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# EFFECTS OF HABITAT MANAGEMENT ON TROUT IN A PORTION OF THE KINNICKINNIC RIVER, ST. CROIX COUNTY, WISCONSIN

by

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ABSTRACT

A stream habitat development project was conducted on the Kinnickinnic River in western Wisconsin during the period 1950-1957. In order to evaluate stream development practices, the resident wild populations of brook and brown trout were sampled in a 1.35 mile "developed" test area and in an adjacent .69 mile "undeveloped" control area from 1953 through 1960.

The streambank and its vegetation were protected in the test section by fencing to exclude livestock, except in limited areas, and instream habitat was changed by the installation of water channelization devices. Wild brook and brown trout populations increased several fold in this area after development. Populations increased more than standing crops, a suggestion that increased cover in the improved portion was beneficial to small fish. In the adjacent control section, there was no consistent general trend toward increase or decrease in trout populations.

Stream habitat development projects have been conducted on many Wisconsin streams. Very few attempts have been made to evaluate any of these projects. Trout habitat on a portion of the Kinnickinnic River in western Wisconsin was experimentally improved during the period 1952-1957. The trout populations in this section and in an adjacent but unimproved section were studied from 1953 to 1960 to evaluate the effects of a stream habitat development program. This report summarizes observations made during that period and provides an evaluation of their significance.

## DESCRIPTION

The Kinnickinnic River, located in western Wisconsin, flows southwesterly into the St. Croix River (Fig. 1). It receives heavy fishing pressure from nearby Wisconsin communities and from the Minneapolis - St. Paul metropolitan area, which is about a 30-minute drive away. Opening day creel censuses gave counts of 878 cars in this area.

The portion of the stream studied was 2.04 miles long; it averaged 18.4 feet wide and 9 inches deep (Fig. 2). The surface area was estimated to be 4.4 acres in 1961. The flow varied from 2.2 c.f.s. at the lower end of the improved area to 3.4 c.f.s. at the lower end of the unimproved area. Pools were common and occurred mostly as deep water in the center of the stream. Riffles were plentiful, stable and provided good spawning areas, especially in the improved section. Springs were abundant in the improved section and occurred mainly along the stream channel. The water was clear and its resistivity averaged about 3000 ohms per $cm^2$ at $77^{\circ}F$.

This section of the Kinnickinnic River was selected as a study area because it appeared to be in very poor condition due to erosion and siltation, was easily accessible, had a native trout population and had a potential for improvement.

Throughout the length of the study area, the stream flowed through open pasture land. Several large dairy herds had access to it at any point and their damage to the banks caused considerable erosion. Deposits of silt covered from 30 to 70 percent of the streambed. Aquatic vegetation was abundant and consisted mostly of water buttercup, (Ranunculus), water weed (Anacharis), water cress (Nasturtium) and various sedges.

Wild brown trout (Salmo trutta) and brook trout (Salvelinus fontinalis) occur in the stream. Other fishes include brook stickleback (Eucalia inconstans), northern muddler (Cottus bairdi), white sucker (Catostomus commersonii), creek chub (Semotilus atromaculatus), common shiner (Notropis cornutus) and central Johnny darter (Etheostoma nigrum). Trout and sticklebacks are abundant. The rest of the fish species listed are relatively scarce throughout the stream.

## Section A (The Improved Area)

The upper 1.35 miles of the study area was improved during 1950-1957 to provide a better habitat for trout. At first, fences were constructed to limit cattle access to the stream. Seven sites for cattle watering and crossing were established. Coniferous and deciduous trees were planted along the banks. Within the 1.35 mile improvement area, 32 digger logs, 134 single wing deflectors, 103 double wing deflectors, 38 rock and log retards and 2 brush shelters were installed. Also installed within this stream segment were 9,864 feet of rock revetment, 3,854 feet of log revetment, 570 feet of willow mat revetment and 75 feet of sod revetment.

A large highway bridge was built across the improved section in 1958, one-quarter mile above the downstream boundary. Before the bridge's approach, grades were stabilized with vegetation, several rains washed a considerable amount of soil from the fill into a large spring and the stream itself. The disturbances caused by the bridge construction and erosion may have caused some fish to move downstream and out of the improved section.

Pre-improvement bottom types in Section A were: gravel (10 percent), sand (20 percent) and silt (70 percent). Post-improvement bottom types were: gravel (25 percent), sand (45 percent) and silt (30 percent). Ranunculus and Nasturtium constricted the stream channel in late summer and even completely covered it in places.

Section B (The Unimproved Area)

The lower 0.69 mile of the study area was used as a control. Cattle can approach the stream at any point, they continue to damage the banks and bank erosion was prevalent in this entire section. Aquatic vegetation was less common than in Section A. Bottom types were: gravel (5 percent), sand (25 percent), and silt (70 percent).

METHODS

During electro-fishing operations, all trout captured on the first run are temporarily marked by clipping a lobe of the caudal fin. The upper lobe is clipped for Section A and the lower lobe for Section B in order to be able to separate fish from the two sections. This fin does not always regenerate completely, especially in larger fish and these fish are easily identifiable. Fish clipped on previous occasions were found to have moved both upstream and downstream.

The lower reaches of the Kinnickinnic River are stocked annually with trout of legal size (6 inches or more). The uppermost stocking site for these fish is 3.5 miles below the study area. Marked trout stocked at this site have never been found in the study area. The trout population in the study area is considered a "wild" population.

Samples of the fishes in Sections A and B were collected by means of electro-fishing gear similar to that described by Shetter (1948). A 230-volt DC generator was mounted in a small boat. The boat's metal bottom served as

the negative electrode. Two hand-held positive electrodes on short poles were connected to the boat by 30-foot leads.

Estimates of the trout populations were made each April and October, before and after the fishing season, employing the Peterson mark and recapture method described by Ricker (1958). When sampling began in 1953, habitat conditions were poor and the trout population in the developed section was less dense than in the control section. Also, there were fewer brook trout in both sections in 1953 than in 1960. All trout were grouped according to species and size groups. The size groups were "under 5.5 inches" and "5.5 inches and over". These length groups were used because there appeared to be a natural breaking point of recovery efficiency[1] at 5.5 inches. A finer breakdown of the "5.5-inch group and over" group was made later by proration according to the values of H (first capture in shocking run) for each of the small size groups.

Clopper - Pearson charts were used to obtain the 95 percent confidence intervals for the size group estimates. To facilitate the procedure only one limit was read (i.e., upper or lower) rather than both because we wished to apply the finite population correction to the limits. The finite population correction applied to the confidence interval is $1 - \frac{C_2}{P}$, where $C_2$ is the second catch and P is the estimated population. The correction factor derived was applied to P; the ratio of $\frac{P}{C}$ and the population limits were calculated directly (Table 4).

## ESTIMATES OF TROUT NUMBERS

Spring and fall population estimates on brook trout showed significant increases in the numbers of fingerlings in Section A, the improved section, (Tables 1 & 2) from 1956 on. The "5.5-inch and over" size group of brook trout also increased during this period.

[1] Recovery efficiency is the ratio of newly captured fish to previously marked fish in a second run of a shocking unit ($\frac{M}{H}$).

The estimates made on fingerling brook trout in Section B from 1953 through 1960 showed no significant changes. Spring estimates in the "5.5-inch and over" group showed no significant increases; fall estimates showed a decline in numbers in the same size group from the 1956-1959 period (Table 2).

Spring population estimates made on fingerling brown trout in Section A showed increases during 1957-1959 and a decrease in 1960. The 1960 decrease coincided with the increase of fingerling brook trout and the increase of the total trout population in this section (Table 1).

The numbers of fingerling brown trout in Section B were quite similar numerically in the spring of 1953, 1954, 1957, and 1958. There was a large increase of fingerling brown trout in the fall of 1958--the year of bridge construction in Section A. Their numbers started to decline the next year. Two years later, their numbers declined to the same population level as in 1953 (Table 2). The fingerling brown trout increase in 1958 is attributed to downstream migration from Section A because of bridge construction and increased population densities.

The brown trout in the "5.5-inch and over" size group showed no definite trends in either the spring or fall population estimates.

Analysis of the 95 percent confidence limits (Table 4) and population trends (Tables 1 & 2) indicate a significant increase in the brown and brook trout populations in the improved section. No significant increases are indicated for the control section.

## ESTIMATES OF TROUT WEIGHTS

During the 1960 spring and fall electro-fishing operations, a total of 832 specimens of brown and brook trout were weighed to the nearest gram, measured to the nearest one-tenth inch in length and then grouped by half-inch size groups; approximately 10 fish were weighed for each half-inch size group. The weights were averaged and applied to the population estimate data (Table 3).

There were 519.9 pounds of trout in Section A or approximately 179.2 pounds per surface acre in April of 1960. Section B contained 328.3 pounds of trout or about 200 pounds per acre. In the fall of 1960, Section A had 121.6 pounds of trout per acre and Section B had 224.3 pounds of trout per acre. This is a loss during the summer of 57.6 pounds of trout in Section A and a gain of 24.2 pounds in Section B.

The brook trout poundage increased in Sections A and B in 1960 but the greatest weight increase occurred in Section B, where it amounted to 100 percent. Brown trout poundage increased 1 percent in Section B and decreased 48 percent in Section A in the same period.

A possible explanation for the changes in poundage between the two sections is that there are no barriers between the two sections to obstruct fish migration and the upper portion of Section B contains large deep pools which are favorable habitat for large trout moving downstream into deeper water.

## CONCLUSIONS

The fingerling trout in Section A showed a significant yearly increase since completion of development work (1957 to 1960). In this same period, the population of trout in the "5.5-inch and over" size range also increased, but the increase noted is considerably smaller than that seen in the fingerling group. Brook and brown trout populations increased simultaneously. This increase in the density of adult trout probably is the explanation for a lower survival of the 1960 year class of brown trout in Section A.

The numbers of fingerling trout in Section B have shown considerable fluctuations during the study period but no definite trends. A large increase in 1958 may have been due to migration caused by turbidity and siltation from the construction of an interstate highway bridge in Section A, just above Section B. The brown trout in Section B decreased during 1953-1957 and

increased during 1958-1960. Increased competition in the expanding trout population in Section A may have caused a downstream migration and thus have supplied immigrants to the trout population in Section B bolstering that population.

The total trout population (trout/acre) in Section A quadrupled itself following stream improvement while the trout population in the unimproved Section B remained essentially static. (Table 1)

Brook trout were benefited more in the improved section than brown trout. The over 5.5-inch segment of the brook trout population increased to 4 or 5 times its original size while the brown trout population over 5.5-inches increased only 1.5 to 2 times.

## ACKNOWLEDGMENTS

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Table 1. Spring trout populations** estimated by the Petersen method in an area of developed habitat and an area of undeveloped habitat in the Kinnickinnic River, Wisconsin, 1953 through 1960.

| | Section "A" (Developed) | | | | | Section "B" (Undeveloped) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Brook Trout | | Number of Brown Trout | | Total Population Density | Number of Brook Trout | | Number of Brown Trout | | Total Population Density |
| Year | Fingerlings | Older | Fingerlings | Older | (Trout/acre) | Fingerlings | Older | Fingerlings | Older | (Trout/acre) |
| 1953 | 17 | 103 | 217 | 373 | 245 | 20 | 100 | 129 | 701 | 594 |
| 1954 | 6 | 158 | 18 | 493 | 225 | 30 | 130 | 106 | 574 | 525 |
| 1955* | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1956 | 124 | 513 | 279 | 670 | 547 | 150 | 344 | 226 | 522 | 775 |
| 1957 | 95 | 282 | 128 | 439 | 325 | 44 | 198 | 112 | 391 | 455 |
| 1958 | 281 | 496 | 474 | 952 | 760 | 60 | 89 | 132 | 341 | 389 |
| 1959 | 595 | 416 | 508 | 962 | 855 | 136 | 108 | 479 | 468 | 744 |
| 1960 | 1503 | 437 | 246 | 608 | 963 | 66 | 105 | 281 | 501 | 596 |

* No estimates were made during April, 1955.

** "Fingerlings" are those trout under 5.5 inches in length; those over 5.5 inches in length are designated as "olde

Table 2. Fall trout populations** estimated by the Peterson method in an area of developed habitat and an area of undeveloped habitat in the Kinnickinnic River, Wisconsin, 1953 through 1960.

| | Section "A" (Developed) | | | | | Section "B" (Undeveloped) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Brook Trout | | Number of Brown Trout | | Total Population Density | Number of Brook Trout | | Number of Brown Trout | | Total Population Density |
| Year | Fingerlings | Older | Fingerlings | Older | (Trout/acre) | Fingerlings | Older | Fingerlings | Older | (Trout/acre) |
| 1953 | 34 | 163 | 124 | 238 | 193 | 62 | 92 | 295 | 388 | 523 |
| 1954* | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1955 | 465 | 575 | 459 | 313 | 625 | 384 | 185 | 459 | 318 | 841 |
| 1956 | 332 | 152 | 222 | 243 | 327 | 162 | 150 | 284 | 303 | 562 |
| 1957 | 616 | 239 | 932 | 453 | 572 | 101 | 49 | 263 | 273 | 409 |
| 1958 | 765 | 296 | 382 | 908 | 811 | 427 | 77 | 1251 | 372 | 1329 |
| 1959 | 2173 | 365 | 321 | 562 | 1180 | 100 | 62 | 536 | 465 | 727 |
| 1960 | 524 | 652 | 6 | 308 | 514 | 220 | 181 | 254 | 523 | 736 |

* No estimates were made during October, 1954.

** "Fingerlings" are those trout under 5.5 inches in length; those over 5.5 inches in length are designated as "older".

Table 3. - Numbers and weights in pounds of brook and brown trout in each Section of the Kinnickinnic River in Western Wisconsin in the spring of 1960.

| | Section A | | | | Section B | | | |
|---|---|---|---|---|---|---|---|---|
| Size | Brook Trout | | Brown Trout | | Brook Trout | | Brown Trout | |
| Range | Number | Pounds | Number | Pounds | Number | Pounds | Number | Pound |
| 2.5-5.4 | 1503 | 45.1 | 246 | 8.0 | 66 | 2.0 | 281 | 9.2 |
| 5.5 & over | 437 | 94.8 | 522 | 372.0 | 105 | 23.0 | 501 | 286.1 |
| Total | 1940 | 139.9 | 768 | 380.0 | 171 | 25.0 | 782 | 295.3 |

Numbers and weights in pounds of brook and brown trout in each Section of the Kinnickinnic River in Western Wisconsin in the fall of 1960.

| | Section A | | | | Section B | | | |
|---|---|---|---|---|---|---|---|---|
| Size | Brook Trout | | Brown Trout | | Brook Trout | | Brown Trout | |
| Range | Number | Pounds | Number | Pounds | Number | Pounds | Number | Pound |
| 2.5-5.4 | 524 | 15.3 | 6 | .2 | 220 | 6.4 | 254 | 6.7 |
| 5.5 & over | 652 | 139.2 | 308 | 198.2 | 180 | 43.6 | 523 | 302.3 |
| Total | 1176 | 154.5 | 314 | 198.4 | 400 | 50.0 | 777 | 309 |

Table 4. 95 percent confidence limits for population estimates on the Kinnickinnic River in western Wisconsin conducted during the 1953-1960 period.

Spring Confidence Limits

| Calculated Pop. | Section A | | | | Section B | | | |
|---|---|---|---|---|---|---|---|---|
| | Brook Trout | | Brown Trout | | Brook Trout | | Brown Trout | |
| Year | Fingerling | Older | Fingerling | Older | Fingerling | Older | Fingerling | Older |
| 1953 | 0-64 | 84-131 | 150-375 | 315-453 | 9-inf. | 75-150 | 94-200 | 575-879 |
| 1954 | --- | 138-183 | 15-21 | 460-524 | 21-53 | 121-142 | 74-137 | 543-594 |
| 1955* | --- | --- | --- | --- | --- | ---- | --- | --- |
| 1956 | 111-146 | 483-555 | 234-348 | 637-701 | 109-250 | 296-411 | 166-379 | 489-599 |
| 1957 | 74-133 | 257-304 | 108-161 | 412-465 | 35-61 | 175-224 | 92-145 | 362-426 |
| 1958 | 257-310 | 484-510 | 454-498 | 922-974 | 39-130 | 81-100 | 106-177 | 332-347 |
| 1959 | 575-638 | 407-428 | 484-535 | 937-983 | 123-153 | 98-123 | 460-501 | 455-476 |
| 1960 | 1495-1510 | 426-446 | 220-277 | 594-621 | 58-77 | 100-111 | 250-322 | 482-516 |

Fall Confidence Limits

| | Section A | | | | Section B | | | |
|---|---|---|---|---|---|---|---|---|
| | Brook Trout | | Brown Trout | | Brook Trout | | Brown Trout | |
| Year | Fingerling | Older | Fingerling | Older | Fingerling | Older | Fingerling | Older |
| 1953 | 30-40 | 151-175 | 107-150 | 220-257 | 48-90 | 78-106 | 254-351 | 352-427 |
| 1954* | --- | --- | --- | --- | --- | --- | --- | --- |
| 1955 | 408-557 | 553-590 | 426-526 | 301-327 | 323-504 | 165-212 | 392-589 | 303-335 |
| 1956 | 290-387 | 141-164 | 190-279 | 230-254 | 141-193 | 138-160 | 236-358 | 289-323 |
| 1957 | 582-666 | 228-251 | 859-1064 | 428-479 | 88-119 | 45-53 | 224-318 | 264-283 |
| 1958 | 718-821 | 287-302 | 357-411 | 882-928 | 407-455 | 73-80 | 1188-1844 | 364-380 |
| 1959 | 2126-2272 | 357-375 | 293-362 | 547-573 | 95-106 | 57-68 | 520-566 | 465 |
| 1960 | 494-561 | 640-671 | 4-inf. | 297-319 | 195-250 | 169-192 | 229-290 | 511-536 |

* Population estimates were not made in the fall of 1954 or the spring of 1955.

"Fingerlings" are those trout under 5.5 inches in length; those over 5.5 inches in length are designated as "Older".

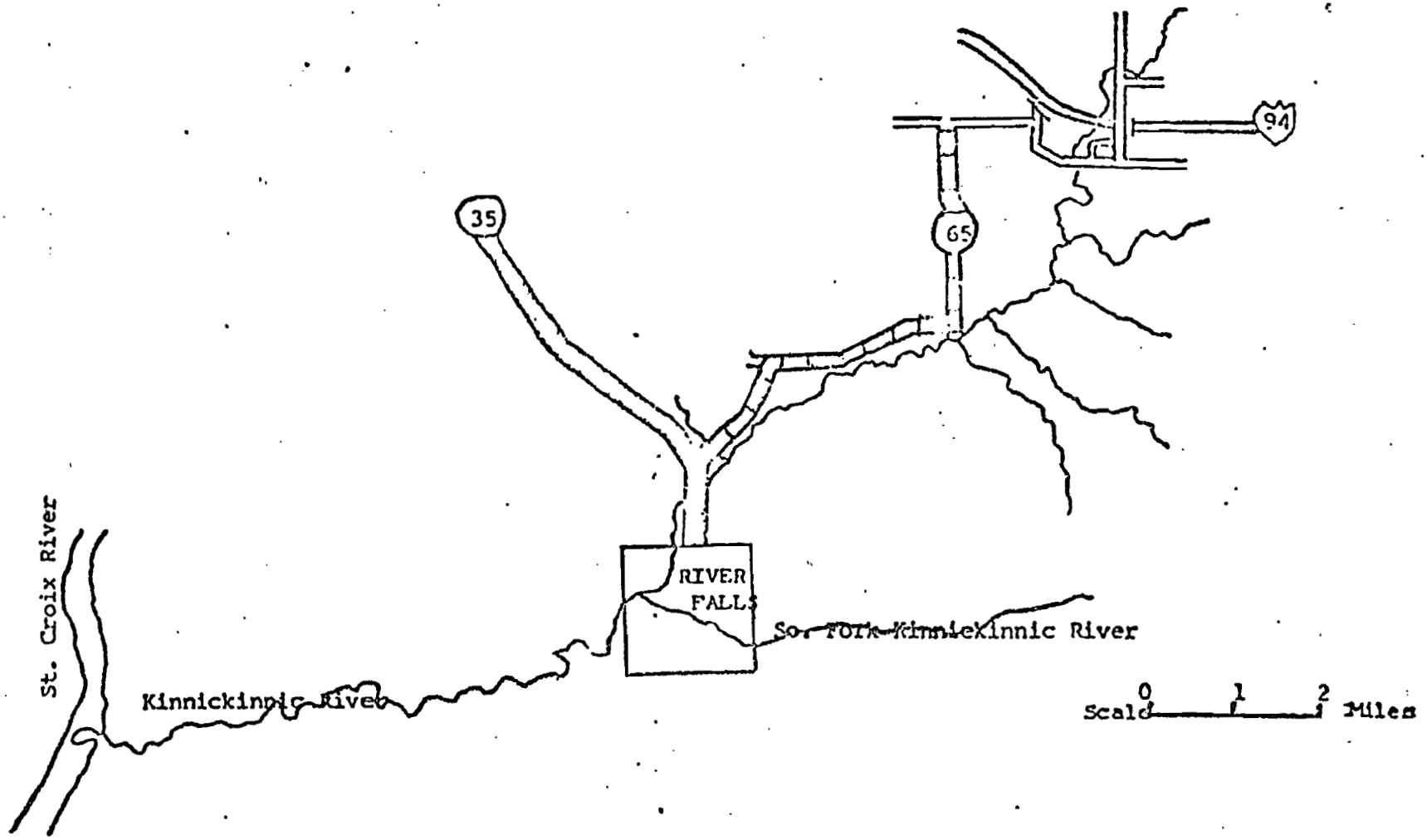


Figure 1. Map of the Kinnickinnic River in Western Wisconsin showing the study area.

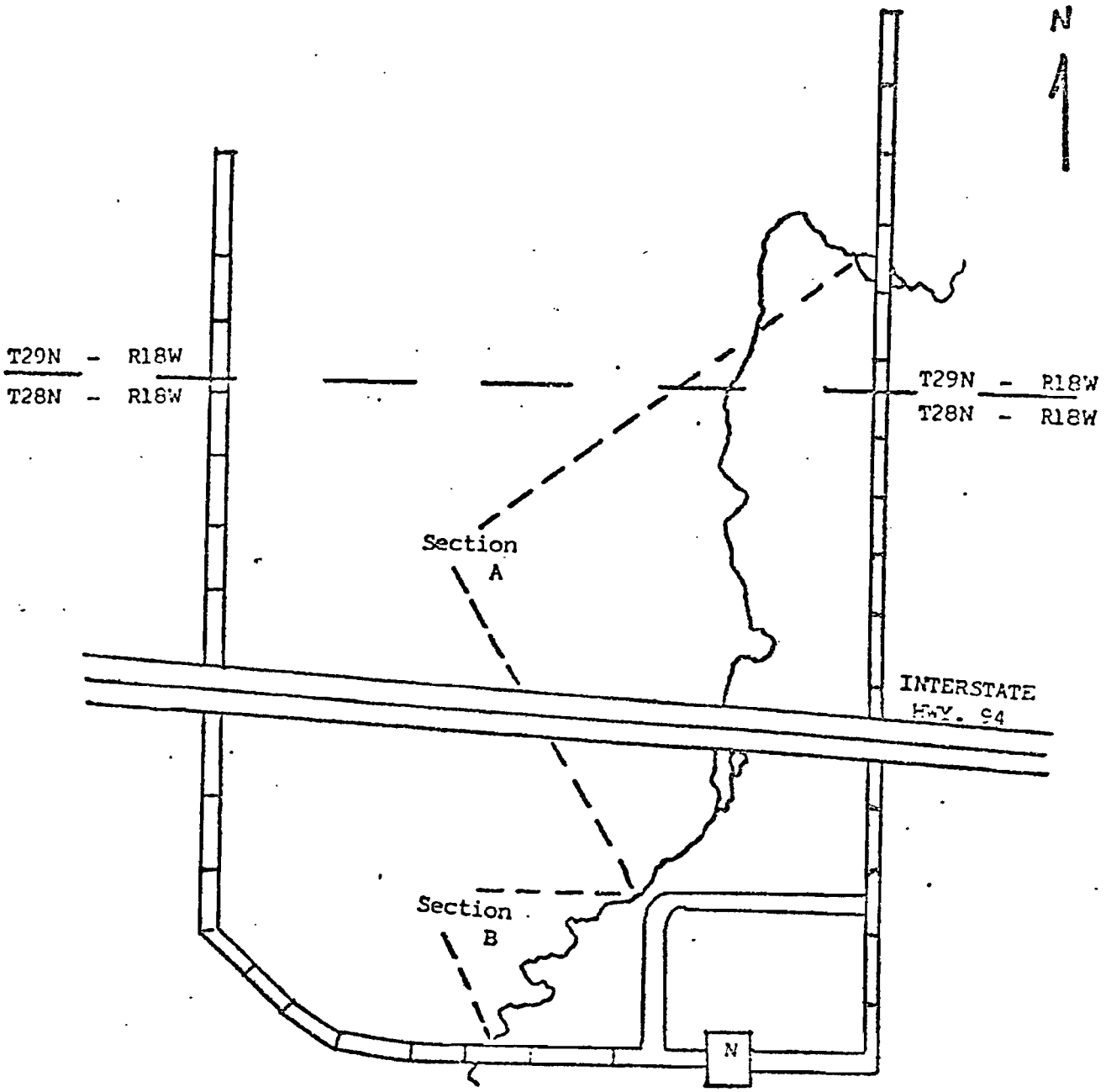


Figure 2. The Kinnickinnic River study area in western Wisconsin showing Sections A and B and the large spring immediately below Interstate Highway 94.