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REPORT NO. 1052

MINNOW PROPAGATION PROGRAM FOR 1946

by

George N. Washburn

As a result of the increasing scarcity of bait minnows in Michigan waters and in conjunction with the studies under way at Minnesota and Wisconsin, the Institute For Fisheries Research has undertaken a thorough investigation of the bait minnow problem placing special emphasis upon the culture of certain desirable species.

Research for the current year in bait minnow culture involves the partial use of seven fish rearing plants, namely: Wolf Lake Hatchery, Van Buren County; Almena Rearing Station, Van Buren County; Hastings Hatchery, Barry County; Comstock Hatchery, Kent County; Drayton Plains Hatchery, Oakland County; Harrisville Hatchery, Alcona County; and the Northville Federal Fish Hatchery in Wayne County. (See Plate VIII for distribution and location.)

A total of 31 ponds having a combined surface area of 45.89 acres located at the above mentioned plants are being utilized for the intensive research on bait minnows. Further, five species of minnows, namely: creek chub, common sucker, golden shiner, northern fine scale dace, and the northern pearl dace are being studied as to the methods of propagation, growth, and production per unit of water.

In the text of this report, the work to date for each species involved in the study is presented under a separate heading.

Creek Chub Culture

A total of 13 ponds, eight at the Hastings Hatchery (see Plate I) and five at the Drayton Plains Hatchery (Plate II) have been devoted to the experimentation of creek chub culture.

At Drayton Plains ponds number one and two are being used to hold the adult fish. Ponds three and four are utilized in production and fertilization experiments and pond number five as a spawning area.

At the Hastings plant the eight ponds are being used for fertilization and production experiments.

Propagation of the Creek Chub.-- Pond number five at the Drayton Plains Hatchery was altered by the installation of a spawning race. The detail of construction of this raceway was as follows: Commencing at the inlet and extending along the margin towards the outlet, a ditch 295 feet long, six feet wide, and eight inches deep was dug. The excavation material was piled along the sides to form banks. At intervals of 20 feet along the race, offset pits, five feet long, two and one-half feet wide and two feet deep were prepared. These pits (see Figure A) were later covered with asphaltum paper, the purpose to offer shelter for the spawning fish. Also, on the main channel at each pit location a splash board was installed of sufficient height to create a small riffle area in the stream.

The next phase of construction was the graveling of the raceway. Gravel (one-fourth and three-fourths inches in diameter evenly proportioned) was spread over the entire race to a depth of five inches.

To offer protection for the breeding fish from predaceous birds, the entire spawning race was covered with netting (see Figure A) suspended above the stream by supporting stakes.

When the race was completed the inlet valve was opened and a flow of water approximating one foot per second was allowed to flow continuously over the area. Splash boards were installed in the pond outlet of a height just sufficient to raise the water level to a point even with the lowest portion of the spawning race (see Figure B).

On April 16, a total of 426 adult chubs, 262 females, and 164 males, were introduced into the pond. These breeders were of a mixed lot consisting of two- to four-year-old fish ranging in lengths of three to seven inches for the females and four to ten inches for the males. Six days after the introduction, spawning activity was observed, beginning at the lower end of the race and progressing with increased intensity, day by day, up stream. At favorable water temperatures, 51°F. to 60°F., spawning activity occurs for 24 hours per day. At temperatures lower than 51° F. spawning activity ceases. Observations made from time to time show that males will prepare beds at least five inches deep, further, groups of males have tendencies to concentrate together in certain areas. It was also noted that the larger (usually older) fish were the first to spawn. The total spawning period in this raceway lasted for 29 days. Normally, it undoubtedly would have been much shorter if periodic low water temperatures had not been encountered.

During the latter part of April, eggs were removed from several beds, by the use of a screen trap, and placed in hatchery jars. The process of removing eggs from nests was repeated until sac fry began appearing in the gravel at which time the operation was stopped to prevent injury to the fry and a subsequent loss in production. During the egg removal process it was estimated that about 25 per cent of the eggs were destroyed by rupture during the shifting of the gravel.

On May 21 the entire stock of breeders was removed from the pond and a fry screen installed in the outlet. Counts of the breeders

showed a loss of 40 per cent of the males and 15 per cent of the females. This was to be expected as much fighting occurs among the male population, and dead fish were occasionally noted in the pond. From past experience, the writer has observed that usually one can expect about a 50 per cent loss in male fish.

On May 27, the outlet valve was closed and the pond allowed to fill completely, immersing the spawning race. It required about two days to accomplish this task at the end of which time the inlet valve was reduced to a point where the incoming flow of water was just sufficient to maintain a constant level. Free swimming fry ranging from 10 to 21 millimeters were very abundant along the shores by June 1.

Hatchery Jar Culture of Creek Chub Eggs.-- As mentioned in one of the preceding paragraphs, eggs were removed from nests on several occasions and placed in hatchery jars. It requires from six to eight days at an average temperature of 54° F. for the eggs to become eyed, at this stage the eye does not contain any pigmentation, but the embryo within assumes a deep orange color. As soon as a few fry begin to hatch in the jars, the eggs are then transferred to screen bottom trays placed in standard hatchery troughs containing running water. The screen on these trays were of the 14 X 18 mesh size, allowing the retention of eggs and the passing through of the sac fry. It required from two to four days for the eyed eggs to become completely hatched--a total incubation period of 8 to 12 days.

The fry, golden in appearance, react negatively to light and remain in small clumps on the bottom of the trough. After a period of two or three days dark pigmentation appears in the eyes and the fry become much more active. In another 10 to 14 days, lateral bands of pigment have appeared on the sides of the fry and they become free swimming; the yolk sac by this time has been almost completely absorbed.

Hatching of chub eggs by this method is quite successful as indicated by our data on several lots. Thirty-one ounces of eggs (count 120,000 to 130,000 per quart) produced 24 ounces of eyed eggs representing a 77 per cent survival; 35 ounces of eggs produced 28 ounces eyed or 80 per cent survival; 32 ounces of eggs produced 23 ounces of eyed eggs representing a 72 per cent survival. It was noted also, that once the eggs become eyed very little loss occurred at later dates.

Transfer of Fry in Stocking Ponds

By experimentation it was found that six-to ten-day-old sac fry could be safely transported long distances in 10-gallon fish cans. On May 7 about 530 c.c. of fry (180 fry per c.c.) representing about 95,000 fry were transferred, at the rate of 12,000 per can, to Hastings Hatchery, a distance of 110 miles with no appreciable loss. The water temperature in the transport cans was in the middle fifties during the three hour transfer period.

On May 13 an additional 115,000 (same age as above) sac fry were transferred by the same means to the Hastings Hatchery with no loss.

As yet, no attempt has been made to transport advanced fry any distance, but it will be tried in the near future. A recent transfer of fry at this stage locally, at the Drayton Plains Hatchery, indicates that no difficulty will be encountered.

Stocking of Ponds

Hastings Hatchery.-- The eight ponds at this hatchery were grouped into four pairs, each pair mated on the basis of size, water supply, and control (see Plate I). Presented below in tabular form is the stocking rate for the ponds mentioned above.

Pond number	Area in acres	Stocking rate per acre	Total stocking	Fertilizer added (lbs. of manure)
5	2.11	10,000	21,100	2,580
12	1.50	10,000	15,000	...
7	1.11	25,000	27,750	...
11	1.25	25,000	31,750	1,530
8	.98	35,000	34,300	1,200
10	1.00	35,000	35,000	...
2	.46	44,000	21,000	635
6	.56	44,000	25,000	...
Total	8.97		210,900	5,945

As noted in the above table, barnyard manure has been added to four of the ponds at the rate of a little over 1,200 pounds per acre. This fertilizer was added during the first week in April and is to be followed up during the summer months with applications of commercial fertilizer. Ponds which are being used in the fertilization experiment have the outlets closed and the incoming supply regulated to maintain a constant level. Dr. Robert Ball of the Institute staff is supervising this experimentation. Our tentative objective is to determine if pond fertilization is a practical means of increasing pond productivity in terms of increased minnow production.

Drayton Plains Hatchery.-- Mentioned in a preceding paragraph, ponds 1, 2, and 5 (see Plate II) are being used for holding ponds for brood stock and as a spawning area. The only ponds used in the production experiment are numbers three and four. Both ponds were stocked at the same rate (20,000) per acre. Pond three, with a surface area of .89 acres was stocked with 17,800 advanced fry. Pond four, a surface area of .77 acres was stocked with 15,400 advanced fry. Pond three is to be fertilized this season and pond four is to act as a control.

The advanced fry for stocking ponds three and four were obtained directly from the spawning race in pond five. In order to accurately determine the number of fry for stocking, individual fry counts had to

be made. This task was accomplished by scapping the fry from pond five into a small container and then by the aid of a tablespoon making the actual count. After a little practice one can easily count several thousand fry per hour. The fry proved to be quite hardy both in netting and counting as indicated by a very low mortality occurring in the counting pans.

Remarks.-- In creek chub propagation, it appears that successful reproduction can be produced in controlled conditions; that eggs can be removed from beds and cultured in jars with a high degree of success. Also, the natural spawning of chubs and the incubation of eggs appears to be a practical means of culture. At present we have no way of determining the actual number of fry present in pond number 5 at Drayton Plains but would estimate it at about 150,000.

It is planned for another year to alter the present method of propagation by developing techniques in stripping ripe fish and the general follow up for the incubation period.

Sucker Culture Experiments

A total of 15 ponds, eight at the Wolf Lake Hatchery (Plate III); two each at the Harrisville and Comstock Hatcheries (Plates IV and V) and one each at the Hastings, Northville, and Almena Hatcheries (Plates I, VI and VII respectively) are being used in sucker studies.

Sucker Propagation.-- Fertile sucker eggs were picked up at Silver Lake in Kent County, Michigan by Mr. Claude Lydell, District Fisheries Supervisor, and crew, commencing on April 10, 1946 and continuing for one week. These eggs were scapped up along the gravelly wind swept shores of the lake where a population of suckers spawn. The eggs were then transported to the Comstock Hatchery and placed in jars. Mr. Lydell supervised all operations during the incubation of these eggs and the information presented in the following paragraph are taken from his records.

A total of 201 quarts of eggs was removed from Silver Lake and placed in hatchery jars at the rate of about two quarts of eggs per jar. When the eggs became eyed and were ready for transfer a remeasurement of the volume showed a loss of 101 quarts representing 50 per cent of the original amount. At water temperatures ranging in the low fifties it required from eight to twelve days for the eggs to become eyed. At the first indications of hatching the eggs were transferred to trays placed beforehand in each of the ponds to be stocked.

These trays, constructed of 14 x 18 wire screen bottom and sides, were two feet square and six inches deep. They were equipped with legs and immersed about one foot under water in depths of about two feet. From one to two quarts of eggs (30,000 per quart) were placed in each tray. Within a few days the eggs had hatched out and the fry (not according to our plans) escaped through the screen sides and bottoms of the trays. The principle in constructing these trays was to provide a haven for the sac fry until they became free swimming and capable of taking care of themselves, as indications from past experiences tend to lead one to believe that a heavy mortality occurs during the sac fry stage when the fry are subjected to unfavorable types of pond bottoms.

After an elapse of six to eight days after planting of the eyed eggs, the free swimming fry begin to appear on the surface of the stocked ponds.

In the transfer of eyed eggs, it was found that at low temperatures (46° F. to 56° F.) no appreciable loss would be encountered, even at long distances, 200 miles or more. The eggs were carried in 10-gallon fish cans and on two occasions in a five-foot metal stock tank. Usually one to two quarts of eggs were carried in a 10-gallon can about two-thirds full of water.

Free swimming fry were also transported for distances up to 150 miles in 10-gallon cans with success. Usually about 7,000 to 10,000 fry were carried in each 10-gallon can.

Stocking of Ponds

Wolf Lake Hatchery.-- The eight ponds (see Plate III) were divided into four pairs, each pair being comparable in size, depth and water supply, and further, each pair was stocked at the same rate per acre. In addition, one pond in each pair was fertilized and is to be managed in the same way as those at the Hastings Hatchery. Presented below in tabular form are the stocking data for the ponds located at Wolf Lake.

Pond number	Area in acres	Stocking rate per acre (eyed eggs)	Total stocking (eyed eggs)+/	Fertilizer added (lbs. of manure)++/
7	1.54	10,000	15,400	2,040
11	1.29	10,000	12,900	...
12	1.78	25,000	44,500	2,360
10	1.47	25,000	36,750	...
9	1.72	50,000	86,000	2,280
17	1.27	50,000	63,500	...
4	.98	100,000	98,000	1,296
5	1.04	100,000	104,000	...
Total	11.09		461,050	7,976

Recent observations in the above ponds indicate that a better hatch of eyed eggs occurred in some ponds than others. As we know that the sac fry escaped from the trays, a different rate of survival is to be expected as some ponds have a soft mucky bottom while others consist of sand. When the ponds are drawn this fall, we should be able to interpret and evaluate the success of hatching in relation to the bottom types of specific ponds.

Harrisville Hatchery.-- Only two ponds, numbers 6 and 7 (see Plate IV)

+/ The eyed eggs were placed in Wolf Lake ponds on April 20, 1946.

++/ It is planned to apply commercial fertilizer to these ponds during the summer. Dr. Robert Ball is in charge of this program.

were used at this plant. Both ponds were fertilized with barnyard manure at the rate of 500 pounds per acre, initial application, and 150 pounds per acre each week following for five consecutive weeks. The first application was made during the fore part of April. The fertilization program will be continued throughout the summer substituting commercial fertilizer for the manure.

These two ponds have an area of about one acre each and were stocked at the rate of 10,000 eyed eggs for pond number 6 and 20,000 for number seven. The objective of this project is to determine the relative growth and survival at different stocking rates in fertilized ponds in the northern part of the lower peninsula. Both ponds were stocked on Friday April 26, 1946 by A. S. Hazzard. The eyed eggs had previously been transported from Comstock Hatchery to Drayton Plains and then to Harrisville, the latter trip covering a distance of over 200 miles. According to Mr. J. Southwick, District Fisheries Supervisor of the Harrisville Hatchery, the loss in eyed eggs was only moderate. (He estimated a 50 per cent hatch in each pond.)

Comstock Hatchery.-- Two ponds were set aside for sucker experimentation. Pond number 6 (see Plate V) having an area of .13 acres was stocked with six quarts of eyed eggs and pond number 14, .41 acres in area, was stocked with 12 quarts of eggs. These ponds were stocked for experimental work in fry removal and are not included as part of the production program. On two occasions, May 4 and again on the 15th, advanced fry were netted from these ponds and transported in 10-gallon cans for distances up to 150 miles. It was noted during these operations that very little loss in the fry was encountered during transport. There was however an appreciable loss of fry during the netting operation. On May 4, it was estimated that about 15 per cent of the fry netted died of injury and on May 15, a loss of 25 per cent was encountered. The fry

appear to be very fragile and an exposure to the air of only a few seconds duration usually proves to be fatal. In netting the fry are very limp and tend to adhere to the net material and are only removed by excessive washing. It is planned to attempt a removal and transfer at least once more this summer of the fry from these two ponds.

Northville Hatchery.-- Only one pond, number A (see Plate VI) was used at this plant. This pond has an area of about one-third acre. It was stocked with 7,500 advanced sucker fry on May 4, 1946. The purpose of this project is to determine the success in survival in stocking with free swimming sucker fry.

Hastings Hatchery.-- Only one pond was used for the sucker experiment, pond number 9 having a surface area of 4.40 acres. This pond was stocked with eyed eggs on April 24 at the rate of 50,000 per acre or a total of 220,000 eyed eggs. The principal objective is to check on seasonal growth and survival.

Almena Rearing Station.-- Pond number one (see Plate VII), of 12 acre pond size, was stocked on April 23 at the rate of 50,000 per acre or a total stocking of 600,000 eyed eggs. The principal objective is to determine production.

Private Ponds.-- The state has furnished three individuals with eyed sucker eggs (total 7 quarts) for experimentation in the rearing of bait minnows. By cooperating with the individuals it is hoped that some additional production figures can be obtained as well as stimulating the public to interest in this type of fish farming.

Contemplated Culture of Other Species

In pond number four at the Hastings Hatchery, 100 pair of adult golden shiners (3 to 6 inches long) were introduced during the fore part of April. Pond number four has an area of .96 acres and some production and growth records are hoped for. This pond will be drawn

in the fall and the production calculated.

Two ponds at the Comstock Hatchery, number 3 with an area of .32 acres and number 5, .29 acres, have been set aside for the experimentations in the propagation of the fine scale dace, Pfrille neogaea and the northern pearl dace, Margariscus margarita natchtriebi. Due to a lack of time in preparation we were unable to secure the brook stock for this season but plan to collect the specimens during the summer and be ready for operation in another year.

Observations and Collection of Data during the Current Investigation

Tentatively it is planned to check each pond under intensive study about once every two weeks, at which time a random sample of minnows will be netted and an aliquot portion measured for lengths. Further, periodic observations will be made as to the behavior of these fish being studied. Also, at least once a day the temperature will be recorded for one pond in a series at each hatchery. It is also planned to use some ponds (not under intensive study) like the Almena Pond for grading experiments. This will involve the periodic removal of saleable fish by means of grading according to specific lengths. In all cases accurate records will be kept as to the number removed from time to time.

For the ponds under intensive study each pair will be drawn at the same time and the production data secured. Also, at certain plants the cost of operation for minnow production will be calculated.

INSTITUTE FOR FISHERIES RESEARCH

by George N. Washburn

Report approved by A. S. Hazzard

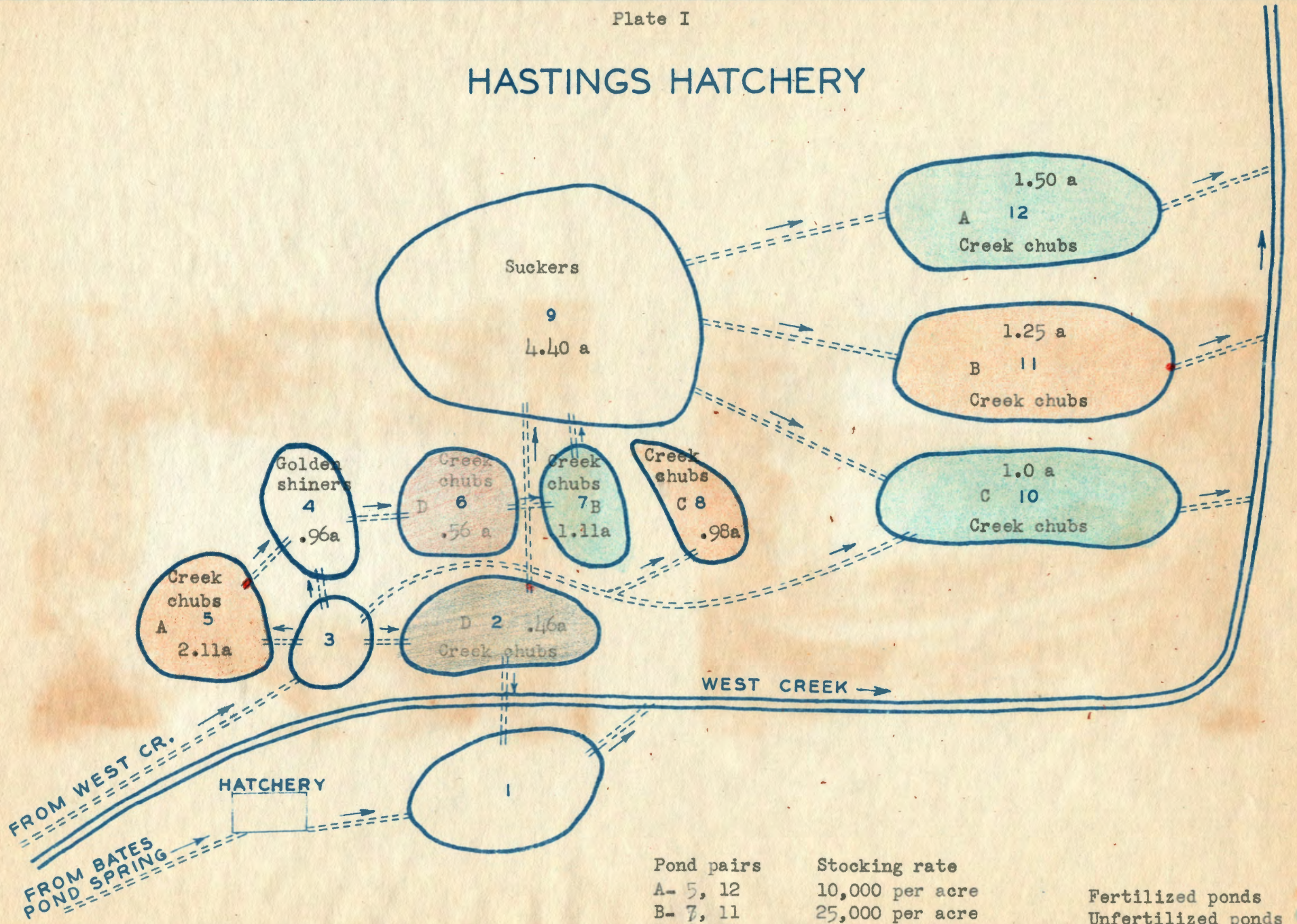
Report typed by M. A. Klaphaak

Figure A

Figure B

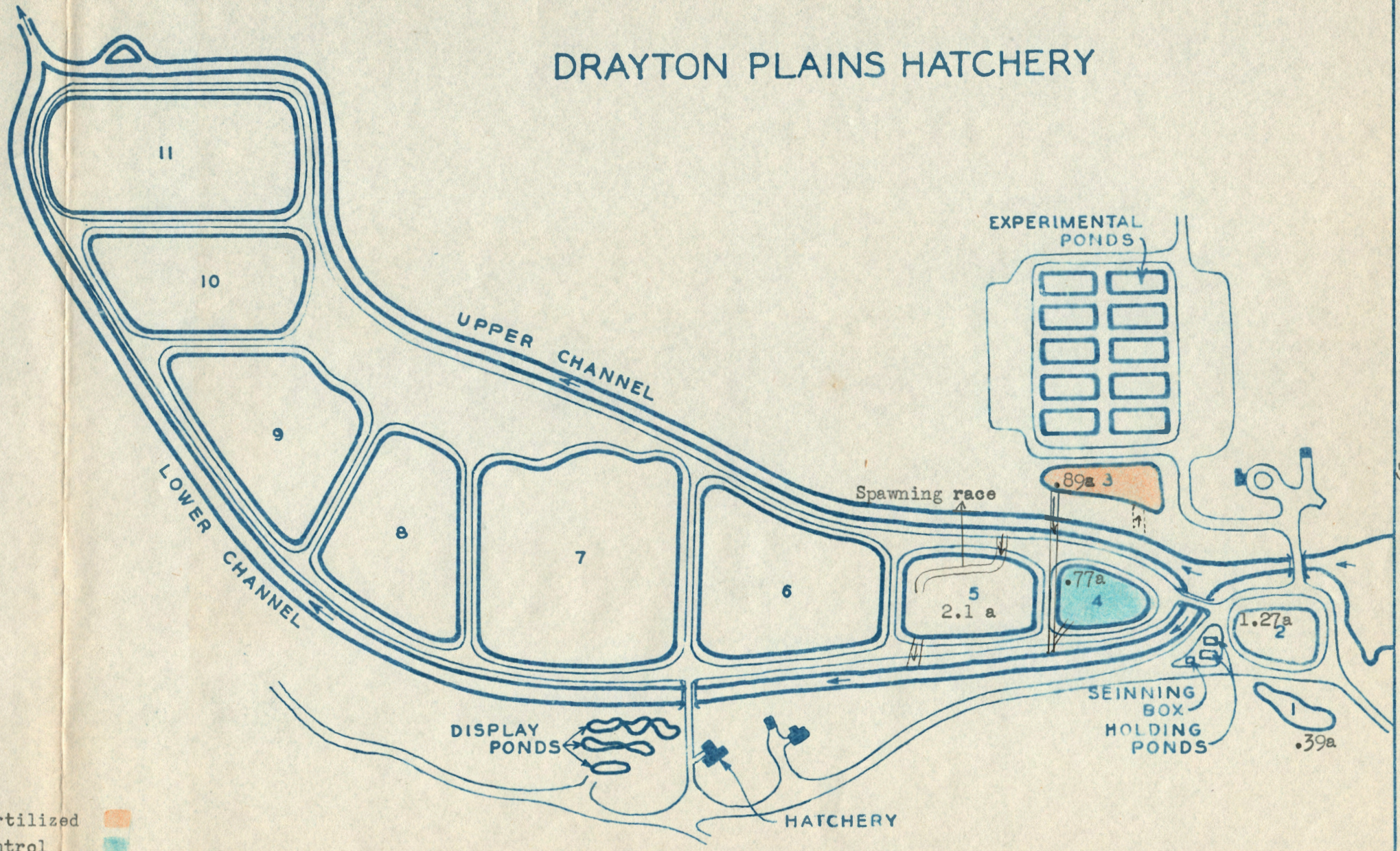
Plate I

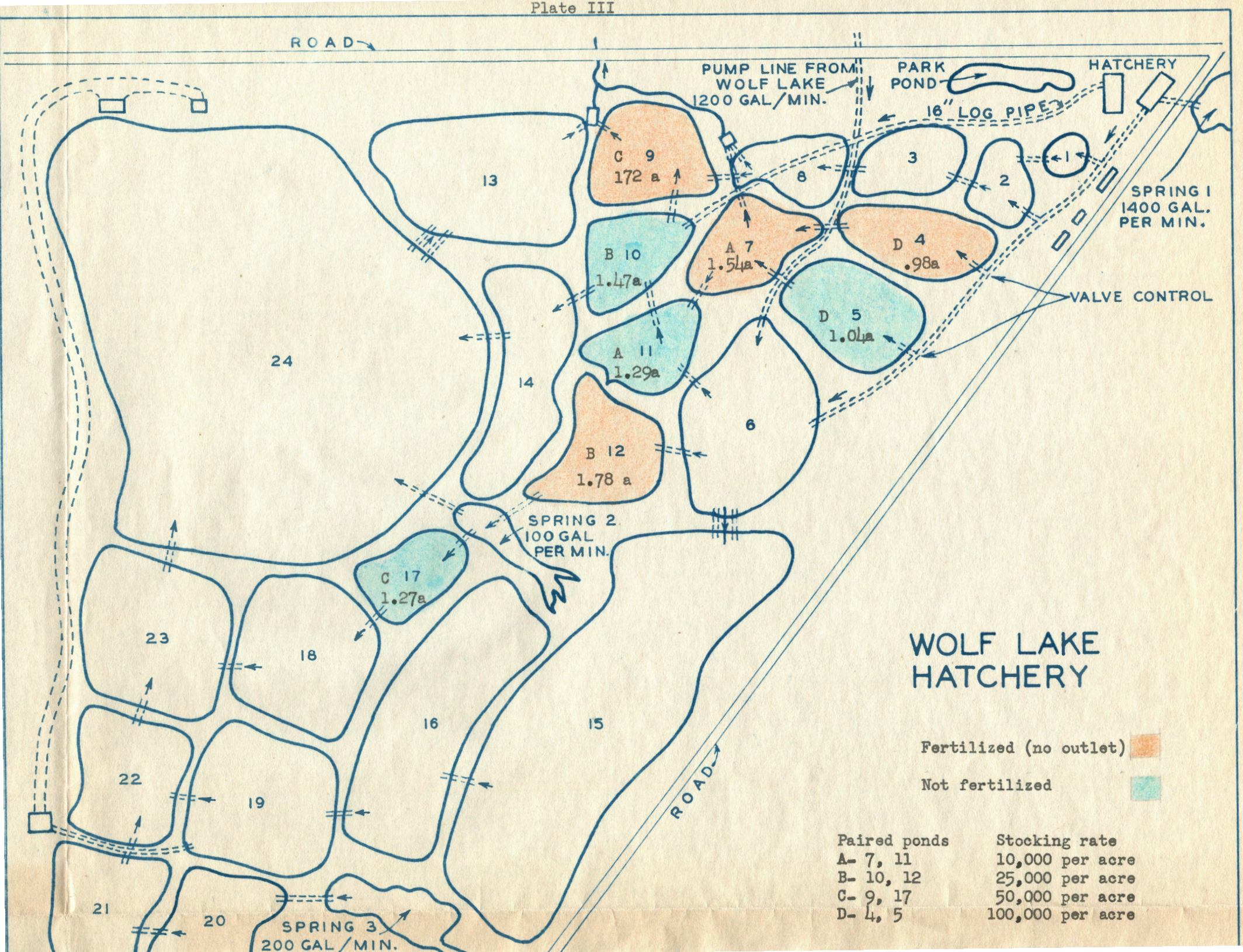
HASTINGS HATCHERY



Pond pairs	Stocking rate
A- 5, 12	10,000 per acre
B- 7, 11	25,000 per acre
C- 8, 10	35,000 per acre
D- 2, 6	44,000 per acre

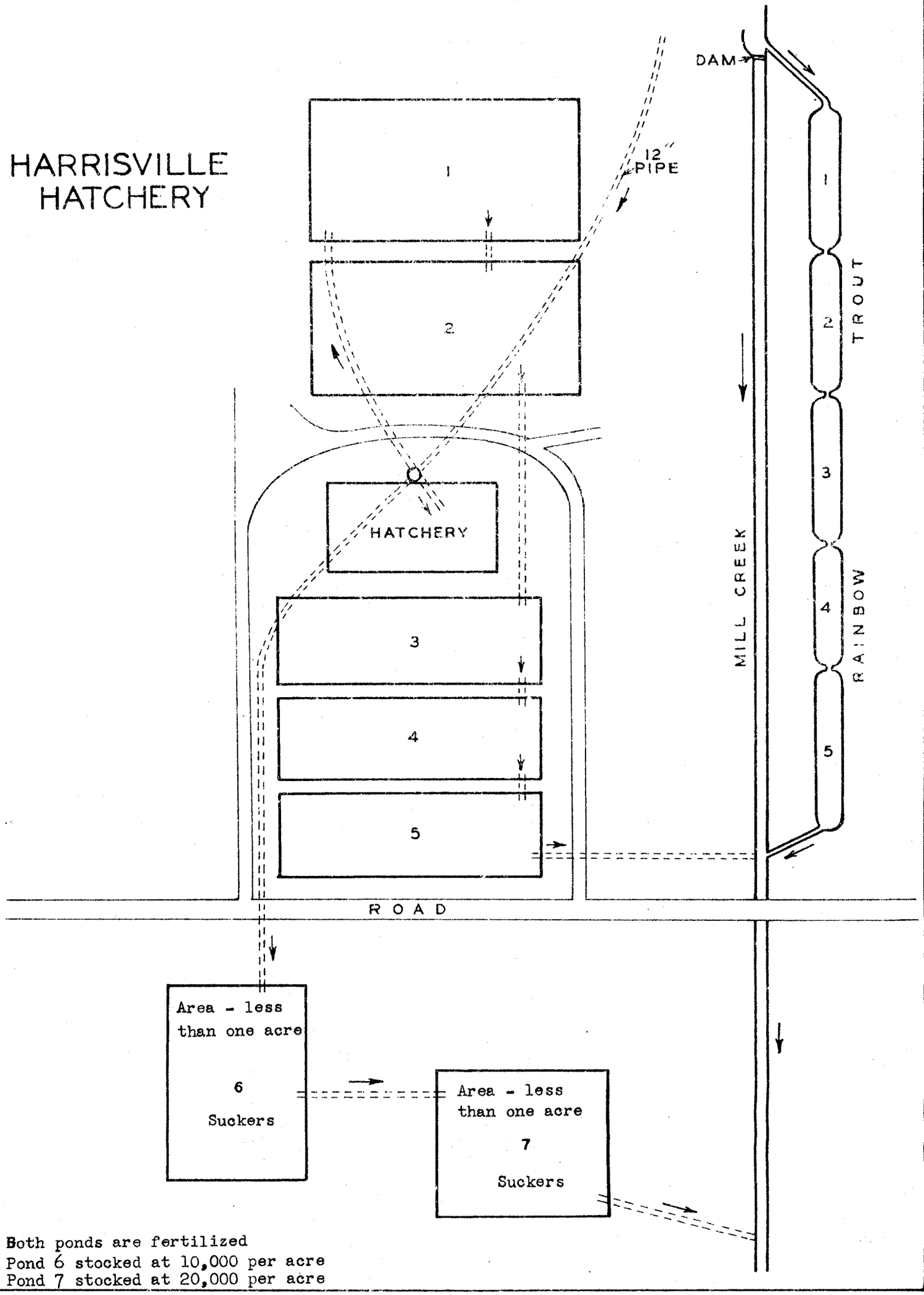
Fertilized ponds
Unfertilized ponds
Outlet blocked


DRAYTON PLAINS HATCHERY
11
10
9
8
7
6
5
2.1 a
4
.77a
3
.89a
2
1.27a
1
.39a
UPPER CHANNEL
LOWER CHANNEL
EXPERIMENTAL PONDS
Spawning race
SEINNING BOX
HOLDING PONDS
DISPLAY PONDS
HATCHERY
Fertilized
Control

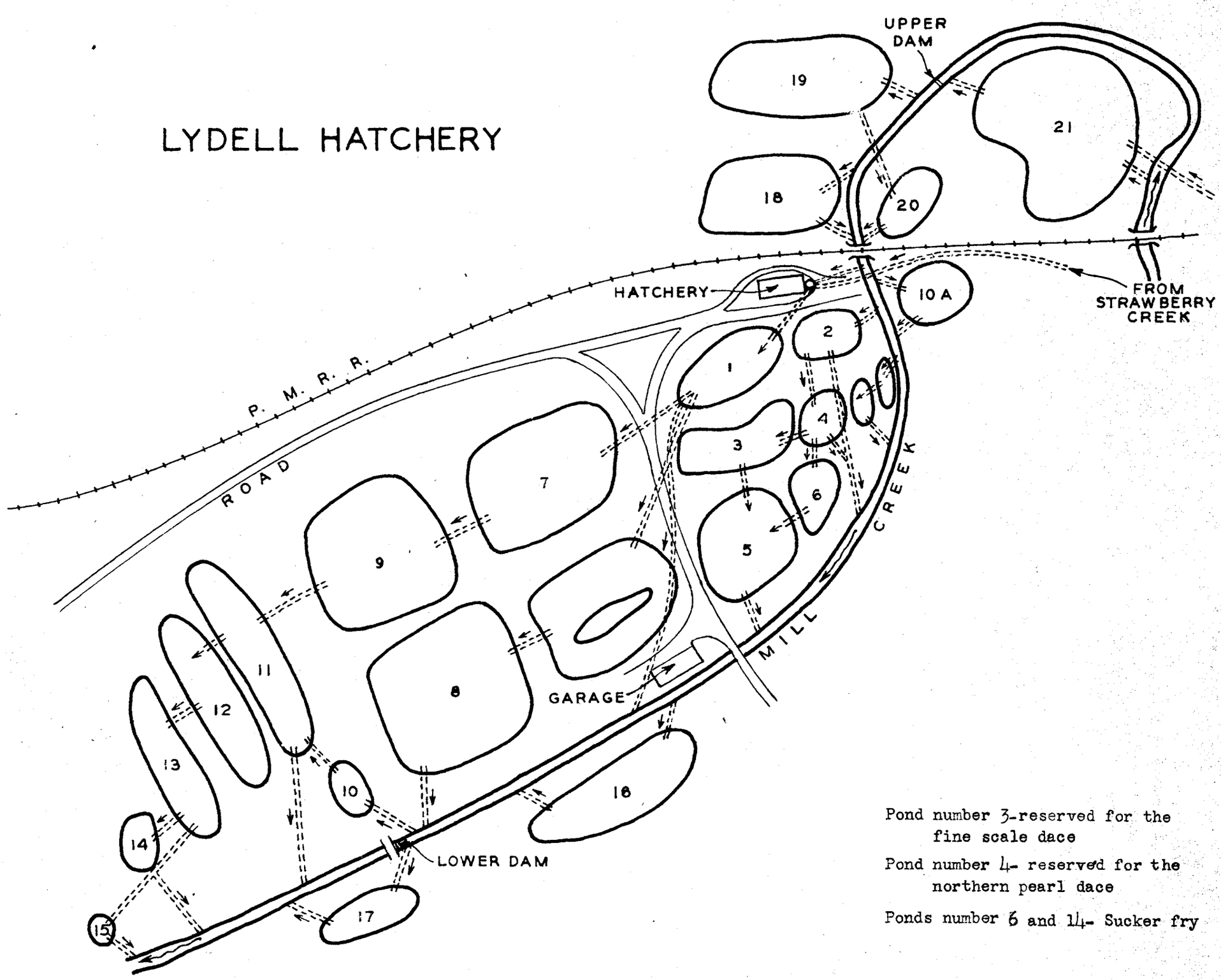


Paired ponds	Stocking rate
A- 7, 11	10,000 per acre
B- 10, 12	25,000 per acre
C- 9, 17	50,000 per acre
D- 4, 5	100,000 per acre

Plate IV



Both ponds are fertilized
Pond 6 stocked at 10,000 per acre
Pond 7 stocked at 20,000 per acre

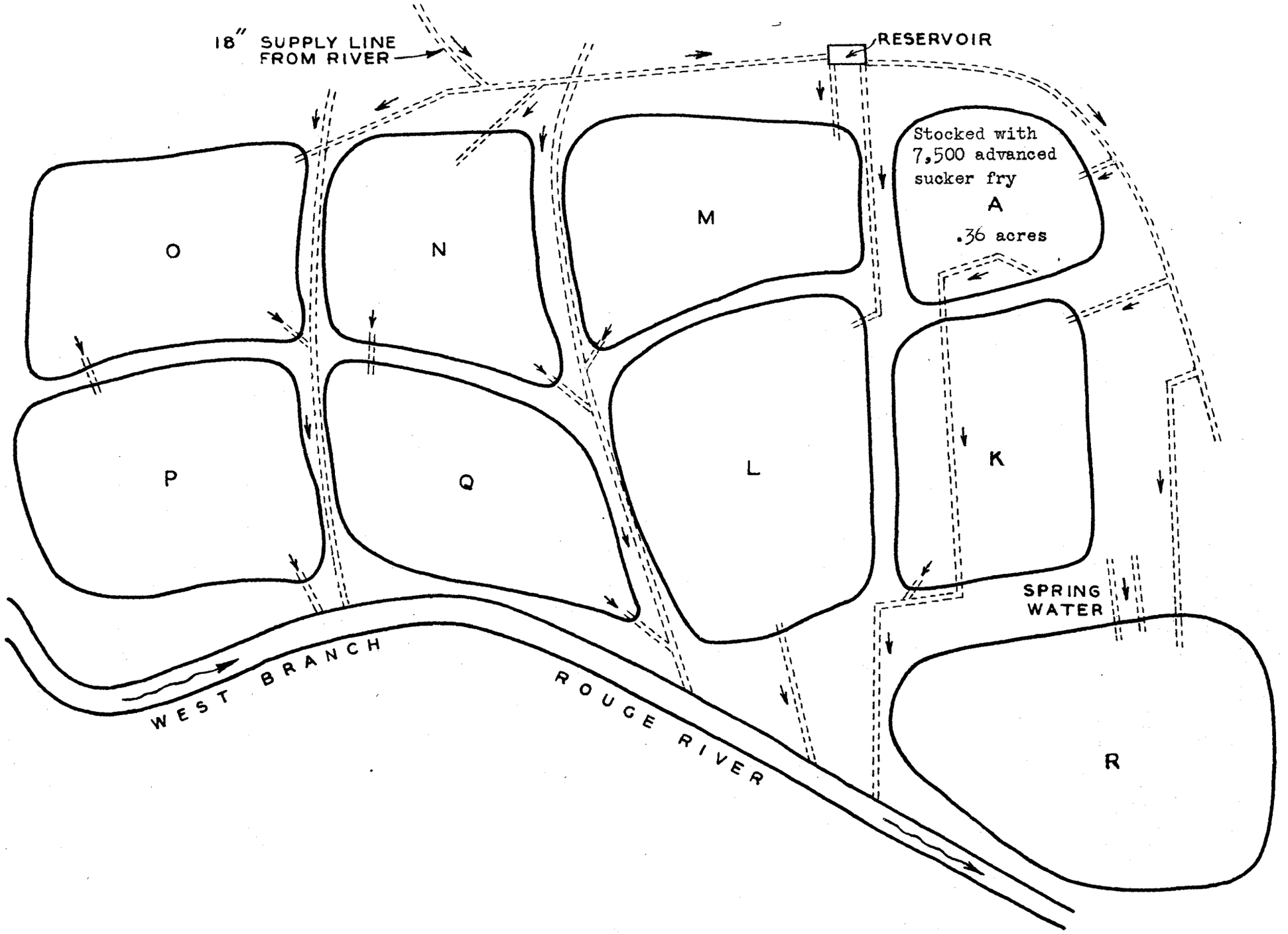


Pond number 3-reserved for the fine scale dace

Pond number 4- reserved for the northern pearl dace

Ponds number 6 and 14- Sucker fry

NORTHVILLE HATCHERY - U. S. Fish & Wildlife Service



ALMENA PONDS

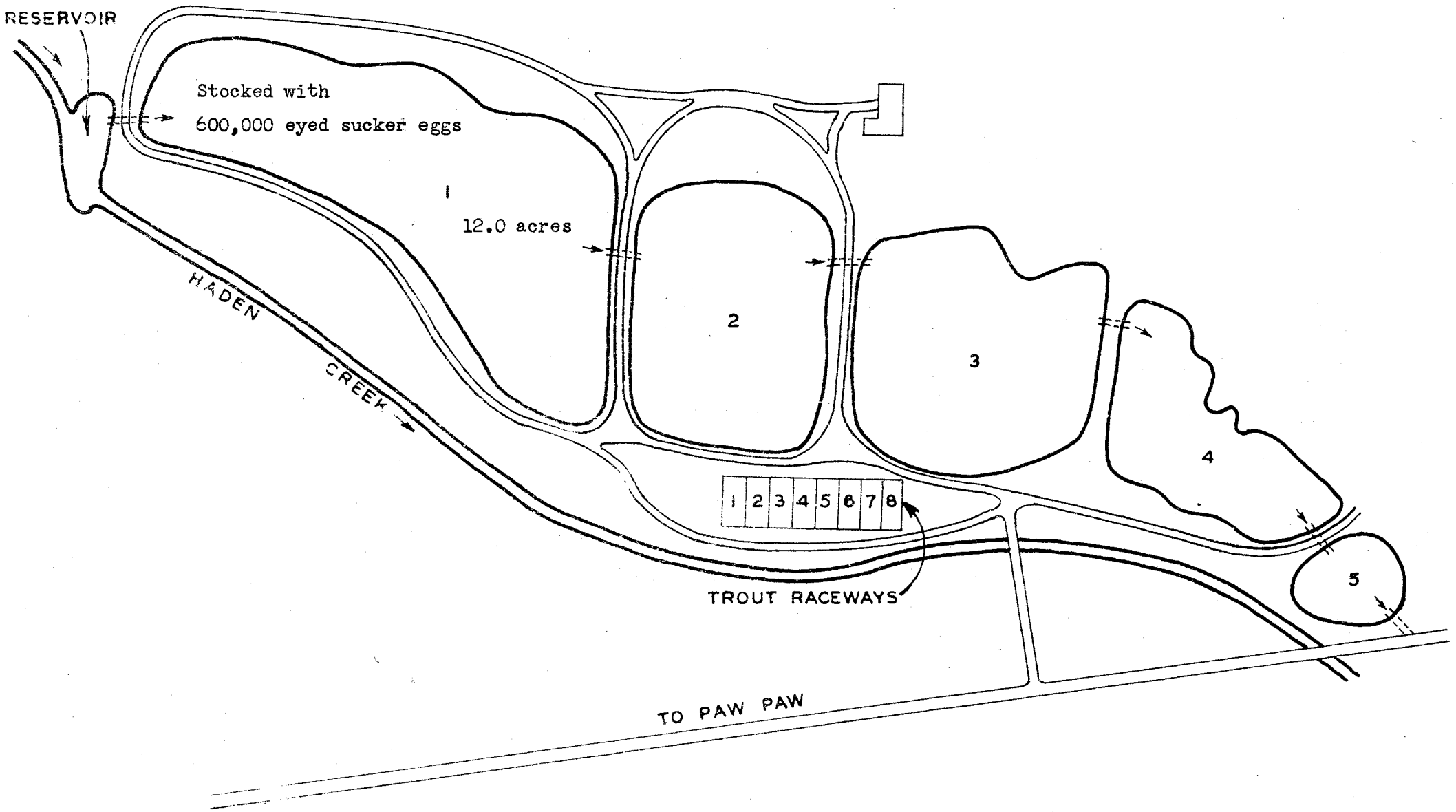
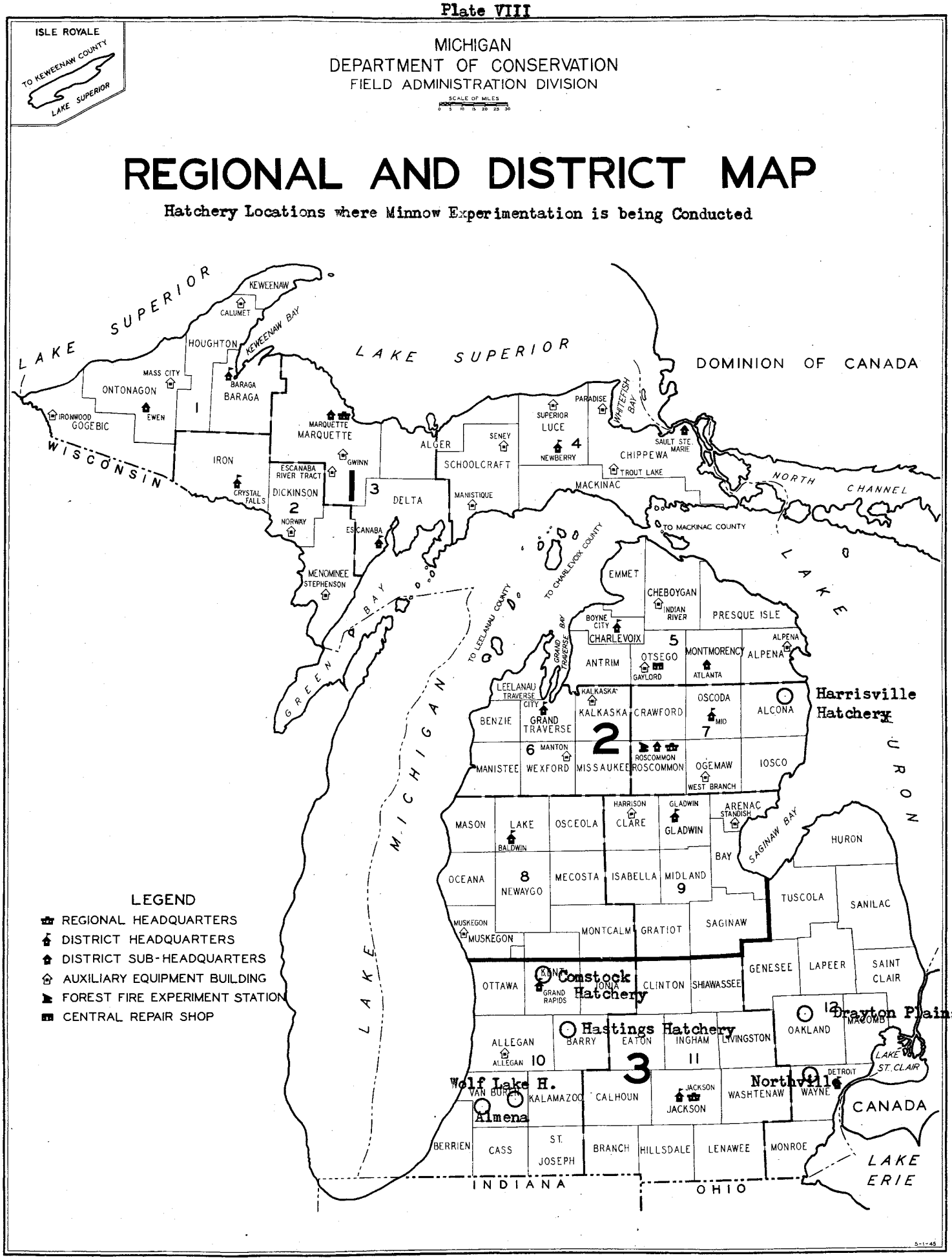


Plate VIII


ISLE ROYALE
TO KEWEENAW COUNTY
LAKE SUPERIOR
MICHIGAN
DEPARTMENT OF CONSERVATION
FIELD ADMINISTRATION DIVISION
SCALE OF MILES
0 5 10 15 20 25 30
REGIONAL AND DISTRICT MAP
Hatchery Locations where Minnow Experimentation is being Conducted
LAKE SUPERIOR
KEWEENAW
CALUMET
KEWEENAW BAY
HOUGHTON
MASS CITY
ONTONAGON
BARAGA
IRONWOOD
GOGEBIC
EWEN
WISCONSIN
MARQUETTE
GWINN
IRON
CRYSTAL FALLS
ESCANABA RIVER TRACT
DICKINSON
NORWAY
ESCANABA
DELTA
ALGER
SENEY
SCHOOLCRAFT
MANISTIQUE
SUPERIOR
LUCE
NEWBERRY
PARADISE
WHITEFISH BAY
SAULT STE. MARIE
CHIPPEWA
TROUT LAKE
MACKINAC
DOMINION OF CANADA
NORTH CHANNEL
TO MACKINAC COUNTY
TO CHARLEVOIX COUNTY
TO LEELANAU COUNTY
GREEN BAY
MENOMINEE
STEPHENSON
EMMET
CHEBOYGAN
INDIAN RIVER
PRESQUE ISLE
BOYNE CITY
CHARLEVOIX
ANTRIM
OTSEGO
GAYLORD
MONTMORENCY
ATLANTA
ALPENA
LEELANAU
TRAVERSE CITY
GRAND TRAVERSE BAY
KALKASKA
CRAWFORD
OSCODA
MIO
ALCONA
Harrisville Hatchery
BENZIE
GRAND TRAVERSE
MANISTEE
MANTON
WEXFORD
MISSAUKEE
ROSCOMMON
OGEMAW
WEST BRANCH
IOSCO
MASON
LAKE
BALDWIN
OSCEOLA
HARRISON
CLARE
GLADWIN
ARENAC
STANDISH
SAGINAW BAY
HURON
BAY
OCEANA
NEWAYGO
MECOSTA
ISABELLA
MIDLAND
TUSCOLA
SANILAC
MUSKEGON
MONTCALM
GRATIOT
SAGINAW
GENESEE
LAPEER
SAINT CLAIR
OTTAWA
KENT
GRAND RAPIDS
IONIA
Comstock Hatchery
CLINTON
SHIAWASSEE
OAKLAND
MACOMB
Drayton Plains
ALLEGAN
Hastings Hatchery
BARRY
EATON
INGHAM
LIVINGSTON
LAKE ST. CLAIR
Wolf Lake H.
VAN BUREN
KALAMAZOO
CALHOUN
JACKSON
WASHTENAW
WAYNE
DETROIT
Northville
Almena
CANADA
BERRIEN
CASS
ST. JOSEPH
BRANCH
HILLSDALE
LENAWEE
MONROE
LAKE ERIE
INDIANA
OHIO
LEGEND
REGIONAL HEADQUARTERS
DISTRICT HEADQUARTERS
DISTRICT SUB-HEADQUARTERS
AUXILIARY EQUIPMENT BUILDING
FOREST FIRE EXPERIMENT STATION
CENTRAL REPAIR SHOP
5-1-45