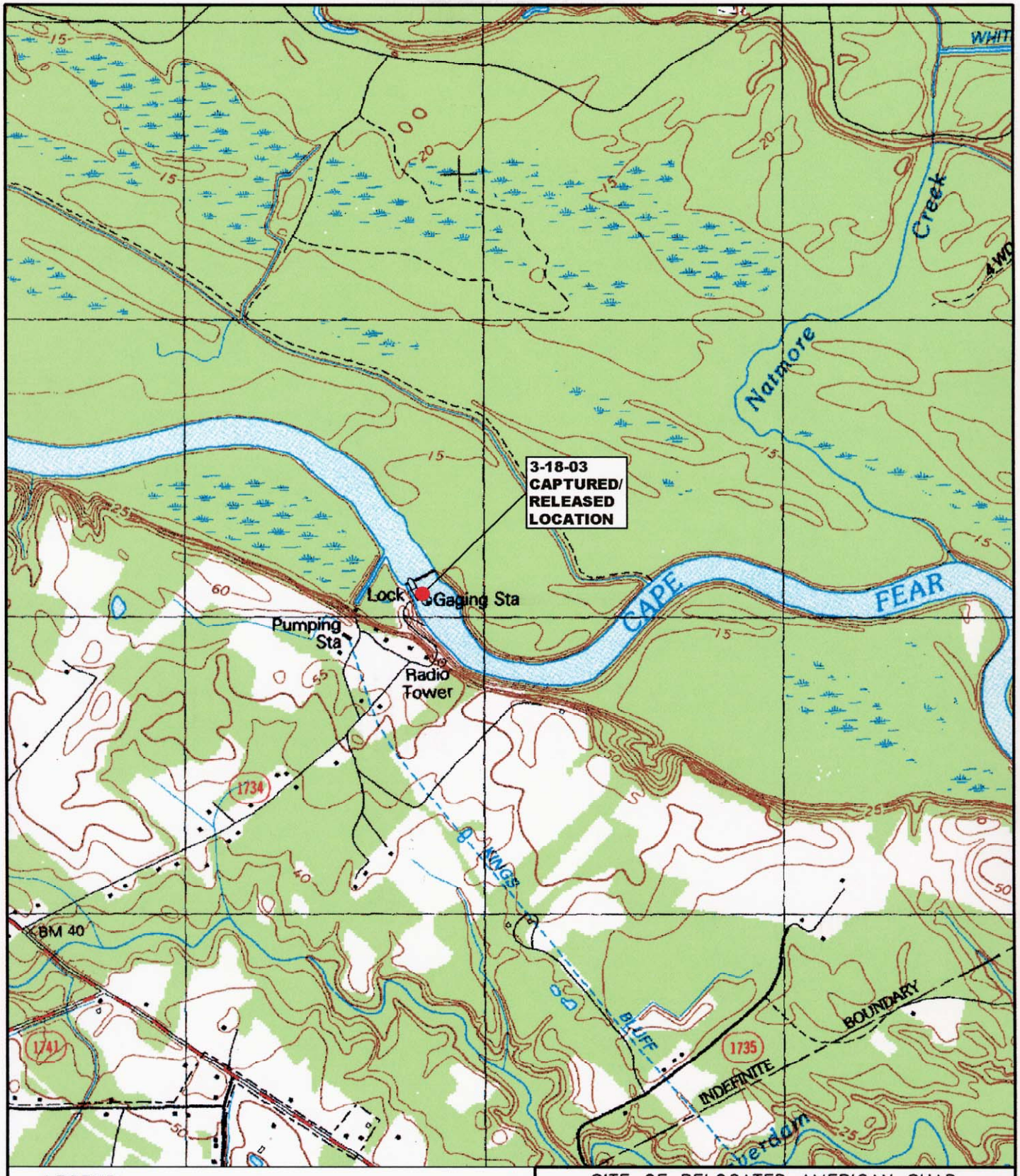
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5168

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5168-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 3-18-03
- SITE OF RELOCATED FISH

0 1500 3000

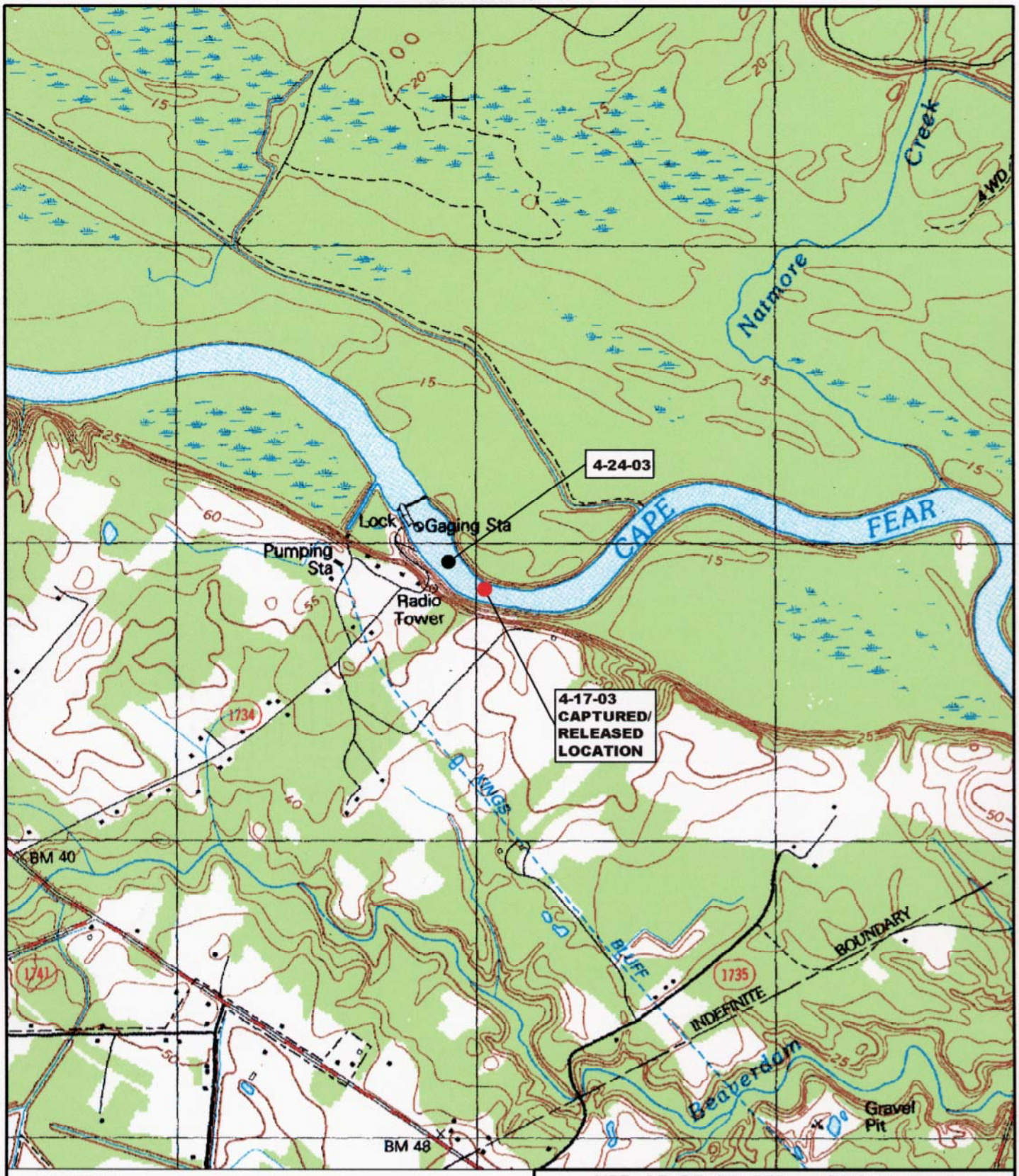
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5169

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5169-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-17-03
- SITE OF RELOCATED FISH

0 1500 3000

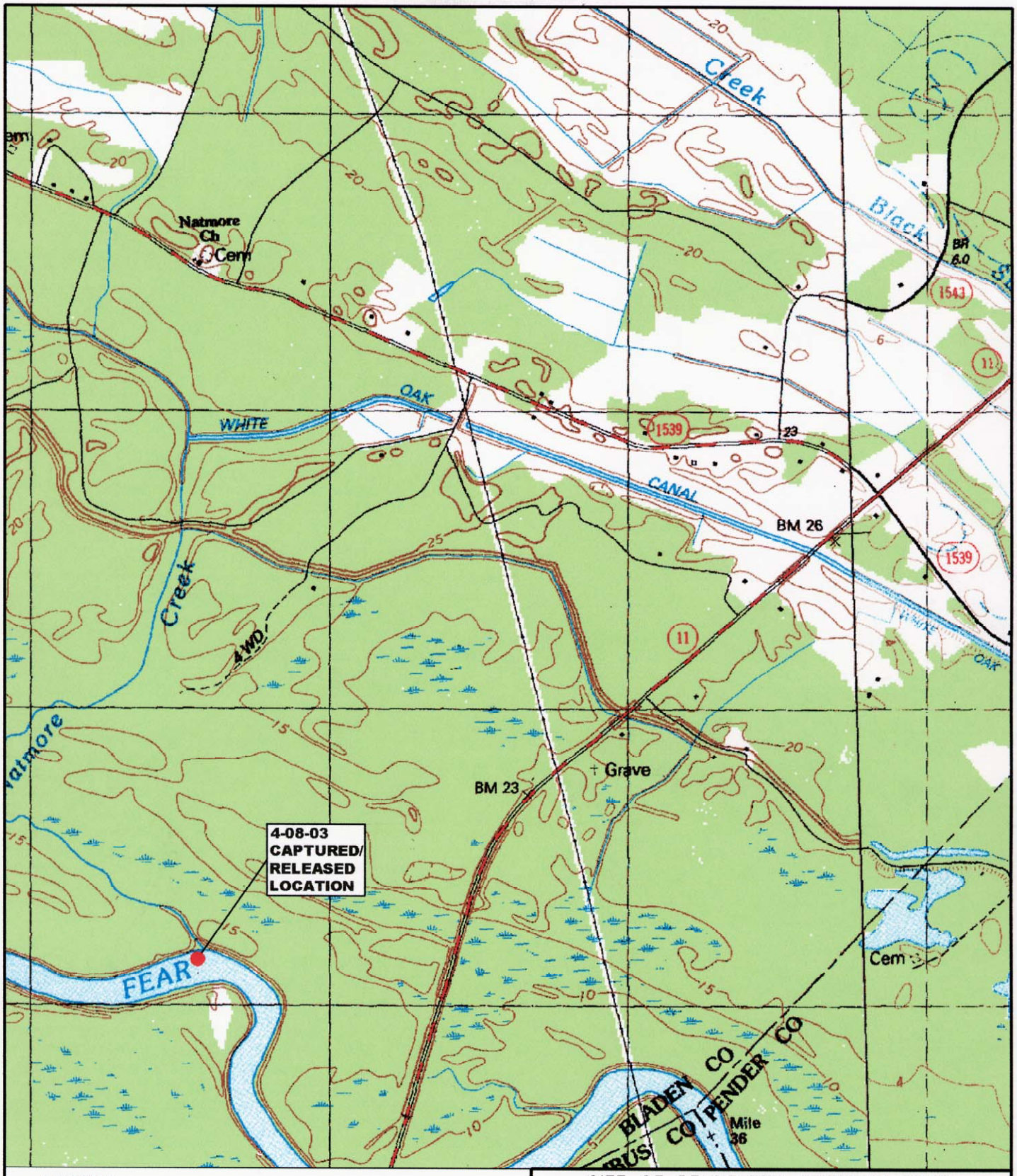
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5169B

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5169B-03 |
| | | CP#1645.32 |

CZR INCORPORATED ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-08-03
- SITE OF RELOCATED FISH

0 1500 3000

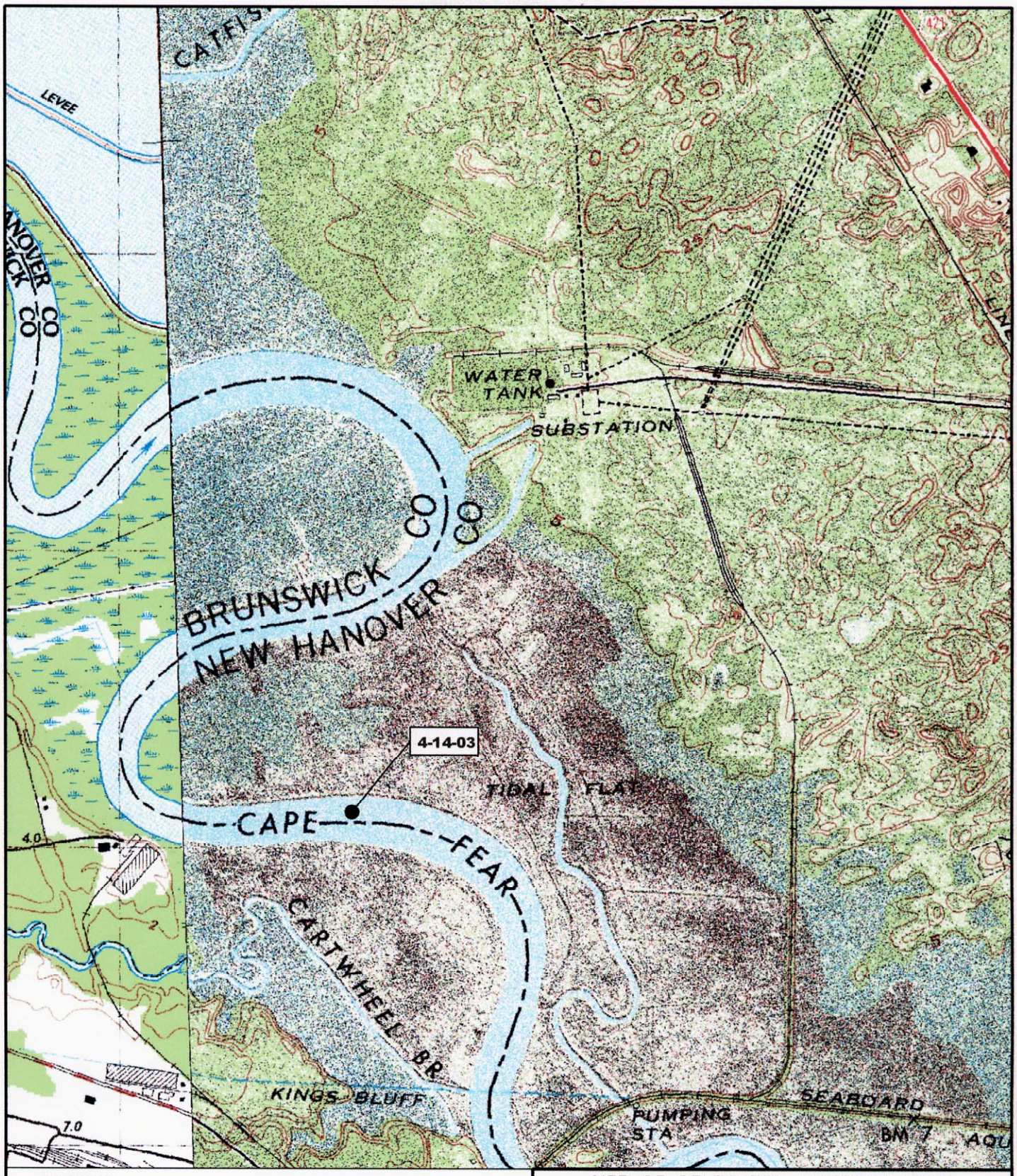
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5170

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5170-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-08-03
- SITE OF RELOCATED FISH

0 1500 3000

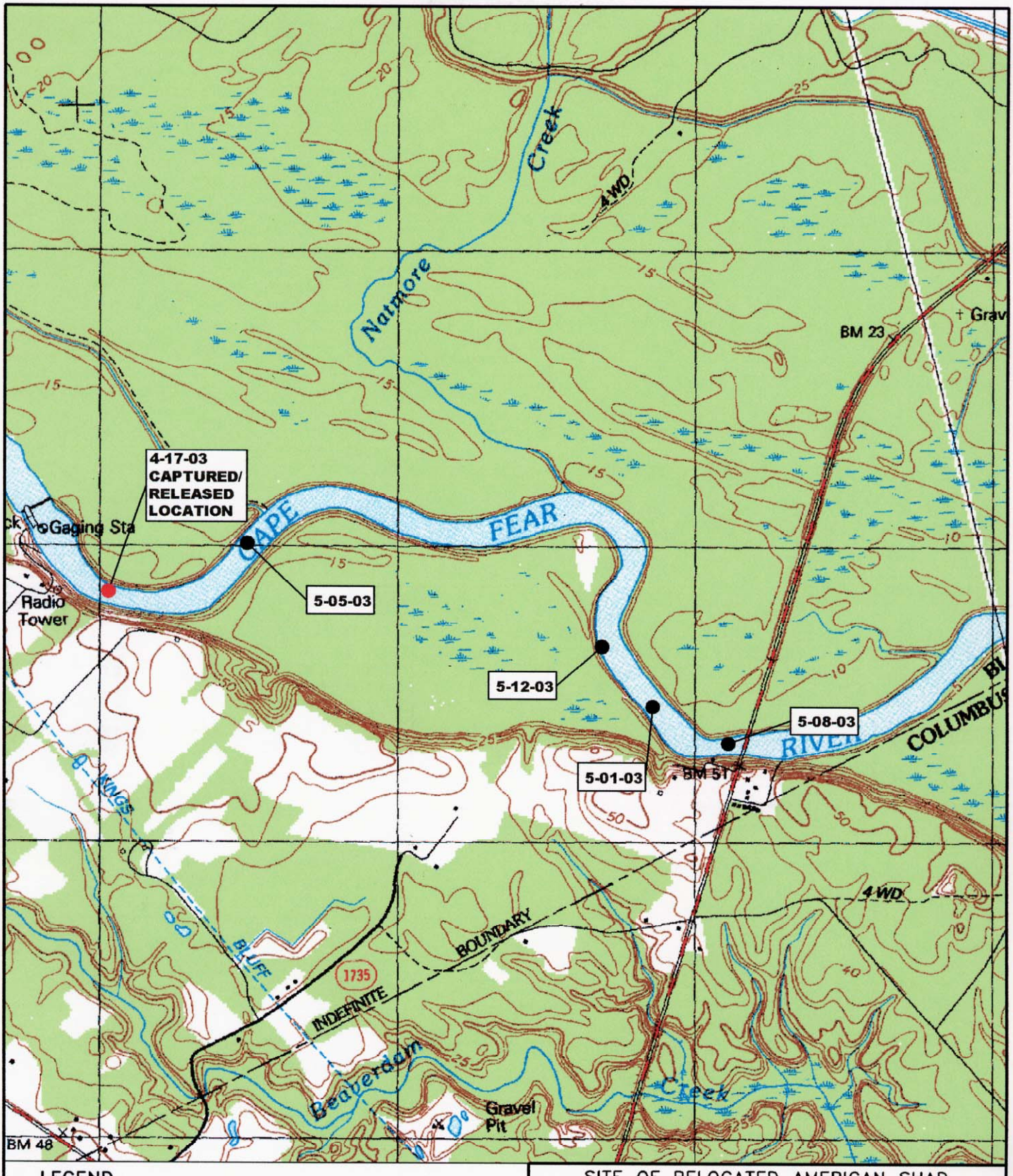
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5170

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5170-03 |
| | | CP#1645.32 |
| | | 2 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-17-03
- SITE OF RELOCATED FISH

0 1500 3000

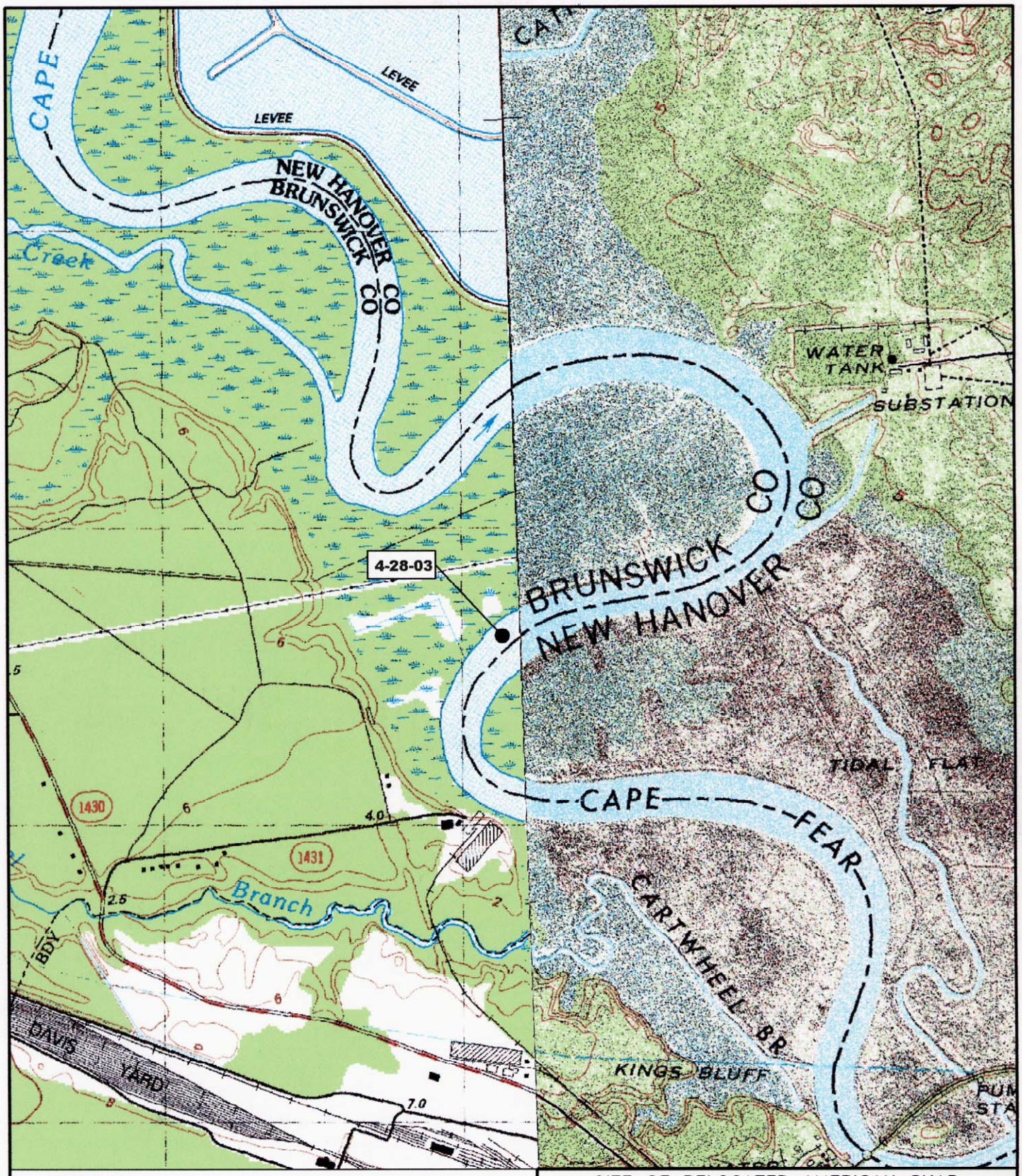
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5171

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5171-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-17-03
- SITE OF RELOCATED FISH

0 1500 3000

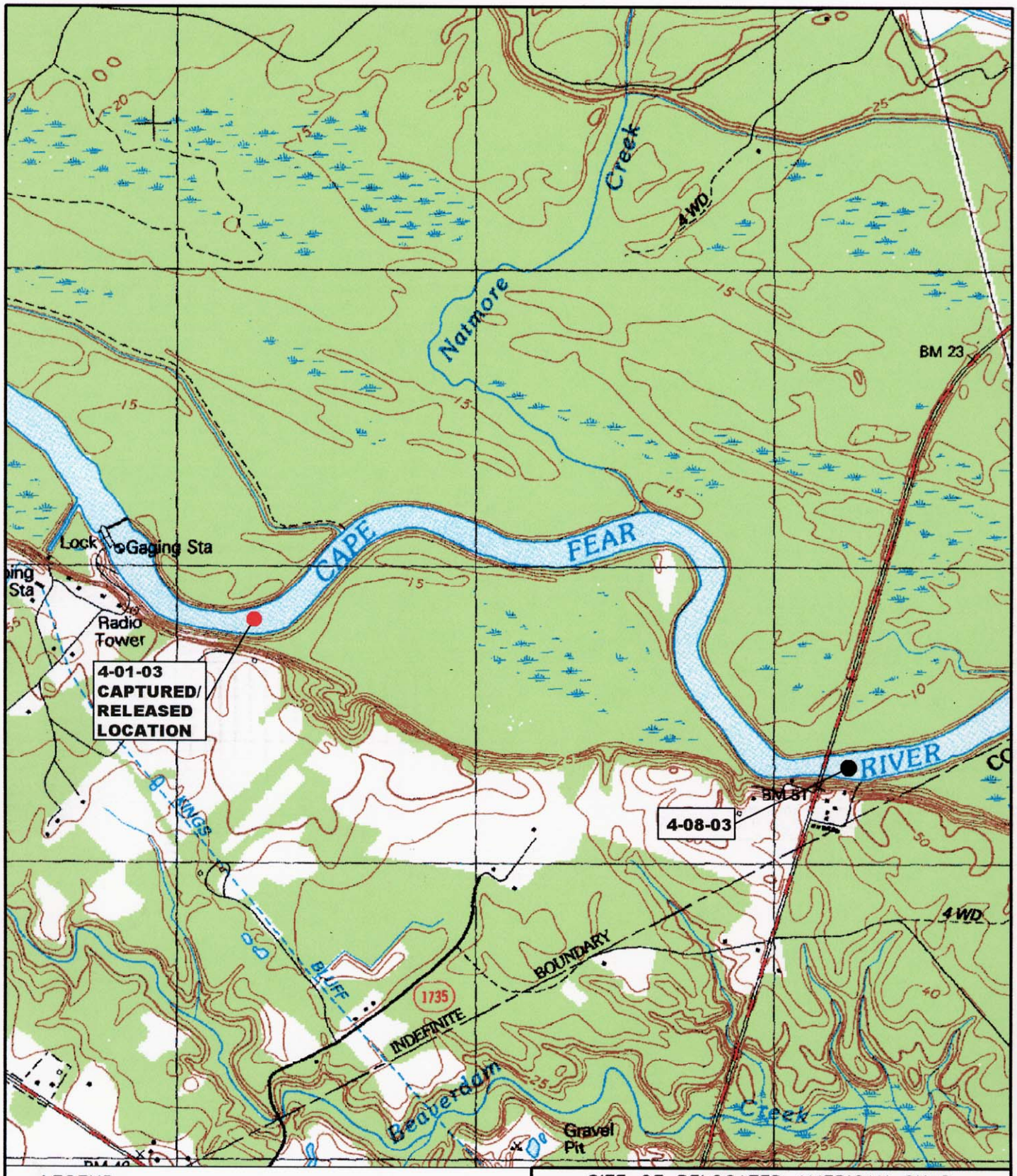
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5171

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5171-03 |
| | | CP#1645.32 |
| | | 2 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-01-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5172

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5172-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-09-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

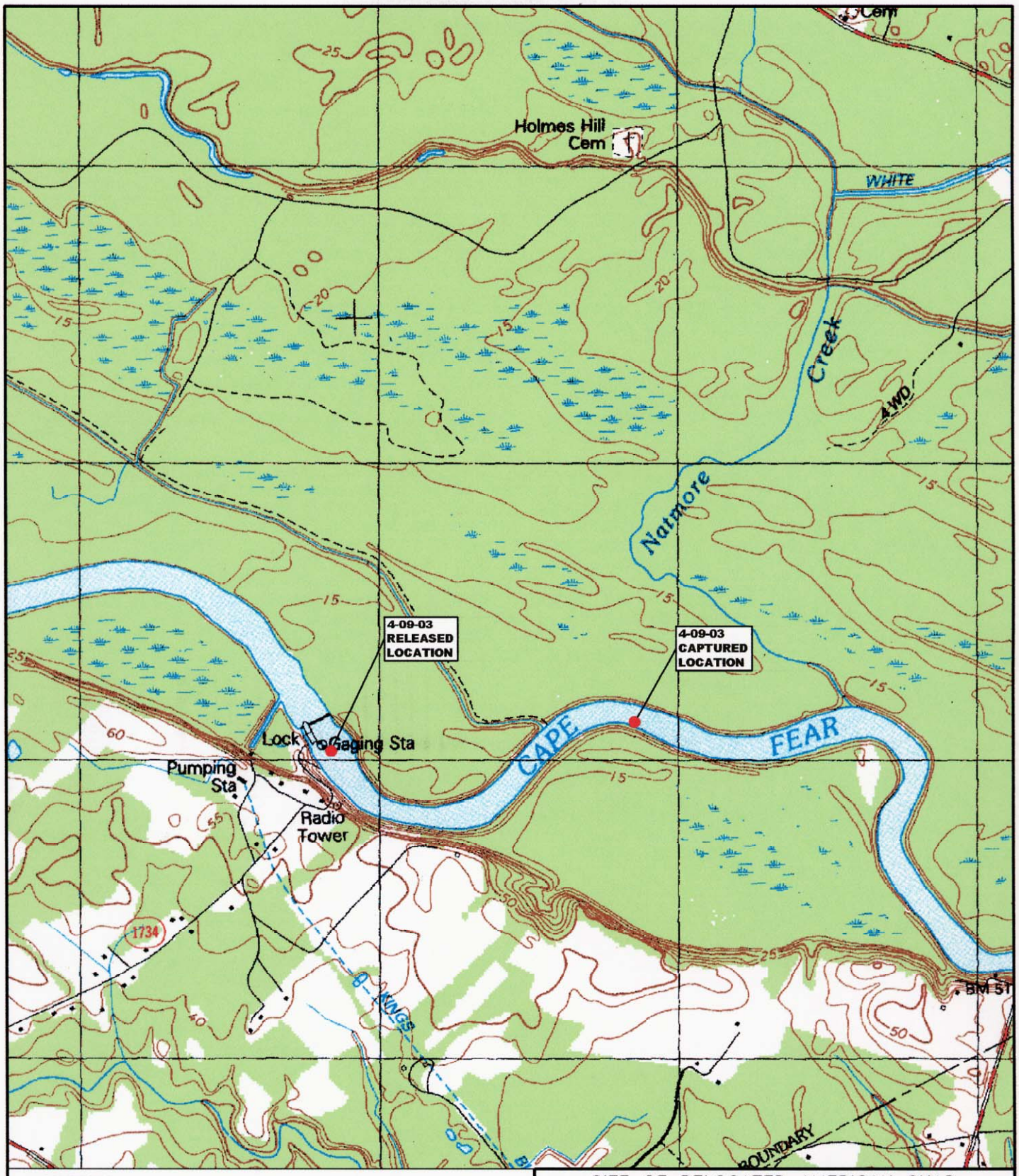
SITE OF RELOCATED AMERICAN SHAD
CZR5173

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5173-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS

4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-09-03
- SITE OF RELOCATED FISH

0 1500 3000

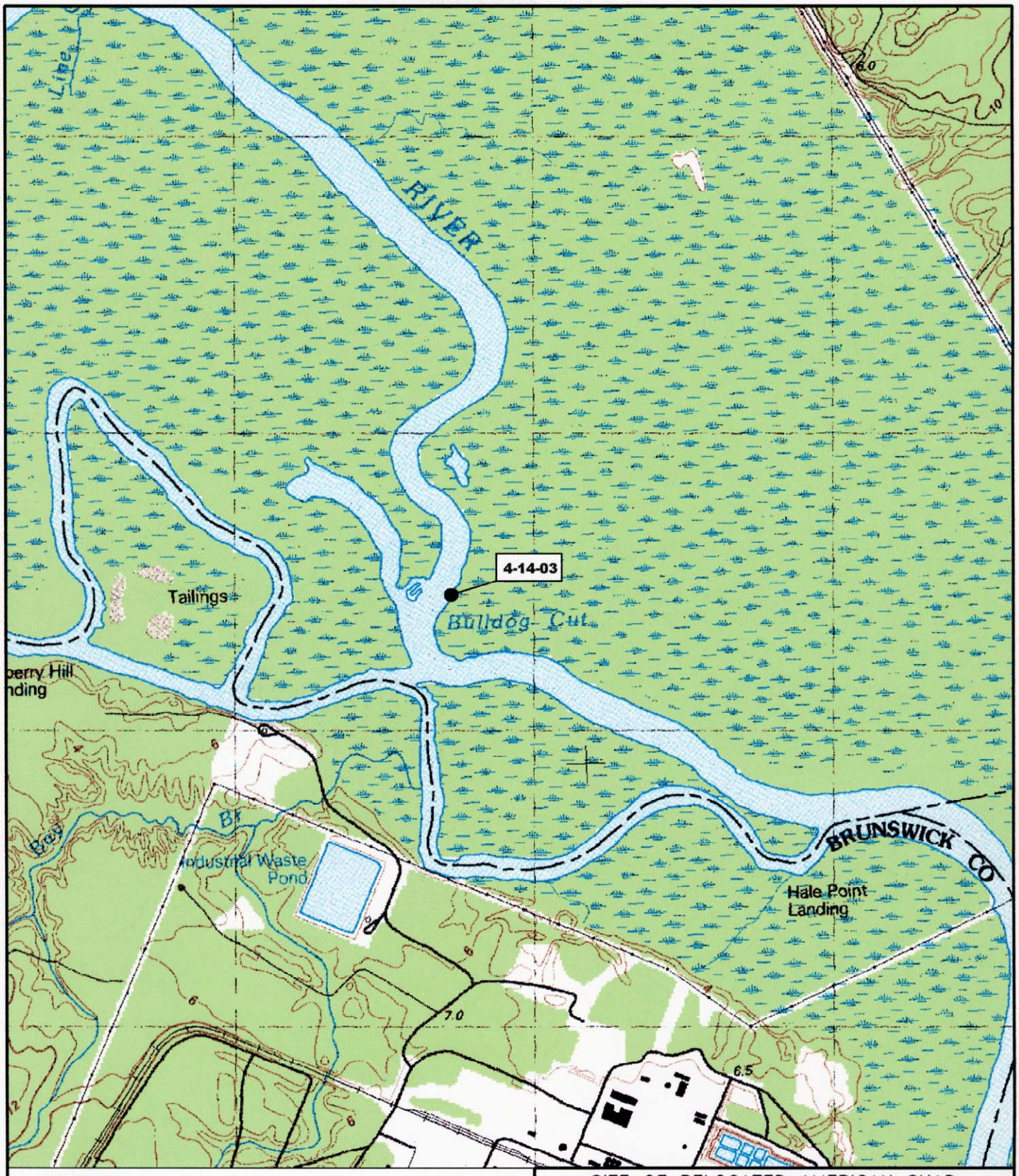
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5174

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5174-03 |
| | | CP#1645.32 |
| | | 1 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-09-03
- SITE OF RELOCATED FISH

0 1500 3000

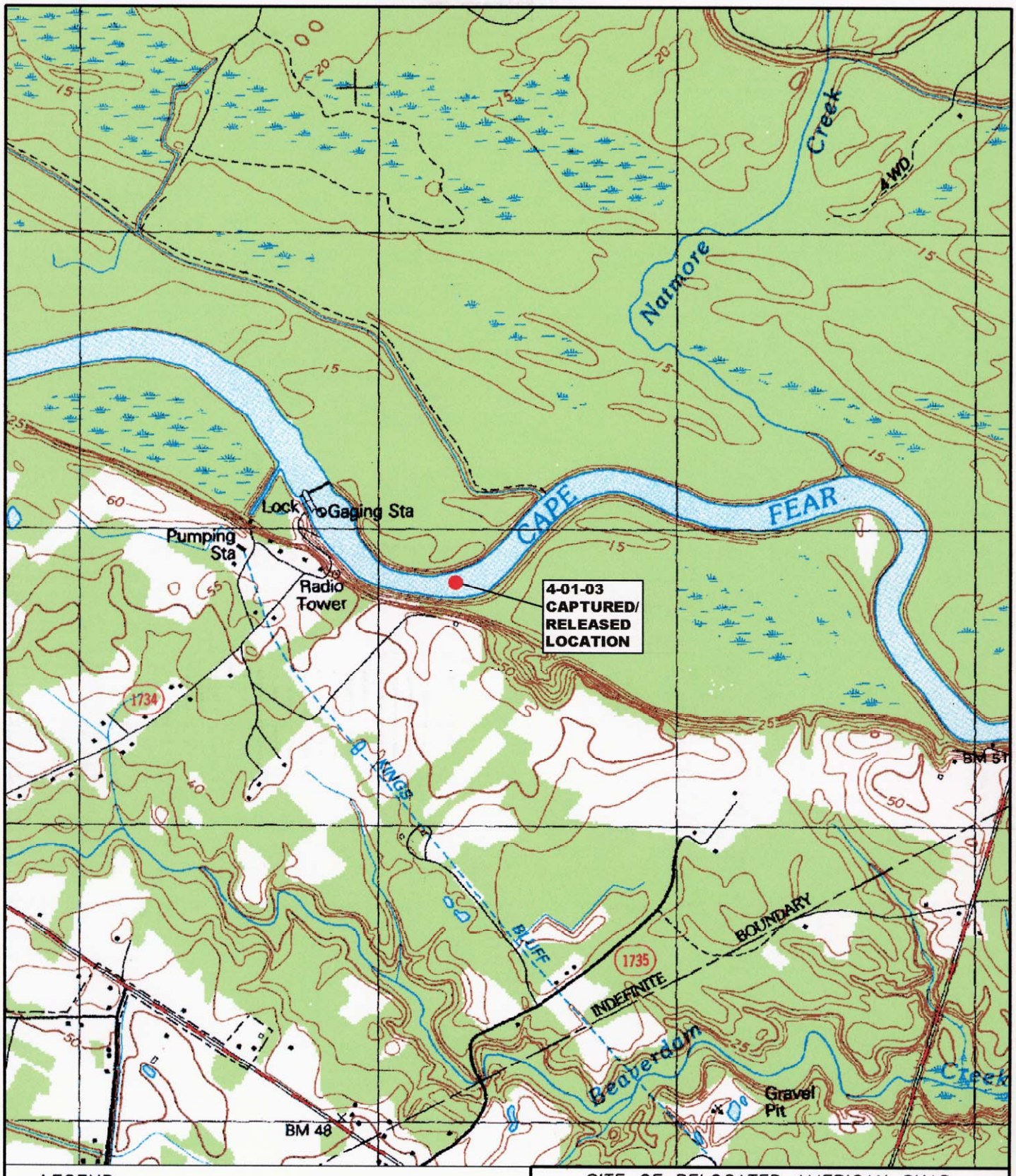
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5174

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5174-03 |
| | | CP#1645.32 |
| | | 2 OF 2 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-01-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

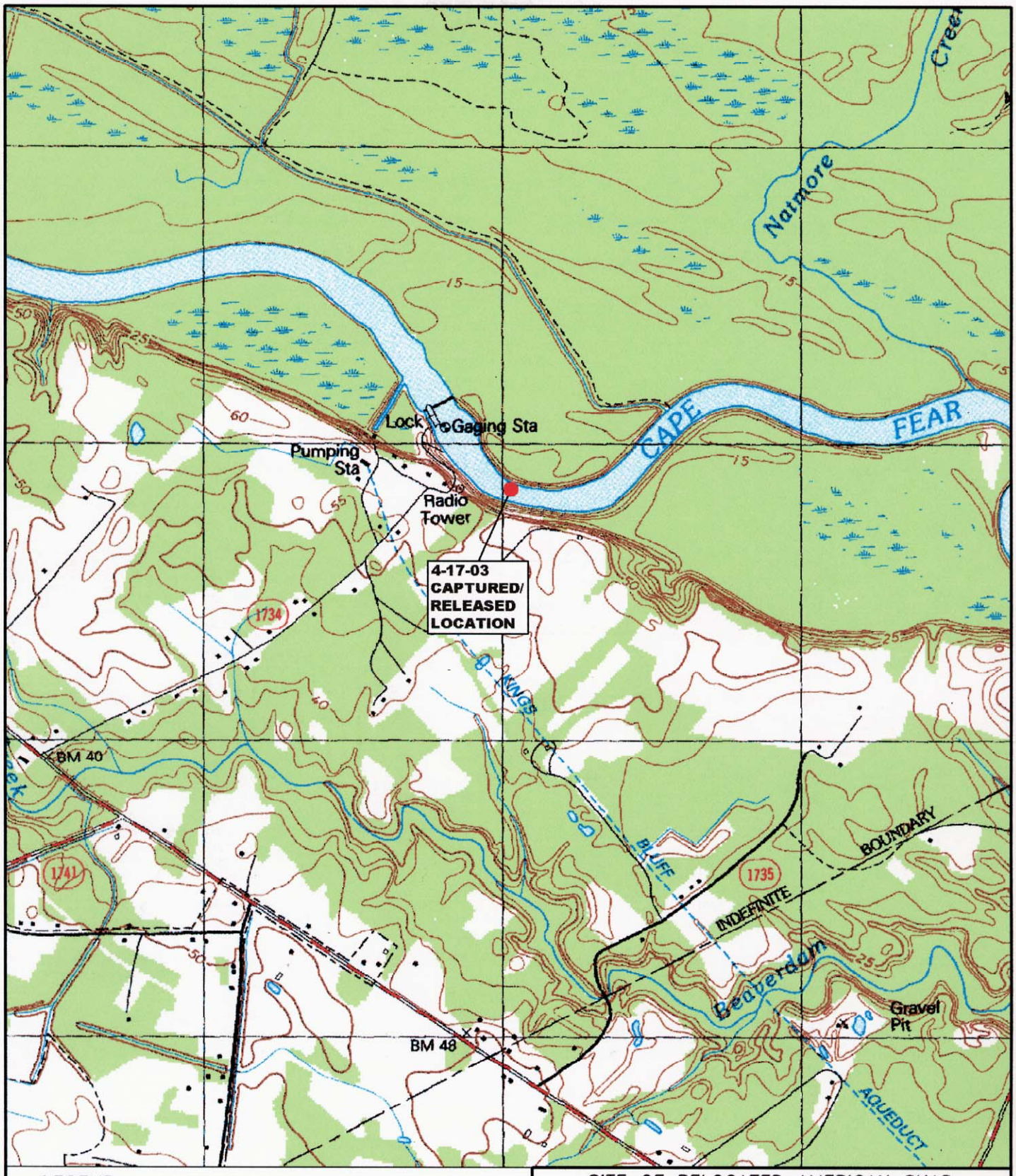
SITE OF RELOCATED AMERICAN SHAD
CZR5175

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5175-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS

4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-17-03
- SITE OF RELOCATED FISH

0 1500 3000

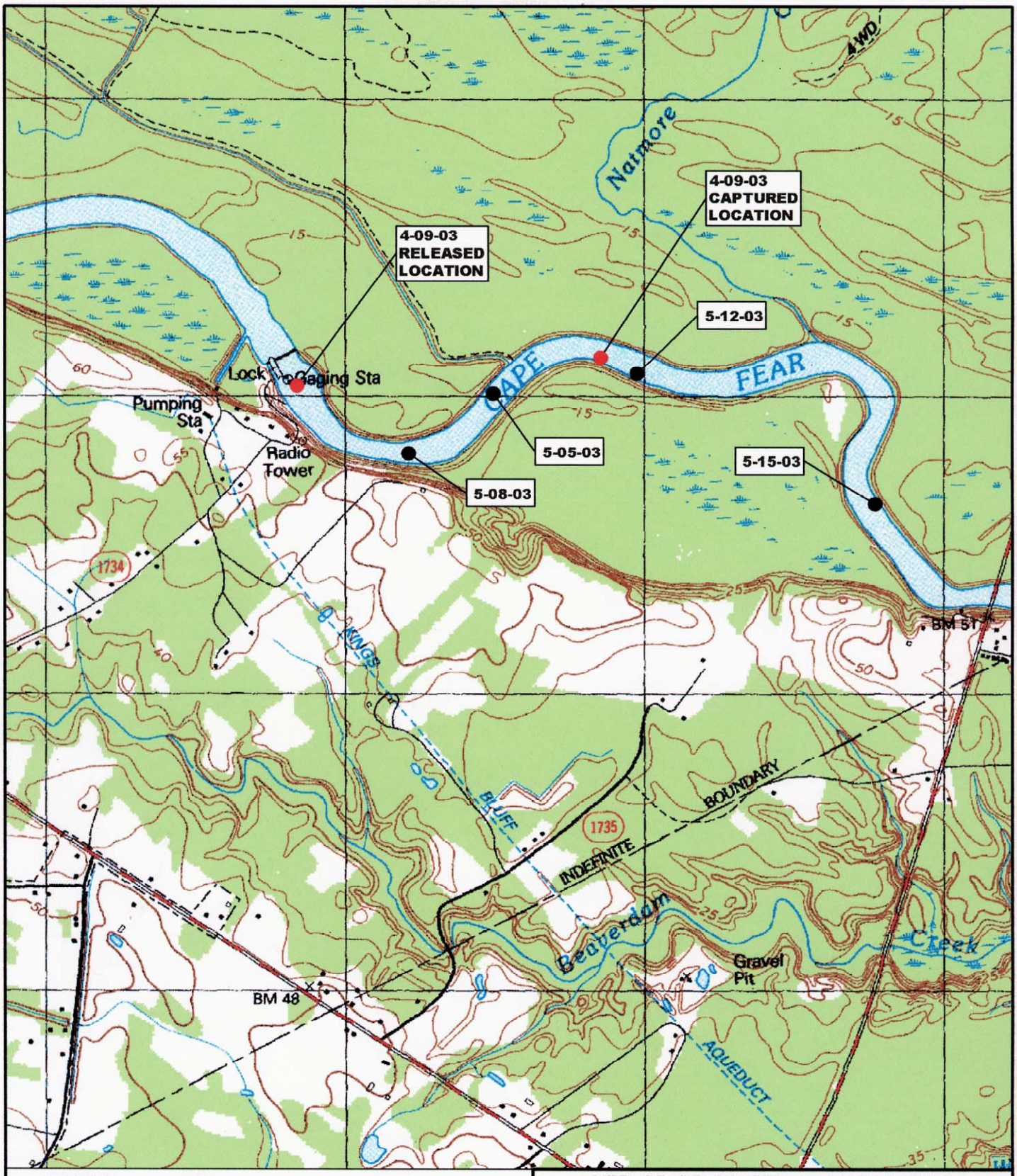
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5176

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5176-03 |
| | | CP#1645.32 |

CZR INCORPORATED ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-09-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5177

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5177-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

LEGEND

- ● CAPTURE AND RELEASE OF TAGGED FISH ON 4-09-03
- ● SITE OF RELOCATED FISH

0 1500 3000

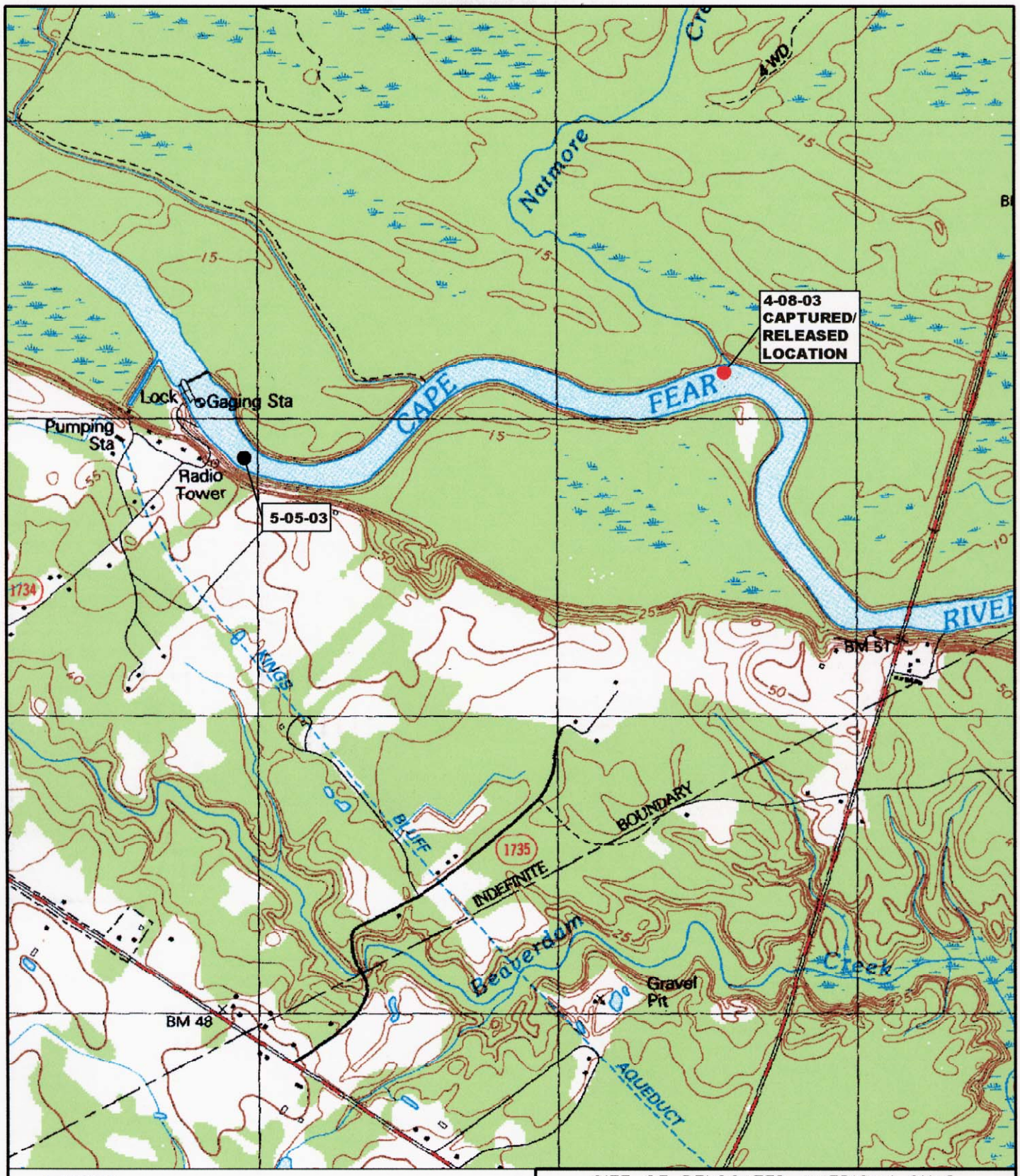
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5178

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5178-03 |
| | | CP#1645.32 |

CZR INCORPORATED ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-08-03
- SITE OF RELOCATED FISH

0 1500 3000

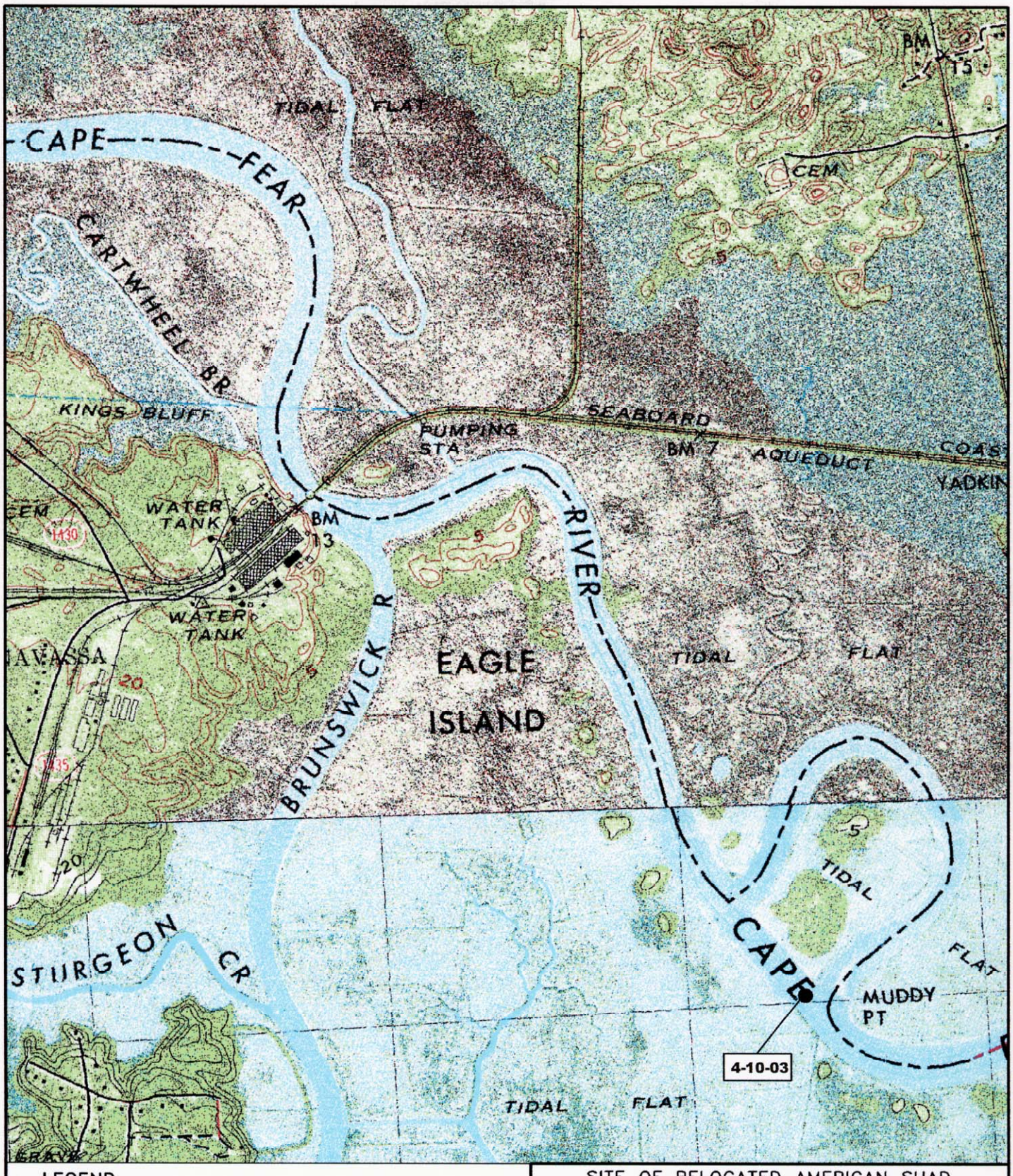
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5179

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5179-03 |
| | | CP#1645.32 |
| | | 1 OF 3 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-08-03
- SITE OF RELOCATED FISH

0 1500 3000

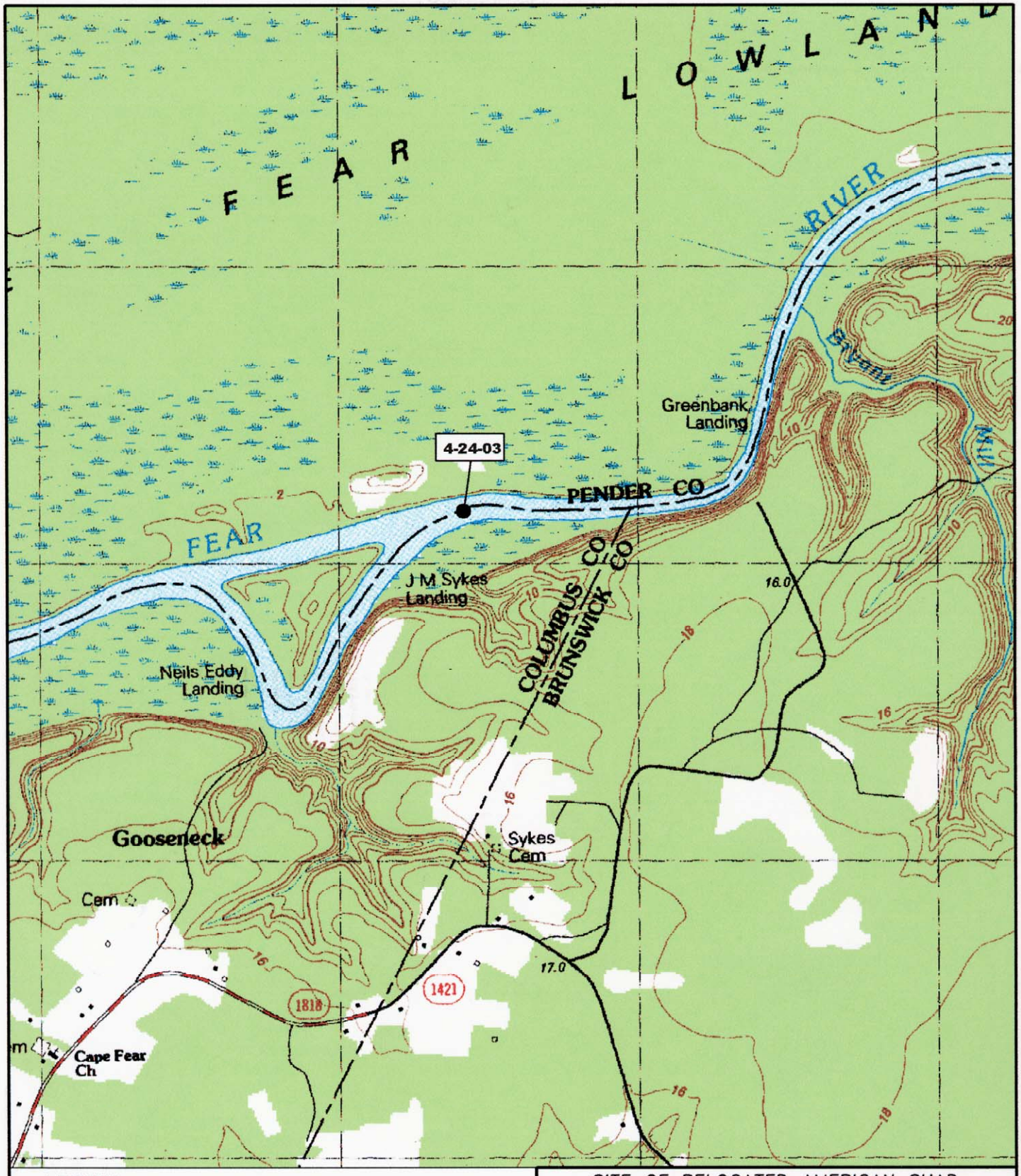
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5179

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5179-03 |
| | | CP#1645.32 |
| | | 2 OF 3 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-08-03
- SITE OF RELOCATED FISH

0 1500 3000

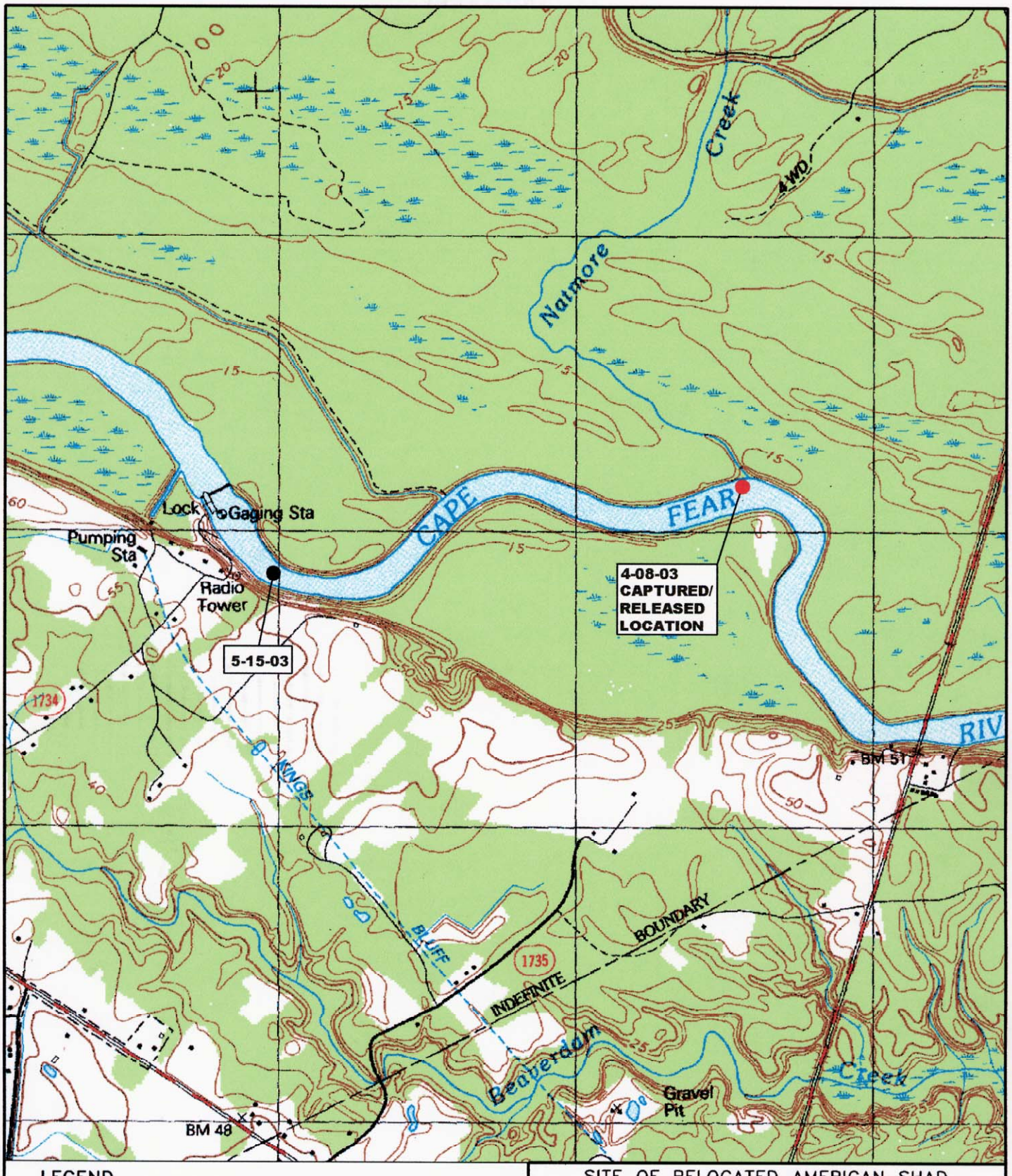
SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5179

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5179-03 |
| | | CP#1645.32 |
| | | 3 OF 3 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139




LEGEND

- CAPTURE AND RELEASE OF TAGGED FISH ON 4-08-03
- SITE OF RELOCATED FISH

0 1500 3000

SCALE IN FEET

SITE OF RELOCATED AMERICAN SHAD
CZR5180

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

| | | |
|---|---|---|
| SCALE: AS SHOWN | APPROVED BY: | DRAWN BY: TLJ/BFG |
| DATE: 8/29/03 | | FILE: CZR5180-03 |
| | | CP#1645.32 |

CZR INCORPORATED
ENVIRONMENTAL CONSULTANTS
4709 COLLEGE ACRES DRIVE
SUITE 2
WILMINGTON, NORTH CAROLINA 28403
TEL 910/392-9253
FAX 910/392-9139

# APPENDIX D

# LIST OF COORDINATES COLLECTED DURING TAGGING AND MANUAL TRACKING

Appendix D. List of coordinates (UTM, NAD83, meters) collected during tagging and manual tracking.

| TAG # | DATE | NORTHING | EASTING |
|---|---|---|---|
| CZR5001 | 2/26/02 | 3792286 | 227491 |
| | 3/3/03 | 3792606 | 227632 |
| | 3/5/03 | 3792606 | 227632 |
| | 3/10/03 | 3792606 | 227632 |
| | 3/14/03 | 3792606 | 227632 |
| | 3/17/03 | 3792606 | 227632 |
| | 3/19/03 | 3792606 | 227632 |
| | 3/24/03 | 3792606 | 227632 |
| | 3/27/03 | 3792606 | 227632 |
| | 3/31/03 | 3792606 | 227632 |
| | 4/3/03 | 3792606 | 227632 |
| CZR5002 | 3/13/02 | 3793037 | 780196 |
| | 3/3/03 | 3792650 | 227590 |
| | 3/5/03 | 3792650 | 227590 |
| | 3/10/03 | 3792650 | 227590 |
| | 3/14/03 | 3792650 | 227590 |
| | 3/17/03 | 3792650 | 227590 |
| | 3/19/03 | 3792650 | 227590 |
| | 3/24/03 | 3792650 | 227590 |
| | 3/27/03 | 3792650 | 227590 |
| | 3/31/03 | 3792650 | 227590 |
| | 4/3/03 | 3792650 | 227590 |
| CZR5004 | 3/14/02 | 3793076 | 226422 |
| | 2/17/03 | 3793034 | 224667 |
| | 2/20/03 | 3793024 | 224614 |
| | 2/24/03 | 3792270 | 228007 |
| | 2/27/03 | 3792581 | 227659 |
| | 3/3/03 | 3792861 | 227247 |
| | 3/5/03 | 3792843 | 227260 |
| | 3/10/03 | 3792745 | 227010 |
| | 3/19/03 | 3792728 | 226645 |
| | 5/15/03 | 3792282 | 228065 |
| | 5/22/03 | 3792530 | 227790 |
| | 5/27/03 | 3792562 | 227833 |
| CZR5007 | 3/13/02 | 3793076 | 226422 |
| | 2/6/03 | 3794687 | 224986 |
| | 2/13/03 | 3794687 | 224986 |
| | 2/17/03 | 3794855 | 224846 |
| | 2/20/03 | 3794758 | 224913 |
| | 3/17/03 | 3794802 | 224781 |
| | 3/19/03 | 3794802 | 224871 |
| | 3/31/03 | 3794817 | 224890 |
| | 4/3/03 | 3794732 | 225000 |
| | 4/7/03 | 3794732 | 225000 |
| | 4/10/03 | 3794732 | 225000 |
| | 4/14/03 | 3794714 | 225047 |

Appendix D. (continued)

| TAG # | DATE | NORTHING | EASTING |
|---|---|---|---|
| | 4/16/03 | 3794760 | 224947 |
| | 5/5/03 | 3794784 | 224915 |
| | 5/15/03 | 3794784 | 224915 |
| | 5/19/03 | 3794648 | 225033 |
| | 5/27/03 | 3794696 | 225047 |
| | 5/29/03 | 3794783 | 225001 |
| | 6/2/03 | 3794783 | 225001 |
| | 6/12/03 | 3794783 | 225001 |
| | 6/26/03 | 2794783 | 225001 |
| CZR5009 | 1/30/03 | 3791146 | 228156 |
| | 2/26/03 | 3792755 | 226940 |
| | 2/13/03 | 3792829 | 227092 |
| | 2/17/03 | 3794094 | 225808 |
| | 2/20/03 | 3792801 | 226954 |
| | 2/24/03 | 3792899 | 226428 |
| | 2/27/03 | 3792769 | 226962 |
| | 3/3/03 | 3792812 | 226498 |
| | 3/5/03 | 3797357 | 224705 |
| | 3/27/03 | 3806204 | 204747 |
| | 4/3/03 | 3806386 | 764892 |
| | 4/10/03 | 3810056 | 749549 |
| | 4/14/03 | 3810159 | 749939 |
| | 4/17/03 | 3806378 | 756401 |
| CZR5010 | 1/30/03 | 3791146 | 228156 |
| | 2/13/03 | 3792913 | 224699 |
| CZR5011 | 1/30/03 | 3791146 | 228156 |
| | 2/6/03 | 3794110 | 224950 |
| | 2/20/03 | 3791870 | 224918 |
| | 2/24/03 | 3791884 | 224959 |
| | 3/10/03 | 3792825 | 227356 |
| | 4/3/03 | 3803908 | 769017 |
| | 4/10/03 | 3806804 | 755298 |
| | 5/15/03 | 3810146 | 750664 |
| | 5/19/03 | 3809463 | 750861 |
| | 7/3/03 | 3855424 | 699253 |
| CZR5012 | 2/10/03 | 3791146 | 228156 |
| | 4/24/03 | 3808700 | 752597 |
| | 4/28/03 | 3804579 | 757560 |
| | 5/1/03 | 3809824 | 749259 |
| | 5/5/03 | 3810147 | 750693 |
| | 5/8/03 | 3809703 | 752198 |
| | 5/12/03 | 3809460 | 750846 |
| | 5/15/03 | 3808003 | 753536 |
| | 5/19/03 | 3810102 | 750567 |

Appendix D. (continued)

| TAG # | DATE | NORTHING | EASTING |
|---|---|---|---|
| CZR5014 | 3/19/02 | 3793056 | 226369 |
| | 2/13/03 | 3793559 | 226068 |
| | 3/14/03 | 3791301 | 228214 |
| CZR5015 | 2/25/03 | 3791518 | 228077 |
| | 2/27/03 | 3792506 | 227749 |
| | 3/3/03 | 3792254 | 227972 |
| | 3/24/03 | 3792445 | 227780 |
| | 3/27/03 | 3792799 | 227140 |
| | 3/31/03 | 3792799 | 227140 |
| | 4/3/03 | 3792711 | 226981 |
| | 4/7/03 | 3791622 | 228154 |
| | 7/3/03 | 3866120 | 700657 |
| CZR5016 | 2/25/03 | 3791518 | 228077 |
| | 4/28/03 | 3791181 | 227979 |
| | 6/26/03 | 3809704 | 752182 |
| CZR5017 | 2/25/03 | 3792445 | 227780 |
| | 3/19/03 | 3794872 | 225530 |
| | 6/2/03 | 3792740 | 226500 |
| | 6/5/03 | 3801247 | 773633 |
| | 6/26/03 | 3806965 | 754254 |
| CZR5018 | 2/25/03 | 3792445 | 227780 |
| | 3/19/03 | 3792460 | 226018 |
| | 3/27/03 | 3807980 | 203588 |
| CZR5019 | 2/25/03 | 3792445 | 227780 |
| | 3/5/03 | 3791727 | 228126 |
| | 3/10/03 | 3791807 | 228141 |
| | 3/14/03 | 3791363 | 228037 |
| | 3/19/03 | 3791911 | 228141 |
| | 3/24/03 | 3791911 | 228141 |
| | 4/10/03 | 3797349 | 775586 |
| | 5/12/03 | 3791831 | 228132 |
| | 5/15/03 | 3791196 | 228169 |
| | 5/19/03 | 3791109 | 228973 |
| | 5/22/03 | 3791121 | 227969 |
| | 5/27/03 | 3791121 | 227969 |
| | 5/29/03 | 3791121 | 227969 |
| | 6/2/03 | 3791692 | 228169 |
| | 6/5/03 | 3791692 | 228169 |
| | 6/10/03 | 3791802 | 228164 |
| | 6/12/03 | 3792472 | 227847 |
| | 6/18/03 | 3791196 | 228143 |
| | 6/26/03 | 3791196 | 228143 |

Appendix D. (continued)

| TAG # | DATE | NORTHING | EASTING |
|---|---|---|---|
| CZR5020 | 2/25/03 | 3792445 | 227780 |
| | 4/3/03 | 3792599 | 227746 |
| | 5/5/03 | 3792355 | 227882 |
| | 5/22/03 | 3792530 | 227790 |
| | 6/2/03 | 3792387 | 227781 |
| | 6/17/03 | 3794578 | 228432 |
| CZR5021 | 2/25/03 | 3792445 | 227780 |
| | 4/10/03 | 3791269 | 228165 |
| | 5/1/03 | 3791254 | 228175 |
| | 5/5/03 | 3791264 | 228160 |
| | 5/8/03 | 3791146 | 228143 |
| | 5/12/03 | 3791287 | 228187 |
| | 5/19/03 | 3791457 | 228060 |
| | 5/22/03 | 3791226 | 228041 |
| | 5/27/03 | 3791226 | 228041 |
| | 5/29/03 | 3791226 | 228041 |
| | 6/2/03 | 3791226 | 228041 |
| | 6/5/03 | 3791226 | 228041 |
| | 6/10/03 | 3791242 | 228348 |
| | 6/12/03 | 3791112 | 228135 |
| | 6/19/03 | 3791395 | 228304 |
| CZR5022 | 2/25/03 | 3792445 | 227780 |
| CZR5023 | 2/25/03 | 3792445 | 227780 |
| | 5/15/03 | 3792619 | 227779 |
| | 7/3/03 | 3833844 | 724019 |
| CZR5024 | 2/25/03 | 3792445 | 227780 |
| CZR5025 | 2/26/03 | 3791872 | 226462 |
| | 3/10/03 | 3791637 | 225079 |
| CZR5026 | 2/26/03 | 3791872 | 226462 |
| | 4/3/03 | 3807084 | 754592 |
| | 4/7/03 | 3807011 | 754124 |
| | 5/1/03 | 3807403 | 754871 |
| | 5/5/03 | 3807004 | 754123 |
| | 5/8/03 | 3809930 | 749438 |
| | 5/15/03 | 3809914 | 749437 |
| | 5/19/03 | 3807331 | 754132 |
| | 5/29/03 | 3807331 | 754142 |
| CZR5027 | 2/26/03 | 3791872 | 226462 |
| | 3/17/03 | 3794877 | 225610 |

Appendix D. (continued)

| TAG # | DATE | NORTHING | EASTING |
|---|---|---|---|
| CZR5028 | 2/26/03 | 3791872 | 226462 |
| | 5/8/03 | 3810037 | 750212 |
| CZR5029 | 2/26/03 | 3791872 | 226462 |
| | 4/3/03 | 3792659 | 224787 |
| CZR5030 | 2/26/03 | 3791872 | 226462 |
| CZR5101 | 2/26/03 | 3791872 | 226462 |
| | 4/3/03 | 3794851 | 225481 |
| | 4/8/03 | 3810043 | 750138 |
| | 4/10/03 | 3810199 | 749832 |
| | 4/17/03 | 3810018 | 750292 |
| | 4/21/03 | 3809862 | 748948 |
| | 5/5/03 | 3810156 | 749922 |
| | 5/15/03 | 3809914 | 749437 |
| CZR5102 | 3/4/03 | 3791467 | 228045 |
| | 3/5/03 | 3791730 | 228123 |
| | 3/10/03 | 3791730 | 228123 |
| | 3/14/03 | 3791857 | 228120 |
| | 3/19/03 | 3791911 | 227141 |
| | 3/24/03 | 3791911 | 228141 |
| | 3/27/03 | 3791911 | 228141 |
| | 3/31/03 | 3791753 | 228148 |
| | 4/3/03 | 3791753 | 228148 |
| | 4/7/03 | 3791622 | 228154 |
| | 4/10/03 | 3791670 | 228119 |
| | 4/14/03 | 3791670 | 228119 |
| | 4/16/03 | 3791670 | 228119 |
| | 5/5/03 | 3805673 | 756406 |
| | 5/8/03 | 3809004 | 753088 |
| | 5/12/03 | 3806055 | 756559 |
| | 5/15/03 | 3791468 | 228213 |
| | 5/19/03 | 3791915 | 228117 |
| CZR5103 | 3/4/03 | 3791601 | 225353 |
| | 3/24/03 | 3791687 | 225068 |
| | 3/27/03 | 3791687 | 225068 |
| | 4/3/03 | 3791929 | 224897 |
| | 5/5/03 | 3803364 | 771608 |
| | 5/8/03 | 3792526 | 227811 |
| | 5/15/03 | 3809367 | 751001 |
| CZR5104 | 3/4/03 | 3791601 | 225353 |
| | 3/10/03 | 3791910 | 224942 |
| | 4/10/03 | 3792680 | 227906 |
| | 5/5/03 | 3808708 | 752607 |

Appendix D. (continued)

| TAG # | DATE | NORTHING | EASTING |
|---|---|---|---|
| | 5/8/03 | 3810037 | 750212 |
| | 5/15/03 | 3809449 | 751643 |
| | 5/19/03 | 3810126 | 750650 |
| | 5/22/03 | 3810099 | 750664 |
| | 5/27/03 | 3792562 | 227833 |
| CZR5105 | 3/4/03 | 3791808 | 225069 |
| | 5/1/03 | 3792570 | 227754 |
| | 5/5/03 | 3792372 | 227905 |
| | 5/8/03 | 3792526 | 227811 |
| | 5/15/03 | 3792619 | 227779 |
| | 5/19/03 | 3792477 | 227813 |
| | 5/22/03 | 3792566 | 227826 |
| CZR5106 | 3/4/03 | 3791808 | 225069 |
| | 4/10/03 | 3792680 | 227906 |
| | 7/3/03 | 3832963 | 724950 |
| CZR5107 | 3/4/03 | 3791808 | 225069 |
| | 4/3/03 | 3793070 | 224592 |
| | 5/27/03 | 3792562 | 227833 |
| | 6/19/03 | 3792559 | 227690 |
| CZR5108 | 3/7/03 | 3791687 | 225068 |
| | 3/31/03 | 3794656 | 225124 |
| | 4/3/03 | 3793070 | 224592 |
| CZR5109 | 3/11/03 | 3791321 | 228225 |
| | 3/31/03 | 3791335 | 228232 |
| | 4/7/03 | 3791724 | 228158 |
| | 4/10/03 | 3791128 | 228119 |
| | 4/14/03 | 3791128 | 228119 |
| | 4/21/03 | 3791295 | 228227 |
| | 4/24/03 | 3791248 | 228176 |
| | 5/1/03 | 3809713 | 751915 |
| | 6/5/03 | 3794030 | 225895 |
| | 6/18/03 | 3791196 | 228143 |
| | 6/19/03 | 3791240 | 228211 |
| | 6/26/03 | 3791240 | 228211 |
| CZR5110 | 3/11/03 | 3791321 | 228225 |
| CZR5111 | 3/12/03 | 3791687 | 225068 |
| CZR5112 | 3/12/03 | 3791687 | 225068 |
| CZR5113 | 3/12/03 | 3791687 | 225068 |
| | 4/16/03 | 3794853 | 225712 |

Appendix D. (continued)

| TAG # | DATE | NORTHING | EASTING |
|---|---|---|---|
| CZR5114 | 3/12/03 | 3791687 | 225068 |
| | 3/24/03 | 3791687 | 225068 |
| | 3/27/03 | 3794861 | 225698 |
| | 4/3/03 | 3792659 | 224787 |
| CZR5115 | 3/13/03 | 3793794 | 226358 |
| | 3/17/03 | 3792714 | 226687 |
| | 3/19/03 | 3793029 | 226353 |
| CZR5116 | 3/13/03 | 3793794 | 226358 |
| | 3/14/03 | 3794561 | 225080 |
| | 4/7/03 | 3796873 | 224625 |
| | 4/10/03 | 3807811 | 753750 |
| | 7/3/03 | 3834529 | 721313 |
| CZR5117 | 3/13/03 | 3794828 | 224887 |
| | 5/19/03 | 3791133 | 227940 |
| | 6/19/03 | 3791862 | 228186 |
| | 6/16/03 | 3791862 | 228186 |
| CZR5118 | 3/18/03 | 3811738 | 198139 |
| | 3/19/03 | 3811684 | 198343 |
| | 3/24/03 | 3811684 | 198343 |
| | 3/31/03 | 3807013 | 754547 |
| | 4/8/03 | 3809997 | 750788 |
| | 4/10/03 | 3810015 | 750297 |
| | 4/17/03 | 3810093 | 750405 |
| | 4/28/03 | 3809791 | 749131 |
| | 5/1/03 | 3809791 | 749131 |
| | 5/5/03 | 3810155 | 749920 |
| | 5/15/03 | 3807063 | 754119 |
| | 5/19/03 | 3807331 | 754132 |
| | 5/22/03 | 3810107 | 749867 |
| | 6/18/03 | 3790080 | 227848 |
| CZR5119 | 3/26/03 | 3790287 | 227978 |
| | 6/2/03 | 3791196 | 228143 |
| | 6/5/03 | 3791196 | 228143 |
| CZR5120 | 3/26/03 | 3792590 | 227827 |
| | 6/17/03 | 3794345 | 228417 |
| CZR5121 | 3/26/03 | 3792590 | 227827 |
| | 3/31/03 | 3792352 | 227886 |
| | 4/3/03 | 3792695 | 227635 |
| | 4/10/03 | 3792524 | 227853 |
| | 5/1/03 | 3792918 | 227228 |

Appendix D. (continued)

| TAG # | DATE | NORTHING | EASTING |
|---|---|---|---|
| | 5/8/03 | 3792846 | 227472 |
| | 5/27/03 | 3792722 | 227579 |
| | 6/2/03 | 3792824 | 227372 |
| CZR5131 | 3/18/03 | 3811738 | 198139 |
| CZR5132 | 4/9/03 | 3810133 | 749855 |
| CZR5133 | 4/8/03 | 3810157 | 750560 |
| CZR5134 | 4/9/03 | 3810133 | 749855 |
| CZR5135 | 4/8/03 | 3810157 | 750560 |
| CZR5136 | 4/9/03 | 3810133 | 749855 |
| | 4/10/03 | 3805467 | 756428 |
| | 5/1/03 | 3809824 | 749259 |
| | 5/5/03 | 3810053 | 750152 |
| | 5/8/03 | 3810037 | 750212 |
| | 5/15/03 | 3810071 | 750167 |
| | 5/19/03 | 3810102 | 750567 |
| CZR5137 | 4/9/03 | 3810133 | 749855 |
| | 4/10/03 | 3802338 | 773589 |
| | 7/3/03 | 3832704 | 727204 |
| CZR5138 | 4/9/03 | 3810133 | 749855 |
| | 7/3/03 | 3832963 | 724950 |
| CZR5139 | 4/17/03 | 3809849 | 749029 |
| | 5/1/03 | 3810155 | 749967 |
| | 5/12/03 | 3810032 | 750340 |
| | 5/15/03 | 3810071 | 750167 |
| CZR5140 | 4/1/03 | 3809824 | 749259 |
| CZR5140b | 4/17/03 | 3809849 | 749029 |
| | 4/21/03 | 3809936 | 748905 |
| CZR5141 | 4/9/03 | 3810133 | 749855 |
| CZR5142 | 4/9/03 | 3810133 | 749855 |
| | 4/17/03 | 3809828 | 749097 |
| | 4/28/03 | 3809783 | 749228 |
| | 5/1/03 | 3809826 | 749241 |
| | 5/12/03 | 3809843 | 749138 |
| | 6/26/03 | 3809737 | 749048 |

Appendix D. (continued)

| TAG # | DATE | NORTHING | EASTING |
|---|---|---|---|
| CZR5143 | 4/1/03 | 3809824 | 749259 |
| CZR5144 | 4/9/03 | 3810133 | 749855 |
| | 5/5/03 | 3810155 | 749920 |
| CZR5145 | 4/1/03 | 3809824 | 749259 |
| | 4/28/03 | 3809783 | 749228 |
| CZR5146 | 4/8/03 | 3810157 | 750560 |
| | 5/5/03 | 3805673 | 756406 |
| | 5/12/03 | 3805262 | 761291 |
| CZR5147 | 4/17/03 | 3809849 | 749029 |
| CZR5148 | 4/8/03 | 3810157 | 750560 |
| CZR5149 | 4/9/03 | 3810133 | 749855 |
| | 4/16/03 | 3802667 | 773491 |
| CZR5150 | 4/8/03 | 3810157 | 750560 |
| CZR5151 | 3/18/03 | 3810080 | 748793 |
| | 3/24/03 | 3811684 | 198343 |
| CZR5152 | 4/1/03 | 3809824 | 749259 |
| | 4/14/03 | 3796378 | 776077 |
| CZR5152b | 4/17/03 | 3809849 | 749029 |
| | 4/21/03 | 3809962 | 748877 |
| | 5/5/03 | 3809818 | 749245 |
| | 5/19/03 | 3809887 | 749398 |
| CZR5153 | 4/1/03 | 3809824 | 749259 |
| | 4/3/03 | 3810172 | 750555 |
| CZR5154 | 4/1/03 | 3809824 | 749259 |
| | 4/3/03 | 3801231 | 773580 |
| CZR5155 | 4/8/03 | 3810157 | 750560 |
| CZR5156 | 4/1/03 | 3809824 | 749259 |
| CZR5157 | 4/9/03 | 3810133 | 749855 |
| | 4/10/03 | 3807460 | 754086 |
| CZR5158 | 4/1/03 | 3809824 | 749259 |
| | 4/10/03 | 3810082 | 750434 |

Appendix D. (continued)

| TAG # | DATE | NORTHING | EASTING |
|---|---|---|---|
| CZR5159 | 4/8/03 | 3810157 | 750560 |
| CZR5160 | 3/18/03 | 3810080 | 748793 |
| | 4/21/03 | 3809943 | 748893 |
| CZR5161 | 4/8/03 | 3810157 | 750560 |
| | 4/10/03 | 3810166 | 749706 |
| | 5/1/03 | 3810102 | 749568 |
| | 5/15/03 | 3809914 | 749437 |
| CZR5162 | 4/1/03 | 3809824 | 749259 |
| CZR5163 | 3/18/03 | 3810080 | 748793 |
| | 3/19/03 | 3797996 | 223384 |
| | 3/31/03 | 3809691 | 750731 |
| | 4/3/03 | 3809846 | 749156 |
| | 7/1/03 | 3912022 | 708665 |
| CZR5164 | 3/18/03 | 3810080 | 748793 |
| CZR5165 | 3/18/03 | 3810080 | 748793 |
| CZR5166 | 3/18/03 | 3810080 | 748793 |
| | 6/19/03 | 3808701 | 752847 |
| CZR5167 | 4/1/03 | 3809824 | 749259 |
| | 4/3/03 | 3794020 | 225908 |
| CZR5168 | 3/18/03 | 3810080 | 748793 |
| CZR5169 | 3/18/03 | 3810080 | 748793 |
| CZR5169b | 4/17/03 | 3809849 | 749029 |
| | 4/24/03 | 3809940 | 748908 |
| CZR5170 | 4/8/03 | 3810157 | 750560 |
| | 4/14/03 | 3796091 | 224355 |
| CZR5171 | 4/17/03 | 3809849 | 749029 |
| | 4/28/03 | 3796640 | 776138 |
| | 5/1/03 | 3809463 | 750859 |
| | 5/5/03 | 3810011 | 749495 |
| | 5/8/03 | 3809339 | 751113 |
| | 5/12/03 | 3809666 | 750688 |
| CZR5172 | 4/1/03 | 3809824 | 749259 |
| | 4/3/03 | 3805807 | 756441 |
| | 4/8/03 | 3809324 | 751251 |

Appendix D. (concluded)

| TAG # | DATE | NORTHING | EASTING |
|---|---|---|---|
| CZR5173 | 4/9/03 | 3810133 | 749855 |
| | 4/10/03 | 3809686 | 750684 |
| | 4/17/03 | 3809990 | 748835 |
| CZR5174 | 4/9/03 | 3810133 | 749855 |
| | 4/14/03 | 3803667 | 771745 |
| CZR5175 | 4/1/03 | 3809824 | 749259 |
| CZR5176 | 4/17/03 | 3809849 | 749029 |
| CZR5177 | 4/9/03 | 3810133 | 749855 |
| | 5/5/03 | 3810011 | 749495 |
| | 5/8/03 | 3809808 | 749212 |
| | 5/12/03 | 3810078 | 749977 |
| | 5/15/03 | 3809638 | 750772 |
| CZR5178 | 4/9/03 | 3810133 | 749855 |
| | 5/19/03 | 3809945 | 748915 |
| | 5/22/03 | 3809952 | 748873 |
| | 5/29/03 | 3809744 | 748704 |
| CZR5179 | 4/8/03 | 3810157 | 750560 |
| | 4/10/03 | 3793037 | 226411 |
| | 4/24/03 | 3805176 | 760418 |
| | 5/5/03 | 3809869 | 748955 |
| CZR5180 | 4/8/03 | 3810157 | 750560 |
| | 5/15/03 | 3809860 | 748982 |

# APPENDIX E

# SUMMARY OF AMERICAN SHAD BEHAVIOR FROM FISH TAGGED AND RELEASED AT LOCK AND DAM #1 DURING 2003

Appendix E. Summary of American Shad behavior from fish tagged and released at Lock and Dam #1 during 2003.

| Tag # | Tagging Date | Collection method | Passed upstream[1] | Comments |
|---|---|---|---|---|
| 5131 | 03/18/2003 | Shocked | No | Female shad tagged near Lock and Dam #1 (L&D#1) was not located again during the study. |
| 5132 | 04/09/2003 | Shocked | Yes | Male shad tagged near L&D#1 was not located manually again during the study period. However, fixed station data indicate that this fish may have been locked through on 05/04/03. This fish was located by the NC11 station on 06/19/03 and remained in the vicinity of the NC11 station for the remainder of the study. |
| 5133 | 04/08/2003 | Gill Net | No | Female shad tagged near L&D#1 was recaptured by commercial shad fisherman on 04/14/03 near Natmore Creek. |
| 5134 | 04/09/2003 | Gill Net | No | Female shad tagged near L&D#1. Fish was recaptured by commercial shad fisherman on 04/13/03 near International Paper (IP). |
| 5135 | 04/08/2003 | Gill Net | No | Female shad tagged near L&D#1 was not located again. |
| 5136 | 04/09/2003 | Shocked | No | Male shad tagged near L&D#1, fell back to a position near IP where it was manually tracked on 04/10/03. The fish was not located again until 05/01/03 a short distance downstream of L&D#1. The fish then fell back again to a position between NC11 and L&D#1 for 20 days, manually located on 05/06/03, 05/08/03, 05/15/03, and 05/19/03. The shad passed the NC11 station on 05/20/03 and the IP station on 05/21/03 and was not located again for the remainder of the study. |
| 5137 | 04/09/2003 | Gill Net | Yes | Female shad tagged near L&D#1 fell downstream where it was located by the IP station at 11:30 on 04/09/03. It appears that this fish passed all fixed stations during periods of high flows when the "noise" level interfered with both fixed stations and manual tracking reception or when the fixed stations were removed due to flooding. The fish was not located again until 07/03/03 when it was manually tracked a short distance downstream of L&D#2. |

Appendix E. (continued)

| Tag # | Tagging Date | Collection method | Passed upstream[1] | Comments |
|---|---|---|---|---|
| 5138 | 04/09/2003 | Shocked | Yes | Male shad tagged near L&D#1 was not located again until 05/02/03 where it was picked-up by the L&D#1 station at 4:20 pm. This fish was likely locked through and was found again on 07/03/03 in the same vicinity as shad #5137. |
| 5139 | 04/17/2003 | Gill Net | No | Female shad tagged near L&D#1 was not located again until 05/01/03 when it was manually tracked between NC11 and L&D#1. This fish was manually tracked two more times on 05/12/03 and 05/15/03 in the same general vicinity as on 05/01/03. The fish was not located again for the remainder of the study. |
| 5140 | 04/01/2003 | Gill Net | No | Female shad tagged near L&D#1 was not located again for the remainder of the study. This fish was recaptured by a commercial shad fisherman on 04/09/03 near L&D#1. The tags were removed and re-used in another fish. |
| 5140B | 04/17/2003 | Gill Net | No | Female shad tagged with re-used sonic and dart tags near L&D#1 was not located again during the study. |
| 5141 | 04/09/2003 | Shocked | No | Female shad tagged near L&D#1 was not located again during the study. |
| 5142 | 04/09/2003 | Shocked | No | Male shad tagged near L&D#1 fell back a short distance after tagging and was tracked five times in the same general vicinity where it is believed that the fish died. |
| 5143 | 04/01/2003 | Gill Net | No | Female shad tagged near L&D#1 was not located again during the remainder of the study. |
| 5144 | 04/09/2003 | Shocked | No | Male shad tagged near L&D#1 was located once on 05/05/03 a short distance downstream from where it was tagged. The fish was not found again for the remainder of the study. |
| 5145 | 04/01/2003 | Gill Net | No | Female shad tagged near L&D#1 was located once on 04/28/03 in the same general vicinity of where it was tagged. The fish was not located again for the remainder of the study. |
| 5146 | 04/08/2003 | Gill Net | No | Female shad tagged near L&D#1 was recaptured the same day by commercial shad fisherman near IP. |

Appendix E. (continued)

| Tag # | Tagging Date | Collection method | Passed upstream[1] | Comments |
|---|---|---|---|---|
| 5147 | 04/17/2003 | Gill Net | No | Female shad tagged near L&D#1 was not located again during the remainder of the study. |
| 5148 | 04/08/2003 | Gill Net | No | Female shad tagged near L&D#1 fell back to the vicinity of IP where it was located by the fixed station. The fish was not located again during the remainder of the study. |
| 5149 | 04/09/2003 | Shocked | No | Female shad tagged near L&D#1 fell back to IP where it was located by the fixed station at 12:25 AM on 04/10/03. The fish was manually tracked near the Black River on 04/19/03 and was not located again during the remainder of the study. |
| 5150 | 04/08/2003 | Gill Net | No | Female shad tagged at the mouth of the Natmore Creek between NC11 and L&D#1. This fish fell back and passed the NC11 station on 04/09/03 at 8:00 PM where it was registered by the fixed station. This shad was recaptured by a commercial shad fisherman near IP on 04/13/03. |
| 5151 | 03/18/2003 | Shocked | No | Male shad tagged between NC11 and L&D#1 was not located again during the remainder of the study. |
| 5152 | 04/01/2003 | Gill Net | No | Female shad tagged near L&D#1. This fish passed IP station on 04/08/03 at 9:00 PM and was manually located near CP&L on 04/14/03. This fish was recaptured the same day in a commercial shad fisherman's drift net. The tags were retrieved and re-used to tag another fish, CZR5152B on 04/17/03. |
| 5152B | 04/17/2003 | Gill Net | No | Male shad tagged near L&D#1 remained in the vicinity of where it was tagged and was located manually three times on 04/21/03, 05/08/03, and 05/19/03. After 05/19/03, the fish was not located again for the remainder of the study. |
| 5153 | 04/01/2003 | Gill Net | No | Female shad tagged near L&D#1 was manually located at the mouth of the Natmore Creek on 04/03/03. After 04/03/03, this fish was not located again during the remainder of the study. |
| 5154 | 04/01/2003 | Gill Net | No | Female shad tagged near L&D#1 was not located again during the remainder of the study. |

Appendix E. (continued)

| Tag # | Tagging Date | Collection method | Passed upstream[1] | Comments |
|---|---|---|---|---|
| 5155 | 04/08/2003 | Gill Net | No | Female shad tagged at the mouth of Natmore Creek. This fish fell back and passed the IP station at 4:20 PM on 04/08/03. The fish was not located again during the remainder of the study. |
| 5156 | 04/01/2003 | Gill Net | No | Female shad tagged a short distance downstream of L&D#1 was not located again during the remainder of the study. |
| 5157 | 04/09/2003 | Shocked | No | Male shad tagged near L&D#1 was located downstream of the mouth of Weyman Creek on 04/10/03, after which it was not located again. |
| 5158 | 04/01/2003 | Gill Net | No | Male shad tagged near L&D#1 was manually tracked near the mouth of Natmore Creek on 04/10/03. The fish was not located again for the remainder of the study. |
| 5159 | 04/08/2003 | Gill Net | No | Female shad tagged at the mouth of Natmore Creek was not located again for the remainder of the study. |
| 5160 | 03/18/2003 | Shocked | No | Male shad tagged near L&D#1 fell back to the vicinity of IP where it was located by the fixed station on 04/07/03. The fish remained in this same general vicinity for three days. The fish was not located again until 04/21/03 when it was found near L&D#1, after which it was not located again during the remainder of the study. |
| 5161 | 04/08/2003 | Gill Net | No | Female shad tagged at the mouth of Natmore Creek. This fish moved upstream after tagging and was manually located on 04/10/03, 05/01/03, and 05/15/03, each time a short distance further upstream from its last location. After 05/15/03 this fish was not located again during the remainder of the study. |
| 5162 | 04/01/2003 | Gill Net | No | Male shad tagged a short distance downstream of L&D#1 was not located again during the remainder of the study. |

Appendix E. (continued)

| Tag # | Tagging Date | Collection method | Passed upstream[1] | Comments |
|---|---|---|---|---|
| 5163 | 03/18/2003 | Shocked | Yes | Male shad tagged near L&D#1 . This fish fell back to a location near Sutton Lake, approximately 9 miles upstream of Wilmington where it was located manually on 03/19/03. This fish then moved back upriver to a location a short distance upstream of NC11 where it was located on 03/31/03. This fish was manually tracked on 04/03/03 near L&D#1. After 04/03/03, this fish was not located again until 07/01/03 when it was found near Erwin, NC or approximately 100 miles upstream from L&D#1. |
| 5164 | 03/18/2003 | Shocked | No | Male shad tagged near L&D#1 was not located during the remainder of this study. |
| 5165 | 03/18/2003 | Shocked | No | Male shad tagged near L&D#1 was not located again until 04/02/03 when it was registered on the L&D#1 station at 10:55AM and 1:30PM. It is unlikely this fish was passed upstream through the locking process due to the elevated river height that day. (On 04/02/03 gauge height at L&D#1 was between 19.75 and 20.00 feet. According to USACOE Lockmaster Robin Hall, lockages cannot take place at elevations of 20.00 feet or higher.) This fish was not located again during the remainder of the study. |
| 5166 | 03/18/2003 | Shocked | No | Male shad tagged near L&D#1. This fish was not located again until 06/19/03 when it was manually tracked near Weyman Creek or 35 miles upstream from Wilmington. This fish was not located again during the remainder of the study. |
| 5167 | 04/01/2003 | Gill Net | No | Female shad tagged near L&D#1 was not located again during the remainder of the study. |
| 5168 | 03/18/2003 | Shocked | No | Female shad tagged near L&D#1 was not located again during the remainder of the study. |
| 5169 | 03/18/2003 | Shocked | No | Male shad tagged near L&D#1 was not located until it was recaptured by a commercial shad fisherman on 04/14/03 near where it was tagged. The tags were retrieved and re-used to tag another fish, CZR5169B. |
| 5169B | 04/17/2003 | Gill Net | No | Female shad tagged a short distance downstream of L&D#1. This fish was located 7 days later on 04/24/03 upstream a short distance from its original tagging location. After 04/24/03, this fish was not located again during the remainder of the study. |

Appendix E. (continued)

| Tag # | Tagging Date | Collection method | Passed upstream[1] | Comments |
|---|---|---|---|---|
| 5170 | 04/08/2003 | Gill Net | No | Female shad tagged near the mouth of Natmore Creek. This fish was located seven days later on 04/14/03 near Indian Creek approximately 8.75 miles upstream from Wilmington. This fish was not located again for the remainder of the study. |
| 5171 | 04/17/2003 | Gill Net | No | Female shad tagged near L&D#1. This fish fell back to a position near Indian Creek where it was located on 04/28/03. This fish then moved upstream to a position between NC11 and L&D#1 where it was manually tracked on 05/01/03 . The fish then moved further upstream to a location near L&D#1 where it was tracked 05/05/03. The NC11 station located this fish on 05/06/03 and it remained there until 05/08/03. Then the fish moved a short distance upstream where it was located on 05/12/03. This fish was registered at the L&D#1 on 05/14/03. It then fell back to NC11 and was located by the fixed station on 05/23/03. The fish returned to L&D#1 where it was located by the fixed station on 05/25/03. After 05/28/03, the fish was not located again for the remainder of the study. |
| 5172 | 04/01/2003 | Gill Net | No | Female shad tagged a short distance downstream from L&D#1. This fish fell back to a location approximately one mile upriver of IP where it was located on 04/03/03. The fish was located at NC11 on 04/08/03. This fish was recaptured by a commercial shad fisherman on 04/14/03 near Natmore Creek. |
| 5173 | 04/09/2003 | Shocked | No | Female shad tagged near L&D#1 fell back to a position a short distance upstream of NC11 bridge where it was manually tracked on 04/10/03. This fish then moved upstream to a position near L&D#1 where it was located on 04/17/03. After 04/17/03, this fish was not located again for the remainder of the study. |
| 5174 | 04/09/2003 | Shocked | No | Male shad tagged near L&D#1 fell back to a position a short distance up the Black River where it was manually tracked on 04/14/03. This fish was not located again for the remainder of the study. |

Appendix E. (concluded)

| Tag # | Tagging Date | Collection method | Passed upstream[1] | Comments |
|---|---|---|---|---|
| 5175 | 04/01/2003 | Gill Net | No | Female shad tagged a short distance downstream from L&D#1 was not located again during the remainder of the study. |
| 5176 | 04/17/2003 | Gill Net | No | Female shad tagged a short distance downstream of L&D#1 was not located again during the remainder of the study. |
| 5177 | 04/09/2003 | Shocked | No | Male shad tagged near L&D#1 was not located again until 05/03/03 when it was manually tracked a short distance downstream from its original tagging location. This fish was manually tracked three successive times (05/05/03, 05/12/03, and 05/16/03) each time the fish was a short distance downstream from its last location. The fixed station at NC11 located this fish on 05/16/03 at 3:30 PM. The fish remained in this general vicinity for two days until it was located at the IP station on 05/18/03 at 10:45 AM. The fish was not located again for the remainder of the study. |
| 5178 | 04/09/2003 | Shocked | No | Male shad tagged near L&D#1 was not located again until 05/19/03 a short distance downstream of its original tagging location. This fish was located again on 05/22/03 and 05/29/03 in the same general vicinity as on 05/19/03. The fish was not located again during the remainder of the study. |
| 5179 | 04/08/2003 | Gill Net | No | Male shad tagged near the mouth of Natmore Creek. This fish fell back and passed the IP fixed station on 04/08/03. The fish was manually located on 04/10/03 near Horeshoe Bend in the lower river approximately 1 mile upstream from Wilmington. The fish was manually located approximately 2 miles downstream from IP on 04/24/03. On 05/05/03, this fish was manually tracked near L&D#1. After 05/05/03, this fish was not located again during the remainder of the study. |
| 5180 | 04/08/2003 | Gill Net | No | Male shad tagged at the mouth of Natmore Creek fell back and passed the IP fixed station on 04/08/03 at 5:30 PM. This fish was not located again until 05/15/03, when it was manually tracked near L&D#1. After 05/15/03, this fish was not found again for the remainder of the study. |

[1] "Yes" indicates tag was recorded above Lock and Dam #1 from the fixed monitoring receiver or was manually tracked during additional tracking effects from Buchorn Dam to Lock and Dam #1

# APPENDIX F

# SUMMARY OF STRIPED BASS BEHAVIOR FROM FISH TAGGED AND RELEASED IN THE CAPE FEAR AND BRUNSWICK RIVER DURING 2003

Appendix F. Summary of Striped Bass behavior from fish tagged and released in the Cape Fear and Brunswick Rivers during 2003.

| Tag # | Tagging Date | Collection method | Passed upstream[1] | Comments |
|---|---|---|---|---|
| 5004 | 03/14/2002 | Gill Net | No | Male bass tagged at Horseshoe Bend returned in 2003 and was located in the Brunswick River on 02/17/03 and 02/20/03. The fish was located in Wilmington Harbor between the USS North Carolina and the NC421 Bridge on 02/24/03 and 02/27/03. Bass 5004 was located four more times between the NC 421 Bridge and Horseshoe Bend on 03/03/03, 03/05/03, 03/10/03 and 03/14/03. He then fell back to a position a short distance downstream from Horseshoe Bend where he was manually tracked on 03/19/03. After 03/19/03, this fish was not found again until 05/15/03 when it was manually tracked in Wilmington Harbor near the battleship. He was located two more times on 05/22/03 and 05/27/03 at Pt Peter after which this fish was not found again for the remainder of the study. |
| 5009 | 01/30/2003 | Gill Net | No | Female bass tagged at Castle Street boat landing was located in various positions between Wilmington Harbor and the Navassa train trestle bridge between 02/06/03 and 02/27/03. This fish was manually located around the piling at the International Paper (IP) barge dock on 03/22/03 and 03/27/03. It then fell back to a position a short distance upstream of the mouth of the Black River where it was found on 04/03/03. The fish passed the fixed station at IP on 04/09/03 at 4:45 AM and the NC11 fixed station on 04/10/03 at 6:11 AM. This fish was manually located on 04/10/03 a short distance downstream at the Lock and Dam. After this, bass 5009 fell back a short distance where it was manually tracked on 04/14/03. It was found again on 04/17/03 approximately 6 miles downstream at Caintuck landing on 04/17/03. After this, the fish was not located again for the remainder of the study. |
| 5010 | 01/30/2003 | Gill Net | No | Female bass tagged at the Castle Street boat landing. This fish was located only once in the Brunswick River near Sturgeon Creek on 02/13/03. This fish was not located again for the remainder of the study. |

Appendix F. (continued)

| Tag # | Tagging Date | Collection method | Passed upstream[1] | Comments |
|---|---|---|---|---|
| 5011 | 01/30/2003 | Gill Net | Yes | Male bass tagged at the Castle Street boat landing was manually tracked a short distance south of where the Brunswick River rejoins the Cape Fear River at Navassa on 02/06/03. This fish was located underneath the 74-76 Bridge where it crosses over the Brunswick River on 02/20/03 and 02/24/03. Bass 5011 moved back into the Cape Fear River to a position a short distance upstream from the NC 421 Bridge where it was manually located on 03/10/03. This fish was next located upstream from Hood Creek on 04/03/03. This fish was manually tracked at approximately river mile 32 on 04/10/03. This fish was located by the fixed station at IP on 05/14/03. On 05/15/03, this fish was located near the mouth of Natmore Creek above NC11. The fish fell back a short distance to a location near NC11 where it was manually tracked on 05/19/03. The fish fell back again to a position just downstream of the IP fixed station where it was registered on the data logger on 05/20/03. Bass 5011 turned back upstream and passed the NC11 fixed station at 6:30 PM on 05/20/03. This fish was registered on the Lock and Dam #1 (L&D#1) station first at 8:45 AM on 05/21/03 and again at 4:00 PM on the same day and was successfully locked upstream. On 07/03/03, bass 5011 was manually located approximately 3/4 of a mile downstream from Lock and Dam #3 (L&D#3) or 94 miles upstream from Wilmington. |
| 5012 | 02/10/2003 | Shocked | No | Male bass tagged at the Castle Street boat landing was not located again until 04/08/03 when it passed the fixed station at IP. Seventeen days later, this fish was manually located near the mouth of Weyman Creek on 04/24/03. Four days later on 04/28/03, the fish was back downstream at the mouth of Livingston Creek near IP. Between 04/28/03 and 05/20/03, both manual tracking efforts and fixed station data from NC11 and IP indicate that bass 5012 made multiple trips back and forth between IP and L&D#1. On 05/20/03, this fish passed the fixed station at IP at 6:00 PM heading downstream and was not located again for the remainder of the study. |

Appendix F. (continued)

| Tag # | Tagging Date | Collection method | Passed upstream[1] | Comments |
|---|---|---|---|---|
| 5014 | 03/19/2002 | Gill Net | No | Male bass tagged at Horseshoe Bend in 2202 returned in 2003 and was manually tracked a short distance upstream from Horseshoe Bend on 02/13/03. This fish was not located again until 03/14/03, when it was found upstream from the Castle Street landing. This fish was not located again for the remainder of the study. |
| 5015 | 02/25/2003 | Shocked | Yes | Female bass tagged at Pt. Peter remained between Wilmington Harbor and Horseshoe Bend from 02/25/03 through 04/07/03. This fish was not located again until it was manually tracked approximately 7.0 miles above L&D#3 on 07/03/03 or 102 miles upstream from Wilmington. |
| 5016 | 02/25/2003 | Shocked | No | Female bass tagged at Pt. Peter was manually located on 4/28/03 below the US 74-76 Bridge near the USACOE boat basin. This fish was not located again until it was registered by the NC11 fixed station at 2:15am on 6/20/03. Bass #5016 remained in the vicinity of the fixed station for six days when it was manually tracked on 6/26/03 near river mile 36. The fish remained in the vicinity of the NC11 fixed station until 7/14/03 after which it was not located again. |
| 5017 | 02/25/2003 | Shocked | No | Male bass tagged at Pt. Peter was manually tracked near Toomer's Creek on 03/19/03. This fish was not located again until 06/02/03 when it was found at Horseshoe Bend. Fixed station data places this fish at NC11 beginning on 06/20/03 where it remained for several days until it was located manually on 06/26/03 approximately four miles downstream from NC11. Bass 5017 moved back upstream where it was located by the fixed station at NC11 on 06/29/03. After 06/29/03 the fish was not located again for the remainder of the study. |

Appendix F. (continued)

| Tag # | Tagging Date | Collection method | Passed upstream[1] | Comments |
|---|---|---|---|---|
| 5018 | 02/25/2003 | Shocked | No | Female bass tagged in Wilmington Harbor was manually located at Horseshoe Bend on 03/19/03. This fish was again manually tracked upstream from IP at approximately mile 32 on 03/27/03. This fish was not located again until 07/10/03 when it was recorded on the L&D#1 station at 3:30 PM. The fish made multiple trips in and out of the lock chamber until 9:30 PM, after which the fish retracted downstream. This bass remained within close proximity to the NC11 fixed station until the evening of 07/11/03. This fish was not located again for the remainder of the study. |
| 5019 | 02/25/2003 | Shocked | No | Female bass tagged at Pt. Peter was manually tracked consistently throughout the study period at various locations in Wilmington Harbor. On 04/10/03 this fish was manually located near the mouth of Indian Creek. Other than this one occasion, bass 5019 remained in Wilmington Harbor until 07/10/03, when it was registered by the fixed station at L&D#1. This fish entered the lock chamber several times but was not passed through to the upstream pool. This fish was not located again. |
| 5020 | 02/25/2003 | Shocked | No | Female bass tagged at Pt. Peter was not located again after tagging until 04/03/03 when it was manually tracked a short distance from where it was tagged. This fish was located on 05/05/03, 05/22/03, and 06/02/03 in the same general vicinity approximately 1,000 feet downstream from the NC 421 bridge. On 06/17/03, this fish was found underneath the train trestle draw bridge crossing the Northeast Cape Fear River approximately 1 mile from Wilmington Harbor. This fish was not located again for the remainder of the study. |
| 5021 | 02/25/2003 | Shocked | No | Female bass tagged at Pt. Peter was not located until 04/10/03 on the east bank of the Cape Fear River approximately 700 feet upstream from the US 74-76 Bridge. This fish was manually located thirteen more times between 05/01/03 and 06/19/03 in the vicinity of the 74-76 Bridge. This fish was not found again. |
| 5022 | 02/25/2003 | Shocked | No | Male bass tagged at Pt. Peter was not located again after tagging for the remainder of the study. |

Appendix F. (continued)

| Tag # | Tagging Date | Collection method | Passed upstream[1] | Comments |
|---|---|---|---|---|
| 5023 | 02/25/2003 | Shocked | Yes | Male bass tagged at Pt. Peter disappeared until 05/15/03 when it was manually tracked near Pt. Peter. This fish disappeared again and was not located until the fixed station at NC11 registered it moving upstream on 06/26/03. This fish was located again on 07/03/03 a short distance downstream from Lock and Dam #2 (L&D#2) at 1:00 PM. |
| 5024 | 02/25/2003 | Shocked | No | Female bass tagged at Pt. Peter was never manually located during the study period. However, fixed station data located this fish passing NC11 on 06/23/03 at 1:00 PM. The fish was located in the lock chamber at 12:00 PM and 2:30PM on 06/29/03. The fish was not successfully locked through since it was not located again during upstream tracking efforts. |
| 5025 | 02/26/2003 | Shocked | No | Male bass tagged in the Brunswick River was manually located on 03/10/03 a short distance downstream from its original tagging location. This fish was not manually located again. Fixed station data indicate that this fish traveled upstream and was registered on the NC11 station on 05/12/03 at 10:30 PM. The fish remained in the vicinity of NC11 for a brief time and was not found again until it was registered on the L&D#1 fixed station on 06/29/03 at 10:40 AM. The fished moved in and out of the lock chamber for the next 10 hours and then moved downstream when it was located at NC11 at 1:30 AM on 06/30/02. Bass 5025 remained at NC11 until 2:00 AM and then departed. This fish was not found again for the remainder of the study. |

Appendix F. (continued)

| Tag # | Tagging Date | Collection method | Passed upstream[1] | Comments |
|---|---|---|---|---|
| 5026 | 02/26/2003 | Shocked | No | Male bass tagged in the Brunswick River was not located until 04/03/03 when it was manually tracked approximately 33 miles upstream from Wilmington. This fish was located again on 04/07/03 a short distance upstream from its last position. The fish was not found again until it was registered at the L&D #1 station on 04/30/03 at 1:30 PM. The fish remained there until 3:30 PM and departed down river and was manually tracked a short distance downstream from its 04/03/03 position on 05/01/03. He then made another short move upstream where it was located on 05/05/03. On 05/08/03 this fish was manually tracked near Natmore Creek between NC11 and L&D #1. The fixed station at NC11 located this fish upstream of the station on 05/12/03 and 05/13/03. On 05/15/03, he was manually tracked a short distance downstream of the Lock and Dam. This fish fell back again to NC11 and passed the station on 05/17/03 at 4:20 PM. On 05/19/03, he was manually tracked in the same vicinity as on 04/07/03 and 05/05/03. This fish moved upstream, passed NC11 station again and remained just upstream of the station from 05/22/03 through 05/26/03. He then fell back to same location as on 05/19/03 where it was manually tracked on 05/29/03. The fish disappeared until 06/2/03 when he showed up at NC11 station at 12:30 AM. Bass 5026 was registered on L&D#1 station on 06/29/03 at 12:30 PM and made several movements into the lock chamber until it departed at 11:15 PM that evening. The fish was registered on the NC11 station as it passed heading downstream at 1:30 AM. The fish was not located again for the remainder of the study. |
| 5027 | 02/26/2003 | Shocked | No | Female bass tagged in the Brunswick River was located one time on 03/17/03 downstream from Toomer's Creek. After 03/17/03, this fish was not located again for the remainder of the study. |
| 5028 | 02/26/2003 | Shocked | No | Female bass tagged in the Brunswick River was located one time on 05/08/03 between NC11 and L&D#1. After this, the fish was not located again for the remainder of the study. |

Appendix F. (continued)

| Tag # | Tagging Date | Collection method | Passed upstream[1] | Comments |
|---|---|---|---|---|
| 5029 | 02/26/2003 | Shocked | No | Female bass tagged in the Brunswick River was located on 04/03/03 at the mouth of Alligator Creek on the Brunswick River. The fish was not located again for the remainder of the study. |
| 5030 | 02/26/2003 | Shocked | No | Female bass tagged in the Brunswick River was not located again during the remainder of the study. |
| 5101 | 02/26/2003 | Shocked | No | Male bass tagged in the Brunswick River was manually tracked in the Cape Fear River near Toomer's Creek on 04/03/03. Five days later on 04/08/03, this fish was manually located near Natmore Creek between NC11 and L&D#1. It was located on 04/10/03 and 04/17/03 in the same general vicinity. On 04/21/03, the fish was found just downstream from L&D#1. On 05/05/03, this fish returned downstream to near Natmore Creek and then moved back upstream towards the L&D#1 where it was located on 05/15/03. After 05/15/03, this fish was not located again for the remainder of the study. |
| 5102 | 03/04/2003 | Shocked | No | Female bass tagged approximately 1,000 feet upstream from the US 74-76 bridge. This fish was manually tracked twelve times in the same general vicinity of its tagging location. On 5/5/03 this fish was manually located a short distance upstream from IP. On 5/8/03, bass #5102 was manually tracked near river mile 36. This fish fell back downstream to a position a short distance downstream from Caintuck landing. This fixed station at IP registered this fish moving downstream on 5/13/03 and it passed the station at 8:15 am. The fish was manually located on 5/15/03 back in Wilmington. The fish located once more on 5/19/03 in the same general vicinity. After this, the fish was not found again. |
| 5103 | 03/04/2003 | Shocked | No | Female bass tagged in the Brunswick River was manually tracked on 03/24/03, 03/27/03, and 04/03/03 in the same vicinity where it was tagged. On 05/05/03, this fish was located at the mouth of the Black River. On 05/08/03, this fish had fallen back to a position a short distance upstream from Pt. Peter in the Northeast Cape Fear River. On 05/15/03, bass 5103 was manually tracked upstream of the NC11 Bridge. After this, the fish was not located again for the remainder of the study. |

Appendix F. (continued)

| Tag # | Tagging Date | Collection method | Passed upstream[1] | Comments |
|---|---|---|---|---|
| 5104 | 03/04/2003 | Shocked | No | Female bass tagged in the Brunswick River was manually located on 03/10/03 in the same position it was tagged. On 04/10/03, this fish was found near Pt. Peter. This fish was then located by the NC11 fixed station on 04/28/03. Six days later this fish entered the lock chamber and was recorded by the L&D#1 fixed station on 05/04/03. The fish was not locked upstream and fell back to NC11 the same day and was recorded by the fixed station until 05/07/03. Between 05/07/03 and 05/26/03, bass 5104 made 4 round trips between NC11 and IP. On 05/27/03, this bass was manually tracked near Pt. Peter near Wilmington. This fish was not located again until 06/19/03 when it was located by the NC11 fixed station. The fish remained in the vicinity of NC11 for the remainder of the study. |
| 5105 | 03/04/2003 | Shocked | No | Female bass tagged in the Brunswick River was not located after tagging until 05/01/03 when it was found at the confluence of the Cape Fear and Northeast Cape Fear Rivers. This fish was tracked five successive times in May, and was located in the same general position as 05/01/03. After 05/22/03, this fish was not found again for the remainder of the study. |
| 5106 | 03/04/2003 | Shocked | Yes | Male bass tagged in the Brunswick River was located on 04/10/03 at the mouth of the Northeast Cape Fear River. This fish was not located again until 07/03/03, when it was found approximately 69.5 miles upstream of Wilmington near L&D#2. |
| 5107 | 03/04/2003 | Shocked | No | Female bass tagged in the Brunswick River was located on 04/03/03 at the mouth of Sturgeon Creek. This fish was not located again until 05/10/03 when it was manually tracked near the confluence of the Cape Fear and Northeast Cape Fear River. It was located again on 05/27/03 at Pt. Peter. After 05/27/03 this fish was not found again. |
| 5108 | 03/07/2003 | Shocked | No | Female bass tagged in the Brunswick River was located at the northern end of the Brunswick River near the Navassa train trestle on 03/31/03. This fish was manually tracked on 04/03/03 at the mouth of Sturgeon Creek. After this, the fish was not found again during the remainder of the study. |

Appendix F. (continued)

| Tag # | Tagging Date | Collection method | Passed upstream[1] | Comments |
|---|---|---|---|---|
| 5109 | 03/11/2003 | Shocked | No | Female bass tagged at Pt. Peter was located on 03/31/03 in Wilmington Harbor. This fish was manually tracked through the month of April at various locations in Wilmington Harbor. On 05/01/03, this fish was found a short distance downstream from the NC11 Bridge. Bass 5109 was located 35 days later on 06/05/03 near Horseshoe Bend. This fish was located three more times in June in Wilmington Harbor. |
| 5110 | 03/11/2003 | Shocked | No | Female hybrid striped bass tagged at Pt. Peter was not manually located during the study, however, fixed station data indicated that this fish passed IP on 04/09/03 at 1:30 PM. The fish passed the NC11 fixed station the same day 8:00 PM. This fish was not located again until one month later on 05/09/03 when it was picked up by the L&D#1 fixed station at 5:20 AM. It is possible that this fish was passed through the lock upstream but cannot be confirmed since it was not located during upstream tracking efforts nor was it located again below the Dam by fixed stations or subsequent tracking runs. |
| 5111 | 03/12/2003 | Shocked | No | Female bass tagged in the Brunswick River was not located again after tagging. |
| 5112 | 03/12/2003 | Shocked | No | Female bass tagged in the Brunswick River was not located again after tagging. |
| 5113 | 03/12/2003 | Shocked | No | Male bass tagged in the Brunswick River was located on 04/16/03 a short distance downstream of Toomer's Creek. This fish was not located again for the remainder of the study. |
| 5114 | 03/12/2003 | Shocked | No | Female bass tagged in the Brunswick River was located on 03/24/03 in the same location it was tagged. On 03/27/03, this fish was found a short distance downstream of Toomer's Creek. Bass 5114 was manually tracked back in the Brunswick River at the mouth of Alligator Creek on 04/03/03. After this, the fish was not found again. |
| 5115 | 03/13/2003 | Shocked | No | Female bass tagged approximately 300 feet downstream of the US 74-76 Bridge was located on 03/17/03 downstream of Horseshoe Bend. This fish was manually tracked on 03/19/03 across from Horseshoe Bend. After this, the fish was not found again. |

Appendix F. (continued)

| Tag # | Tagging Date | Collection method | Passed upstream[1] | Comments |
|---|---|---|---|---|
| 5116 | 03/13/2003 | Shocked | Yes | Male bass tagged approximately 300 feet downstream of the US 74-76 Bridge was located on 03/14/03 in Horseshoe Bend. This fish was manually tracked on 04/07/03 near the Navassa train trestle. The fixed station at IP picked up this fish as it passed at 6:30 AM on 04/09/03. The fish was again manually located upstream of IP on 04/10/03. This fish was not found again until 07/03/03 when it was found approximately 500 feet upstream of L&D#2 or 72 miles upstream from Wilmington. |
| 5117 | 03/13/2003 | Shocked | No | Female bass tagged at the Castle Street landing was not located again until 05/19/03 when it was found among the dock pilings adjacent to the USACOE boat basin underneath the US 74-76 Bridge. This fish was located two more times on 05/25/03 and 06/19/03 in Wilmington Harbor. After 06/19/03, this fish was not found again. |
| 5118 | 03/18/2003 | Shocked | No | Female hybrid striped bass tagged a short distance downstream from L&D#1. This fish remained in the vicinity of its tagging location until 3/31/03 when it was manually tracked downstream at river mile 33. Bass #5118 returned upstream to the vicinity where it was tagged and was manually tracked at various locations on 4/8, 4/10, 4/17, 4/28, 5/1, and 5/5/03. The fish fell back down river and was manually located on 5/15/03 near river mile 33 again. The fixed station at IP registered this fish on 5/16/03 at 4:20 am. The fish remained in the vicinity of the fixed station until 10:00 am on 5/18/03. The fish moved upstream to river mile 32 where it was manually located on 5/19/03. It fell back to IP where the station located it for two days until 5/21/03 when it moved upstream. The NC11 fixed station registered bass #5118 on 5/22/03 at 9:50 am. Bass #5118 was not found again until 6/18/03 located at the State Ports Authority in Wilmington. The fish was located twelve days later at NC11 when it was registered by the fixed station at 12:20 am on 6/30/03. Bass #5118 remained in the vicinity of the NC11 fixed station until 7/1/03, after which time it was not found again. |

Appendix F. (concluded)

| Tag # | Tagging Date | Collection method | Passed upstream[1] | Comments |
|---|---|---|---|---|
| 5119 | 03/26/2003 | Shocked | No | Male bass tagged at Pt. Peter was not located until 06/02/03 when it was found near the Castle Street boat landing. This fish was found on 06/05/03 and 06/12/03 in the same position as on 06/02/03. The fish was not located again. |
| 5120 | 03/26/2003 | Shocked | No | Male bass tagged at Pt. Peter was not tracked again until 06/17/03 when it was found among the dock piling near the train trestle bridge crossing the Northeast Cape Fear River. |
| 5121 | 03/26/2003 | Shocked | No | Female hybrid striped bass tagged at Pt. Peter was located seven times between 03/31/03 and 06/02/03 at various locations between the confluence of the Cape Fear and Northeast Cape Fear River and power lines that cross the Cape Fear River just upstream of the NC 421 Bridge. After 06/02/03, this fish was not found again. |

[1] "Yes" indicates tag was recorded above Lock and Dam #1 from the fixed monitoring receiver or was manually tracked during additional tracking effects from Buchorn Dam to Lock and Dam #1