

ERIE NATIONAL WILDLIFE REFUGE  
Crawford County  
Pennsylvania

MASTER PLAN

PART II

PHYSICAL DEVELOPMENT

Bureau of Sport Fisheries  
and Wildlife  
Fish and Wildlife Service  
Department of the Interior

Region 5  
(Northeast)  
July 1966

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# ENGINEERING DRAWINGS - 8 SHEETS IN BACK OF REPORT -- HALF SIZE

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REVISIONS		
Date		Description

# NATIONAL WILDLIFE REFUGES IN THE ATLANTIC FLYWAY

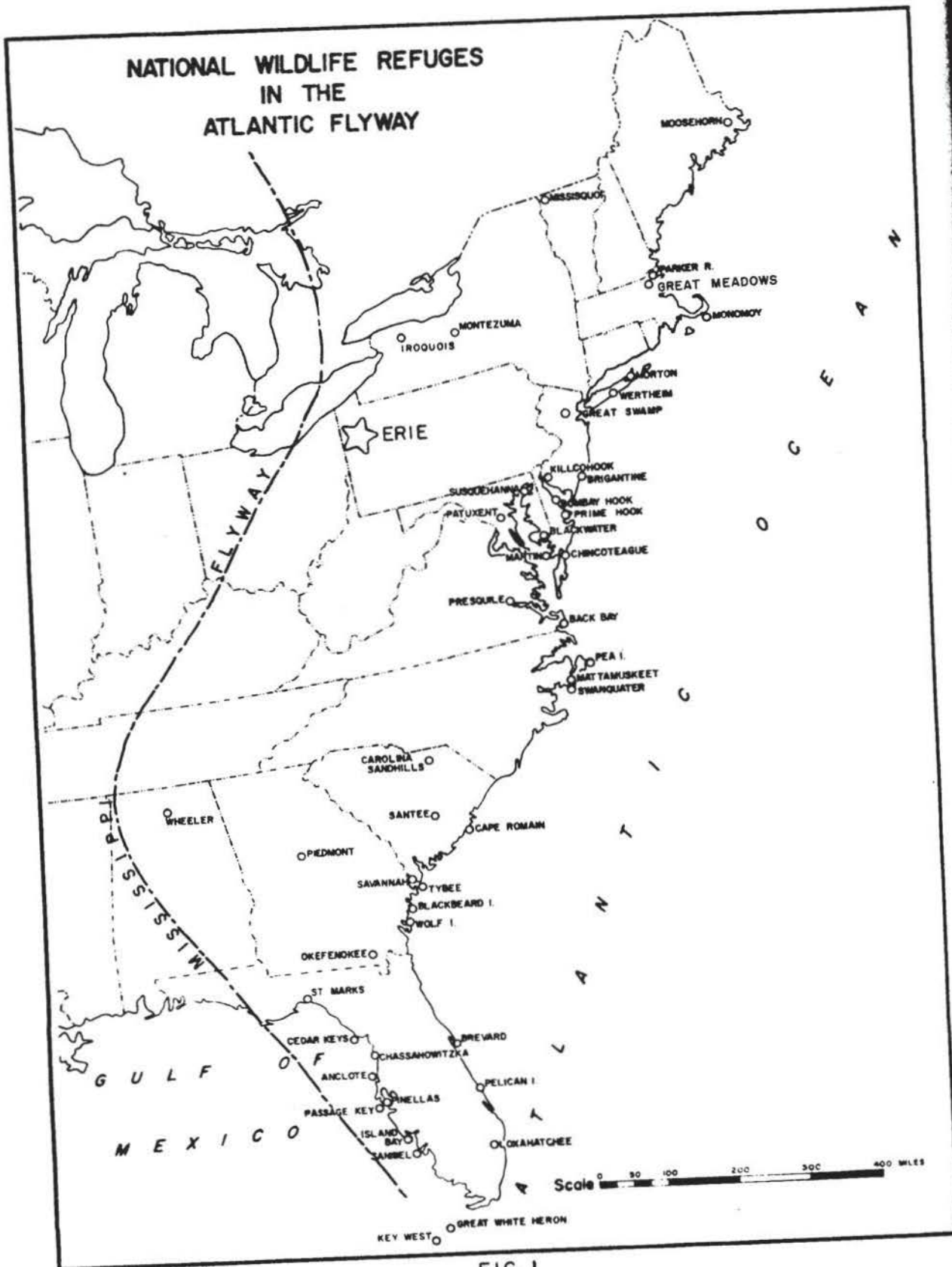


FIG. I

## SUMMARY

This Master Plan is presented as a plan for the use of land for the benefit and preservation of migratory waterfowl and other wildlife in Northwestern Pennsylvania.

The location of this refuge in the Atlantic Flyway is shown on Figure 1. A vicinity map is the insert on Sheet 1 of 8 in the back of the Report. The detailed location is shown on the Watershed Map, Figure 2.

The Master Plan is in three parts: Part II of the Master Plan is contained in this report.

The three parts of the Master Plan are as follows:

Part I - Contains the general characteristics of the area; management objectives; development concepts; and analyses of refuge operations.

Part II - Contains the Development Plan, Acquisition and Cost Estimate.

Part III - Contains management plans for the resource and other wildlife; agriculture; soil conservation; fishery; hunting; land management; and recreation.

The drawings in the back of this report show the Development Plan. The Cost Estimates are presented in Chapter 4.

The handling of flood flows over spillways in the dams and dikes have resulted in an estimated development

cost for six impoundments at a total of:	\$515,000
Access Roads for these facilities are estimated at:	47,200
Headquarters Area development is estimated at:	109,300
Biological Development	11,000
Recreation and other facilities are estimated at:	79,500
Development Cost Total	<u>\$762,000</u>
Acquisition Costs	<u>620,000</u>
Total Project Costs	\$1,382,000

Of the total acquisition costs, about \$558,000 has been paid for land, or obligated.

Estimated remaining land acquisition outstanding costs are \$62,000 as of July 1, 1966.

This development has been based in three general categories:

- A. Benefit to resource
- B. Benefit to other wildlife
- C. Benefit to public

Development has been scheduled in three budgetary phases. Benefits first received are for categories "A" and "C" with benefits for category "B" automatically included therein.

### Estimated Cost of Phases

<u>Phase</u>	<u>Cost</u>
1	\$270,800
2	318,600
3	<u>172,600</u>
Total Development Costs	\$762,000

Acquisition costs in the summary do not include land acquisition administration costs. Development costs include 15% for contingencies and 15% for engineering charges.

The Preface and Chapter 1 of this report have been prepared by the Division of Wildlife Refuges. The Summary, Chapters 2, 3, and 4, and all maps, charts, and tables, have been prepared by the Division of Engineering.



## PREFACE

The Erie National Wildlife Refuge is located in northwestern Pennsylvania, the most important waterfowl region in the Commonwealth today. Historically, this region has been a crossroads for waterfowl. Early settlers found many waterfowl on the numerous marshes along the streams that meander between the forested hills. But with intensive land use, and the removal of nature's marsh manager - the beaver - waterfowl use declined and remained low for many decades.

Pymatuning Dam, built in the '30's, created habitat that again attracted large numbers of waterfowl to the region. At the same time, the Pennsylvania Game Commission began to purchase and transform other wetlands into topflight nesting and resting areas.

To supplement this pioneer waterfowl management program of the Game Commission, the Migratory Bird Conservation Commission in 1958 approved acquisition of the Erie Refuge with funds from the Migratory Bird Hunting Stamp Act. This 5,150-acre refuge, together with other existing and planned State and Federal projects, will make northwestern Pennsylvania a key nesting and resting area for waterfowl using the western portion of the Atlantic Flyway.

The natural swamps and marshes on the Erie Refuge have had only minor and sporadic waterfowl use. Only for a few days after the spring runoff or after a rainstorm do these wetlands hold sufficient water to attract ducks and geese that

happen to be in the vicinity. Development of impoundments where water levels can be managed will increase waterfowl use spectacularly. Over 20,000 ducks, and 7,500 geese will be seen in both the spring and fall. Each year, duck use will approach 1,000,000 days, and goose use, 500,000 days.

Erie Refuge will provide excellent recreation for people who enjoy wildlife and wild areas. A visitor center, nature trails, and other facilities will increase public use from 10,000 visitor days to over 75,000 visitor days annually.

## Chapter 1

### INTRODUCTION

#### Refuge Management Objectives

The Erie National Wildlife Refuge was established for the protection and preservation of the migratory waterfowl resource. The basic authorities for establishing the Erie National Wildlife Refuge are found in the Migratory Bird Hunting Stamp Act. Erie Refuge was acquired with funds made available under the Migratory Bird Hunting Stamp Act. The Migratory Bird Conservation Commission approved the acquisition of Erie Refuge on March 4, 1958. The Commission subsequently approved acquisition of a total of about 5,150 acres. Approximately 97 percent of this acreage is either owned or optioned at this time, but the habitat has not yet been developed.

Refuge management and development efforts will be directed toward providing ducks and Canada geese with feeding and resting migrational habitat, breeding grounds, and protection during the hunting season.

Secondary purposes of the refuge are to: (1) provide habitat for wildlife species other than waterfowl, to the extent that this does not significantly interfere with the attainment of primary objectives; and (2) provide opportunities for the general public to observe all game and nongame species of wildlife frequenting the refuge.

Development and management of the refuge for primary purposes will create waterfowl hunting and opportunities in the vicinity of the refuge, as well as provide surplus upland game and big game populations which could

be harvested on the refuge. If waterfowl hunting opportunities for the general public become limited in the area, the establishment of a public hunting area on the refuge will be considered. The refuge will incidentally create a local opportunity for conservation education and will fulfill the need in this regard.

## Summary of Wildlife Use and Management Objectives

### A. Ducks

Use: Wood ducks, black ducks, blue-winged teal, and mallards breed at Erie and remain all summer. During the fall and spring migration, wood ducks, black ducks, mallards, scaup, buffleheads, pintails, hooded mergansers, shovelers, green-winged teal, and American widgeon frequent the area, more or less in this order of abundance. Since the refuge is undeveloped and wetland habitat limited, use of the area is relatively low. For example, during May through August 1963, duck use-days totaled 20,700 and about 50 ducklings were produced; from September to December 1963, duck use-days totaled 9,300; and in the spring of 1963, duck use-days totaled 11,600.

Management Objectives: To provide habitat capable of supporting but not exceeding a peak population of 20,000 ducks during the period from September 1 to mid-November, or a total of 500,000 duck use-days during that period. A corollary objective will be to discourage use of the refuge by waterfowl after mid-November.

Recognizing that there are limitations in providing food for spring populations, as well as those in the fall, the goal is to provide habitat capable of supporting a peak population of 20,000 ducks and 500,000 use-days during the spring migration.

The production goal is to produce 2,000 ducks each year. Emphasis will be placed on the production of mallards, black ducks, and wood ducks, although it will be an aim to produce some of all species which breed naturally in this general region.

In the event of conflicts in land use between the duck production and migration use objectives, production goals will be given the the higher priority.

#### B. Canada Geese

Use: There has been little use of the Erie Refuge by geese. This situation has been due mainly to the lack of resting areas and perhaps food. It is reported that some goose broods have been produced on beaver ponds. Large flocks of Canada geese pass overhead and have been observed on Sugar Lake adjacent to the south boundary.

Management Objectives: (1) To provide habitat capable of supporting, but not exceeding, a peak population of 7,500 Canada geese or 250,000 goose use-days from September through mid-November (use of the area by geese will be discouraged after mid-November); (2) to provide habitat capable of supporting a similar peak population during the spring migration; and (3) to establish a breeding population of Canada geese.

In the event of conflicts between the use of land for the production of upland goose foods and duck production, the latter will be given priority.

#### C. Coots, Grebes, Herons, and Other Waterbirds

Use: Coots, grebes, herons, and other water and marsh birds are found on the area in limited numbers.



Management Objectives: Coots, grebes, herons, and other waterbirds will benefit incidentally from refuge development and management, and no special efforts for their benefit are planned. However, sufficient habitat will be maintained to assure that any such species now using the refuge will continue to be represented.

#### D. Upland Game Birds

Use: Ring-necked pheasants, mourning doves, ruffed grouse, and woodcock occur on the refuge in the order of hunting importance. A substantial population of pheasants occurs on the area as a result of the State's stocking program - pheasant populations do not maintain themselves naturally. Grouse are native in the area and are quite common. Woodcock and mourning doves are produced on the area.

Management Objectives: Special habitat management efforts for pheasants and ruffed grouse are not necessary, but nesting habitats of woodcock and mourning dove populations will be protected insofar as such goals do not interfere with the attainment of primary objectives.

Pheasant and grouse hunting will be provided in cooperation with the Pennsylvania Game Commission when, (1) population levels permit, and (2) the hunting program will not have adverse effect upon primary objectives.

#### E. White Tailed Deer

Use: The deer herd on the Erie Refuge, and Crawford County, has been gradually increasing during the past 20 years. The local deer herd has been in the best condition in the State in recent years. From impressions based on several hunting seasons, it is estimated that the refuge supports a resident herd of approximately 100, though up to 200 may be present during the hunting season.

Management Objective: To maintain deer populations within the carrying capacity of the deer range on the refuge. Removals through public hunting will be made when necessary to attain this goal and when it will not interfere with management for objectives of higher priority.

#### F. Furbearers

Use: Furbearing animals on the Erie Refuge in their approximate order of abundance are muskrat, raccoon, red and gray foxes, skunk, weasel, mink, and beaver. The species which are of concern to the local trappers are, in order of importance, beaver, fox, and muskrat. Foxes are common; beavers have been intensively trapped, and the total harvest in 1960 was 47 from within the approved boundary of the refuge.

Management Objectives: (1) To maintain muskrats at population levels determined to be most useful in the management of waterfowl habitat, without significantly damaging dikes and structures; (2) to maintain beaver populations as high as is consistent with primary waterfowl objectives, in view of their value as furbearers; and (3) to maintain populations of predatory furbearers at as low a level as possible during the waterfowl production season.

#### Management Programs Necessary To Accomplish Objectives

A. Water Management. Refuge waters will be managed primarily from the standpoint of waterfowl production from April through mid-June, and thereafter to provide a maximum of aquatic foods and resting area, except that sufficient brood areas will be maintained.

B. Land Management. Management of upland areas include the production of duck and goose foods in strategic locations, the maintenance of high quality nesting habitat adjacent to breeding pair habitat, and the preservation of habitat necessary to assure the continued use of the refuge by game and nongame animals of interest to the visiting public.

A permittee-farming program is planned to produce waterfowl foods by sharecropping. Areas not needed for cropland will be seeded to grass. Grasslands will be pastured or hayed where these activities will not conflict with the attainment of objectives or where such operations will aid in the attainment of goals. A progressive soil and moisture program will be undertaken.

C. Public Use of the Resource. Erie Refuge is the first national wildlife refuge in Pennsylvania, and there is a great deal of public interest in our operations and programs. There are only two recognized recreational areas, Conneaut Lake Park and Canadota Lake Park, and several managed waterfowl areas including Pymatuning, in the general vicinity.

The refuge will provide opportunities for bird and other wildlife observations. Observation areas, nature trails and a display pool are planned.

Public hunting programs for deer and upland game hunting are planned. Management to attain primary objectives will incidentally provide waterfowl hunting on private lands surrounding the refuge, but if opportunities for the general public become limited, public hunting on the refuge will be considered in the light of surplus populations which may develop.



#### D. Wildlife Management Studies or Applied Research.

Wildlife management studies and/or applied research will be conducted by refuge personnel and student assistants when the facilities and capabilities are available. The opportunity for cooperative studies are present involving institutions of higher learning and/or State department biologists and will be sought when appropriate. The following subjects are recommended for study:

1. Cover type mapping and general habitat analysis of the refuge area.
2. Detailed vegetation analysis and ecological succession as related to the water management program.
3. Nesting and productivity investigations as related to goose and wood duck management.
4. General wildlife population changes as a result of land use and other environmental changes.
5. Determine the relationship between Erie Refuge waterfowl populations, especially goose populations, with the State Pymatuning Area.
6. Determine predevelopment populations of mourning doves and woodcock.

## Role of Erie Refuge in Flyway Management Plan

1. Help maintain Atlantic Flyway waterfowl populations by providing feeding and resting migrational habitat and breeding grounds.
2. Supply 2,000 ducks annually to the Flyway and establish a breeding population of Canada geese.
3. Maintain public duck and goose hunting opportunities in the locality by insuring a nucleus of birds.
4. Ensure through public ownership an area for waterfowl hunting, should local opportunity become restricted and refuge populations warrant.

## Functional Criteria

### Water Management

About 800 acres of marsh and water will be required to achieve refuge management goals; production of 2,000 ducks and 150 geese, and peak migration use of 20,000 ducks and 7,500 geese.

To obtain this acreage of aquatic habitat, pools and ponds will be developed wherever economically feasible. Comparatively high stream gradients and narrow flood plains make necessary on-stream impoundments.

A number of small, shallow main pools on Lake and Woodcock Creeks will create a habitat more attractive to waterfowl than would a few large impoundments. Along Lake Creek the topography is suitable for larger impoundments where adjacent uplands will be managed to attract migrating Canada geese. The smaller impoundments possible on Woodcock Creek will probably be used mostly by ducks.

Where topography and soil conditions permit, upland ponds will be built on tributaries or small drainages.

Nesting islands will be erected at suitable sites where the water depth is not more than one foot at maximum pool level. Perimeter access by boat is required for hericidal control of vegetation on these islands.

Because flooded timber is prime nesting habitat for wood ducks and black ducks, no timber will be cleared from impoundments except where necessary along dike and drain sites adjacent to cropland to encourage goose utilization and for nesting islands.

Carp exist in all streams. Movement of carp into the refuge and between impoundments will be minimized by screens in all water control structures.

Normally, all impoundments will be drawn down or completely drained concurrent with the fall freeze-up to (1) discourage continued waterfowl use, (2) prevent ice damage to water control facilities, (3) control the carp problem, and (4) provide storage to minimize the spring runoff.

To provide optimum nesting conditions for waterfowl, all impoundments will be charged early during the spring run-off period. All impoundments will be maintained at or near maximum water level through the nesting and brooding period. Some drop in water levels during the summer will stimulate the growth of aquatic food plants. The water level of impoundments may be raised to maximum level any season of the year when gravity water is available.

Not much more than 25% of each water area should exceed 30" in depth. Extensive production of aquatic waterfowl food plants does not occur beyond this depth.

It is important for management purposes to be able to drain each impoundment essentially dry within a 15-day period. When drained, stream flow will be confined to a channel below pool bottom grade.

### Land Use Management

A. Cropland - About 1,200 acres of existing cropland will be needed to satisfy wildlife management objectives with farming done by cooperators on a sharecrop basis (75%-25%). To achieve use goals of 500,000 days of goose use and 1,000,000 days of duck use, 300 acres of green browse and 100 acres unharvested cereal crops will be required.

The additional 800 acres will be required by the cooperators. Fields seeded to grass/legume in a crop-rotation program will be mowed or grazed to maintain their attractiveness to browsing geese. Where grazing is used, fencing will be required.

B. Grassland - About 550 acres of permanent grass adjacent to water areas and elsewhere will be required for waterfowl nesting habitat and resident wildlife habitat. Management will consist of haying, grazing, and herbicidal control. Where grazing is permitted, fences will be required.

C. Timberland - About half the refuge, 2,600 acres, will be maintained in brush or timber to provide habitat for wildlife other than waterfowl. Management will consist of timber-stand improvement and mechanical or herbicidal control of brush.

D. Other Economic Uses - Furbearing mammals will be harvested, probably by sharetrappers. No physical development is necessary to facilitate this operation.

### Service Facilities

#### A. Buildings

Office-Visitor Center - Space for: (1) Clerk and reception room; (2) Refuge Manager's room large enough for meetings of ten people; (3) room for Assistant Manager and Trainee; (4) room for Refuge Ranger (in charge of visitor center) and another person; (5) two toilets; (6) storage for office supplies; (7) exhibit room; (8) public toilets; and (9) space for storage and oil, hot air furnace.

Shop Building - In two parts - both areas to be heated.

(1) Room for crew, toilet room, and furnace room.

(2) One-stall shop with one overhead door.

Hydraulic floor hoist with space to park and hoist 3-ton flatbed truck with at least two-foot clearance in front, and 2 1/2-foot clearance on sides, air line to oil house and service island, shop wide and deep enough to provide for 26-inch deep bench and cabinets along inside walls and side opposite overhead door. An air compressor will be housed in this building.

Equipment Building - Metal lean-to, one side open. Electricity. Storage space for one farm tractor; mowers; one 3-ton flatbed truck; one 12-foot boat with trailer; one motor patrol, and miscellaneous supplies.

Oil House - Space required to house kerosene, turpentine, grease, paint and motor oil needing about 200 square feet of floor space. No heat or water. Electricity. Sliding 4-foot door with loading platform in front at height of pickup truck bed. Two pressure oil lines to service island - air compressor for this system to be housed in Shop Building. This service island will dispense gasoline, diesel fuel, two motor oils, water and air.

Residences - Two existing dwellings will be utilized - one at Headquarters on Route 27, and the other on Route 173.

B. Roads and Trails

Gravel Surface - All-weather one-way access road will be provided to all water control structures, with vehicle turnarounds where required, to permit travel of refuge vehicles including a loaded 4-yard dump truck. Public travel routes shall be wide enough to permit safely, two-way traffic.

Trails - Fair weather unsurfaced one-way access roads will be built to operational sites and physical facilities such as fences and farming areas. These trails will be used periodically by refuge personnel during dry seasons of the year with all types of refuge vehicles.

#### C. Fences

Three strand, twisted pair wire fences will be erected to permanently define boundaries contiguous to privately-owned property. Four strand barbed wire fences are required where necessary to control cattle - these fences will be either interior or on the boundary. No fences are required along well defined roads, except where necessary to control cattle.

#### D. Posting

All boundaries, including both sides of public roads will be posted with standard boundary signs on standard posts. Normally, along unfenced boundaries, the maximum interval between signs would be 0.1 mile; along fences boundary, 0.2 mile. In areas of rough terrain or poor visibility, the posting interval will be such that a person can see a sign from any approach. Signs shall be erected on both sides of all corners within 5 feet of the corner. Signs shall be posted on both sides (within 5 feet) of all gates and/or access roads along the boundary.

Recognition signs shall be erected at both ends of all major public roads traversing or bordering the Refuge. Directional signs will advise the public of headquarters, visitor center, and other public use areas. Informational signs will be erected where necessary to inform the public of Refuge activities.

#### E. Headquarters Plot Plan

Headquarters will be located on an elevated, well drained site adjacent to Highway 27. All buildings will be off this public road a safe distance.

Headquarters will be laid out to physically separate three units - the administrative area, operations area, and residence area. The plot plan will allow for eventual independent expansion of each area. Following are the facilities in each area:

#### Administrative Area

1. Office-Visitor Center
2. An access road from Highway 27
3. Visitor's parking area
4. Standard flagpole in front of office or off to one side
5. Standard radio tower
6. Windbreaks and landscaping for beautification and to screen operations area from view

#### Operations Area

1. Shop building
2. Equipment storage building
3. Oil house
4. Service island - gas, diesel, oil, water and air
5. Personnel parking area
6. Separate access road off Highway 27
7. Windbreaks for shelter from weather and to screen off from public view

#### Residence Area

1. One existing residence with garage
2. Separate access road from Highway 27
3. Windbreaks and landscaping



### Utilities

Commercial electricity and telephone are available.

Water and sewer systems are required for office-visitor center and shop building. Anticipated peak use of 200 people a day.

### Recreational Facilities

Nature-oriented recreational activities will be encouraged. To encourage the public to take a close look at nature, and at Refuge programs, there will be four self-guided nature trails. For each, parking areas with a capacity for 15 cars are needed.

Three overlook parking area sites have been selected along public roads where the public will be able to observe wildlife on refuge impoundments. These parking areas will accommodate 35 cars each.

A picnic area has been developed to accommodate approximately 400 people. Facilities include: 30 Units-2 tables, 1 fireplace, 1 trash can each unit; 2 shelters; 4 double toilets; 2 water fountains; parking areas.

Public fishing will be permitted on Woodcock Creek north of the public road across the north end of the refuge. A 10-car capacity parking area is needed.

No developments will be necessary to facilitate hunting of resident game on the Refuge. It is planned that the entire refuge be opened to controlled deer hunting with refuge headquarters serving as the check-in point. Hunting of waterfowl is not planned for the immediate future. Waterfowl hunting will be considered when it can be done without adversely influencing management objectives.

## Chapter 2

### DEVELOPMENT

#### Project Purpose

The Erie National Wildlife Refuge is located in northwestern Pennsylvania halfway between James Bay in Canada on the north, and the central Atlantic Coastal area of South Carolina on the south. Thus it will provide a feeding, resting, and protecting area for migrating ducks and geese traveling the west corridor of the Atlantic Flyway, and the east corridor of the Mississippi Flyway, See Figure 1.

In addition to providing aquatic habitat for migrating waterfowl, primary emphasis will be placed on furnishing nesting and brooding areas for ducks and geese.

The provisions for creating nesting and brood habitat, and providing for migratory waterfowl are the primary objectives of the Erie Refuge. Secondary objectives are: (1) to provide habitat for indigenous wildlife, and (2) to provide for public enjoyment of wildlife.

The facilities to accomplish these objectives are proposed as follows:

Creation of about 800 acres of marsh and water by construction of dams or dikes, control structures and channels for three impoundments on the main stems of the stream, three impoundments on major tributary streams, and for small impoundments on brooks, and minor undefined drainages adjacent to existing potential feeding areas.

Construction of facilities designed to drain each impoundment in approximately 15 days while maintaining management levels of all other impoundments.

Construction of nesting islands in some large pools in not more than one foot of water.

Service roads, trails, access roads, fences and parking areas.

A Headquarters area with offices for administration, visitor center and other buildings for operations and garaging of equipment.

Provide utilities and appurtenances for services and operation at building sites.

Utilization and development of existing lands for feeding of waterfowl and other wildlife.

Development of these facilities is the essence of this Part II of the Master Plan on Erie National Wildlife Refuge.

The refuge is sited in a relatively narrow valley with its long axis running north to south. The northerly portion of the valley is in the Woodcock Creek drainage, composed of about 20% of the refuge area and about 40% of the drainage area. The remainder of the Valley is Lake Creek drainage and contains about 80% of the refuge and about 60% of the drainage area. See Figure 2.

Both drainage systems slope gently up from the valley floor to the east, but on the west, some slopes are in excess of 10%. The valley bottom varies from a few hundred feet to about a mile in width. The longitudinal slope of both drainages is from one-tenth to one-half percent.

The terrain is well suited for the formation of numerous pools by cross diking the main streams as well as the tributaries on the eastern slopes. The disadvantage of this type of development lies in the difficulties in handling flood flows. Provisions are proposed in construction that are feasible to carry floods through the valley with a minimum of structural damage.

The twenty-three impoundments shown on the plans include development of about all the potential marsh and water area in the valley. Only six of these impoundments are scheduled for development in this plan, and four of the small upland ponds have been completed.

These four upland ponds built at nominal cost have very high waterfowl use. Other potential marsh and water upland areas not programmed, may be constructed by force account.

An alternate development plan could be one wherein certain impoundments would be substituted in the Development Plan. Alternate or intermediate sites have been eliminated and only those impoundments best suited for management have been selected. Data on all twenty-three pools are shown on the plans and in the tables and figures.

Sufficient selected soils for dike construction may not be found at the immediate vicinity of each dike site, but are available nearby in the valley within a comparatively short haul.

#### Master Plan Site Layout

Plans for total development of the area are shown on Sheets 1 to 8 inclusive. Sheet 1 shows the entire refuge area with all of the proposed or potential physical development except nesting islands. The location of agricultural fields is not shown on these drawings, but is shown in Part 1 (under separate cover) and only the development of existing



fields is planned. Separate plans in this report include a land status map, topographic maps, soils map, impoundment locations and descriptions, roads and trails and other maps and plans. These plans are of a general type and only the necessary details have been presented. Although building details have been omitted, a site plan for the headquarters area has been included. A general description of each building is included in the text of this report.

The Development and Operation Schedules divide the impoundments and other items into five units. The division of the refuge into units is to identify items geographically, and for management purposes.

1. Unit 1 refers to the refuge area north of Route 198 at Guys Mills.
2. Unit 2 is between Route 198 and Township Road T-472.
3. Unit 3 is between Road T-473 and Route 27.
4. Unit 4 is between Route 27 and Route 173.
5. Unit 5 refers to the refuge area south and east of Route 173.

The phasing of major items of construction is accomplished by selection of impoundments by first, benefit to the resource and secondly, public recreation.

Phasing has been scheduled into three parts. Phases 1, and 2, include items based on benefits to the resource and public recreation. Phase 3 creates impoundments and facilities needed but delayed because of large expenditures proposed for Phases 1 and 2.

The complete phasing program is contained in the Program Schedule Detail at the back of the report on Table 4.

## Water Use

All impoundments will be filled and maintained at management levels by runoff of the main stem and tributaries of Lake and Woodcock Creeks. This runoff will be augmented by local undefined runoff and direct precipitation.

Water control structures are designed to substantially drain each impoundment to streambed. These structures also will carry more than average stream flow when the gates are open and allow the normal flow to pass through the impoundment area. All impoundments will be drawn down or completely drained after fall migration of waterfowl, and recharged during or after spring runoff, to be ready for spring migration.

Reduction in average and minimum discharges resulting from the Construction of impoundments are shown in Table 1. These flows are estimated with all pools filled during spring runoff. Losses during dry periods are shown in the last column.

Elevation of each pool may be set by use of stoplogs as high as the maximum management level. Spillways and overflow sections are provided to remove excess waters and carry peak flood flows.

A reservoir for flood control with a permanent conservation pool is proposed on Woodcock Creek by the Corps of Engineers, but will have no effect on the refuge development. The Corps' project is located on the Watershed Map, Figure 2. Light manufacturing plants and warehouses are located on Woodcock Creek near its confluence with French Creek. Minor uses of water by these plants would not be affected by our impoundments.

**TABLE I**  
**Estimated Water Losses**  
**Average and Minimum Discharges**

1	2	3	4	5	3	6	7
Pool No.	Monthly Average Inflow to each Pool	Pool Loss	Average Discharge after Construction	Monthly Minimum Inflow to each Pool	Pool Loss	Minimum Discharge after Construction	Loss in Each Pool Level with Minimum Discharge
	cfs	cfs	cfs	cfs	cfs	cfs	Feet
<b>Woodcock Creek</b>							
3	0.3	0.2	0.1	0.1	0.2	0.	1.0
2	0.2	0.2	0.	0.1	0.2	0.	1.0
1	6.3	0.5	5.9	1.6	0.5	1.1	0.
<b>Lake Creek</b>							
4	1.9	0.5	1.4	0.5	0.5	0.	0.
6	0.9	0.2	0.7	0.2	0.2	0.	0.
5	0.5	0.2	2.4	0.1	0.2	0.	0.7
7	0.7	0.3	0.4	0.2	0.3	0.	0.5
8	0.7	0.3	3.2	0.2	0.3	0.	0.6
9	2.0	0.7	4.5	0.5	0.7	0.	0.4
10	0.9	0.4	0.5	0.2	0.4	0.	0.8
12	0.5	0.4	0.1	0.1	0.4	0.	1.2
11	2.3	1.5	5.9	0.6	1.5	0.	1.0

Col.

- 1 Arranged in flow pattern. See Sheet 5 of 8.  
 2&5 Runoff into each pool with no overflow from tributary pools.  
 3 Evaporation and Seepage losses less precipitation gain.  
 4 Discharge from pool includes inflows from tributary pools.

All figures are based on 5 months record, June 1 to October 31 - 153 days. Period of record - 30 years.

**TABLE 2**  
**POOL DESIGN DATA**

POOL NO.	DRAINAGE AREA SQUARE MILES  (ACRES CFS)	MAXIMUM MANAGEMENT LEVEL ELEVATION  (AV. FLOW CFS)	2 YEAR FLOOD PEAK ELEVATION  (FLOOD FLOW CFS)	50 YEAR FLOOD PEAK ELEVATION  (FLOOD FLOW CFS)	Pa.D.of F.&W. CURVE C FLOOD ELEVATION  (FLOOD FLOW CFS)
1	11.5 (7330)	1328.0 (18)	1329.5 (1020)	1330.4 (2460)	1332.6 (8600)
2	0.4 (230)	1338.0 (0.6)	1339.2 (120)	1340.0 (290)	— —
3	0.5 (320)	1343.0 (0.8)	1344.4 (170)	1345.0 (340)	— —
4	3.2 (2050)	1336.0 (5)	1337.1 (430)	1337.6 (900)	1340.0 (3600)
5	5.6 (3600)	1321.0 (9)	1322.1 (650)	1322.6 (1300)	1325.0 (5350)
6	1.5 (965)	1332.0 (2.5)	1332.9 (280)	1333.5 (650)	1335.0 (1960)
7	1.1 (725)	1324.0 (1.8)	1325.5 (280)	1326.0 (575)	1327.0 (1580)
8	8.0 (5100)	1313.0 (13)	1314.2 (830)	1314.6 (1560)	1317.0 (6800)
9	11.3 (7250)	1303.0 (18)	1304.5 (970)	1304.9 (1760)	1307.2 (8600)
10	1.5 (935)	1302.0 (2.3)	1303.3 (420)	1303.8 (970)	1304.5 (1900)
11	17.6 (11,250)	1293.0 (27)	1294.1 (1300)	1294.5 (2300)	1297.0 (11,300)
12	0.9 (580)	1302.0 (1.4)	1303.6 (290)	1304.1 (650)	1304.6 (1300)

DRAINAGE AREA INCLUDES ENTIRE WATERSHED  
TRIBUTARY TO DAM OR DIKE SITE.

\*MODIFIED JARVIS MEYERS CURVE SEE FIG. 9



As shown on the plans, the Refuge is located in the valley floor of the headwaters of both creeks. The only pollution existing in the tributaries above the valley floor would be seepage of domestic sewage, barnyard runoff, and drainage from roads, garages, and parking areas.

Local planning board officials are interested in increasing the fishing potential of Sugar Lake just below the refuge on Lake Creek, by construction of a dike across the eastern end of the lake. The board has not been encouraged to expect inclusion of the Lake in the refuge development as it is outside the scope of our management objectives.

The Lake may be developed by the planning board separately. Some modification to the toe and downstream slope of the dike for Pool #11 may be required. An adverse affect on the drainage capabilities of the control structure in this dike may also result.

The development of Sugar Lake by the local planning board has not reached the proposal stage and most probably will not be proposed.

### Water Requirements

Water requirements are shown on the plans in tables and graphs within this report. Special Elevations, Areas, and Capacities are shown on Sheet 5 of 8.

Area-Capacity curves are shown on Figures 4 to 7 inclusive. Design Flood flows, Elevations and Drainage Areas shown on Table 2.

### Water Rights

Water level records on Lake Creek and Woodcock Creek have been recorded at Route #173, Route #27, and County Road 20085 since March 1962. The Geological Survey has maintained a flow recording meter on Sugar Creek near French Creek since 1932. The U.S.G.S. records have been published in the Water Supply Papers.

Succeeding is a copy of a letter dated August 12, 1964, and signed by Mr. M.J. Golden at that time Executive Director of the Pennsylvania Game Commission. The reference to Water Rights in the last paragraph is self explanatory.

Mr. Fred L. Jacobson  
Acting Regional Director  
Bureau of Sport Fisheries and Wildlife  
Fish and Wildlife Service  
59 Temple Place  
Boston, Massachusetts 02111

Dear Mr. Jacobson:

Your letter of August 6, 1964, regarding wildlife refuge development in Crawford County, Pennsylvania, was received.

Existing Pennsylvania statutes which control dams and encroachments on Commonwealth waters, apply to all forms of impoundments including those constructed primarily for wildlife water use.

Copies of the law covering dams and encroachments on Commonwealth waters, apply to all forms of impoundments including those constructed primarily for wildlife use.

Copies of the law covering dams and encroachments are enclosed.

You will note that for each proposed impoundment, a separate application for a dam permit must be made, if the watershed above the proposed structure is 320 acres or more, and if the structure is three or more feet in height.

We have been advised that no Pennsylvania statutes exist, or are proposed, which would restrict your use of Muddy, Woodcock or Lake Creeks, within the interpretation of P. L. 555.

Very truly yours,

M. J. Golden  
Executive Director

The design of the dams, dikes, and structures has included the requirements of Pennsylvania Public Law 555 including amendments. This law and amendments are in the Pennsylvania Department of Forests and Waters, Water and Power Resources Board Form FWWR-23, "Information on Construction of Bridges, Wells, Fills, Channel changes, etc.", dated 1961.

Curve "C" on Plate 1 of this publication has been reproduced on Figure 9 of the report. This curve has been the design basis for maximum flood flow for all impoundments with a drainage area one-half square miles or more (320 Ac.) and is referred to as the Jarvis-Meyers Curve. (Actually, Curve "C" is a modification of the Jarvis-Meyer Formula) Impoundments with a drainage area of one-half square mile or less are designed for a 50-year frequency runoff.

#### Existing Improvements

Figure 10 is a topographic map of the refuge area. The conditions in the valley prior to development are shown. Roads, buildings, bridges, culverts and existing electrical and gas lines are indicated.

On real property acquired as of July 1, 1966, there were 152 major buildings; of these, 123 have been removed. Three buildings have been remodeled and are being used for the office, the shop and garage, and the refuge manager's residence. The remaining 26 buildings will be disposed of through public sales.

There are 30 (more or less) major buildings within the proposed refuge boundary on private property. The use or disposal of these buildings will be determined after this real estate is acquired. Two modern houses with garages will be saved for permanent residences for service personnel.

Four subimpoundments ( B, C, D&H) are classified as existing ponds and are shown on the plans as such.

Public roads with appurtenant drainage facilities, power lines, and a natural gas pipe traverse the refuge area.

The existing picnic area described in Chapter 1 is located on the plans.

### Construction Features

#### Buildings

The headquarters site plan is shown on Sheet 8 of 8, and includes new buildings, roads, parking areas, well and pump house, vehicle service station and landscaping. A nature trail is shown from the Office-Visitor Center Building leading to the display pool (Pond H).

Layout plans for the individual building have not been formulated in detail and therefore, drawings of these buildings are not included in the report. The functional criteria for each building is given in Chapter 1. In addition to providing for the proposed buildings, the Site Plan also includes gravel walks, and a driveway to the Office from the Service Court.

#### Office-Visitor Center

This is a gable roof insulated metal unit 32' x 64' as shown on the site plan. The Visitor Center occupies about one third of the building with an area of about 800 square feet. A complete set of utilities will be installed in this building.

A radio tower will be located in the rear next to the Office, and the flag pole will be in front of the building so as to be clearly visible to travelers on Route 27.

### Shop Building

A gable roof insulated metal building approximately 1200 square feet in area (32'x38') placed on concrete footing with a concrete floor slab on grade. A crew's room and one stall with an overhead 17'-4" door, and hydraulic floor lift will be provided. Hot air heat, air compressor and a complete set of utilities will be installed in this building.

### Equipment Building

A metal panel wood frame pole type building, one side open and an earth floor will be provided. Approximately 1800 square feet in area (60'x30'). Only electric service will be furnished in this building.

### Oil House

A raised metal panel steel frame building on concrete foundation approximately 200 square feet (12'x18') in area. Electric service will be furnished in this building.

### Service Island

Service Island will be located at the entrance to the court and will be supplied with compressed air, water, oil, and electricity, and have pumps for delivering gasoline and diesel fuel.

### Residences

Two modern existing fully serviced houses of recent construction will be used as residences. One is off Route 27 and is a six-room cape constructed in 1955 with an area of 1200 sq. ft. The grounds are landscaped. There is a driveway and detached two-car garage. The other house is off Route 173 and is a six-room ranch with a large attached garage. The house was constructed in 1960 and has an area of about 1400 square feet. The grounds about this house and driveway could stand improvement. These houses are located on the General Plan Sheet 1 of 8.

### Utilities

Water supply will be furnished at the Headquarters Site by one well supplying water for the fire suppression system as well as other uses. The pump, well, and two 220-gallon glass-lined supply tanks will be located in the pump house. The well should be capable of 30 gallons per minute flow. Fire suppression system will be by two one and one-half inch hydrants, one at Office-Visitor Center Building, and one at the Service Court. Both hydrants will be supplied by a booster pump with water from a 6000-gallon storage tank. Storage tank and booster pump unit will be housed in underground reinforced concrete chambers.

Water supply will be furnished to the Office-Visitor Center, Shop Building, and Service Island.

Sewerage system includes collection from the Office-Visitor Center and Shop Building, and disposal through a 2500-gallon septic tank and tile field.

Electric power will be furnished by underground cables from Route 27 to the Office and to all buildings and the pump house.

Telephones will be available in the Office-Visitor Center and Shop Building.

### Roads

Cross sections of gravel roads are shown on Sheet 7 of 8. The details of parking areas are also shown on Sheet 7 and Sheet 8 of 8.



The Public Access Road is designed for a daily traffic volume of 100 vehicles. Overflow parking on grassed area adjacent to the visitor's parking area will be allowed in fair weather.

All dike and access roads and service road, visitor's and personnel parking, service court, overlook parking and other parking areas, are metalled with at least six inches of compacted gravel on a prepared sub-base.

#### Patrol Trails

Patrol trails will be provided on natural soil as shown on the plan. Clearing of brush and trees for these fair weather access roads is necessary to the extent required for the passage of the equipment used on the refuge.

Drainage for the patrol trails across defined drainages is provided.

#### Landscaping

Trees shown on the site plan (Sheet 8 of 8) are to be transplantings from the refuge area.

#### Fencing and Posting

Fencing and Posting is defined in Chapter 1 and provided for in the cost estimate.

### WATER IMPOUNDMENTS

Minor impoundments or ponds are designed in the same manner as major impoundments. A tabulation of these ponds is shown on Sheet 5 of 8. All pools are designed without regard to storage capabilities of upstream pools. Any structure can be constructed or filled independently.

Area capacity curves for major impoundments are shown on Figures 4 to 7 inclusive. Curves for minor impoundments are not included in the report.

Drainage areas were measured from U. S. Geological Quadrangles, Townville and Meadville, Pennsylvania. Figure 3 shows a portion of each of these quadrangles with the drainage area of the refuge heavily outlined.

Topography of the low lands and marsh of both valleys was taken by field survey in 1963 using aerial photographs for horizontal control. Figure 10.

Areas for the major pools were measured from the topography shown on Figure 10, and capacity computed.

Rainfall intensities were determined at Meadville, Pennsylvania from U. S. D. A. Publication #204 (Yarnell).

Coefficient of runoff for use with the Rational Method of flow computation varied, but averaged from 0.40 to 0.45.

Duration (time of concentration) was computed from profiles and velocities based on field observations and estimates.

Evaporation amounts used in computing losses from pools were from records at Jamestown and Ithaca, New York, and were reduced to Lake Evaporation from pan evaporation records, Table 3.

Seepage losses are included as three inches per month per acre of maximum management level area.

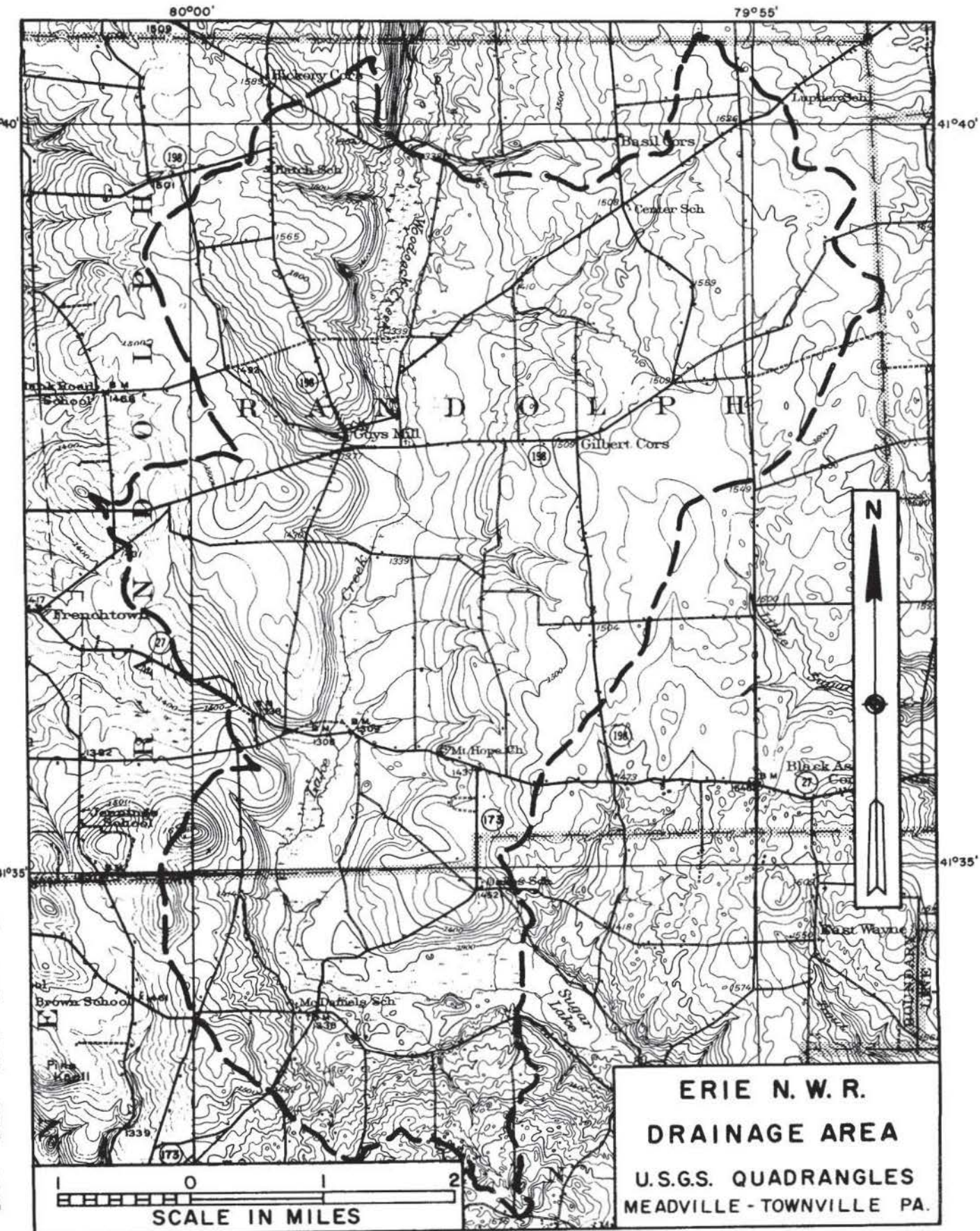
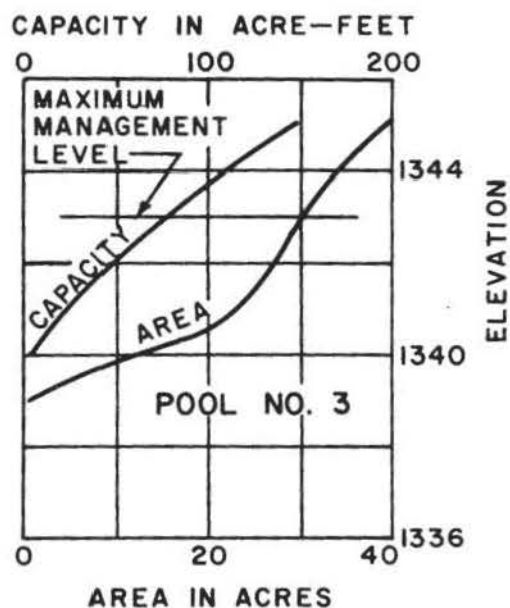
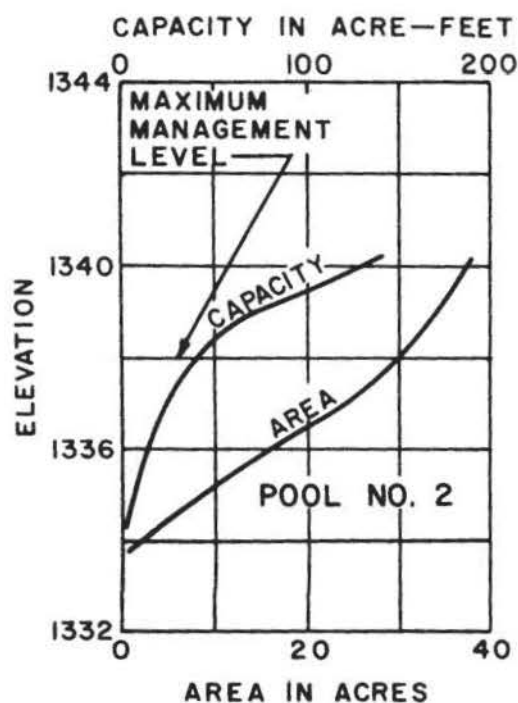
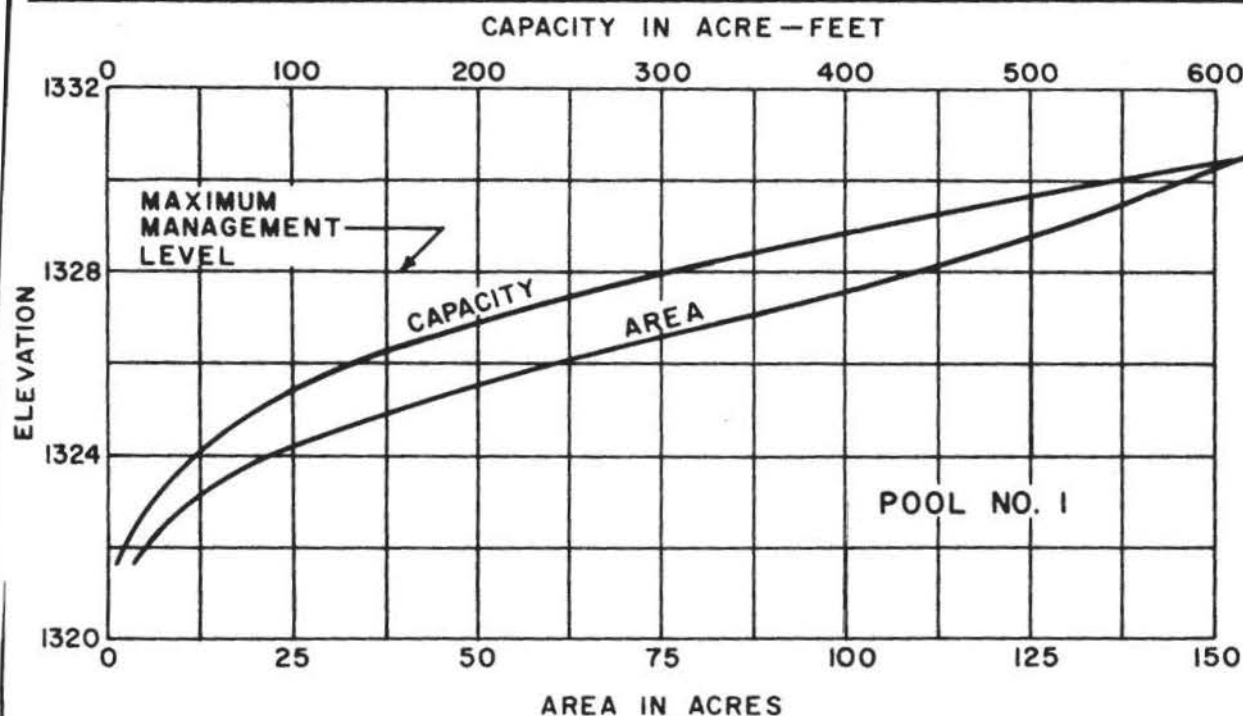
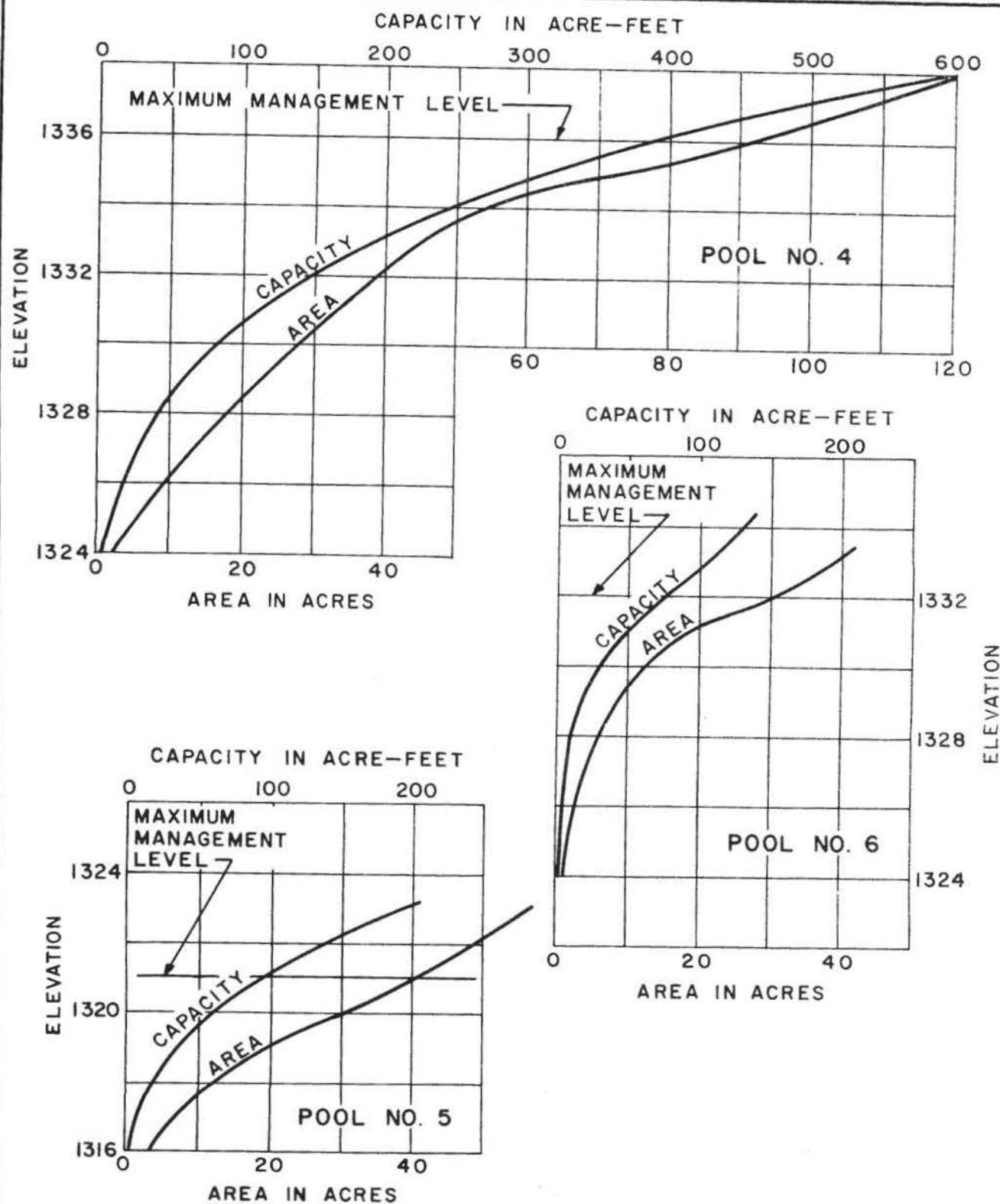


FIG 3

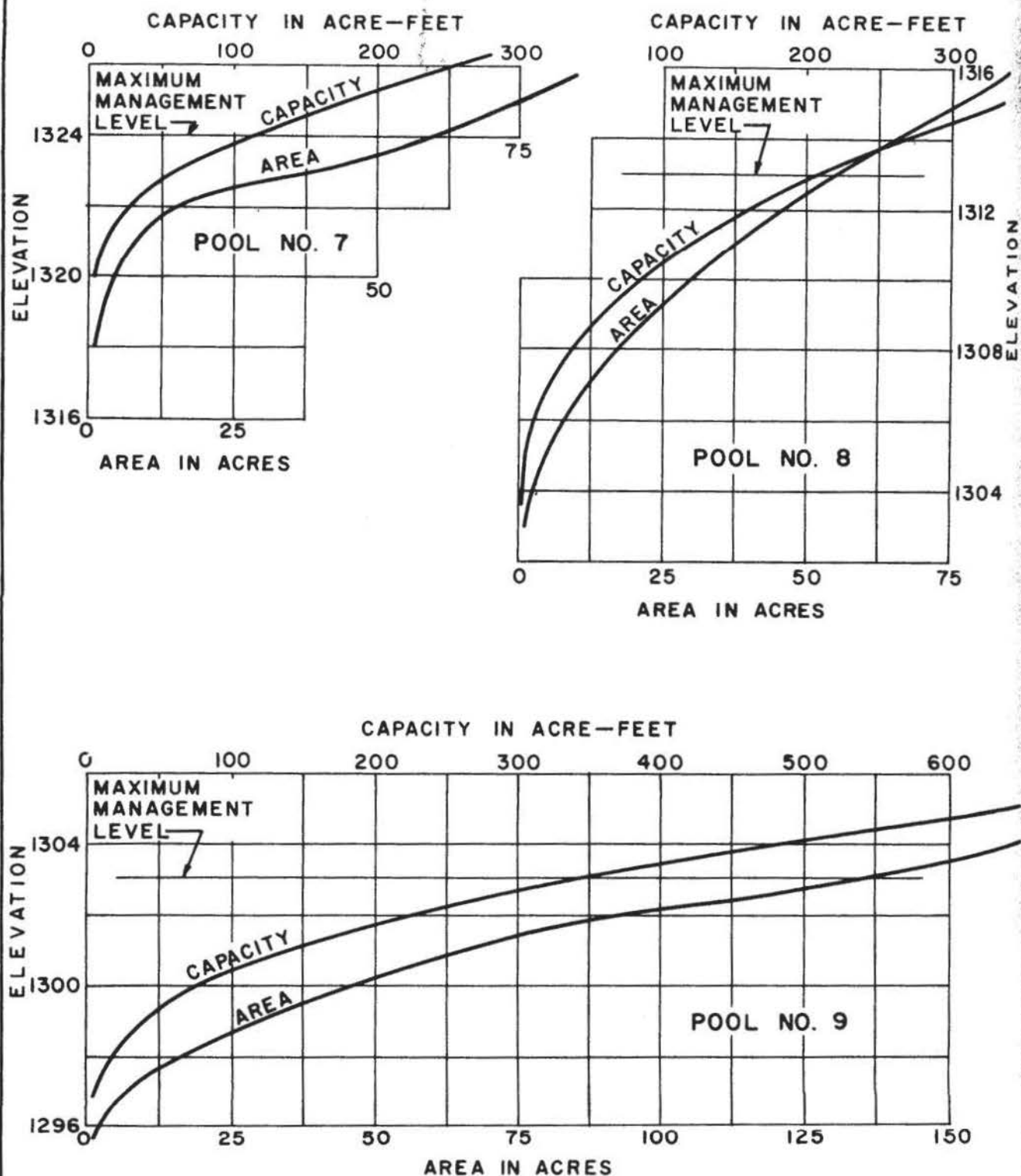




AREA-CAPACITY CURVES

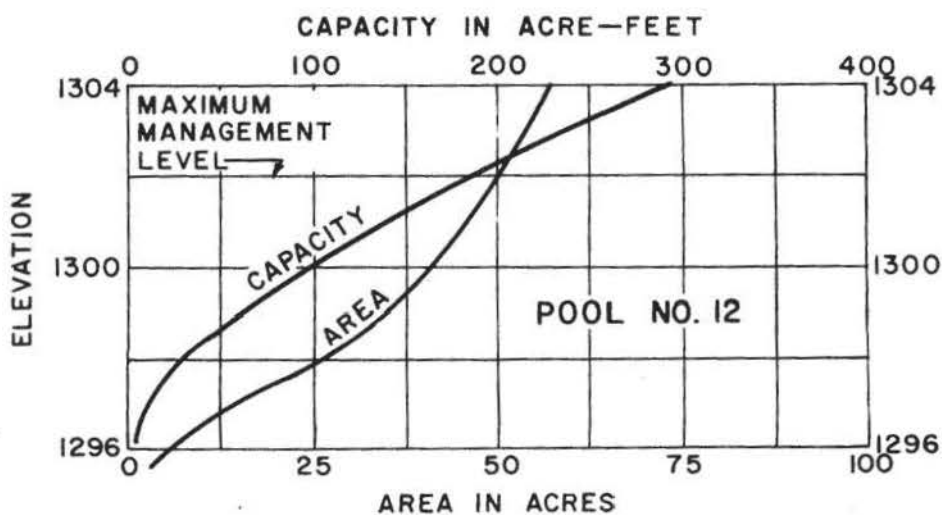
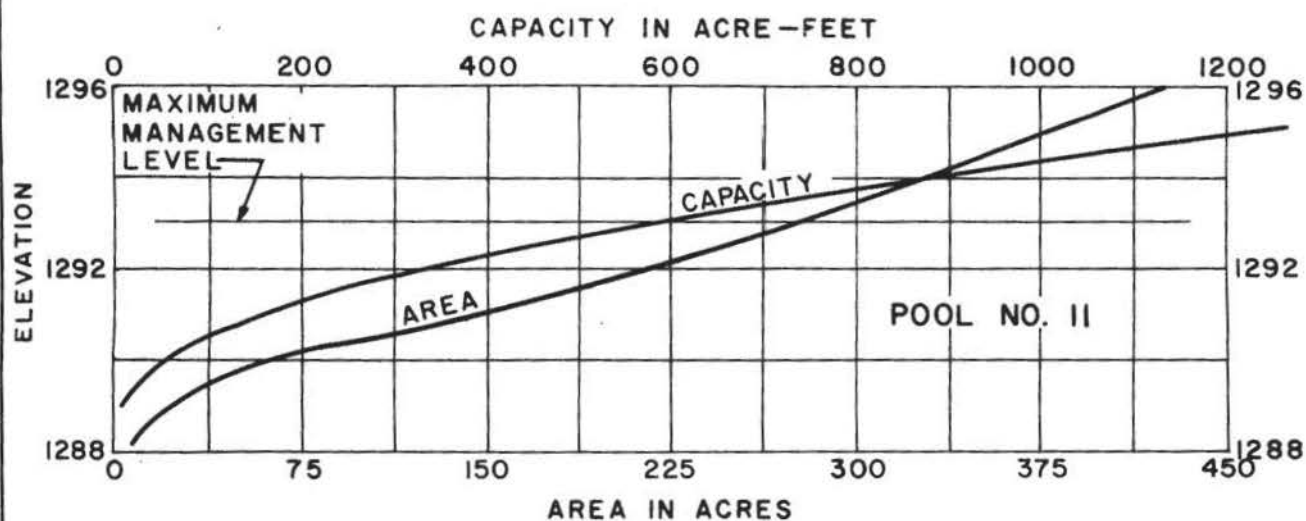
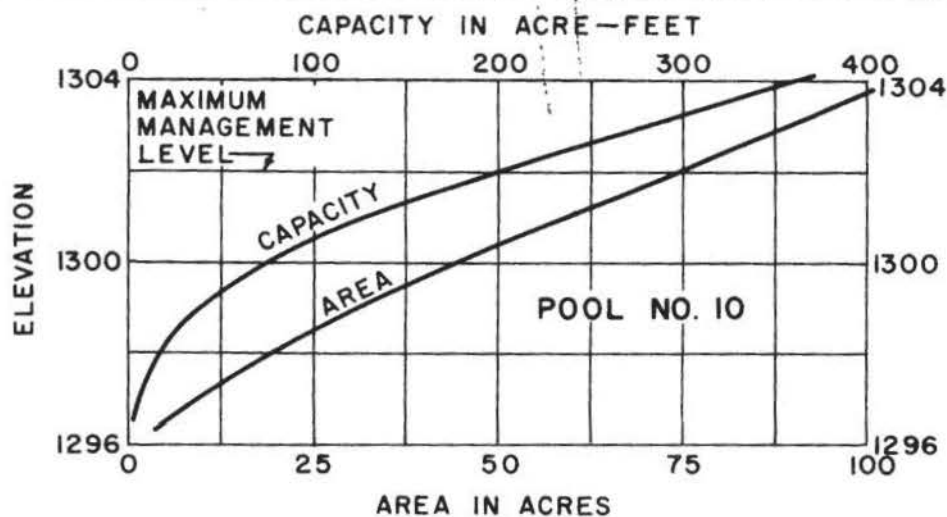


AREA-CAPACITY CURVES



**AREA-CAPACITY CURVES**

**FIG. 6**



### AREA-CAPACITY CURVES

FIG. 7



## WATER CONTROL STRUCTURES

The outlet works are designed to drain all pools within fifteen days, and pass the average flow of the stream without retention. Maximum, average, and minimum flows for Sugar Creek Drainage are shown on Figure 8.

Control structures, spillways and overflow sections are designed to discharge the Jarvis-Meyers peak flood, modified, according to Pennsylvania Regulations. For Pool 1, the Jarvis-Meyers flood discharge curve (modified Curve "C", Figure 9) is equal to about a flood with a recurrence probability of 0.1 of one percent in any one year.

This curve applies to pools with drainage areas more than one-half square mile. Structures for pools and ponds with drainage areas less than one-half square mile are designed to discharge the 50-year frequency storm with one foot freeboard.

Figure 9 shows the design discharge flood curves.

All stop log bays are to be equipped with four slots each, two for stop logs and two for fish or trash screens. The area of overflow at the stop logs is taken into account in spillway design length.

The spillway consists of a mass concrete wall, concrete splash pad, reinforced concrete end retaining walls, and riprap where necessary for protection from erosion. The spillway wall shall have a cross section similar to Figure 73, p. 5-9 of Kings Handbook of Hydraulics. The coefficient of discharge used to determine spillway capacity was taken from Table 57 p. 5-16 of Kings Handbook of Hydraulics, and varies from 3.45 to 3.88.

Earth overflow sections were designed with a coefficient of discharge of 2.6.

Concrete spillways, generally, are designed to pass at least the 2-year storm runoff without the flooding over the overflow section of major impoundments. A complete tabulation of the design of major pools is presented on Sheet 5 of 8, and Table 2.

Spillways for the minor impoundments (A, B, C, D, G, H, J), with drainage areas less than one-half square mile, are to be constructed with an earth overflow section in place of a concrete spillway. Other minor impoundments having a drainage area of from 0.5 to 1.0 square miles (I, K), and with a drainage area of 1.0 to 1.5 square miles (E, F), have the same design basis as the major impoundments. All eleven minor impoundments (A through K) have the top of the riser set at the 50-year flood peak elevation which is 2.5 feet above the MML. Concrete spillways for ponds E, F, I, K, are designed to discharge the 50-year peak flood without flooding over the overflow section.

Control sections with stop logs are to be placed in the spillway section except when excessive depth would result. In cases of excessive depth, control works are placed in an independent structure, the discharge being carried through the dike or dam by a conduit.

The top of the riser, or intake, for the independent control work structure for major impoundments has been set at an elevation two feet above maximum management level (MML) an elevation just at or above the 50-year flood peak elevation.



# DISCHARGE CURVES

## SUGAR CREEK

1932 - 1962

SUGARCREEK VILLAGE

PENNSYLVANIA

SEPT. 1965

RUN OFF IN CFS

60

1000.0

100.0

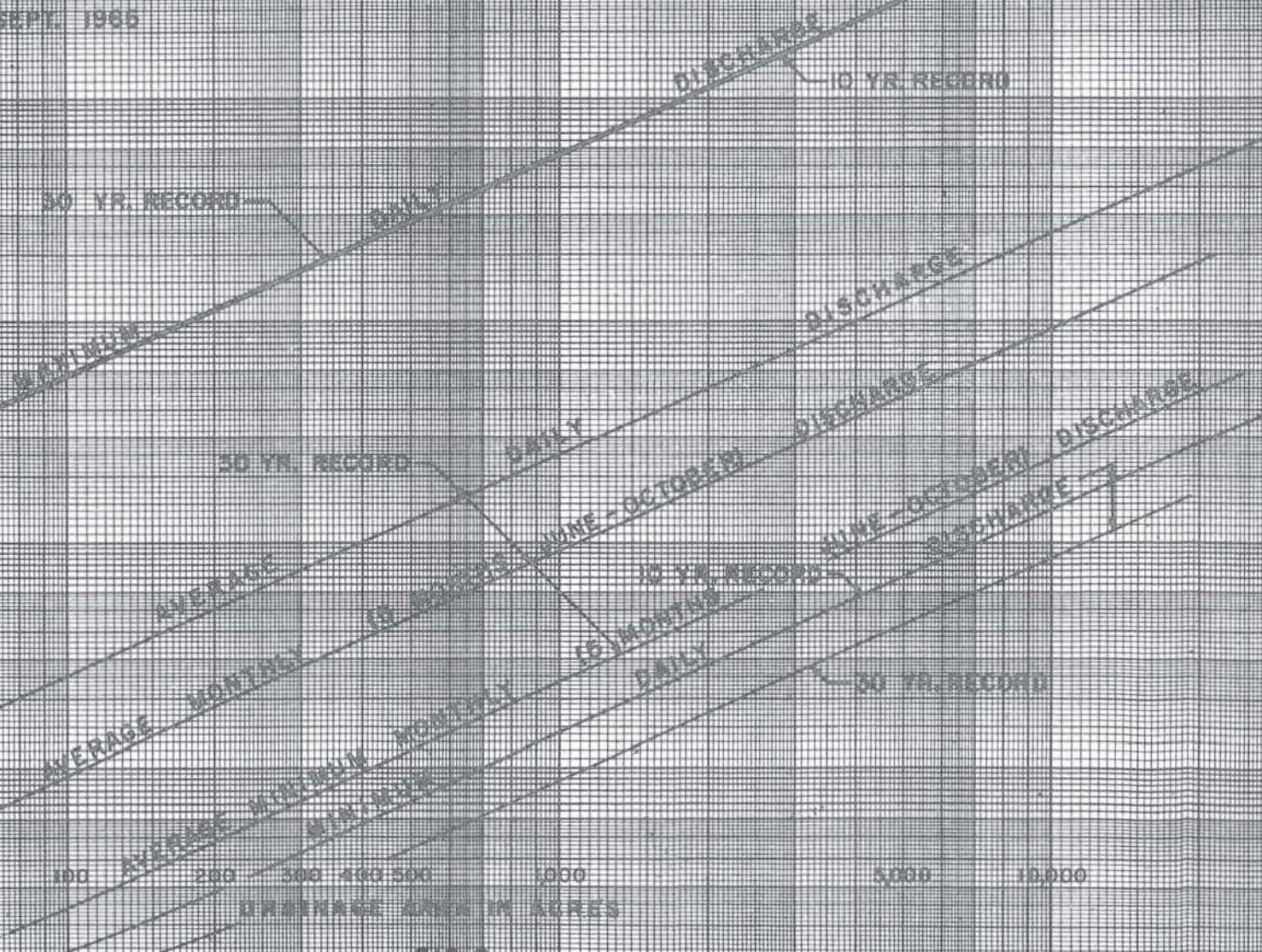
10.0

1.0

0.1

0.01

0.001



DRAINAGE AREA IN ACRES

FIG. 3



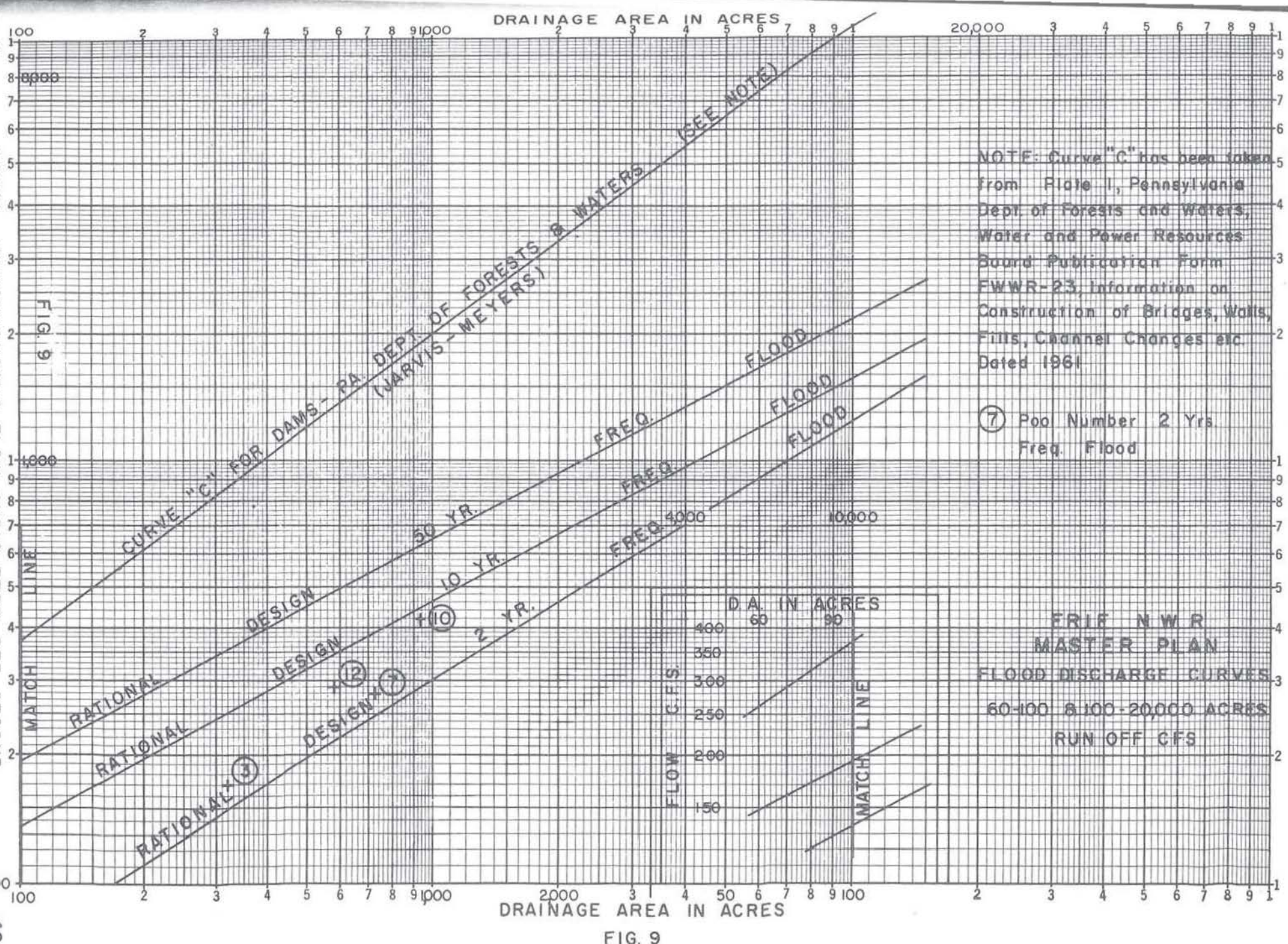


FIG. 9

(Note - Dikes with tops five feet or more above original ground are classified as dams for report purposes)

Dikes shall be constructed of suitable material, excavated from areas adjacent to the dike. Dikes shall be sloped 3:1 on both faces, with fourteen foot wide top and ten foot gravel roadway. All dikes and dams are to have a free board of one foot when control structures and spillways are discharging the peak flood. The dam shall have an impervious core. The selected embankment fill shall be placed and compacted at the same time that the core is constructed. The dam shall be sloped 3:1 on both faces with fourteen foot wide top and ten foot gravel roadway. The core shall be constructed as shown on Sheet 7 of 8. Suitable material for dams is available on Government property within one or two miles of each site.

All slopes of earth dams and dikes shall be surfaced with stripped material and seeded.

### CONSTRUCTION SUPPORT ACTIONS

Where the top of the dike or dam embankment is three feet or more above the streambed, which is the case for all impoundments proposed for the Erie Refuge, a permit for construction should be obtained from the Pennsylvania Department of Forests and Waters.

This permit may be obtained by making application to the Water and Power Resources Board and submitting the application with finished plans and specifications. Sufficient background data and computations also should be submitted in order that a review can be made in an orderly and efficient manner. Drawings should be on the standard construction sheets.



All public roads, state, county, and township, would remain in public ownership and no relocation or raising of these roads is planned. The gas transmission line right-of-way across Pool #4 would be reinforced or relocated. Agreement must be made with the Tennessee Gas Pipeline Company, owner of the pipeline, for this work and work must be completed before Pool #4 is impounded.

Power and communication lines traverse the area and two may require relocation before impoundments are created - Pool #9 and Pond F. A check on the elevation of each pole base should be required to determine extent of relocation if required.

Property on the north of the dike for Pool #11 should be acquired and included within the proposed boundary. This additional land should be provided for (1) construction (2) access road (3) flowage easement.

## PROJECT SITE DATA

### Location

The refuge is in the French Creek Basin in Crawford County, Northwestern Pennsylvania. Sheet 1 of 8 shows further details.

### Topography

Topography of the watershed is shown on Figure 3. Detail topography of the valley is shown on Figure 10. This detail topography was made by alidade on aerial photographs mounted on a plane table. Scale of the photographs is 500 feet to the inch, but reduced for inclusion in this report.

## Geology

Northwestern Pennsylvania is covered with deposits of drift. These deposits were brought by continental ice sheets which invaded Pennsylvania from the north and northeast. Ice moved down the Erie Basin as a major lobe known as the Erie Lobe, and spread out into northwestern Pennsylvania twice during the Illinoian Age and five times during the Wisconsin Age of the Pleistocene Epoch.

Only three of these ice sheets are believed to have advanced as far south as the Erie Refuge. The first was the Illinoian, the second was the Second Illinoian, the the third the Kent. The Illinoian ice sheet extended almost to the Allegheny River valley. The first advance of the Illinoian ice sheet deposited rocks, thin till, and coarse gravel. The Second Illinoian ice sheet deposited a fairly continuous till blanket five to ten feet thick, and scattered gravel mounds.

Deposits laid down by the Kent ice sheet consist mainly of till blanket covering roughly two-thirds of northwestern Pennsylvania. In addition to the till blanket, the Kent ice deposited a rather bold and continuous end moraine (mound) and extensive glacio-fluvial deposits (gravel outwash). Kent drift rests on Tazewell (early Wisconsin), or Illinoian age drift, or upon bedrock. The drift is a mixture of gravels, clays, and silt, averaging 41% sand-gravel, 43% silt, 16% clay over the whole area. There are numerous sand and gravel deposits in the Kent terminal moraine.

The end moraine of the Kent advance, extends diagonally across northwest Pennsylvania from Warren County to Beaver County. The moraine trends from Warren County through Crawford County just south of the refuge, and Venango County into northeast Mercer County as a three to four mile wide bank broken only by cross cutting valleys.



The valleys contain relatively deep deposits of gravelly till deposited from outwash streams during melting of glaciers. The depth of these valley deposits are over 150 feet deep as determined from drilled wells.

The drainage of northwestern Pennsylvania was into Lake Erie prior to the ice age. The drainage was altered by the deepening of some valleys parallel to the direction of glacial advance, filling and blocking of some valleys across the path of the glacial flow, and debris from melting flows. The drainage now is principally into Allegheny Valley.

The French Creek basin lies north of the commercial coal fields and the streams are free of the coal mining drainage pollution characteristics.

### Climate

The Allegheny Plateau is the largest natural division of the state and occupies more than half the area. It is drained by the Allegheny and Monongahela Rivers.

Floods may occur during any month of the year, although they occur with greater frequency in the spring months of March and April. Flooding occurs in any season but most generally during the winter and spring when associated with heavy rains, or heavy rains combined with snowmelt. Serious local flooding sometimes results from ice jams during the spring thaw. Heavy local thunderstorm rains cause severe flash flooding.

Precipitation is fairly evenly distributed throughout the state and throughout the year. Annual precipitation has a mean of about 41 inches, ranging from less than 35 inches in the northern parts of Tioga and Bradford Counties,

TABLE 3  
Climatological Data  
U. S. Weather Bureau  
Climate of the States  
Erie Pennsylvania Airport  
30 Year Record

Mo	Temperature °F				Precipitation Inches				Lake Evapor- ation Inches
	High	Low	Mean Max Min		(1) Av	(1) Max	(1) Min	(2) Snow Fall	
J	73	-15	34	20	3.2	8.5	0.9	22	1.0
F	72	-16	34	19	2.7	4.4	0.7	19	1.0
M	82	-5	43	26	3.3	6.3	0.9	18	1.9
A	86	7	54	35	5.4	4.6	1.5	5	2.9
M	91	30	66	45	4.1	7.4	1.8	T	3.2
J	97	40	76	55	4.1	9.0	1.4	T	3.8
J	98	47	81	60	4.2	9.4	1.5	0	4.3
A	96	42	79	59	3.4	6.0	1.6	0	3.6
S	99	33	73	54	3.0	6.5	1.2	T	2.6
O	89	23	61	43	3.3	6.5	1.2	T	1.6
N	82	6	48	34	3.1	7.0	0.7	11	1.7
D	70	-11	37	24	2.7	4.9	1.3	26	1.4
Annual					40.5	(2) 53.3	(2) 34.4	(2) 101	29.0

(1) 27 Year record at Meadville, Pa.

(2) 10 Year record at Meadville, Pa.

T Trace

164 inches of snow fell in Meadville in 1960. Maximum rainfall of 10.4 inches fell in 24 hours in July 1947. Maximum snowfall of 27 inches in 24 hours in December 1944. Last frost in spring averages about May 18. First frost in fall averages about October 4 (139 days). In March 1917 maximum wind recorded at Erie, Penna., was 60 mph from the southwest. Average annual temperature at Meadville is 49°F.

to more than 45 inches in parts of Crawford, Warren, and Wayne Counties. The seasonal snowfall at Meadville has averaged 101 inches for the period 1951 to 1960, however, for a record period of 65 years, the average is about 67 inches. Fields are normally snow covered three fourths of the time during the winter season. With rapidly flowing streams in the Ohio Drainage System (except the Monongahela) it is fortunate that this part of the state is not subject to torrential rains such as sometimes occur along the Atlantic slope. Although average precipitation is about equal to that for the state as a whole, it usually occurs in smaller amounts at more frequent intervals; 24-hour rains exceeding 2.5 inches are comparatively rare.

The average temperature at Meadville is about 49° F. Frost penetration averages about 20 inches with a maximum depth of 40 inches. Frost free growing season averages about 140 days.

Table 3 gives weather data at Erie and Meadville Pennsylvania.

### Soils

According to the Soil Conservation Service, twenty-three classifications of types of soils are within the proposed refuge area. Four general types comprise about 74% of the total area. The soil along the flood plain of Lake Creek is a silt clay loam along the wide southerly portions, and silt loam along the narrower northerly portion, and comprises about 30% of total area. These soils are poorly drained, subject to flooding, and unless drained, good only for pasture in southern part. The soil along the terrace slopes and knolls adjacent to the flood plains, is moderately deep, poorly drained silt loam with moderate natural fertility and high water table, and comprises about 21% of total area. The soil on the lower

upland slopes adjacent to the terrace slopes, is mostly deep, well drained silt loam suitable for general farm crops, and comprises about 11% of total area. Hilltops, adjacent depressions, and poorly drained, nearly level areas are mostly silt loam derived from sandstone and shale with hardpan twelve to eighteen inches below surface. The areas adjacent to hilltops are suitable for hay, pasture, and shallow-rooted crops. These hilltop area silt loam soils comprise about 12% of total area. The remaining 26% of area is comprised of various classifications of silt loam, stony or gravelly silt loam. Sheet 3 of 8 is a soils map made from information furnished by the Soil Conservation Service.

Use of the valley has been essentially for agriculture. The area is completely vegetated and is composed of about 1200 acres of good quality cropland that will be cultivated to provide supplemental food for waterfowl and game. Other areas are good for pasture, timber and hay. Some brush land would be cleared if found necessary. Small marshes occupy some uplands with the larger marshes in the valley bottom.

Auger borings were made throughout the valley, and results indicate heterogeneous surface soil conditions. Rod soundings were also taken and generally soft materials were encountered only in the marsh area at the south end of refuge. In this marsh, site of Pool 11, muck depths were more than 15 feet below the surface. Soil bearings elsewhere are expected to be more than two tons per square foot.

Borings should be made after precise dam and structure sites have been tentatively selected as foundation conditions vary considerably.

## Ground Water

Information on two wells drilled recently was available. One is at the area school (12 grades) at Guys Mills. This well is 130 feet in depth and with a 12-inch casing is serviced by a 75 gpm pump. Probably yield of this well is 150 gpm. The other well is at the residence on Route 27 in the Headquarters Area, is reported about 170 feet deep, the yield is of good quality, and is sufficient for household use.

No other information on wells in the area was available. Although the yield varies, water is available throughout the area in the glacial till in either shallow or deep wells.

## Watershed

Sugar Creek and tributary streams as well as Woodcock Creek are in the French Creek Watershed. Lake Creek is a tributary to Sugar Creek. The entire Sugar Creek Watershed and the Woodcock Creek Watershed are shown on the Watershed Map Figure 2.

A gaging station is located on Sugar Creek near French Creek. Records at this station show a yield of 1.6 cubic feet per second (cfs) per square mile. Average, Maximum, and Minimum curves for discharges in cfs for drainage areas up to 20,000 acres, are shown on Figure 8. These curves are based on flows at the Sugar Creek gaging station and are used for both Lake Creek and Woodcock Creek computations.

Small farm ponds have been constructed in the upper reaches of the watersheds to a minor extent. Continuation of this type of development can be expected. These small ponds could cut off a portion of the runoff to the proposed upland ponds proposed in this report, but developments so far have been negligible in this respect.

The Corps of Engineers had, at one time, considered a flood control dam for the Allegheny Basin on Lake Creek just east of Sugar Lake. This site has been dropped in favor of another. Their plan is to control floods by construction of numerous small retention reservoirs throughout the Allegheny River Basin. The proposed reservoir on Woodcock Creek is one of these projects.

### Streams

Within the project site, flows of over 200 cfs cause flooding over banks and low areas of roads (based on discharge measurements).

Recorded discharges based on 30 years of record at Sugarcreek Village are as follows: (166 square miles drainage area)

Max. Instantaneous	10,000 cfs May 28, 1946
Max. Daily (30 years)	6,240 cfs May 28, 1946
Max. Daily (10 years)	5,880 cfs Jan. 22, 1959
Av. Daily (30 years)	265 cfs
Min. Daily (10 years)	15 cfs Oct. 1961
Min. Daily (30 years)	9.2 cfs Oct. 22 1935

### Monthly Average Flows in cfs at Sugarcreek, Pennsylvania (1933-1963) (D.A. = 166 sq. mi.)

January	410
February	417
March	570
April	508
May	330
June	180
July	105
August	68
September	51
October	88
November	172
December	283
Average	265

## Surface Water Areas

Existing ponds are shown on the Topographic Map Figure 10.

Evaporation used in determining fluctuations in water levels and losses in proposed pools were taken from records at Jamestown and Ithaca, New York. Figures have been reduced to show lake evaporation (76% of Pan Evaporation) and are presented on the Climatological Data Table 3. Seepage losses are estimated at three inches per month.

## Water Use History

South of Sugar Lake, Lake Creek flows into Sugar Creek. Sugar Creek flows into French Creek at Sugarcreek which is northwest of Franklin. The land bordering these streams is farmland but there is no apparent use of the water for irrigation. In some areas, the land slopes to the waters edge and cattle could be watered in the stream.

Woodcock Creek flows directly into French Creek at Saegerstown. The land bordering this creek is also farmland and again there is no apparent use of the water for irrigation or watering of livestock.

East of the confluence of French and Woodcock Creeks, the Hughson Chemical Company is located on Route 198. However, the plant appears to be too far away from Woodcock Creek to make use of its waters.

## State Water Laws

Water Rights in Pennsylvania generally follow and are land ownership rights.



Law passed in 1937 appropriates to the Commonwealth all unappropriated flowing (surface) waters except private springs and private water supplies, and sets up a procedure for appropriation of water for public supply purposes. Private use is not mentioned. (See previous discussion and letter from Executive Director, Pennsylvania Game Commission.)

#### Existing Easements and Rights-of-Way

Ownership of easements and rights-of-way within the proposed boundary generally have been transferred to the Service, subject to outstanding rights of the public for roads and highways and the rights-of-way of the Tennessee Gas Pipeline Company, Meadville Telephone Company, Pennsylvania Electric Company, Northwestern Rural Electric Company, and others. Miscellaneous rights of the public and private individuals for residences, wood-cutting, etc., have been reserved in deeds. For location of roads and public and private utilities see Topographic Map Figure 10.

The Service is obtaining releases from companies holding oil and natural gas rights in certain land tracts in the refuge area. Mineral rights are included in the land purchased.

#### Utilities

The above services, communication lines and power lines are overhead transmission lines. The 26-inch gas line is an underground transmission line.

Utilities available in the area are confined to power and telephone. Both these services are available throughout the refuge. All are above ground and beside or near roads. Three-phase electric power is available at Mount Hope. Public fire fighting equipment is housed at Guys Mills and at Mount Hope.

## Chapter 3

### ACQUISITION

From the initial date of approval of this project, March 11, 1958 to July 1966, a total of 5005 acres had been acquired or optioned at an estimated land cost of approximately \$558,000.

The total proposed Project Area is estimated to contain about 5150 acres and the land is estimated to cost approximately \$620,000.

Engineering has requested an estimated additional 20 acres cost estimated to about \$10,000, making the Project Area and land cost approximately 5170 acres \$630,000.

About 20% must be added to this land cost estimate to allow for administration costs. With the 20% total, acquisition costs would be about \$756,000.

Land has been acquired and is being acquired within the proposed boundary in order to insure full development for maximum waterfowl benefits in the marsh and water areas. Area acquired above the marsh for feeding areas for the resource has been limited to reduce acquisition costs, but in some cases has gone beyond actual needs to prevent undue hardship on the land owner or tenant farmer. In some cases land has been acquired for access purposes and for administrative and enforcement purposes.

Details of Acquisition and Status of the Program are shown on the Land Status Map Sheet 2 of 8.

## Chapter 4

### DEVELOPMENT

#### COST ESTIMATE

Each pool and pond has been placed in one of five units. These units are for identification and are management units. They have no place in the priority or phase of the proposed construction.

The explanation for phasing and the objectives of each phase are presented in Chapter 2. The following is a compilation of estimated cost of each item required to complete the impoundment or facility. Miscellaneous items such as Patrol Trails, Fencing and Posting, Nesting Structures and Islands, and Recreation Development have been included. A contingency factor of 15% is included in the estimated costs of all items except the buildings, and 15% for engineering has been added to all items requiring substantial amount of engineering services.

#### Pool 1

Dam and Dike	\$ 32,500
Control Works	78,000
Access Road R-1	3,500
	<u>\$114,000</u>

#### Pool 2

Dam and Dike	\$ 12,500
Control Works	13,000
Access Road R-2	3,300
	<u>\$ 28,800</u>

### Pool 3

Dam and Dike	\$ 7,000
Control Works	13,600
Access Road R-3	<u>1,800</u>
	\$ 22,400

### Pool 7

Dam and Dike	\$ 70,200
Control Works	21,400
Access Road R-7	<u>9,000</u>
	\$100,600

### Pool 9

Dam and Dike	\$ 17,800
Control Works	66,000
Access Road R-9	<u>15,400</u>
	\$ 99,200

### Pool 11

Dam and Dike	\$ 45,000
Control Works	138,000
Access Road R-11	<u>14,200</u>
	\$197,200

### Headquarters Area

Office-Visitor Center	\$ 35,000
Shop Building	15,000
Equipment Storage Building	10,000
Oil House	3,000
Service Island	1,700
Electrical System	2,700
Sewers	6,600
Water Supply	20,000
Visitor Parking & Access Road,	
Service Road and Court	15,300
	<u>\$109,300</u>

Costs of landscaping, grading, and drainage are included in the above items.

### Miscellaneous

Patrol Trails (partially completed)	\$ 19,500
Fencing & Posting (partially completed)	32,000
Nesting Structure & Islands (Biol.)	11,000
Recreation Facilities	28,000
	<u>\$ 90,500</u>

Total Development Costs:	\$762,000
Total Acquisition Costs:	\$620,000*
Total Project Cost:	\$1,382,000**

\*With additional land requested by Engineering (\$10,000) and 20% for administration added, Total Acquisition costs would be: \$756,000

\*\*Total Project cost including extra land and administration:

\$1,518,000

The following impoundments studied in this plan are not scheduled for development.

Pool 4

Dam and Dike	\$ 80,000
Control Works	85,000
Reinforce Gas Line	30,000
Access Road R-4	<u>2,800</u>
	\$197,800

Pool 5

Dam and Dike	\$ 7,400
Control Works	76,000
Access Road R-5	<u>17,400</u>
	\$100,800

Pool 6

Dam and Dike	\$ 30,000
Control Works	47,500
Access Road R-6	<u>3,400</u>
	\$ 80,900

Pool 8

Dam and Dike	\$ 60,000
Control Works	94,500
Access Road R-8	<u>2,500</u>
	\$157,000

Pool 10

Dam and Dike	\$ 89,200
Control Works	31,500
Access Road R-10	2,600
	<u>\$123,300</u>

Pool 12

Dam and Dike	\$ 59,800
Control Works	16,800
Access Road R-12	11,800
Access Road R-11A	6,600
	<u>\$ 95,000</u>

Pond A

Dam	\$ 8,000
Control Works	3,400
Road R-a	3,300
	<u>\$ 14,700</u>

Pond E

Dam	\$ 12,900
Control Works	16,100
Road R-e	3,300
	<u>\$ 32,300</u>

Pond F

Dam	\$ 12,900
Control Works	16,100
Road R-f	3,300
	<u>\$ 32,300</u>



Pond G

Dam	\$ 8,000
Control Works	3,400
Road R-g	2,900
	<u>\$ 14,300</u>

Pond I

Dam	\$ 10,400
Control Works	14,300
Road R-i	2,900
	<u>\$ 27,600</u>

Pond J

Dam	\$ 8,000
Control Works	3,400
Road R-j	1,600
	<u>\$ 13,000</u>

Pond K

Dam	\$ 10,400
Control Works	14,300
Road R-k	1,600
	<u>\$ 26,300</u>

Total phasing of the project development is shown in Table 4, Program Detail Schedule and Table 5, Development Schedule. The estimated annual funds required for operations during each phase are shown in Table 6, Operation Schedule.

Unit costs used in the development cost estimate were current, Summer 1965.

PROGRAM SCHEDULE DETAIL

PROGRAM ITEM	Total Planned Units	Total Estimated Cost	Phase 1	Phase 2	Phase 3
TOTAL DEVELOPMENT COST		(762, 000)	( 270, 800)	(318, 600)	(172, 600)
WATER FACILITIES		(515, 000)	(175, 400)	(183, 000)	(156, 600)
Dams and Dikes	(1.5 miles)	(185, 000)	( 88, 000)	( 45, 000)	( 52, 000)
Unit 1, Pool 1	0.1	32, 500			32, 500
Unit 1, Pool 2	0.1	12, 500			12, 500
Unit 1, Pool 3	0.1	7, 000			7, 000
Unit 3, Pool 7	0.8	70, 200	70, 200		
Unit 4, Pool 9	0.1	17, 800	17, 800		
Unit 5, Pool 11	0.3	45, 000		45, 000	
Control Works and Spillways	(10 each)	(330, 000)	( 87, 400)	(138, 000)	(104. 600)
Unit 1, Pool 1	1	78, 000			78, 000
Unit 1, Pool 2	2	13, 000			13, 000
Unit 1, Pool 3	2	13, 600			13, 600
Unit 3, Pool 7	3	21, 400	21, 400		
Unit 4, Pool 9	1	66, 000	66, 000		
Unit 5, Pool 11	1	138, 000		138, 000	

PROGRAM ITEM	Total Planned Units	Total Estimated Cost	Phase 1	Phase 2	Phase 3
BIOLOGICAL DEVELOPMENT		( 11,000)	( 4,300)	( 4,700)	( 2,000)
Nesting Islands	(10 each)	( 5,000)	( 2,500)	( 2,000)	( 500)
Unit 1, Pool 1	1	500			500
Unit 3, Pool 7	3	1,500	1,500		
Unit 4, Pool 9	2	1,000	1,000		
Unit 5, Pool 11	4	2,000		2,000	
Nesting Structures	(200 each)	( 6,000)	( 1,800)	( 2,700)	( 1,500)
BUILDINGS	( 4 each)	( 63,000)		( 63,000)	
Office-Visitor Center	1	35,000		35,000	
Shop	1	15,000		15,000	
Equipment Storage	1	10,000		10,000	
Oil Storage	1	3,000		3,000	

Table 4 (3)  
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PROGRAM ITEM	Total Planned Units	Total Estimated Cost	Phase 1	Phase 2	Phase 3
FENCING AND POSTING		( 32,000)	( 31,000)	( 1,000)	
Boundary Fencing	(18.9 miles)	( 18,900)	( 18,900)		
Unit 1	6.8	6,800	6,800		
Unit 2	2.3	2,300	2,300		
Unit 3	3.0	3,000	3,000		
Unit 4	3.9	3,900	3,900		
Unit 5	2.9	2,900	2,900		
Interior Fencing	(5.5 miles)	( 5,500)	( 5,500)		
Unit 1	2.0	2,000	2,000		
Unit 2	1.1	1,100	1,100		
Unit 3	1.3	1,300	1,300		
Unit 4	1.1	1,100	1,100		
Boundary Posting	(47.2 miles)	( 4,600)	( 4,600)		
Unit 1	12.0	1,200	1,200		
Unit 2	7.1	700	700		
Unit 3	9.4	900	900		
Unit 4	13.2	1,300	1,300		
Unit 5	5.5	500	500		
Signs	(30 each)	( 3,000)	( 2,000)	( 1,000)	

PROGRAM ITEM	Total Planned Units	Total Estimated Cost	Phase 1	Phase 2	Phase 3
ROADS AND TRAILS		( 82,000)	( 43,900)	( 29,500)	( 8,600)
Gravel Access Roads	(4.5 miles)	( 47,200)	( 24,400)	( 14,200)	( 8,600)
					8,600
Unit 1	0.8	8,600			
Unit 3	1.2	9,000	9,000		
Unit 4	1.1	15,400	15,400		
Unit 5	1.4	14,200		14,200	
Patrol Trails	(10.1 miles)	( 19,500)	19,500		
Unit 1	2.9	5,000	5,000		
Unit 2	1.8	4,000	4,000		
Unit 3	2.4	5,000	5,000		
Unit 4	2.5	4,500	4,500		
Unit 5	0.5	1,000	1,000		
Headquarters Road and Parking	(40,000 sq. ft.)	( 15,300)		( 15,300)	
STRUCTURES AND UTILITIES		( 31,000)		( 31,000)	
Headquarters Utilities	(1 Set)	( 31,000)		( 31,000)	

PROGRAM ITEM	Total Planned Units	Total Estimated Cost	Phase 1	Phase 2	Phase 3
RECREATION DEVELOPMENT		( 28,000)	( 16,200)	( 6,400)	( 5,400)
Parking Areas	(87,000 sq. ft.)	( 22,500)	( 11,700)	( 5,400)	( 5,400)
Unit 1	36,000	9,300	3,900		5,400
Unit 3	9,000	2,400	2,400		
Unit 4	21,000	5,400	5,400		
Unit 5	21,000	5,400		5,400	
Nature Trails	(2.8 miles)	( 3,500)	( 2,500)	( 1,000)	
Unit 1	1.2	1,500	1,500		
Unit 3	0.8	1,000	1,000		
Unit 4	0.8	1,000		1,000	
Observation Platform	(1 each)	( 2,000)	( 2,000)		

TABLE 5

## DEVELOPMENT SCHEDULE

PROGRAM ITEM	Total Planned Units	Total Estimated Cost	Phase 1		Phase 2		Phase 3	
			Units	Funds	Units	Funds	Units	Funds
<b>WATER FACILITIES</b>		(515,000)		(175,400)		(183,000)		(156,600)
Dams and Dikes	1.5 miles	185,000	0.9	88,000	0.3	45,000	0.3	52,000
Control Works and Spillways	10 each	330,000	4	87,400	1	138,000	5	104,600
<b>BIOLOGICAL DEVELOPMENT</b>		(11,000)		(4,300)		(4,700)		(2,000)
Nesting Islands	10 each	5,000	5	2,500	4	2,000	1	500
Nesting Structures	200 each	6,000	60	1,800	90	2,700	50	1,500
<b>BUILDINGS</b>		(63,000)				(63,000)		
Office-Visitor Center	1 each	35,000			1	35,000		
Shop	1 each	15,000			1	15,000		
Equipment Storage	1 each	10,000			1	10,000		
Oil Storage	1 each	3,000			1	3,000		
<b>FENCING AND POSTING</b>		(32,000)		(31,000)		(1,000)		
Fences	24.4 miles	24,400	24.4	24,400				
Boundary Posting	47.2 miles	4,600	47.2	4,600				
Signs	30 each	3,000	20	2,000	10	1,000		
<b>ROADS AND TRAILS</b>		(82,000)		(43,900)		(29,500)		(8,600)
Roads	4.5 miles	47,200	2.3	24,400	1.4	14,200	0.8	8,600
Trails	10.1 miles	19,500	10.1	19,500				
Headquarters Area	40,000 sq. ft.	15,300			40,000	15,300		
<b>STRUCTURES AND UTILITIES</b>		(31,000)				(31,000)		
Headquarters Utilities	1 set	31,000				31,000		
<b>RECREATION DEVELOPMENT</b>		(28,000)		(16,200)		(6,400)		(5,400)
Parking Areas	87,000 sq. ft.	22,500	45,000	11,700	21,000	5,400	21,000	5,400
Nature Trails	2.8 miles	3,500	2.0	2,500	0.8	1,000		
Observation Platform	1 each	2,000	1	2,000				
<b>TOTAL DEVELOPMENT COSTS</b>		762,000		270,800		318,600		172,600



TABLE 6

## OPERATIONS SCHEDULE

PROGRAM ITEM	Type of Unit	Phase 1		Phase 2		Phase 3	
		Units	Funds	Units	Funds	Units	Funds
MAINTENANCE			(14,000)		(18,000)		(23,000)
Water Facilities	miles/no.	0.9/4	5,500	1.2/5	6,500	1.5/10	9,500
Roads and Trails	miles	12.4	2,000	13.8	2,500	14.6	3,000
Fencing and Posting	miles	71.6	3,000	71.6	3,500	71.6	4,000
Buildings and Structures	sq. ft./no.	8,300/5	3,500	7,800/6	5,500	7,800/6	6,500
MANAGEMENT (5,150)	acres		(10,000)		(17,000)		(25,000)
Cropland (1,200)	acres	1,200	1,500	1,200	3,000	1,200	7,500
Timberland (2,600)	acres	2,600	2,500	2,600	4,000	2,600	4,500
Grassland (550)	acres	995	2,000	720	3,000	550	4,000
Marsh and Water (800)	acres	355	4,000	630	7,000	800	9,000
PROTECTION			(8,000)		(4,000)		(4,000)
Enforcement	acres	5,150	2,000	5,150	2,500	5,150	2,500
Fire Control	acres	4,795	1,000	4,520	1,500	4,350	1,500
RECREATION	vis. days	15,000	(4,000)	30,000	(5,000)	75,000	(5,000)
POPULATIONS MANAGEMENT			(5,000)		(6,000)		(7,000)
Surveys and Censuses	acres	5,150	3,500	5,150	4,000	5,150	4,500
Animal Control	no proj.	2	1,500	2	2,000	2	2,500
CONSERVATION EDUCATION	contacts	50	(2,000)	100	(4,000)	250	(7,000)
SUB-TOTAL			38,000		54,000		71,000
SOIL AND MOISTURE			(6,000)		(4,000)		(4,000)
Land Use Planning	acres	5,150	1,000	5,150	500	5,150	500
Soil Management	acres	350	2,500	300	2,000	150	1,500
Water Management	acres	35	2,500	40	1,500	30	2,000
TOTAL			44,000		58,000		75,000

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Pennsylvania, Commonwealth of

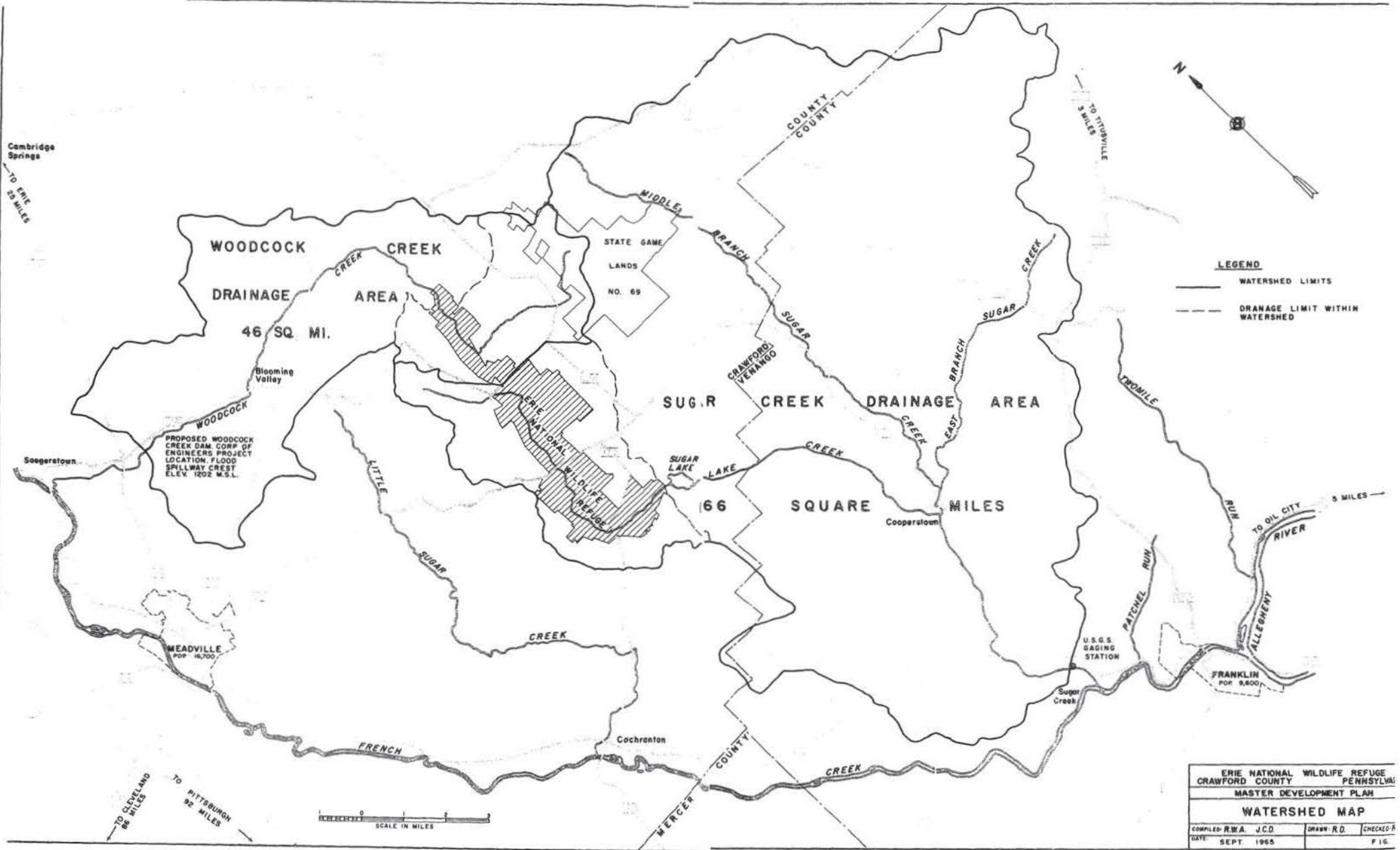
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- (b) Department of Forests and Waters Water and Power Resources Board Form FWWR-23 P. L. 555 Bridges, Walls, Fills Around Changes, Etc. 1961

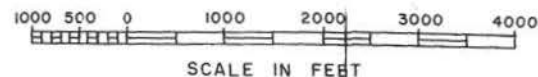
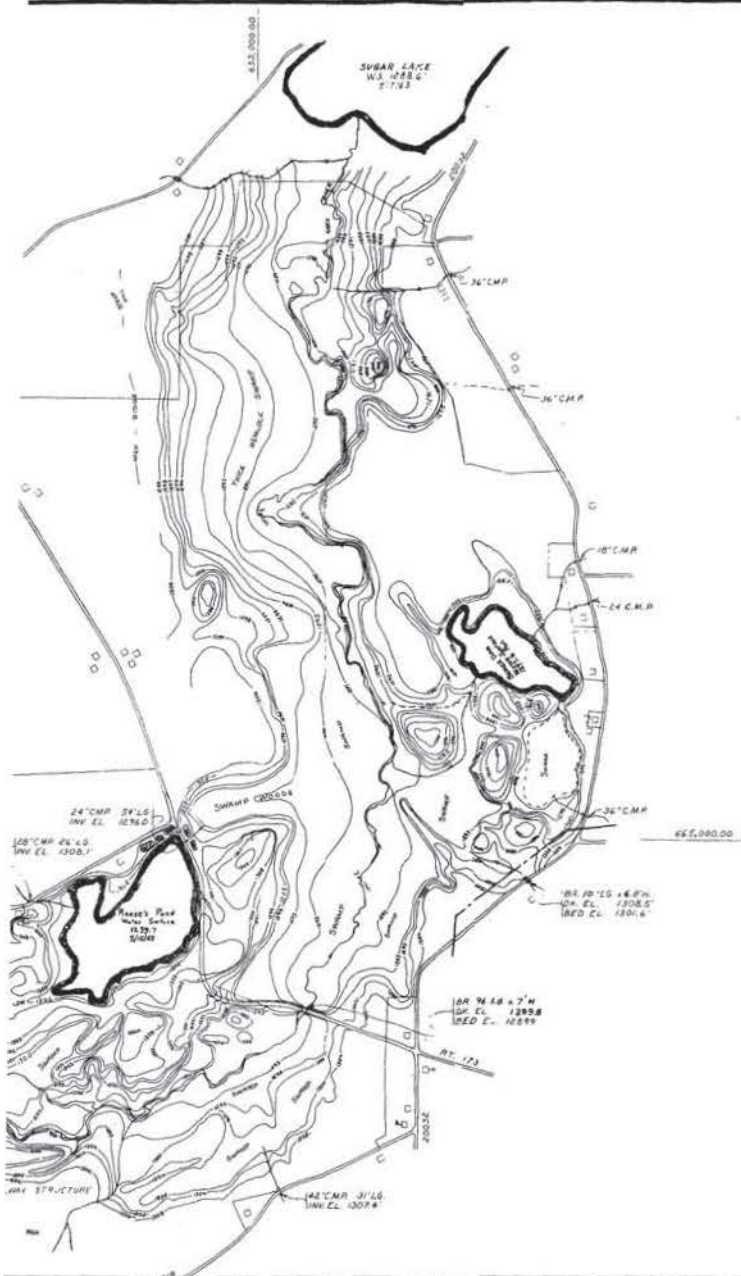
U. S. Department of the Interior, Fish and Wildlife Service,  
Bureau of Sport Fisheries and Wildlife

- (a) Division of Wildlife Refuges, Concept of Development and Management - Erie National Wildlife Refuge.
- (b) Division of Wildlife Refuges - Functional Criteria Erie National Wildlife Refuge.
- (c) Division of Wildlife Refuges:  
Water level recordings; oblique aerial photographs; overflow observations; and gagings.
- (d) Division of Administration and Engineering:  
Reconnaissance and Topography Surveys.
- (e) Aerial Photographs obtained from Central Office

LIST OF ENGINEERING DRAWINGS NO. 5R-Pa-523-2.0  
(Bound in back of Report)

Sheet 1 of 8 - General Plan  
Sheet 2 of 8 - Land Status  
Sheet 3 of 8 - Soils  
Sheet 4 of 8 - Woodlands  
Sheet 5 of 8 - Impoundments  
Sheet 6 of 8 - Roads, Trails and  
                    Fences  
Sheet 7 of 8 - Typical Details  
Sheet 8 of 8 - Headquarter Site Plan





ERIE NATIONAL WILDLIFE REFUGE  
CRAWFORD COUNTY PENNSYLVANIA

MASTER DEVELOPMENT PLAN

TOPOGRAPHY

COMPILED: R.W.A., J.C.D.

DRAWN: R.D.

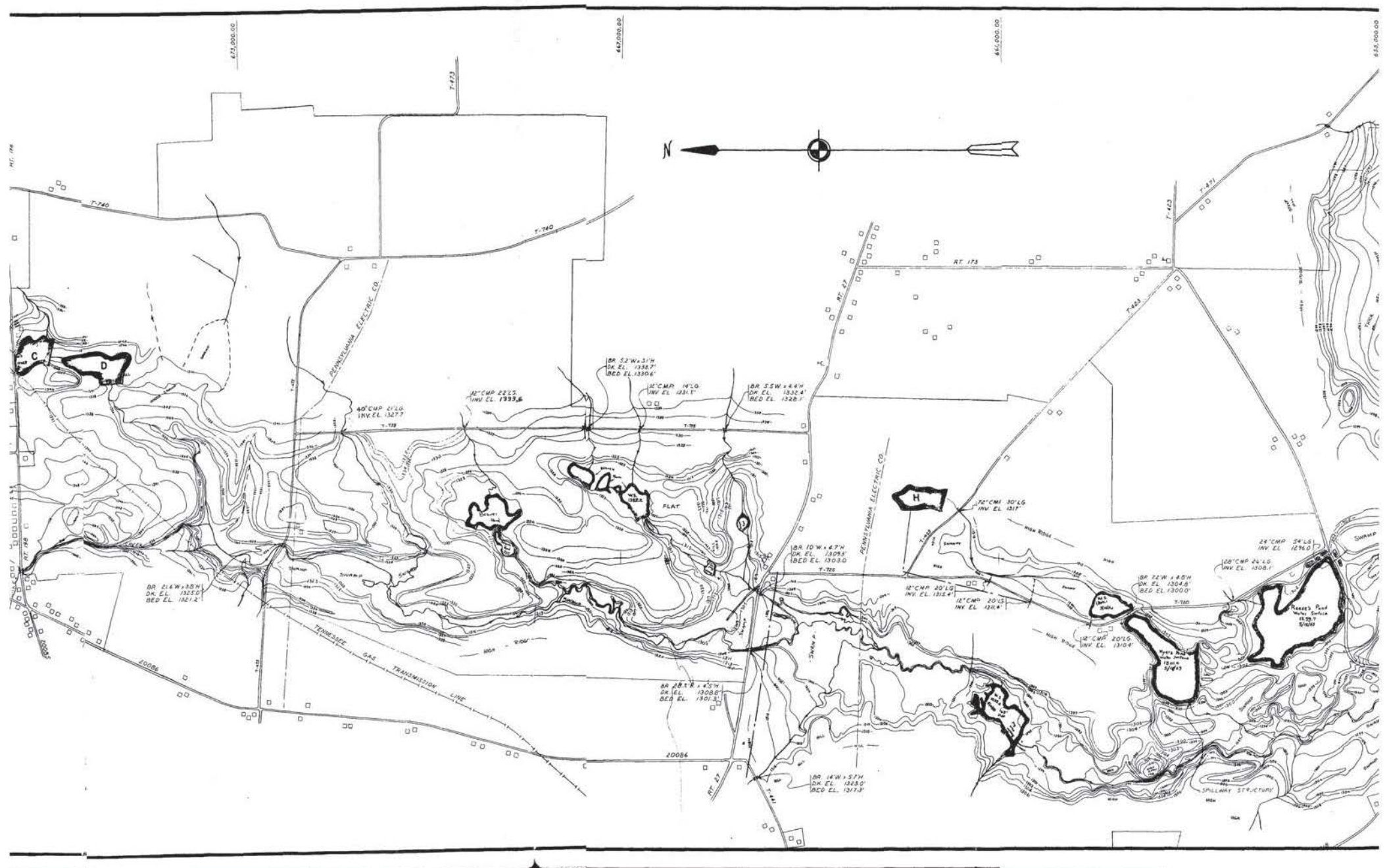
CHECKED: R.W.A.

DATE: SEPT. 1965

FIG. 10



NY 198



475,000.00

447,000.00

447,000.00

455,000.00

C

BR 21.6W x 3.5H  
OK EL. 1325.0  
BED EL. 1321.2

40' CUP 21' LG  
INV. EL. 1327.7

12' CUP 22' LG  
INV. EL. 1335.6

BR 52' W x 3' H  
OK EL. 1338.7  
BED EL. 1330.6

12' CUP 14' LG  
INV. EL. 1331.1

BR 5.5W x 4.4H  
OK EL. 1332.4  
BED EL. 1328.1

BR 28' W x 4.5H  
OK EL. 1308.0  
BED EL. 1301.3

BR 14' W x 5.7H  
OK EL. 1318.0  
BED EL. 1317.3

H

12' CUP 20' LG  
INV. EL. 1315.4

12' CUP 20' LG  
INV. EL. 1314.4

12' CUP 30' LG  
INV. EL. 1311

BR 7.2W x 4.8H  
OK EL. 1304.8  
BED EL. 1300.0

12' CUP 24' LG  
INV. EL. 1308.1

12' CUP 24' LG  
INV. EL. 1306.0

BR 7.2W x 4.8H  
OK EL. 1304.8  
BED EL. 1300.0

12' CUP 20' LG  
INV. EL. 1304.1

12' CUP 20' LG  
INV. EL. 1304.1

BR 7.2W x 4.8H  
OK EL. 1304.8  
BED EL. 1300.0

12' CUP 20' LG  
INV. EL. 1304.1

12' CUP 20' LG  
INV. EL. 1304.1

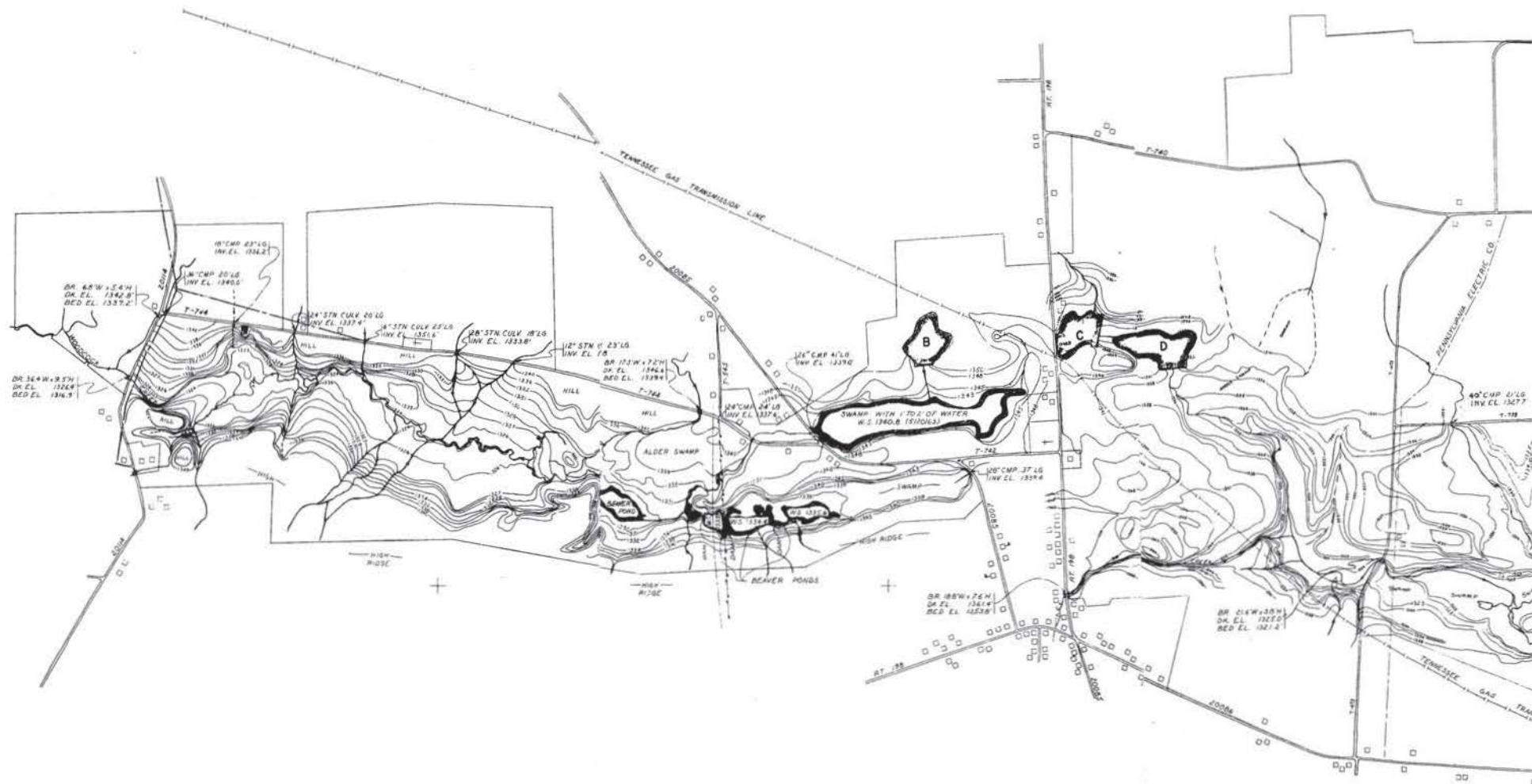
BR 7.2W x 4.8H  
OK EL. 1304.8  
BED EL. 1300.0

12' CUP 20' LG  
INV. EL. 1304.1

12' CUP 20' LG  
INV. EL. 1304.1

BR 7.2W x 4.8H  
OK EL. 1304.8  
BED EL. 1300.0

12' CUP 20' LG  
INV. EL. 1304.1



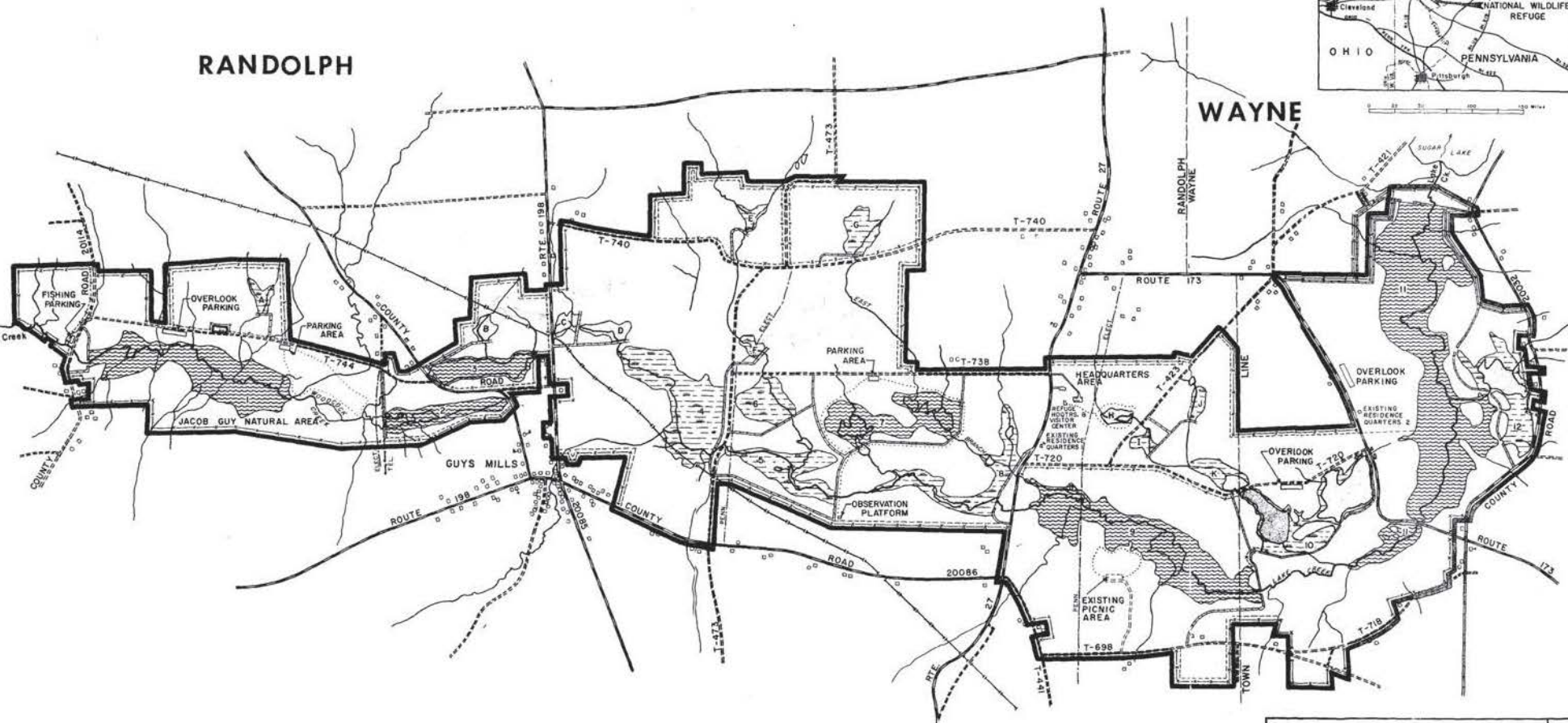


- INDEX OF DRAWINGS  
 SHEET 1 GENERAL PLAN  
 2 LAND STATUS  
 3 SOILS  
 4 WOODLANDS  
 5 IMPOUNDMENTS  
 6 ROADS TRAILS & FENCES  
 7 TYPICAL DETAILS  
 8 HEADQUARTERS SITE PLAN



RANDOLPH

WAYNE



LEGEND

- EXISTING GRAVEL ROAD
- EXISTING BITUMINOUS ROAD
- PROPOSED BOUNDARY
- PROPOSED IMPOUNDMENT WITH IDENTIFICATION
- PROPOSED GRAVEL ACCESS ROAD
- PROPOSED PATROL TRAIL
- PROPOSED NATURE TRAIL
- PROPOSED BOUNDARY FENCE
- PROPOSED GRAZING FENCE
- POTENTIAL WATERFOWL IMPOUNDMENTS
- EXISTING PONDS AND SUBIMPOUNDMENTS

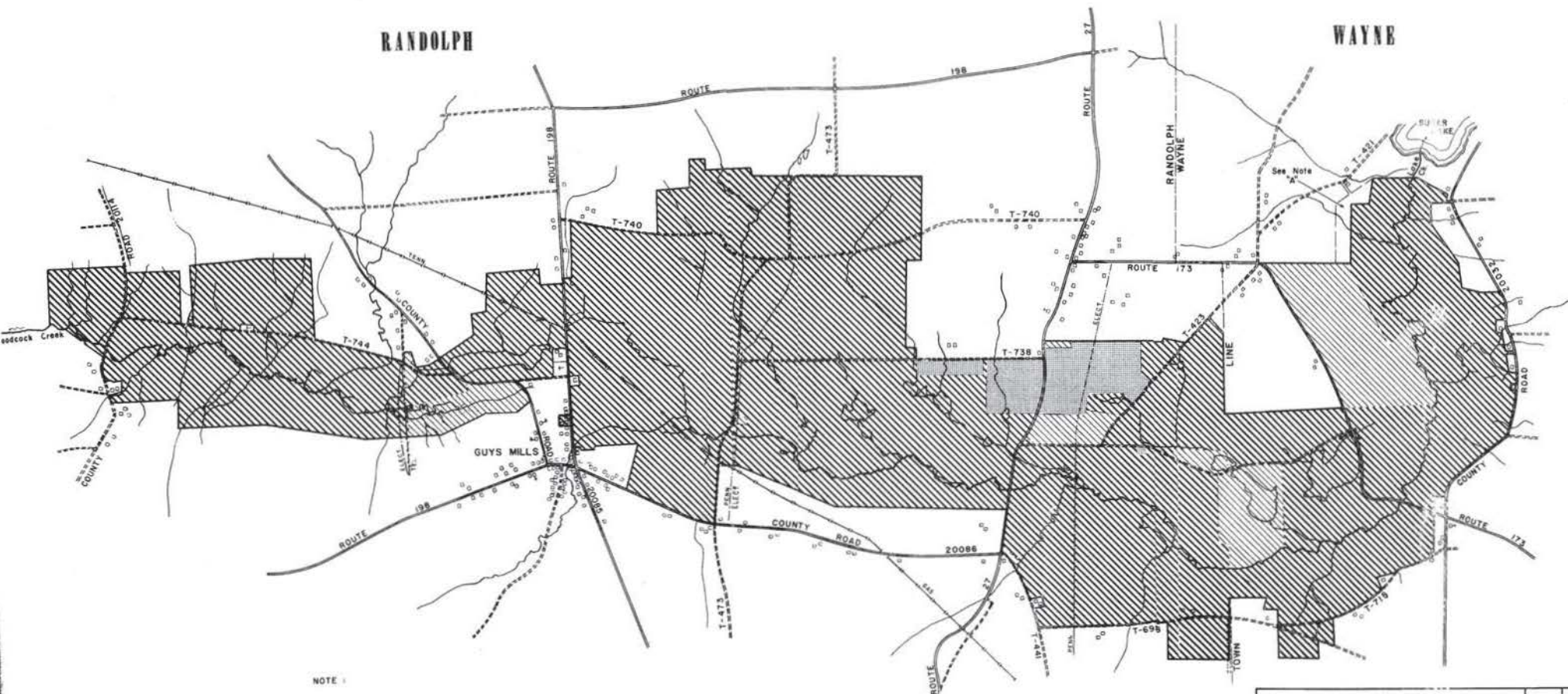
0 1000 2000 3000 4000  
 SCALE IN FEET

REVISIONS		DATE	BY
UNITED STATES DEPARTMENT OF THE INTERIOR FISH AND WILDLIFE SERVICE BUREAU OF SPORT FISHERIES AND WILDLIFE BRANCH OF ENGINEERING			
SUBMITTED <i>[Signature]</i> REGIONAL ENGINEER		ERIE NATIONAL WILDLIFE REFUGE CRAWFORD COUNTY PENNSYLVANIA	
REVIEWED <i>[Signature]</i> REGIONAL ENGINEER		MASTER DEVELOPMENT PLAN	
RECOMMENDED <i>[Signature]</i> REGIONAL ENGINEER		GENERAL PLAN	
W.T. APPROVAL CHIEF		COMPILED: R.W.A., J.C.D. DATE: JULY 1966	DRAWN: R.D. DWS. NO. SR-PG-523-2.0 CHECKED: R.W.A.



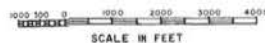
RANDOLPH

WAYNE



NOTE :

"A" Addition recommended by Engineering for dike construction and shore protection.



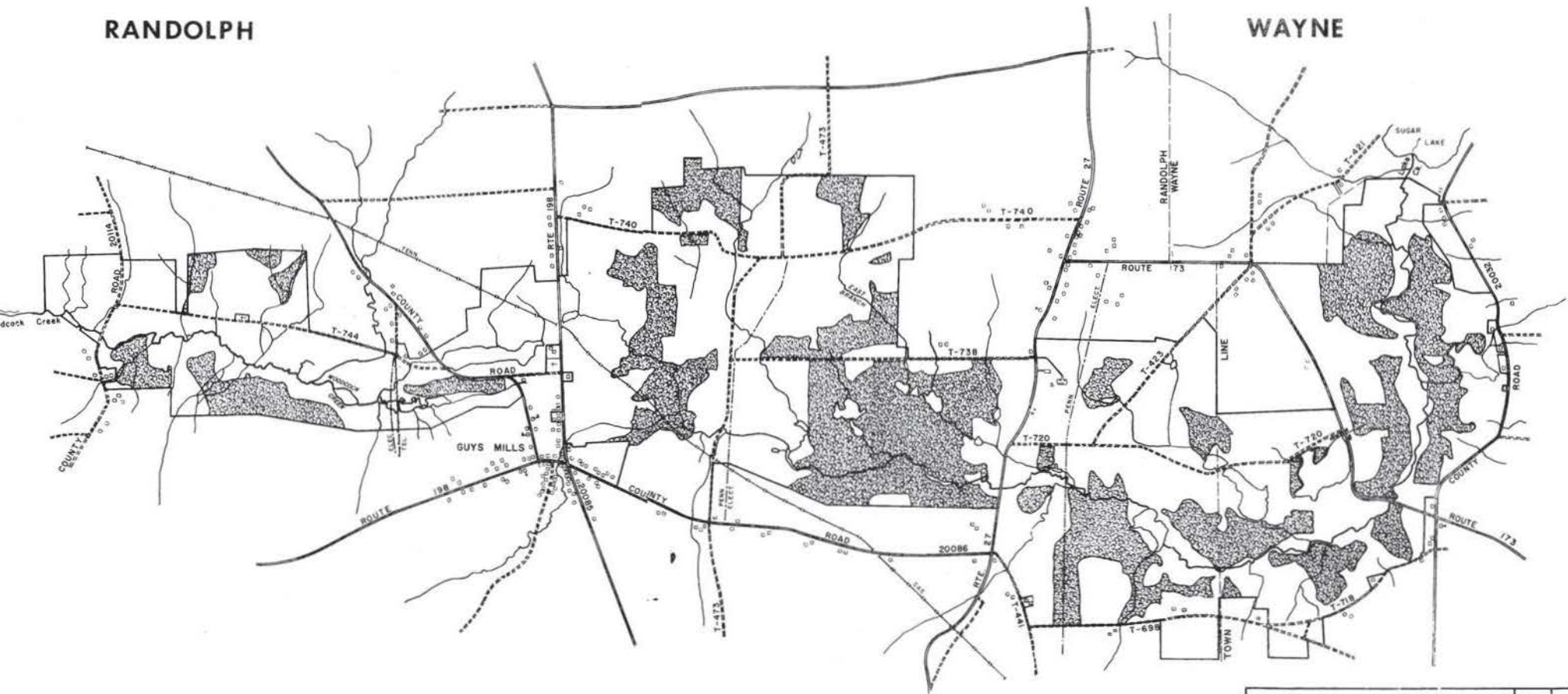
- LEGEND**
- /// LAND IN UNITED STATES TITLE
  - LAND UNDER OPTION
  - ==== LAND PROPOSED FOR ANNEXATION
  - BITUMINOUS ROAD
  - GRAVEL ROAD

REVISIONS		DATE	BY
UNITED STATES DEPARTMENT OF THE INTERIOR FISH AND WILDLIFE SERVICE BUREAU OF SPORT FISHERIES AND WILDLIFE BRANCH OF ENGINEERING			
SUBMITTED:	REGIONAL ENG. ERIE NATIONAL WILDLIFE REFUGE		
REVIEWED:	CRAWFORD COUNTY PENNSYLVANIA		
MASTER DEVELOPMENT PLAN			
LAND STATUS			
REGIONAL DIRECTOR	COMPILED: RWA, J.C.D.	DRAWN: R.D.	CHECKED: RWA
W.D. APPROVAL: DATE:	DATE: JULY 1966	DWG NO: 5R-Pg-523-2.0	





WAYNE



1000 500 0 1000 1000 3000 4000

SCALE IN FEET

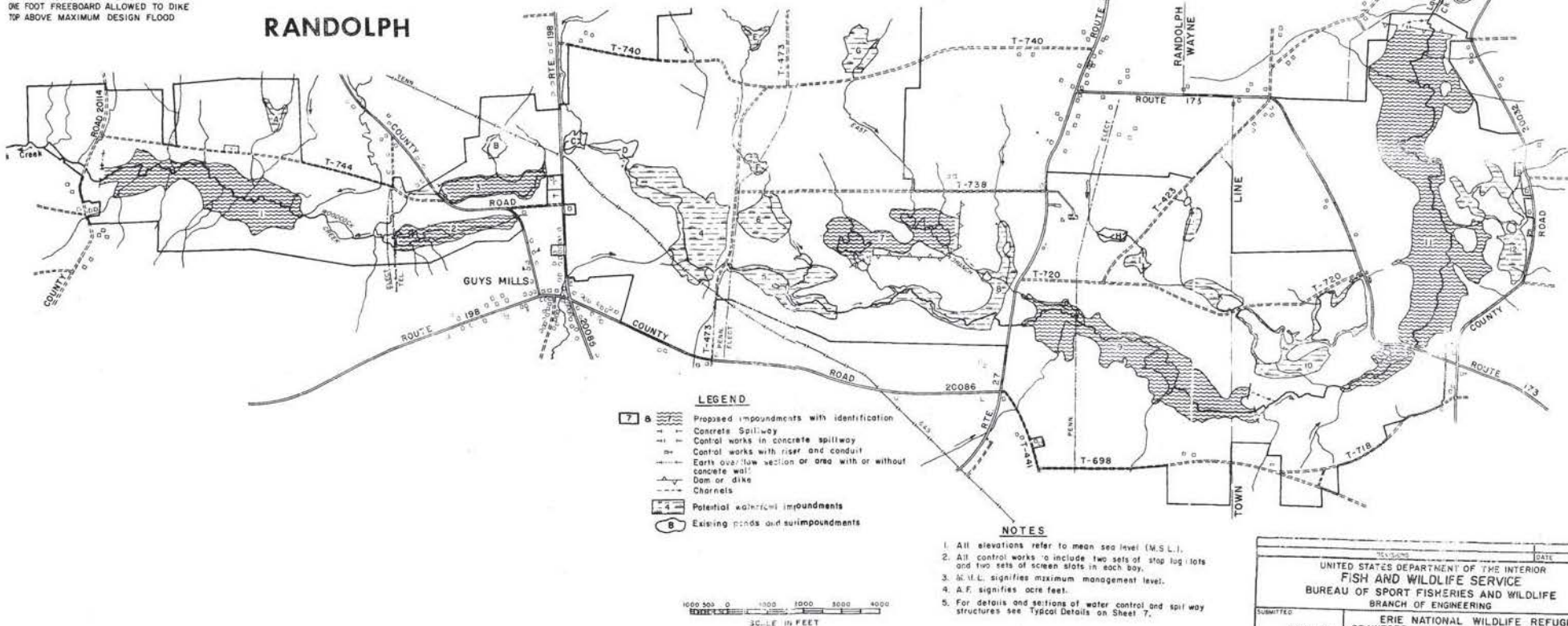
Existing woodland 1960

REVISIONS		DATE	BY
UNITED STATES DEPARTMENT OF THE INTERIOR FISH AND WILDLIFE SERVICE BUREAU OF SPORT FISHERIES AND WILDLIFE BRANCH OF ENGINEERING			
SUBMITTED	ERIE NATIONAL WILDLIFE REFUGE		
REGIONAL EXAM.	CRAWFORD COUNTY PENNSYLVANIA		
REVIEWED	MASTER DEVELOPMENT PLAN		
REG. REPLY NEEDED	WOODLANDS		
REGIONAL DIRECTOR	COMPILED R.W.A. J.C.D.	DRAWN R.D.	CHECKED R.W.A.
W.D. APPROVAL DATE	DATE: JULY 1966	DWG NO:	SR-Pa-523-20



POOL	MAXIMUM MGMT LEVEL (MML) ELEV.	POOL AREA AT MML ACRES	POOL CAPACITY AT MML ACRE FEET	TOP EARTH DIKE ELEV.	CONCRETE SPILLWAY			EARTH OVERFLOW SECTION			CONTROL WORKS						POOL
					CREST	LENGTH		TOP OR CHST. ELEV.	CONCRETE WALL CREST	WIDTH	LOCATION AND TYPE	STOP LOG BAYS & SCREENS NO. BAYS	TOP STRUCTURE ELEV.	FLOOR ELEV.	CONDUIT SIZE AND TYPE	ACCESS CATAWALL TYPE	
1	1328.0	110	310	13336	1328.0	150		1329.5	YES	200	SPILLWAY	2	1333.6	13175	NONE	ALUM.	1
2	1338.0	30	40	1341.0	1338.0	28					RC RISER	1	1340.0	13330	30" RC PIPE	NONE	2
3	1343.0	30	75	1346.0	1343.0	32					RC RISER	1	1345.0	13390	30" RC PIPE	NONE	3
4	1336.0	90	385	1341.0	1336.0	120					SPILLWAY	2	1341.0	13220	NONE	ALUM.	4
5	1321.0	40	90	1326.0	1321.0	175					SPILLWAY	1	1326.0	13140	NONE	ALUM.	5
6	1332.0	30	75	1336.0	1332.0	100					RC RISER	1	1334.0	13220	4" RC BOX	NONE	6
7	1324.0	60	115	1328.0	1324.0	43	1325.5	YES	150		RC RISER RC RISER	1 1	1328.0 1326.0	13175 13160	30" RC PIPE 30" RC PIPE	NONE NONE	7
8	1313.0	55	205	1318.0	1313.0	210					RC RISER RC RISER	1 1	1315.0 1315.0	13030 13030	4" RC BOX 4" RC BOX	NONE NONE	8
9	1303.0	135	340	1308.2	1303.0	160	1304.5	YES	300		SPILLWAY	2	1308.2	12960	NONE	ALUM.	9
10	1302.0	75	200	1305.5	1302.0	90	1305.3	YES	160		RC RISER RC RISER	1 1	1304.0 1304.0	12960 12960	30" RC PIPE 30" RC PIPE	NONE NONE	10
11	1293.0	275	600	1298.0	1293.0	365					SPILLWAY	3	1298.0	12880	NONE	ALUM.	11
12	1302.0	50	185	1305.6	1302.0	40	1303.6	YES	250		RC RISER	1	1304.0	12960	36" RC PIPE	NONE	12

## RANDOLPH



POND	COLLECTOR DRAINWAY		EAST		WEST		FLOOR		CEILING		SLOPE	TYPE
	LENGTH	DRAIN AT	LENGTH	DRAIN AT	FEET	FEET	FEET	FEET	FEET	FEET		
ABCD	FEET	—	34	AT MML	35	1	25	30	36" RC	PP		
I,X	33	YES	80	2.5	50	1	25	40	36" RC <td>PP</td>	PP		
E,F	40	YES	125	2.5	50	1	25	40	36" RC <td>PP</td>	PP		



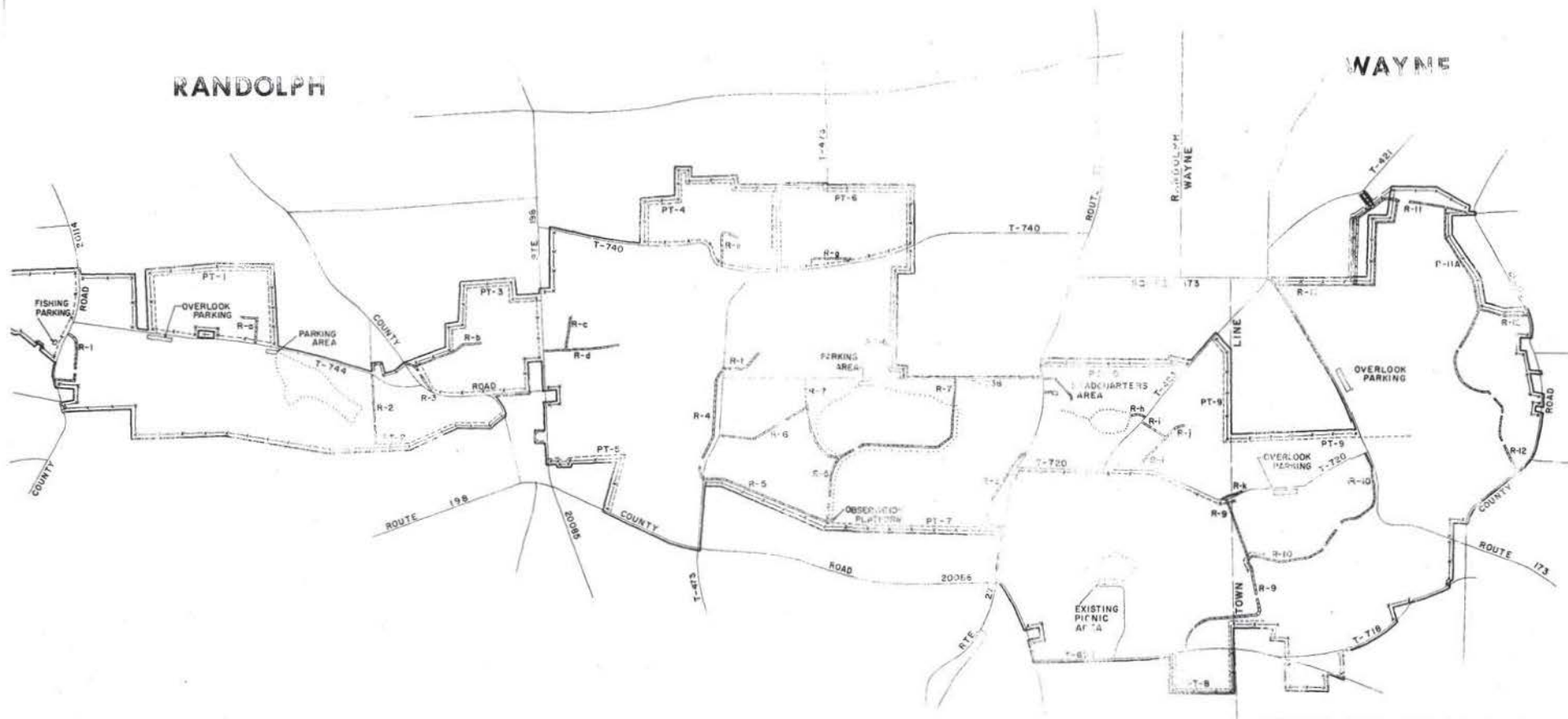
## NOTES

1. All elevations refer to mean sea level (M.S.L.).
2. All control works include two sets of stop log slots and two sets of screen slots in each bay.
3. M.M.L. signifies maximum management level.
4. A.F. signifies acre feet.
5. For details and sections of water control and spill way structures see Typical Details on Sheet 7.

TELEPHONE		DATE	BY
UNITED STATES DEPARTMENT OF THE INTERIOR			
FISH AND WILDLIFE SERVICE			
BUREAU OF SPORT FISHERIES AND WILDLIFE			
BRANCH OF ENGINEERING			
SUBMITTED	ERIE NATIONAL WILDLIFE REFUGE		
REGIONAL ENGR.	CRAWFORD COUNTY PENNSYLVANIA		
REVIEWED	MASTER DEVELOPMENT PLAN		
REC. INFO. SUPP.			
RECOMMENDED			
REGIONAL DIRECTOR	IMPOUNDMENTS		
W.D. APPROVAL	DATE	COMPILED RWA, J.C.D.	DRAWN R.D. CHECKED RWA
	JULY 1966		38-Pg. 523-2.0

RANDOLPH

WAYNE



**NOTES**

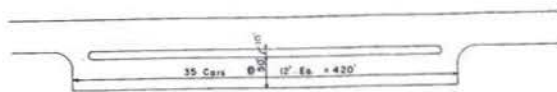
For sections of roads and parking areas see Typical Details on Sheet 7.



**LEGEND**

- PROPOSED GRAVEL ACCESS ROAD
- PROPOSED PATROL TRAIL
- PROPOSED NATURE TRAIL
- PROPOSED BOUNDARY FENCE
- PROPOSED GRAZING FENCE
- EXISTING PUBLIC ROAD

REVISIONS		DATE	BY
UNITED STATES DEPARTMENT OF THE INTERIOR FISH AND WILDLIFE SERVICE BUREAU OF SPORT FISHERIES AND WILDLIFE BRANCH OF ENGINEERING			
SUBMITTED:		ERIE NATIONAL WILDLIFE REFUGE CRAWFORD COUNTY PENNSYLVANIA	
DESIGNED:		MASTER DEVELOPMENT PLAN	
CHECKED:		ROADS, TRAILS, & FENCES	
DRAWN:		COMPILED BY: RWA, JCO	
DATE:		JULY 1966	CHECKED BY: RWA
SCALE:		5R-Pg-513-2.0	



### DETAIL OF OVERLOOK PARKING

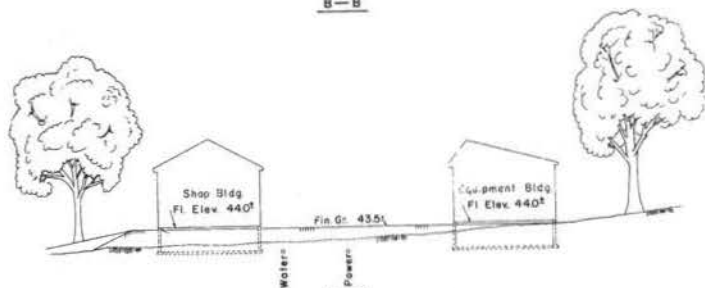
Overlook Parking area for 35 cars = 42' x 100'  
 Nature Parking area for 10 cars = 18' x 100'  
 Fishing Parking area is for 10 cars = 15' x 50'



A-A

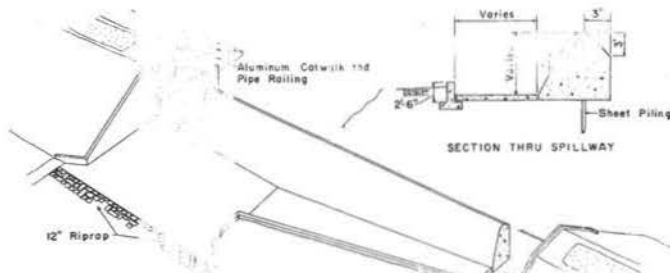


B-B



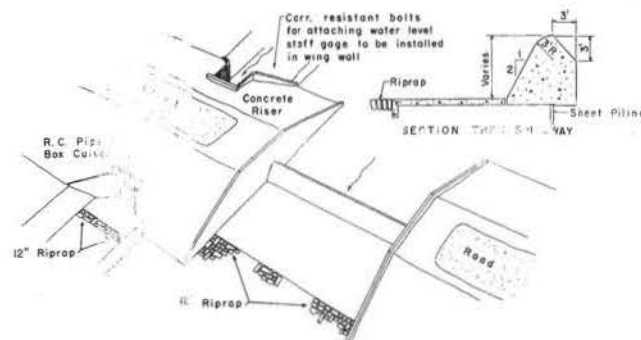
C-C

### SECTIONS THRU HEADQUARTERS SITE



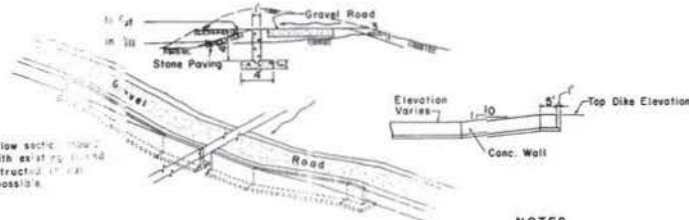
### CONCRETE SPILLWAY

AND CONTROL WORKS IN SPILLWAY



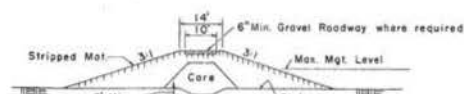
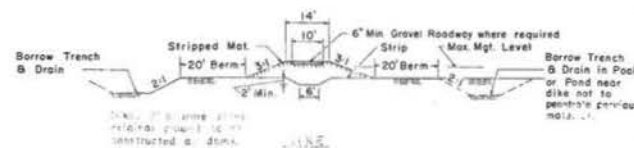
### CONCRETE SPILLWAY

WITH SEPARATE CONTROL WORKS

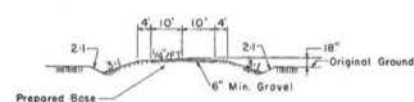


### EARTH OVERFLOW SECTION

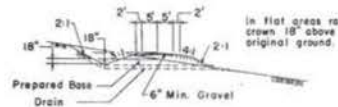
(WITH CONCRETE WALL)



### DAM



### ENTRANCE ROAD TO HEADQUARTERS & VISITOR CENTER



### ACCESS ROAD

### PROPOSED CROSS SECTIONS

### NOTES

1. For index see Sheet 1.
2. For location of sections, access roads, visitors entrance road, and parking areas see Sheets 6 & 8.
3. For location of water impoundments and appurtenant structures see Sheet 5.
4. Corrosion resistant bolts for attaching water level staff gage and bronze tablets for bench marks are to be installed in control works for all impoundments.

REVISIONS		DATE	BY
UNITED STATES DEPARTMENT OF THE INTERIOR FISH AND WILDLIFE SERVICE BUREAU OF SPORT FISHERIES AND WILDLIFE BRANCH OF ENGINEERING			
SUBMITTED:	REGIONAL ENGINEER	ERIE NATIONAL WILDLIFE REFUGE CRAWFORD COUNTY PENNSYLVANIA	
REVIEWED:	REGIONAL ENGINEER	MASTER DEVELOPMENT PLAN	
RECOMMENDED:	REGIONAL ENGINEER	TYPICAL DETAILS	
APPROVED:	REGIONAL ENGINEER	CAMPBELL: J. H. J. C. D.	GRAND: R. D.
DATE:	JULY 1956	DATE:	SR-Ps-523-2.0

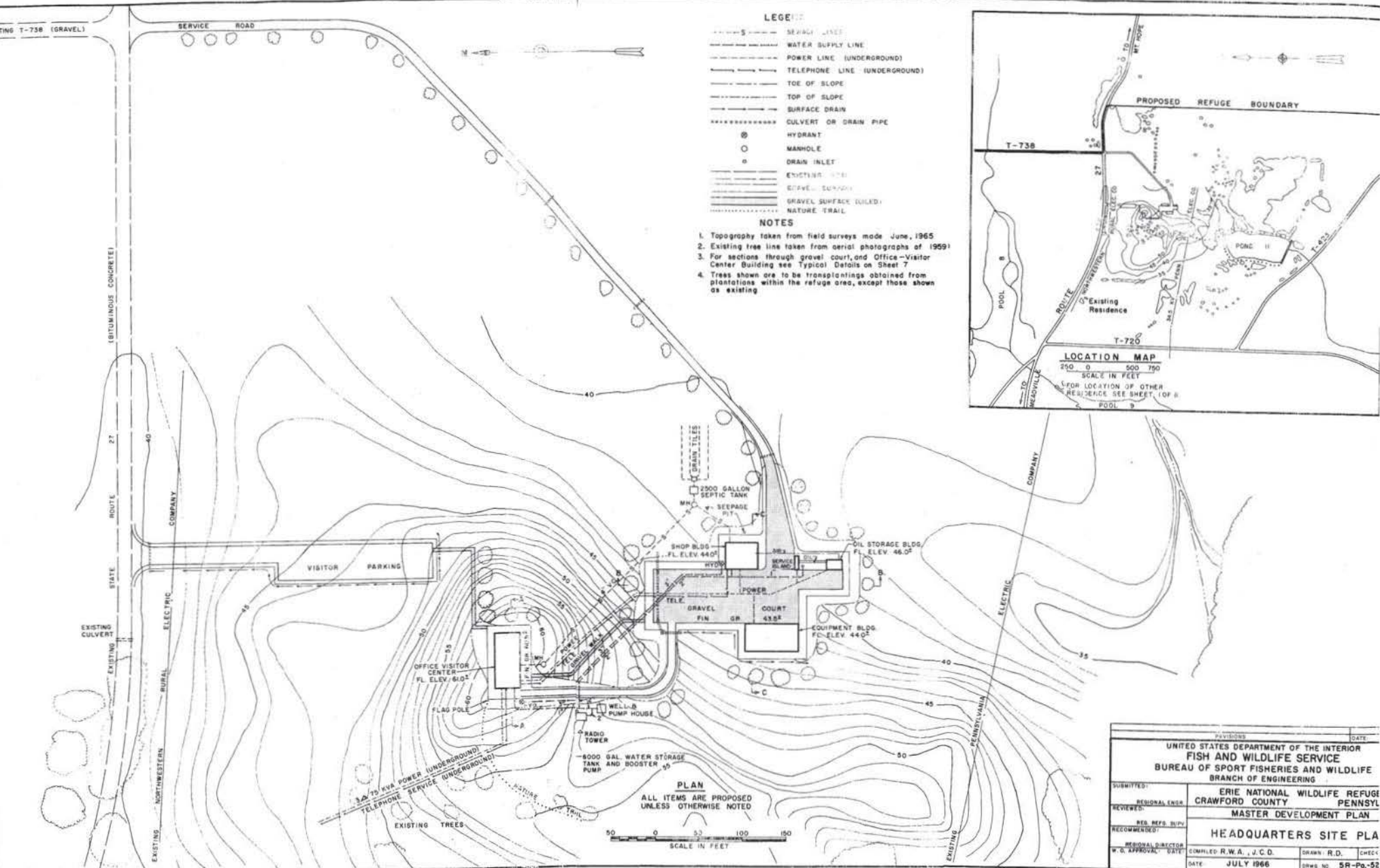
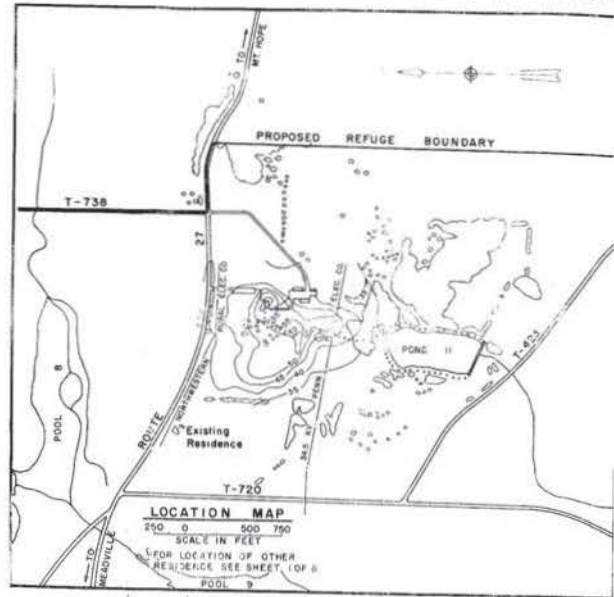


# LEGEND

- 5 --- SEWAGE LINE
- WATER SUPPLY LINE
- POWER LINE (UNDERGROUND)
- TELEPHONE LINE (UNDERGROUND)
- TOE OF SLOPE
- TOP OF SLOPE
- SURFACE DRAIN
- \*\*\*\*\* CULVERT OR DRAIN PIPE
- HYDRANT
- MANHOLE
- DRAIN INLET
- EXISTING ROAD
- GRAVEL SURFACE
- GRAVEL SURFACE (DUL)
- NATURE TRAIL

## NOTES

1. Topography taken from field surveys made June, 1965
2. Existing tree line taken from aerial photographs of 1959
3. For sections through gravel court, and Office-Visitor Center Building see Typical Details on Sheet 7
4. Trees shown are to be transplantings obtained from plantations within the refuge area, except those shown as existing



PAYMENTS		DATE
UNITED STATES DEPARTMENT OF THE INTERIOR FISH AND WILDLIFE SERVICE BUREAU OF SPORT FISHERIES AND WILDLIFE BRANCH OF ENGINEERING		
SUBMITTED:	REGIONAL ENGINEER	ERIE NATIONAL WILDLIFE REFUGE CRAWFORD COUNTY MASTER DEVELOPMENT PLAN
REVIEWED:	REGIONAL DIRECTOR	HEADQUARTERS SITE PLAN
RECOMMENDED:	REGIONAL DIRECTOR	
W.C. APPROVAL:	DATE	COMPILED R.W.A., J.C.D. JULY 1966
		DRAWN R.D. 5R-Pa-52

Created in 1849, the Department of the Interior - America's Department of Natural Resources - is concerned with the management, conservation, and development of the Nation's water, wildlife, mineral, forest, and park and recreational resources. It also has major responsibilities for Indian and Territorial affairs.

As the Nation's principal conservation agency, the Department works to assure that nonrenewable resources are developed and used wisely, that park and recreational resources are conserved for the future, and that renewable resources make their full contribution to the progress, prosperity, and security of the United States - now and in the future.

This administrative plan proposed and prepared by the Bureau of Sport Fisheries and Wildlife's Northeastern Region, Boston, Massachusetts supports and furthers the high objectives of the Department of the Interior for the wise development, management and use of the lands, waters and resources of the National Wildlife Refuge System.

Richard E. Griffith  
Regional Director