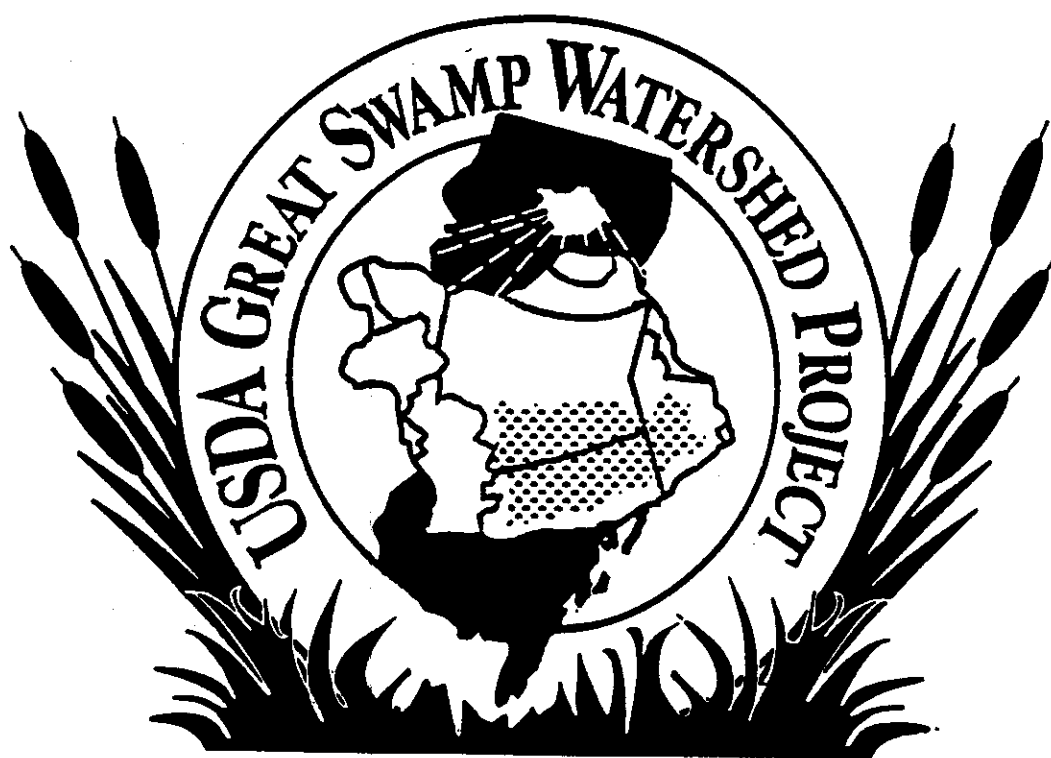


# **1992 Water Quality Inventory: Macro Invertebrate Sampling Study**



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Prepared by the United States Department of Agriculture  
in cooperation with the Morris County Soil Conservation District  
and Somerset-Union Soil Conservation District.

Water Quality Inventory  
Macro-Invertebrates of the Great Swamp Tributaries

Overview

On 24 June, 14 July and 17 July 1992, sampling of macro-invertebrates was done in the tributaries feeding the Great Swamp. The purpose for the sampling was to use macro-invertebrates present to indicate relative water quality using a pollution tolerance index. By recording numbers of pollution tolerant, semi-tolerant, and intolerant macro-invertebrate species found, and using Beck's Biotic Index, a numerical water quality value was assigned to the sampling point. Several sampling points present a general water quality picture of the stream, or particular stream reach.

Methods

Sampling was done at points distributed along each tributary that were easily accessible. A surber net was used to collect the macro-invertebrates once the stream bottom was thoroughly disturbed in a 1 foot square area upstream adjacent to the net. This included turning over all rocks in the square foot and rubbing them thoroughly to dislodge any clinging organisms. At each location, at least two samples were taken in this manner. Whenever possible, one sample was taken from a riffle and one from a run in the stream.

Collected material was removed from the net by rinsing into a basin 1/2 filled with clean water. Species identification and counts were then made. Unknown species were recorded and identified later in the office.

Beck's Biotic Index, which is found in the SCS Water Quality Indicators Guide: Surface Waters, is the mathematical tool used to convert numbers of categorized species into an actual assessment of water quality at a given point.

The Index was developed primarily for use in Florida and assumes taxonomic expertise, but it can be used with generic level identification when less sensitivity is acceptable. This system can be used to indicate both the magnitude and probable cause of environmental stress. Beck developed the methodology to categorize stream macro-invertebrates.

Three categories are defined as follows:

**Class I Organisms (Sensitive or Intolerant)**

Organisms that exhibit a rapid response to aquatic environmental changes and are killed, driven out of the area, or as a group are substantially reduced in number when their environment is degraded.

### **Class II Organisms (Facultative)**

Organisms that have the capability to live under varying conditions; e.g., a facultative anaerobe is an organism that although usually and normally lives in the presence of free oxygen, can live in absence of free oxygen. Most survive in areas where organic pollution is producing eutrophication or "enrichment" of the aquatic ecosystem.

### **Class III Organisms (Tolerant)**

Organisms capable of withstanding adverse conditions within the aquatic environment.

According to this approach, which assumes that there are not naturally occurring limiting factors, an undisturbed community will include representatives of the majority of the groups contained in Class I as well as some representatives of Classes II and III. By contrast, a sample which consists mainly of Class II organisms is being "limited" or impacted by either natural factors, such as low flow, homogenous substrate, etc. or is impacted due to human activities. Waters dominated by Class III organisms are probably adversely affected by organic pollution.

The structure of the benthic (bottom) invertebrate community in waterways polluted by organic waste (nutrients) differs quantitatively from invertebrate communities in unpolluted waterways. That is, nutrient pollution results not just in a reduction in species richness (the total number of benthic groups), but may increase density (the total number of organisms collected per sample).

By contrast, waterways impacted with toxic materials, such as pesticides or acid mine drainage, show decreases both in richness and density. Sediment causes a greater reduction in density than in richness. Because of the above differences and because there are often dominant organisms characteristic of sediment pollution, it is possible to differentiate sediment stress from the stresses of toxic materials and organic wastes.

### **Mathematical expression.**

$$BI = 2n_I + n_{II}$$

where:

BI = Beck's Biotic Index  
 $n_I$  = the number of Class I species identified from the samples  
 $n_{II}$  = the number of Class II species identified from the samples

Once compiled, Beck's Index values yield the following water quality assessments:

| <u>Index value</u> | <u>Water body assessment</u>                                      |
|--------------------|-------------------------------------------------------------------|
| 0                  | Grossly polluted                                                  |
| 1-5                | Moderately polluted                                               |
| 6-9                | Stream clean, but with a monotonous habitat and instream velocity |
| 10 or greater      | Stream clean                                                      |

### Results and Discussion

Tabulated results of the sampling can be found in the attached tables. The tables show both species richness (diversity) and density (population). The results show a great variation in water quality among the five tributaries samples.

Great Brook: Five points were sampled. The best water quality was immediately downstream of Silver Lake, with an excellent rating of 15. The poorest water was found downstream of Interstate 287, with a rating of 4. The most critical point, just before Great Brook flows into the swamp at Pleasant Plains Road, had an index of 6, which is not indicative of a critical pollution problem. The high value below Silver Lake is no doubt due to the falls from the lake, which provides a great deal of dissolved oxygen to the water. The low value below I-287 may be attributed to the slow flowing channel, sediment laden bottom, and road pollutants.

Black Brook was sampled in one spot just below Southern Boulevard, where an index of 3 was recorded. A large feeder ditch which evidently conveys flows from the Chatham Sewage Treatment Plant to Black Brook was also sampled, providing an index of 2. The low value of 3 on the brook itself may be attributed to low volume, low velocity flow that is picking up runoff from a golf course and Southern Boulevard. The value of 2 on the large feeder ditch may be attributed to very low velocity, with the bottom covered with a least 4" of mud and organic matter and high turbidity. The large numbers in density may indicate elevated nutrient levels in this watercourse. It should be noted that this watercourse emitted the most objectionable odor encountered in the sampling.

Loantaka Brook also was of generally poor water quality, with values of 0 and 2 recorded at four sampling points. The poor water quality may be attributed to the amount of development, presence of the Woodland Sewer Treatment Plant, and the sluggish nature of the brook itself. Extensive bank erosion and depositional bars and mud drapes were observed downstream of the Woodland plant. The water also had an unnatural odor here. The high density numbers below the STP and below the Loantaka

Reservation pond above Kitchel Avenue may indicate elevated nutrient levels. Waterfowl in the pond may contribute to this.

The Passaic River was found to be in very good condition through four sampling locations, with values ranging from 11 just above the swamp to 14. The river has good volume, high velocity in many stretches, and is well-oxygenated. The watershed of the river above the swamp is predominantly wooded with low-density development.

Primrose Brook is also in very good shape, with values of 9, 14, and 15 in the three sampling locations. The value of 14 was recorded just above the swamp. Again, the watershed is mostly wooded and lightly developed.

### Conclusion

The obvious conclusion is that wooded watersheds with limited development help provide conditions that result in high-quality surface waters. Urbanized watersheds have the opposite effect. This is certainly not a new concept. However, it should also not be overlooked that the size, velocity, streambank soils and stream bottom substrate can also play an important role in the level of quality. Faster streams with stable banks, rocky bottoms and high dissolved oxygen will always score higher in this type of sampling than slower streams with sandier bottoms and higher turbidity.

Water Quality Inventory:  
Macro-Invertebrates of Great Swamp Watershed

Note: tolerance 1: pollutant intolerant; tolerance 2: pollutant semi-tolerant; tolerance 3: pollutant tolerant.

1. Great Brook

A. Pleasant Plains Road - at closed bridge

| <u>Tolerance</u> | <u>Species</u> | <u>Sample</u> |          |          |
|------------------|----------------|---------------|----------|----------|
|                  |                | <u>1</u>      | <u>2</u> | <u>3</u> |
| 1                | water penny    | 3             | -        | -        |
| 2                | damsel fly     | -             | 1        | -        |
| 2                | dragon fly     | 2             | 2        | -        |
| 2                | sowbug         | 57            | 6        | 1        |
| 2                | black fly      | -             | -        | 3        |
| 3                | midge          | -             | 10       | 17       |
| 3                | leech          | 6             | 6        | 1        |
| 3                | aquatic worm   | -             | 28       | 4        |

$$\text{Beck's Index} = 2(1) + 4 = 6$$

B. Woodland Road - above bridge

| <u>Tolerance</u> | <u>Species</u> | <u>Sample</u> |                  |
|------------------|----------------|---------------|------------------|
|                  |                | <u>1(Run)</u> | <u>2(Riffle)</u> |
| 1                | water penny    | -             | 1                |
| 2                | scud           | 3             | 4                |
| 2                | sowbug         | 1             | 1                |
| 2                | black fly      | -             | 1                |
| 3                | aquatic worm   | 25            | 1                |
| 3                | midge          | -             | 1                |
| 3                | crane fly      | 1             | 1                |
| 3                | leech          | 2             | 2                |

$$\text{Beck's Index} = 2(1) + 3 = 5$$

C. Below bridge at Silver Lake: R

| <u>Tolerance</u> | <u>Species</u>        | <u>1. (Riffle)</u> | <u>2. (Run)</u> |
|------------------|-----------------------|--------------------|-----------------|
| 1                | caddis fly(species 1) | 6                  | -               |
| 1                | caddis fly(species 2) | 1                  | 1               |
| 1                | riffle beetle         | 2                  | 1               |
| 1                | water penny           | 4                  | -               |
| 1                | hellgramite           | 1                  | -               |
| 1                | may fly               | 1                  | 3               |
| 2                | sowbug                | 2                  | 10              |
| 2                | scud                  | 10                 | 8               |
| 2                | crayfish              | 1                  | -               |

|   |         |   |   |
|---|---------|---|---|
| 3 | leech   | 6 | 5 |
| 3 | redworm | 2 | 2 |
| 3 | midge   | 2 | 2 |

$$\text{Beck's Index} = 1(6) + 3 = 15$$

- D. End of Loantaka Road - After passing under Interstate 287.

| <u>Tolerance</u>         | <u>1. (Riffle)</u> | <u>2. (Run)</u> | <u>Total</u> |
|--------------------------|--------------------|-----------------|--------------|
| 1 caddis fly (species 2) | 1                  | -               | 1            |
| 2 sowbug                 | -                  | 4               |              |
| 2 scud                   | 5                  | 1               |              |
| 3 redworm                | 1                  | 5               |              |
| 3 midge                  | 1                  |                 |              |

$$\text{Beck's Index} = 2(1) + 2 = 4$$

- E. Below Spring Lake

| <u>Tolerance</u>     | <u>1. (fast run)</u> |
|----------------------|----------------------|
| 1 riffle beetle      | 11                   |
| 1 caddis (species 2) | 1                    |
| 1 water penny        | 1                    |
| 2 scud               | 2                    |
| 2 sowbug             | 2                    |
| 2 black fly          | 2                    |
| 2 scud (green)       | 1                    |
| 3 redworm            | 2                    |
| 3 leech              | 3                    |
| 3 midge              | 3                    |

$$\text{Beck's Index} = 2(3) + 3 = 9$$

2. Black Brook

- A. Below bridge - Southern Boulevard

| <u>Tolerance</u> |    |
|------------------|----|
| 1 riffle beetle  | 1  |
| 2 black fly      | 3  |
| 3 pouch snail    | 1  |
| 3 red worm       | 12 |
| 3 leech          | 4  |

$$\text{Beck's Index} = 2(1) + 1 = 3$$

- B. On channelized reach feeding waters from Chatham S.T.P. to Black Brook

| <u>Tolerance</u> | <u>1. (slow run)</u><br>Number |
|------------------|--------------------------------|
| 2 dragonfly      | 12                             |
| 2 damsel fly     | over 50                        |
| 3 midge          | over 25                        |
| 3 redworm        | over 25                        |

Beck's Index = 2

3. Loantaka Brook

- A. Below Green Village Road

| <u>Tolerance</u> | <u>1</u> | <u>2</u> | <u>3</u> |
|------------------|----------|----------|----------|
| 2 sowbug         | 3        | 15       | 5        |
| 2 blackfly       | 25       | -        | 2        |
| 3 midge          | 21       | -        | -        |
| 3 no-see-um      | -        | 1        | -        |

Beck's Index = 2

- B. Below park pond off Kitchel Avenue

| <u>Tolerance</u> | <u>1. (Riffle)</u> |
|------------------|--------------------|
| 2 black fly      | 1                  |
| 2 damsel fly     | 1                  |
| 3 midge          | over 50            |
| 3 redworm        | over 100           |
| 3 leech          | over 50            |

Beck's Index = 2

Note: Waters enriched - most blue-green algae than any site. Large numbers of bluegills present. Waters slightly greenish.

- C. Below Seaton Hackney Farm, below Woodland S.T.P.

| <u>Tolerance</u> |     |
|------------------|-----|
| 3 redworms       | 50+ |
| 3 midge          | 3   |
| 3 mosquito cases | 15  |

Beck's Index = 0

Note: Water clear, antiseptic odor, extensive bank erosion and deposition.

D. Above Seaton Hackney; above STP - branch of stream.

| <u>Tolerance</u> | <u>1.(Run)</u> | <u>2.(Riffle)</u> |
|------------------|----------------|-------------------|
| 3 redworms       | 40±            | 1                 |
| 3 midges         | 2              | -                 |
| 3 ag. earthworm  | 2              | -                 |

Beck's Index = 0

Note: Much less flow than below STP. Banks more stable.  
Little substrate.

4. Passaic River

A. Below Lee's Hill Road & Osborne Pond

| <u>Tolerance</u>          | <u>1.(Riffle)</u> | <u>2.(Run)</u> |
|---------------------------|-------------------|----------------|
| 1 riffle beetle           | 3                 | 1              |
| 1 gilled snail (rt. open) | 5                 | -              |
| 1 water penny             | 4                 | -              |
| 1 freshwater clam         | 3                 | -              |
| 1 may fly                 | -                 | 1              |
| 2 scud                    | 5                 | 2              |
| 3 leech                   | 20                | 7              |
| 3 pouch snail (left open) | 2                 | -              |
| 3 horse fly               | 2                 | -              |
| 3 orb snail               | 2                 | -              |
| 3 aq. earthworm           | 3                 | -              |

Beck's Index =  $2(5) + 1 = 11$

B. Just below Interstate 287.

| <u>Tolerance</u> | <u>1.(Riffle)</u> | <u>2.(Run)</u> |
|------------------|-------------------|----------------|
| 1 water penny    | -                 | 2              |
| 1 hellgramite    | 2                 | -              |
| 1 caddis fly     | 8                 | -              |
| 1 may fly        | 3                 | -              |
| 1 stone fly      | 1                 | 1              |
| 1 riffle beetle  | 1                 | -              |
| 2 scud           | -                 | 1              |
| 3 midge          | 5                 | 5              |
| 3 leech          | 3                 | 4              |

Beck's Index =  $2(6) + 1 = 13$

C. Below confluence with Indian Grove Brook

| <u>Tolerance</u>       | <u>1.(Riffle)</u> | <u>2.(Run)</u> |
|------------------------|-------------------|----------------|
| 1 water penny          | 3                 | -              |
| 1 stone fly(species 1) | 6                 | -              |
| 1 stone fly(species 2) | 2                 | 3              |
| 1 may fly              | -                 | 4              |
| 1 riffle beetle        | 1                 | -              |
| 1 caddis fly           | 1                 | 1              |
| 3 redworms             | 1                 | 3              |

$$\text{Beck's Index} = 2(6) = 12$$

5. Primrose Brook

A. Below Lee's Hill Road

| <u>Tolerance</u> | <u>1</u> | <u>2</u> | <u>3</u> |
|------------------|----------|----------|----------|
| 1 water penny    | -        | -        | 1        |
| 1 stone fly      | 3        | -        | -        |
| 1 may fly        | 1        | 1        | 4        |
| 1 caddis fly     | -        | -        | 21       |
| 1 hellgramite    | -        | -        | 1        |
| 1 riffle beetle  | -        | -        | 1        |
| 2 sowbug         | 7        | 4        | 4        |
| 2 blackfly       | -        | -        | 1        |
| 3 leech          | 1        | -        | 1        |
| 3 ag. earthworms | -        | 3        | 4        |
| 3 midge          | 4        | 4        | -        |

$$\text{Beck's Index} = 2(6) + 2 = 14$$

B. Below Bailey's Mill Road

| <u>Tolerance</u>       | <u>1.(Run)</u> | <u>2.(Riffle)</u> |
|------------------------|----------------|-------------------|
| 1 stone fly(species 1) | -              | 2                 |
| 1 stone fly(species 2) | 16             | -                 |
| 1 caddis fly           | -              | 2                 |
| 1 may fly              | -              | 2                 |
| 2 alder fly            | 1              | -                 |
| 3 redworm              | 2              | 10                |
| 3 midge                | -              | 1                 |
| 3 aq. earthworm        | 1              | -                 |

$$\text{Beck's Index} = 2(4) + 1 = 9$$

C. Below Tempe Wick Road

Tolerance

1. (Riffle)    2. (Run)

|                        |    |   |
|------------------------|----|---|
| 1 hellgramite          | 1  | - |
| 1 stone fly(species 2) | 26 | 5 |
| 1 stone fly(species 1) | 2  | - |
| 1 may fly(species 1)   | 5  | 4 |
| 1 may fly(species 2)   | 2  | - |
| 1 water penny          | 1  | 2 |
| 2 crayfish             | 1  | - |
| 2 alder fly            | 1  | - |
| 2 black fly            | 1  | - |
| 3 midge                | 1  | - |
| 3 redworm              | 5  | 4 |

$$\text{Beck's index} = 2(6) + 3 = 15$$