Appendix E
Water Quality Program

2009 VBWD Water Quality Data Collection Program

Introduction
The lakes, streams, and wetlands in the VBWD are valuable community resources that:

- Provide wildlife habitat
- Provide recreational opportunity
- Provide fishery resources
- Provide aesthetic enjoyment
- Enhance property values
- Serve as sources for groundwater recharge and nutrient removal.

Urbanization can result in the addition of increased loads of pollutants to the lakes, ponds, wetlands, and streams within the VBWD. The Board of Managers is concerned about the water resources within the VBWD and tries to protect them from degradation through careful management practices. The VBWD collects water quality samples from its lakes, ponds, wetlands, and streams to assess current conditions and changes or trends in the water quality or habitat over time, thereby determining the effect of changing land use patterns in the watershed and the effectiveness of the VBWD's efforts to preserve/improve water quality.

Basin Monitoring Program
The type of monitoring conducted for a water body varies according to the classification the VBWD has assigned to it. Following is a description of the VBWD's basin monitoring programs.

Secchi Disc Only/CLMP Water Quality Monitoring
This monitoring program involves measuring Secchi disc transparencies from spring to fall, typically through participation in the Minnesota Pollution Control Agency's (MPCA's) Citizen Lake Monitoring Program (CLMP). The CLMP provides low-cost Secchi discs to participants for measuring water clarity on an approximate weekly basis. In 2009, the VBWD did not recruit and CLMP volunteers. In 2009, Paul Anderson continued to monitor the Silver Lake Secchi disc transparency depths for the MPCA through CLMP.

Survey Level/CAMP Water Quality Monitoring
This monitoring program is equivalent to the Metropolitan Council's Citizen Assisted Monitoring Program (CAMP). The CAMP uses volunteers to measure surface water temperature and transparency (Secchi disc readings), and to collect surface water samples on a biweekly basis from mid-April to

mid-October (approximately 14 sampling events). The water samples are analyzed for total phosphorus, total Kjeldahl nitrogen, and chlorophyll-a. In 2009, the VBWD recruited volunteers to collect the water quality samples for this monitoring program at the following 14 basins: Lakes Jane, Olson, DeMontreville, Edith, Elmo, Long, Eagle Point, Sunnybrook, Cloverdale, Echo, McDonald, and Downs Lakes; and Klawitter and Rest Area Ponds. Ramsey County Public Works continued to monitor the water quality of Silver Lake in a manner equivalent to the CAMP in 2009. The VBWD hired the Washington Conservation District to collect water quality samples in a manner equivalent to CAMP from 20 basins, including Acorn Lake, Weber Pond, east Capaul's Pond, west Capaul's Pond, Buetel Pond, Horseshoe Lake, Upper West Lakeland Storage Site, east Fahlstrom Pond, west Fahlstrom Pond, Clear Lake, Bay Lake, Goetschel Pond, Friedrich's Pond, Legion Pond, north Goose Lake, south Goose Lake, Mergens Pond, north Rose Lake, south Rose Lake, and Kramer Pond. These samples were generally collected once in April, once in May, five times in June through September, and once in October. However, several basins completely dried up in 2009 so only a few samples were collected.

Supplemental Water Quality Monitoring

This monitoring program is supplemental to the Survey Level/CAMP Water Quality Monitoring Program, and involves collecting supplemental (additional) samples and data approximately six times between mid-April to mid-October (typically once in April, June, July, and September and twice in August). In addition to the sample collection and analysis performed as part of the Survey Level/CAMP Water Quality Monitoring Program, the supplemental monitoring involves analyzing total phosphorus concentrations at depths throughout the water column, analyzing surface water samples for ortho-phosphorus and total nitrogen, and collecting dissolved oxygen, specific conductance, turbidity, and pH data. This type of monitoring is needed to assess problems (e.g., degrading water quality trends) and is also appropriate for regular monitoring of regionally important water bodies, such as the High Priority water bodies. This sampling and laboratory work is performed by a contractor for the VBWD. In 2009, the VBWD hired Washington Conservation District to collect supplemental water quality data at Eagle Point Lake, Horseshoe Lake, and Lake Edith.

Intensive Water Quality Monitoring

This monitoring program involves more sample collection dates and analyzing parameters at depth in addition to total phosphorus. This program is more intensive than the Supplemental Water Quality Monitoring program. If triggered or implemented, this program will be developed for a specific water body to answer specific questions, calibrate water quality models, etc., usually as part of a diagnostic-feasibility study. Intensive water quality monitoring was done by Barr Engineering Company for the VBWD at Long, DeMontreville, and Sunfish Lakes in 2009.

Habitat Monitoring
This program monitors habitat conditions, using indicators such as the existence and extent of an upland buffer zone surrounding the water body, erosion and sedimentation in the water body and along its shoreline, the presence and number of non-native exotic species in or near the water, vegetative diversity, ecological quality, and wildlife habitat. The Habitat Monitoring Program involves collecting data in the summer (late June/mid-July is ideal). The monitoring is completed by a wetland scientist or a team of water resource professionals. In 2009, the VBWD conducted Habitat Monitoring at all 31 major basins within the District. In addition to looking for sedimentation areas and shoreline erosion, this monitoring included the following:

- *Macrophyte Surveys* – Macrophyte data were collected in all 31 basins. Macrophyte (rooted aquatic plant) surveys were performed to identify the current conditions of plant growth throughout the lakes. Macrophytes are primary producers in the aquatic food chain, converting the basic chemical nutrients in the water and soil into plant matter, which becomes food for all other aquatic life.

- *Upland Vegetative Buffer Surveys* – Summer surveys of two or three sample plots were completed for all of the basins.

- *Wetland Functions and Values Assessment* – The hydrologic system and ecosystem making up each basin were evaluated using the Minnesota Routine Assessment Method of Evaluating Wetland Functions (MNRAM) Version 3.1. Evaluating each ecosystem with the MNRAM is used to provide a detailed picture of the overall health of the watershed and water resource. Instead of just evaluating specific parameters that are direct indicators of habitat quality, MNRAM is used to evaluate a variety of perimeters for the water body and its watershed which contribute to sustaining the wetland functions. The MNRAM assessments provide an independent evaluation of the overall wildlife habitat of the water body and a tool to detect land use or ecological changes which may otherwise go unnoticed, but which might affect the water body in the long term.

Further discussion on the collections methods as well as the results and recommendations are included in the report, *2009 Habitat Monitoring of Water*

Bodies, Valley Branch Watershed District. Table E-1 provides a summary the 2009 Habitat Monitoring results. Table E-2 summarizes the recommendations and actions.

Basin Water Quality Action Triggers

The VBWD set water quality "action triggers" in its 2005-2015 Watershed Management Plan (Plan) for water bodies with water quality rankings of A, B, or C (better than poor). These action triggers were designed to assist in determining appropriate water quality management actions. After each year of sampling, the VBWD re-evaluates the action triggers, re-analyzes trends for each water body, and makes appropriate changes. Action triggers were (and will be) set as follows:

- For water bodies with at least five years of data and unchanging water quality (no statistically significant improving or degrading trend), the 25th and 75th percentiles of summer-average Secchi disc transparency data from the last five to ten sampling years were calculated to obtain the interquartile range. The action trigger was set at the 25th percentile (i.e., some type of water quality management action must be taken if the summer-average transparency is less than the 25th percentile value).

- For water bodies with at least five years of data and changing water quality (statistically significant improving or degrading trend), the 25th and 75th percentiles of *individual* summer Secchi disc transparency data from the last five sampling years were calculated to obtain the interquartile range. The action trigger was set at the 25th percentile.

- For water bodies with insufficient (or no) water quality data, the VBWD will need to collect more data before setting lake-specific action triggers. In the meantime, the following action triggers apply:

    - *Water Bodies with "A" and "B" Water Quality*: the action trigger was set at an summer-average Secchi disc reading of 1.3 meters (4.3 feet),

    - *Water Bodies with "C" Water Quality*: the action trigger was set at a summer-average Secchi disc reading of 0.7 meters (2.3 feet).

- For all "A" water bodies, the following action trigger also applies: if more than two individual Secchi disc readings (in a sampling season) are less than 1.2 meters (3.9 feet), water quality management action is required.

Each year the VBWD analyzes the collected water quality data and compares it to the action trigger. If the lake water quality data (Secchi disc transparency) is worse than the action trigger, or there is a degrading trend in water quality, some type of water quality management action will need to be taken. Table E-3 (following: Table 4.2-6 from the VBWD Plan) from the Plan summarizes the recommended actions.

Table E-3

(Table 4.2-6 from the VBWD Plan)

RECOMMENDED WATER QUALITY MANAGEMENT ACTIONS FOR HIGH AND MEDIUM PRIORITY WATER BODIES[1]
Valley Branch Watershed District

Comparison of Most Recent Summer Average Secchi Disc Transparency to Action Trigger[2]	95% Confidence Water Quality Trend	Type(s) of Management Action Needed		
		Watershed Management	Water Quality Monitoring	Runoff Monitoring or Equivalent
Better Than Trigger Value	No Trend Analysis Available, No Trend or Improving Trend	No Action	Continue existing water quality monitoring program	None
	Degrading Trend	No Action	Perform Supplemental monitoring next year	Watershed land use review[3]
At or Worse Than Trigger Value	No Trend Analysis Available, No Trend or Improving Trend	No Action	Perform Supplemental monitoring next year	None
	Degrading Trend	Comprehensive lake/ watershed diagnostic-feasibility study	Intensive monitoring (as part of diagnostic-feasibility study)	Detailed runoff water quality monitoring, if needed, as part of diagnostic-feasibility study

1. For Low Priority lakes, the VBWD Managers will review data and implement appropriate actions, on a case by case basis.

2. For lakes with an "A" water quality ranking that fail to meet the VBWD's minimum summer Secchi disc depth goal of at least 3.5 feet (1.1 meters), the VBWD Managers will review data and implement appropriate actions, on a case by case basis.

3. Watershed land use review: Review changes in watershed land use since last trend analysis and review weather/climate conditions.

2009 Basin Water Quality Results & Anticipated 2009 Basin Monitoring Program

Barr Engineering Company added the 2009 water quality monitoring data to the VBWD water quality database and compared the data to VBWD's water quality action triggers. Barr also updated the VBWD water quality action triggers and evaluated the data for statistically-significant water quality trends. Table E-4 summarizes this information. Figure E-1 shows the 2009 summer-average Secchi disc transparency depths for all of the basins monitored in 2009. Charts of historic water quality data for each water body monitored in 2009 are included at the end of this appendix.

Five water bodies had 2009 summer-average Secchi disc transparency depths less than their respective action triggers: Silver Lake, Lake Edith, Lake Jane, Goetschel Pond, and Legion Pond. Silver Lake also had two individual Secchi disc transparency depths less than the summer minimum trigger of 3.9 feet (1.2

meters). Two lakes, Lake Edith and Silver Lake, have statistically significant degrading trends in water quality.

The following paragraphs discuss the noteworthy 2009 water quality monitoring results and 2010 monitoring plans. Table E-5 shows the Managers' 2010 monitoring plan, based on 2009 results and the annual monitoring plan framework contained in the VBWD Plan.

Lakes Failing VBWD Action Triggers

Silver Lake

Silver Lake's 2009 summer-average Secchi disc transparency of 3.6 feet (1.1 meters) is the worst observed summer-average Secchi disc transparency since 1977. The historic water quality data show a rapid decrease in water quality beginning in 2007. The poorer water quality conditions observed in 2007, 2008, and 2009 are most likely due to the whole-lake aquatic plant treatment applied to the lake. As previously stated in the memoranda to the Managers regarding the 2007 and 2008 Silver Lake water quality results, the relationship between total phosphorus and phytoplankton (as chlorophyll *a*) levels in Silver Lake may have been fundamentally changed. Meaning, there were much higher levels of phytoplankton in the lake in 2007 and 2008 even though total phosphorus concentrations were only somewhat higher. Because of the loss of shading that the macrophytes once provided in Silver Lake, it may be expected that even if total phosphorus levels in Silver Lake are similar to past levels, phytoplankton levels will be higher.

The VBWD summer-average Secchi disc action trigger for Silver Lake was 4.5 feet (1.37 meters) for 2009, while the calculated summer-average was only 3.6 feet (1.10 meters). In addition, the VBWD set a goal for Silver Lake of having at least a 3.9 foot minimum summer Secchi disc transparency depth, but two readings were only 2 feet. A statistical analysis of the Silver Lake Secchi disc transparency depths for the last 10 years indicates that there is a statistically significant degrading trend to a 99% confidence level.

In addition to poorer Secchi disc transparency, the 2009 summer-average total phosphorus concentration for Silver Lake was 52 μg/L, which is poorer than the VBWD goal. Because the MPCA total phosphorus criterion for shallow lakes is 60 μg/L or less, Silver Lake remains below (better than) the level that would cause it to be included on the MPCA's list of Impaired Waters (ref. Sec. 303(d) of the Clean Water Act, PL 92-500). According to MPCA guidance on impaired water determination, total phosphorus is the primary determinant upon which listing is based; however, chlorophyll *a* or Secchi disc depth are also used to determine listing (chlorophyll *a* must be above 20 µg/L or Secchi disc depth must be below 3.2 feet in addition to total phosphorus levels above 60 µg/L). In 2009, Silver Lake the summer-average chlorophyll *a* was below (better than) the impaired water listing criterion. The summer-average Secchi disc transparency was greater (better) than the impaired water listing criterion.

One of the VBWD Managers' missions is to manage and protect water resources by *improving and protecting the quality of water for all water bodies within the VBWD*. Based on the 2007, 2008, and 2009 monitoring results for Silver Lake, the lake's water quality is not improving or being protected. The Managers plan to take the following actions at Silver Lake in 2010:

- The Managers will continue to discourage the Minnesota Department of Natural Resources (DNR) from allowing the Silver Lake Improvement Association (SLIA) to conduct lake-wide aquatic plant management treatments that adversely affect lake water quality conditions.
- The Managers will continue to encourage the DNR to conduct point intercept aquatic plant surveys of the lake.
- The Managers will continue to request that Ramsey County Public Works collect water quality, phytoplankton, zooplankton, and water level data.
- The Managers will work with the Cities of North St. Paul and Maplewood and the SLIA to implement stormwater runoff treatment practices, in an effort to improve water clarity.

<u>Lake Edith</u>
The VBWD summer-average Secchi disc action trigger for Lake Edith was 5.7 feet (1.75 meters) in 2009, while the calculated average was 5.3 feet (1.63 meters). However, Lake Edith met the VBWD goal of having at least a 3.9-foot minimum summer-average Secchi disc transparency depth. A statistical analysis of the Lake Edith Secchi disc transparency depths over the last 10 years indicates that there is a statistically significant degrading trend at a 95% confidence level. Lake Edith is 77 acres in size, with a maximum depth of 43 feet. The lake remains strongly stratified during the

summer, and the hypolimnion becomes anoxic. As a result, there is high internal loading in the hypolimnion. Although samples were not collected at depth intervals in 2009, samples were collected at depth intervals in 2005. The 2005 data shows depleted oxygen and elevated total phosphorus in the hypolimnion.

For lakes that have water quality worse than the action trigger and have a trend of degrading water quality, Table 4.2-6 of the VBWD Plan recommends a comprehensive study and intensive monitoring of the watershed and the lake be conducted. The Managers plan to take the following actions in 2010 in order to assess the internal and external loading of phosphorus to Lake Edith:

- The Managers will have additional water quality data collected, consisting of 1) five one-meter depth profiles for total phosphorus and total dissolved phosphorus; and 2) surface water samples of chlorophyll *a* and total Kjeldahl nitrogen. Sampling will be conducted seven times between April and September.

- The Managers will have lake water levels recorded.

- The Managers will have phytoplankton and zooplankton samples collected in April, June, July, and August.

- The Managers will have macrophyte habitat surveys conducted in early spring and late summer.

<u>Lake Jane</u>

The 2009 summer-average Secchi disc transparency was slightly less than the summer average trigger for Lake Jane. Overall, the water quality of Lake Jane remains excellent. The period of 2004-2008 consistently saw some of the highest summer-average Secchi disc transparencies on record for Lake Jane. Although the 2009 summer-average Secchi disc transparency was slightly less than the summer average trigger, Lake Jane continues to have the highest Secchi disc transparency readings of all the VBWD lakes, with the exception of Lake Elmo and Long Lake (post alum treatment). In 2010, the Managers will not conduct any additional water quality monitoring above the standard monthly survey level monitoring of Secchi disc transparency, total phosphorus, and chlorophyll *a*.

Goetschel Pond

The 2009 summer-average Secchi disc transparency of 2.9 feet (0.88 meters) for Goetschel Pond was less than the summer average trigger of 4.7 feet (1.43 meters). VBWD considers Goestschel Pond a wetland; therefore, no additional monitoring above normal monthly water quality monitoring is planned in 2010.

Legion Pond

Legion Pond had only one Secchi disc transparency measurement during the summer months of 2009. The Secchi disc transparency measured on June 1, 2009 was 1.0 foot (0.3 meters), less than the default summer average trigger of 2.3 feet (0.7 meters) for a water body with a "C" water quality ranking. Water levels were too low from July through September to allow for water quality monitoring in Legion Pond. No additional monitoring above normal monitoring is planned for Legion Pond in 2010.

Other Noteworthy Results and Recommendations

Based on past monitoring results, the Managers took additional water quality management actions in 2008 and/or 2009 at Long Lake, Sunfish Lake, and Lake DeMontreville. Results of these additional water quality management actions are discussed in the following paragraphs.

Long Lake

In 2006, Long Lake's summer-average Secchi disc transparency depth (4.63 feet) failed to be better than the VBWD-set action trigger (4.92 feet). In accordance with Table 4.2-6 of the Plan, the VBWD collected supplemental water quality data from Long Lake in 2007. The Managers also ordered a detailed study of the lake to determine if it is feasible to improve the lake's water quality so that it will not eventually be listed as nutrient-impaired by the Minnesota Pollution Control Agency. In 2008 and 2009, the Managers implemented a water quality improvement project. The project consisted of:

- Application of aluminum sulfate (alum) to the lake in October 2008
- Application of a second dose of alum to the lake in October 2009

The 2008 and 2009 Long Lake water quality monitoring results indicate much improved water quality, including lower concentrations of total phosphorus and chlorophyll *a*, and higher Secchi disc transparencies compared to previous years. The 2008 improved water quality was likely due to late ice-out that year, which resulted in a shorter period of summer thermal stratification, less hypolimnetic oxygen depletion, and reduced late-summer internal phosphorus loading to the lake. Nearby Lake DeMontreville also experienced improved water quality in 2008 for the same reasons. The 2009 water quality results for Long Lake demonstrate the effects of the Fall 2008 alum treatment. The 2009 summer-average Secchi disc transparency was (5.3 meters), nearly double the summer-averages of 2007 and 2008, and the highest on record. Summer averages of total phosphorus and chlorophyll *a* concentrations in 2009 were the lowest on record for Long Lake.

As expected, the improved average summer lake water clarity created more habitat for aquatic plants in the lake. Low water levels also allowed plants to grow in more areas of the lake. The Friends of Long Lake Association is very concerned that Eurasian watermilfoil and curlyleaf pondweed have overtaken the native plants in the lake and these invasive plants are negatively affecting the lake.

The Managers plan to conduct the following monitoring activities at Long Lake in 2010:

- The Managers will have a June point-intercept aquatic plant survey conducted to determine the extent to which aquatic plants have been able to colonize additional areas of the lake. All sampling and data analysis will be conducted according to the methodologies described in the DNR protocol for aquatic vegetation surveys. The survey would incorporate assessments at roughly 150 GPS points, with documentation of the following at each sample point:
    - Water depth
    - Plant species retrieved (using the rake method)
    - Plant growth density

- The Managers will have routine water quality data and additional water quality data collected in seven sampling events between April and September. The additional monitoring will include three one-meter depth profiles for total phosphorus and total dissolved phosphorus.

- The Managers will have phytoplankton and zooplankton samples collected in April, June, July, and August.

Sunfish Lake
In 2006, Sunfish Lake's summer-average Secchi disc transparency depth was 1.44 feet, which was worse than the VBWD-set action trigger of 2.3 feet. Therefore, in accordance with Table 4.2-6 of the Plan, the VBWD collected supplemental water quality data from Sunfish Lake in 2007. The Managers also ordered a detailed study of the lake to determine if it was feasible to improve the lake's water quality so that it will not eventually be listed as nutrient-impaired by the Minnesota Pollution Control Agency. In 2008, the Managers implemented the following plan to improve Sunfish Lake's water quality:

- Applying alum to the lake in October/November of 2008 at a low dosage to improve water quality, but not dramatically enough to the point where macrophytes colonize the entire lake bed due to high water clarity;
- If needed, apply additional alum within five years to maintain water quality

- Alum was applied in the fall of 2008 at a relatively low dosage, in accordance with the Managers' plan. The 2009 Sunfish Lake water quality monitoring results do not show improved water quality over year 2008. Summer-average Secchi disc transparency for 2009 was 1.9 feet (0.57 meters), still less than the MPCA shallow lake water quality standard of 3.3 feet. Therefore, the Managers are planning to perform an additional alum treatment in fall 2010. Additionally, a sediment core is planned to be collected for sediment phosphorus analyses in April 2010 in order to evaluate the effect of the 2008 alum treatment and to provide information for planning a 2010 alum treatment. The Managers will have water quality data collected, consisting of 1) two one-meter depth profiles for total phosphorus and total dissolved phosphorus; and 2) surface water samples of chlorophyll *a* and total Kjeldahl nitrogen. Sampling will be conducted seven times between April and September.

Lake DeMontreville

In 2008, Barr completed a study of Lake DeMontreville's water quality for the Managers. The study was conducted in part because 2007 had seen a summer-average Secchi disc transparency worse than the previous six years. The study evaluated the potential benefit of internal and external phosphorus loading reductions on lake water clarity, including an evaluation of the influence of varying climatic conditions, and provided recommendations to the Managers on how to improve the lake's water quality.

Water quality monitoring results from 2008 showed dramatically improved water quality over previous years, with concentrations of total phosphorus and chlorophyll *a* at their historically lowest levels, and Secchi disc transparencies at historic highs. The reason for these improvements is likely due to late ice-out in spring 2008, which resulted in a shorter period of summer thermal stratification, less hypolimnetic oxygen depletion, and reduced late-summer internal phosphorus loading to the lake. Ice-suppressed growth of curlyleaf pondweed in 2008 may also have resulted in a lower early-summer internal phosphorus load. The summer-average Secchi disc transparency in 2009 was 9.3 feet (2.8 meters). Although not as high as in 2008, the 2009 summer-average Secchi disc transparency was greater than the VBWD summer-average trigger, and was above average. No additional monitoring is planned in 2010 beyond normal monthly monitoring of Secchi disc transparency and collection of surface samples for phosphorus and chlorophyll *a* for Lake DeMontreville.

Stream Water Quality Monitoring Program
Stream monitoring can be broken down into three categories:

1) Physical condition of the stream (including such factors as riffles, pools, bottom material, bank stability, bank vegetation)

2) Quality and quantity of the water supply (including water chemistry parameters such as pH, temperature, dissolved oxygen, fecal coliform bacteria, etc. and the fluctuation of water levels and flow rates)

3) Diversity of aquatic insects and other stream inhabitants

2009 Stream Water Quality Monitoring Results
The 2009 stream water quality program consisted of quality, quantity, invertebrate, and fish monitoring on Valley Creek.

WOMP Station
In 2009, the VBWD continued to participate in the Metropolitan Council's Watershed Outlet Monitoring Program (WOMP) by collecting discrete and continuous quality and quantity data from the Main Stem of Valley Creek, just upstream of the Putnam Boulevard bridge. The Metropolitan Council will report the water quality data in a yet to be published 2009 annual report, which will be available from the VBWD.

Stations Upstream of WOMP Station
In 2009, the VBWD continued to collect discrete and continuous quality and quantity data from one station on the South Fork of Valley Creek and one station on the North Fork of Valley Creek. The VBWD contracts with the St. Croix Watershed Research Station to collect these data and the data at the WOMP station. The St. Croix Watershed Research Station's *Valley Creek Data Report July 2008 – June 2009* will be available from the VBWD when it is complete.

Invertebrate Sampling
<u>Sampling by VBWD</u>
Invertebrate samples were collected by the VBWD from two locations (Stations B and C) on Valley Creek in 2009. The invertebrate program is discussed in the following paragraphs. Sample locations were

- *Station B*: Located on the South Fork of Valley (Branch) Creek, 800 feet upstream of the Main Stem, near Stagecoach Trail.

- *Station C*: Located on the Main Stem of Valley (Branch) Creek, immediately downstream of CSAH 18 (old Highway 95).

While water samples provide an assessment of stream water quality at the time of sample collection, benthic invertebrates provide a long-term assessment of water quality. They live on the bottom and in the vegetation of a stream as long as water quality conditions permit. As attached organisms, benthic aquatic invertebrates are exposed to all the temporal variations in stream quality and "integrate" the quality of passing water. Each type of benthic invertebrate has a different tolerance for pollution; studying the numbers and types of benthic invertebrates can indicate pollution in a stream. When sufficient pollutants enter the stream to prevent their survival, they are eliminated. Monitoring the presence or absence of biological indicator organisms provides indirect evidence of the effects of transitory changes in stream water quality related to stormwater runoff.

Methods

Samples were collected from a riffle location with a D-frame aquatic net. The substrate was disturbed with the sampler's feet, allowing dislodged invertebrate to drift into the net downstream. Samplers also passed the D-frame net through debris and vegetation near the banks. Rocks were examined, too. All the invertebrate samples were preserved in 80 percent alcohol and later identified. The samples collected by Barr Engineering Company were identified by Dr. Dean Hansen of the University of Minnesota.

Results

Once individual invertebrates were identified, the Hilsenhoff's Biotic Index (HBI, Hilsenhoff, W.L. 1987. An Improved Biotic Index of Organic Stream Pollution. The Great Lakes Entomologist, 20(1): 31--39) was used to further analyze the data. The index uses invertebrate data to rank a stream according to its water quality. Water quality categories include excellent, very good, good, fair, poor, and very poor. Other indicators of stream water quality include numbers of families and the dominant family percentage.

Invertebrate data for 2009 are included in Table E-6 for each station. The Hilsenhoff Biotic Index (HBI) for Station B and for Station C is presented for the period of record in Figures E-1 and E-2 within this appendix, as is a graph (Figure E-3) comparing the 2009 HBI of Station B to Station C.

Based on the HBI, the 2009 water quality for Valley Creek at Station B was "Excellent." Station C's water quality rated "Very Good." The Station B rating is better than previous sampling years, while the Station C rating is a poorer rating. The HBI rating for Valley Creek has been Very Good or Excellent during the entire period of record, except for 1993 and 1995, when fair water quality indices were calculated. Sampling staff observed that the stream substrate had changed from sandy/rocky to sediment during 1993. Therefore, it appears that conveyance of sediment to Valley Creek caused the significant change noted by the biotic index assessment of the stream. During the 2008 and 2009 sample collections at Station C, the sampling staff member observed sediment, likely caused a slower water velocity due to a silt fence installed for a bridge replacement project directly upstream of Station C.

For 2009, the pollution-sensitive organisms again dominated the benthic invertebrates found at Station B and Station C. A large number of the specimens captured at both sites were mayflies, scuds, and caddisflies. These organisms have a relatively low HBI, indicating higher water quality. The pollution-sensitive organisms at both stations exist in similar percentages and make up a diverse biotic community, which is also an indicator of high water quality.

Sampling by Stillwater Area High School Students

Through VBWD funding, students from the Stillwater Area High School collected stream macroinvertebrate and physical habitat data from Valley Creek in 2009 as in previous years. The samples will be identified by the students, and verified by their teacher and staff of the Washington Conservation District. The 2008 data were reported by the Stillwater Area High School to the VBWD Managers in a May 28, 2009 presentation, but there is no paper report available. The 2009 data will likely be reported to the VBWD Managers in the spring of 2010.

Fish Sampling

One of the intents of the Valley Creek Downstream Stabilization Project on the Johnson/Stanton properties was to improve the trout habitat of the creek by raising the profile of the streambed, creating deeper water and more diverse stream structure. Through the 2008 stabilization project, eight rock riffles were installed in the stream; floodplain terraces were excavated, and the streambanks were graded and replanted with native vegetation. The rock riffles have raised the water level of the stream throughout the project reach and created more trout habitat in an area which was previously quite poor quality trout habitat.

The MDNR had completed a fishery assessment of parts of Valley Creek in 2006 with electro shocking equipment. The downstream site sampled by the DNR in 2006 coincided with the Johnson/Stanton restoration area (Site I on Figure E-4). In the fall of 2009, VBWD's contractor (Barr Engineering crews) completed another electro shocking fishery assessment within the restoration area and at a second upstream location that was also sampled by the MDNR in 2006 (Figure E-4). The fish data collected at the restoration site (Site I) and the upstream control location (Site II) were compared based upon number of fish collected, standardized for the sampling time (number of fish per hour of sampling effort). This data analysis method standardizes sampling results for fish such that different locations and years can be compared consistently.

Figure E-5 shows the number of fish collected at the two sites for the two years and a number of important trends:

1) Four species were collected in both 2006 and 2009 – native brook trout, non-native brown trout, non-native rainbow trout, and non-native hybrid tiger trout (a brown-brook hybrid). However all four species were collected at the restoration site (Site I) only in 2009. (The MDNR lumped tiger trout and brown trout together in their data and we have used the same grouping for the 2009 data presentation for consistency.)
2) The number of trout per hour was significantly higher at both sites in 2009 over 2006.
3) Brown trout numbers were higher at the restoration location (Site I) in 2009 than in 2006.
4) Most significantly, native brook trout were collected at the restoration site in 2009; there were no book trout collected at this location in 2006. Brook trout were present at Site I even though brook trout numbers were lower at Site II in 2009.

The increase in overall trout numbers at both locations could be due to a number of factors related to improved habitat quality and lower stream water temperatures. The increased numbers of trout and the presence of the previously absent brook trout at Site I is likely related to the improved habitat quality – increased water depth, lower water temperatures and a greater diversity of structure – within the restoration areas.

The Managers are considering further sampling over succeeding years to help define the long-term benefits of the stream restoration work and habitat improvements. A longer term sampling program would help the Managers better discern and understand how trout population changes due habitat improvements and year-to-year changes within the watershed impact the species composition and fish numbers