1.0 Natural Resource Inventory Criteria

This section provides background information on the natural resource criteria discussed individually for each subwatershed later in this report. It discusses definitions, methodologies, and the basis for collection of this natural resource information.

1.1 Location and General Information

Subwatershed locations and general information was taken from their respective watershed management plans. Currently there are three watershed management plans which information was drawn from. These watershed management plans were developed by the following watershed units.

1) Valley Branch Watershed District (VBWD) (renamed the Lower St. Croix Valley Watershed District-LSCVWD) contains the Valley Creek (NVB, MVB, SVB), the Rest Area Pond (RAP), Fahlstrom Pond (FAL), and Lake Edith (EDI) subwatershed.
2) Lower St. Croix Water Management Organization (LSCWMO) (which has now been combined with the Lower St. Croix Valley Watershed District) contains Swede Hill Creek (SHC), Kelles Coulee (KLC), and Trout Brook (TRB) Subwatersheds.
3) South Washington Watershed District (SWWD) contains the Bailey Lake (BL) Subwatershed

See **Figure 1 and Table 1** for descriptions of watersheds in Afton

1.2 Landscape Units Criteria

Landscape Management Units features were inventoried and criteria developed which is contained in the companion report titled Afton Natural Resource Inventory – Natural Community Assessment. This report contains a cross-reference of the hydrologic information detailed in this report, with landscape units identified in the companion report.

Water Quality Management Criteria

Details on water quality management were derived from the pertinent Watershed's Water Management Plan.
Detailed information was available for those subwatershed within the LSCVWD (formerly VBWD), so relevant information was directly related in this report.
The SWWD contained good detail on the Bailey Lake subwatershed, although this subwatershed portion located in Afton was fairly minor compared to the whole Bailey Lake watershed unit.
The LSCWMO plan contained only general information on water quality management goals for the entire watershed. Therefore it was determined, specifically for this report, which of these goals would apply on a subwatershed basis. The listed goals are virtually identical for the Swede Hill Creek, Kelles Coulee, and Trout Brook subwatersheds.

As a part of this Natural Resource Inventory (NRI), water quality management ranking criteria was developed. The appendix contains additional information regarding the categorization of waterbodies, and general information on the evalutation of water quality management.
This ranking was itemized into three categories, defined as follows.

1. **High water quality ranking: Drains to a VBWD-designated subwatershed of Category I or II water and/or drains directly to St. Croix River without pretreatment.**
2 **Medium water quality ranking: Drains to a VBWD-designated subwatershed of Category III. (None within Afton)**
3 **Low water quality ranking: Drains to a VBWD-designated subwatershed of Category IV or V or a SWWD-designated stormwater utility area.**

See **figure 2** for identification of subwatershed water quality rankings.
Water quality ranking criteria can be used to identify subwatershed priority for maintenance, protective, and/or restoration measures.

1.4 Groundwater Recharge/Infiltration/Permeability Criteria

The Afton NRI evaluated the natural ability of an area to allow water infiltration into the groundwater. To do this, a combination of soil and geologic information was used.
Figure 3 shows the combination of soil infiltration rates and surficial geology permeability. This figure shows a ranking of the area in terms of total infiltration potentials, based on the Soil Survey of Washington and Ramsey Counties Minnesota (1980) and the Washington County Geologic Atlas (1990). (**Figure 4** shows the hydrologic groupings of the soils according to the soils survey. **Figure 5** shows the permeability of the surficial geology according to the geologic atlas.)

Groundwater ranking criteria was developed as follows.

1. **High-The areas with soils having both high infiltration rates and permeable surficial geology are shown as having a high total infiltration potential.**
2. **Medium-Areas with soils that have high infiltration rates, but the surficial geology is less permeable are shown as having a moderate total infiltration potential. Areas with soils of lower infiltration rates, but high surficial geology permeability are also shown as having a moderate total infiltration potential.**
3. **Low-Areas of low soil infiltration and low surficial geology permeability are shown as having a low total infiltration potential.**

Although this total infiltration ranking can be used to identify good locations to infiltrate stormwater runoff and provide groundwater recharge, it is also useful in determining areas that are more susceptible to contamination (groundwater sensitivity). If contaminated water continues to percolate down into underlying geology, it may lead to the contamination of groundwater.

1.5 Erosion Index Criteria

With the Afton NRI, the potential for erosion was determined to be the significant feature to address the sensitivity of an area to a disturbance which would cause erosion.

To determine the susceptibility of a subwatershed to erosion, portions of the soil loss equation were used.
To determine estimated annual to soil loss of an area, the Revised Universal Soil Loss Equation (RUSLE) is used. RUSLE was developed by the United States Department of Agriculture –Natural Resource Conservation Service (USDA-NRCS) to predict soil loss on cropland. This equation incorporates the factors for rainfall, soil erodibility, slope length, slope degree, land cover, and

remedial measures which would reduce erosion. This equation calculates an actual annual estimate of soil loss (tons/acre) for the current land cover. The RUSLE is useful with current landuse conditions.

To assess the *potential* of an area for erosion, a shortened version to the soil loss equation is used. This shortened equation omits the landcover and remedial factor of the equation, and just deals with rainfall and soil characteristics. The calculation of potential for soil loss is referred to as erosivity index (EI).

The ability of a soil to regenerate itself at the rate at which it is lost is referred to as the soils "T" value. This is a value established by the USDA-NRCS. EI is the potential of a soil for erosion, compared with the ability of the soil regenerate itself.

For purposes of developing ranking criteria the following thresholds were used.

1. **If the calculated EI value is greater than 8 times or greater than the T value, then the soil has a high potential for erosion.**

2. **If the calculation is between 4 and 8 it is a medium ranking is assigned.**

3. **If the EI was less than 4, a low ranking is assigned.**

To make EI more valuable on a broader scale, EI was calculated on a subwatershed cluster and, subwatershed scale. Therefore, the erosion potential of the entire drainage area as well as the smaller subwatersheds within the larger cluster was determined. The previous ranking criteria was then utilized on a hydrologic basis.

This will be helpful in determining the susceptibility of areas to erosion and can be used to:

- Direct actions away from high erosion potential areas.
- Consider measures more carefully in areas determined to be sensitive.
- Establish acceptable landuses for defined areas.

EI results and finding will be discussed in greater detail in subwatershed analysis further in this report. See **figure 6 and Table 2** which identifies the EI values and ranking for each watershed within Afton. Additional figures for each subwatershed are also included, and will be identified within each subwatershed report.

1.6 Natural Resource Inventory Criteria -Hydrology Natural Resource Inventory

In addition to conducting a resource assessment based on hydrologic units, in depth on site natural resource data was collected. This data was collected for Valley Creek, Kelles Coulee, and Trout Brook. These three drainage features make up the three most significant drainage channels within the City of Afton.

For each of the these three drainage features, the following information was collected.

Centerline of Stream. The intent of mapping this feature was to illustrate a continuous line, locating the drainage features (Valley Creek, Kelles Coulee, and Trout Brook) perennial and

intermittent channels. In addition to simply a line showing the location of the stream, the **percent canopy** and **riparian landuse** was also mapped along with and attached to the centerline of stream feature.

- **Percent canopy** is a visual observation of the amount of tree cover directly above the centerline of the stream, or in other words when looking straight up what percentage of what is seen is tree (branches, leaves) versus sky. For this inventory the percent canopy was recorded in one of 3 categories. 0-33 %, 34-66%, or 67-100% canopy cover. It should be noted that this data was gathered in spring, before full leaf out, for Valley Creek and Kelles Coulee, and some of Trout Brook. The percent canopy was recorded assuming full leafout had occurred. This feature was mapped because tree cover can have an effect on stream temperatures, and the amount and type of ground cover.

- **Riparian Landuse** recorded what the land was being used for adjacent to the stream. Due to limitations with data collection, only one side of the stream could be recorded as a part of this inventory, therefore the side of the stream which exhibited the most disturbed landuse (most influenced by man) was recorded. The landuse features recorded, in general order from most disturbed to least were; lawn, cropland, pastureland, trail, brushland, meadow, wooded, wetland, and other. In most cases where the Creek channel was intermittent, the riparian landuse was identical to the centerline of the stream. This feature was mapped, since what landuse is occurring next to the stream, impacts the stream itself.

Sediment Delivery Site: Sediment delivery sites are any area where concentration of water occurs. This line feature was mapped to illustrate where water flows concentrate, and therefore sediment could be carried through this system. It should be noted that areas mapped as centerline of stream could, in some cases, have also been mapped as sediment delivery areas or vice versa. All sediment delivery areas mapped have only intermittent waterflows, and outlet adjacent to or into the perennial stream. This mapping feature is significant in that sediment deposited within a Creek has the potential harmful effects of disturbing aquatic flora and fauna habitat, changing stream characteristics, causing the development of plant populations, and nutrient loading attached to sediment. Sediment delivery sites were further defined by two mapping categories identifying **type** and **severity index** of the sediment delivery site.

- **Type** of sediment delivery site was mapped by three categories. These are gully, ditch/waterway, or pipe. The gully was the type identified in almost all of the data collected. For purposes of this inventory, gully can be defined as areas of intermittent water flow with distinct topographic relief.

- **Severity Index** was also mapped using three categories. These categories labeled slight, moderate, and severe are a relative measurement of the amount of erosion occurring within the sediment delivery site. The severity index was not intended to measure the amount of erosion and sedimentation which is occurring from the water draining into (watershed) the sediment delivery site. It is limited to an observation of the amount of erosion (soil movement, instability) occurring within the bottom and sides of the sediment delivery site (gully). The severity index is relative in that it is a comparison of sediment delivery sites within the study area. This index was not intended to quantify the amount of erosion which was occurring, but rather provide a simple assessment tool. It is expected that the severity index will be used to prioritize areas which will warrant future site investigation by a qualified resource professional to determine what remedial action is needed.

Sedimentation Site: This area feature was mapped to identify areas where settlement of sediment would occur due to the deceleration of water movement. This included significant in stream pools, and riparian deposition areas, usually located at the base of sediment delivery sites. This feature was mapped to identify areas which currently or have the potential to eliminate or mitigate sedimentation into the Creek. These mapped areas can be analyzed as for locating future sediment treatment facilities, and can be further analyzed as to the effectiveness of current sedimentation. Sedimentation areas were further defined by the type of sedimentation areas encountered which included **ponds**, **wetland**, and **nonwetland** areas. Due to the large floodplain areas, especially in Kelles Coulee, it was difficult to inventory likely sedimentation areas occurring due to lack of runoff concentration directly into the perennial channel.

- **Ponds** which were mapped were generally found within or adjoining the streambank of the Creek or at the beginning of sediment delivery areas. These ponds contained a permanent pool of water. These ponds were mainly mad-made created by excavation or dam construction. They were characterized by containing the deposition of fine sediments, and/or evident sediment deltas.

- **Wetlands** found adjacent to the stream channel, were floodplain wetlands, and generally did not contain standing water to the time of mapping.

- **Nonwetlands** which were mapped included depressional areas and flats. Nonwetland sedimentation areas were commonly located at the outlet of a steep topography sediment delivery areas where the slope flattened out. These sedimentation areas were characterized by course sediments broadly dispersed along the flats. Fine sediments were either not predominant from these sediment delivery areas, or they continued on to the Creek.

Stream Widths were measured at points along the perennial portions of the channels where significant changes occured. The width of the stream was measured at the bankfull height, which is higher than the baseflow water level and the water level found during the mapping period. Stream widths were mapped to provide base information regarding physical stream characteristics.

Streambank Erosion: Streambank erosion was observed and mapped along perennial and intermittent reaches of the Creek These areas were identified by exposed soils and unstable side slopes along the stream side. Most appeared to be caused by the scouring effect of water movement, while some were cause by soil exposure due to tree downfalls. Streambank erosion was further mapped by it's **condition** and **size**. In addition to the size and condition of the streambank erosion it is significant to note the frequency of streambank erosion sites along the Creek. As with the severity index with sediment delivery areas, it is anticipated that qualified resource professionals will utilize this data to determine threshold condition, size, and frequency. This will assist in determining priority of site visits to determine correction measures needed.

- **Condition** of streambank erosion was mapped as either slight, moderate, or severe. Severe streambank erosion was characterized by areas of bare soils, exceeding their angle of repose (vertical banks, to overhangs), significant down stresses, and evidence of current soil movement. Conversely slight erosion contained some bares soils, but may have vegetative regrowth, stabile soil slopes, and/or small unstable bank height. Moderate is obviously somewhere in between.
- **Size** of streambank erosion was labeled as small, medium, or large. The size of the erosion related to the height, width, and length of area, with the largest area exposed receiving the large size mapping. All sizes mapped were categorized relative to all streambank erosion sites mapped along the Creek.

Plant Populations: *This feature was mapped in Valley Creek only to assist with St. Croix Watershed Research Station efforts.* Points of significant plant populations were mapped within the perennial Valley Creek. Only plant growth occurring within the banks of Valley Creek were mapped. Significant plant populations were mapped as to their **size** and **type**. Some plant population areas were sampled by the St. Croix Watershed Research Station at the time of mapping, and were identified as areas of future sampling in the future. This size and type plant population data is currently being utilized by the St. Croix Watershed Research Station for their follow-up site visits. This feature was mapped, since further research will occur to determine if these are areas with a greater accumulation of sediment which facilitate the associated plant growth.

- **Sizes** of significant plant populations were labeled as small, medium, or large. The size designated was based on the area and density the plant bed occupied. All areas mapped were related to one another when determining size.
- **Type** of plant populations mapped were either, algae, moss, or macrophyte. Generally when mapped it was one of these three types which dominated the streambed.

Human-Made: Man-made features were by far the largest amount of points mapped. Man-made features were mapped along perennial and intermittent sections of the Creeks, along sediment delivery areas, or sedimentation sites. This feature was mapped to provide information on quantities and locations of man-made features within the Valley Creek, Kelles coulee, and Trout Brook subwatersheds. Man-made points mapped were further identified by **type**, with the type allowed to be further identified by **extent or feature.**

- **Type** of man-made features were divided into several categories. These were, dam, rock rip-rap, bridge, culvert, retaining wall, monitoring station, pipe/pump, fence, and other. The type of feature was mapped if it dissected the stream or sediment delivery line, was adjacent to or above the primary mapping feature.
- **Extent or feature** on the type of human-made point was further described. This allowed for more descriptive information about the man-made feature. Some examples of this include, sizes (length, with, height, diameter) of the manmade feature, material (wood, concrete, metal), and condition of man-made feature.

Sediment Sample Point: *This was done in Valley Creek only only to assist with St. Croix Watershed Research Station efforts.* Sediment Sample Points were mapped along the perennial portions of Valley Creek. These area were mapped when the SCRWRS took sediment samples. These samples were taken to the SCWRS lab to be analyzed. Point mapping will served to identify these areas again in the future, to assist with developing trends within Valley Creek. It is important to note that samples were taken in locations only where unusual amounts and types of fine sediments were found.

Tree Downfalls The locations where trees were down across the stream were mapped as points for the perennial portion of the Creek. Tree downfalls were only mapped if the tree partially or totally crossed the stream, and could serve either as habitat or impediments to stream flows.

Seeps: Seeps were mapped where found along all of the Creeks, and in some sediment delivery areas. These were predominately found along the streambank of perennial portions of the Creeks, and is characterized by rust coloring at the slow water discharge area.

Springs: *Springs were found along perennial Valley Creek only.* 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.

Figure 7 identifies NRI features inventoried within the City of Afton. NRI results figures were also made and will be discussed under their respective subwatershed report.

Note: The following individual watershed reports are presented in relative order form north to south within Afton.

2.0 Valley Creek Watershed

2.1 Location and General Description

The majority of Valley Creek (sometimes called Valley Branch Creek) is located in the City of Afton and a small portion is located on the east edge of the City of Woodbury. It is comprised of two major branches. The Main Stem of the creek flows 2.7 miles from Lake Edith to the mouth of the creek at the St. Croix River. The other major branch, known as the South Fork, flows 4 miles from its headwaters in the southwest portion of LSCVWD, in Woodbury, to its junction with the Main Stem, 1.7 miles above the mouth of the creek.

Valley Creek has a drainage area of 6,699 acres, in addition to the Lake Edith tributary area of 1,234 acres. Therefore, the total watershed area of Valley Creek is 7,933 acres. The South Fork portion of the drainage area is 5,099 acres and is comprised of subwatersheds SVB-1 to SVB-12. (The group of subwatersheds draining to the South Fork is sometimes collectively called the subwatershed cluster.) The remainder of the Valley Creek tributary area is comprised of subwatersheds NVB-1, NVB-4, MVB-1, and MVB-2. Subwatersheds NVB-2, NVB-3, MVB-3, MVB-4, and MVB-5 drain directly to wetlands that do not have a surface outlet into Valley Creek. (Subwatersheds designated NVB are part of the North Fork Valley Branch Creek cluster. Subwatershed designated MVB are part of the Main Stem Valley Branch Creek cluster.) **Figure 1** shows the tributary area. The majority of the flow at the mouth of the creek comes from the South Fork, which is fed by springs and has very little pond storage. Most of the watershed is undeveloped. Existing and proposed land use is a mixture of rural residential, agricultural and agricultural preserve uses.

The following reaches of the creek are watercourses that are protected by the Minnesota Department of Natural Resources (DNR):

1. The northerly branch of the South Fork, from its beginnings in the southwest quarter of Section 12, Township 28 North, Range 21 West (subwatershed SVB-10), in the City of Woodbury to its junction with the Main Stem.

2. The Main Stem, from Lake Edith to its junction with the South Fork.

3. The Main Stem, from its junction with the South Fork to the St. Croix River.

In addition to Valley Creek, the Valley Creek watershed contains other unnamed DNR- protected waterbodies. DNR- protected waterbody #82-7w is located in NVB2, DNR protected waterbody #82-8w is located within NVB3, and DNR- protected waterbody #82-468w is located within MVB3, and DNR- protected waterbody #82-467w is located within MVB5.

The portion of the creek in Sections 9, 10, 14, 15, 16, and 17 of Township 28 North, Range 20 West is a DNR-designated trout stream, one of 13 trout streams in the Twin Cities metropolitan area. The cold, relatively clean waters of Valley Creek are suitable for trout. The DNR reports that brook, brown and

rainbow trout are currently present in Valley Creek. The reach from the Lake Edith outlet to its junction with the South Fork is a marginal trout stream, mainly because of the warm water discharges from Lake Edith.

2.2 Landscape Units

The Valley Creek Watershed contains several landscape units. These includes significant portions or all of Landscape Units 9-20, and an unmapped Landscape Unit in southwestern Afton. Further description and analysis of these landscape units are contained in the landscape portion of this Natural Resources Inventory (NRI) report.

2.3 Water Quality Management Goals

The LSCVWD 1995 *Water Management Plan* (Plan) identifies Valley Creek as a Category I water body. Further description of this classification is given *in Appendix A* This designation results in a Surface Water Quality Ranking of High. **See Figure 2**

The management goal for Valley Creek is preservation of its water quality and trout stream habitat. Foremost among local concerns is the problem of siltation, which destroys trout spawning habitat. Siltation in the stream has occurred and could still occur as a result of four major watershed factors: sheet erosion from agricultural practices on uplands, gully erosion, runoff from developments, and construction site erosion in and near the stream itself. The DNR recommends that the LSCVWD manage the tributary watershed to:

- maintain its current (high) dissolved oxygen concentration
- avoid increases in water temperature
- avoid increased discharge

Such changes, especially an increase in water temperature, could jeopardize the stream's ability to support a trout population. LSCVD's current regulations concerning development will help prevent impacts to the trout stream. These regulations require that the rate of runoff not be increased as a result of development and that erosion controls be in place on construction sites. The City of Afton's shoreland ordinance requires buffer strips along the stream.

To prevent temperature increases in the creek, the DNR suggests that infiltration ponds be built as development occurs. Instead of relatively warm stormwater runoff entering the creek, the runoff water would seep through the bottom of the infiltration basin into the groundwater, giving the water a chance to cool before discharging to the creek. The LSCVWD requires the use of infiltration basins in developments in the Valley Creek Watershed on a case-by-case basis.

In the LSCVWD plan, the watershed district expressed interest in installing an automatic temperature-monitoring device in Valley Creek to determine if the creek is affected by temperature changes. Since 1998, the St. Croix Watershed Research Station (SCWRC) has been collecting

continuous flow and temperature data at four monitoring locations on Valley Creek. Two of the monitoring sites are along the perennial portions of the stream, and two are along the intermittent portions. The SCWRC operates another continuous monitoring station through their participation in the Metropolitan Council's Watershed Outlet Monitoring Program (WOMP) station. The SCWRC also operates an automatic weather station in the Valley Creek watershed.

The overall water quality of the stream is excellent and has not changed significantly since 1972. During the period 1984 through 1991, 1993, and annually since 1995, the LSCVWD has conducted an annual biological survey of the Main Stem of the stream, immediately downstream of Highway 95, to evaluate its water quality. Monitoring for the presence or absence of biological indicator organisms provides indirect evidence of the effects of transitory changes in stream water quality related to storm runoff. As attached organisms, benthic aquatic invertebrates are exposed to all the variations in stream water quality over time, and will live on the stream bottom only as long as water quality conditions permit. As more pollutants enter the stream, more organisms are eliminated, depending on their sensitivity to pollution. During the period 1984 through 1991, and again from 1996 through 2000, the biological monitoring results indicate the water quality of Valley Creek was consistently very good. This ranking suggests there may only be a slight possibility of organic pollution in the stream. During 1993, however, the biotic index value was in the fairly poor water quality category, probably due to high quantities of suspended solids contained in the backwaters from the (flooded) St. Croix River, which affected the stream. In 1995, the stream had recovered somewhat, with a biotic index value on the borderline of fair and good. Since 1996, the biotic index value has been. within the very good water quality category.

The LSCVWD has also conducted biological monitoring on the South Fork of the stream, 800 feet upstream of its junction with the Main Stem. The biotic index values for 1998 through 2000 indicate the water quality of the South Fork is also in the very good category.

In 1999 and 2000, the DNR worked with students from the Stillwater Area High School to collect physical and biological stream data.

Further evidence of the excellent water quality in Valley Creek is the presence of the American brook lamprey. Valley Creek is the only stream supporting this species in the Twin Cities metropolitan area. The American brook lamprey is threatened because of the effects of urbanization on stream habitat. The DNR considers this species of special concern. The American brook lamprey is a non-parasitic filter feeder and it does not exceed 8 inches in length. Because a trout habitat is also suitable for the American brook lamprey, protection of the trout habitat in Valley Creek will also ensure the survival of this species.

2.4 Groundwater Recharge/Infiltration/Permeability

The Valley Creek watershed contains variable groundwater recharge/infiltration rates. As a generalization, the rankings move from high groundwater recharge/infiltration to the west and moderate to the east. Some subwatersheds contain a majority of high groundwater recharge/infiltration rankings. These include NVB-4, SVB-3, SVB-8, and SVB-9. Other subwatersheds contain a predominance of moderate groundwater recharge/infiltration rankings, including NVB-1, NVB-2, NVB-3, and all of the MVB subwatershed cluster. No subwatersheds contain a dominance of low groundwater recharge/infiltration rankings.

The Valley Creek watershed is the only riverine drainage system in Afton with areas ranked high in groundwater recharge/infiltration. Some of these areas ranked high in groundwater

recharge/infiltration are located in low areas, where stormwater runoff can accumulate. **See Figure 3**

2.5 Erosion Index Ranking

The Valley Creek watershed as a whole receives a high soil erosion index (EI) ranking of 11. Although the ranking varies by subwatershed throughout the watershed, from an EI of 8.55 in the North Valley Branch subwatershed cluster to an EI of 11.01 in the South Valley Branch subwatershed cluster, all of the subwatersheds receive a high erosion ranking. On a subwatershed basis, the EI values vary widely, ranking from low to high. The low EI values are in the MVB-1 (ranking of 2.52), while the high EI values are in the SVB-1 (ranking of 16.33). **See Table 3, which itemizes the EI values according to subwatershed.** See also **Figures 6a**-6c for EI values and rankings for the Valley Creek Subwatershed Clusters.

No trends regarding EI rankings were evident for the Valley Creek Watershed.

2.6 Valley Creek Natural Resource Inventory Results

The Valley Creek NRI was conducted in 2000. The data and supporting information is included in this document to create a more comprehensive report. The NRI for Trout Brook and Kelles Coulee were done to compliment what was started here.

Valley Creek 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	21	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	25	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	50	Identification of stream characteristics	Data can be used in stream classification & stream flow analysis.
Streambank erosion	point	condition, size	59	Identification of areas where stream	These areas identify where streambank stabilization is

Valley Creek Natural Resource Inventory Components					
Feature Inventoried	**Feature Type**	**Additional Inventory Information**	**Number of Features Mapped**	**Why Feature Was Mapped**	**Discussion**
				is unstable, and there is an opportunity for remediation	warranted and should undergo further analysis.
Plant Population	point	size, type	50	Identification where significant plant populations exist	Plant populations may impact habitat, relate to sedimentation and nutrients.
Human-Made	point	type, extent/feature	458	Identifications of structures in and along creek	These structures may impact stream flow, habitat, water quantity and quality.
Sediment Sample Point	point	Number	42	Locate sample collection point which will be analyzed	Coordinated with SCWRS for identification of sample location and numbers.
Tree Downfalls	point	none	118	Identification of where trees impede stream flow, and could provide habitat	May impact streamflow, streambank erosion, habitat
Seeps	point	none	48	Identification where groundwater may be discharging	May provide base flow & other inputs
Springs	point	none	12	Identification where groundwater is discharging	May provide baseflow & other inputs
		Total	**862**		

The Valley Creek Natural Resource Inventory, completed by the Washington Soil and Water Conservation District (SWCD) gathered the above information. All information was gathered by utilizing Global Positioning System (GPS) Technology, and compiled and formatted using Geographic Information System (GIS) Technology.

The purpose of this report is to further describe the features inventoried, identification of feature criteria, the significance of inventorying these features, and general discussion of findings.

See Figures 7a for NRI features identified in the Valley Creek Watershed. **Figures 7a1—7a9** illustrate each of these features individually.

Centerline of Stream: This feature was mapped from the confluence of Valley Creek and the St. Croix River, to the origin of the stream channel in Section 12, Woodbury to the west, and Section 29, Afton at its most southerly point. The north branch was also mapped to it's intersection with Stagecoach Trail. In general, the **percent canopy** tended to be higher downstream, and tended to open up further west. The **riparian landuse** was variable adjacent to the stream, and generally tended to become more undisturbed the further downstream traveled.

Sediment Delivery Site: This feature was mapped predominately along the main branch to south fork of Valley Creek in Sections 16 and 17 in Afton. This area was mapped to a greater extent, not only because of the greater occurrence of sediment delivery sites in this area, but because this area of the creek was determined to be the area of greatest concern, therefore more inventory detail was warranted. The major **type** of sediment delivery areas noted through out the watersheds were gullies. There was no evident pattern to the **severity** of these gullies.

Sedimentation Site Sedimentation Areas identified areas where soil deposition was evident. These sites included significant in-stream pools and riparian deposition areas, usually located at the base of sediment delivery sites. This feature was mapped to identify areas which either currently or potentially may eliminate or mitigate sedimentation into Valley Creek

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

Streambank Erosion: Streambank erosion was observed and mapped along perennial and intermittent reaches of Valley Creek. The **condition and size** of streambank erosion sites tended to be slight to moderate, indicated a healthy drainage system. It is noteworthy that the South Branch tended to have a greater density of erosion sites.

Plant Populations: Points of significant plant populations were mapped within the perennial Valley Creek. Only plant growth occurring within the banks of Valley Creek was mapped. Significant plant populations were mapped as to their **size** and **type**. Some plant population areas were sampled by the St. Croix Watershed Research Station at the time of mapping, and were investigated in greater detail at a later date. This feature was mapped, since further research will occur to determine if these are areas with a greater accumulation of sediment which facilitate the associated plant growth.

Human-Made features were mapped along all areas of the Valley Creek Sub-watershed. Compared to the Trout Brook, and especially Kelles Coulee perennial reaches, Valley Creek has much higher occurrences of human-made features. This includes both the **extent and type** of human made features. This is due the Valley Creek area containing large lot development, which has resulted in greater use of the stream corridor.

Sediment Sample Point: Sediment Sample Points were mapped along the perennial portions of Valley Creek. These area were mapped when the SCRWRS took sediment samples as a part of a separate study. These samples were taken to the SCWRS lab to be analyzed. Point mapping will served to identify these areas again in the future, to assist with developing trends within Valley Creek. It is important to note that samples were taken in locations only where unusual amounts and types of fine sediments were found. 42 Sediment Samples were collected within perennial Valley Creek.

Tree Downfalls: Tree Downfalls were mapped within the perennial Valley Creek if it made it difficult to walk the stream. Tree downfall locations were mapped in Valley Creek more closely due to both their potential to impact stream flow and for their trout habitat value.

Seeps were predominately along perennial sections of Valley Creek, and are likely sites of groundwater discharge. Springs were evident throughout the perennial portion of Valley Creek, with three occurrences within a sediment delivery area.

Springs: Springs were mapped along perennial Valley Creek. In its two forks, Valley Creek becomes perennial due to the presence of springs. Springs are evident by the presence of small areas white sands often with water bubbling out due to water pressure. These are locations of groundwater discharge. Of the three drainage area inventoried, springs were only found within Valley Creek.

3.0 Rest Area Pond Subwatershed

3.1 Location and General Description

The Rest Area Pond Subwatershed is within the Lower St. Croix Valley Watershed District (formerly Valley Branch Watershed District). Rest Area Pond, located in subwatershed RAP-1, and Barton Pit, located in subwatershed BRT-1, were part of a single dry depression located in the west half of Section 33, T29N, R20W in West Lakeland Township.

The area tributary to Rest Area Pond is 1,789 acres, and is comprised of subwatersheds RAP-1 through RAP-6 and RAP-8 through RAP-13. Since flows from West Lakeland Storage Site enter Rest Area Pond, the total tributary area to Rest Area Pond is 15,844 acres. The majority of the Rest Area Pond subwatershed is located outside of Afton, with only very small portions of subwatersheds RAP-4, RAP-5, RAP-6, RAP-8, and RAP-9 located within Afton (paralleling I-94).

At its outlet elevation of 834.0, the Rest Area Pond has a surface area of 11 acres. The 100-year flood elevation of the pond is 857.5. A pipe carries outflows from the Rest Area Pond to the St. Croix River, paralleling the north side of I -94. **See Figure 1**

3.2 Landscape Units

Landscape units were determined only for those portions of the subwatershed located in Afton and includes small portions of Landscape Units 3,4, and 5. In general, the land cover is related to adjacent highway land use, and includes pavement and grassed highway right-of-way areas.

3.3 Water Quantity Management Goals

The LSCVWD collected water quality samples from the Rest Area Pond during 1986 and is collecting data in 2001. The Minnesota Department of Transportation (MNDOT) collected samples from the pond during 1990 and 1991. The historic available data indicate the water quality of the pond is relatively poor, but consistent with the pond's use as a detention basin. The data indicates the pond would be assigned a trophic status of eutrophic to hypereutrophic, which means the pond is rich to extremely rich in nutrients, and has poor to very poor water transparency.

Rest Area Pond and the land surrounding it are owned by MNDOT. There is no public boat access to the pond and its use is limited to passive viewing by Rest Area visitors and detaining and treating stormwater runoff. Use of the pond is not expected to change. Because the water quality of the pond is consistent with its use, the LSCVWD will continue to manage the pond as a detention basin.

The LSCVWD Plan classifies the Rest Area Pond as a Category IV water body, based on its existing water quality and its existing and desired recreational uses. This gives the Rest Area Pond a low water quality ranking. **See Figure 2** Further discussion of this classification is included in Appendix A.

3.4 Groundwater Recharge/Infiltration/Permeability

The portion of the Rest Area Pond subwatershed located within Afton has a high total infiltration potential and a high groundwater sensitivity **(see Figure 3).** (Section 1.4 describes the methodology used to determine the ranking levels.) Although the Afton portion of the subwatershed cluster is small compared with the entire Rest Area Pond subwatershed cluster, the high infiltration capacity means that the creation of additional impervious area could have a water quantity impact downstream in other communities.

3.5 Erosion Index Ranking

The Rest Area Pond subwatershed cluster receives a low soil erosion index (EI) ranking of 3.39, the lowest value of any subwatershed within Afton. **(See figure 6)** The majority of the Rest Area Pond watershed is outside of Afton, and flow out of Afton, therefore limited evaluation was done for this subwatershed cluster.

4.0 Fahlstrom Pond Subwatershed

4.1 Location and General Description

The Fahlstrom Pond Subwatershed is within the Lower St. Croix Valley Watershed District (formerly Valley Branch Watershed District). Fahlstrom Pond (DNR #82-5W) is located in subwatershed FAL-1, south of I-94, between Neal Avenue South (CSAH 71) and Indian Trail South. **(See Figure 1)** During near normal water level conditions (approximately Elevation 838), the pond is split into two basins with a combined surface area of approximately 10 acres. At higher water levels, the two ponds act as one and a third pond to the north (in subwatershed FAL-2) combines with Fahlstrom Pond. The DNR's hydrographic survey report for Fahlstrom Pond found the Ordinary High Water (OHW) to be Elevation 848.1. The highest recorded water level was reached in November, 1986, when it reached Elevation 844.4.

The tributary area of Fahlstrom Pond is 763 acres and is comprised of subwatersheds FAL-1, FAL-4, FAL-6, and FAL-7. Should subwatersheds FAL-5, FAL-8 and FAL-9 overflow, the tributary area increases by 1,788 acres to 2,551 acres. This could occur during stormwater runoff events of longer duration than the 100-year 10-day snowmelt. Construction of I-94 diverted approximately 1,000 acres of the Fahlstrom Pond tributary area into the I-94 drainage system. Currently, most of the tributary area is undeveloped The Landuse planed for Afton calls for rural residential development, with lot sizes ranging from 2.5 acres to 5 acres, or agricultural use. Some of Afton's planned industrial development along I-94 is within the Fahlstrom Pond tributary area. The area of Woodbury that is tributary to Fahlstrom Pond is planned to be used for industrial, commercial, and high and medium density residential purposes

Fahlstrom Pond has no surface water outlet (landlocked). Prior to construction of the I-94 drainage system, the pond overflow was at Elevation 874.3, the low point in Indian Trail South, to subwatershed EDI-4 and the large wetland west of Lake Edith (Metcalf Marsh). Construction of the I-94 drainage system changed the Fahlstrom Pond overflow. Fahlstrom Pond will now overflow to the MNDOT drainage system when the pond reaches approximately Elevation 869, with the water eventually reaching MNDOT's Rest Area Pond. Under extreme events, Fahlstrom Pond might also overflow to Metcalf Marsh.

The seepage rate from the pond was measured to be approximately 1.5 cfs (3 acre-feet per day) in the fall of 1986, when water levels were between 840 and 845. Based on this seepage rate and the total drainage area of 2,551 acres, the 100-year flood elevation of Fahlstrom Pond would be approximately 858.0. Without seepage, the 100-year flood elevation would be approximately 864.0.

However, the cooperative agreement between LSCVWD and MNDOT allows MNDOT to redirect the entire West Lakeland Storage Site tributary area (14,055 acres) to Fahlstrom Pond by closing a gate in Structure 2B (outlet control structure for West Lakeland Storage Site). If the gate were closed for a long enough period of time, the West Lakeland Storage Site would overflow to Fahlstrom Pond. If the gate were closed under 100-year flooding conditions, Fahlstrom Pond could reach its overflow elevation of 869, and back up into the MNDOT I-94 drainage system. Since MNDOT can operate the Structure 2B gate at any time, LSCVWD set the 100-year flood elevation for Fahlstrom Pond at Elevation 870. Although LSCVWD recognizes the possibility of a flooding problem, LSCVWD believes the likelihood to be remote

4.2 Landscape Units

The Fahlstrom Pond Subwatershed contains several landscape units. These Landscape Units all or significant portions of 4-9. Further description and analysis of these landscape units are contained in the landscape portion of the NRI report.

4.3 Water Quality Management Goals

The LSCVWD Plan classifies Fahlstrom Pond as a Category V water body, based on its existing and desired recreational uses. This designation results in a Surface Water Quality Ranking of Low. **(See Figure 2)** Further description of this classification is included in *Appendix A.*

Water quality samples were collected from Fahlstrom Pond in 2000. The data show very high concentrations of total phosphorus and chlorophyll-a, and low Secchi disc transparencies. The water quality data are all in the hypereutrophic range (very nutrient rich). If an outlet is to be constructed from the pond to Lake Edith, water quality samples will be collected to help determine the water quality impact of a Fahlstrom Pond discharge on Metcalf Marsh, other downstream wetlands, and Lake Edith.

4.4 Groundwater Recharge/Infiltration/Permeability

The majority of the Fahlstrom pond subwatershed within Afton has a high groundwater recharge/infiltration ranking, with moderate and low rankings in the west portion of the subwatershed within Afton and Fahlstrom Pond itself **(see Figure 3)**. (Section 1.4 describes the methodology used to determine the ranking levels.) Nearly all of subwatersheds FAL-1, FAL-2, FAL-3, FAL-6, and FAL-8 have a high groundwater recharge/infiltration ranking. The portions of subwatersheds FAL-5 and FAL-9 within Afton contain a mixture of low, moderate and high groundwater recharge/infiltration rankings.

Generally, the groundwater recharge/infiltration increases as you move further east and lower in the landscape. This may result in a greater accumulation of runoff from the lower (moderate) groundwater recharge/infiltration areas to the west, leading to greater infiltration as this water heads downhill to the east. Possible implications include: 1)surface water runoff from the west could negatively impact the groundwater to the east due to increase runoff, and 2)an increase in impervious cover along the eastern Fahlstrom Pond subwatershed could result in increased volumes of surface water moving east through this subwatershed (and potentially exiting this system).

4.5 Erosion Index Ranking

The Fahlstrom Pond subwatershed receives a moderate soil erosion index (EI) ranking of 5.92. The EI ranking varies throughout the subwatershed cluster, from a low EI ranking of 2.67 in FAL-6, to a moderate EI ranking of 7.51 in FAL-8 . Subwatersheds FAL-6 and FAL-7, located north of I-94, received low EI rankings, with the balance of the Fahlstrom Pond subwatersheds receiving a moderate EI ranking. **(See Figure 6d1 –6d7)** See also, **table 2**, which itemized the EI values by subwatersheds.

5.1 Location, General Description and Drainage Patterns

The Lake Edith Subwatershed is within the Lower St. Croix Valley Watershed District (formerly Valley Branch Watershed District). Lake Edith (DNR #82-4P), also known as May's Lake, is located in subwatershed EDI-1, between Indian Trail South and Stagecoach Trail South, in the City of Afton. The lake has a surface area of approximately 75 acres and a maximum depth from 35 to 40 feet. The lake consists of a north basin connected by a narrow channel to a smaller south basin. The tributary area of the lake is 1,234 acres, consisting of subwatersheds EDI-1, EDI-2, EDI-4, and EDI-5, most of which is undeveloped. All but approximately 70 acres of the tributary area is located within the City of Afton. Other than a strip of industrial development planned along the I-94 corridor, the planned land use in the tributary area is limited to rural residential development. Almost half of the Lake Edith tributary area drains to a large wetland area (Metcalf Marsh, DNR #82-464W) approximately 3/4 mile upstream (west) of Lake Edith. This marsh area is characterized by many springs, which contribute water to the marsh and wetland. Lake Edith overflows to the south to Valley Creek (also known as Valley Branch Creek), through a 24-inch diameter culvert under Indian Trail. This culvert has an invert elevation of 795.8. **(See Figure 1)**

The LSCVWD collected and analyzed water quality samples from Lake Edith in 1973, 1979, 1984, 1992, and 1997. The water quality of Lake Edith has been very good, especially in the northern basin where the lake is distinctly stratified. The most recent water quality data from 1997 show an average summer total phosphorus concentration of 20 µg/L, Secchi disc transparency of 2.6 meters, and chlorophyll-a concentration of 5.2 µg/L. Based on this data, Lake Edith would be assigned a trophic status of mesotrophic (moderately productive).

Current use of the lake is limited to area residents, who use the lake for a variety of recreational activities, including swimming, fishing and canoeing. The City of Afton's shoreland ordinance allows only non-motorized craft on the lake, with the exception of small electric motors. Prior to the ordinance, the lake residents agreed among themselves to the same restriction. The current water quality of Lake Edith is very good and is consistent with its use. The water quality of the lake is suitable for all kinds of recreational uses, including swimming. Preservation of Lake Edith's water quality is also important in maintaining the water quality of Valley Creek.

5.2 Landscape Units

The Lake Edith Subwatershed contains several landscape units. These Landscape Units include significant portions of 1-3 and 10. Further description and analysis of these landscape units are contained in the landscape portion of the NRI report.

5.3 Water Quality Management Goals

The LSCVWD plan classifies Lake Edith as a Category I water body, based on its existing water quality and existing and desired recreational uses. This designation results in a high surface water quality ranking for Lake Edith. **(See Figure 2)** Further description of this classification is included in

Appendix A. The LSCVWD's management goal is to protect and possibly restore Lake Edith's water quality. Restoration may be necessary because the lake has experienced more frequent algae blooms than would be expected. This results in possible conflicts between the water quality and recreational use of Lake Edith. The LSCVWD will continue to monitor Lake Edith's water quality once every five years. If it appears that restoration is necessary to maintain Category I water quality levels, the LSCVWD will complete hydrologic and nutrient budgets for Lake Edith. The LSCVWD will use the water quality monitoring and budget results to determine future actions.

The water quality of Lake Edith is unlikely to change, due to its small undeveloped watershed. The presence of large areas of wetlands in the watershed makes additional development unlikely. Area residents, however, will be encouraged to update aging septic systems to minimize phosphorus loading to the lake.

5.4 Groundwater Recharge/Infiltration/Permeability

The groundwater recharge/infiltration ranking in the Lake Edith subwatershed varies. (See Figure 3.) (Section 1.4 describes the methodology used to determine the ranking levels.) Generally, the rankings move from high to the west to moderate and low to the east. The majority of the EDI-4 subwatershed has a high groundwater recharge/infiltration ranking, while the EDI-1 and EDI-2 subwatersheds have a mixture of high, moderate, and low groundwater recharge/infiltration rankings. **(See Figure 3)**

5.5 Erosion Index Ranking

The Lake Edith subwatershed cluster as a whole receives a moderate soil erosion index (EI) ranking of 6.59. All of the subwatersheds receive a moderate EI ranking, with values ranging from 4.03 for EDI-5 and 7.71 for EDI-3. The erosion potential of all the subwatershed clusters is fairly consistent, therefore distinguishing trends are not evident. **(See figure 6e1-6e5 and table 2).**

6.0 Bailey Lake Subwatershed

6.1 Location and General Description

The Bailey Lake Watershed is within the South Washington Watershed District (SWWD). This subwatershed area of Afton is located within portions of the west half of Sections 19, 30, and 31 and drains to the west into Woodbury. The subwatershed drains to DNR- protected waterbodies #82-96w and to #82-455w, both in Sec. 25, of Woodbury. **(See Figure 1)** The runoff subsequently drains west into Bailey Lake (#82-456w) located approximately 2.5 miles away in Section 27, Woodbury. Bailey lake has historically had fluctuating water levels, and had been a series of isolated wetlands. Due to landlocked conditions and development upstream, runoff has increase to the basin and caused it to become one large open waterbody. North and South Bailey Lake is approximately 80 acres at a water level elevation of 870 feet.
Bailey lake is anticipated to have a total future watershed of 12,600 acres. The approximately 750 acres of watershed in Afton contributing to Bailey Lake is in agriculture.

6.2 Landscape Units

The Bailey Lake subwatershed is one unmapped Landscape Unit. Further description and analysis is contained in the landscape portion of the NRI report.

6.3 Water Quality Management Goals

The water quality management goals for the Bailey Lake subwatershed, according to the SWWD rules, is stormwater use. This means that the lake is limited it its ability to support a sustained quality fishery due to depth and contributing subwatershed size, and are best suited for flood control, aesthetic viewing, limited recreation, and wildlife habitat. As a result, the Bailey Lake Subwatershed receives a water quality ranking of low. **(See Figure 2)**
The trophic state of the lake is categorized as hypereutrophic due to stormwater drainage and the shallow condition. Bailey Lake serves as a regional flood storage area. The target phosphorous standard is 10% below predevelopment runoff concentrations, with a targeted uses of wildlife and waterfowl habitat, fishery, and recreation.
Very limited water quality testing has been done on Bailey Lake. One grab sample was collected in 1994.

6.4 Groundwater Recharge/Infiltration/Permeability

The Bailey Lake subwatershed within Afton is almost entirely composed of a moderate groundwater sensitivity ranking. Small pockets of low sensitivity ranking are present. **(See figure 3)** No trends are evident for this subwatershed.

6.5 Erosion Index Ranking

The Bailey Lake subwatershed receives a moderate erosion potential ranking with an EI value of 4.58. This value is the second lowest of any subwatershed within Afton. **(See figure 6f)**

7.0 Kelles Coulee Subwatershed

7.1 Location and General Description

The Kelles Coulee Watershed is within the Lower St. Croix Watershed Management Organization, which had recently been incorporated into the enlarged Lower St. Croix Valley Watershed District (formerly Valley Branch Watershed District). This subwatershed is located in Sections 21, 22, 27, 28, and 29 with small areas within Sections 15, 32, and 33. Kelles Coulee flows into the St. Croix River in Section 23. **(See Figure 1)** The coulee channel commences as an intermittent channel in the south half of Section 28, then flows north and continues east into the St. Croix River a distance of approximately 16,100 feet (3.1 miles). The perennial reach of the channel begins in the Southeast quarter, of the southeast quarter, of Section 21 It has a approximate length of 9200 feet (1.7 miles). The approximate elevation at the Start of the Kelles Coulee main channel is 900, with an outlet elevation into the St. Croix River of approximately elevation 680.

Kelles Coulee is identified as a DNR- protected waterbody for the outlet into the St. Croix River to its intersection with Trading Post Trail, approximately at the center of Section 28. No other DNR-protected waterbodies are identified within this subwatershed.
Unlike the other riverine drainage systems within Afton (Valley Creek and Trout Brook), Kelles Coulee contains only one central drainage channel. Additional drainage from this subwatershed is provided by several intermittent streams (gullies). Kelles Coulee watershed, due to it single main drainage channel, was identified as one subwatershed. This subwatershed has a drainage area of approximately 2350 acres.
The lower watershed is characterized by woodlot landcover, with the upper watershed transitioning into agriculture landuse.

7.2 Landscape Units

The Kelles Coulee subwatershed is mapped with several significant landscape units. These Landscape Units include all or significant portions of 20-26. Further description and analysis is contained in the landscape portion of the NRI report.

7.3 Water Quality Management Goals

Specific water quality management goals for the Kelles Coulee subwatershed have not been established by the LSCWMO. Due to its drainage into the St. Croix River, the Kelles Coulee subwatershed receives a water quality ranking of high. **(See figure 2)**
General water quality goals, from the LSCWMO Plan which apply to Kelles Coulee include;

- Protecting of the existing natural drainage system.
- Managing gully erosion along tributaries that outlet directly into the St. Croix River is a priority.
- Maintaining water quality through the treatment or control of surface runoff.
- Maintaining or improving the quality of runoff waters from agricultural lands.
- Preventing flooding and erosion from surface runoff

- Controlling erosion and sedimentation on construction sites, agricultural lands, and along streambanks, lakeshores and roadsides.
- Utilizing wetlands for the treatment of stormwater runoff.
- Identifying and managing contributions from non point source pollution, (priorities are identified as; sediment, nutrients, fecal coliforms, and pesticides)

No water quality monitoring has been done within the Kelles Coulee subwatershed.
Appendix A contains additional information regarding the categorization of waterbodies, and general information on the evaluation of water quality management.

7.4 Groundwater Recharge/Infiltration/Permeability

The Kelles Coulee subwatershed is composed of a majority of moderate groundwater sensitivity ranking with small pockets of low sensitivity ranking. **(See Figure 3)** A noteworthy observation is that the Coulee floodplain area has a low ranking which is the lowest area in the landscape position. This means as water runoff occurs downstream, the less likely infiltration will occur. This is in contrast to the Valley Creek Subwatershed, where much of the higher infiltration is lower in the landscape position.

7.4 Erosion Index Ranking

The Kelles Coulee subwatershed receives a severe erosion potential ranking with an EI value of 19.98. This value is the highest of any subwatershed within Afton. This severe ranking is evident by the steep topography, including escarpments, and concentration of drainage features. **(See figure 6g)**

7.6 Natural Resource Inventory Results

The Kelles Coulee Natural Resource Inventory, completed by the Washington Soil and Water Conservation District (SWCD) gathered the above information in the spring of 2001. All information was gathered by utilizing Global Positioning System (GPS) Technology, and compiled and formatted using Geographic Information System (GIS) Technology.
The purpose of this report is to further describe the features inventoried, identification of feature criteria, the significance of inventorying these features, and general discussion of findings.
See figures 7b1-7b7 which illustrate natural resource feature mapped.

Kelles Coulee 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	29	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	5	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	5	Identification of stream characteristics	Data can be used in stream classification & stream flow analysis.
Streambank erosion	point	condition, size	37	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.
Plant Population	point	size, type	NA	Identification where significant plant populations exist	Plant populations may impact habitat, relate to sedimentation and nutrients.
Human-Made	point	type, extent/feature	76	Identifications of structures in and along creek	These structures may impact stream flow, habitat, water quantity and quality.
Sediment Sample Point	point	Number	NA	Locate sample collection point which will be analyzed	Coordinated with SCWRS for identification of sample location and numbers.
Tree Downfalls	point	none	70	Identification of where trees impede stream flow, and could provide habitat	May impact streamflow, streambank erosion, habitat
Seeps	point	none	16	Identification where groundwater may be discharging	May provide base flow & other inputs
Springs	point	none	0	Identification where groundwater is discharging	May provide baseflow & other inputs
		Total	**238**		

Centerline of Stream: This feature was mapped from the confluence of Kelles Coulee and the St. Croix River, to the origin of the stream channel in Section 28. The centerline of stream feature was mapped until approximately the end of the perennial portion of the stream, and upstream of this was identifies as sediment delivery site. In some cases the stream becomes braided. The Kelles Coulee

floodplain is very large and defined. The channel which appeared to be the most defined was mapped. This channel represents the low flow channel. The **percent canopy** was high over much of the stream, with only the upper most reaching having an open canopy. The **riparian landuse** was conspicuously undisturbed throughout most of the stream channel. The exceptions were at the beginning and end of the stream channel.

Sediment Delivery Site: This feature was mapped as a continuation of the main branch, and all intermittent channels which outlet into the main channel. All of the sediment delivery **types** which outletted into the main channel were mapped as gullies, while the terminus of the channel were waterways within agricultural area. The majority of the sediment delivery sites were mapped with a **severity index** of having slight erosion, although gullies with severe erosion are present. Several gullies along the south bluffline, within the Valliswood Subdivision have obtained a slight erosion ranking, due to erosion control structures being constructed.

Sedimentation Sites identified areas where soil deposition was evident or would likely occur. The majority of these areas within the Kelles Coulee subwatershed are ponding **(type)** areas. A couple of these are hydrologically linked with the main channel. Several of these are ponds created along with the gully control structures within the Valliswood subdivision. Not mapped as a sedimentation area, but a significant sedimentation area, is the Kelles Coulee floodplain itself. It is difficult to account for the amount of sediment treatment achieved by the floodplain. To assist in determining the likelihood of this, the flow paths of the sediment delivery areas were followed as far is they could be determined to the intersection with the main channel. The greater the distance the flow pattern terminated from the main channel, the greater the likelihood sediment treatment is occurring.

Stream Width: Stream widths were measured at points along the perennial Kelles Coulee The width of the stream was measured at bankfull, which is higher than the low or baseflow water level, and the water level during the mapping period. This feature was mapped to provide some base information regarding stream characteristics. Limited stream width values were recorded for the Kelles Coulee channel.

Streambank Erosion: Streambank erosion was observed and mapped along perennial and intermittent reaches of Kelles Coulee. Frequency and severity **(condition and size)** of erosion tended to increase the further downstream the Kelles Coulee channel. It was also observed that areas of severe erosion occurred where there was a convergence of a sediment delivery area with the main channel. In these cases the erosion tended to be channel head cutting. Erosion tended to occur in channel meanders.

Plant Populations were not mapped within the Kelles Coulee Subwatershed

Human-Made Features were mapped along all areas of the Valley Creek Sub-watershed. It is noteworthy that, likely due to the difficulty in access because of the steep escarpments, that man-made feature were few within the main channel of Kelles Coulee.

Sediment Sample Points were not mapped within the Kelles Coulee Watershed

Tree Downfalls: were mapped within the perennial Valley Creek, though on a limited basis. This is due to the nonexistence of trout to create a habitat concern.

Seeps were found within the perennial portion of Kelles Coulee, and also several sediment delivery areas along the main channel.

Springs were not found within the Kelles Coulee subwatershed.

8.0 Swede Hill Subwatershed

8.1 Location and General Description

The Swede Hill Creek Watershed is within the Lower St. Croix Watershed Management Organization, which had recently been incorporated into the enlarged Lower St. Croix Valley Watershed District (formerly Valley Branch Watershed District). This subwatershed is located of Sections 26, 27, 34, and 35 and flows to the east into the St. Croix River **(See Figure 1).** Drainage from this subwatershed is provided by several intermittent streams (gullies). Swede Hollow watershed has a watershed of approximately 840 acres.

8.2 Landscape Units

The Swede Hill subwatershed is mapped as one Landscape Unit, identified as 24. Afton State Park is located within the Swede Hill Watershed which is an unmapped Landscape Unit. Further description and analysis is contained in the landscape portion of the NRI report.

8.3 Water Quality Management Goals

Specific water quality management goals for the Swede Hill subwatershed have not been established by the LSCWMO. Due to its drainage into the St. Croix River, the Swede Hill subwatershed receives a water quality ranking of high. **(See figure 2)** The LSCWMO plan identifies gully erosion along tributaries that outlet directly into the St. Croix River to be a priority concern. Contributions from non point source pollution, (identified in order of priority to be, sediment, nutrients, fecal coliforms, and pesticides) was determined to be the most significant water quality concern.
The LSCWMO water management plan identifies the protection of existing natural drainage system a goal.
No water quality monitoring has been done within the LSCWMO.

8.4 Groundwater Recharge/Infiltration/Permeability

The Swede Hill subwatershed is composed of a majority of moderate groundwater sensitivity ranking. Small pockets of low sensitivity ranking are present which roughly parallels the St. Croix River, and tributary drainage. **(See Figure 3)** No trends are evident for this subwatershed.

8.5 Erosion Index Ranking

The Swede Hill subwatershed receives a severe erosion potential ranking with an EI value of 15.84. This value is the second highest of any subwatershed within Afton. This severe ranking is evident by the steep topography and concentration of drainage features. **(See figure 6h)**

9.0 Trout Brook Subwatershed

9.1 Location and General Description

The Trout Brook Watershed is within the Lower St. Croix Watershed Management Organization, which had recently been incorporated into the enlarged Lower St. Croix Valley Watershed District (formerly Valley Branch Watershed District). This subwatershed is located in Sections 31, 32, 33, 34, 35 with small areas within Sections 30 and 27. Much of the Trout Brook watershed, as well as the main channel and tributaries is located within Denmark Township. 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, then flows south approximately one mile, and continues east into the St. Croix River a distance of 20,700 feet (3.9 miles). The perennial reach of the channel begins in the SW1/4, SE1/4, Section 32 flowing for a distance of 14,000 feet (2.7 miles). The elevation at the start of Trout Brook is approximately 1000, with an outlet elevation into the St. Croix River of approximately elevation 680. **(See Figure 1)**

The Trout Brook Watershed is broken into four subwatershed, which are located in Afton and Denmark Township.

Trout Brook is identified as a DNR- protected waterbody for the outlet into the St. Croix River to its intersection with 50th Street, approximately at the north line of Section 31. One additional DNR protected waterbody (#82-483w is identified within this subwatershed in Section 5, Denmark Township. It appears this waterbody outlets into the main channel of Trout Brook approximately one mile away.

The Trout Brook watershed contains several significant drainage channels. The main channel starts within Aftón before meandering into Denmark Township approximately 2 miles downstream. It continues within Denmark Township for approximately a mile before reentering Afton. It continues within Afton for about one half mile before finally exiting Afton as the channel continues to the St. Croix River. Additional drainage from this subwatershed is provided by several intermittent streams (gullies). Trout Brook watershed, due to it multiple main drainage channels, was split into four subwatersheds. The Trout Brook watershed has a drainage area of approximately 5400 acres The lower watershed is characterized by woodlot landcover, with the upper watershed transitioning into agriculture Landuse.

9.2 Landscape Units

The Trout Brook subwatershed is 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 portion of the NRI report.

9.3 Water Quality Management Goals

Specific water quality management goals for the Trout Brook subwatershed have not been established by the LSCWMO. Due to it's drainage into the St. Croix River, the Kelles Coulee subwatershed receives a water quality ranking of high. **(See figure 2)**
General Water Quality Goals, from the LSCWMO Plan which apply to Trout Brook include;

- Protecting of the existing natural drainage system.
- Managing gully erosion along tributaries that outlet directly into the St. Croix River is a priority.
- Maintaining water quality through the treatment or control of surface runoff.
- Maintaining or improving the quality of runoff waters from agricultural lands.
- Preventing flooding and erosion from surface runoff
- Controlling erosion and sedimentation on construction sites, agricultural lands, and along streambanks, lakeshores and roadsides.
- Utilizing wetlands for the treatment of stormwater runoff.
- Identifying and managing contributions from non point source pollution, (priorities are identified as; sediment, nutrients, fecal coliforms, and pesticides)

No water quality monitoring has been done within the Trout Brook subwatershed.

9.4 Groundwater Recharge/Infiltration/Permeability

The Trout Brook subwatershed is composed of a majority of moderate groundwater sensitivity ranking with small pockets of low sensitivity ranking. A noteworthy observation is that the much of the main channel area and some adjacent intermittent channel areas have low rankings. These areas are the lower areas in the landscape position. This means as water runoff occurs downstream, infiltration is less likely to occur, and more runoff could occur. This is in contrast to the Valley Creek Subwatershed, where much of the higher infiltration is lower in the landscape position. **(See Figure 3)**

9.5 Erosion Index Ranking

The Trout Brook subwatershed receives a severe erosion potential ranking with an EI value of 14.27. Three of the four subwatershed receive a severe ranking with a the lowest ranking being in TRB3 with a value of 7.54 , and the highest being in TRB2 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 go from lower to higher moving from west to east (downstream) in the watershed. **(See figure 6i1-6i4 and Table 2)**

9.6 Natural Resource Inventory Results

The Trout Brook Natural Resource Inventory, completed by the Washington Soil and Water Conservation District (SWCD) gathered the above information in the fall of 2000, and spring of 2001. All information was gathered by utilizing Global Positioning System (GPS) Technology, and compiled and formatted using Geographic Information System (GIS) Technology. To demonstrate the location of continuous water flow a small portion of the main channel was inventoried within Denmark Township. No other inventory information was gathered within Denmark Township.

The purpose of this report is to further describe the features inventoried, identification of feature criteria, the significance of inventorying these features, and general discussion of findings. **See figures 7c1-7c7 which illustrate NRI features mapped.**

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	16	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	17	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	43	Identification of stream characteristics	Data can be used in stream classification & stream flow analysis.
Streambank erosion	point	condition, size	25	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.
Plant Population	point	size, type	NA	Identification where significant plant populations exist	Plant populations may impact habitat, relate to sedimentation and nutrients.
Human-Made	point	type, extent/feature	167	Identifications of structures in and along creek	These structures may impact stream flow, habitat, water quantity and quality.
Sediment Sample Point	point	Number	NA	Locate sample collection point which will be analyzed	Coordinated with SCWRS for identification of sample location and numbers.
Tree Downfalls	point	none	81	Identification of where trees impede stream flow, and could provide habitat	May impact streamflow, streambank erosion, habitat
Seeps	point	none	28	Identification where groundwater may be discharging	May provide base flow & other inputs
Springs	point	none	0	Identification where groundwater is discharging	May provide baseflow & other inputs
		Total	**377**		

Centerline of Stream: This feature was mapped from approximately the intersection of the main channel with the City of Afton boundary at the south line of Section 34, to the origin of the perennial

stream channel in Section 32. The centerline of stream feature was mapped until approximately the end of the perennial portion of the stream, and upstream of this was identifies as 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 and trailways. Intermediate reaches contained current or evidence of recent pastureland. The upper reached 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 nonerosive cropped 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.

Sedimentation Site 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. Like the Kelles Coulee drainage area, some sedimentation areas were located at the start of sediment delivery areas.

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

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.

Plant Populations were not mapped for the Trout Brook drainage channel

Human-Made features were mapped throughout the Trout Brook subwatershed. Human made feature were more prevalent than Kelles Coulee, but were more spread out than Valley Creek. In general, the human-made features found tended to be associated with the agricultural Landuse prevalent in this area, which the human-made features along Valley Creek were more indicative of the rural development present.

Sediment Sample Points were not collected in the Trout Brook subwatershed.

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

Seeps were predominately along perennial sections of Trout Brook.

Springs were not found within the Trout Brook subwatershed.