Prepared by: Emmons & Olivier Resources, Inc.
for the Lower St. Croix Watershed Management Organization

# Trout Brook Management Plan

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EOR water ecology community

Lower St. Croix Watershed
Management Organization

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## PLAN DEVELOPMENT

The Lower St. Croix Watershed Management Organization (LSCWMO) contains numerous high quality water resources. Protection of these resources is critical to maintaining the ecological integrity of the watershed, providing diversity of fish and wildlife habitats, maintaining unique natural communities, and contributing to the protection of key recreational areas including the St. Croix and Mississippi Rivers. As identified in the 2005 LSCWMO Watershed Management Plan, Trout Brook has been identified by the LSCWMO as one of the highest priority water resources in the watershed. This stream is groundwater supported and provides habitat and water temperatures suitable for trout. Do to urbanization, trout streams are rare in the Metro Area and their protection has been identified as a priority by the MN Department of Natural Resources (DNR).

The need to effectively manage this important LSCWMO resource was identified in the LSCWMO Watershed Management Plan. The following Trout Brook Management Plan was developed for the ongoing protection of this unique resource. The Trout Brook Management Plan consisted of two primary phases. The first phase consisted of data collection, data review, and analysis. The second phase, the public participation process, consisted of landowner and public meetings, along with agency representatives and the LSCWMO Board. During the first meetings, stream data issues were presented to the groups, after which residents discussed concerns and future goals for the stream. Short and long term goals for the stream were first discussed. The implementation plan was then addressed with meeting participants giving input regarding how Trout Brook will be able to meet future goals.

## GENERAL DESCRIPTION & LOCATION OF RESOURCE

(Modified from WCD and LSCWMO. 2001)
Trout Brook Subwatershed is within the Lower St. Croix Watershed Management Organization. Trout Brook watershed boundary, as well as the main channel and tributaries are located within Denmark Township and the City of Afton. Trout Brook channel commences as an intermittent channel at approximately the center of the southeast quarter, of Section 30, Afton, then flows south approximately one mile, and continues east into the St. Croix River a distance of 31,000 feet (5.87 miles). The perennial reach of the channel begins in the SW1/4, SE1/4, Section 32, in Afton, flowing for a distance of 14,000 feet (2.7 miles). The starting elevation of Trout Brook is approximately 1000 feet, with an outlet elevation into the St. Croix River at approximate elevation of 676 feet. Trout Brook watershed has a total area of 4893 acres.

Trout Brook is identified as a DNR-protected waterbody from the St. Croix River confluence to the 50th Street crossing, approximately at the north line of section 31 in Afton. Trout Brook is not currently a designated trout stream, as determined by the Minnesota Department of Natural Resources.

## EXISTING DATA

*Washington Conservation District (WCD). 2002. Demark Township Water Resource Evaluation. Prepared for Washington County & Barr Engineering Company (Barr). 2002. Maintaining and Enhancing Environmental Quality in Denmark Township; A Natural Resources Inventory with Stewardship Recommendations. Prepared for Washington County.*

Relevant Content

Inventories of both natural communities and water resources completed in 2002. Plant communities and land cover were identified and mapped with the MLCCS throughout the Township. Additionally, seeps, springs, and areas of streambank erosion were identified within the Trout Brook watershed. Detailed mapping of potential sediment delivery pathways to Trout Brook was also completed.

Outcomes of the report included water quality rankings and erosion potential of each subwatershed. All subwatersheds identified in the report received a high water quality ranking that outlet to either the St. Croix or Mississippi Rivers. Trout Brook received a high water quality ranking and recommendations to restore it to a trout producing stream.

See Appendix D for an excerpt of this study

*Schmidt, K. and P. Talmage. 2001. Fish Community Surveys of Twin Cities Metropolitan Area Streams. Minnesota Department of Natural Resources, Special Publication 156*

Relevant Content

The DNR conducted a fish community survey within Trout Brook, as part of an overall fish community survey conducted in 1999 in the Twin Cities. Several brown trout were found within Trout Brook as part of this study. The presence of brown trout indicates the relatively undisturbed nature and high quality of this creek. Groundwater seeps and springs along the creek provide a source of cold water suitable for trout development. Three additional fish species were identified in Trout Brook as part of the study. It is thought that these trout likely moved in from Valley Branch and/or other nearby St. Croix River cold-water tributaries.

*Barr Engineering Company, Washington County & Washington Conservation District. 2005. Integrating Groundwater and Surface Water Management – Southern Washington County.*

Relevant Content

During 2004, the WCD conducted automated stream-flow measurements near the mouth of Trout Brook. Stream flows varied from 0.87 cfs in early June 2004 to 0.13 cfs in November 2004. The median stream flow was 0.42 cfs. Given the small watershed of Trout Brook, most of the flow appears to be groundwater-derived base flow, originating in a fashion similar to the base flow of Valley Creek. Groundwater elevation data suggest that the potentiometric surface of the regional aquifer systems intersect the ground surface of Trout Brook approximately where Trout

Brook becomes a perennial stream. This takes place much closer to the regional discharge feature (the St. Croix River) than Valley Creek, which likely accounts for the lower base flows in Trout Brook, compared to Valley Creek.

Nearly all of southern Washington County is an area of groundwater recharge. Groundwater discharge takes place only in areas where the water table is at or near the ground surface; along the St. Croix River, along the Mississippi River, in the Lake DeMontreville-Lake Jane-Lake Elmo area, in Valley Creek, and in the smaller drainages in Afton and Denmark Township (e.g., Trout Brook).

Valley Creek is the dominant stream in the study area and over 90 percent of its typical flow is base flow derived from groundwater. Regional groundwater pumping has the potential for causing drawdown in the potentiometric head of aquifers, resulting in reduced flow in Valley Creek. This same condition likely also applies to Trout Brook. Thus, the health of these steams is dependent upon maintaining the groundwater contribution. This will pose a challenge to managers as development in the study area progresses.

*Trout Brook Monitoring (Washington Conservation District, 2004-2006)*

Relevant Content

Trout Brook is not routinely monitored. During 2004, 2005 and 2006, the WCD collected stream flow measurements at one location on Trout Brook.

*Stream Survey (MPCA 1998., MNDNR 2000., MNDNR 2005.)*

Relevant Content

Fisheries sampling, temperature data, flow estimation and geomorphological description of multiple reaches. Data was used in part for the Schmidt, K. and P. Talmage. 2001 study.

See Appendices A, B, C for an excerpt of these analysis

## COLLECTED DATA

Knowing what a stream ought to look like and how it ought to behave is important in assessing the impact of flooding in the region of that stream and the health of that stream's ecology and wildlife habitat. Historically, comparing and contrasting streams has been difficult because the overall conceptual model of streams has been too simple to describe the variety of stream morphologies observed in the world's streams and rivers. Dave Rosgen (1996) has developed a method of stream classification that has been used for stream habitat preservation and erosion control.

The purpose of this system is to classify streams based on quantifiable field measurements to produce consistent, reproducible descriptions of stream types and conditions. There are four levels in Rosgen's classification hierarchy: geomorphic characterization (Level 1), morphological description (Level 2), stream condition assessment (Level 3), and validation and monitoring (Level 4). Trout Brook was classified to level 3 via this assessment.

Upon thorough reconnaissance of all perennial flow reaches of Trout Brook, five plausible unique reaches were identified and assessed using the Rosgen classification system. Just downstream of 60th Street, Site A is representative of the headwater

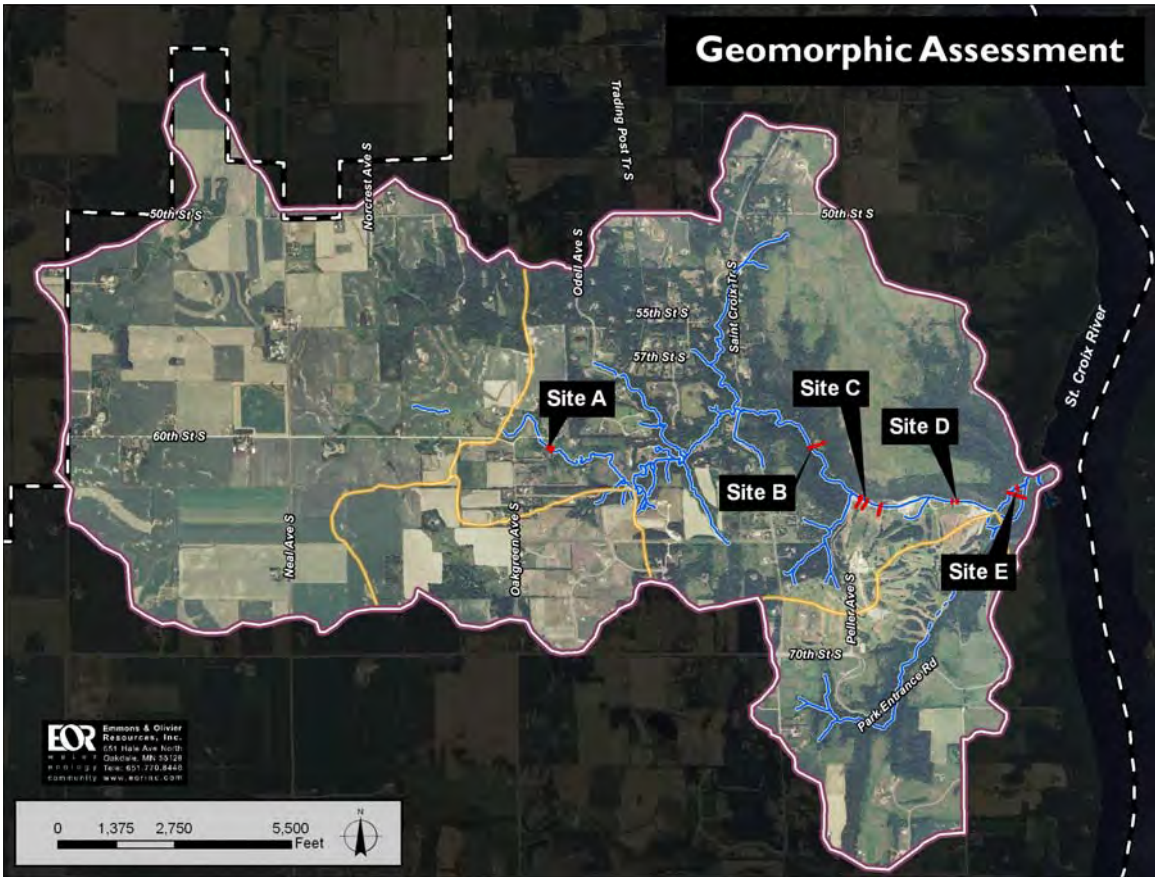


Figure 4.1 – Location of geomorphic assessment

flowage. Site B, located within Afton State Park, is typical of Trout Brook between St. Croix Trail and Afton Alps. Sites C and D, both within Afton Alps, are unique from the rest of the system. Site E, again within Afton State Park is influenced by and located within the St. Croix floodplain. Sites locations are identified in figure 4.1 and a summary of the assessments can be found in figures 4.2 – 4.6

Sites A and E are relatively stable with limited areas of instability and/or bank failure (accelerated erosion), often the result of human disturbance and impact. Located within the floodplain of the St. Croix River, site E is directly influenced by this flowage. Site B, also relatively stable, is over-wide (relative to its stream type) with regular occurrence and has poor riffle-pool definition due to sand embeddedness. Sites C and D have been directly altered (realigned) in the late 1960's and/or early 70's. These human-made reaches exhibit very poor habitat and relative instability. Site C is grossly over-wide with no discernable bank and pool-riffle definition. A 'B' stream has formed within the entrench channel of Site D. This ditch-like channel is confining the stream and subsequently provides poor habitat.

| REACH 'A' SUMMARY | | | | |
|---|---|---|---|---|
| Stream: | Trout Brook | | | |
| Watershed: | LSCWMO | | | |
| Location: | Denmark Township (D.S. of Trading Post Trail) | | | |
| State: | MN | | | |
| County: | Washington | | | |
| Date: | November 18, 2008 | | | |
| Observers: | John Barry, Mike Majeski | | | |
| Channel type: | C4c- | | | |
| Drainage area (sq.mi.): | 3.2 | | | |
| **Dimension** | | typical | min | max |
| floodplain: | width flood prone area (ft) | 73.5 | 63.2 | 83.7 |
| riffle-run: | x-area bankfull (sq.ft.) | 8.8 | 7.4 | 10.1 |
| | width bankfull (ft) | 18.5 | 14.5 | 22.5 |
| | mean depth (ft) | 0.47 | 0.4 | 0.5 |
| | max depth (ft) | 1.8 | 1.7 | 1.9 |
| | hydraulic radius (ft) | 0.4 | | |
| **Dimensionless ratios** | | typical | min | max |
| | width depth ratio | 39.0 | 28.2 | 50.1 |
| | entrenchment ratio | 4.0 | 3.4 | 4.5 |
| | riffle max depth ratio | 3.8 | 3.6 | 3.9 |
| **Pattern** | | typical | min | max |
| | stream length (ft) | 256.5 | | |
| | valley length (ft) | 215.0 | | |
| | Sinuosity | 1.19 | | |
| **Profile** | | typical | min | max |
| | channel slope (%) | 0.94 | | |
| **Channel Materials** | | Channel | | |
| | D50 (mm) | 2.8 | --- | --- |
| **Reference Image** | | | | |

Figure 4.2 – Summary of site 'A' assessment

| REACH 'B' SUMMARY | | | | |
|---|---|---|---|---|
| Stream: | Trout Brook | | | |
| Watershed: | LSCWMO | | | |
| Location: | Denmark Township (Afton State Park) | | | |
| State: | MN | | | |
| County: | Washington | | | |
| Date: | November 18, 2008 | | | |
| Observers: | John Barry, Mike Majeski | | | |
| Channel type: | C4 | | | |
| Drainage area (sq.mi.): | 6 | | | |
| **Dimension** | | typical | min | max |
| floodplain: | width flood prone area (ft) | 283.0 | --- | --- |
| riffle-run: | x-area bankfull (sq.ft.) | 18.1 | --- | --- |
| | width bankfull (ft) | 13.2 | --- | --- |
| | mean depth (ft) | 1.37 | --- | --- |
| | max depth (ft) | 1.9 | --- | --- |
| | hydraulic radius (ft) | 1.3 | | |
| **Dimensionless ratios** | | typical | min | max |
| | width depth ratio | 9.7 | --- | --- |
| | entrenchment ratio | 21.4 | --- | --- |
| | riffle max depth ratio | 1.4 | --- | --- |
| **Pattern** | | typical | min | max |
| | stream length (ft) | 294.7 | | |
| | valley length (ft) | 279.8 | | |
| | Sinuosity | 1.05 | | |
| **Profile** | | typical | min | max |
| | channel slope (%) | 1.2 | | |
| **Channel Materials** | | Channel | | |
| | D50 (mm) | 6.9 | --- | --- |
| **Reference Image** | | | | |

Figure 4.3 – Summary of site 'B' assessment

| REACH 'C' SUMMARY | | | | |
|---|---|---|---|---|
| Stream: | Trout Brook | | | |
| Watershed: | LSCWMO | | | |
| Location: | Denmark Township (Afton Alps) | | | |
| State: | MN | | | |
| County: | Washington | | | |
| Date: | November 14, 2008 | | | |
| Observers: | John Barry, Mike Majeski | | | |
| Channel type: | B4a | | | |
| Drainage area (sq.mi.): | 6.2 | | | |
| **Dimension** | | typical | min | max |
| floodplain: | width flood prone area (ft) | 34.7 | 31.9 | 36.9 |
| riffle-run: | x-area bankfull (sq.ft.) | 18.0 | 16.0 | 19.9 |
| | width bankfull (ft) | 27.2 | 23.2 | 33.5 |
| | mean depth (ft) | 0.66 | 0.6 | 0.7 |
| | max depth (ft) | 1.3 | 1.1 | 1.4 |
| | hydraulic radius (ft) | 0.7 | | |
| **Dimensionless ratios** | | typical | min | max |
| | width depth ratio | 41.0 | 33.6 | 56.3 |
| | entrenchment ratio | 1.3 | 1.2 | 1.4 |
| | riffle max depth ratio | 1.9 | 1.7 | 2.2 |
| **Pattern** | | typical | min | max |
| | stream length (ft) | 764.6 | | |
| | valley length (ft) | 733.6 | | |
| | Sinuosity | 1.04 | | |
| **Profile** | | typical | min | max |
| | channel slope (%) | 0.76 | | |
| **Channel Materials** | | Channel | | |
| | D50 (mm) | 9.4 | --- | --- |
| **Reference Image** | | | | |

Figure 4.4 – Summary of site 'C' assessment

| REACH 'D' SUMMARY | | | | |
|---|---|---|---|---|
| Stream: | Trout Brook | | | |
| Watershed: | LSCWMO | | | |
| Location: | Denmark Township (Afton Alps) | | | |
| State: | MN | | | |
| County: | Washington | | | |
| Date: | November 14, 2008 | | | |
| Observers: | John Barry, Mike Majeski | | | |
| Channel type: | B4a | | | |
| Drainage area (sq.mi.): | 6.2 | | | |
| **Dimension** | | typical | min | max |
| floodplain: | width flood prone area (ft) | 24.6 | 23.5 | 25.7 |
| riffle-run: | x-area bankfull (sq.ft.) | 21.2 | 18.9 | 23.5 |
| | width bankfull (ft) | 17.3 | 16.8 | 17.8 |
| | mean depth (ft) | 1.23 | 1.1 | 1.4 |
| | max depth (ft) | 2.2 | 2.1 | 2.2 |
| | hydraulic radius (ft) | 1.1 | | |
| **Dimensionless ratios** | | typical | min | max |
| | width depth ratio | 14.1 | 12.0 | 16.7 |
| | entrenchment ratio | 1.4 | 1.4 | 1.5 |
| | riffle max depth ratio | 1.8 | 1.7 | 1.8 |
| **Pattern** | | typical | min | max |
| | stream length (ft) | 352.8 | | |
| | valley length (ft) | 349.7 | | |
| | Sinuosity | 1.01 | | |
| **Profile** | | typical | min | max |
| | channel slope (%) | 0.48 | | |
| **Channel Materials** | | Channel | | |
| | D50 (mm) | 6.9 | --- | --- |
| **Reference Image** | | | | |

Figure 4.5 – Summary of site 'D' assessment

| REACH 'E' SUMMARY | | | | |
|---|---|---|---|---|
| Stream: | Trout Brook | | | |
| Watershed: | LSCWMO | | | |
| Location: | Denmark Township (Afton State Park) | | | |
| State: | MN | | | |
| County: | Washington | | | |
| Date: | November 17, 2008 | | | |
| Observers: | John Barry, Mike Majeski | | | |
| Channel type: | C4 | | | |
| Drainage area (sq.mi.): | 8.4 | | | |
| **Dimension** | | typical | min | max |
| floodplain: | width flood prone area (ft) | 387.4 | --- | --- |
| riffle-run: | x-area bankfull (sq.ft.) | 24.3 | --- | --- |
| | width bankfull (ft) | 17.0 | --- | --- |
| | mean depth (ft) | 1.43 | --- | --- |
| | max depth (ft) | 2.4 | --- | --- |
| | hydraulic radius (ft) | 1.3 | | |
| **Dimensionless ratios** | | typical | min | max |
| | width depth ratio | 11.9 | --- | --- |
| | entrenchment ratio | 22.8 | --- | --- |
| | riffle max depth ratio | 1.7 | --- | --- |
| **Pattern** | | typical | min | max |
| | stream length (ft) | 387.2 | | |
| | valley length (ft) | 230.6 | | |
| | Sinuosity | 1.68 | | |
| **Profile** | | typical | min | max |
| | channel slope (%) | 0.46 | | |
| **Channel Materials** | | Channel | | |
| | D50 (mm) | 2.8 | --- | --- |
| **Reference Image** | | | | |

Figure 4.6 – Summary of site 'E' assessment

## EXISTING CONDITIONS

Each inventory and study that has analyzed Trout Brook and/or this region of Washington County has labeled Trout Brook as a resource of special concern and high value. Although limited, due to recent findings of Brown Trout and high percentage of groundwater contribution to baseflow, Trout Brook is seen as having high potential for supporting species of its namesake.

Stream Evolution and Stability

Significant disturbances have occurred within the basin over the last 125 years and subsequently Trout Brook has been responding to these changes. Typically major disturbances, such as conversion of a forested landscape to agriculture production, which has occurred in this basin, result in stream instability and an evolutionary response to coincide with the changes in hydrology and/or sediment delivery. As evident in the 1938 aerial photography (see figure 5.1), the earliest photography of this area, the conversion of forest to agriculture has already occurred. This date precedes the soil conservation movement and soil erosion and downstream sedimentation is very evident. Extreme soil loss in the headwaters was deposited in the lower gradient reaches of present day Afton Alps and Afton State Park. Due to overwhelming sediment loads these reaches likely aggraded, which is supported by the lack of vegetation and presence of braided channels.

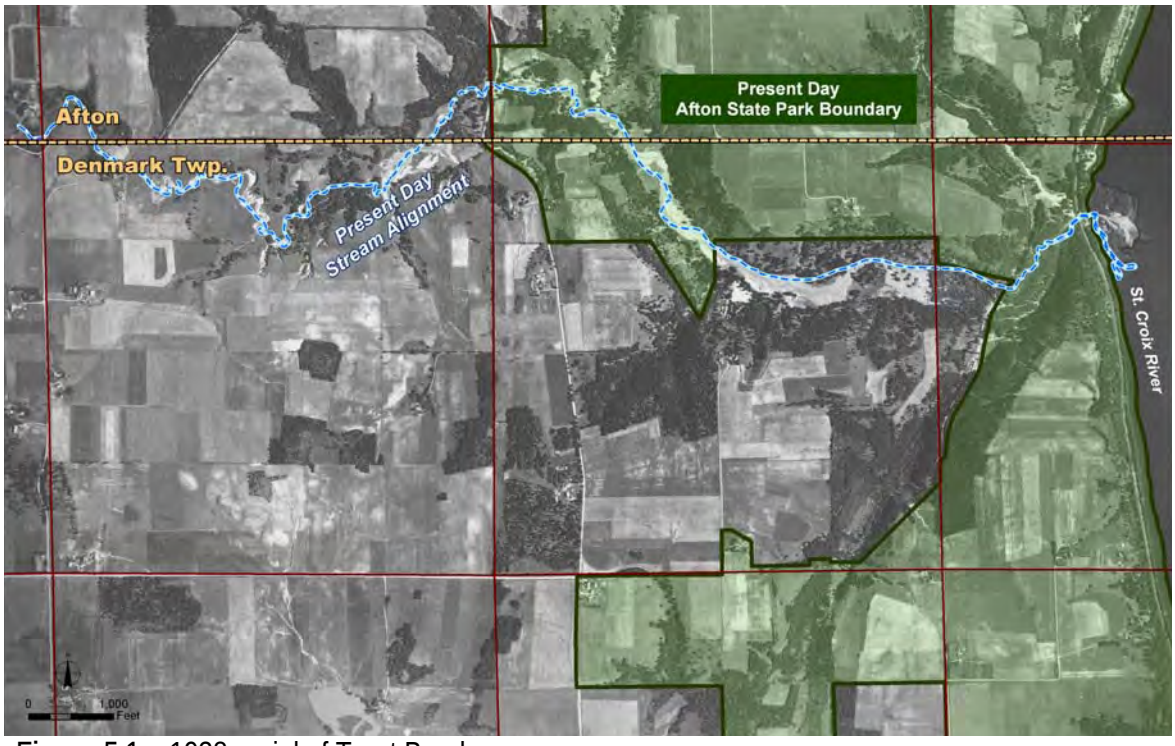


Figure 5.1 – 1938 aerial of Trout Brook

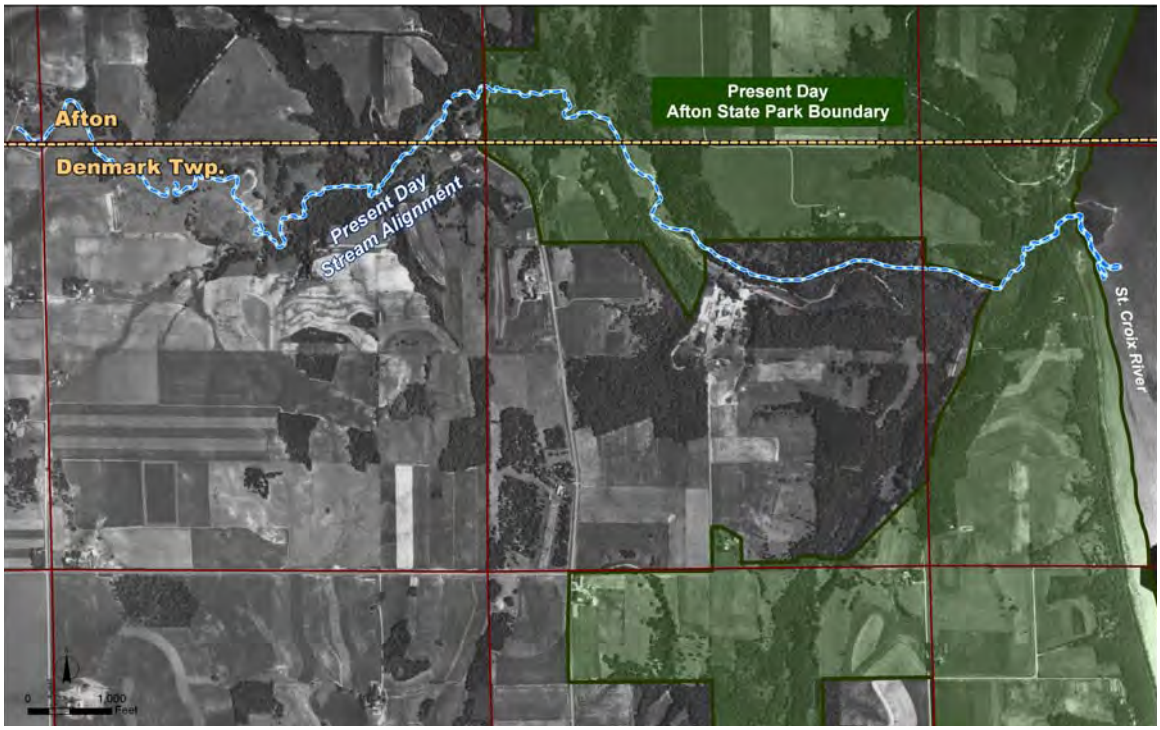


Figure 5.2 – 1964 aerial of Trout Brook

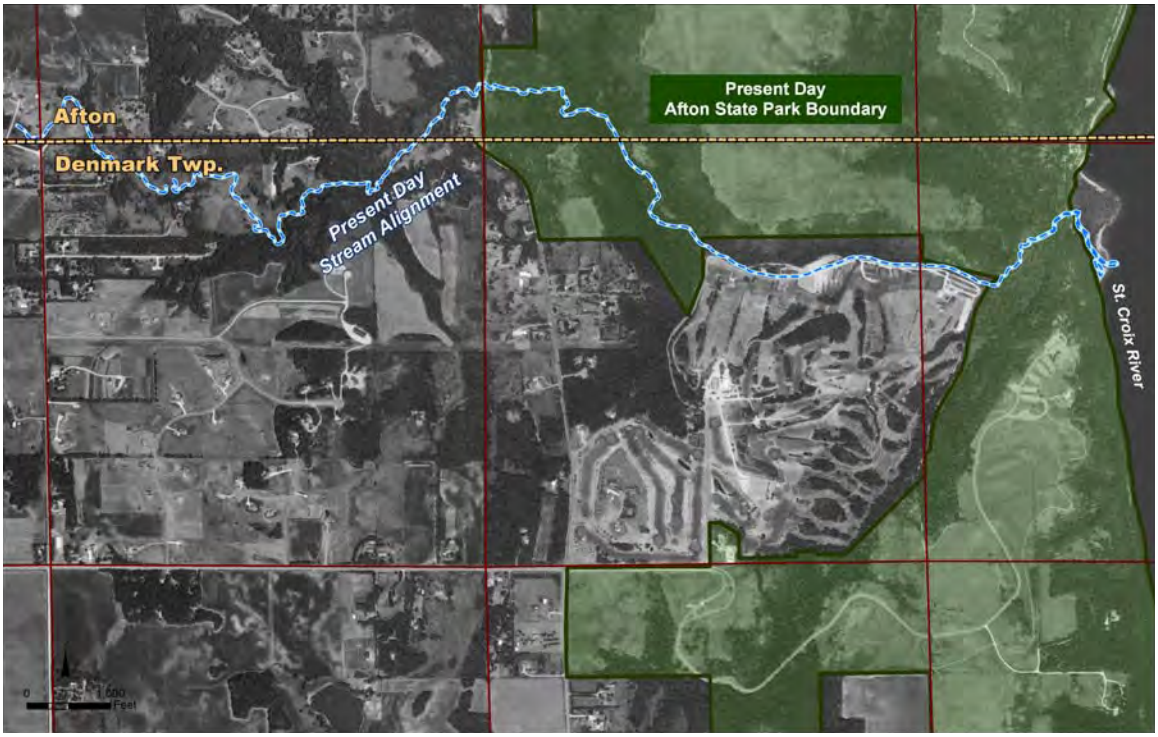


Figure 5.3 – 2006 aerial of Trout Brook

By 1964 (see figure 5.2) significant soil conservation practices are in place (as evident in the contour farming) and Trout Brook is responded to a reduction in sediment delivery. In response a more defined steam channel is apparent and riparian plant species began colonizing the floodplain of these same lower gradient reaches of present day Afton Alps and Afton State Park. Afton Alps is in its infancy at this time.

Trout Brook is still responding to the significant disturbances of the last century and seeking a balance with more recent disturbances. As illustrated in the 2006 aerial photography (figure 5.3), residential development is replacing agriculture as the dominant landuse and the water course through Afton Alps has been rerouted to make room for this growing business. Further reductions in grazing and row-cropping have resulted in a reforestation response with the Afton State Park and Afton Alps reaches.

Stream Flows

The Washington Conservation District conducted automated stream-flow measurements near the mouth of Trout Brook in 2004, 2005 and 2006. This data was analyzed and calibrated by Emmons and Olivier Resources, Inc. Typical base flows ranged from extended weeks around 4.5cfs to extended weeks less than 1cfs. Fourteen precipitation related spikes exceeding 15cfs were witnessed over the 3 years and three events exceeding 30cfs were recorded over this period of record. A summary of the flow data can be found in Figures 5.4 – 5.6.

Groundwater elevation data suggest that the potentiometric surface of the regional aquifer systems intersect the ground surface of Trout Brook approximately where Trout

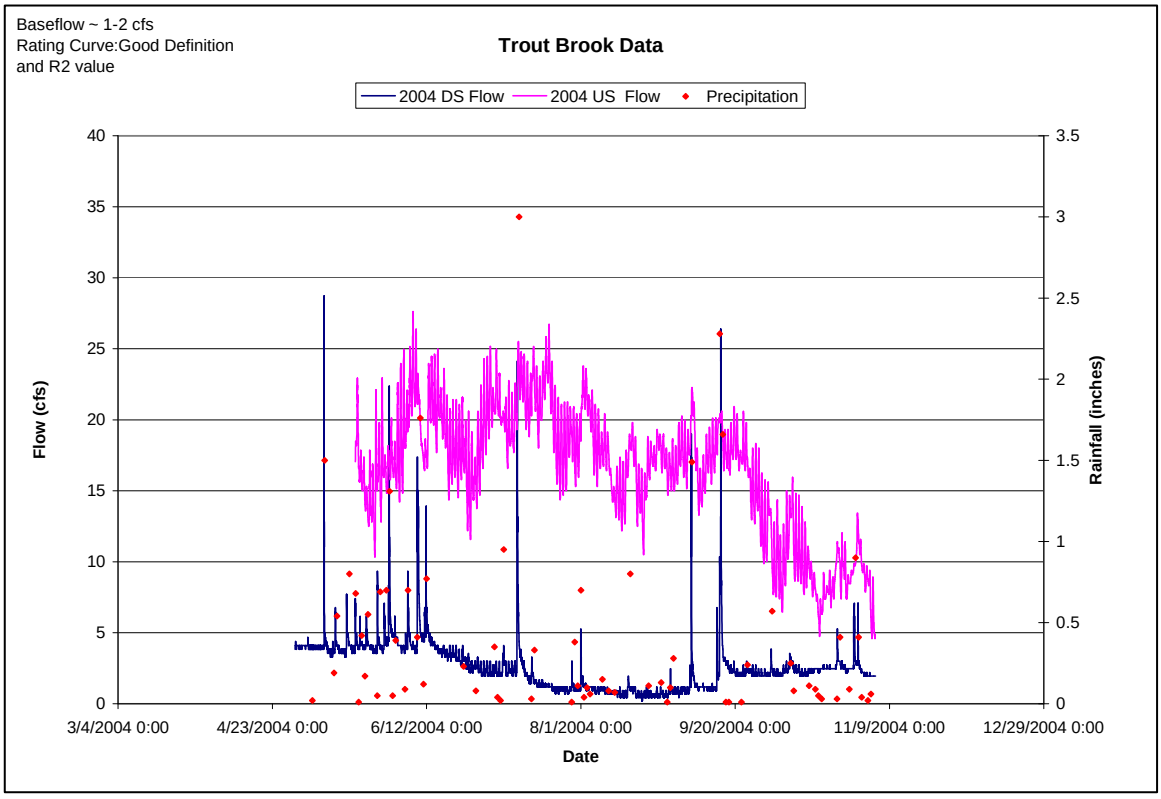


Figure 5.4 – 2004 Trout Brook flow data

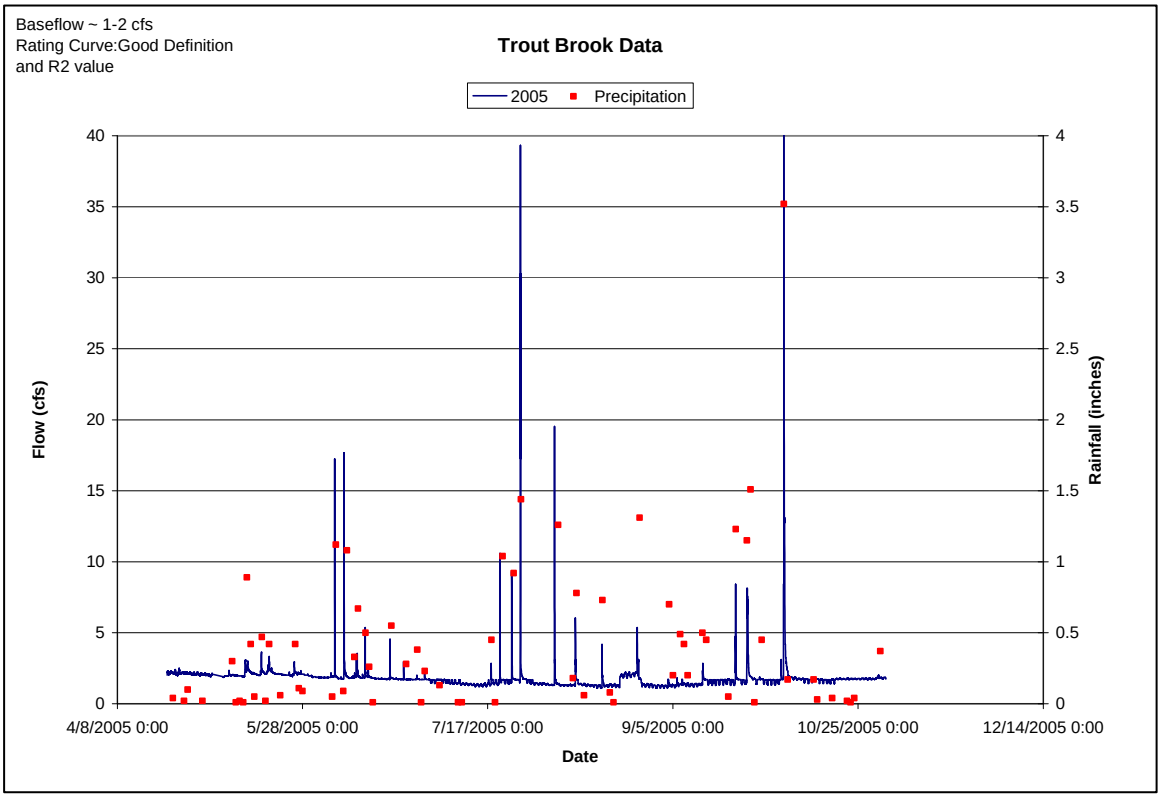


Figure 5.5 – 2005 Trout Brook flow data

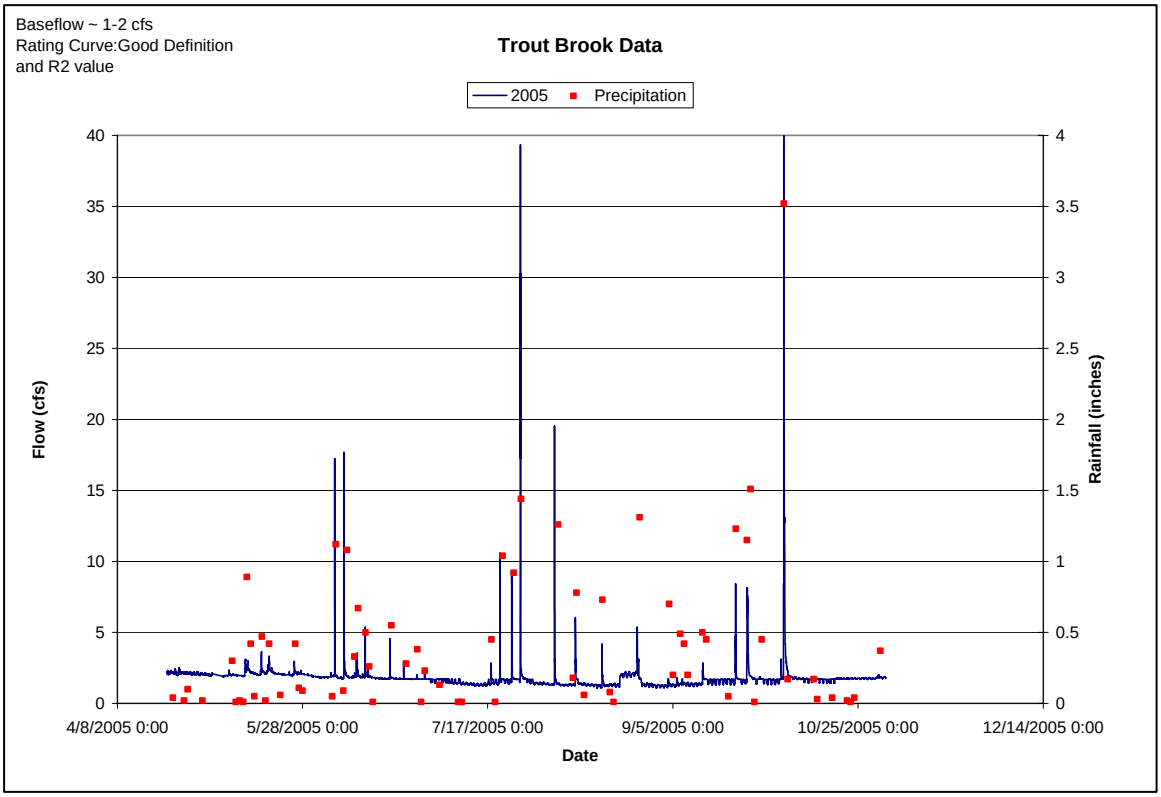


Figure 5.6 – 2006 Trout Brook flow data

Brook becomes a perennial stream. This takes place much closer to the regional discharge feature (the St. Croix River) than Valley Creek, which likely accounts for the lower base flows in Trout Brook, compared to Valley Creek (Barr 2005).

Discussion of Fishery

Low base flow and a lack of well-developed pool-riffle sequences limit suitability for cold-water and warm-water species. Do to its relatively small drainage area Trout Brook derives most of its flow from base flow. This flow has likely been reduced by the conversion of the watershed landscape from prairie, forest and wetlands to agriculture, residential dwellings and ski resort and subsequent groundwater demand. Do to the exorbitant amount of recent and historic sedimentation the pools are embedded with sand and fines. The result is inadequate habitat and holding space for invertebrates and fish.

Elevated temperatures above tolerances are limiting cold water species. Stream temperatures are too high for trout, except for a limited reach downsteam of Afton Alps to the St. Croix confluence, which coincides with the area of most significant groundwater contribution.

## MANAGEMENT & IMPROVEMENT RECOMMENDATIONS

### Instream Recommendations

*Specific to Afton Alps Reach of Trout Brook*

Improving the reach of Trout Brook through Afton Alps is essential to improving this resource. The reach is the most degraded reach of the system, but it holds the greatest potential, as the majority of the base flow is daylighted within this reach. Historic infrastructure encroachment and manipulation of the floodplain will pose challenges to any improvement, but solutions do exist that benefit the resource and Afton Alps. It is understood that since improvements benefit the community, matching public funding will likely be necessary to implement most solutions. It is also understood that some solutions may limit certain business operations and therefore concessions and/or collaborative partnerships may need to be made to balance the give-and-take necessary to improve the resource. The viable recommendations in figure 6.1, which benefit both the land owner and the resource, were explored with Afton Alps and LSCWMO managers.

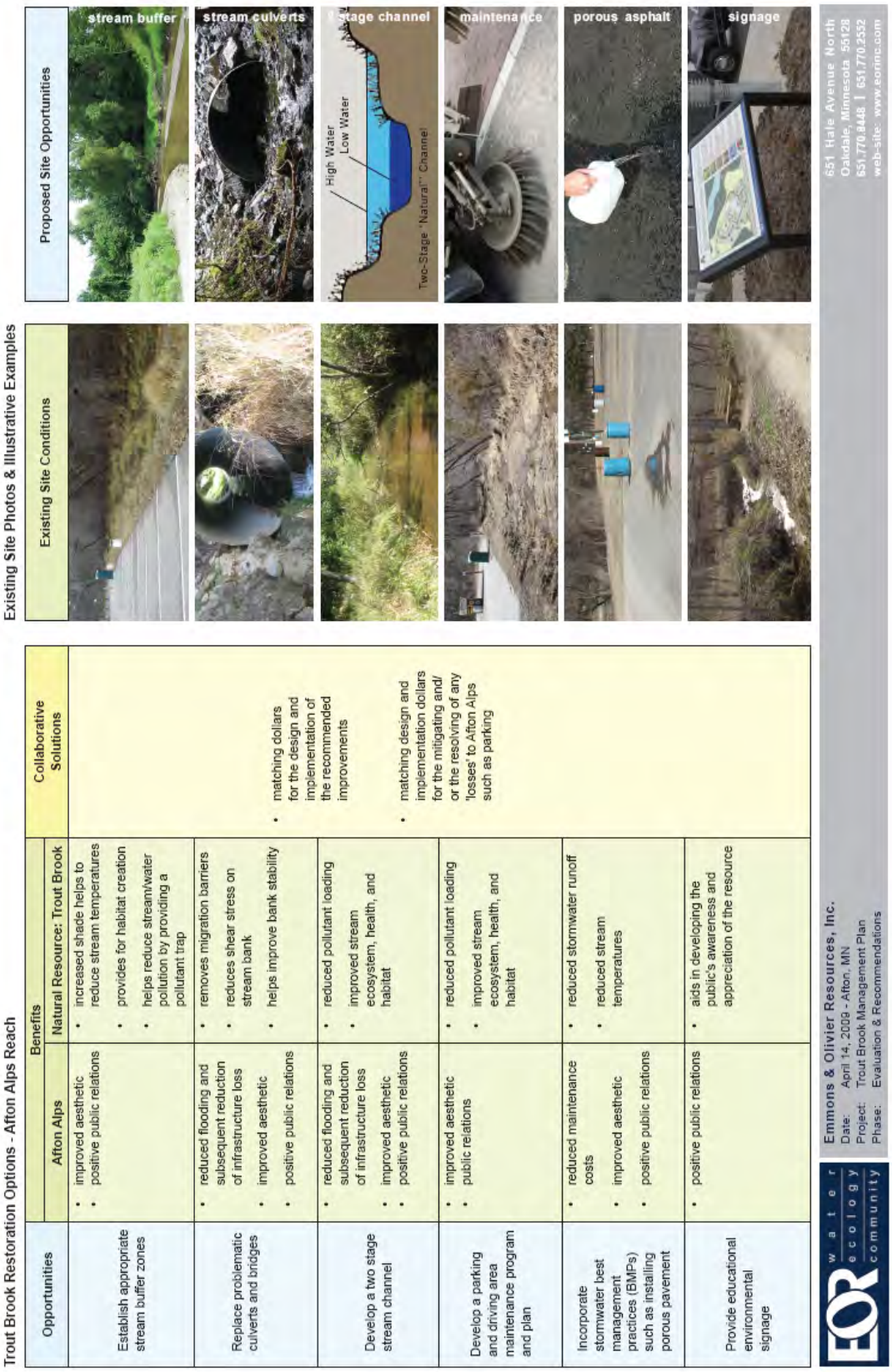


Figure 6.1 – Specific recommendations for Afton Alps Reach

*All reaches of Trout Brook and Tributaries:*

*Instream Impoundments* – prior surveys have questioned the benefits and impacts of the man-made pond near the intersection of Oakgreen Avenue and 60th Street as well as smaller impoundments within the area. One concern is that the large area of the impoundment(s) is artificially warming surface waters and subsequently raising the temperature of stream base flows. Of additional concern is the probability that the pond is promoting fish and plant species that are in conflict with cold-water flora and fauna. These theories should be evaluated and if detrimental impacts are verified, modifications to these impoundments should be pursed to limit their impact.

*General Guidelines for Grazing Riparian Areas* – Although limited in the Trout Brook watershed, grazing is currently conducted within the stream, corridor. The impacts of livestock grazing riparian areas include manure and urine deposited directly into or near surface waters where leaching and runoff can transport nutrients and pathogens into the water. Unmanaged grazing may accelerate erosion and sedimentation into surface water, change stream flow, and destroy aquatic habitats. Improper grazing can reduce the capacity of riparian areas to filter contaminates, shade aquatic habitats, and stabilize streambanks. The negative impacts of livestock grazing riparian areas can be prevented, minimized, or improved by controlling when, where, how long, and with what intensity livestock graze the forages in the riparian area. There are many USDA extension related references for Live Stock Stream Crossings, Livestock Exclusions and Controlled Grazing.

*Stream Crossings* – Improperly designed crossings and/or the density of crossings can have devastating effects on the stability and health of a water course. In conjunction with the WMO's rules and regulations (6.0), the siting of additional crossings on Trout Brook and its tributaries is discouraged. Replacement and new crossing shall follow the WMO's submittal and design criteria to maintain stream stability, conveyance capacity, and the ability to transport, without adverse effect, the flows and detritus of its watershed. Specifically:

1) The portion of a road, highway, utility, or associated structure that crosses the bed or bank of any waterbody shall not be installed, modified, or replaced without first demonstrating a public benefit and ensuring that the crossing will retain adequate hydraulic capacity and navigational capacity if applicable, preserve wildlife passage along each bank, not adversely affect water quality, and represent the "minimal impact" solution to a specific need with respect to all other reasonable alternatives. Projects must follow the DNR manual Best Practices for Meeting DNR General Public Waters Work Permit GP 2004-0001, when applicable.
2) Analysis is required demonstrating the stream's physical characteristics and the effect of the project on hydraulic capacity and water quality.
3) Construction must be timed to take advantage of seasons with no or low stream flow.
4) Construction must be timed to avoid spawning seasons if applicable.
5) Sizing and placement of stream crossings

a) Regardless of the stream's width to depth ratio (bankfull width/mean depth), minimum culvert width shall match or exceed stream bankfull width (water surface width at discharge associated with the 1.5-year return period). Combined width of multiple culverts is satisfactory.
b) Culvert length shall extend beyond side slope toe.
c) Slope of culvert shall match stream thalweg slope.
d) Culverts shall be buried 1/6th of their height.
e) When using multiple culverts, offset culvert inverts. Use the fewest and largest multiples possible.
f) A minimum vertical separation of 1foot is required between the lowest placed culvert and multiples.
g) Alignment of culvert shall match stream alignment.

*Stream Bank Stabilization* – Although some stabilization projects may be a temporary band-aid and others may permanently lock a stream into place with negative consequences, bank stabilization is often required when infrastructure is threatened and/or restoration is not a feasible option. The stream bank erosion sites identified via the Washington Conservation District 2001/2002 data gathering exercise should be re-evaluated. Highly disturbed sites, exacerbated by human disturbance rather than natural occurrence should be prioritized and addressed. Natural approaches to streambank restoration (often called bioengineering) should be favored over hard-armor or other structural solutions. The key to successful stabilization is an understanding of the natural processes that are causing destabilization at each location.

*Restoration* – aside from the apparent need within the Afton Alps reach, the need for channel restoration is less apparent. The most significant benefits to channel stability will come in the form of watershed improvements. That being said the impoundments built through the headwaters, likely for erosion control and "wildlife habitat improvement" should be evaluated. Removal or modification of improper facilities and water course restoration will improve adjacent and downstream habitat.

Watershed Recommendations

*Groundwater wells* - Regional groundwater pumping for irrigation, potable water and snow making has the potential for causing drawdown in the head of aquifers, resulting in reduced flow in Trout Brook. Thus, the health of this stream is dependent upon maintaining the groundwater contribution. Watershed managers should advocate for conservation, reclamation and efficient water use practices. This will pose a challenge to managers as development in the study area progresses.

*Identification and protection of the groundwater recharge areas* - Groundwater is susceptible to contamination when unrestricted development occurs within significant groundwater recharge areas. Groundwater recharge is also threatened by inappropriate landuse practices. It is therefore necessary to manage land use within groundwater recharge areas in order to ensure that pollution threats are minimized and recharge is maintained. Protect groundwater quality by ensuring that any development that occurs within the basin shall have no adverse effect on groundwater quality and quantity. Relative to stormwater management the karst geology of the watershed should be taken

into account. See *Integrating Groundwater and Surface Water Management – Southern Washington County* for more information on local karst geology.

*Road maintenance* – Many reaches of Trout Brook are sand-filled, with a lack of well-developed pool-riffle sequences. This is due in part to noticeable high volumes of fines and sand contributed from road sanding and gravel road maintenance. Road maintenance and road improvements should be put in place to minimize this contribution.

*Agriculture Best Management Practices* – Portions of the basin's headwaters are actively farmed and artificially drained for agriculture production. Recent advancements in conservation drainage technologies have shown to reduce nutrient loading, increase groundwater recharge and improve productivity. Conservation drainage is a term that symbolizes drainage with both crop production and environmental objectives in mind. It typically involves the implementation of one or more practices that mitigate unwanted environmental effects while still providing for, and in some cases, improving productivity benefits of artificial drainage systems. Conservation Drainage and other agriculture best management practices should be promoted to improve the quality of surface and subsurface waters and increase groundwater recharge.

## EXECUTIVE SUMARY

Do to the significant disturbances caused by the pre-soil conservation movement agriculture practices and recovery post soil conservation progress, Trout Brook is likely healthier now than it was in the early 20th century. Given enough time without addition disturbances Trout Brook would fully recover and would likely be hospitable for fish species of it name sake, but more recent and present disturbances are delaying and altering this recovery.

While there are positive signs, such as the finding of Brown Trout by a DNR survey in 2001, it is known with relatively certainty that these particular specimens likely moved in from nearby cold-water streams and that presently Trout Brook can not support the full life-cycle of trout. Regardless of whether restoring the stream to support trout is a goal, there are numerous undertakings that can be implemented to improve the resource as a fishery (warm & cold water), for passive and active recreation, to support non-game species and natural plant communities and to restore the waters of the St. Croix River

The recommendations included in this report range from large undertakings, across parcel boundaries, to do-it-yourself residential projects. The more significant undertakings will require the collaboration of multiple private and public stakeholders and will likely require some public funding to implement. Education and public assistance will be required to accomplish a meaningful number of the lot-by-lot projects across the watershed. To truly improve or restore the waters of Trout Brook projects across both scales will need to be implemented.

## REFERENCES

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Washington Conservation District and Lower St. Croix Valley Watershed Management Organization. 2001. City of Afton Natural Resource Inventory Water Resource Evaluation.

Washington Conservation District (WCD). 2002. Demark Township Water Resource Evaluation. Prepared for Washington County & Barr Engineering Company (Barr). 2002. Maintaining and Enhancing Environmental Quality in Denmark Township; A Natural Resources Inventory with Stewardship Recommendations. Prepared for Washington County.

# APPENDIX A:

## 1999 MPCA Stream Survey

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# STREAM VERIFICATION FORM

MPCA

99SC001

| Field Number: | Date of Visit (M/D/Y): |
|---|---|
| 99TC014 | 6/4/99 |
| **Stream Name:** | **Crew:** |
| Trout Run Brook | KS JT |

## STREAM VERIFICATION INFORMATION

**Stream Verified By** (check all that apply): ☑ GPS ☐ Local Contact ☐ Signs ☐ Roads ☐ Topo. Map ☐ Other (describe here) ☐ Not Verified (explain in comments)

| COORDINATES | LATITUDE | LONGITUDE | TYPE of GPS |
|---|---|---|---|
| Emap: | 44.8582° | ° ' . " | ☐ 2D |
| Field GPS: | 44° 51' 29.6" | 92° 46' 33.1" | ☑ 3D |

| GPS TIME | PDOP | ROV. FILE # |
|---|---|---|
| 1228 | FOM 55.0 | |

## X SITE STATUS -- CHECK ONE BOX FROM ONE SECTION ONLY

**Sampleable**

- ☑ Regular - (flowing water/defined channel)
- ☐ Intermittent - (dry spots along reach)
- ☐ Other (explain in comments)

99TC014

**Non-Sampleable (no sample taken)**

- ☐ No Channel or Waterbody Present
- ☐ Impounded (underneath lake/pond)
- ☐ Impounded (beaver dam)
- ☐ Wetland (no definable channel)
- ☐ Dry - (no water anywhere along reach)
- ☐ Access Permission Denied
- ☐ Inaccessible (unable to reach site)
- ☐ Other (explain in comments)

**Gear Type:** Back Pack

## DIRECTIONS TO STREAM SITE / COMMENTS

Go in main entrance of Afton State Park to Visitor Center. Drive down asphalt trail to bridge over Trout Brook. Walk upstream about 150 m to station.

27-20-2 Washington Co

## PHOTOGRAPH DOCUMENTATION

| | |
|---|---|
| Looking downstream / upstream from the downstream end of station: Frame Seg. # | 1 |
| Looking downstream / upstream from the midpoint end of station: Frame Seg. # | 1 |
| Looking downstream / upstream from the upstream end of station: Frame Seg. # | 1 |

## STREAM REACH DETERMINATION

| Channel Width Used to Define Reach (m) | Distance (m) From X Site | | |
|---|---|---|---|
| | Upstream Length | Downstream Length | Total Length |
| | 75 | 75 | 150 |

**Comments:** Lower End of station Pooled from Lake St. Croix (above normal) Creek

## SKETCH GENERAL FEATURES OF REACH ON REVERSE SIDE

Revised April 1999

VISIT SUMMARY MPCA

LOCATION 445130/924633

FIELD #: 99TC014 DATE (M/D/Y): 6-18-99 STREAM NAME: Trout Brook

LOCATION: Afton State Park above* mouth COUNTY: Washington 27-20-2

VISIT RESULT: REPORTABLE - REPLICATE - OTHER (EXPLAIN)_____

GPS FILE NAME:_____ TYPE OF GPS FIX: ☐ 2D ☐ 3D PDOP:_____
(only if GPS taken during visit)

DATA SOURCE:_____ PROJECT:_____

## FIELD WATER CHEMISTRY MEASUREMENTS

TIME (24 hr clock): 0946 AIR TEMP (C):_____ WATER TEMP (C): 11.6

CONDUCTIVITY (umhos@25C): 598 TURBIDITY (ntu): 1.58

DISSOLVED OXYGEN (mg/l): 9.9/9.9 pH: 8.50 STREAM FLOW (m/s):_____

TRANSPARENCY TUBE (cm): >60

WATER LEVEL: V NORMAL _____BELOW_____(m) _____ABOVE_____(m)

## LAB WATER CHEMISTRY MEASUREMENTS

COLLECTION TIME (field sample): 0946 COLLECTION TIME (field duplicate):_____

## CHANNEL AND BASIN CHARACTERISTICS

TRANSECT SPACING (m):_____ STATION LENGTH (m) (from stream features form):_____

CHANNEL CONDITION (circle one code):

NA = NATURAL OC = OLD CHANNELIZATION RC = RECENT CHANNELIZATION CC = CONCRETE CHANNEL

MEAN DISTANCE BETWEEN BENDS (m):_____ MEAN DISTANCE BETWEEN RIFFLES (m):_____

TOTAL (sum) LENGTH OF ALL (m): RIFFLES:_____ POOLS:_____ RUNS:_____

TOTAL NUMBER OF: RIFFLES:_____ POOLS:_____ RUNS:_____ BENDS:_____ LOG JAMS:_____

COMMENTS/NOTES:_____

# FISH SURVEY RECORD

MPCA

| | |
|---|---|
| Field Number: 99TC014 R / S * (* Circle One: R = Reference or S = Statistical Site) | Date (M/D/Y): 6-18-99 |
| Stream Name: Trout Brook | County: Washington |
| Location: Afton State Park | Crew: KS JL |

Gear Type: (Backpack) Stream Shocker Boom Shocker Miniboom (Circle One Method)

If Large River (boom shocking site) Circle Habitat Type: Right Bank Mid-Channel Left Bank

| Distance (m): | Time Fished: | Identified by: |
|---|---|---|
| 150 m | 1034 | KS |

* All brown trout taken upstream of station

| Species (common name) | Length Range (mm) | Weight (g) | No. | Anomalies | Voucher |
|---|---|---|---|---|---|
| 1. Brown trout | 185-305 | *78 | 5 | | 1 -3 @ 212 |
| 2. Strikeback | 44-49 | 8.0 | 6 | | 6 |
| 3. White Sucker | 81 | 5.5 | 1 | | 1 |
| 4. Log perch | 78 | 3.5 | 1 | | 1 |
| 5. Bullhead | 61 | 1.5 | 1 | | 1 |
| 6. | | | | | |
| 7. | | | | | |
| 8. | | | | | |
| 9. Brown trout | 305 | | 1 | | 0 |
| 10. " | 212 | | 3 | | 0 |
| 11. " | 185 | | 1 | | 1 |
| 12. | | | | | |
| 13. | | | | | |
| 14. | | | | | |
| 15. | | | | | |
| 16. | | | | | |
| 17. | | | | | |
| 18. | | | | | |
| 19. | | | | | |
| 20. | | | | | |
| 21. | | | | | |
| 22. | | | | | |
| 23. | | | | | |
| 24. | | | | | |
| 25. | | | | | |

Not in station

Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

# Qualitative Habitat Evaluation Index Field Sheet — QHEI Score: ___

REMAP Station Code: 99TC014 Stream: Trout Brook
Date: 6-16-99 Location: Below Trail rip-rap and above trib
Scorers Name: ___

**1] SUBSTRATE (Check *ONLY* Two Substrate *TYPE BOXES; Estimate %* or note every type present):**

| TYPE | POOL | RIFFLE |
|---|---|---|
| ☐ ☐ -BLDR-/SLBS [10] | ___ | ___ |
| ☐ ☐ -BOULDER [9] | ___ | ___ |
| ☐ ☐ -COBBLE [8] | ___ | ___ |
| ☐ ☐ -HARDPAN [4] | ___ | ___ |
| ☐ ☐ -MUCK [2] | ___ | ___ |
| ☐ ☐ -SILT [2] | ___ | ___ |
| ☑ ☐ -GRAVEL [7] | ___ | 30 |
| ☑ ☑ -SAND [6] | 90 | 70 |
| ☐ ☐ -BEDROCK [5] | ___ | ___ |
| ☑ ☐ -DETRITUS [3] | 10 | ___ |
| ☐ ☐ -ARTIFICIAL [0] | ___ | ___ |

NOTE : (Ignore sludge originating from point-sources; score on natural substrates)
NUMBER OF SUBSTRATE TYPES: ☑ -5 or More [2] ☐ -4 or Less [0]
COMMENTS: ___

Check ONE (OR 2 & AVERAGE)
☐ -LIMESTONE [1]
☑ -TILLS [1]
☐ -WETLANDS [0]
☐ -HARDPAN [0]
☐ -SANDSTONE [0]
☐ -RIP/RAP [0]
☐ -LACUSTRINE [0]
☐ -SHALE [-1]
☐ -COAL FINES [-2]

SILT: EMBEDDEDNESS:

**SUBSTRATE QUALITY**
Check ONE (OR 2 & AVERAGE)
☐ -SILT HEAVY [-2]
☐ -SILT MODERATE [-1]
☑ -SILT NORMAL [0]
☐ -SILT FREE [1]
☐ -EXTENSIVE [-2]
☑ -MODERATE [-1]
☐ -NORMAL [0]
☐ -NONE [1]

Substrate Max 20

**2] INSTREAM COVER**

TYPE: (Check *All* That Apply)
☑ -UNDERCUT BANKS [1]
☑ -OVERHANGING VEGETATION [1]
☑ -SHALLOWS (IN SLOW WATER) [1]
☐ -ROOTMATS [1]
☐ -DEEP POOLS > 70cm [2]
☐ -ROOTWADS [1]
☐ -BOULDERS [1]
☐ -OXBOWS [1]
☑ -AQUATIC MACROPHYTES [1]
☑ -LOGS OR WOODY DEBRIS [1]
COMMENTS: ___

AMOUNT: (Check *ONLY* One or check 2 and *AVERAGE*)
☐ -EXTENSIVE > 75% [11]
☑ -MODERATE 25-75% [7]
☐ -SPARSE 5-25% [3]
☐ -NEARLY ABSENT < 5% [1]

Cover Max 20

**3] CHANNEL MORPHOLOGY: (Check *ONLY* One PER Category OR check 2 and *AVERAGE*)**

| SINUOSITY | DEVELOPMENT | CHANNELIZATION | STABILITY |
|---|---|---|---|
| ☐ -HIGH [4] | ☐ -EXCELLENT [7] | ☑ -NONE [6] | ☑ -HIGH [3] |
| ☐ -MODERATE [3] | ☐ -GOOD [5] | ☐ -RECOVERED [4] | ☐ -MODERATE [2] |
| ☑ -LOW [2] | ☐ -FAIR [3] | ☐ -RECOVERING [3] | ☐ -LOW [1] |
| ☐ -NONE [1] | ☐ -POOR [1] | ☐ -RECENT OR NO RECOVERY [1] | |

MODIFICATIONS/OTHER
☐ -SNAGGING ☐ -IMPOUND.
☐ -RELOCATION ☐ -ISLANDS
☐ -CANOPY REMOVAL ☐ -LEVEED
☐ -DREDGING ☐ -BANKSHAPING
☐ -ONESIDE CHANNEL MODIFICATIONS

Channel Max 20

COMMENTS: ___

**4]. RIPARIAN ZONE AND BANK EROSION** (check ONE box per bank or check 2 and AVERAGE per bank) ★River Right Looking Downstream★

| RIPARIAN WIDTH (L, R Per Bank) | FLOOD PLAIN QUALITY (PAST 100 FOOT RIPARIAN) (L, R Most Predominant Per Bank) | BANK EROSION (L, R Per Bank) |
|---|---|---|
| ☑ ☑ -WIDE > 50m [4] | ☑ ☑ -FOREST, SWAMP [3] | ☐ ☐ -CONSERVATION TILLAGE [1] |
| ☐ ☐ -MODERATE 10-50m [3] | ☐ ☐ -SHRUB OR OLD FIELD [2] | ☐ ☐ -URBAN OR INDUSTRIAL [0] |
| ☐ ☐ -NARROW 5-10m [2] | ☐ ☐ -RESIDENTIAL, PARK, NEW FIELD [1] | ☐ ☐ -OPEN PASTURE, ROW CROP [0] |
| ☐ ☐ -VERY NARROW < 5m [1] | ☐ ☐ -FENCED PASTURE [1] | ☐ ☐ -MINING/CONSTRUCTION [0] |
| ☐ ☐ -NONE [0] | | ☑ ☑ -NONE/LITTLE [3] |
| | | ☐ ☐ -MODERATE [2] |
| | | ☐ ☐ -HEAVY/SEVERE [1] |

Riparian Max 10

COMMENTS: ___

**6.]POOL/GLIDE AND RIFFLE/RUN QUALITY**

MAX. DEPTH (Check 1 ONLY!)
☐ -> 1m [6]
☐ -0.7-1m [4]
☑ -0.4-0.7m [2]
☐ -0.2-0.4m [1]
☐ -< 0.2m [POOL=0]

MORPHOLOGY (Check 1 or 2 & AVERAGE)
☐ -POOL WIDTH > RIFFLE WIDTH [2]
☑ -POOL WIDTH = RIFFLE WIDTH [1]
☐ -POOL WIDTH < RIFFLE [0]

CURRENT VELOCITY (POOL & RIFFLES) (Check *All* That Apply)
☐ -EDDIES [1] ☐ -TORRENTIAL [-1]
☐ -FAST [1] ☐ -INTERSTITIAL [-1]
☑ -MODERATE [1] ☐ -INTERMITTENT [-2]
☑ -SLOW [1]

Pool/Glide Max 12

COMMENTS: ___

CHECK ONE OR CHECK 2 AND AVERAGE

RIFFLE/RUN DEPTH
☐ -GENERALLY > 10 cm; MAX > 50 [4]
☐ -GENERALLY > 10 cm; MAX < 50 [3]
☑ -GENERALLY 5-10 cm [1]
☐ -GENERALLY < 5 cm [RIFFLE=0]

RIFFLE/RUN SUBSTRATE
☐ -STABLE (e.g., Cobble, Boulder) [2]
☐ -MOD. STABLE (e.g., Large Gravel) [1]
☐ -UNSTABLE (Fine Gravel, Sand) [0]
☐ -NONRIFFLE [Metric=0]

RIFFLE/RUN EMBEDDEDNESS
☐ -NONE [2]
☐ -LOW [1]
☑ -MODERATE [0]
☐ -EXTENSIVE [-1]

Riffle/Run Max 8

Gradient Max 10

COMMENTS: ___

6] GRADIENT (ft/mi): ___ DRAINAGE AREA (sq.mi.): ___

%POOL: 10 %GLIDE: ___
%RIFFLE: 80 %RUN: 30

3/24/95

EPA 4320

# APPENDIX B:

## 2000 Minnesota DNR Stream Survey

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Site Code: 610

MINNESOTA DEPARTMENT OF NATURAL RESOURCES

**River or Stream Survey** Initial Survey
Date(s) of Field Work: August 1-11, 2000 Resurvey

Leader: Jim Stewart

Assistant(s): Pete Carlson
Dan Wilfond

NAME, LOCATION, AND FLOW CHARACTERISTICS

1. Stream Name: Trout Brook
2. Alternate Name(s): none
3. Tributary Number: M-50-5
4. Counties: Washington
5. Watershed Name and Number: Mississippi River (Metro),20
6. Sequence of Waterways to Basin: Trout Brook to St. Croix River to Mississippi River
7. Map(s) Used: USGS Quad.: Prescott
8. Length of Stream: 3.5 miles
9. Average Width: Upper Station: 3.0 ft. Lower Station : 14 ft.
10. Mouth Location: T.27N., R.20 W., S.2
11. Flow at Mouth: 1.4 cfs., Date 8-1-00
12. Flow at Gaging Station: Minimum ___cfs Average ____cfs
13. Location of Gaging Station
14. Initial Source of Sustained Flow: T27N, R20W, S.32
15. Gradient: 49.0 ft./mi.
16. Sinuosity: 1.2

## WATERSHED DESCRIPTION AND USE

17. Description of Watershed (soil types, cover types, topography, land useage and ownership.

a. Entire Watershed: Soils above the St. Croix River Valley are loess(mixture of wind-blown sand and silt). Valley terraces are Sandy loam and bottom lands consist of sand and silt.

Topography of the area is typical of the St. Croix River Valley. The upland plateau is about 250 feet above average Lake St. Croix water level. The valley is characterized by flat uplands Dissected by stream valleys which cut down through ancient terraces to discharge into Lake St. Croix. Plateau lands are farmed and also contain many roads, housing developments and isolated residences. Valley terraces contain residential developments, farmland, and orchards.

Lands around the shoreline of Lake St Croix are mostly wild and drop steeply down to the lake. The steep shoreline is interrupted by alluvial fans and beaches created by inflowing streams. These lands are developed as parkland, private holdings, marinas and small villages.

b. Land adjacent to stream : Stream-side land ownership is either private or State(Afton State Park). Cover types along the stream are trees(60 %), open grassland(un-grazed)(20%) and farmland(20%).

## GENERAL INFORMATION ON THE STREAM

18. Reason for Survey: This full stream survey was scheduled to update area stream files.

19. Previous Investigations and Surveys: No previous surveys or investigations were found in the stream file.

20. Special Problems or Conditions:
Problems and conditions with the stream at this time are 1) low flow, 2) unsuitable water temperature, 3) erosion, 4) habitat degradation(sand aggregation), 5) livestock activity, 6) beaver activity, 7) logjams, 8) channelization, 9) impoundment, 10) flooding, 11) lack of watershed management, 12) effects of utility and road crossings, 13) inadequate habitat(overhead cover, deep pools, adequate riffle area, 14) likely pollution from runoff containing agricultural pesticides and other harmful chemicals from maintenance of roadways, golf courses and a ski area,15) possible de-watering from a well used to supply summer watering and winter snow making at a ski area and golf course.

21) Sources of Pollution*

| Source | Location (miles from mouth) | Substance discharged |
|---|---|---|
| private ski area and golf course | 0.7 | road salt, herbicides, snow making chemicals |
| county road maintenance | 1.8, 3.0 | road salt, herbicides |
| impoundment | 3.3 | warmed water |
| agricultural runoff | 2,6(S. branch) 3.5(N. branch) | fertilizers, herbicides, pesticides |

* Sources of pollution were not documented by sample-taking and analysis. These are potential sources of pollution which should be taken into consideration should the stream be considered for active fish management(stocking etc.)

| 22) Erosion | | |
|---|---|---|
| Type | Degree | Affected Reach |
| stream bank | moderate/severe | I,II,III,IV |
| gully | moderate/severe | I, II, III, IV |
| sheet | moderate | II, IV |

| 23) Stream alterations(dredging, channeling): | | |
|---|---|---|
| Alteration | Location (miles from mouth) | Date |
| channel movement, channel alteration | 0.7 | Probably 1960's (construction of Afton Alps) |
| grade control* | 1.8 | When T.H. 95 built |
| grade control* | 3.0 | When 60th St, installed |
| grade control* | 4.0 | When Co, Rd, 71 built |
| tiling, straightening** | 2.6,3.5 | 1930's-1960's |
| impoundment | 3.3 | 1961 |

* Grade Control: Grade control structures (bridge bases, culverts, check dams, impoundment dams) control the gradient of the stream. This can have desirable effects, such as the prevention of head-cutting damage to roads and property. Grade control can also prevent the stream from undergoing changes in sinuosity and gradient it needs in order to maintain adequate riffles, runs and pools to provide optimal habitat for trout and their prey.

** Tiling out of wetlands in times past(also currently) has greatly affected water flow dynamics between the upper landscape and the stream. Trout Brook derives much of its flow from its upper watershed. This flow used to come from a watershed covered by prairie, wetlands and forest. This resulted in a more stable base flow and water quality was adequate for brook trout.

The current situation has most of the prairie, wetlands and forest obliterated by human development. Base flow is low, runoff events are often catastrophic, and maintenance of temperatures suitable for trout is not possible.

| 24) Dams and other obstructions (including beaver dams): | | |
|---|---|---|
| Type | Check dam | Impoundment dam |
| Miles from mouth | 2.6(S. Branch) | 3.3(N. Branch) |
| Head | 10 ft. | 20 ft. |
| Length | 70 ft. | 170 ft. |
| Type of Control Structure | standpipe | standpipe |
| Use | flood control | create reservoir |
| Fish Barrier | yes | yes |
| Status | functional | functional |
| Owner | private | private |

| 24) Dams and other obstructions (continued): | |
|---|---|
| Type | Beaver dam |
| Miles from mouth | 2.7 |
| Head | 5 ft. |
| Length | 35 ft. |
| Type of control structure | -- |
| Use | -- |
| Fish barrier | yes |
| Status | semi-active* |
| Owner | -- |

* This beaver dam is an old one and has been destroyed a time or two by either high water or the human hand. Currently the dam is intact, except for a small end cut on the east side and numerous leaks in its face. Beavers are attempting to repair the dam but haven't been successful.

25. Use of Water: Fishing___Recreation___ Com.Nav.___Power___Irrigation_ Livestock Watering X Other(specify) hiking trails parallel stream in Afto State Park

26. Access (location and ownership): Access is within Afton State Park, at Afton Alps Ski Area and at bridge crossings on county and township roads.

27. Shoreline Developments : Afton State Park, Afton Alps Ski Area

28. Recreational Boating: none

| 29. Tributaries, Springs | | | | | |
|---|---|---|---|---|---|
| Names, Tributary Numbers | M-50-5-1 | M-50-5-2 | M-50-3 (S. Branch) | M-50-4 (N. Branch) | M-50-5 (spring) |
| Water Source | springs | *springs | seepage from wetlands | pond | spring |
| Bank (R or L) | L | R/L | L | R | R |
| Length Miles | 0.2 | N/A* | 0.9 | 0.7 | N/A** |
| Width at Mouth (Feet) | 1.5 | Avg. 6 in. | 1.5 | 2.0 | 6 in. |
| Miles from Mouth | 0.3 | 0.4-.5 | 2.4 | 2.4 | 2.8 |
| Flow (c.f.s.) | 0.2 | 0.05-0.1 | 0.25 | .5 | .1 |
| Stage (high, normal, low) | low | normal flow | low | low | normal flow |
| Temperature Mouth(F) | | | | | |
| Air | 68 | 70 | 75 | 79 | 79 |
| Water | 68 | 56 | 60 | 77 | 60 |
| Time | 1000 | 1030 | 1100 | 1230 | 1415 |
| Temperature Source(F) | | | | | |
| Air | 74 | 72 | 80 | 80 | 77 |
| Water | 65 | 49 | 60 | 80 | 59 |
| Time | 1100 | 0900 | 1200 | 1315 | 1130 |
| Date | 8-2-00 | 8-7-00 | 8-8-00 | 8-12-00 | 8-12-00 |

* Ten springs occur in this short(Reach II) segment at the toe of a large bluff. They have similar flows and come out of the bank directly into the stream.



-8-

| 30. Stream Physical Conditions | | | | |
|---|---|---|---|---|
| **a)** Station* No. and description | 1 Mouth to Afton Alps | 2 Afton Alps | 3 Afton Alps to trib. M-50-5-3(S. Branch) | 4 Upstream of Trib. M-50-5-3 |
| **b)** Date | 8-1-00 | | | |
| **c)** Location(mi. From mouth) | 0.2 | 0.5 | 1.0 | 1.7 |
| **d)** Length of Station(ft.) | 500 | 500 | 500 | 500 |
| **e)** Percent of station in: | | | | |
| Pools | 40 | 10 | 40 | 50 |
| Riffles | 50 | 40 | 40 | 30 |
| Runs | 10 | 50 | 20 | 20 |
| Other(list) | 0 | 0 | 0 | 1(plunge pool) |
| **f)** Average width(ft.) | 14.0 | 6.0 | 5.0 | 3.0 |
| **g)** Average depth(ft.) | 0.1 | 0.7 | 0.7 | 0.5 |
| **h)** Discharge (cfs) | 3.0 | 1.5 | 1.1 | 0.4 |
| **i)** High water mark | 1 ft. | 1.0 | 1.0 | 1.0 |
| **j)** Present stream stage | low | low | low | low |

* Sampling stations shown on map at end of report.

| 30) Stream Physical Conditions (Continued): | | | | |
|---|---|---|---|---|
| Station No. | 1 | 2 | 3 | 4 |
| k) Banks: | | | | |
| Average height (ft.) | 3.0 | 3.0 | 3.0 | 10.0 |
| Height range (feet) | 1-4 | 1.0-4.0 | 1.0-4.0 | 5.0-15.0 |
| Erosion (light, moderate, severe) | severe | moderate | moderate | light |
| Percent grazed | 0 | 0 | 5.0 | 0 |
| Percent ditched or channeled | 0 | 100 | 5.0 | 5.0 |
| l) Shade* (light, moderate, heavy) | heavy | heavy | heavy | moderate |

| 30) Stream Physical Characteristics | | | | |
|---|---|---|---|---|
| Station No. | 1 | 2 | 3 | 4 |
| m) Pools** | | | | |
| Average width(ft.) | 12.0 | 1.0 | 3.0 | 6.0 |
| Width range (ft.) | 0.5-2.0 | 0.5-1.0 | 1.0-4.0 | 3.0-9.0 |
| Average depth(ft.) | 0.5 | 0.5 | 0.7 | 0.5 |
| Maximum depth(ft.) | 2.0 | 0.8 | 1.0 | 0.8 |
| Percent of each type** | | | | |
| A | 0 | 0 | 0 | 0 |
| B | 0 | 0 | 100 | 0 |
| C | 0 | 0 | 0 | 0 |
| D | 100 | 100 | 0 | 100 |
| Bottom type*** | | | | |
| sand | 85 | 80 | 80 | 50 |
| detritus | 10 | 5 | 0 | 20 |
| gravel | 5 | 15 | 20 | 30 |

| 30) Stream physical characteristics | | | | |
|---|---|---|---|---|
| Station | 1 | 2 | 3 | 4 |
| n) Riffles and rapids: | | | | |
| Average width(ft.) | 4.2 | 8.0 | 4.0 | 2.0 |
| Width range (ft.) | 2.0-6.0 | 6.0-10.0 | 3.0-5.0 | 1.0-3.0 |
| Average depth(ft.) | 0.1 | 0.5 | 0.2 | 0.5 |
| Maximum depth(ft.) | 2.0 | 0.7 | 2.0 | 0.7 |
| Velocity range(fps) | 1.0-1.8 | 1.0-1.3 | 0.1-0.3 | 0.2-0.4 |
| Bottom type** (percent) | | | | |
| Gravel | 5 | 5 | 10 | 30 |
| Sand | 90 | 90 | 80 | 50 |
| Rubble | 5 | 5 | 10 | 20 |
| o) Runs: | | | | |
| Average width(ft.) | 4.0 | 7.0 | 3.0 | 5.0 |
| Width range(ft.) | 2.0-4.0 | 6.0-8.0 | 2.0-4.0 | 4.0-6.0 |
| Average depth(ft.) | 0.5 | 0.5 | 0,5 | 0.5 |
| Maximum depth(ft.) | 0.5 | 6.0 | 0.7 | 0.7 |
| Velocity range(fps) | 0.3-0.8 | 0.5-1.0 | 0.2-1.0 | 0.4-0.5 |
| Bottom type*** (percent) | | | | |
| sand/silt | 90 | 90 | 80 | 60 |
| gravel | 5 | 5 | 10 | 20 |
| boulders | 0 | 0 | 0 | 10 |
| detritus | 5 | 5 | 10 | 10 |

| 30) Stream Physical Characteristics(Continued): | | | | |
|---|---|---|---|---|
| Station No, | 1 | 2 | 3 | 4 |
| p) Other (describe) | --- | -- | -- | plunge pool below reservoir outlet pipe |
| Average width(ft.) | -- | -- | -- | 20 |
| Width range (ft.) | -- | -- | -- | 15-25 |
| Average depth(ft.) | -- | -- | -- | 4.0 |
| Maximum depth(ft.) | -- | -- | -- | 6.0 |
| Velocity range(fps) | -- | -- | -- | 0.0-0.1 |
| Bottom Type*** (percent of each) | --- | -- | -- | |
| Sand | -- | -- | -- | 0 |
| Detritus | -- | -- | -- | 0 |
| Gravel | -- | -- | -- | 100 |

| 30) Stream Physical Characteristics (Continued): data pertaining to similar reach: | | | | |
|---|---|---|---|---|
| q) Location (mi. to mi.) | 0.0-0.4 | 0.4-0.7 | 0.7-1.3 | 1.3-2.1 |
| r) Gradient | 38.5 | 46.2 | 71.4 | 40.0 |
| s) Sinuosity | 1.3 | 1.0 | 1.1 | 1.4 |
| t) Channel changes | slight | extensive | slight | slight |

Remarks: The stream is reduced in value as a potential trout stream because of extensive sand bed-load and flow problems caused by watershed changes (tiling, ditching, loss of wetlands).

*Shade:
light 0-25%
moderate 25-75%
heavy 75-100%

**Pool types:
Type A - Good cover, 3 ft or deeper
B - Good cover, less than 3 ft
C - Poor cover, 3 ft or deeper
D - Poor cover, less than 3 ft

***Bottom types:
Ledge rock -Large mass of solid rock
Boulder -over 10" in diameter
Rubble -3" to 10" in diameter
Gravel -1/8" to 3" in diameter
Sand -less than 1/8" in diameter
Silt -fine material with little grittiness
Clay -compact, sticky material
Muck -decomposed organic material, usually black
Detritus -organic material composed of sticks, leaves, decaying plants
Marl -calcareous material

| (31) Characteristics of Water: | | | | |
|---|---|---|---|---|
| a) Station No. | 1 | 2 | 3 | 4 |
| b) Date | 8-1-00 | 8-2-00 | 8-1-00 | 7-12-00 |
| c) Location (miles from mouth) | 0.2 | 0.5 | 1.0 | 1.7 |
| d) Length(ft.) | 500 | 500 | 500 | 500 |
| e) Time | 1030 | 0850 | 1340 | 1200 |
| f) Air temp(F) | 78 | 68 | 85 | 79 |
| g) Water temp.(F) | 60 | 53 | 62 | 77 |
| h) Color | clear | clear | clear | clear |
| i) Cause of color | -- | -- | -- | -- |
| j) Secchi disc(ft.) | -- | -- | -- | -- |
| FIELD DETERMINATIONS: | | | | |
| Dissolved Oxygen(ppm) | 8.8 | 8.3 | 8.5 | 7.7 |
| Free carbon dioxide(ppm) | -- | -- | -- | -- |

| FIELD DETERMINATION OR LABORATORY ANALYSIS(F or L) | | |
|---|---|---|
| Station | Upstream | Downstream |
| Total Alkalinity (ppm) | 311(L) | 206(L) |
| Conductivity (micromhos /cm) | 800(L) | 450(L) |
| pH | 7.77 | 7.78 |

| 31) Characteristics of Water(Continued): | | |
|---|---|---|
| LABORATORY ANALYSIS | | |
| Station No, | Upstream Station | Downstream Station |
| Total Nitrogen (ppm) | -- | -- |
| ammonia(ppm) | -- | -- |
| nitrite(ppm) | -- | -- |
| nitrate(ppm) | -- | -- |
| Total phosphorous (ppm) | 0.107 | 0.074 |
| Orthophosphates (ppm) | -- | -- |
| Sulfate ion(ppm) | -- | -- |
| Chloride ion (ppm) | 61.6 | 9.2 |
| B.O.D(ppm) or | -- | -- |
| C.O.D.(ppm) | -- | -- |
| Turbidity(JTU) | -- | -- |
| Tot. diss. Solids(ppm) | 536 | 308 |

| (32) Temperature Profile | | | | | | |
|---|---|---|---|---|---|---|
| Date | Location (miles from mouth) | Water Temp. | Air Temp. | Water Stage | Time | Cloud Cover |
| 8-3-00 | 3.5 | 70 | 70 | low | 0830 | 0 |
| " | 3.3 | 78 | 71 | low | 0850 | 0 |
| " | 3.0 | 62 | 71 | low | 0855 | 0 |
| " | 1.8 | 58 | 76 | low | 0935 | 0 |
| " | 0.7 | 58 | 78 | low | 1000 | 0 |
| " | 0.2 | 58 | 83 | low | 1015 | 0 |
| " | 0 | 59 | 84 | low | 1020 | 0 |

Remarks: Stream temperature unacceptable for trout is present in the upper reach. This is caused by lack of shading, cultivation of the watershed, and presence of a large reservoir.

| (33) Biological Characteristics | | | | |
|---|---|---|---|---|
| a) Station No. | 1 | 2 | 3 | 4 |
| b) Date | 7-13-00 | 7-13-00 | 7-13-00 | 7-13-00 |
| c) Location (miles from mouth) | 0.2 | 0.5 | 1.0 | 1.7 |
| d) Length of station(ft.) | 500 | 500 | 500 | 500 |
| e) Aquatic plants or filamentous algae* | | | | |
| Water smart-weed | C | C | C | C |
| Spike-rush | C | C | C | C |
| Curly-leaf pondweed | O | none | none | none |
| River bullrush | O | O | O | O |
| Water plantain | O | O | C | C |
| Broadleaf cattail | none | C | O | C |

*Plant or algae abundance:
A-Abundant C-Common O-Occasional R-Rare P-Present

f. Description of aquatic plants: Aquatic plants are scattered along the stream where bank moisture and sunlight are favorable. Curly-leaf pondweed was observed in the reservoir.

| (g) Aquatic Invertebrates | | | | |
|---|---|---|---|---|
| Common name/taxon | Abundance | | | |
| | Station 1 | Station 2 | Station 3 | Station 4 |
| Scud/ Gammarus/ Amphipoda | A | A | A | A |
| aquatic sow-bug Asellus/ Isopoda | O | O | O | O |
| aquatic beetle/ Coleoptera dytiscidae | O | O | O | O |
| Aquatic beetle/moss beetle/ Hydraenidae | O | O | O | O |
| Snail/ Gastropoda/ Amnicoloidae | O | O | O | O |
| whirligig beetle/ Coloeoptera/ Gyrinidae | 0 | O | O | O |
| water boatmen/ Hemiptera/ Coryxidae | O | -- | -- | -- |
| Diptera/ Chironomidae | P | -- | C | -- |
| mayfly/ Ephemeroptera/ Baetidae | C | C | C | O |
| midge/ Trichoptera | P | C | C | C |
| black fly/Diptera Simuliidae | -- | C | O | O |
| Deer fly/Diptera/ Tabanidae | — | — | O | — |

| g) Aquatic Invertebrates (Continued) | | | | |
|---|---|---|---|---|
| Species | Station No. | | | |
| | 1 | 2 | 3 | 4 |
| Crayfish/ Decapoda/ Cambarus | C | O | O | O |

g) Aquatic Invertebrates (Continued)
* Invertebrate abundance: A = abundant, C = common, O = occasional
R = rare, P = present
** Small drowned slugs are often found in bottom samples in streams. These organisms are also commonly found in stomach samples of trout and other stream fishes.
Remarks: Low diversity of aquatic invertebrate taxa in the stream is most likely due to low habitat diversity and water quality limitations.

| (34) Fishery Characteristics: | | | | |
|---|---|---|---|---|
| a) Station Number | 1 | 2 | 3 | 4 |
| b) Sample date | 8-7-00 | 8-7-00 | 8-8-00 | 8-8-00 |
| c) Miles from mouth | 0.2 | 0.5 | 1.0 | 1.7 |
| D) Station Length(ft.) | 500 | 500 | 500 | 500 |
| e) Capture method/gear | Back-pack Shocker | Back-pack Shocker | Back-pack Shocker | Back-pack Shocker |
| f) Amnt. Of sampling effort | 1 hr. | 1 hr. | 1 hr. | 1 hr. |
| Species | Number | | | |
| Brown trout | 2 | 0 | 0 | 0 |
| Creek chub | 1 | 0 | 0 | 0 |
| White sucker | 25 | 0 | 0 | 0 |
| Stickleback | 12 | 44 | 60 | 35 |
| Fathead minnow | 20 | 50 | 42 | 80 |

| h) Gamefish young-of-year: NONE OBSERVED | | | | |
|---|---|---|---|---|
| Species | Station No. | | | |
| | 1 | 2 | 3 | 4 |
| -- | | | | |

Remarks: The two brown trout captured probably move into Trout Brook from an adjacent stream(Valley Creek)in the fall of 1999 during spawning or were displaced from Valley Creek in a flood the spring of 2000. Five brown trout were sampled by Conrad Schmidt in the same area as Station 1 in June of 1999. These fish ranged in length from 7 to 12 inches.

| 35) Length-Frequency | | |
|---|---|---|
| Total length (inches) | Species | |
| 3.0-3.4 | Brown trout | Creek chub |
| 3.5-3.9 | | |
| 4.0-4.4 | | |
| 4.5-4.9 | | |
| 5.0-5.4 | | 1 |
| 5.5-5.9 | | |
| 6.0-6.4 | | |
| 6.5-6.9 | | |
| 7.0-7.4 | | |
| 7.5-7.9 | 1 | |
| 8.0-8.4 | | |
| 8.5-8.9 | | |
| 9.0-9.4 | | |
| 9.5-9.9 | | |
| 10.0-10.4 | | |
| 10.5-10.9 | | |
| 11.0-11.4 | | |
| 11.5-11.9 | | |
| 12.0-12.4 | | |
| 12.5-12.9 | | |
| 13.0-13.4 | 1 | |
| Total | 2 | 1 |

36) Age and Growth of Game fish

a) Age class distribution

| Species | Sample Size | Number of fish in age group | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI | VII |
| Brown trout | 2 | 1 | 1 | | | | | |

b) Growth of game fish

| Species | Calculated mean total length(in.) at last annulus(No. fish used in back-calculation) | | | | | | |
|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII |
| Brown trout | 5.0(2) | 11.0 (1) | | | | | |

| 37) Escape Cover for Gamefish | |
|---|---|
| Similar Reach | Type* and Amount** of Cover |
| I | LJ(O),B(O),OV(O),UB(O) |
| II | OV(F) |
| III | LJ(O),OV(F),UB(O) |
| IV | LJ(S),OV(F), UBF) |

*Cover types
- LJ - log jam
- B - boulders
- OV - overhanging vegetation
- UB - undercut bank
- IV - instream vegetation

**Amount of Cover
- S - scarce
- O - occasional
- F - frequent

38. Portion of Stream Suitable for Gamefish: Reach I is the only reach with even temporary suitability for trout. The sand-filled channel, lack of well-developed pool-riffle sequences and poor flow contribute to the habitat problems in the stream. The temperature is suitable for brook trout only in Station II and a small upstream portion of Station I.

39. History of Stream and Fishing Conditions:

a. Comparisons with past investigations and surveys: There are no past surveys to make comparisons with.

b. History of fishing conditions: Although no historical information is available on fishing in the stream, it is likely that in pre-settlement times brook trout were commonly caught by Native Americans and early explorers.

c. Records of past management: None are present in the stream file.

40. Discussion of Fishery:

A) General characteristics: A conversation with a park manager at Afton State Park revealed that a couple of people per year come down to fish the creek for trout.

b) Fish management problems: The problems relating to fish and fishing in this stream are limited to poor habitat and questionable water quality(temperature). If the problems of temperature and habitat were addressed there would be no big fish management problems. Access is assured because of the presence of state parkland along a significant portion of the stream. Other opportunities for fishing access at road crossings.

41. Ecological Classification of Waterway: Class ID(Marginal Trout)

42. Summary: Trout Brook is a small cold-water stream in the St. Croix Valley. It is beset with water quality and habitat problems which render it unsuitable for expenditure of resources in stocking and habitat improvement at this time. Watershed changes aimed at controlling the time-course of runoff events, water appropriation, pollution and physical changes(straightening, crossings) would go a long way toward making the stream suitable for trout.

43. Credits and Signatures:

a. Funding

b. Field work by: Jim Stewart

Name of crew leader: same

Name of aide(s) : Pete Carlson, Dan Wilfond

c. Completed report by

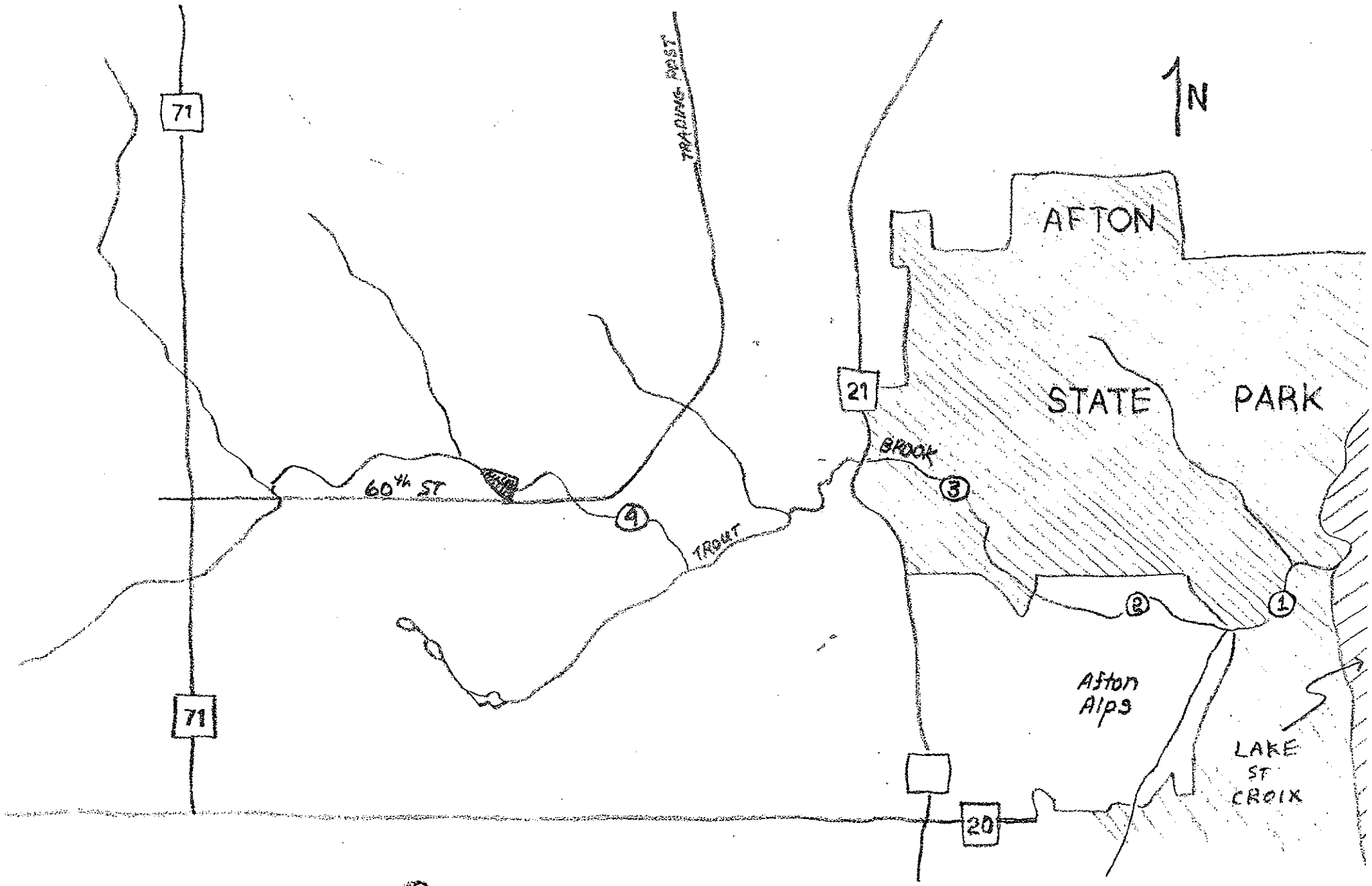
Name : Jim Stewart

Title: Fisheries Specialist

Approved by: 2/8/01
Area Fisheries Supervisor:

Regional Fisheries Supervisor:

4/27/01
Date:


N
AFTON
STATE PARK
71
71
21
20
60¼ ST
TRADING POST
TROUT
BROOK
Afton Alps
LAKE ST CROIX
1
2
3
4
= SAMPLING STATIONS

# APPENDIX C:

## 2005 Minnesota DNR Stream Survey

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MINNESOTA DEPARTMENT OF NATURAL RESOURCES
STREAM SURVEY

Date(s) of Field Work: 7-12-05

Report Completion Date:

Leader: Jim Stewart Assistant(s): Nora Helf

Type of Survey: Population Assessment

NAME, LOCATION, AND FLOW CHARACTERISTICS

1. Sream Name: Trout Brook

2. Alternate Name(s): none

3. Tributary Number: M-50-5

4. Counties: Washington

5. Watershed Name and Number: Mississippi River (Metro), 20

6. Sequence of Waterways to Basin: Trout Brook to St. Croix River to Mississippi River

7. Map(s) Used: USGS Quad.: Prescott

8. Length of Stream: 3.5 miles

9. Average Width: Upper Station:3.0 ft. Lower Station : 14 ft.

10. Mouth Location: T.27 N., R.27 W.,S. 2

11. Flow at Mouth: 1.4 cfs

12. Flow at Gaging Station: N/A

13. Location of Gaging Station: N/A

14. Initial Source of Sustained Flow: T27N, R20W, S.32
15. Gradient: 49.0 ft./mi.

16. Sinuosity: 1.2

## WATERSHED DESCRIPTION AND USE

17. Description of Watershed (soil types, cover types, topography, land usage and ownership):

a) Entire Watershed: Soils above the St. Croix River Valley are loess(mixture of wind-blown sand and silt). Valley terraces are Sandy loam. Bottom lands consist of sand and silt. Topography of the area is typical of the St. Croix River Valley. The upland plateau is about 250 feet above average Lake St. Croix water level. The valley is characterized by flat uplands dissected by stream valleys which cut down through ancient terraces to discharge into Lake St. Croix. Plateau lands are farmed and contain many roads, housing developments and isolated residences. Valley terraces contain residential developments, farmland, and orchards.

Lands around the shoreline of Lake St Croix are mostly wild and drop steeply down to the lake. The steep shoreline is interrupted by alluvial fans and beaches created by inflowing streams. These lands are developed as parkland, private holdings, marinas and small villages.

b. Land Adjacent to Stream : Stream-side land ownership is either private or state(Afton State Park). Cover types along the stream are trees(60 %), open grassland(un-grazed)(20%) and farmland(15%). Five percent of riparian land is grazed

GENERAL INFORMATION ON THE STREAM

18. Reason for Survey: This population assessment was requested to update information on status of the fish population.

19. Previous Investigations and Surveys: An initial survey was completed in 2000.

20. Special Problems or Conditions:
1) low flow, 2) water temperature problems upstream, 3) erosion, 4) habitat degradation(sand aggregation), 5) livestock activity, 6) beaver activity, 7) log jams, 8) channelization, 9) impoundment, 10) flooding, 11) lack of watershed management, 12) effects of utility and road crossings, 13) inadequate habitat(overhead cover, deep pools, adequate riffle area, 14) likely pollution from runoff containing agricultural pesticides and other harmful chemicals from maintenance of roadways, golf courses and a ski area,15) possible de-watering from a well used to supply summer watering and winter snow-making at a ski area and golf course.

| 21) Sources of Pollution* | | |
|---|---|---|
| Source | Location (miles from mouth) | Substance discharged |
| private ski area and golf course | 0.7 | road salt, herbicides, snow making chemicals |
| county road maintenance | 1.8, 3.0 | road salt, herbicides |
| impoundment | 3.3 | warmed water |
| agricultural runoff | 2,6(S. branch) 3.5(N. branch) | fertilizers, herbicides, pesticides |

* Sources of pollution were not documented by sample-taking and analysis. These are potential sources of pollution which should be taken into consideration should the stream be considered for active fish management(stocking etc.)

| 22) Erosion | | |
|---|---|---|
| Type | Degree | Affected Reach |
| stream bank | moderate/severe | I,II,III,IV |
| gully | moderate/severe | I, II, III, IV |
| sheet | moderate | II, IV |

| 23) Stream alterations(dredging, channeling): | | |
|---|---|---|
| Alteration | Location (miles from mouth) | Date |
| channel movement, channel alteration | 0.7 | Probably 1960's (construction of Afton Alps) |
| tiling, straightening* | 2.6,3.5 | 1930's-1960's |
| impoundment^^ | 3.3 | 1961 |

* Tiling of wetlands has greatly affected water flow dynamics between the upper landscape and the stream.
Trout Brook derives much of its flow from its upper watershed. This flow used to come from a watershed covered by prairie, wetlands and forest. This resulted in a more stable base flow and water quality was adequate for brook trout.

The current situation has most of the prairie, wetlands and forest obliterated by human development. Base flow is low, runoff events are often catastrophic, and maintenance of temperatures suitable for trout is not possible.

^^ The impoundment above 80$^{th}$ St. is about 3.5 acres and contains bullhead and carp. The reservoir warms to around 80 in the hot portion of summer and is choked with submerged vegetation.

| 24) Dams and other obstructions (including beaver dams): | | | |
|---|---|---|---|
| Type | Check dam | Impoundment dam | Beaver dam |
| Miles from mouth | 2.6(S. Branch) | 3.3(N. Branch) | 2.7 |
| Head | 10 ft. | 20 ft. | 5 ft. |
| Length | 70 ft. | 170 ft. | 35 ft. |
| Type of Control Structure | stand pipe | stand pipe | -- |
| Use | flood control | create reservoir | -- |
| Fish Barrier | yes | yes | yes |
| Status | functional | functional | semi-active* |
| Owner | private | private | -- |

- This beaver dam functions as an in-channel obstruction even though

it is in disrepair.

25. Use of Water: Fishing___Recreation___ Com.Nav.___Power Irrigation__ Livestock Watering_X_Other(specify) hiking trails parallel stream in Afton State Park.

26. Access (location and ownership): Access is within Afton State Park,at Afton Alps Ski Area and at bridge crossings on county and township roads.

27.Shoreline Developments : Afton State Park, Afton Alps Ski Area

28. Recreational Boating: none

| 30) Stream Physical Characteristics(Continued):data pertaining to similar reach: | | | | |
|---|---|---|---|---|
| Similar Reach | I | II | III | IV |
| q) Location(mi. to mi.) | 0.0-0.4 | 0.4-0.7 | 0.7-1.3 | 1.3-2.1 |
| r) Gradient | 38.5 | 46.2 | 71.4 | 40.0 |
| s) Sinuosity | 1.3 | 1.0 | 1.1 | 1.4 |
| t) Channel changes | slight | extensive | slight | slight |

| (31) Characteristics of Water: | | |
|---|---|---|
| a) Station No. | Downstream | Upstream |
| b) Date | 7-12-05 | 7-12-05 |
| c) Location (mi.from mouth) | Mouth | Above Co. 21 |
| d) Length of station (ft.) | Sample point | Sample point |
| e) Time | 1300 | 1200 |
| f) Air temp (F) | 78 | 87 |
| g) Water temp.(F) | 57 | 62 |
| h) Color | Clear | Clear |
| i) Cause of color | -- | -- |
| j) Secchi disc(ft.) | -- | -- |
| FIELD DETERMINATIONS: | | |
| Dissolved Oxygen(ppm) | 8.3 | 7.2 |
| Total Alkalinity (ppm) | 211 | 280 |

(32) Temperature Profile

| Date | Location (miles from mouth) | Water Temp. (F) | Air Temp. | Water Stage | Time | Cloud Cover |
|---|---|---|---|---|---|---|
| 7-12-05 | 4.1 | 63 | 76 | low | 0900 | overcast |
| 7-12-05 | 3.7 | 82 | 78 | trickle* | 0910 | " |
| 7-12-05 | 3.2 | 67 | 90 | low | 1130 | " |
| 7-12-05 | 2.0 | 62 | 87 | low | 1200 | " |
| 7-12-05 | 0.5 | 57 | 78 | low | 1300 | " |

* Trickle through standpipe at reservoir

(34) Fishery Characteristics:

| a) Station Number | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Descr. Of Station | Mouth to Afton Alps | Afton Alps | Afton Alps to Co. 21 | Upstream of Co. 21 |
| b) Sample date | 8-7-00 | 8-7-00 | 8-8-00 | 8-8-00 |
| c) Miles from mouth | 0.2 | 0.5 | 1.0 | 1.7 |
| D) Station Length(ft.) | 500 | 500 | 500 | 500 |
| e) Capture method/gear | Back-pack Shocker | Back-pack Shocker | Back-pack Shocker | Back-pack Shocker |
| f) Sampling effort | 1 hr. | 1 hr. | 1 hr. | 1 hr. |
| Species | Number | | | |
| Brown trout | 2 | 0 | 0 | 0 |
| Creek chub | 1 | 0 | 0 | 0 |
| White sucker | 6 | 0 | 0 | 0 |
| Stickleback | 26 | 16 | 32 | 21 |
| Fathead minnow | 22 | 13 | 0 | 58 |
| Burbot | 4 | 0 | 0 | 0 |

| 35) Length Frequency of Fish Sampled | | |
|---|---|---|
| Total Length (0.1 inch) | BNT | BUB |
| 2.0-2.4 | | |
| 2.5-2.9 | | |
| 3.0-3.4 | | |
| 3.5-3.9 | | |
| 4.0-4.4 | | |
| 4.5-4.9 | | |
| 5.0-5.4 | | |
| 5.5-5.9 | | |
| 6.0-6.4 | | |
| 6.5-6.9 | | |
| 7.0-7.4 | | |
| 7.5-7.9 | | 2 |
| 8.0-8.4 | | 1 |
| 8.5-8.9 | | |
| 9.0-9.4 | 1 | |
| 9.5-9.9 | | |
| 10.0-10.4 | 1 | |
| 10.5-10.9 | | |
| 11.0-11.4 | | |
| 11.5-11.9 | | |
| 12.0-12.4 | | 1 |
| 12.5-12.9 | | |
| 13.0-13.4 | | |
| Total | 2 | 4 |

(36) Age and Growth of Gamefish: no scales taken

37. Escape Cover for Gamefish

| Similar Reach | Type* and Amount** of Cover |
|---|---|
| I | LJ(O),B(O),OV(O),UB(O) |
| II | OV(F) |
| III | LJ(O),OV(F),UB(O) |
| IV | LJ(S),OV(F), UBF) |

*Cover types
- LJ - log jam
- B - boulders
- OV - overhanging vegetation
- UB - undercut bank
- IV - in-stream vegetation

**Amount of Cover
- S - scarce
- O - occasional
- F - frequent

38. Portion of Stream Suitable for Game fish:

Reach I is the only reach suitable for trout. A sand-filled channel, lack of well-developed pool-riffle sequences and poor flow contribute to habitat problems in the upstream areas. The temperature is suitable for brook trout only in a portion of Station I and the lower part of Station II.

39. History of Stream and Fishing Conditions:

A. Comparisons with past investigations and surveys: Fish populations, stream morphology and habitat are similar to the 2000 survey report.

B. History of fishing conditions: No historical information is available. No signs of recent fishing activity were observed and no information from park personnel or local citizens indicated recent fishing has occurred.

C. Records of past management:

Fish Stocking: No history of fish stocking.

Rough Fish Removal: No history of rough fish removal.

Special Regulations: No special regulations are in place or proposed. Trout Brook is not listed as a Designated Trout Stream.

Habitat Improvement: None completed or planned.

40. Discussion of Fishery:

a) General Characteristics: No established fishery is apparent. There may be an occasional angler from Afton State Park but specifics are unknown.

b) Fish management problems: Temperature too high for trout except for small portion in Afton Alps and adjoining downstream area in Afton State Park. Sand bed load and inadequate holding space for adult trout are also problems.

41. Ecological Classification of Waterway: Class ID (Marginal Trout)

42. Summary: Trout Brook is a small cold-water stream in the St. Croix Valley. Low flow, elevated temperatures, sand bed load and lack of living space for adult trout are fish management problems. The two brown trout sampled likely moved into the creek from the St. Croix during spring or fall when St. Croix water temperature is cool enough for them to survive. The brown trout likely moved out of Valley Creek which has populations of brook, brown and rainbow trout. They also could have come from a stream on the Wisconsin side of the St. Croix.

43. Credits and Signatures:

a. Funding:

b. Field work and report by: Jim Stewart, Fisheries Specialist

Approved by:

Area Fisheries Supervisor: 3/29/06

Regional Fisheries Supervisor:

Date: 04/26/06

# APPENDIX D:

## Excerpt of 2002 Denmark Township Water Resource Evaluation

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# Chapter 1: Trout Brook Subwatershed (TRB 1-4)

## 1.1 Location and General Description

The Trout Brook Subwatershed is within the Lower St. Croix Watershed Management Organization. Trout Brook watershed boundary, as well as the main channel and tributaries are located within Denmark Township and the City of Afton. This subwatershed is located in Sections 31, 32, 33, 34, 35 with small areas within Sections 30 and 27 in the City of Afton (T.28N., R.20W.) In Demark Township (T.27N., R.20W.), it is located in Sections 2, 3, 4, 5, 6, and 10. Trout Brook flows into the St. Croix River in Section 2 of Denmark Township. The Trout Brook channel commences as an intermittent channel at approximately the center of the southeast quarter, of Section 30, Afton, then flows south approximately one mile, and continues east into the St. Croix River a distance of 31,000 feet (5.87 miles). The perennial reach of the channel begins in the SW1/4, SE1/4, Section 32, in Afton, flowing for a distance of 14,000 feet (2.7 miles). The starting elevation of Trout Brook is approximately 1000 feet, with an outlet elevation into the St. Croix River at approximate elevation of 676 feet. **See Figure 1 and 1.1a-1.1d**. Trout Brook watershed has a total area of 4893 acres.

Trout Brook has the greatest complexity and diversity of drainage features within the study area. Therefore it was divided into 4 drainage areas (sub-subwatersheds) which are similar in nature. This allowed this subwatershed to be examined in greater detail. These were labeled TRB 1 – 4.

TRB-1, the southeastern most subwatershed is located in portions of Sections 2, 3, 10, 11, Township 27N, Range 20W (Denmark Township)TRB-1 has an area of 727.4 acres. The main drainage feature is an intermittent stream which flows from south to north. TRB-1 includes the east facing slopes of Afton Alps Ski Area. The spring run-off from these slopes flows into what appears to be the old Trout Brook stream channel. The additional snowmelt from the ski area extends and expands spring run-off well beyond the typical season and restraints. The effects of this have not been studied.

Bedrock outcrop of the St. Lawrence and Franconia Formation along Trout Brook in TRB-2.

TRB-2 is located in portions of Sections 27, 33, 34, 35, Afton (T.28N, R. 20W), and portions of Sections 2, 3, 4, 5, Denmark Township (T.27N, R.20W). TRB-2 has an area of 2134 acres. The Trout Brook channel is a perennial stream throughout TRB-2. The northeast portion of the subwatershed is located in Afton State Park.

TRB-3 is located in portions of Sections 4, 5, Denmark Township (T.27N, R.20W.) It has an area of 406 acres. TRB-3contains a DNR protected waterbody (#82-483w in Section 5, Denmark Township). Field investigation reveals this wetland is landlocked or would need a large storm event before water would outlet into an intermittent drainage channel and subsequently reach the main channel of Trout Brook approximately one mile away.

TRB-4 is located in portions of Sections 30, 31, 32, 33, Afton (T.28N, R.20W), portions of Sections 5, 6, Denmark Township (T.27N, R. 20W), and very small portions of Section 36, Woodbury (T.27N, R.21W). TRB-4 has an area of 1627 Acres. It is dominated by 2 main intermittent channels, that converge into perennial Trout Brook at the outlet of TRB-4. The outlet of this subwatershed is an impoundment structure which creates an in-stream pond.

Trout Brook is identified as a DNR-protected waterbody from the outlet into the St. Croix River to its intersection with 50th Street, approximately at the north line of Section 31, Afton.

Trout Brook perennial stream channel as it enters Denmark Township, Section 4, T. 27N, R.20W.

The Trout Brook watershed contains several significant drainage channels. The main channel starts within Afton before meandering into Denmark Township approximately 2 miles downstream. It continues within Denmark Township for approximately a mile before re-entering Afton. It continues within Afton for about one half mile before finally exiting Afton as the channel continues in Denmark Township to the St. Croix River. **See Figure 1 and 1a-1d for location and drainage information.**

## 1.2 Land Cover Classification

The Trout Brook subwatershed was mapped with several significant landscape units. All or a significant portion of Landscape Units 27-30 are located in this subwatershed. Further description and analysis is contained in the Landscape NRI report and the Afton NRI. The lower watersheds (TRB-1 and TRB-2) are characterized by woodlot land cover, with the upper watershed (TRB-3 and TRB-4) transitioning into agriculture landuse. **See Landscape NRI for more detail.**

## 1.3 Water Quality Ranking Criteria

Specific water quality management goals for the Trout Brook subwatershed have not been established by the LSCWMO. Due to its drainage into the St. Croix River, Trout Brook subwatershed receives a water quality ranking of high. **See Figure 3 and Table 2.**

## 1.4 Erosion Index Ranking

The Trout Brook subwatershed receives a severe erosion potential ranking with an EI value of 14.27. Three of the four subwatersheds receive a severe ranking with the lowest ranking being in TRB-3 with a value of 7.54, and the highest being in TRB-2 with a value of 18.99. This severe ranking is evident by the steep topography, including escarpments, and concentration of drainage features. In general the topography and soil erodibility (EI) rankings go from lower to higher moving from west to east (downstream) in the watershed. Also soil polygons boarding the streambed tend to receive a high erosion index ranking.

EI value and ranking for each of the subwatersheds are:

- TRB-1: 18.99, High
- TRB-2 - 18.03, High
- TRB-3 - 7.54, Moderate
- TRB-4 - 10.21, High

**See Figures 3.1a – 3.1d and Table 4**

## 1.5 Natural Resource Inventory Results

The St. Croix Valley Wildlife and Recreation Corridor Natural Resource Inventory, completed by the Washington Conservation District (WCD) gathered Water Resource NRI information for Trout Brook in the fall of 2000 and spring of 2001 (Afton NRI) and fall of 2001 and spring 2002. All information was gathered utilizing Global Positioning System (GPS) Technology, and compiled and formatted using Geographic Information System (GIS) Technology.

The purpose of this section is to provide specific water resource information gathered from the field inventory of Trout Brook, and further describe the features inventoried, identification of feature criteria, the significance of inventorying these features, and general discussion of findings. **See figures 6-6f, illustrating NRI features mapped for Trout Brook.**

**Centerline of Stream:** This feature was mapped from the St. Croix River to the origin of the perennial stream channel in Section 32, Afton. The centerline of stream feature was mapped until approximately the end of the perennial portion of the stream, and upstream of this was identified as a sediment delivery site. The **percent canopy** tended to be high in the lower reaches, and opened within approximately the upper two thirds. The **riparian landuse** was variable. The lower reach, within Afton State Park, contains intermittent undisturbed land cover and trail ways. Intermediate reaches contained current or evidence of recent pastureland. The upper reach is dominated by cropland.

**Sediment Delivery Site**: This feature was mapped as a continuation of the main branch, and all intermittent channels which outlet into the main channel. The sediment delivery areas **(type)** mapped in the lower reaches of the main channel were mapped as gullies, while the upper channel were waterways or non-erosive cropland within agricultural area. The majority of the sediment delivery sites were mapped as having **(severity index)** slight erosion, although gullies with severe erosion are present. **See Figure 6b**

**Sedimentation Area** Sedimentation Areas identified areas where soil deposition was evident. The most significant **type** of sedimentation sites were ponding areas within the main channel. The largest of these is a man-made pond located in the southeast quarter of the southeast quarter of Section 32, Afton. Some sedimentation areas were located at the start of sediment delivery areas. **See Figure 6c.**

**Stream Width:** Stream widths were measured at points along the perennial Trout Brook. The width of the stream was measured at bank full, which is higher than the low or base flow water level, and the water level during the mapping period. This feature was mapped to provide some base information regarding stream characteristics.

**See Figure 6f.**

Stream width was measured at various locations of the perennial stream.

**Streambank Erosion:** Streambank erosion was observed and mapped along perennial and intermittent reaches of Trout Brook. Streambank erosion **condition and size** tended to be moderate. **See Figure 6e.**

**Human-Made** features were mapped throughout the Trout Brook subwatershed. In general, the human-made features found tended to be associated with agricultural landuse prevalent in the upper watershed, and recreational uses in the lower watershed. **See Figure 6a.**

**Tree Downfalls** were mapped within the perennial Trout Brook if they made it difficult to walk the stream. Since identification of tree downfalls was not associated with trout habitat, it was not high priority for mapping. **See Figure 6f.**

**Seeps** were predominately along perennial sections of Trout Brook, especially in the lower reaches of TRB-2. The suspected old stream channel appears to have seepage throughout its entire reach. **See Figure 6d.**

**Springs** were mapped along perennial Trout Brook. Springs are evident by the presence of small areas of white sands often with water bubbling out due to water pressure. These are locations of groundwater discharge. Few springs were found in the Trout Brook subwatershed. **See Figure 6d.**

## *Trout Brook Natural Resource Inventory Components*

| Feature Inventoried | Feature Type | Additional Inventory Information | Number of Features Mapped | Why Feature Was Mapped | Discussion |
|---|---|---|---|---|---|
| **Centerline Stream** | line | percent canopy, riparian landuse | NA | Identification of where stream is located, determine amount of tree/shrub cover, identify what is adjacent to the stream | This data can be used and compared as future site visits occur. Canopy can affect such things as stream temperature and vegetative growth in and along the stream. What is done along the stream impacts the stream itself. |
| **Sediment Delivery** | line | type, severity index | 25 | Identification of where sediment could be entering the creek, and therefore identify areas which may need to be addressed | In the US, sediment is the biggest polluter by volume. Sediment can impact water quality, habitat, and carry nutrients, and other chemicals. |
| **Sediment-ation Site** | area | depression Area Type | 30 | Identification of areas where sediment from a sediment delivery site may settle before entering the creek | This data identifies and can be analyzed as to the amount of sediment that is treated. May be areas where future sediment treatment facilities are located. |
| **Stream Width** | point | number | 71 | Identification of stream characteristics | Data can be used in stream classification & stream flow analysis. |
| **Streambank Erosion** | point | condition, size | 65 | Identification of areas where stream is unstable, and there is an opportunity for remediation | These areas identify where streambank stabilization is warranted and should undergo further analysis. |
| **Human-made** | point | type, extent/feature | 480 | Identifications of structures in and along creek | These structures may impact stream flow, habitat, water quantity and quality. |
| **Tree Downfalls** | point | none | 127 | Identification of where trees impede stream flow, and could provide habitat | May impact stream flow, streambank erosion, habitat |
| **Seeps** | point | none | 100 | Identification where groundwater may be discharging | May provide base flow & other inputs |
| **Springs** | point | none | 12 | Identification where groundwater is discharging | May provide base flow & other inputs |
| **Total** | | | **910** | | |

# Denmark Subwatersheds

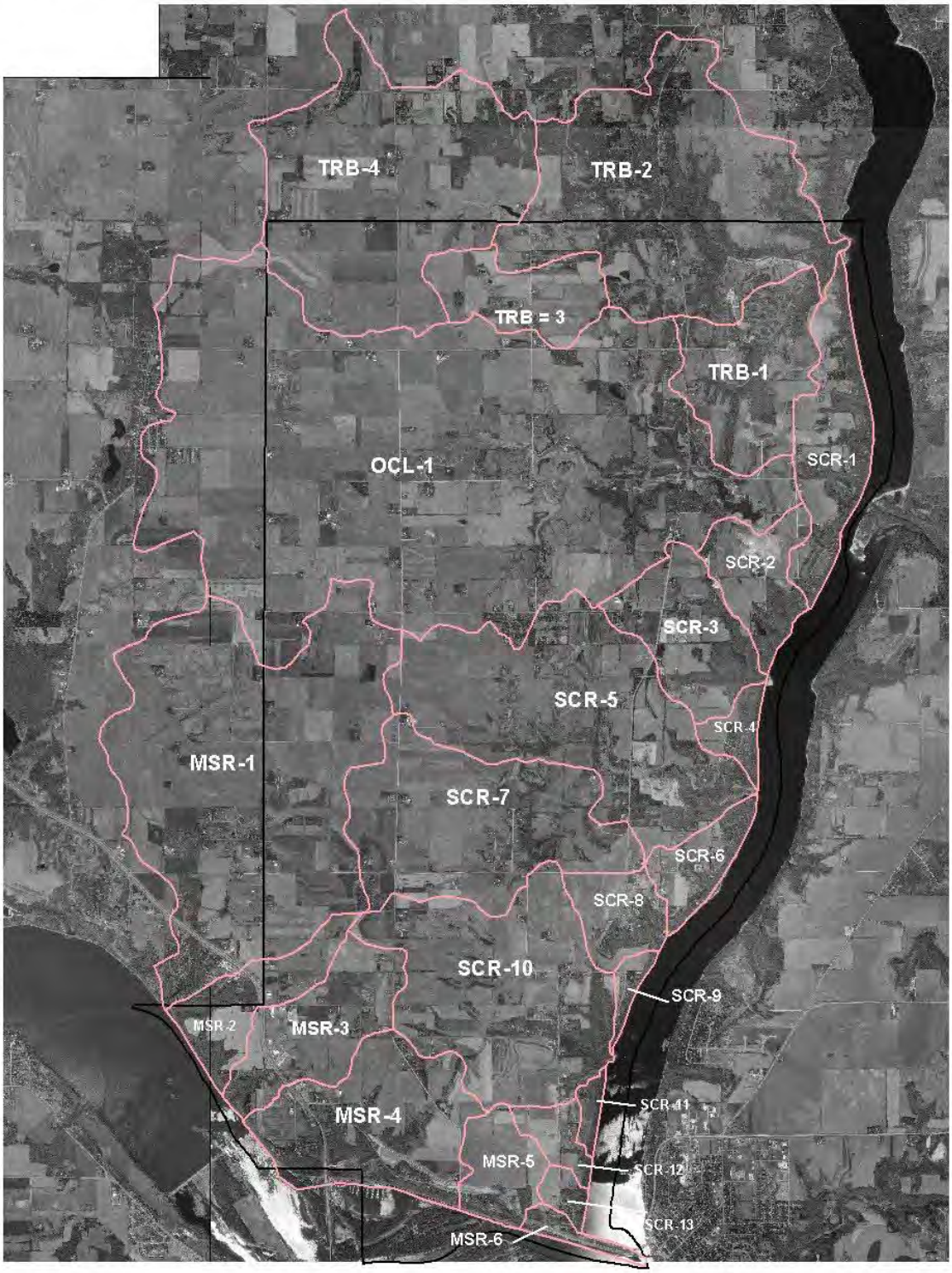


**Figure 1**

DENMARK TOWNSHIP
NATURAL RESOURCE INVENTORY
Washington County Parks
Washington County, Minnesota

This map was produced by the Washington CD. Natural Resource Inventory data gathered in 2001-2002. Other data is a compilation and reproduction of various Washington County land records. For additional information contact the Washington CD at 430-6820.

# Denmark Subwatershed
# Water Quality Rankings

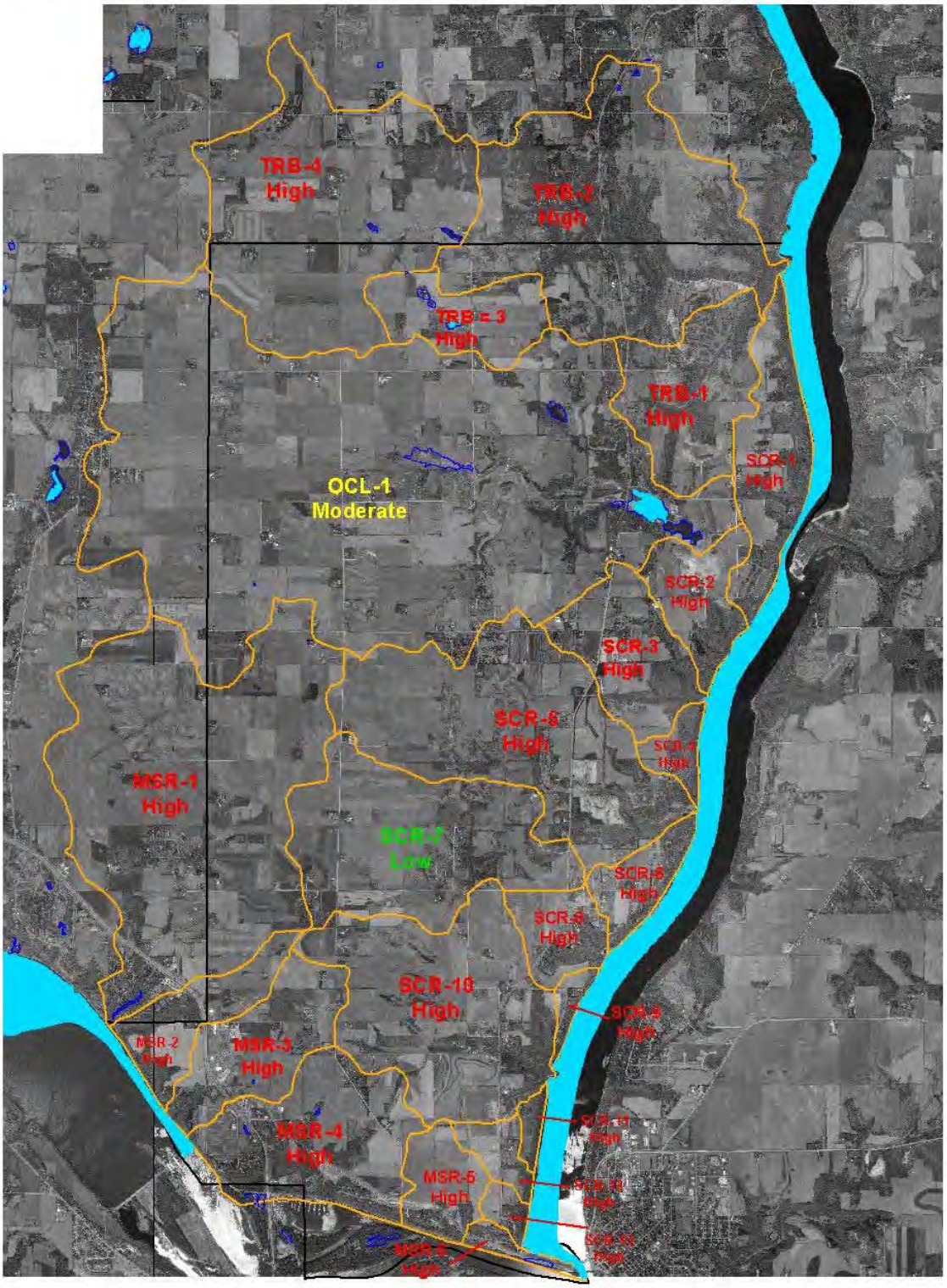


**Figure 2**

DENMARK TOWNSHIP
NATURAL RESOURCE INVENTORY
Washington County Parks
Washington County, Minnesota

N

0 4000 8000 Feet

Protected Waters & Wetlands
Water Bodies
Denmark Subwatersheds
Denmark Boundary

This map was produced by the Washington CD. Natural Resource Inventory data gathered in 2001-2002. Other data is a compilation and reproduction of various Washington County land records. For additional information contact the Washington CD at 430-6820.

## Denmark Subwatersheds
## Erosivity Index Rankings

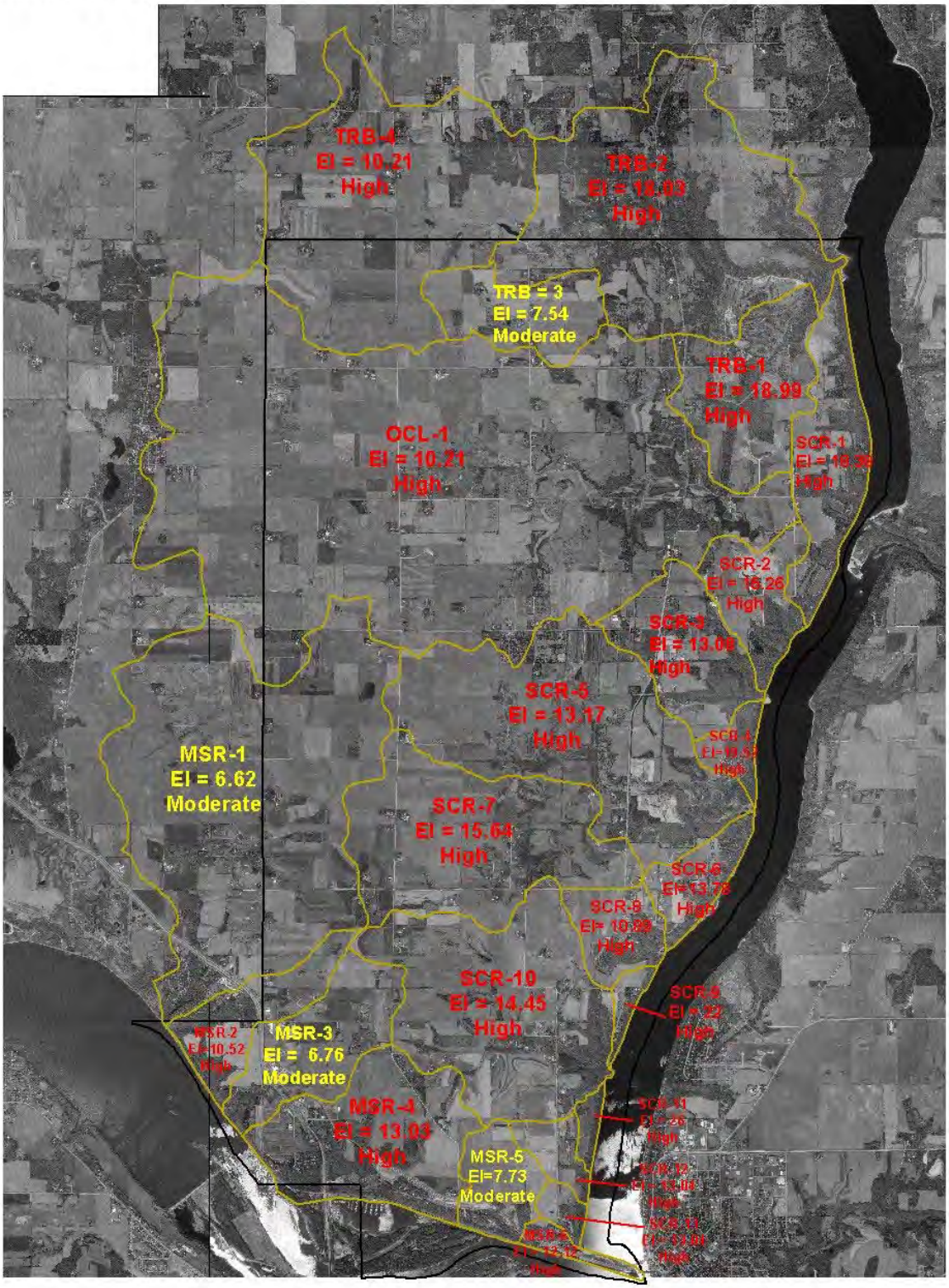


**Figure 3**

DENMARK TOWNSHIP
NATURAL RESOURCE INVENTORY
Washington County Parks
Washington County, Minnesota

N

0 4000 8000 Feet

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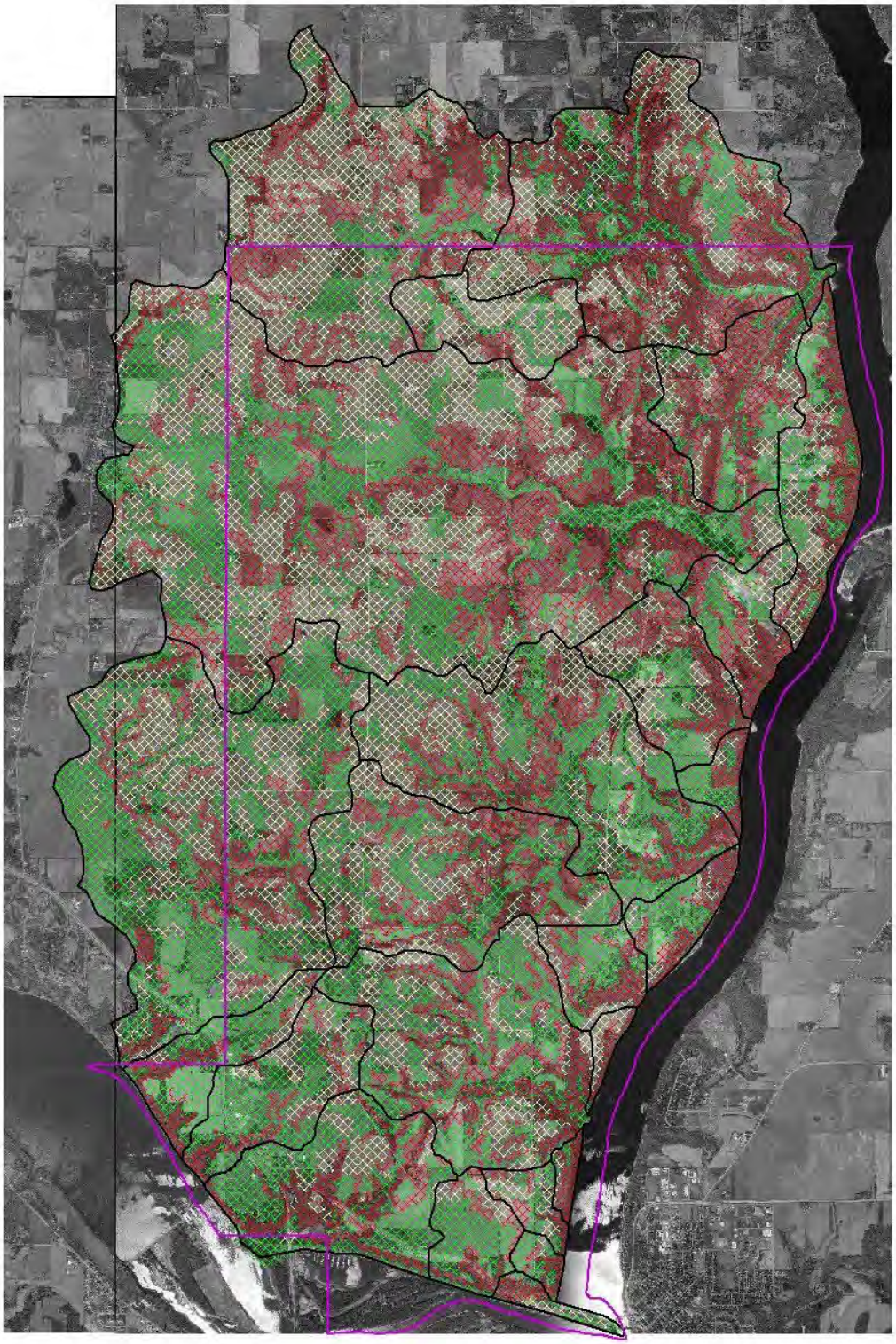


**Erosivity Index Ranking by Soil Mapping Unit**

- 0 - 3.9 Low
- 4 - 7.9 Moderate
- 8 + High
- Subwatershed Boundaries
- Denmark Township

**Figure 4**

N

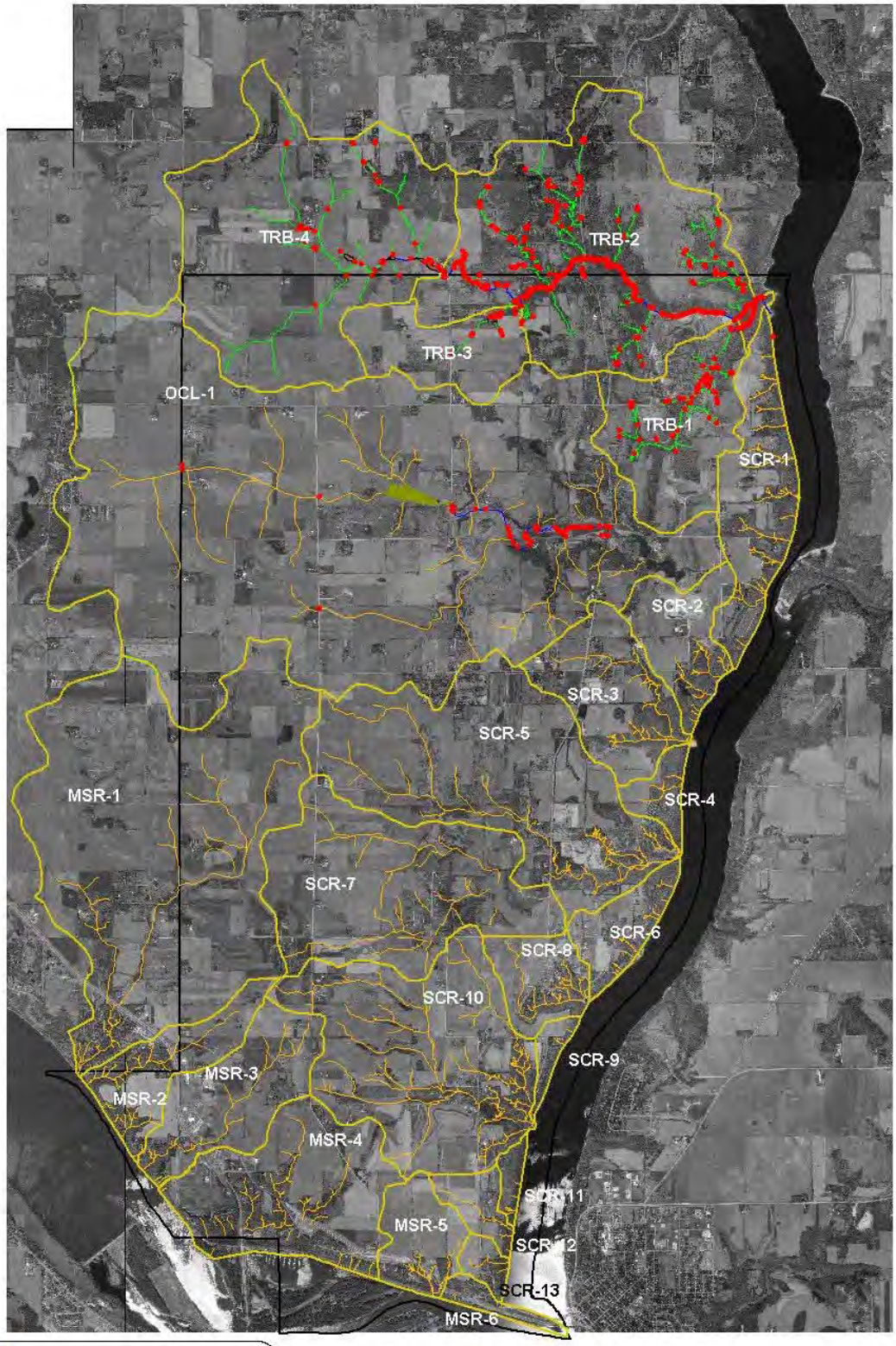
0 4000 8000 Feet

DENMARK TOWNSHIP
NATURAL RESOURCE INVENTORY
Washington County Parks
Washington County, Minnesota

This map was produced by the Washington CD. Natural Resource Inventory data gathered in 2001-2002. Other data is a compilation and reproduction of various Washington County land records. For additional information contact the Washington CD at 430-6820.

## Denmark Watershed
## Major Drainage Features

DENMARK TOWNSHIP
NATURAL RESOURCE INVENTORY
Washington County Parks
Washington County, Minnesota




NRI Features, GPS
Centerline of Stream, GPS
Sediment Delivery, GPS
Sediment Delivery, Digitized *

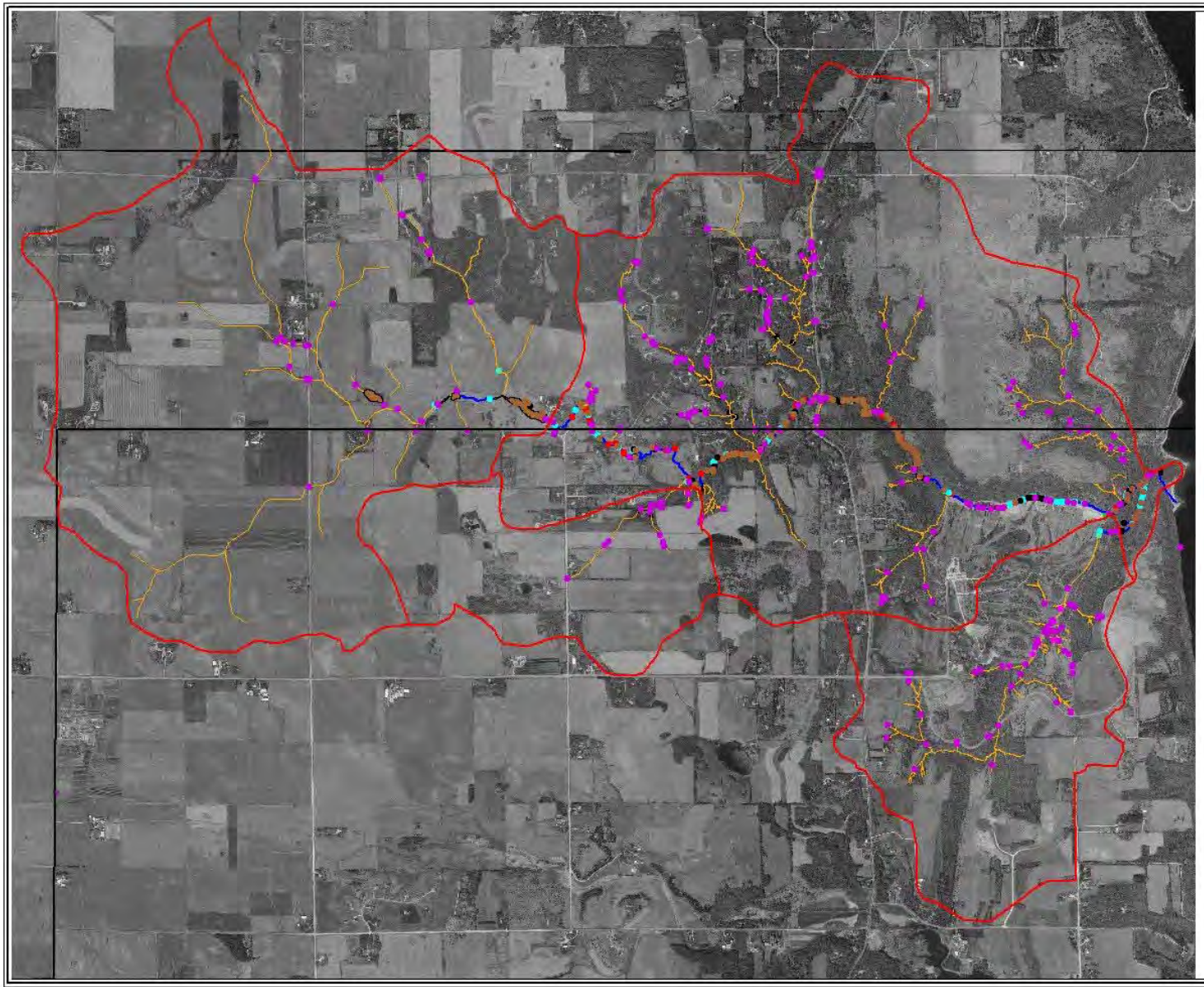
*These sediment delivery areas have been digitized using Washington County produced 2' contour lines.

**Figure 5**

0 4000 8000 Feet

N

This map was produced by the Washington Conservation District. Natural Resource Inventory Data gathered in 2001/2002. Other data is a compilation and reproduction of various Washington County Land records For additional information contact the Washington Conservation District at 430-6820.



# Trout Brook Watershed
# Natural Resource Inventory
# Water Resource Evaluation

DENMARK TOWNSHIP
NATURAL RESOURCE INVENTORY
Washington County Parks
Washington County, Minnesota

- Human-made Feature Location
- Tree Downfall Location
- Seep
- Spring
- Width Measurement Location
- Stream Bank Erosion Site
- Sedimentation Areas
- Sediment Delivery Area
- Centerline of Stream
- Trout Brook Watersheds
- Denmark Township Boundary

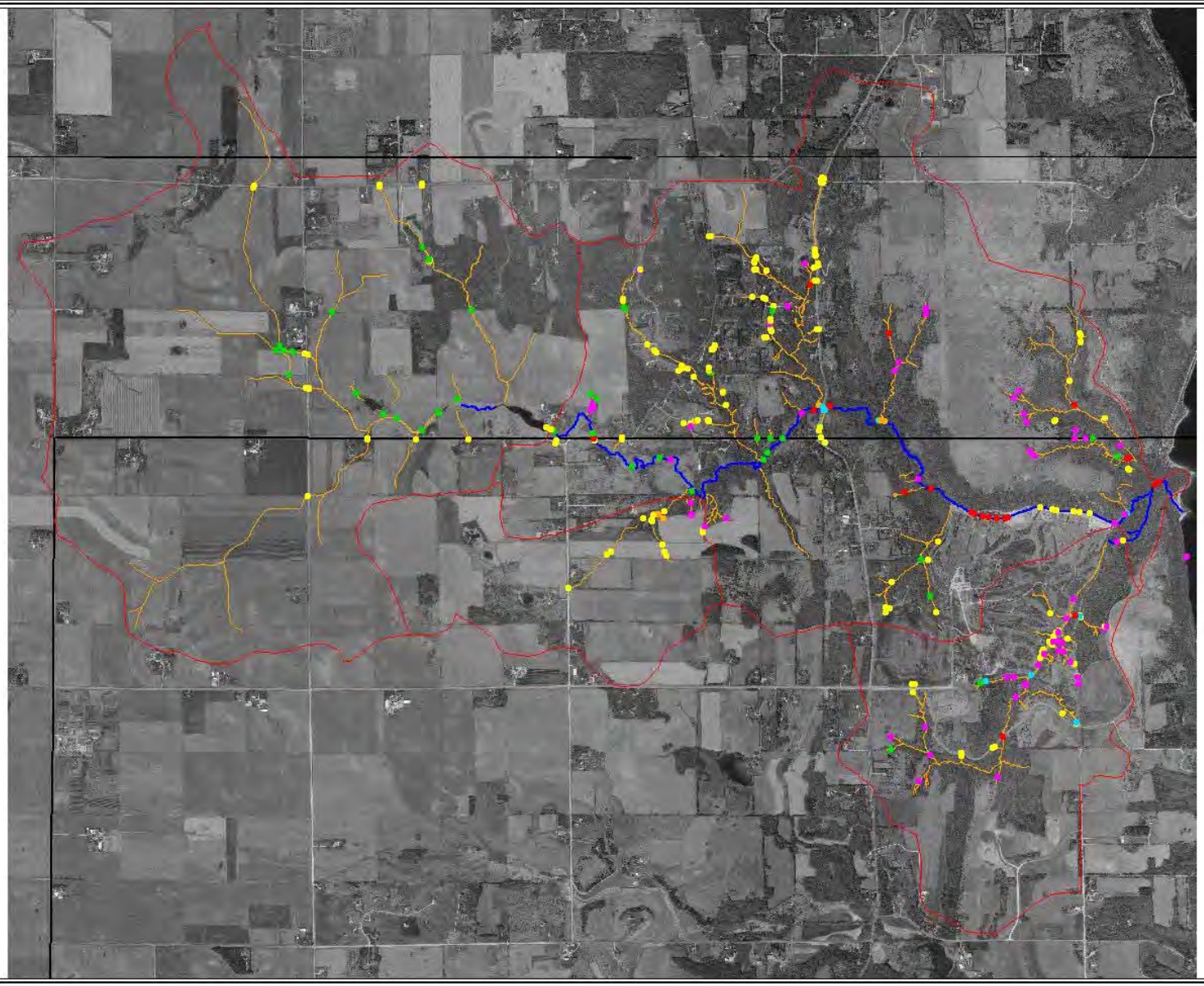
0 2000 4000 Feet

1" represents 2000'

N

**Figure 6**

This map was produced by the Washington Conservation District. Natural Resource Inventory Data gathered in 2001/2002. Other data is a compilation and reproduction of various Washington County Land records For additional information contact the Washington Conservation District at 430-6820.



# Trout Brook Watershed
# Human-made Features

DENMARK TOWNSHIP
NATURAL RESOURCE INVENTORY
Washington County Parks
Washington County, Minnesota

Human-made Feature Location

- bridge
- culvert
- dam
- fence
- other
- rock rip-rap
- Centerline of Stream
- Sediment Delivery Area
- Trout Brook Watersheds

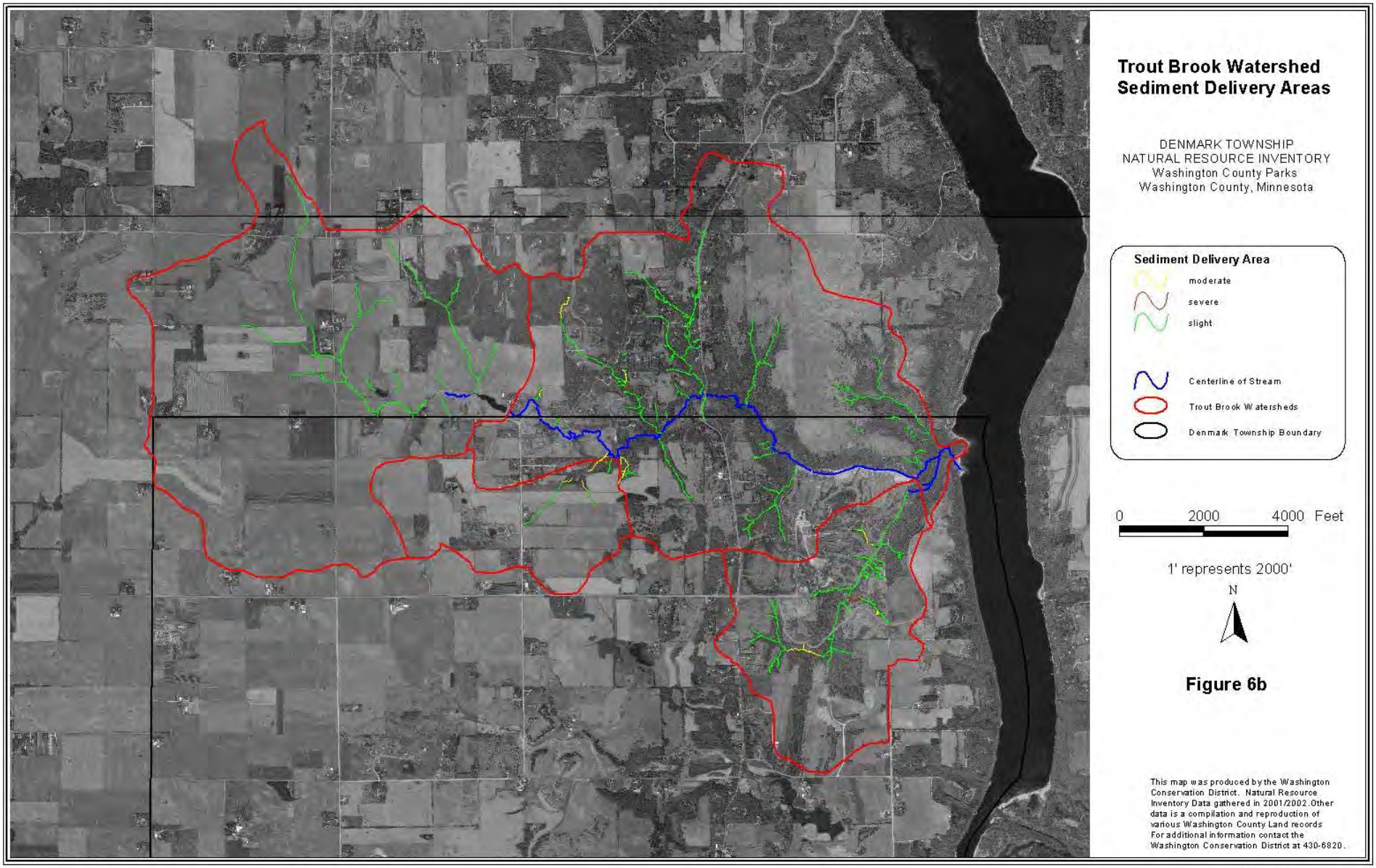
0 2000 4000 Feet

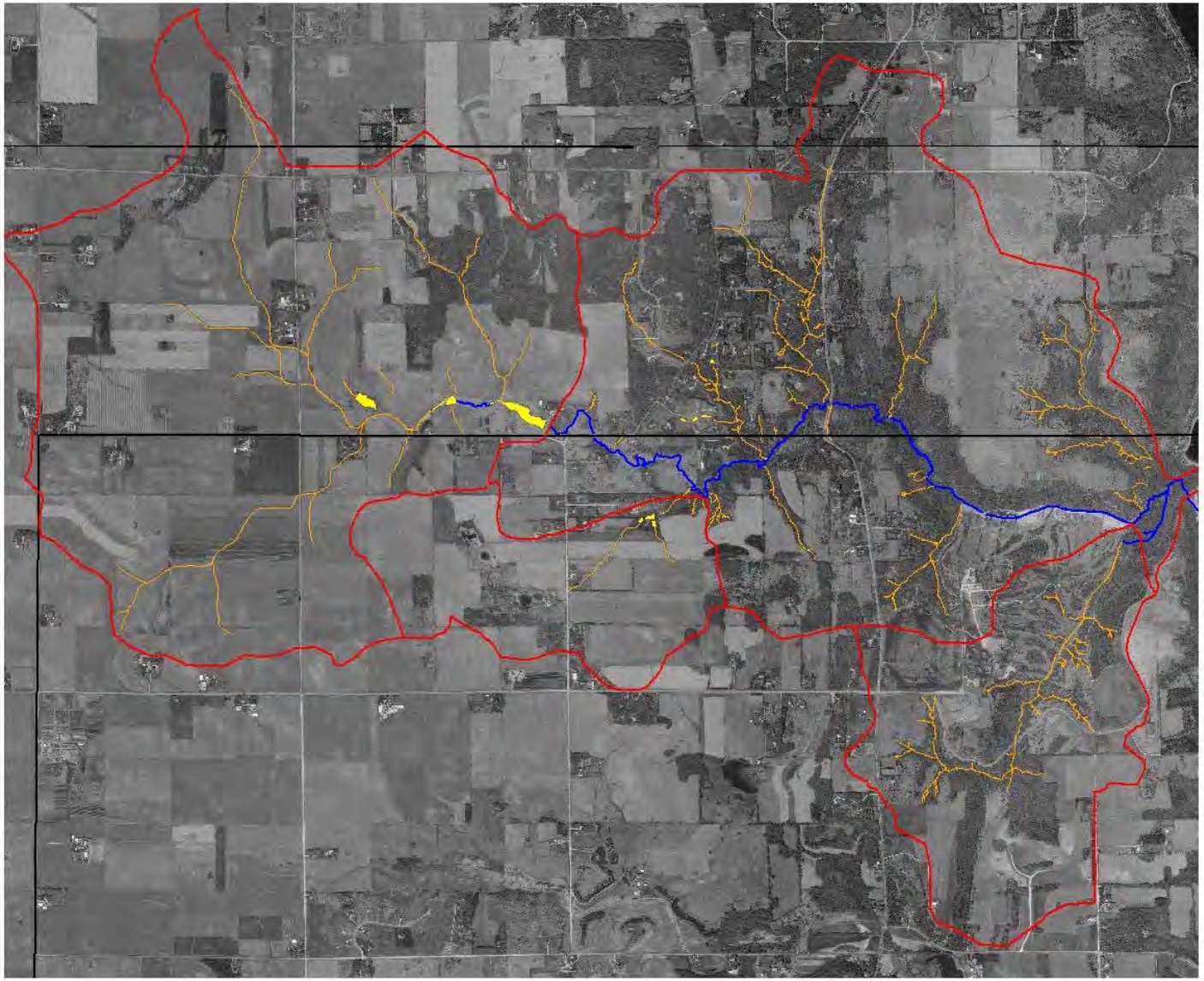
1" represents 2000'

N

**Figure 6a**

This map was produced by the Washington Conservation District. Natural Resource Inventory Data gathered in 2001/2002. Other data is a compilation and reproduction of various Washington County Land records. For additional information contact the Washington Conservation District at 430-6820.


Trout Brook Watershed
Sediment Delivery Areas
DENMARK TOWNSHIP
NATURAL RESOURCE INVENTORY
Washington County Parks
Washington County, Minnesota
Sediment Delivery Area
moderate
severe
slight
Centerline of Stream
Trout Brook Watersheds
Denmark Township Boundary
0
2000
4000 Feet
1" represents 2000'
N
Figure 6b
This map was produced by the Washington Conservation District. Natural Resource Inventory Data gathered in 2001/2002. Other data is a compilation and reproduction of various Washington County Land records For additional information contact the Washington Conservation District at 430-6820.



## Trout Brook Watershed Sedimentation Areas

DENMARK TOWNSHIP
NATURAL RESOURCE INVENTORY
Washington County Parks
Washington County, Minnesota

- Sedimentation Areas
- Sediment Delivery Area
- Centerline of Stream
- Trout Brook Watersheds
- Denmark Township Boundary

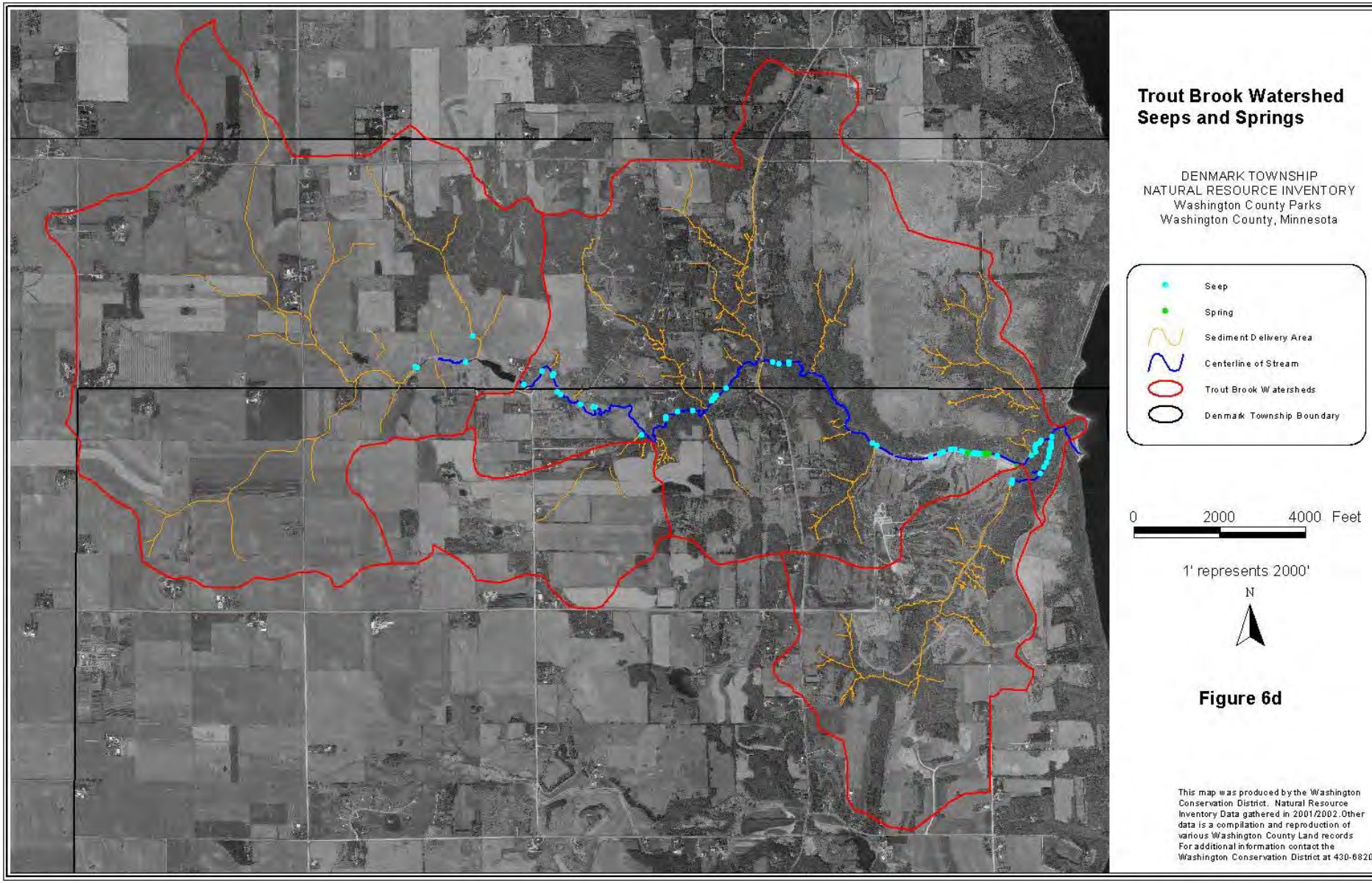
0 2000 4000 Feet

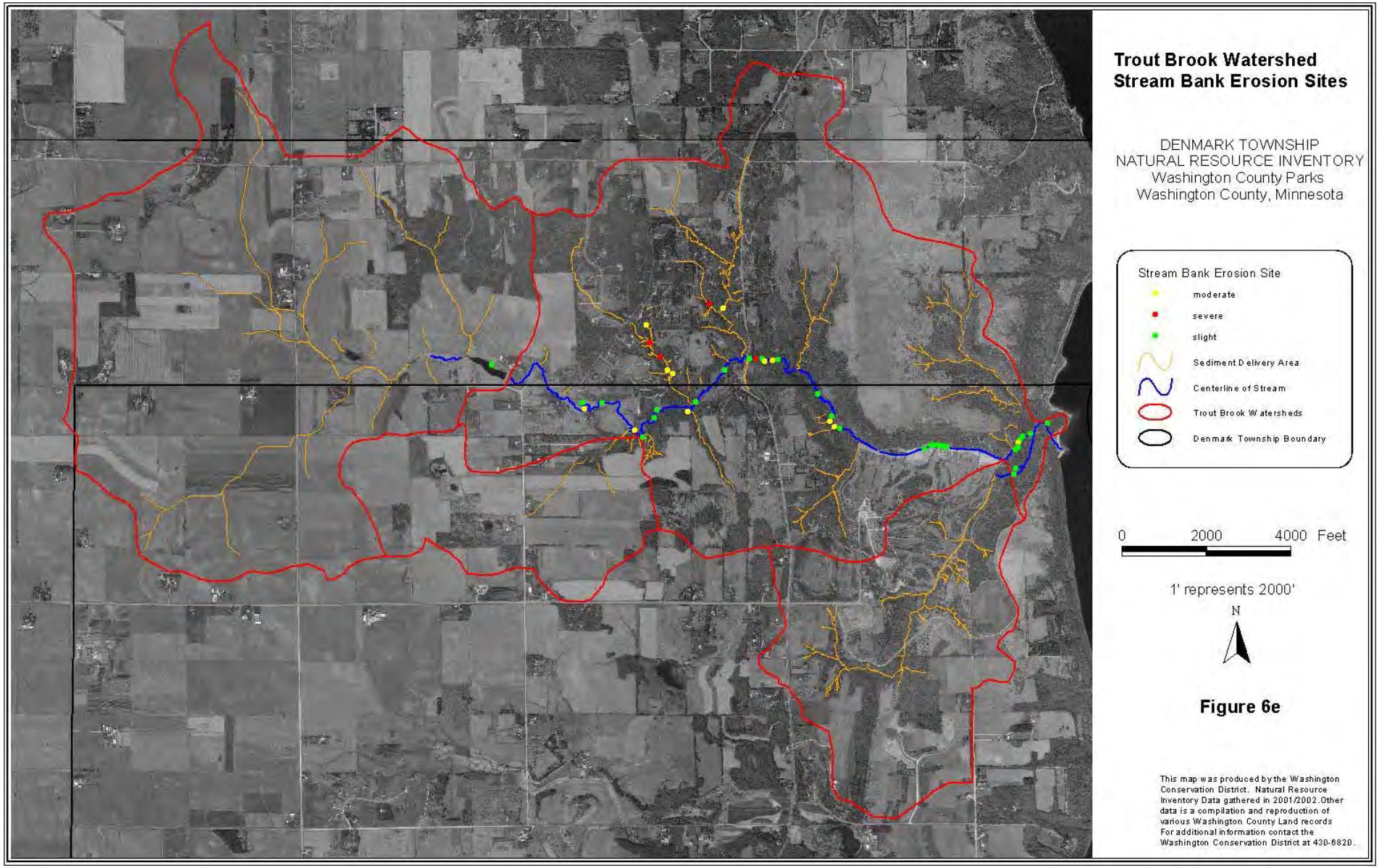
1" represents 2000'

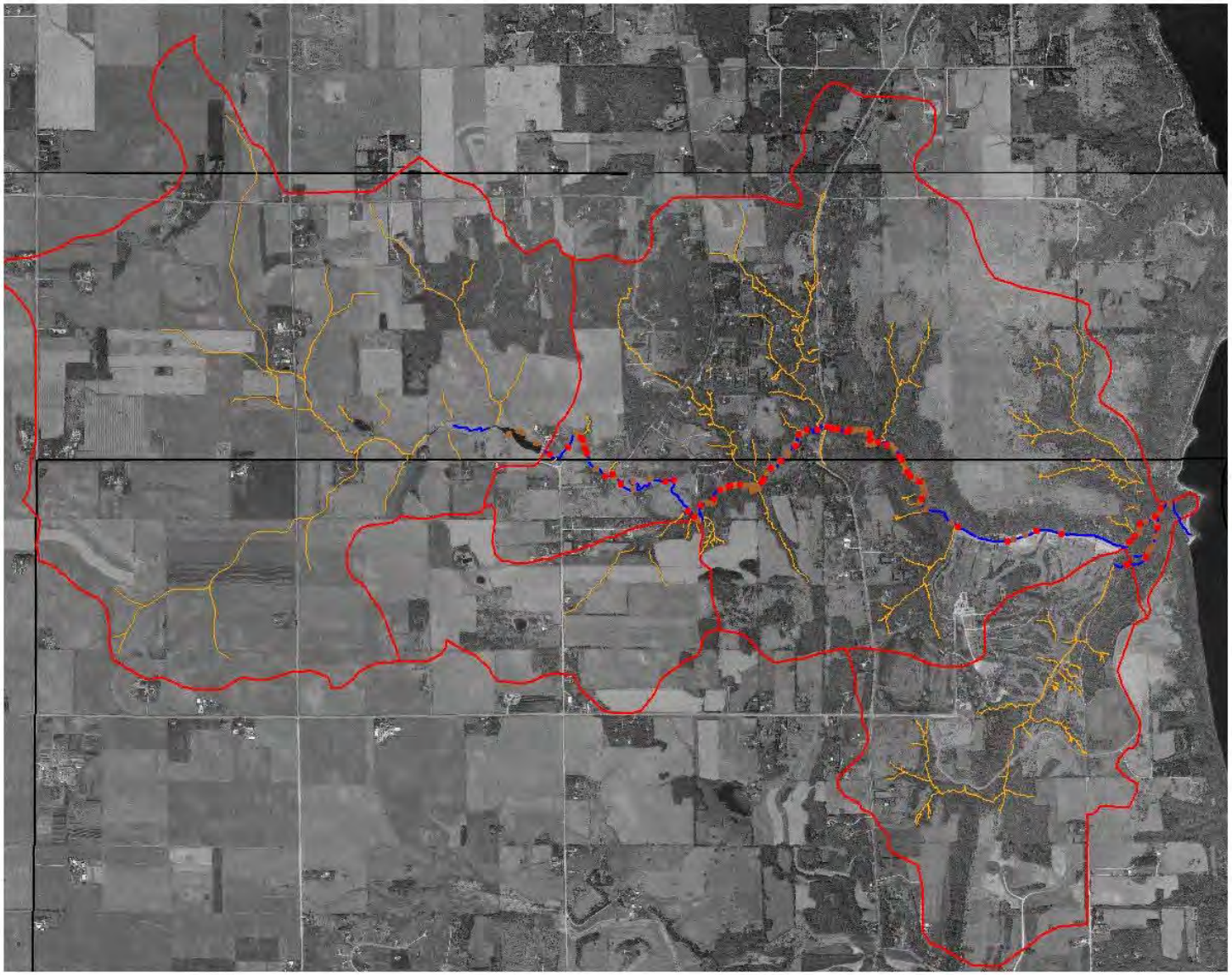
N

**Figure 6c**

This map was produced by the Washington Conservation District. Natural Resource Inventory Data gathered in 2001/2002. Other data is a compilation and reproduction of various Washington County Land records For additional information contact the Washington Conservation District at 430-6820.


Trout Brook Watershed
Seeps and Springs
DENMARK TOWNSHIP
NATURAL RESOURCE INVENTORY
Washington County Parks
Washington County, Minnesota
Seep
Spring
Sediment Delivery Area
Centerline of Stream
Trout Brook Watersheds
Denmark Township Boundary
0
2000
4000 Feet
1" represents 2000'
N
Figure 6d
This map was produced by the Washington Conservation District. Natural Resource Inventory Data gathered in 2001/2002. Other data is a compilation and reproduction of various Washington County Land records For additional information contact the Washington Conservation District at 430-6820.


Trout Brook Watershed
Stream Bank Erosion Sites
DENMARK TOWNSHIP
NATURAL RESOURCE INVENTORY
Washington County Parks
Washington County, Minnesota
Stream Bank Erosion Site
moderate
severe
slight
Sediment Delivery Area
Centerline of Stream
Trout Brook Watersheds
Denmark Township Boundary
0
2000
4000 Feet
1" represents 2000'
N
Figure 6e
This map was produced by the Washington Conservation District. Natural Resource Inventory Data gathered in 2001/2002. Other data is a compilation and reproduction of various Washington County Land records For additional information contact the Washington Conservation District at 430-6820.



# Trout Brook Watershed
# Tree Downfall &
# Width Measurement Locations

DENMARK TOWNSHIP
NATURAL RESOURCE INVENTORY
Washington County Parks
Washington County, Minnesota

- Tree Downfall Location
- Width Measurement Location tb 1-4
- Sediment Delivery Area
- Centerline of Stream
- Trout Brook Watersheds
- Denmark Township Boundary

0 2000 4000 Feet

1" represents 2000'

N

**Figure 6f**

This map was produced by the Washington Conservation District. Natural Resource Inventory Data gathered in 2001/2002. Other data is a compilation and reproduction of various Washington County Land records For additional information contact the Washington Conservation District at 430-6820.