

WATER QUALITY STANDARDS REVIEW
SPRINGVILLE BRANCH OF THE BAD AXE RIVER

VIROQUA POTW

October 16, 1989
Paul LaLiberte

The Viroqua POTW discharges wastewater to meet "marginal" effluent limitations. The POTW design flow is 0.6 mgd. The treated wastewater enters an intermittently flowing drainageway 2.2 miles upstream from a large spring (approximately 4 cfs) which constitutes the origin of the Springville branch. The Springville Branch is classified as a class 3 trout stream. About one mile above the POTW, Viroqua Whey Products discharges cooling water into the drainageway. Since the original stream classification in 1975, a preoperative point source impact study was conducted in 1978, as well as postoperative chemical sampling on 3-6-86 and macroinvertebrate sampling on 4-17-87.

During the preoperative study, the POTW and Viroqua Whey Products were discharging high strength wastewater. Other waste sources included the Viroqua Whey Products ridge and furrow system and the Viroqua landfill, both located adjacent to the drainageway near the old POTW (see map). Leachate from these sites was suspected to surface in the drainageway and standing surface water from the landfill was pumped to the drainageway. An additional waste load came from the Vernon County Health Care Center. Wastewater discharged from this facility collected behind a Soil Conservation Service concrete dam before reaching the Viroqua drainageway. Water and associated sewage sludge passed over the dam only during runoff and rain events.

METHODS

Dissolved oxygen, pH, and temperature grab sample measurements were taken in the field in accordance with the DNR field procedures manual. Other chemistry parameters were grab samples collected in accordance with the State Lab of Hygiene (SLOH) Handling and Preservation Handbook and analyzed by SLOH. Macroinvertebrate samples were collected and processed utilizing the procedures for sampling and sorting adopted by the Department in 1983, which included sorting in the lab. The biometrics applied were those of Hilsenhoff (1987) and Szczytko (1988). Table 1 lists Hilsenhoff's biotic index classification categories. The community diversity statistic used was that proposed by Margalef. It is a measure of richness and equitability relating the total number of macroinvertebrates in each sample to the number of individuals in each genus found. The 1978 macroinvertebrate samples were sorted live in the field with an effort being made to pick no more than 25 individuals of a single species.

TABLE 1. HILSENHOFF WATER QUALITY CATEGORIES

BIOTIC INDEX	WATER QUALITY	DEGREE OF ORGANIC POLLUTION
0.00-3.50	EXCELLENT	NO APPARENT ORGANIC POLLUTION
3.51-4.50	VERY GOOD	POSSIBLE SLIGHT ORGANIC POLLUTION
4.51-5.50	GOOD	SOME ORGANIC POLLUTION
5.51-6.50	FAIR	FAIRLY SIGNIFICANT ORGANIC POLLUTION
6.51-7.50	FAIRLY POOR	SIGNIFICANT ORGANIC POLLUTION
7.51-8.50	POOR	VERY SIGNIFICANT ORGANIC POLLUTION
8.51-10.00	VERY POOR	SEVERE ORGANIC POLLUTION

RESULTS

Despite the volume and variety of pollutants entering the study reach under preoperative conditions, it fared remarkably well. The high stream gradient provided aeration to offset much of the BOD. The exception was in the winter when ice cover blocked aeration and DO dropped. Even under ice cover, water quality standards for DO applicable for each reach were met. Although summer ammonia levels were high at the POTW, the water quality standard for trout streams was still met below the springs under preoperative conditions. Unfortunately, no ammonia data was collected under winter conditions, when even higher effluent ammonia levels can occur.

Under postoperative conditions, the discharge from Vernon County Health Care Center had been eliminated and the Viroqua POTW upgraded. The BOD load from Viroqua Whey Products cooling water discharge had been reduced and their ridge and furrow abandoned. (Viroqua Whey Products recently ceased operation completely.) The Viroqua landfill was no longer pumping surface water to the drainageway. However, agricultural and urban nonpoint source problems were still evident including manure storage within 10 feet of the stream bank. In 1987, a large dry dam was constructed on the Springville Branch at the site located on the map. This structure is designed to impound water during high flow events and slowly release it.

The winter DO levels (Table 2) had improved from 2.2 to 13 mg/l immediately above the spring (cs 9) and from 8.8 to 13 mg/l immediately below the spring (cs 12). The un-ionized ammonia concentration immediately above the spring under winter conditions met the water quality standard for trout, even before dilution occurred. Since ammonia did not present a problem in winter, when in-stream and in-plant nitrification would be minimal, it should not pose a problem for the remainder of the year.

TABLE 2. WINTER PHYSICAL - CHEMICAL DATA

SITE	DATE	DO	TEMP.	pH	NH3-N	BOD ₅	CHLORIDE
CS1	1-4-79	5.8	20.1				
	3-6-86	8.9	17			3.7	43
CS9	1-4-79	2.2	-1.0				
	3-6-86	13	0	7.45	0.97		
CS12	1-4-79	8.8	5.5				
	3-6-86	13	6				

Three biometrics were applied to the macroinvertebrate data from this study: Hilsenhoff Biotic Index (HBI), Margalef Diversity and Percent Ephemeroptera, Plecoptera and Trichoptera (% EPT). The preoperative data had significant seasonal differences in HBI and diversity. The spring, 2.2 miles below the POTW caused a major shift in all indices on all sample dates. At the site 10 miles below the POTW, HBI and diversity were comparable, while percent EPT varied drastically on the two days sampled. This could be the result of seasonal insect emergence patterns. Also, differences in DNR macroinvertebrate sample sorting methods between 1978 and 1987 may have affected the results.

CONCLUSIONS

The lack of stability in the macroinvertebrate indices suggests that water quality is not consistently good in this study reach. Existing chemical and biological data is insufficient to identify the nature or origin of the water quality problem. Despite it's normally good water quality and adequate habitat, the Springville Branch is unable to sustain a trout fishery. Periodic fish kills occur in the springtime. The Viroqua POTW has had high BOD and suspended solids discharges in the springtime. The discharges were of a duration so short that the 24HR composite, flow proportional sample used for compliance tracking was not significantly affected. The facility therefore remained in compliance with it's WPDES permit. These discharges were thought to be the result of excessive contributions from Viroqua Whey Products and inadequate sludge storage facilities at the POTW.

Fish kills caused by point sources usually occur under low flow conditions, either in mid-winter or summer. While the POTW may be responsible for fish kills in the Springville Branch, mortality that occurs after rainfall events, such as the one in April 1989, is likely to be the result of nonpoint sources of pollution. Rainfall events can cause problems via BOD and ammonia in manure, toxic substances in urban runoff (oil, antifreeze etc.) or runoff of freshly applied agricultural pesticides.

The Department has requested that the POTW expand their sludge storage capability. Because the plant is in compliance with it's permit, the Department cannot require expanded sludge storage. In addition to expanded sludge storage capacity at the POTW, nonpoint source best management practices will have to be utilized in both the urban and agricultural portions of the Springville Branch watershed before survival of the trout fishery can be assured.

RECOMMENDATIONS FOR FUTURE MONITORING

To further investigate seasonal effects, fall macroinvertebrate sampling in the Springville Branch is recommended. Additional macroinvertebrate samples from comparable sites in the Esofea branch of the Bad Axe River might be useful in interpreting the data from the more heavily impacted Springville Branch. A fishery survey of the reach above the spring should be conducted. Until this data is obtained, the stream classification should remain unchanged. Once adequate pollution control practices are implemented in this watershed, it should be possible to upgrade the stream classification from marginal (use class E) to intermediate (use class D) above Springville and possibly from class 3 to class 2 trout below the spring.

REFERENCES

- Hilsenhoff, W. L. 1987. An Improved Biotic Index of Organic Stream Pollution. Great Lakes Entomologist. Vol. 20, #1, page 31.
- Szczytko, S. 1988. Investigation of New Interpretive Techniques for Assessing Biomonitoring Data and Stream Water Quality in Wisconsin Streams. Report to DNR. 85 pp.
- Vetrano, D. 1989. Personal communication. WI DNR, LaCrosse Area Office

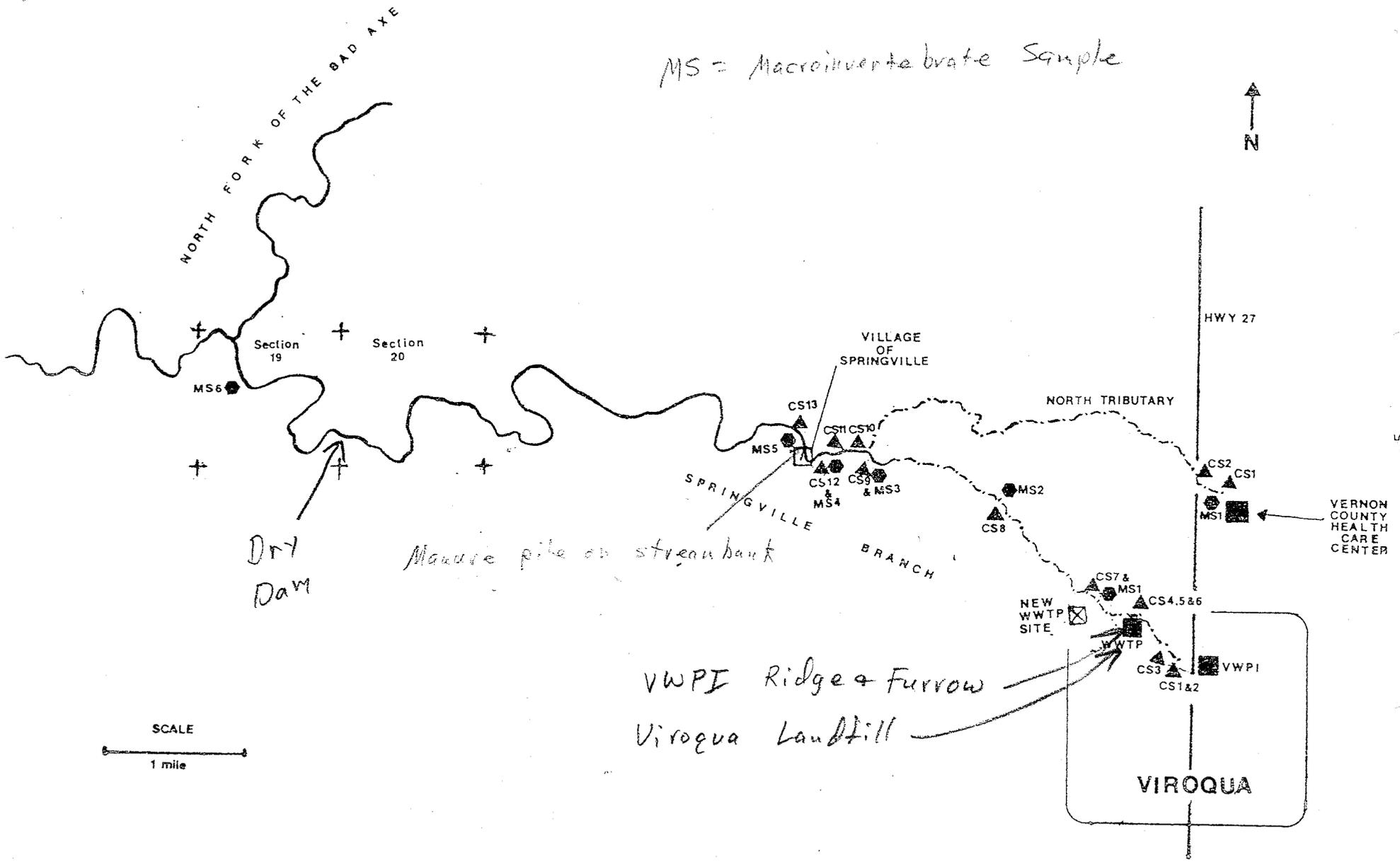
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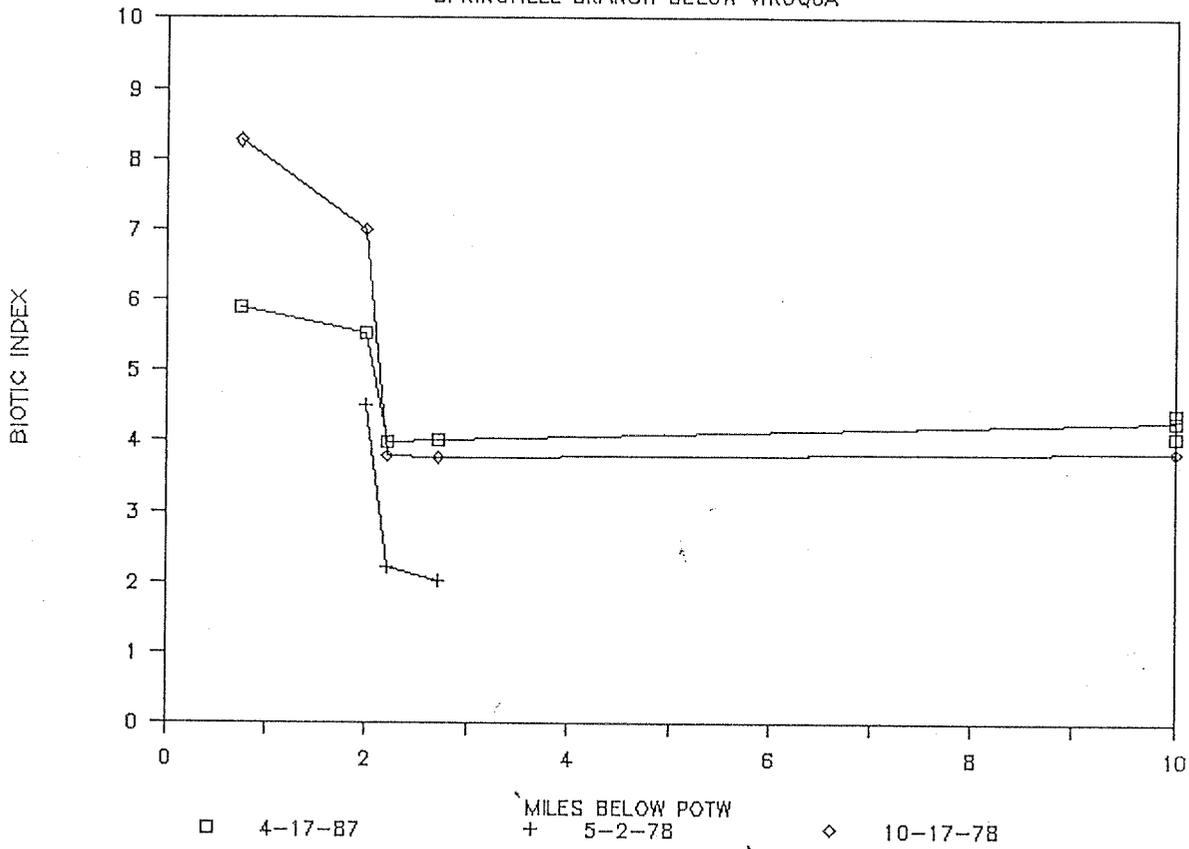
Viroqua

MS = Macroinvertebrate Sample



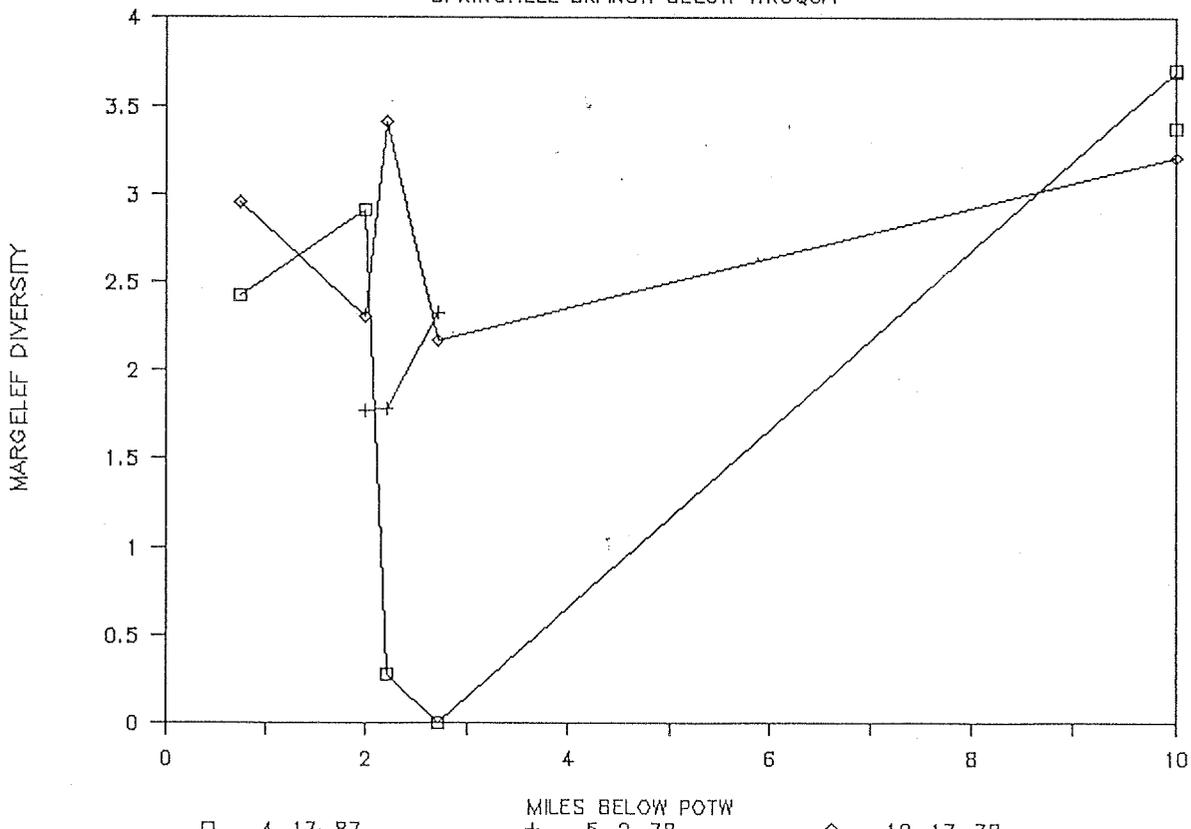
MACROINVERTEBRATE BIOTIC INDEX

SPRINGVILLE BRANCH BELOW VROQUA



MACROINVERTEBRATE DIVERSITY

SPRINGVILLE BRANCH BELOW VROQUA



Sample
Statistics

District Samplenum Rep	Species Richness			Sample Statistics			EPT Plecoptera Ephemeropt. Trichoptera	Margelef's Diversity Index	
				FBI	HBI	Total			
District 780502-63-04 Rep 1	Species Genera	8 8	Value Count %EPT	2.230 135 47%	2.209 134 48%		Plecop. Epheme. Trichop. EPT	0 0 64 64	1.786
District 780502-63-05 Rep 1	Species Genera	17 16	Value Count %EPT	2.264 235 69%	2.017 235 69%		Plecop. Epheme. Trichop. EPT	0 33 129 162	2.329
District 781017-63-04 Rep 1	Species Genera	24 22	Value Count %EPT	3.646 158 46%	3.782 147 49%		Plecop. Epheme. Trichop. EPT	0 27 45 72	3.357
District 781017-63-05 Rep 1	Species Genera	12 11	Value Count %EPT	3.763 135 64%	3.752 129 67%		Plecop. Epheme. Trichop. EPT	0 62 25 87	2.165
District 781017-63-06 Rep 1	Species Genera	25 20	Value Count %EPT	3.691 152 77%	3.850 113 104%		Plecop. Epheme. Trichop. EPT	1 62 54 117	3.207
District 870417-63-02 Rep 1	Species Genera	9 9	Value Count %EPT	5.739 23 4%	5.889 9 11%		Plecop. Epheme. Trichop. EPT	0 0 1 1	2.423
District 870417-63-03 Rep 1	Species Genera	11 9	Value Count %EPT	5.151 53 9%	5.529 34 15%		Plecop. Epheme. Trichop. EPT	0 0 5 5	2.915
District 870417-63-04 Rep 1	Species Genera	3 2	Value Count %EPT	4.095 126 0%	3.976 126 0%		Plecop. Epheme. Trichop. EPT	0 0 0 0	0.276
District 870417-63-05 Rep 1	Species Genera	1 1	Value Count %EPT	4.000 133 0%	4.000 133 0%		Plecop. Epheme. Trichop. EPT	0 0 0 0	0.000
District 870417-63-06 Rep 1	Species Genera	28 20	Value Count %EPT	4.566 129 37%	4.279 129 37%		Plecop. Epheme. Trichop. EPT	1 17 30 48	3.702

VIROQUA, VERNON COUNTY

Wastewater Receiving Stream Classification

Effluent from the Viroqua WWTP is discharged to a headwater tributary of the Springville Branch of the Bad Axe River, one-half mile downstream from the headwater origin. The headwater origin is a Viroqua city storm sewer at STH 27, 41, which is presently discharging wastewater from Viroqua Whey Products.

From the WWTP downstream to the large volume (4 cfs) spring flow contribution about 1000 feet above CTH "B" at Springville, the majority stream bank land use is agricultural pasture land. Dry weather conditions with no wastewater discharge would result in zero stream flow from the Springville spring upstream 2.5 miles to the Viroqua WWTP discharge site.

Biological evaluation of the above tributary on October 29, 1975, documented a recovering benthic aquatic macroinvertebrate population upstream from the Springville spring and a clean unaffected population below the spring. Flow volume was similar from the WWTP discharge to the spring.

Viroqua WWTP

Viroqua tributary to Springville branch of the Bad Axe River - downstream view from CTH "B" above Springville - 2 miles below WWTP and 1/3 mile above spring.

Springville branch of Bad Axe River - upstream view from CTH "B" at Springville - spring visible under tree in center of picture.

Recommendations:

The Viroqua tributary of the Springville branch of the Bad Axe River, upstream from the Springville spring (about 1000 feet east of CTH "B" at Springville) shall be classified as a noncontinuous, marginal use stream. Downstream from the spring the classification shall be continuous flow, fish and aquatic life.

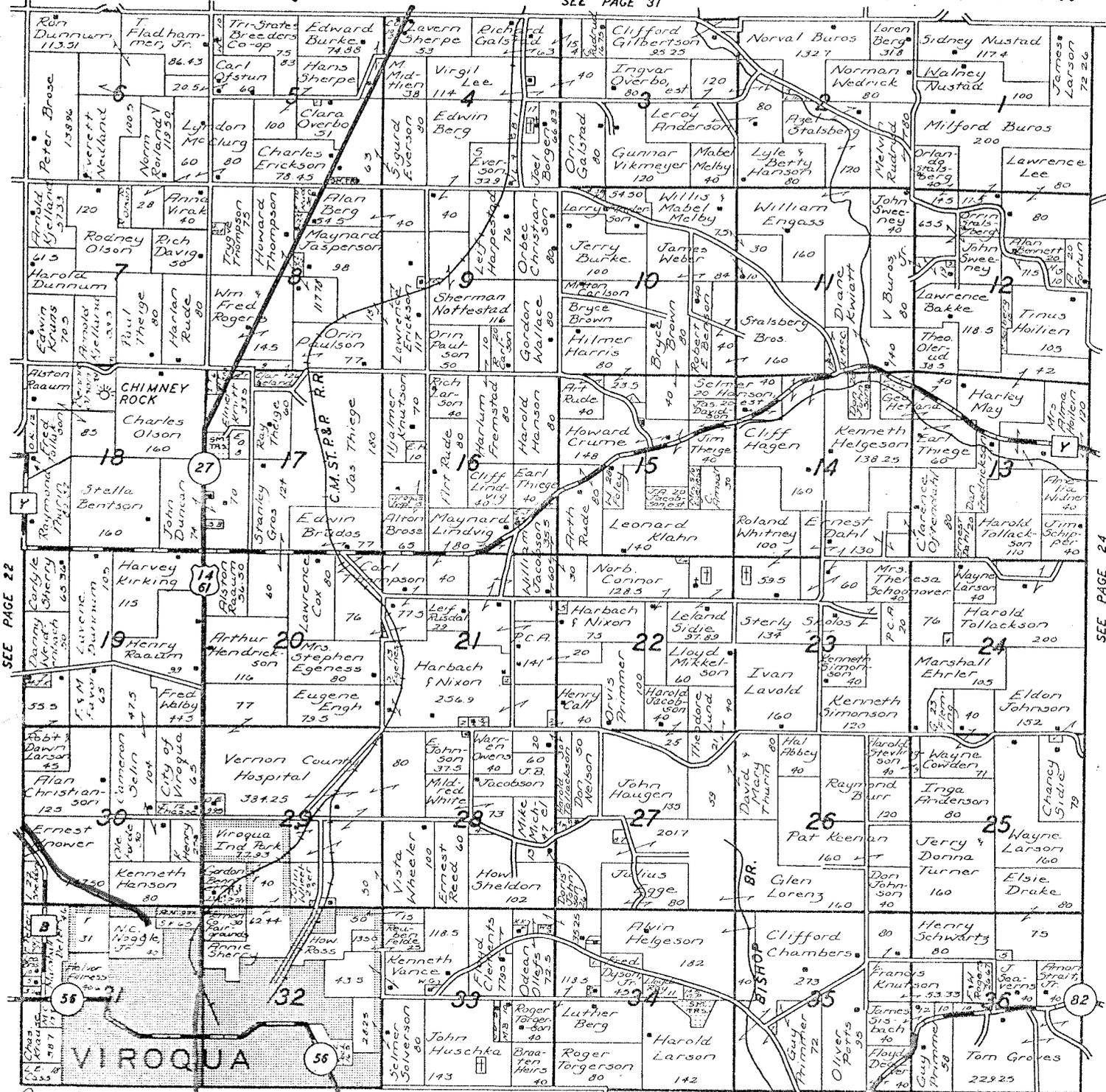
Evaluation Date: September 4, 1975.

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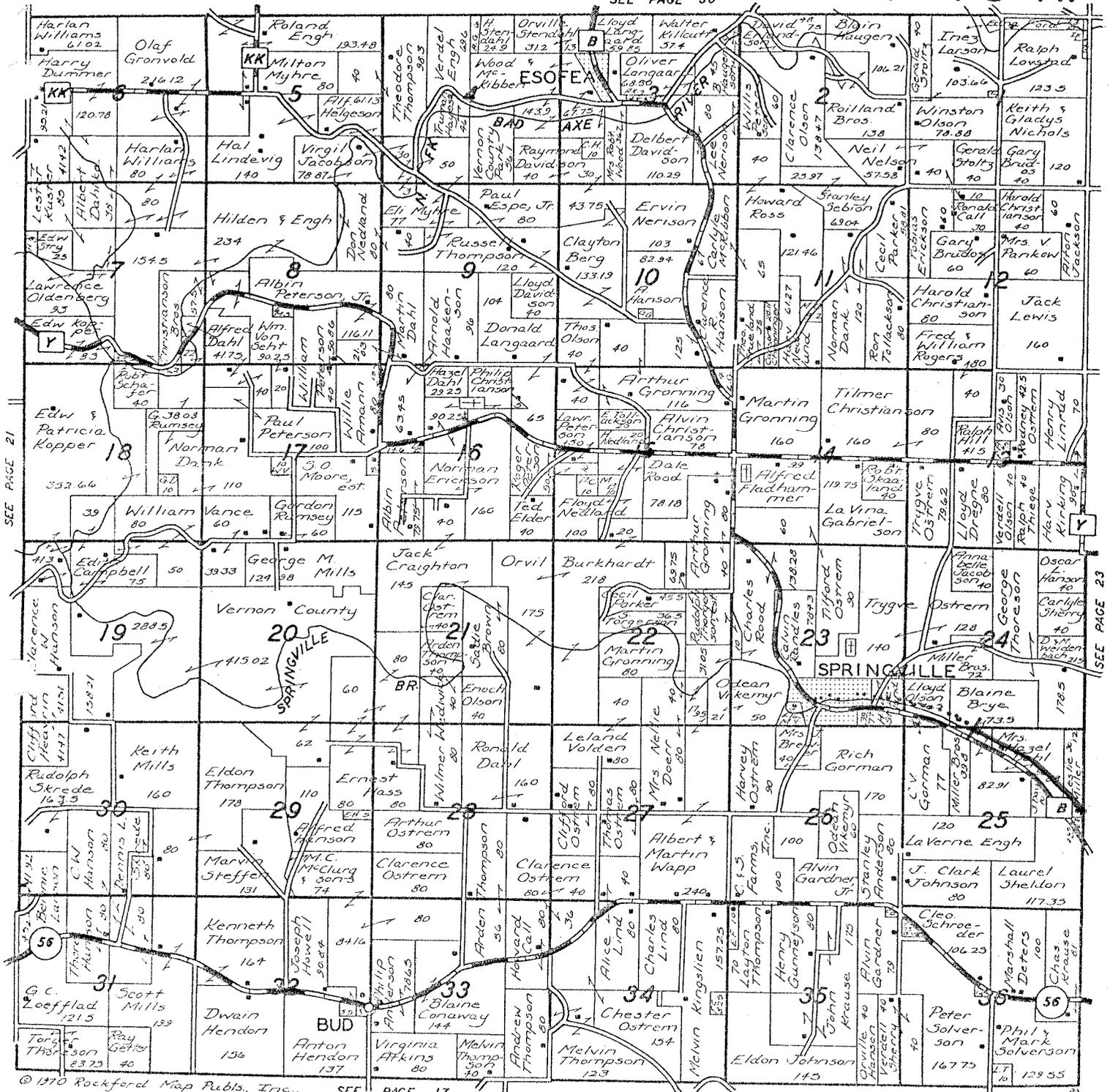
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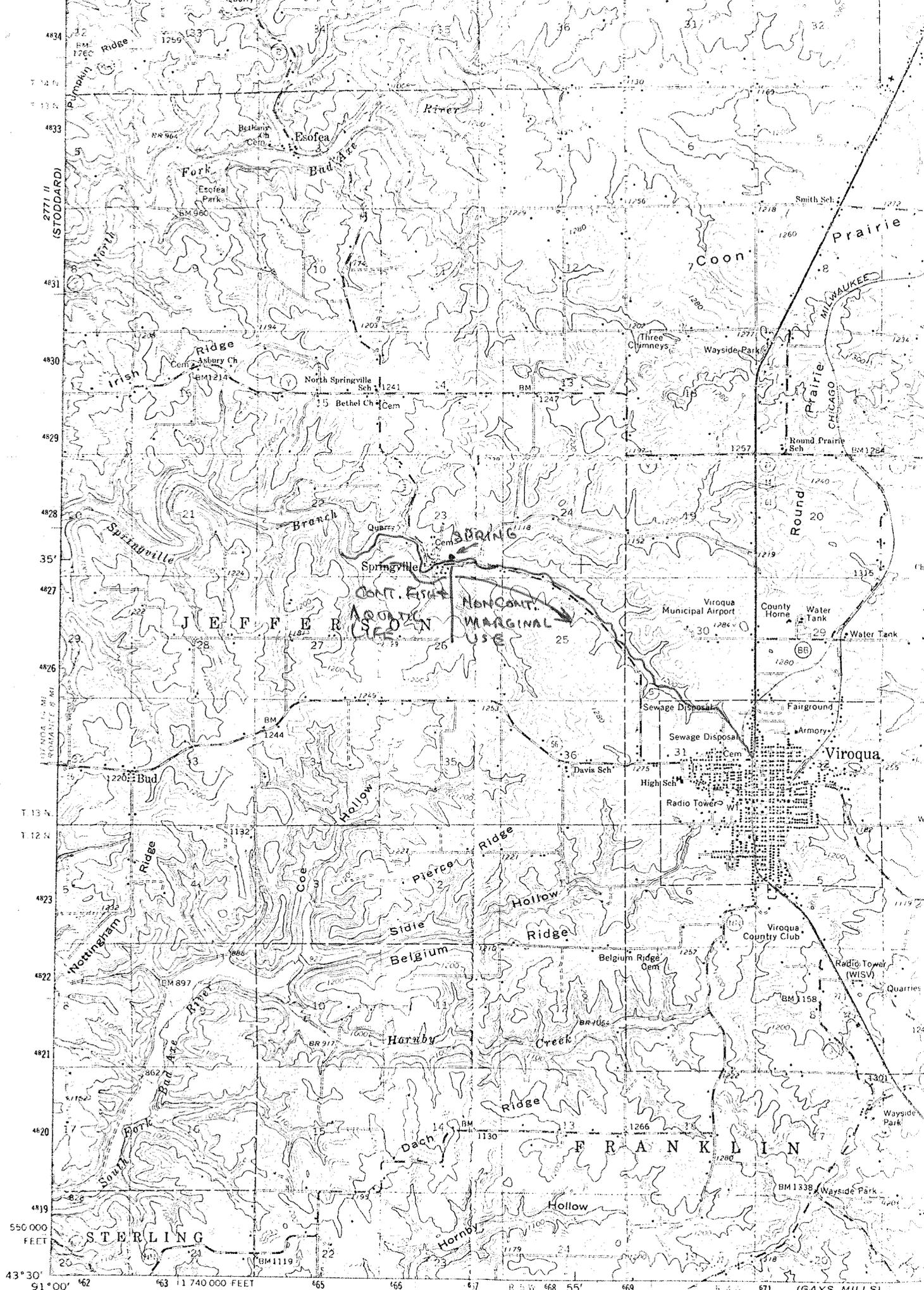
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 LUNCHES

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Viroqua
STP



Viroqua
Trib. at
CTH B Looking
downstream above
Springville,
2 miles below
STP, $\frac{1}{3}$ mile
above spring



Springville
Branch of Bad
Axe - Looking
upstream from
CTH B at
Springville.
Spring located
under tree
at center
of picture