

ANNUAL WATER MANAGEMENT PROGRAM - CY 1991

PRIME HOOK NATIONAL WILDLIFE REFUGE

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ANNUAL WATER MANAGEMENT PROGRAM - CY 1991
PRIME HOOK NATIONAL WILDLIFE REFUGE

I. INTRODUCTION

The Prime Hook National Wildlife Refuge consists of 8,818 acres acquired in fee simple and 884 acres of flowage easements. Approximately 77% of the refuge consists of wetlands types, both salt and fresh marsh, and brackish and fresh water. Water level management is possible on 200 acres in Unit IV, 2,500 acres in Unit III and 1,500 acres in Unit II.

In 1981, two small water control structures(WCS) were constructed on tidal ditches in Unit IV to permit management of approximately 200 acres. Water for impoundment is provided by the two tidal ditches and excess water from Unit III which enters the impoundment through a small gut plug. Flap gates on both structures permit the opportunity to dewater approximately 90% of the impoundment. Water levels are regulated by stoplogs.

In 1984, two large WCS and one mile of low dike were constructed in Unit III to provide water management capability on 2,500 acres of marsh. A smaller gut plug permits transfer of water into Unit IV. Water levels are regulated by stoplogs and screw gates.

A large WCS was completed in Unit II in November, 1988, providing the capability for water management for 1,500 acres. Stoplogs provide management ability. Two flap gates assist in reducing excessive water levels to lessen impact on adjacent privately-owned agricultural lands. A small (4 inch wide) bay was constructed to permit fish passage during periods of impoundment.

No specific water management plans have been developed for Unit I or 800 acres of unmanaged wetland acreage in Unit IV. Both units will be included in open marsh water management(OMWM) plans being developed by the State's Mosquito Control Section of the Division of Fish and Wildlife through a cooperative program. OMWM work began in Unit IV in December, 1988 and was completed in January, 1991.

In 1983, the refuge began a program to control Phragmites and to return the marsh to a more desirable vegetative cover. That year, 500 acres in Unit III were sprayed with the aquatic herbicide Rodeo by helicopter. In 1984, 1,100 acres in Units III and IV were treated. In 1985, 1,000 acres in Unit II were sprayed and 625 acres in Units III and IV were spot sprayed to control areas missed during previous applications. In 1986, a total of 2,030 acres

in Units II, III and IV were treated: Units II and IV received a second application as did part of Unit III and spot treatment was delivered as needed. Overall, control has been excellent where two applications have been made in consecutive years. Initial results in Unit III had given us a false sense of control; thus, this area was not sprayed a second time. This has proven to be a serious mistake. All areas must be treated for two consecutive years for best control of Phragmites. Respray of problem areas was begun in 1987 and is continuing.

II. Annual Management Program

A. Effects of Water Management - 1990

General

Above normal precipitation through much of the period April to October, aided in maintaining excellent marsh water levels throughout the refuge. Following a severe freeze in late 1989, much of the marsh remained ice-free from January to March and only a few days of thin ice were noted during November and December 1990. The ice free marsh helped to maintain excellent duck populations from October to December, 1990.

Winter populations of Canada geese peaked at 8,000 birds in January and had dropped to 4,500 in late February. Snow geese peaked at 63,500 in early January, causing extensive eat-outs in Unit III as well as in Units I and II. Numbers had dropped to 30,000 by mid February. Winter duck populations showed over 8,000 birds in January including 4,500 black ducks; and over 11,000 birds in February, including 4,500 black ducks and 4,500 green-winged teal.

The spring period saw most geese gone by late March; however, 15,000 snow geese were still present through April 11. March duck populations peaked at over 13,000 birds including 4,000 black ducks, 4,000 green-winged teal, 1,000 blue-winged teal and 600 wood ducks. In April, numbers had dropped to less than 5,000 birds, primarily consisting of green-winged teal(2,500), blue-winged teal(800) and wood duck(800).

Breeding populations from May to August were near average; however, nesting success was poor, with estimated production to flight stage of:

50	Black ducks
100	Mallards
60	Gadwall
30	Blue-winged teal
400	Wood Duck
3	Hooded merganser
8	Canada goose

Pre-season banding for both black ducks and wood ducks was poor due to an abundance of natural foods available in the area.

Fall arriving ducks and geese found a gourmet feast including duckweed, smartweed, millet and wild rice, as well as excellent water levels. The result was record duck populations from November through December. Average duck populations for the period were:

October	27,915
November	22,555
December	29,705

These totals included fall peaks of 15,000 green-winged teal, 5,600 black ducks, 5,000 pintail, 4,500 mallards, 2,600 gadwall and 1,800 ring-necked ducks.

The first migrant Canada geese were observed on September 8, with the arrival of 25 birds. A few snow geese were also present at that time. Canada geese peaked in December at 4,000 birds, far short of the 20-25,000 birds present in the early 1980's. Snow geese peaked at 40,000 birds in November and December, again causing extensive eat-outs in the marsh. The eat-outs, however, provided excellent short-term feeding habitat for ducks.

We do not attempt to maintain records of bird use by units since field observations indicate that both ducks and geese utilize more than one unit each day. Bombay Hook Biologist Frank Smith made periodic flights from January to March and from October to December to monitor snow goose populations and eat-outs. No other aerial surveys were flown. Although funding for aerial surveys was provided in the FY 91 budget, no contract, OAS approved pilots are available locally. State Biologist Thomas Whittendale also makes monthly aerial flights. Much of the survey data from Units III and IV is obtained by ground counts or airboat surveys.

Unit I

No active water level management currently is possible nor planned for this unit. Personnel from the Delaware Division of Fish and Wildlife, Mosquito Control Section, began mapping the unit for implementation of Open Marsh Water Management (OMWM). The unit includes 934 acres of potential mosquito breeding habitat. Preliminary studies indicate that since the Unit II Water Control Structure was built, tidal water has spread out over more of the Unit I area, thus reducing the number of acres of potential mosquito breeding habitat.

Current management consists of salinity testing, prescribed burning and monitoring vegetation transects. Wetlands consist of Phragmites along the eastern boundary (15%), salt hay (Spartina patens, Distichlis spicata) (60%), salt marsh cordgrass (S. alterniflora) (10%) and a mixture of myrtle and switchgrass (15%).

Tidal salt water is the primary source for the unit, entering through Slaughter Canal which flows southward from the Mispillion River. Rainfall and frequent storm tides maintained excellent wetland conditions in the unit.

Four 30 meter transects have been established in the unit to monitor eat-outs and other vegetation. Only two of the transects were surveyed in 1990 due to staff shortages and a temporary off-refuge assignment. The snow goose eat-out was estimated at 42.5 acres in April, using aerial photographs and videos. Shorebirds and ducks, primarily green-winged teal, have made extensive use of the eat-out. Mosquito breeding in the eat-outs has also been extensive.

Mosquito Control personnel began survey of Unit I mosquito breeding areas in September. Actual OMWM excavation is expected to begin in early 1991.

Unit II

Water levels were held slightly below planned levels from January to March to counter the possibility of complaints from adjacent landowners (farmers) who opposed the project. Planned drawdown was initiated in early March to permit adequate drainage of off-refuge croplands. Although this action is less than ideal, it is a condition of our wetlands permits from the State and Corps of Engineers. The marsh was drawdown to or near an elevation of 1.80' msl. This level was maintained until fall when impoundment was

again initiated.

The March-September water level allows tidal water to flow-over the stoplogs into the unit or for excessive water in the unit to flow over the stoplogs out of the impoundment, thus maintaining a small area of tidal marsh adjacent to Slaughter Canal. Much of the tidal marsh vegetation, however, has now been removed by snow geese, creating a mudflat.

The eat-out in Unit II was estimated from aerial photographs and videos at 167.5 acres. Four additional 30 meter transects were established near the junction of Slaughter Canal and Slaughter Creek in July. Only approximately 20% of the eat-out had started to revegetate at that time, apparently to millet. Unfortunately, as discussed above, manpower was not available to monitor the transects in September. Two transects established in 1989 were also not surveyed in 1990; however, the latter two transects appear to have contained dense stands of millet, three-square and sedges.

In August, four hundred acres of Phragmites in the unit were sprayed aerially with Rodeo, including two hundred acres sprayed as a part of the State Cost Sharing Program. During this second year the application rate was one quart per acre. Total cost to the refuge was \$18.50 per acre. The additional 200 acres were sprayed at the 2 quart per acre rate using resource problem funds.

Areas treated in 1989, including the 200 acre cost sharing section, showed excellent control of Phragmites. Planned establishment of additional transects in this area was deferred.

A system of bench marks and observation wells have been established within the unit to monitor surface and ground water levels. This data will provide information on whether our management is impacting upon septic systems along Prime Hook Beach or upon agricultural lands on the western side of the unit. The data is summarized in Appendix Table 1. The wells and bench marks are surveyed twice monthly (first and fifteenth of each month).

Unit III

Over 63,000 snow geese made extensive use of Unit III in January, consuming salt hay and cattail in the southern end of the unit. The eat-out was estimated at 386 acres, an increase of 236 acres over last year. Much of the vegetation between Draper's Ditch and

Route 16, east of Petersfield Ditch was stripped to a mudflat.

Following the severe cold of November through December 1989, January was warm with most ice gone by mid-month. No extensive freezing was noted during the rest of the winter. Marsh water levels remained excellent throughout the remainder of 1990 with only a few days of light ice in December.

Drawdown to spring/summer water levels (2.2' msl) was accomplished in March; however, above normal rainfall in April and May required frequent manipulation of the screw gates to prevent flooding of private lands. During July and August, heavy rainfall again resulted in frequent manipulation of screw gates. This labor intensive work is necessary until flap gates can be installed.

By late August, it was noted that much of the eat-out had broken back to millet, nutsedge and some cattail, however, in less dense stands than in 1989. Duck weed was also abundant.

Elsewhere in the unit, excellent stands of aquatic plants were noted including 1.5 acres of wildrice, smartweeds, millet, etc. Once again, migrating ducks found a gourmet feast available to them. These ideal conditions aided in producing record duck use for the unit as well as throughout the refuge. During October and November, 50% of the birds present were green-winged teal.

During March and April the Service's cookie cutter was used to rehabilitate and clean approximately five miles of existing ditches in Unit III. This ditch work has greatly improved our capability to drawdown the unit as well as improve our access, via airboat, for surveys and nest box checks.

In August, 400 acres of marsh were treated with Rodeo to control Phragmites, including 200 acres as part of a cost sharing program with the State. Much of Unit III has seen excellent control of Phragmites; however, the eastern edge of the unit, adjacent to private lands continues to see invasion from their untreated marsh. Periodic applications of Rodeo along this border are necessary to maintain control. The success of the control program can be seen in the sharp increase in duck use during the past 5 to 7 years.

Mosquito control personnel identified 43 acres of severe mosquito breeding habitat in the unit adjacent to State Route 16. In June, the special use permit

for OMWM operations was amended to include this acreage for OMWM treatment. Work on the systems was started in July and will be complete in early 1991.

A muskrat house count in a portion of the unit in December 1989 revealed 736 houses in a 350 acre area north of State Route 16. The houses had been built prior to the snow goose eat-out. In December, 1990, a count in this same area, following one season of regrowth on the eat-out, revealed only 350 houses. As a result of the eat-out there were less materials available to muskrats for food and houses.

Four 30 meter transects established in 1989 were surveyed in September by Biologist Smith. Two additional transects were established and surveyed in October.

Water level monitoring on Broadkill Beach continued through the year on the first and fifteenth of each month. Well readings are summarized in Table 2. No complaints of septic system failures were received during the year.

Unit IV

The 200 acre impoundment remained ice free for much of the period from January through March. Use by waterfowl during this period was high with black ducks, green-winged teal, gadwall and shovelers the most numerous. Only a small additional area was eaten-out this year with the total eat-out estimated in April at 80 acres.

During March to October, the impoundment was operated as a tidal pool with water levels permitted to ebb and flow with the tides. Fish screens were installed to prevent carp from entering the unit; however, a large number of carp are permanently established in the impoundment.

Spring shorebird, marsh and waterbird use was excellent with up to several thousand shorebirds observed in May. In August, over 400 snowy egrets were observed feeding in the area.

Small plots of Phragmites were sprayed by hand in August.

Above normal rainfall prevented evaporation of water in four small ponds within the unit; thus growth of millet was poor. A survey of the area was made to plan construction of ditches to draw the water off in July. Although it appears that the ditches and spoil

would be in upland areas, permitting agencies indicate that a permit will be required from the U.S. Army Corps of Engineers.

OMWM work in Unit IV continued throughout the year and is nearly completed. By the end of 1990, 362 acres of salt marsh had been completed with OMWM treatment which should be completed in January, bringing the total treatment to 405 acres. The environmental assessment for the work had identified 417 acres of severe breeding habitat.

Within Unit IV, a total of 39 ponds were excavated ranging in size from .05 acres to .70 acres. The amount of open, ponded water created by OMWM excavations was 5.75 acres. A variety of waterbirds, aquatic furbearers and other mammals have been directly and indirectly observed using these ponded areas immediately following excavations and continuing through the vegetation recovery period. Vegetation recovery is progressing well with over 90% of the spoil areas revegetated within two years following installation of the systems. Revegetation is occurring at a slower rate in areas where highly mineralogical spoil was compacted during OMWM installations (e.g. ditch plugs). As a result of OMWM work, only spot spraying by helicopter was required during 1990 using Abate and Altosid for mosquito larvae. The maximum area treated was 15 acres.

Three vegetation transects were surveyed during September/October. Approximately one-third of the eat-out had revegetated to sedges, saltmarsh fleabane, millet and Spartina patens.

B. Planned Management - 1991

General

Additional transects will be established in each unit to further monitor vegetative cover, especially in areas of snow goose eat-outs. In September, when vegetative cover is at its peak, all transects will be surveyed and a photo record made. Aerial photographs of eat-outs will be made to compute acreage involved and the increase in size from 1988. Random transects will be established within the eat-outs to monitor regrowth, if any, and use by wildlife.

Preparation of annual water management programs for Units II and III must bear in mind management constraints outlined in pages 9-11 of Prime Hook's Water Management Plan. Spring reductions of water levels

to permit drainage of adjacent lands may not be the most ideal plan for refuge habitat or wildlife resources; however, we have assured the public during the planning process for the water control structures, that we would not adversely impact their lands. The relatively flat topography of our marshes is such that a small increase in the marsh water level may affect a large area. We must also realize that with Units II and III we are managing large impoundment areas (1,500 and 2,500 acres respectively).

Salinity testing will be conducted as manpower is available. Waterfowl and muskrat surveys will continue to be conducted in accordance with the Wildlife Inventory Plan.

In January 1991, refuge staff met with Field Biologist Harold Laskowski to review and discuss our water management program. These discussions are reflected in this program.

Unit I

OMWM excavations will begin in February and survey planning will continue throughout the year. State personnel will also continue to monitor mosquito breeding populations both on foot and via helicopter. Vegetation transects will be photographed and surveyed in September. In addition, OMWM treatment areas will be photographed and mapped prior to excavation dependent upon availability of refuge staff.

If assistance is available from the Memorial Fire Department, Inc. of Slaughter Beach, prescribed burn in marsh grasses and switchgrass is planned for March, to remove accumulated fuels and lessen the threat to the community of Slaughter Beach. Some stress will be placed on woody growth in the marsh; however, little control is expected. If available, the Service's Hydroaxe will be used in August to open portions of brush within the unit for woodcock and duck nesting habitat (Figure 9). The once farmed lands have reverted to tall dense stands of myrtle.

In April/May aerial photographs of the snow goose eat-out area will be taken to determine the size of the area impacted by the geese.

Unit II

We will continue to monitor observation wells and bench marks on the first and fifteenth of each month, as well as following severe storms where a threat of impacting upon privately-owned croplands occurs. At

the end of the year we will re-evaluate our monitoring program to determine future monitoring efforts.

Drawdown from winter water levels will begin in late February to reduce the impact on adjacent lands. The early date is set so that the adjacent owners would be able to plant peas if they desire. When the water levels have been lowered to 1.80' msl, stoplogs will be installed to maintain that level. At this time tidal water will ebb and flow over the logs to maintain the small area of salt marsh within the impoundment, as we insured during the permit process. This level will provide sufficient habitat for brood rearing.

In July, the impoundment water level will be further lowered to expose the soils in the eat-out area to stimulate emergent aquatic plants. To accomplish the drawdown we will install stoplogs to the tops of each bay to prohibit tidal exchange and draw water off through use of the flap gates. We expect drawdown to take two weeks.

We will closely monitor the effects of this drawdown on Phragmites along the eastern boundary of the unit. Working with mosquito control personnel we will also look at the impact of the drawdown on mosquito populations.

Fall impoundment will be initiated in October, following harvest of crops adjacent to the refuge.

Fields 210, 211 and 212 - total 85 acres - will be converted to moist soil units. This year we will plant 12 acres of Field 211 to clover. These fields will be surveyed to obtain elevation data. A rice plow will be borrowed from Blackwater National Wildlife Refuge and a berm, ^{well} constructed around the perimeter of the fields as indicated by the survey. Survey data will also indicate if cross berms are needed to break up the area. Future considerations will be to either excavate a ditch to the fields from Slaughter Canal or to install a pump station and/or well to provide a dependable water supply for the area. In wet years, rainfall would probably be sufficient to provide the necessary water.

Snow goose eat-outs will be mapped in April/May to determine present size as compared with 1988. Additional transects will be established as required. All transects will be surveyed in September.

Phragmites spraying will continue as funds permit. Total funding for the refuge for 1991 is \$20,000. A

portion of this will be used to hire a student to map areas previously sprayed and to conduct other biological surveys. Additional funds may be available through the Isaacs donation, and through Ducks Unlimited. Distribution of the funds by units will be determined at a later date.

All vegetation transects will be photographed and surveyed in September.

If manpower is available, the cookie cutter will be placed into Unit II by crane in March to clean ditches within the marsh for access, water circulation and drainage and as a firebreak(Figure 8). The hydroaxe, if available, will be used in August to open dense stands of myrtle for woodcock habitat(Figure 9).

Unit III

Water management in this unit will continue as in the past during the early part of the year; however, this year we plan to draw the impoundment down to stimulate summer growth of emergent aquatic plants. The plan is as follows:

January - Mid-February - Maintain water at the 2.8' msl level.

Mid-February - Begin drawdown to spring water management level to lessen the impact on adjacent privately-owned croplands.

March 15 - Open WCS to permit the impoundment to drop to the summer level of 2.2' msl for brood habitat. At this level, brackish water will ebb and flow, maintaining the small area of salt marsh near State Route 16.

June 15 - Begin further drawdown to expose mudflats created by snow geese to permit growth of emergent aquatic plants.

October 1-10 - Begin reflooding impoundment for use by migrating waterfowl.

In the past we have hesitated to drawdown Unit III because such action might benefit Phragmites growth. However, the extent of the eat-out in the southern end of the unit requires that we draw water off to stimulate growth of aquatic plants. The drawdown will be closely monitored to determine the effects on Phragmites growth, response of emergent aquatics and the effects on mosquito breeding.

Contacts will be maintained with the State's Mosquito Control Division to monitor mosquito breeding

populations and to plan additional OMWM work, if required. The drawdown is expected to receive adverse reaction from anglers who will experience problems running boats in the shallow ditches.

The drawdown will be accomplished by frequent raising and lowering of the screw gates at the two water control structures. We will further explore the possibility of installing flap gates to replace the screw gates (similar to the Unit II Water Control Structure). If possible, FY 91 funds will be used to purchase at least two flap gates for Unit III.

With assistance from the Delaware Department of Transportation, Highways Section(DELDOT), three 36" CMP culverts will be replaced on the perimeter of Unit III to provide the capability for moving water between Units II and III and Units III and IV(Figure 10). The existing culverts are over 25 years old and barely operational. The pipes have been purchased with FY 90 funds and will be placed by DELDOT at their expense, under a cooperative agreement. All culverts have a built-in stoplog bay. The culvert on State Route 16 will be used to replace the non-functional gut plug installed as part of the Unit III project in 1984. Two additional culverts are needed for Prime Hook Beach Road and one on State Route 16 as funds permit.

The cookie cutter will be used in March to continue cleaning of ditches within the unit(Figure 7). The hydroaxe will be used, if available, in August to open dense stands of myrtle to improve habitat for woodcock and other wildlife(Figure 9).

A portion of FY 91 funding for Phragmites control will be used to hire a biological technician for up to 10 weeks to map Phragmites treatment areas in both Units II and III. Field work will also indicate priority areas for treatment in 1991.

Field 340(22 acres) was removed from cultivation in 1987. In 1991 we will survey the field and construct a dike along its perimeter using a rice plow to be borrowed from Blackwater National Wildlife Refuge. Survey work will also indicate if a ditch will be required to supply fall/winter water for moist soil management.

If additional vegetation transects are necessary, they will be established in early summer. All transects will be surveyed in September.

Observation wells and benchmarks in Unit III will be monitored twice monthly, on the first and fifteenth, and when abnormal weather conditions exist (heavy rainfall, strong coastal storms). This work is necessary to provide base information in the event that a complaint is received from a refuge neighbor.

OMWM work in Unit III will be monitored and photographed to determine the extent and rate of revegetation, as well as the revegetating species.

Unit IV

During 1991, the 200 acre tidal impoundment will be converted to a freshwater/brackish pond using water from Unit III as a water source. Water from Unit III currently washes through the pool; however, up to now strong tidal action maintained the area in predominately salt marsh vegetation such as saltmarsh fleabane, which is not a particularly good waterfowl food plant. The pool will continue to wash with freshwater with little to no tidal fluctuation until mid-June, at which time the area will be dewatered to the extent possible to stimulate emergent aquatic species. This action may create difficulty for black duck banding; however, we feel that the drawdown should occur.

Four transects within the impoundment will be surveyed in September. Areas containing Phragmites will be mapped in June and spot sprayed in August or September by hand. If large areas are found, they will be sprayed by helicopter.

OMWM work has been completed in Unit IV. We will continue to monitor revegetation through use of photo points and, if manpower is available, cover mapping of OMWM treated areas. Mosquito control personnel will continue to monitor mosquito breeding populations to evaluate the effectiveness of the OMWM treatment.

Background data collected in 1990 will be used to put together a permit application/proposal for creating drains for four small ponds outside of the impounded areas. Hopefully work will be completed by August to permit drawdown of the ponds.

TABLE 2

ANNUAL WATER MANAGEMENT PROGRAM - Year 1991

Refuge Prime Hook NWR Water Unit Name or Number IIIMaximum w.s. elevation permissible 2.8' mslFlowline elevation of lowest drain structure -2' mslAverage elevation of pool bottom (not borrow pit bottom) Unknown

I. A. Water Surface Elevations and Salinity for Past Year				II. A. Planned Elevation and Salinity for Program Year	
Date	Water Surface Elevations		Salinity (% of Sea Water)	Water Surface Elevation	*Salinity Objective
	WCS	Blind #22			
Jan. 1	2.50	2.49	0	2.80	
15	2.40	2.40	0	2.80	
Feb. 1	2.60	2.50	0	2.80	
15	2.40	2.66	0	2.80	
Mar. 1	2.44	2.41	0	2.60	
15	2.80	2.41	0	2.50	
Apr. 1	2.78	3.04	0	2.40	
15	2.80	3.00	0	2.20	
May 1	3.00	3.12	0	2.20	
15	2.60	3.04	0	2.20	
June 1	2.70	3.37	0	2.20	
15	2.58	2.79	0	2.20	
July 1	2.40	2.54	0	2.20	
15	2.70	2.96	0	1.90	
Aug. 1	2.30	2.71	Not recorded	1.80	
15	2.30	2.73	Not recorded	1.60	
Sept. 1	2.50	2.79	Not recorded	1.50	✓
15	2.30	2.87	Not recorded	1.70	
Oct. 1	2.30	2.80	Not recorded	2.20	
15	2.60	2.71	Not recorded	2.30	
Nov. 1	2.74	3.04	Not recorded	2.40	
15	2.70	2.87	Not recorded	2.60	
Dec. 1	2.70	3.12	Not recorded	2.80	
15	2.80	3.00	Not recorded	2.80	
31	2.80	2.85	Not recorded	2.80	

*To be used for pools approved for brackish water management.

TABLE 1

ANNUAL WATER MANAGEMENT PROGRAM - Year 19 91

Refuge Prime Hook NWR Water Unit Name or Number II

Maximum w.s. elevation permissible 4.0' NGVD

Flowline elevation of lowest drain structure -2' NGVD

Average elevation of pool bottom (not borrow pit bottom). Unknown

I. A. Water Surface Elevations and Salinity for Past Year				II. A. Planned Elevation and Salinity for Program Year	
Date	✓ Water Surface Elevations	✓ Salinity (% of Sea Water)		✓ Water Surface Elevation	*Salinity Objective
	WCS	TP5			
Jan. 1	2.00	2.46	0	2.3	
15	2.20	2.38	0	2.3	
Feb. 1	2.18	2.38	1	2.3	
15	2.10	2.46	0	2.3	
Mar. 1	1.88	2.30	0	2.2	
15	1.58	2.30	0	2.1	
Apr. 1	2.00	2.38	0	2.0	
15	2.00	2.38	0	1.9	
May 1	2.00	2.38	0	1.9	
15	2.00	2.47	0	1.9	
June 1	2.40	2.63	0	1.9	
15	1.50	2.30	0	1.6	
July 1	1.10	1.80	0	1.5	
15	2.00	2.30	0	1.3	
Aug. 1	2.20	2.13	Not recorded	1.0 ✓	
15	2.30	2.13	Not recorded	1.0	
Sept. 1	2.30	2.13	Not recorded	1.0	
15	2.20	2.63	Not recorded	1.0	
Oct. 1	2.00	2.40	Not recorded	1.0	
15	1.00	2.23	Not recorded	1.3	
Nov. 1	2.20	2.30	Not recorded	1.8	
15	2.14	2.38	Not recorded	2.0	
Dec. 1	2.30	2.23	Not recorded	2.3	
15	2.30	2.62	Not recorded	2.3	
31	2.30	2.65	Not recorded	2.3	

*To be used for pools approved for brackish water management.

5RF-8/8/68

TABLE 3

ANNUAL WATER MANAGEMENT PROGRAM - Year 19 91Refuge Prime Hook NWR Water Unit Name or Number IVMaximum w.s. elevation permissible 4.0' mslFlowline elevation of lowest drain structure 0' mslAverage elevation of pool bottom (not borrow pit bottom) UnknownI. A. Water Surface Elevations
and Salinity for Past YearII. A. Planned Elevation and
Salinity for Program Year

Date	Water Surface Elevations	Salinity (% of Sea Water)	Water Surface Elevation	*Salinity Objective
Jan. 1	WCS			
15	Not recorded	0	2.2	< 4 ppt
	Not recorded	0	2.2	
Feb. 1	Not recorded	1	2.2	
15	Not recorded	1	2.2	
Mar. 1	Not recorded	4	2.2	
15	Not recorded	4	2.2	
Apr. 1	2.00	4	2.2	
15	2.25	4	2.2	
May 1	2.25	4	2.2	
15	2.04			
June 1	2.08	1	2.2	
15	1.83	12	2.1	
July 1	2.08	12	1.9	
15	2.33	12	1.8	
Aug. 1	2.33	5	1.5	
15	2.33	5	1.0	
Sept. 1	2.33	Not recorded	1.0	
15	2.33	Not recorded	1.0	
Oct. 1	2.20	Not recorded	1.8	
15	2.00	Not recorded	2.0	
Nov. 1	2.50	Not recorded	2.2	
15	2.58	Not recorded	2.2	
Dec. 1	2.50	Not recorded	2.3	
15	2.58	Not recorded	2.3	
31	2.52	Not recorded	2.3	

*To be used for pools approved for brackish water management.

PRIME HOOK NATIONAL WILDLIFE REFUGE
SUSSEX COUNTY, DELAWARE

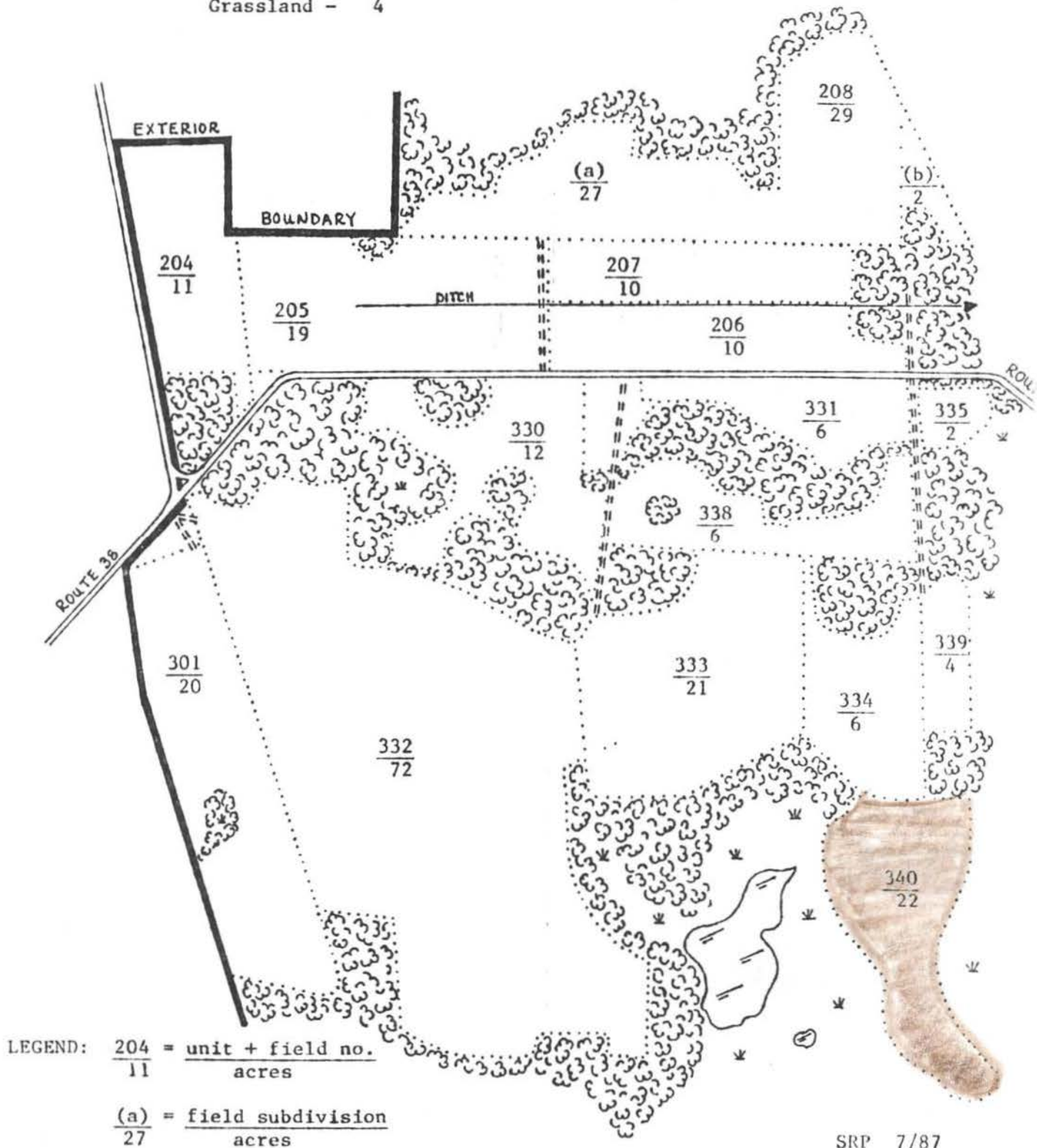
FIGURE 12

EXHIBIT G



Field 340 planned construction of
rice dike

TOTAL ACREAGE: Cropland - 246
Grassland - 4




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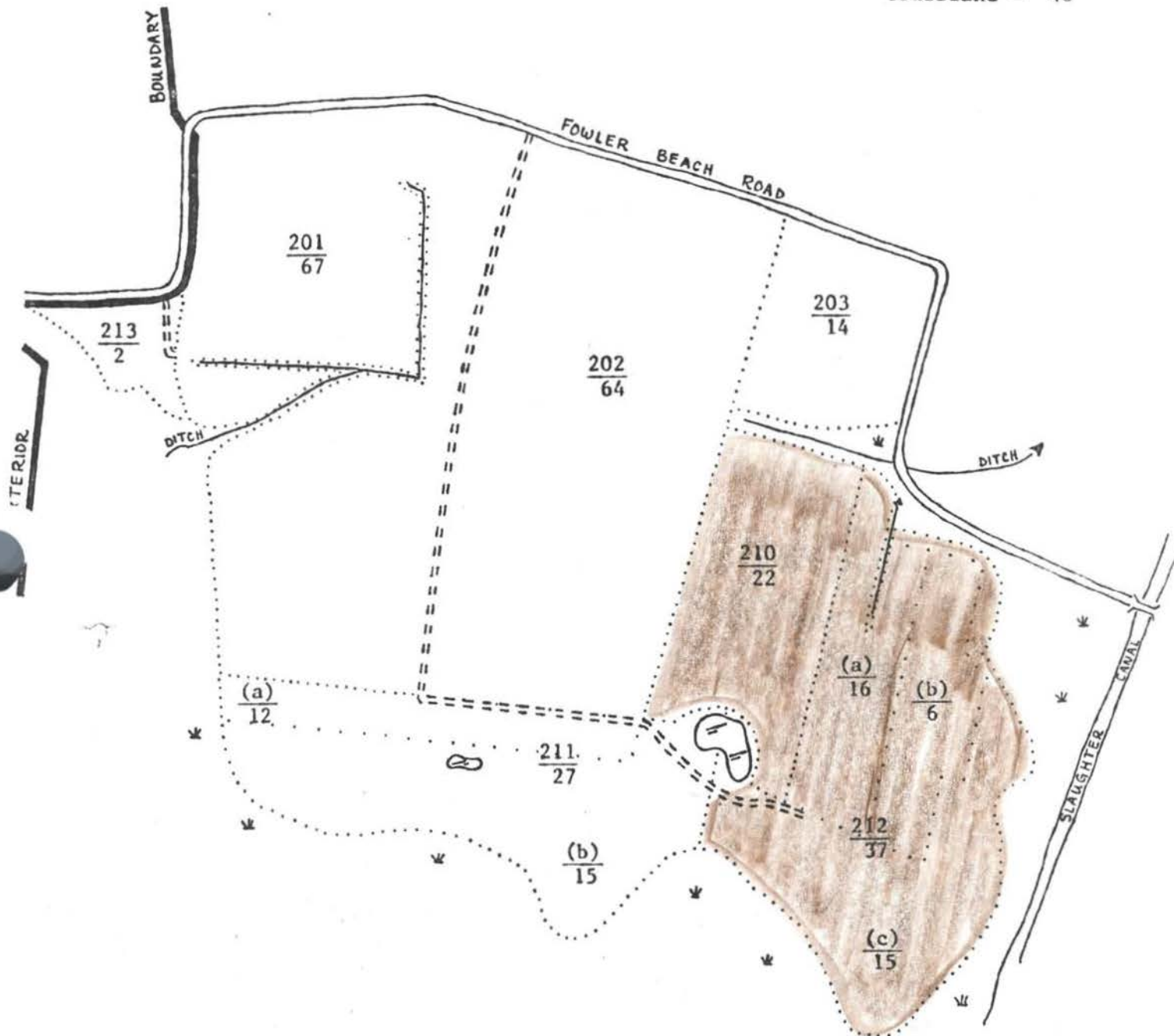
PRIME HOOK NATIONAL WILDLIFE REFUGE
SUSSEX COUNTY, DELAWARE

FIGURE 11

EXHIBIT E

 Fields 210, 211 planned construction of rice dike

TOTAL ACREAGE: Cropland - 187
Grassland - 46



LEGEND: $\frac{212}{37} = \frac{\text{unit} + \text{field no.}}{\text{acres}}$

$\frac{(a)}{16} = \frac{\text{field subdivision}}{\text{acres}}$

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FIGURE 10 Culvert Replacement
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SUSSEX COUNTY, DELAWARE

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BUREAU OF SPORT FISHERIES AND WILDLIFE

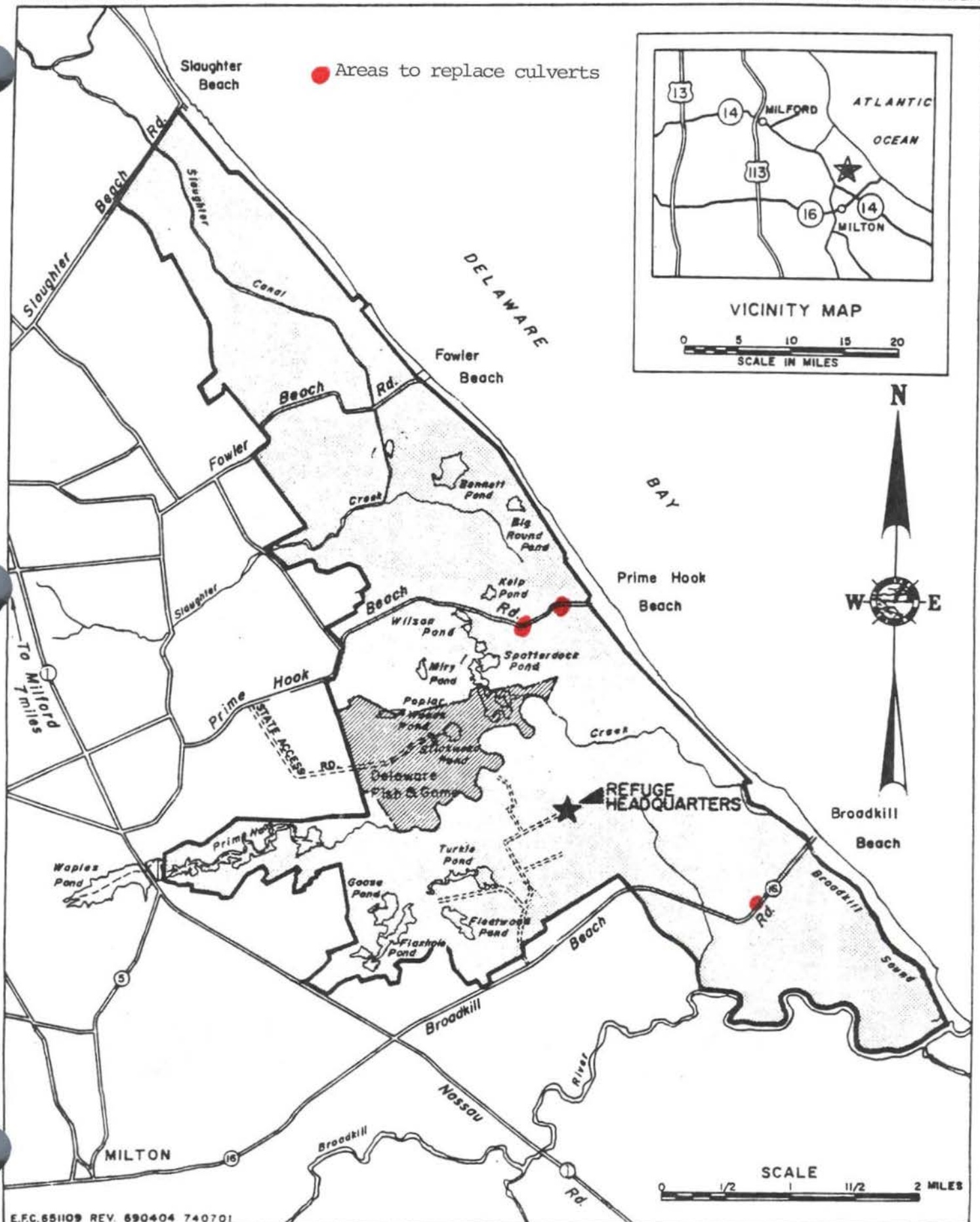


FIGURE 9

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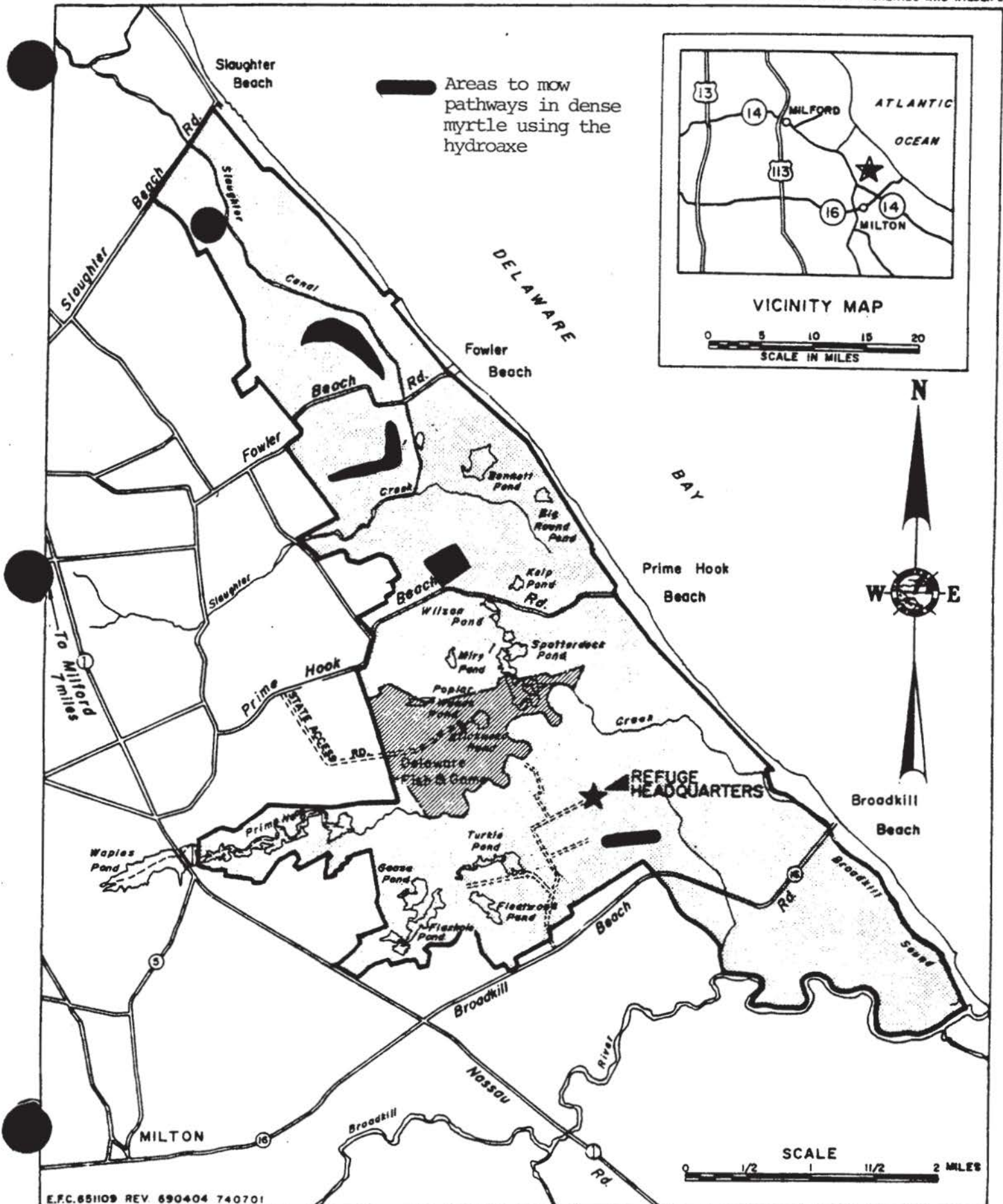
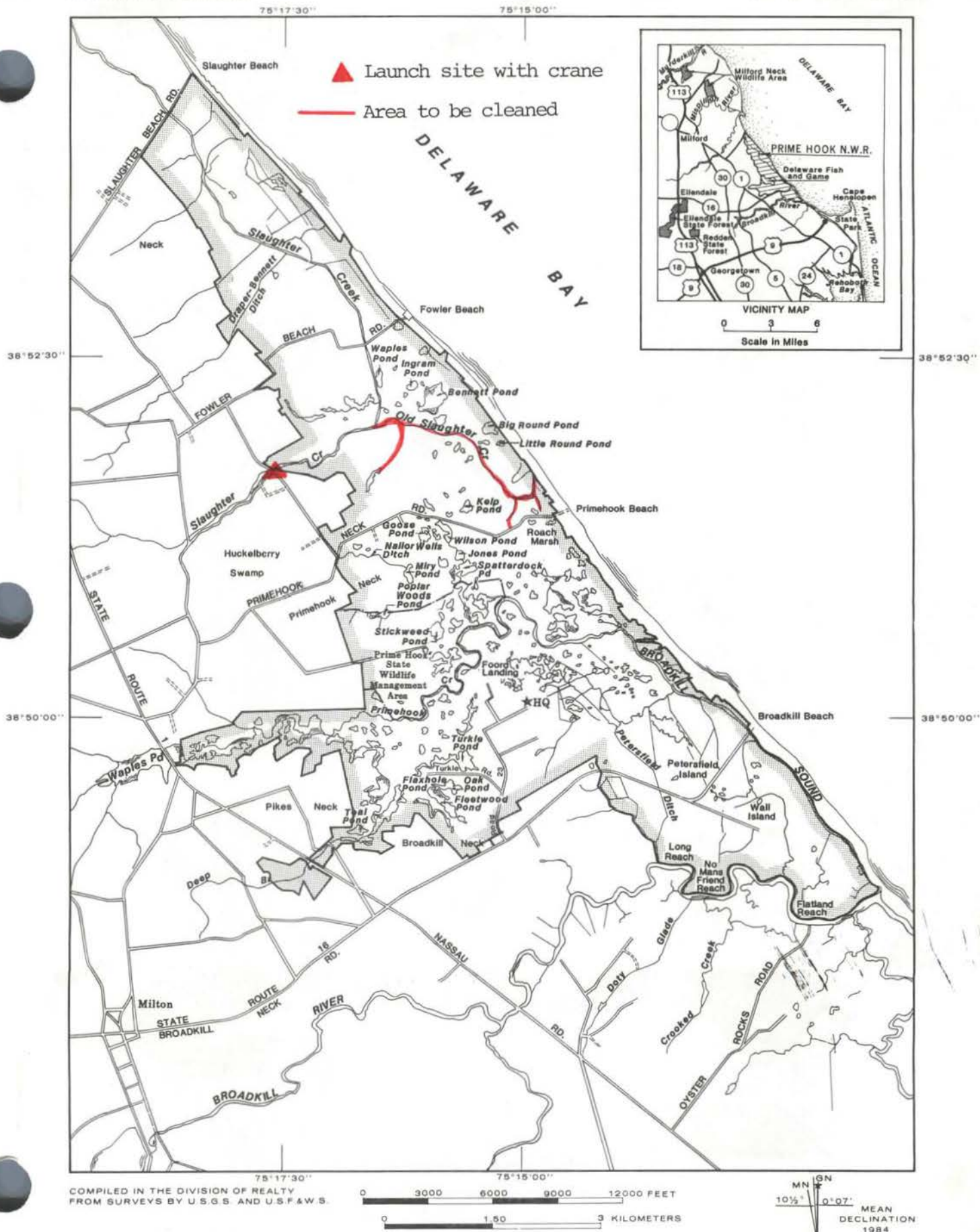


FIGURE 8 Cookie Cutter proposal 1991 PRIME HOOK NATIONAL WILDLIFE REFUGE

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SUSSEX COUNTY, DELAWARE

UNITED STATES
FISH AND WILDLIFE SERVICE



COMPILED IN THE DIVISION OF REALTY
FROM SURVEYS BY U.S.G.S. AND U.S.F.&W.S.

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PRIME HOOK
National Wildlife Refuge
SUSSEX COUNTY, DELAWARE

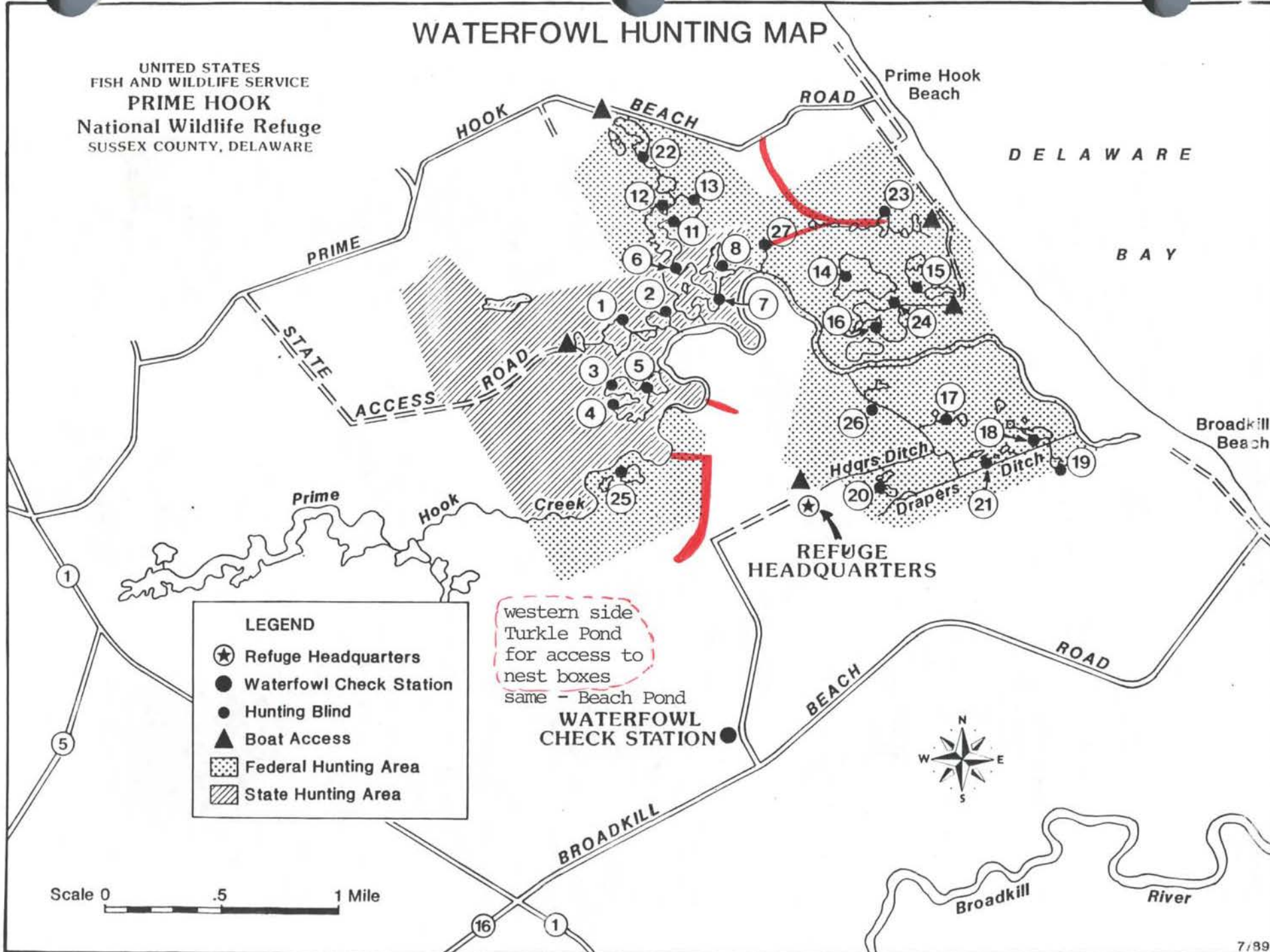


FIGURE 7 To be cleaned in 1991

WATERFOWL HUNTING MAP

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PRIME HOOK
National Wildlife Refuge
SUSSEX COUNTY, DELAWARE

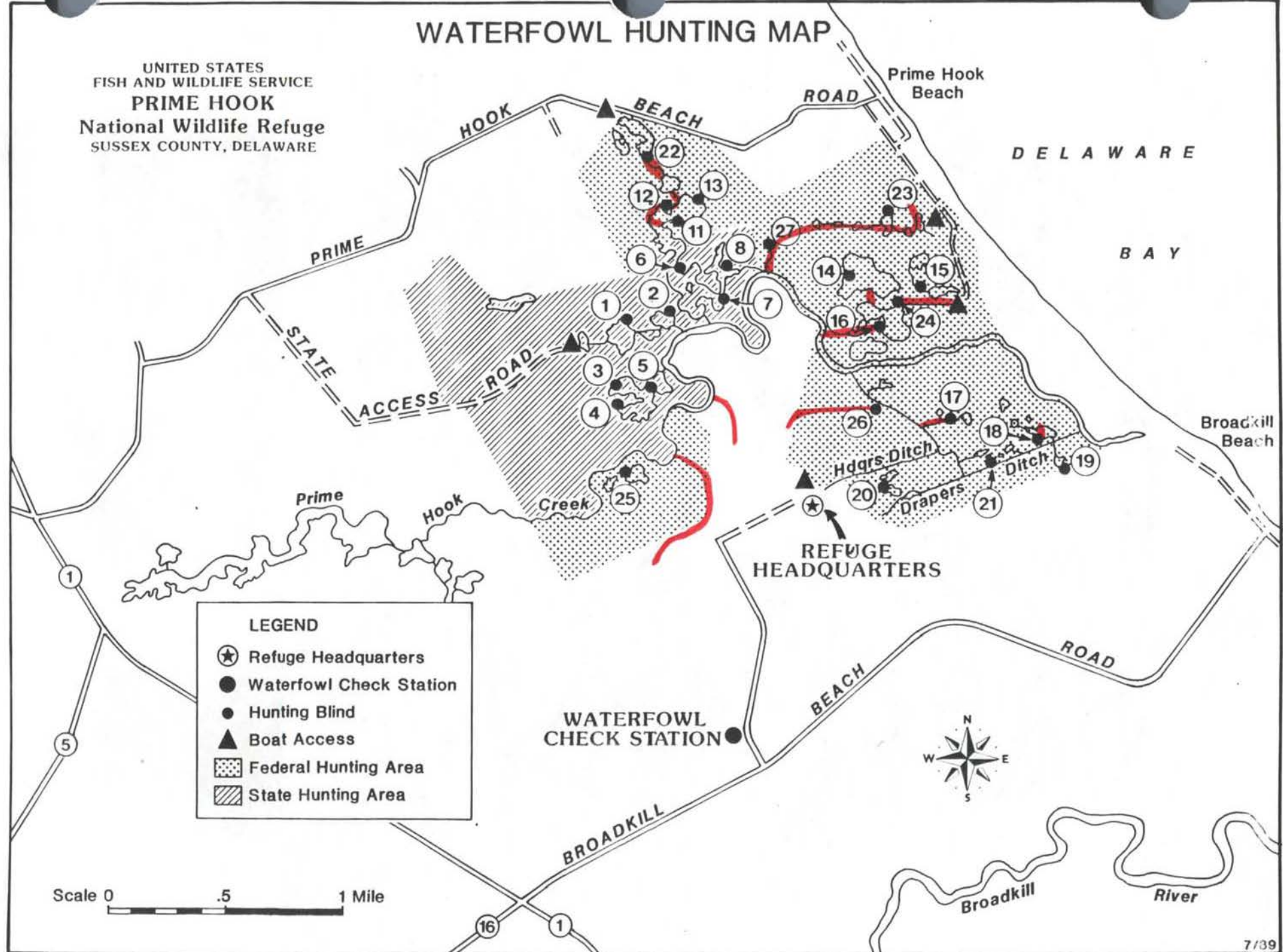


FIGURE 6 Cleaned in 1990

FIGURE 5
PRIME HOOK NATIONAL WILDLIFE REFUGE
SUSSEX COUNTY, DELAWARE

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FISH AND WILDLIFE SERVICE
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Area to treat with
Rodeo 1991

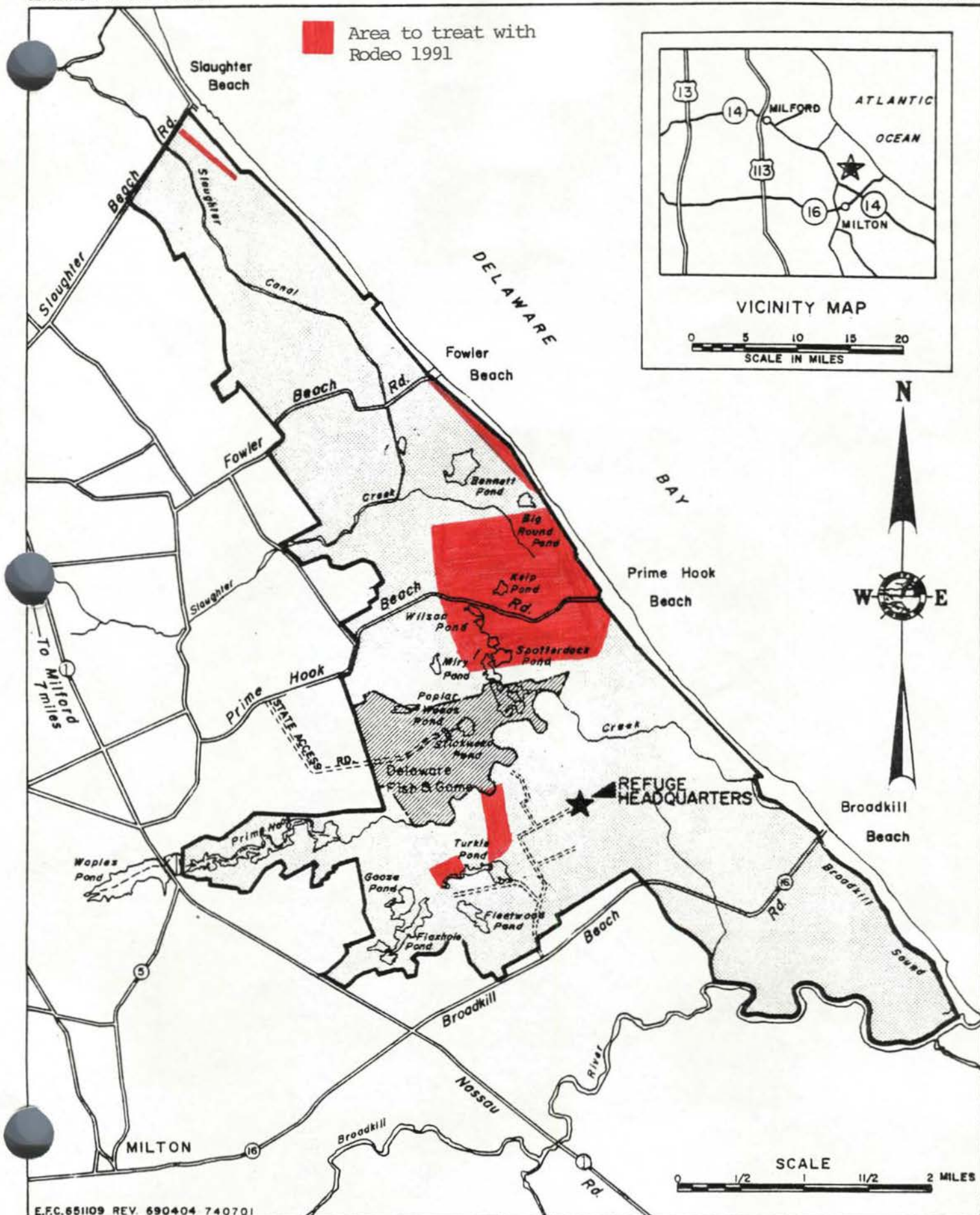


FIGURE 4
PRIME HOOK NATIONAL WILDLIFE REFUGE
SUSSEX COUNTY, DELAWARE

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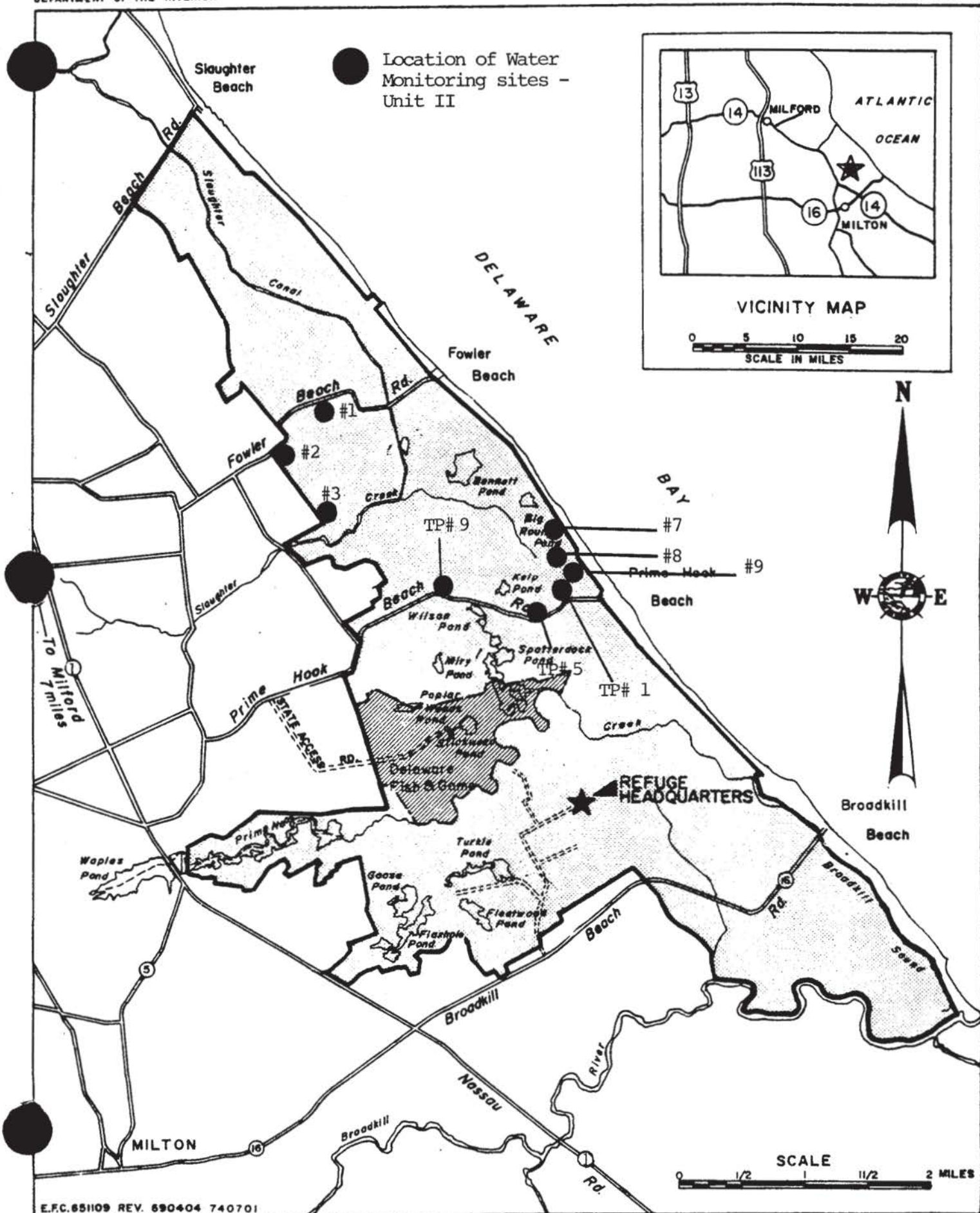


FIGURE 3
PRIME HOOK NATIONAL WILDLIFE REFUGE
SUSSEX COUNTY, DELAWARE

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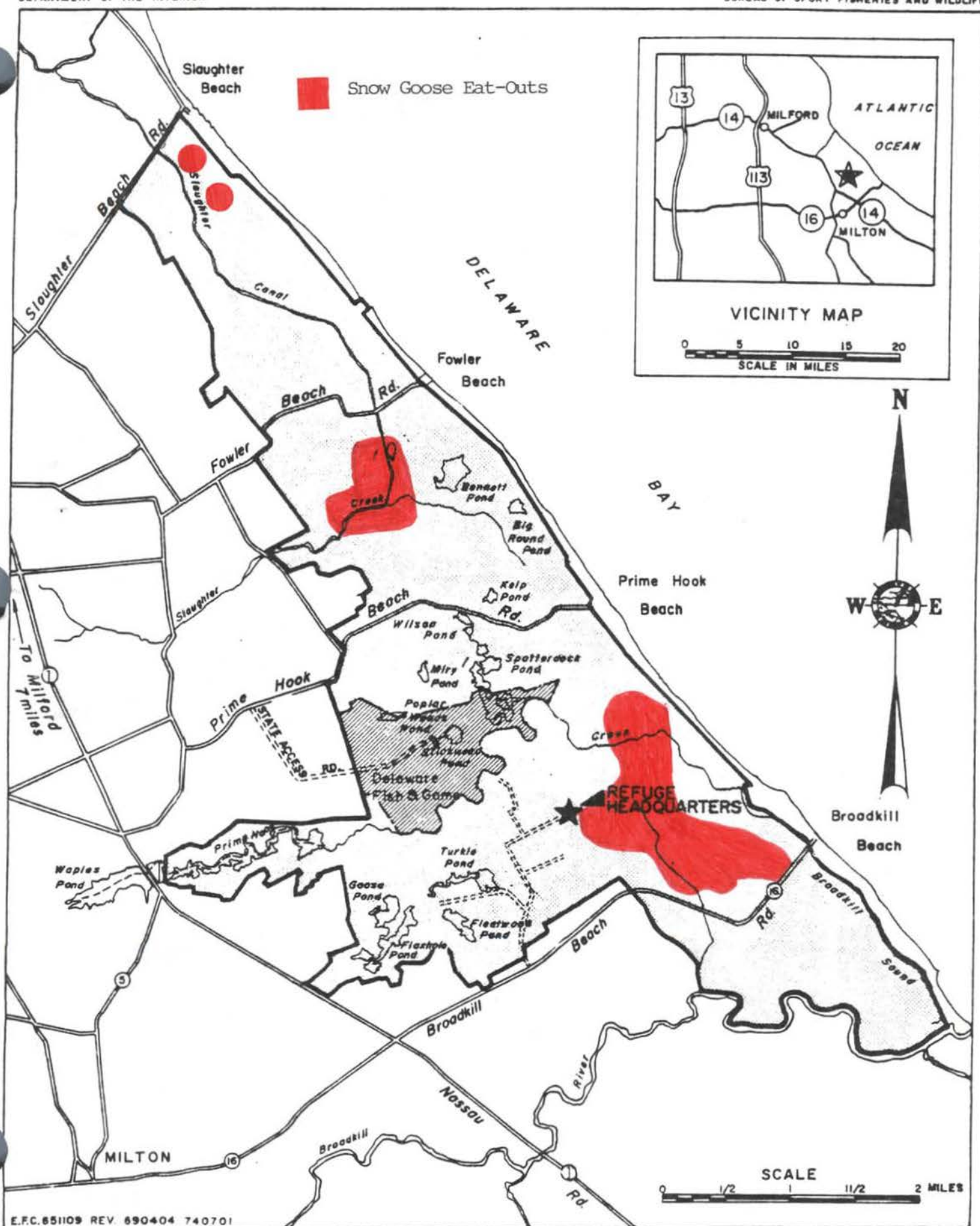


FIGURE 2
PRIME HOOK NATIONAL WILDLIFE REFUGE
SUSSEX COUNTY, DELAWARE

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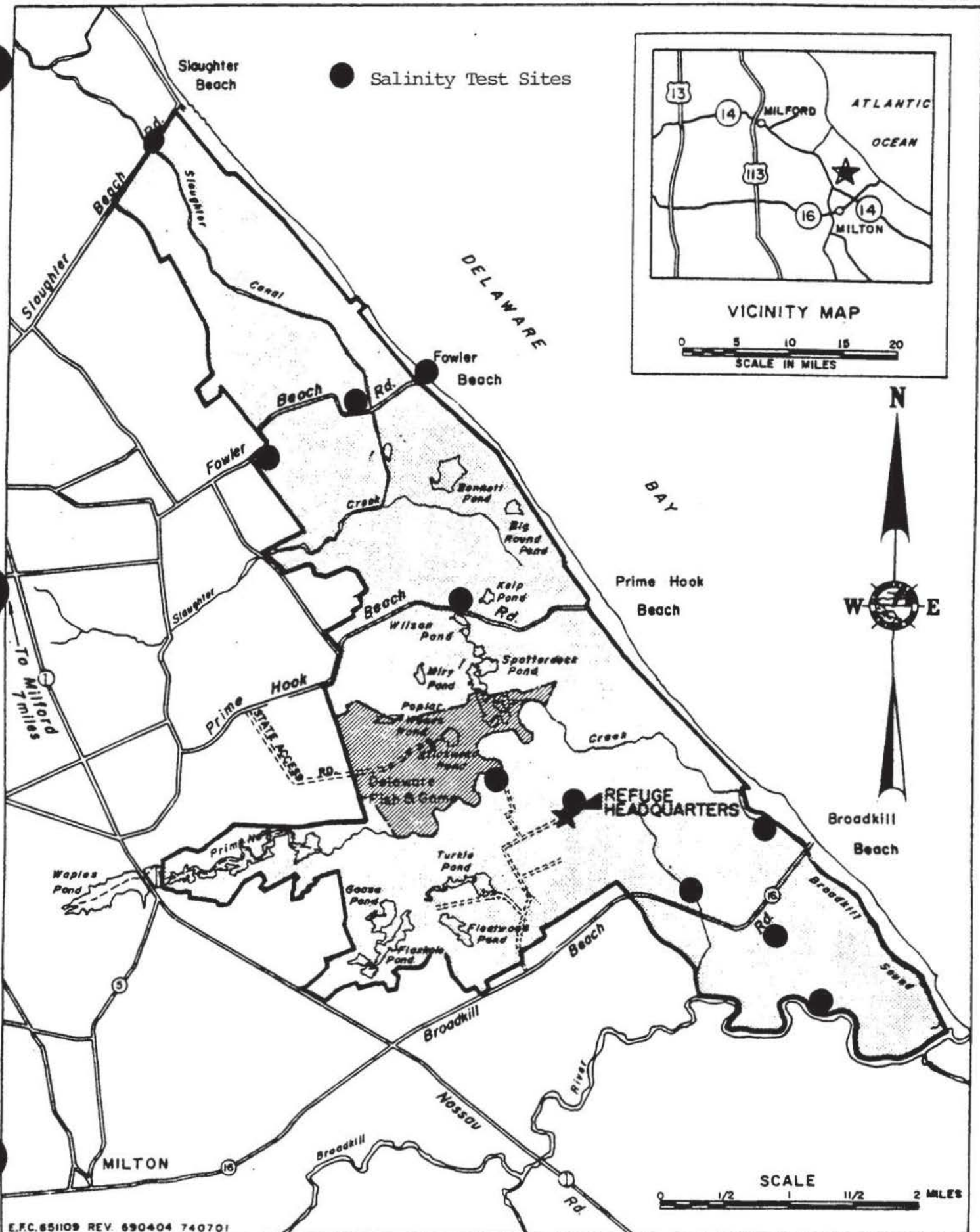


FIGURE 1

PRIME HOOK NATIONAL WILDLIFE REFUGE SUSSEX COUNTY, DELAWARE

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