Quality Assurance/ Quality Control Protocol

Virginia Save Our Streams Program

Rocky Bottom Benthic Macroinvertebrate Method

July 2007

The Virginia Save Our Streams Program (VA SOS)

A program of the Virginia Chapter of the Izaak Walton League of America

Stacey Brown, Coordinator

Approvals:

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Stacey Brown, VA SOS Coordinator Date

Table of Contents

Element 3. Distribution List

The following groups and people will receive copies of the VA Save Our Streams (VA SOS) quality assurance plan for sampling rocky bottomed streams with the modified VA SOS method:

VA Save Our Stream Staff:

- Stacey Brown, Coordinator
- Advisory Committee Members – Jay Gilliam, Paul Bugas, Kent Ford, John Murphy, Joanna Cornell, Wes Jargowski
- Other appropriate personnel to be determined

VA Department of Environmental Quality Personnel:

- Regional Biologists
- Data Liasion
- Biological Monitoring Coordinator
- Other appropriate personnel to be determined

VA Department of Conservation and Recreation

- Appropriate personnel to be determined

US Environmental Protection Agency

- Otto Guttenson, Senior Ecologist
- Other appropriate personnel to be determined

Groups using VA SOS methods

VA SOS Regional Trainers

The quality assurance plan will also be provided to anyone requesting it, and will be made available on the VA SOS website (www.vasos.org).

Element 4. Project/ Task Organization

Virginia Save Our Streams Program Coordinator or Designee

- Provides training and follow-up testing to volunteers
- Trains additional regional trainers and quality assurance auditors
- Acts as quality assurance auditor when necessary
- Develops and maintains partnerships with groups and agencies across the state
- Assists in site selection
- Assist volunteers who have failed quality assurance procedures to correct problems

- Database manager – Reviews all incoming data, assesses for inclusion in database, makes all updates to database, makes the data available through reports and on the VA SOS website (www.vasos.org)
- Maintains databases of trained, certified, regional trainers, and quality assurance auditors
- Ensures field sheets and training materials are up to date
- Identifies, analyzes, and stores incoming quality assurance samples
- Identifies incoming unknown specimens for volunteers
- Develops and maintains reference and testing collections

VA SOS Regional Trainers

- Locally trains and certifies volunteers
- Maintains equipment needed to train volunteers

VA SOS Regional Coordinators

- Does initial review and updates of local data and sends it to VA SOS Coordinator or designee in a timely fashion
- Makes sure volunteers in his or her area are progressing to certification and doing their sampling in a timely manner
- May maintain database of local monitoring data and volunteer monitors
- May purchase and maintain approved sampling equipment for volunteer monitors
- May assist in site selection.
- May develop and maintain reference and testing collections

VA SOS Quality Assurance Auditors

- Periodically goes into the field with volunteers to review their equipment and procedures
- Sends results of these observations to VA SOS Coordinator or designee in a timely fashion
- Helps volunteers preserve their samples for submittal to VA SOS Coordinator or designee for identification checks

VA SOS Volunteers

- Attends the proper training and passes the certification test
- Purchases and maintains approved sampling equipment
- Monitors adopted site(s) four times a year
- Follows proper procedures for maintaining certification status

VA SOS Data Users

There are a wide variety of data users for this statewide program. These users include the Virginia Department of Environmental Quality (DEQ), the Virginia Department of Conservation and Recreation (DCR), local Soil and Water Conservation Districts, localities, planning commissions, and universities. The VA SOS data is available to any interested party on the website (www.vasos.org) or by request.

Virginia Save Our Streams recommends that all potential data users contact the VA SOS Coordinator to discuss the use of the volunteer collected data and the appropriate uses of this data.

Element 5. Problem Definition/ Background

With the passage of the Clean Water Act in the early seventies, there has been a focus on cleaning up our nation's waterways. Great strides have been made in reducing point source pollution, or that pollution that enters the stream through a specific known source, such as a discharge pipe. Discharging parties must obtain permits and are regulated to prevent too much pollution from entering our waterways.

While our waterways have greatly improved since these efforts were implemented, there are still steps to be taken. In the last ten years, there has been a shift in thinking to include non-point source pollution in addition to the point sources. Non-point source pollution is hard to regulate, as it comes from a broad area rather than one easily located source. Non-point source pollution includes nutrient additions and erosion from livestock in streams, runoff of fertilizer from agricultural fields and suburban lawns, and stormwater runoff carrying not just large pieces of litter but also all the oils and chemicals on our roadways and parking lots. It takes a broader monitoring plan to detect these types of pollution and to determine their origin.

This means that already overburdened state agencies must increase the monitoring they must do throughout the state. There are thousands of miles of streams in Virginia that must be monitored, and agencies have very limited resources with which to monitor all these streams. With current workloads and limited resources, it is not feasible that the majority of these streams are monitored on a regular basis. This is where the Virginia Save Our Streams Program helps.

The Virginia Save Our Streams Program has monitors across the state collecting large quantities of benthic macroinvertebrate data. The data collected under this quality assurance plan will be used in DEQ and DCR water quality assessment reports including the 305(b) report. It will be used to identify waters were agency scientists will conduct follow-up monitoring to identify if the water should be classified as impaired on the 303(d) report. VA SOS data not be used to list streams on the 303(d) report. It will be used to identify pollution incidents when immediate agency response is required to mitigate the pollution event. VA SOS data may also be used in the development and implementation of total maximum daily load plans.

In addition, the data collected by VA SOS volunteers can be used locally by Soil and Water Conservation Districts when looking at the effectiveness of implemented best management practices (BMPs). It can also help determine where future BMPs should be implemented. Localities can also use the volunteer data in evaluating current land use practices, to create an integrated water quality management approach to land use development, and to identify pristine conditions so that future developments do not degrade local streams.

Element 6. Project/ Task Description

Training and certification sessions will be held as needed for VA SOS monitors. This training program will continue in perpetuity.

The VA SOS volunteers monitor the benthic macroinvertebrate populations and the habitat of their adopted stream four times a year, once each season, using a method developed for the VA SOS program by Virginia Tech scientists (Engel 2000). This method is outlined in the Sampling Methods Requirements section of this document. The samples are analyzed in the field using a multimetric index developed as part of the Virginia Tech study. Additional information about the analysis can be found in the Analytical Methods Requirements section of this document. The field analysis gives a water quality score to let the volunteer know if the ecological conditions of the stream are acceptable or unacceptable.

VA SOS volunteers will record general site conditions and fill out a streamside visual assessment sheet.

Data is submitted and reviewed by regional coordinators and the VA SOS Coordinator or designee. Data is compiled in a database that is kept current. Reports are made to interested parties whenever requested, and data is updated on the VA SOS website biannually.

Element 7. Data Quality Objectives for Measurement Data

Precision and Accuracy

The VA SOS modified method was developed and tested by scientists at Virginia Tech (Engel 2000) and further tested in 2006 in a study by Virginia Tech (Voshell, 2006) and Virginia Commonwealth University (Garey, 2006), to accurately represent the stream condition and compare favorably with the results VA Department of Environmental Quality professional biologists would find when sampling the same sites. The new method compared very favorably with agency findings, and was found to be a good method for volunteers to use to determine the condition of their streams (Engel 2000). Further evaluation in the 2006 studies compared the VA SOS modified method with the Virginia Department of Environmental Quality's Virginia Stream Condition Index (VSCI). The 2006 studies found that a change in the final VA SOS multi-metric scoring

is needed to be comparable to the VSCI. These changes are reflected in this QAPP and the field sheets found in Appendix A. The 2006 studies can be found in the Appendices.

The precision and accuracy of VA SOS volunteers will be measured in the lab. Every two years, volunteers will be asked to preserve their entire sample and submit it to the VA SOS Coordinator for lab identification. The volunteers must correctly identify the number and type of each organism 90% of the time.

The precision of the VA SOS method will be evaluated every four years. The method will be conducted at the same time as a professional Department of Environmental Quality biologist to determine if the results correlate 90% of the time.

Representativeness

For the VA SOS program, representativeness depends largely upon site selection. Volunteers are requested to select sites that are representative of the stream and the conditions that are influencing the stream (see appendix M). However, volunteers are asked not to monitor below permitted discharges. In selecting a riffle, volunteers survey the stream section to determine the most appropriate and representative riffle. Also, generally more than one sample in the riffle is collected. Each sample is picked in its entirety and the results are composite into the final score.

Comparability

VA SOS ensures comparability requiring all volunteers to use the protocol designed by scientists at Virginia Tech (abstract located in Appendix K). This protocol includes taxonomic keys to identify macroinvertebrates correctly. VA SOS also maintains several sets of reference collections for use by volunteers in the field.

During development of the protocol, comparisons were made with findings from VA Department of Environmental Quality professional biologists at the same sites. The new method compared very favorably with agency findings. The VA SOS multimetric rating is similar to that rating used by DEQ biologists.

The comparability of the VA SOS method to professional methods will be evaluated every four years. The VA SOS method will be conducted at the same time as a professional Department of Environmental Quality biologist to determine if the results correlate 90% of the time.

Completeness

VA SOS does not apply rigorous completion standards to the volunteers collecting data. VA SOS expects each monitoring site to be monitored 4 times during the course of a year. The completion of all 4 monitoring events during the year is hampered by several factors: the need for the site (as identified by the monitor or regional coordinator) may have changed during the course of the year or the volunteer may have dropped from the program (the need for the change should be documented and kept with other site information). We do instruct volunteer monitors that monitoring over an extended period of time and during the same approximate times per year provides the most useful data.

Element 8. Training Requirements/ Certification

VA SOS Volunteer

Persons interested in becoming a VA SOS volunteer must attend at least one training session given by VA SOS staff or a regional trainer. This training session includes information about the program and basic watershed education, safety information, instruction in methods of collection and analysis, instruction in macroinvertebrate identification, and a hands on experience with the methods (Appendix B). The volunteer then has up to 18 months to practice the method and identification before becoming certified. This practice can be done alone, with other volunteers, or at other official training sessions. If it has been over 18 months since the volunteer last attended an official training session, they must attend another session before becoming certified. The volunteer cannot be certified during their initial training session.

The certification process includes an in-stream observation and a macroinvertebrate identification test. VA SOS staff or a regional trainer must administer the certification procedure. The in-stream observation consists of the volunteer completing an entire sampling session (collecting and processing an entire sample and completing the habitat assessment), while the person doing the certification fills out an observation report (Appendix C). This portion of the test is open book and can be completed as a team with other volunteers attempting certification.

The identification portion of the process is a written test (Appendix C). There are 19 lettered, unidentified vials containing preserved representatives of groups used in the VA SOS method. The volunteer must identify at least 17 vials correctly in order to pass. While this portion of the certification process is open book, it must be completed individually by each individual wishing to become certified.

Within two months of successfully completing both parts of the certification process, the volunteer receives a certificate indicating (s)he is a VA SOS monitor. If the volunteer continues to pass further quality assurance measures (see Quality Control Requirements), (s)he will remain a certified volunteer. If the volunteer misses sampling for 18 months, or 6 subsequent sampling events, (s)he will lose his or her certification status and must go through the certification process again.

Quality Assurance Auditor

Volunteers wishing to become quality assurance auditors must have been a certified volunteer for at least 6 months and have completed at least two monitoring events. During these two monitoring events, the volunteer must have demonstrated their ability to follow the method by completely and accurately filling out the data forms for all monitoring events.

If the interested volunteer meets these requirements, (s)he attends a training session that teaches him or her how to conduct an audit of a volunteer. During this session, equipment needs and condition is covered, as are proper methods. How to complete the audit checklist used during the audit is covered (Appendix D).

The auditor must complete at least two audits every two years to remain an auditor, and must send the audit forms to the regional biologist with three weeks of completion. Incoming audits are reviewed by the Coordinator or designee. Should the audit form not be filled out properly, the Coordinator or designee works with the auditor to improve his or her auditing performance. Should the auditor continually fail to properly complete the forms, (s)he is required to attend another auditor training session or will loose his or her auditing status.

Regional Coordinator

As this is a local organization position, no additional training is required to be a regional coordinator. However, the VA SOS staff will remain in close contact with the regional coordinators and will act as a resource to these volunteers. In addition, the Coordinator or designee will remain in close contact with these volunteers to help them learn to assess the incoming data for completeness and how to respond to incomplete data forms.

Regional Trainers

Volunteers wishing to become trainers must have been a certified volunteer for at least 6 months and have completed at least two monitoring events. During these two monitoring events, the volunteer must have demonstrated his or her ability to follow the method by completely and accurately filling out the data forms for all monitoring events. The potential trainer must also have observed at least two training sessions implemented by VA SOS staff or regional trainers. The initial training session a volunteer attended to become a monitor may count as one of these sessions. In addition, the volunteer must feel comfortable talking in front of a group, and must remember that (s)he is representing the VA SOS program while training volunteers so must accurately and correctly represent the goals and opinions of the VA SOS program.

Should the volunteer meet these requirements, (s)he must go through an additional training session administered by the VA SOS staff before training other volunteers. This training includes a discussion of what is involved in a training session. A checklist of these items will be given to each regional trainer during this training session (Appendix B). In addition, the training session will cover how to be an effective trainer, frequently asked questions, reference collections, and the certification process. The potential regional trainer must complete the macroinvertebrate identification portion of the certification process again, but must receive a 100% in order to become a trainer. (The same form will be used for both the certification process and the regional trainer process – Appendix C).

Once the regional trainer successfully completes the training requirements, (s)he will enter an observational period. VA SOS staff must observe the regional trainer's first training session, either in person or via videotape, for review and comment on the trainer's performance. A training observation report will be completed at that time and a copy will be returned to the trainer within three weeks of the training (Appendix E). The regional trainer must complete at least one training session and certify at least one volunteer per year in order to remain a trainer. In addition, the trainer must undergo an observation by VA SOS staff in person or by video once every two years.

Element 9. Documentation and Records

Volunteer Field Sheets

All volunteers complete a field sheet packet at each sampling event (Appendix A). The packet includes a front informational sheet, which includes date, location, sampling team, and some basic physical stream information. The second sheet contains raw macroinvertebrate counts, the third sheet has individual metric calculations, and the forth sheet is a multimetric index calculation. The fifth sheet is a habitat assessment form.

The volunteer saves a copy of these forms and sends another copy, either hard copy or electronically, to the regional coordinator or the VA SOS Coordinator or designee. Those sheets sent to the regional coordinator are copied and sent hardcopy or electronically to the Coordinator or designee. The Coordinator or designee compiles the data in a database, where they are permanently saved. Back-up copies of the database are housed elsewhere outside of the main VA SOS office.

Training and Certification Forms

A sign-in sheet should be completed at each training session, whether it is for volunteers, quality assurance officer training, or regional trainer training (Appendix F). Regional trainers or coordinators should send a copy of these sheets to the VA SOS office within three weeks of the training session, retaining a copy for themselves. The Coordinator or designee will maintain a permanent database of all volunteers. Back-up copies of this database are housed elsewhere outside of the main VA SOS office. Hardcopies of sign-in sheets will be kept on file in the VA SOS offices for a minimum of five years, and then recycled.

All certification tests will be handled in the same manner as the sign-in sheets.

Quality Assurance Forms

A copy of forms filled out by the quality assurance auditor should be sent to the Coordinator or designee within three weeks of the audit (Appendix D). The pass/ fail status of each volunteer will be recorded in the database of volunteers. A copy of the audit will be sent to the volunteer(s) in question, and a copy will be kept on file for a minimum of five years at the VA SOS offices.

All samples preserved for quality assurance purposes (See Quality Control Requirements) must be properly labeled with a sample submittal form (Appendix D). This form will be kept with the sample at all times. After these samples have been identified, the laboratory record sheet (Appendix G) will be housed in the VA SOS records for a minimum of five years, and then recycled. The pass/fail status will be recorded in the database of volunteers, and a copy of this status will be sent to the volunteer(s) in question. Preserved samples will be archived for a minimum of five years, then the organisms will be used in reference collection development or donated to a school, college, or university.

The results of the quality assurance audit and identification check will be sent to the volunteer(s) in question within three months of the audited monitoring event.

Unknown Specimen Submittal

All unknown specimens needing identification by the Coordinator or designee must be properly labeled with an unknown specimen form (Appendix H). After identification, the form will be completed by the Coordinator or designee. A copy of the form will be filed in the VA SOS offices for a minimum of five years, and a copy of the form and the unknown specimen will be returned to the volunteer.

Element 10. Sampling Process Design

Volunteers collect macroinvertebrate samples and complete habitat assessments every three months, or once each season. While sampling can occur any time during a season, it is recommended that sampling occur in January, April, July, and October, on a regular basis. Descriptive location information and latitude and longitude identify each monitoring site.

Most volunteers have a specific stream they wish to monitor. Often, this stream is located in close proximity to their home, or they spend time on the stream for recreational purposes. To promote continued interest and involvement in the VA SOS program, it is important that volunteers be allowed to monitor these locations. Some monitors do not have a specific spot in which they are interested, but rather wish to monitor somewhere in their watershed of interest. In such a case, VA SOS staff with representatives from DEQ and DCR, will use GIS maps, to assess where current volunteer and agency monitoring is occurring, and help the volunteer choose the most appropriate site. Site selection will also take in consideration potential uses of the data (background information, assess effectiveness of BMPS, monitor land use changes, etc). All sites must be located on public property, or the volunteer must obtain permission if they choose to monitor private property. Sites are added to the program as often as new volunteers are trained. Sites may also be changed if the need for the monitoring site has changed. For example, if a volunteer chooses a site below a construction site to evaluate potential impacts, once the

construction is complete, the volunteer may choose to abandon the site. See appendix M for detailed site location directions.

Volunteers are not to conduct their normal sampling within one week of heavy rainfall. Rather, they should sample the stream during its average conditions for that season. Should there be heavy rain, the sampling must be postponed to allow the stream to return to normal conditions.

If the volunteer is not going to be able to complete their sampling for a season, they should alert their regional coordinator or the VA SOS staff, and assist them in locating a substitute volunteer for that season.

The VA SOS program has some specific safety recommendations to keep all volunteers safe and healthy:

- Monitoring sites should be conducted in wadable sections of streams. The depth of the stream should be no deeper than 3 feet (the height of the net).
- If high waters are present at the site, this should be noted on the front page of the field sheet and the site should not be monitored at this time.
- Always monitor in at least pairs.
- Never allow children to go to the stream alone. When monitoring with children, stress that they should not come back to the stream without an adult present.
- All kits should contain some sort of waterless hand sanitizer and/or peroxide. These should be used frequently, especially before touching face or eyes and before eating.
- Be careful of glass. If a site has known glass, use a garden rake to dig up substrates and consider purchasing neoprene gloves to help protect hands. Should a volunteer get cut, (s)he should clean the cut immediately.
- Be sure to have plenty of water and sunscreen in the summer, and wear plenty of clothing in the winter. In the winter, consider purchasing neoprene gloves to help keep hands warm, and bring plenty of towels to stay dry.

Element 11. Sampling Methods Requirements

Required equipment includes a 1/16” mesh kick-seine, a sheet for under the net, forceps, a plastic container in which to sort bugs, collection jars and alcohol for collecting unknown specimens, a magnifying glass, pencils, stream shoes, field sheets and a simple calculator. Volunteers are responsible for purchasing and maintaining their own equipment. The VA SOS program provides volunteers with a list of needed equipment and approved vendors (Appendix I).

Choosing where to sample within the stream

Volunteers select a riffle typical of the stream, that is, a shallow, fast-moving area with a depth of 3 to 12 inches (8 to 30 cm) and stones, which are cobble-sized (2 – 12 inches). Stone size is important since the macroinvertebrates surveyed prefer these stones for

protection and food supply. In addition, the bubbling of water over the rocks provides needed oxygen for healthy growth.

How to Sample

Volunteers place the kick seine perpendicular to the flow of water immediately downstream of the 1 foot^2 area in the riffle they have selected to sample. The bottom, weighted edge of the net should fit tightly against the stream bottom. Volunteers use cleaned rocks from outside the sampling area to hold the net firmly to the bottom. This prevents insects from escaping under the net. Volunteers tilt the net back, so the water flowing through the net covers a large portion of the net, however, they are careful not to tilt the net so much that water flows over the top, allowing organisms to escape.

A volunteer quickly samples the targeted area for 20 seconds. To sample, (s)he lifts and rubs underwater all large rocks in the sample area to dislodge any clinging organisms. (S)he rubs all exposed surfaces of rocks in the sampling area that are too large to lift. (S)he then digs around in the small rocks and sediments on the streambed in order to dislodge any burrowing macroinvertebrates.

After sampling for 20 seconds, volunteers carefully rub off any rocks used to anchor the net. They then remove the seine with an upstream scooping motion, being careful not to allow water to escape over the top of the net, in order to keep all the macroinvertebrates in the net.

For more detailed information about how to sample, reference the VA SOS Modified Method Field Guide.

Processing the Sample

Volunteers place the net on a flat, light colored surface, such as a white sheet, table, or piece of plastic. This makes the organisms easier to see. Using forceps or their fingers, volunteers gently pick all the macroinvertebrates from the net and place them in a collecting container. Volunteers carefully look on both sides of any debris in the sample, as many insects will cling to any available litter. They look closely for very small organisms. It is important to thoroughly pick all the organisms from the net. Once all the organisms have been sorted off the net, the net is lifted and the underlying area is examined. Any organisms that have crawled through the net are collected. Again, it is important to collect all these organisms to have an accurate sample.

Once all the macroinvertebrates are removed from the seine and underlying sheet, the number of organisms in the sample is counted. If at least 200 organisms have not been collected, another net must be collected from a different area in the same riffle. The organisms from the second net are added to the first. The length of sampling time can be adjusted depending on the number of organisms collected in the first, with the maximum sampling time per net being 90 seconds. The second net and area beneath are again sorted in their entirety. Again the organisms are counted, and a third net is collected if

200 organisms have not been obtained. This process is repeated until at least 200 organisms are found or 4 nets are collected, whichever is first. Each net collected must be sorted in its entirety, even if that leads to a sample of well over 200 organisms.

Once at least 200 organisms have been obtained, the organisms are separated into look-alike groups, using primarily body shape and number of legs and tails, as the same family or order can vary considerably in size and color. Volunteers use the tally sheet (Appendix A), the macroinvertebrate identification card (Appendix J), andother reference materials as to aid in the identification process. Volunteers record the number of individuals they find in each taxonomic group on the tally sheet. The tally sheet has one box set aside for "other aquatic macroinvertebrates". Volunteer should note the number and type (if known) of aquatic macroinvertebrate not included in the tally sheet. The number put in this box will be included in the total number of organisms found in the sample. Please do not use this box to document fish, salamanders or other aquatic or semi-aquatic organisms. When identification and recording are completed, samples are returned to the stream unless the quality assurance audit is occurring (See Quality Control Requirements). All equipment should be thoroughly rinsed at this time so as not to contaminate future samples.

For more detailed information about how to process the sample, reference the VA SOS Modified Method Field Guide.

Habitat Analysis

Volunteers complete a qualitative streamside visual analysis that assesses the general conditions in the stream (Appendix A) every time the conduct a biomonitoring session. Some parameters require volunteers to pick the most representative description for their sites, while other parameters require volunteers to determine percentages present at their site. Guidelines for completing the habitat analysis are available to the volunteers on the VA SOS website (www.vasos.org) or in the Save Our Stream's Monitor's Guide to Aquatic Macroinvertebrates (Kellogg 1994). These data are used to gain perspective on the macroinvertebrate data collected from the same site.

Virginia Save Our Streams also recommends volunteers complete a quantitative annual habitat assessment of their stream. Volunteers interested in conducting an annual habitat assessment of their stream should attend a training session conducted by VA SOS staff or regional VA SOS trainers. Directors for completing the habitat analysis are available to the volunteers on the VA SOS website and are also included in Appendix O. Data collected by the annual habitat assessment can be used to gain perspective on the macroinvertebrate data collected at the same site and also can be used to evaluate potential threats to the stream's aquatic life.

Element 12. Sample Handling and Custody Requirements

Quality Assurance Samples

The majority of VA SOS volunteer samples are processed in the field and the macroinvertebrates are returned to the stream within a few hours of their collection. However, samples for the identification quality assurance procedure are preserved for identification by VA SOS staff. The preserved samples are treated as follows:

In the field, the samples are the responsibility of the volunteers. The volunteers must provide the jar and alcohol, and are responsible for preserving the sample. At that time, the volunteer must properly fill out the sample submittal form and properly label the jar (Appendix D). The label should be written in permanent ink or pencil and placed inside the sample container. This form and the label must remain with the sample at all times. A copy of the data sheet for the sampling event must also accompany the sample.

The sample then becomes the responsibility of the quality assurance auditor. They must transport the sample to the regional drop-off location within three weeks of its collection.

The VA SOS Coordinator or designee is responsible for picking up the samples and identifying them within three months of their collection. After the sample has been proceeded by the VA SOS Coordinator or designee, the organisms will be used in reference collections or donated to schools, colleges, or universities.

Unknown Specimens

Individual organisms that volunteers collect but cannot identify should either be preserved and send to the VA SOS office for identification (see instructions below) or alternatively, a picture of the organism may be taken for identification.

If the organism is preserved, please place organism in a vial and fill with rubbing alcohol (available at a local drugstore), label properly (Appendix H), and sent to the VA SOS office for identification or delivered to VA SOS employee at an appropriate time. The label should be written in permanent ink or pencil and placed inside the sample container. The volunteer is responsible for all costs associated with delivering the sample to the VA SOS office. The VA SOS program will return the identified sample to the volunteer for future reference.

If the organism is photographed, take as many photographs as possible to document the number of legs/appendages (if any), the head and mouth features, the thorax and abdomen (top and bottom if possible), any tail features, and other distinguishing characteristics. In addition, a photo with another object (like a ruler) in the picture for scale purposes is helpful.

Element 13. Analytical Methods Requirements

Volunteers use a multimetric index based on six individual metrics to analyze their macroinvertebrate data. Scientists at Virginia Tech developed this index for the VA SOS

volunteers (Engel 2000). Volunteers complete the index by following the steps in four tables found on pages three and four in the field sheet packet (Appendix A). The results of the multimetric index are calibrated to determine if stream condition is acceptable or not. There is no real analytical procedure for analyzing the results of the streamside visual analysis. Rather, the results from this analysis are used to help the data users understand the scores obtained by the macroinvertebrate samples.

Element 14. Quality Control Requirements

There are four quality control requirements that VA SOS maintains for its monitoring program.

Training and Certification

All Virginia SOS volunteers must attend an initial training session and complete a subsequent certification test. See the Training Requirements/ Certification section for details on these quality assurance efforts. Upon the completion of these requirements a volunteer is considered a certified monitor. Certified monitors go through the rigors outlined in this quality assurance plan and provide data for the state water quality agencies. If a certified monitor does not collect and submit data to the VA SOS office during the two year period after their initial certification, they are considered inactive and must go through the training and certification process again. VA SOS monitors are those who routinely monitor their sites (at least twice a year) are considered active certified monitors and must maintain their quality assurance status by participating in the field and lab audits as outlined below.

Reference Collection

VA SOS staff and regional trainers and/or coordinators have a complete reference collection of macroinvertebrates for volunteers to use during the course of their sampling. VA SOS staff is responsible for maintaining these reference collections.

Field and Lab Audits

All certified monitors must undergo periodic quality assurance audits. The quality assurance audit will occur once during the two years after the initial certification and at least every four years in subsequent years for active monitors (those who conduct sampling at least twice a year). The quality assurance audits involve a field visit by a quality assurance auditor. The auditor reviews all volunteer materials to check that the proper equipment is used and is functioning properly. In addition, the auditor watches the volunteers collect and process their sample. The auditor uses a checklist (Appendix D) to assure the volunteers are correctly completing their sampling event. The completed auditing forms are sent to VA SOS staff. The forms are reviewed by VA SOS staff. Should the volunteers fail their audit, the VA SOS staff will work with the volunteer to update his or her equipment and/or collection and processing methods. The volunteers must have each sampling event audited until they pass. Once a volunteer fails an audit, his or her certification is revoked until (s)he successfully completes an audit. Should the

volunteer fail three audits in a row, (s)he must attend a training session with an official trainer to refresh his or her sampling methods.

At the time the auditor reviews the volunteers' field methods and equipment, the volunteers will also preserve their entire sample. The samples will be sent to the VA SOS Coordinator or designee (See Sample Handling and Custody Requirements), who will re-identify these samples to check the volunteers' identification skills. Should the volunteer fail to correctly identify a significant portion of the sample (over 10%), his or her certified status will go on hiatus. The VA SOS staff will work closely with the volunteer to help him or her learn troublesome organisms. The volunteer must successfully complete the macroinvertebrate identification test (See Training and Certification) in order to re-instate their certified status. The volunteer must preserve his or her next sample after his or her certification status is re-instated for review by the Coordinator or designee. Should the volunteer fail that identification check, (s)he must go through a training session with an official trainer and must once again go through the certification process in order to be a certified volunteer.

Method Evaluation

Every four years, VA SOS staff will coordinate sampling with the Virginia Department of Environmental Quality professional biologists to evaluate the continued correlation of the two methods. Efforts to sample different flow regimes, ecological conditions, and regions will be made to ensure the VA SOS water quality assessment corresponds with the professional assessment under a variety of conditions and across different areas of the state. If the method does not correspond to the professional assessment, the VA SOS method will undergo a re-evaluation by scientists in the aquatic entomology field.

Element 15. Instrument/ Equipment Testing, Inspection, and Maintenance Requirements

Each VA SOS volunteer will be responsible for maintaining his or her own equipment. Prior to each monitoring event, the volunteer should check his or her net for cleanliness and for any small rips or holes. A sewing repair kit should be included in each kit, and small holes and rips should be repaired prior to sampling. Should the hole or rip be of substantial size (irreparable), the volunteer is responsible for obtaining a new net prior to sampling. The sheet for under the net should also be cleaned and repaired as needed prior to sampling.

In addition, each volunteer is responsible for keeping the rest of his or her equipment up to date, clean, and in good condition. The volunteer is responsible for repairing or replacing all necessary equipment. The volunteer is also responsible for having the proper field sheets with them, either by making copies or downloading them from the VA SOS website (www.vasos.org). The volunteer should have the most current, up to date field sheets available.

The quality assurance officer will review all equipment and supplies during the field audit.

The VA SOS program will assist volunteers in keeping current, functioning supplies by providing volunteers recommendations as to where to purchase equipment (Appendix I). The VA SOS program will keep all necessary documents current on the website, and will supply copy masters of these documents to those volunteers without Internet access.

Element 16. Instrument Calibration and Frequency

No calibration is needed for macroinvertebrate collection/ processing equipment. However, the quality assurance officer will review all equipment during his or her visit with the volunteer.

Element 17. Inspection and Acceptance Requirements for Supplies

All equipment must meet specifications for VA SOS macroinvertebrate collection. Kick seines must be approximately 3 ft x 3 foot, and must have a 1/16" mesh size. These nets can be purchased from an approved supplier (Appendix I) or the VA SOS program. If the nets are obtained through another supplier or made by the volunteer, they must be mailed to the VA SOS state office for inspection prior to use. The sheet must be at least the same size as the net, if not larger, and may be obtained at a local supply store. All other supplies may be obtained from a local supply store or through catalogs, and are subject to review during the quality assurance officer's regular visit.

The VA SOS program encourages its volunteers to be innovative in order to improve the collection and analytical process. However, all innovations must be reviewed by the VA SOS state office either in person, by mail, or through photographs prior to their use in data collection.

Element 18. Data Acquisition Requirements

The VA SOS uses collection and analytical methods for benthic macroinvertebrates developed for the program by Virginia Tech scientists (Engel 2000). USGS 7.5-minute quadrangles are used together with GIS maps for site selection and land use data. The GIS maps include land use data, location of dams, roads, and permitted discharges, and collection locations for agencies (VA DEQ, US FWS, etc). A USGS 7.5-minute topographic map or a GPS unit is used to determine the latitude and longitude of the volunteers' sites.

Some VA SOS volunteers also collect chemical parameter data. When this information is reported to the VA SOS database manager, it is included in the master database under the

memo field (not searchable). However, their chemical data is not covered by the VA SOS quality assurance plan. Those volunteers collecting chemical data should create and submit their own quality assurance plan for that monitoring.

Element 19. Data Management

Field sheets (Appendix A) are filled out completely by the volunteers in the field. The volunteer should review his or her data sheets from each sampling event to make sure they are filled in as completely and accurately as possible. The volunteers have four weeks to submit their data hardcopy or electronically, keeping a copy of the data themselves.

Where available, field sheets are sent to the regional coordinators, who review the data for completeness. Should there be any data gaps, the regional coordinators contact the volunteers to fill in the missing information as much as possible. The regional coordinators must send his or her region's data to the VA SOS staff hardcopy or electronically within three weeks of obtaining all of that season's monitoring reports for his or her area. Again, the regional coordinators keep a copy of all data forms. Where no regional coordinator is available, the VA SOS Coordinator or designee acts as first reviewer of data.

The VA SOS Coordinator or designee reviews all data coming to the state office. Should there still be missing or incorrect information, the Coordinator or designee works with the volunteers, regional coordinator, and maps if necessary to fill in the gaps. VA SOS staff has final say over whether the data is complete enough to be entered in the state database by VA SOS staff. The VA SOS Coordinator or designee also maintains a database of all volunteers and their certification status, so can appropriately mark data as certified or not. The database will contain all data from all years. Hardcopy forms will be filed and kept by the VA SOS program for a minimum of five years from its collection. After this time, the data forms will be recycled.

The data for the last five years will be delivered in electronic database form to the Department of Environmental Quality every other year, or when needed. The database is reviewed and manipulated as needed by the DEQ Data Liaison, who works closely with the VA SOS Coordinator or designee to correct any problems found in the database. Other organizations requesting the data are responsible for reviewing the database in accordance with their data needs.

The VA SOS staff will also keep data available on the VA SOS website for easy review by all interested parties. The data on the website will have gone through reviews by the VA SOS Coordinator or designee, and will be updated biannually. Data request needs that cannot be met by the internet data retrieval site should be made in writing. Data will be label with the following: "This data is intended for uses outlined in our most recent Letter of Agreement with state and federal natural resource agencies."

Element 20. Assessments and Response Actions

A quality assurance auditor will review the field performance and equipment of all certified volunteers as outlined in the Quality Control Requirements section. In addition, the volunteer's identification skills will be reviewed by VA SOS staff through preserved samples in conjunction with a monitor's quality assurance audit (see Quality Control Requirements). Corrective actions, if necessary, will be taken and are discussed in detail in the Quality Control Requirements section.

All field sheets will be reviewed for completeness and anomalies by the collecting volunteer, regional coordinator, and VA SOS Coordinator or designee. Should any problems be detected, the involved parties will work together to fix the problem and assure future field sheets will be complete and meet quality assurance standards. Should the problem be irreparable, the VA SOS Coordinator or designee may decide not to include the data in the statewide public database.

Element 21. Reports

The data collected by the VA SOS volunteers will be available to anyone interested on the VA SOS website (www.vasos.org). The website is updated biannually, and contains highlights of the data from each site. Those parties interested in seeing the full data from any site can request such from the VA SOS program. A full report will be made to the requesting group within three weeks of said request. Full data sets will not include the name of the certified monitor, but may include the organization name (such as Streamwatch or Friends of the Maury River).

Reports, in terms of the full database from the last five years, are made to the VA DEQ every other year or when requested. Should other information, such as information about passage of quality assurance audits and identification passage, be required, it will be delivered upon request. Data collected when a volunteer has failed to pass a quality assurance check will be marked as uncertified when submitted to the DEQ.

As the database of volunteer data will be marked appropriately with certification status, the "raw" results of the quality assurance tests will not be available unless requested, and specific names will only be provided to the Department of Environmental Quality and other appropriate agencies, and to the regional coordinators. The names of volunteers having quality assurance troubles will not be made public to any other interested parties. However, statistics such as percentage passed in each watershed or overall will be available by request and on the VA SOS website.

Element 22. Data Review, Validation and Verification Requirements

All data sheets are reviewed by the collecting volunteer, the regional coordinator where appropriate, and the VA SOS Coordinator or designee. In addition, the DEQ Data Liaison reviews the database once every other year. The decision to accept or reject data is made by the VA SOS Coordinator or designee.

Data entry is checked for errors as it is entered. Data will be entered into a spreadsheet set up to calculate metrics and final scores. Should the scores in the spreadsheet be different from those calculated by the volunteers, the data will be reviewed for accurate entry. Habitat assessments are mainly ranges of scores, and these will be reviewed at the time of entry.

Element 23. Validation and Verification Methods

The data will be reviewed for any inaccuracies and gaps and will be updated as described in the Data Management Section. Data will be updated as available. The VA SOS Coordinator or designee makes the final decision as to whether or not the data is complete and accurate enough to include in the database.

All quality assurance data will also be reviewed and recorded by the Coordinator or designee, as described in the Quality Control Requirements section. Any problems will be dealt with as described in that section by the VA SOS staff.

All data reported to users will have undergone all reviews and will have passed all completeness and accuracy tests prior to reporting.

Element 24. Reconciliation with Data Quality Objectives

Precision and Accuracy

The precision and accuracy of the VA SOS monitoring program is evaluated during the quality assurance audits and at the time the method is evaluated. If a volunteer fails the quality assurance audits, they must go through corrective action as outlined in Element 14, Quality Control Requirements.

During the method evaluation process, if the VA SOS method does not correlate with the professional method 90% of the time, the VA SOS method will not be considered precise or accurate and will undergo scientific evaluation and validation to make any necessary changes to the actual collection method or the metrics that are calculated.

Representativeness

The representativeness of the sample will be evaluated during data entry and during the field portion of the quality assurance audits. VA SOS will evaluate the site sampled during data entry (or data review) to make sure the site is representative of the conditions in the area. During the data review, VA SOS staff will also make sure that more than 200 organisms were selected and that the riffle was sampled for the appropriate amount of

time and the appropriate number of times. The quality assurance auditor will make sure the volunteer chooses the most appropriate riffle in the course of the field audit and that the riffle is sampled for the appropriate length of time and number of times. If either course indicates the site location is not representative or the riffle was not sampled in a representative manner corrective actions as outline in the Element 14, Quality Control Requirements, will be taken.

Comparability

Adherence to the VA SOS protocol will be evaluated periodically as outlined in the quality assurance audit section. At the same time the ability to correctly identify the macroinvertebrates will be determined through a lab audit. If the volunteer does not successfully complete either element, corrective actions as identified in Element 14, Quality Control Requirements, will be taken.

The VA SOS Method will also be evaluated every four years to ensure comparability. During the method evaluation process, if the VA SOS method does not correlate with the professional method 90% of the time, the VA SOS method will not be considered comparable and will undergo scientific evaluation and validation to make any necessary changes to the actual collection method or the metrics that are calculated.

Completeness

VA SOS will continue to encourage its volunteers to conduct sampling at their sites 4 times a year. This will be considered a complete sample set. No corrective action will be taken if a volunteer fails to monitor his or her site 4 times during a year, but the data may not be considered as useful by VA SOS or data users.

References Cited

Engel, S.R. 2000. The effectiveness of using volunteers for biological monitoring of streams. Masters Thesis, Department of Entomology, Virginia Polytechnic Institute and State University.

Kellogg, L. 1994. Monitor's guide to aquatic macroinvertebrates. The Izaak Walton League of America, Gaithersburg, Maryland.

Appendix A

Blank Field sheets for macroinvertebrate and habitat assessment

And

Example Field Sheets

Also available for download at www.vasos.org

For Office Use Only
Name of Reviewer_____
Date Reviewed_____
Data sent to_____
VA SOS Data Entry Date _____

Virginia
Save Our Streams
Stream Quality Survey

The purpose of this form is to aid you in gathering and recording important data about the health of your stream. By keeping accurate and consistent records of your observations and data from your macroinvertebrate count, you can document changes in ecological condition. Refer to the Virginia Citizen Monitor's Methods Manual for instructions on how to collect and identify stream macroinvertebrates. *Please note, this method was designed and tested for conditions in the state of Virginia and may not be appropriate in other areas.*

Date_____

Stream_____ Station_____ # of participants_____

Group or individual_____

Name of certified* monitor_____

County_____ Latitude_____ Longitude_____

Location (please be specific) _____
_____

Average stream width _____ft Average stream depth _____in

Flow rate: High_____ Normal_____ Low_____ Negligible_____

Weather last 72 hours _____
_____

Water Temperature_____°F (Please specify if reporting temperature in Celsius)

Collection Time:
Net 1:_____sec
Net 2:_____sec
Net 3:_____sec
Net 4:_____sec

Other comments:
_____
_____
_____
_____
_____
_____
_____

Please send data sheets to your regional coordinator or to VA SOS, P.O. Box 8297, Richmond, Va 23226. If you have any questions about the modified method or this particular collection, please call 804-615-5036 or e-mail stacey@vasos.org

* Your data is most useful when you pass your certification. Please contact VA SOS to schedule your certification!

Monitors checklist for the Va. SOS modified method

1) Choose a site (riffle) that is accessible (public property or with landowner permission) and that has the stream water bubbling over cobblestone sized rocks (3"-10" at the widest part of the particle). We strongly encourage monitors to avoid DEQ monitoring sites and the mixing zone of permitted wastewater discharges.

2) Use a Va. SOS seine net. This mesh is important for quality assurance purposes.

3) Approach the riffle from downstream (so as not to disturb potential collection areas) and position the net just below a spot with maximum bubbling action and a predominant number of cobbles. (approx. 45 degree angle) The net should be spread as widely as possible and set to allow a direct flow of water into the center of the net.

4) The monitor that will do the rubbing should take some cobbles from OUTSIDE the area to be sampled and rub them underwater (and outside of the "net zone")before gently laying them on the bottom of the net to anchor the net to the stream bottom.

5) The person holding the net will then time the other monitor to allow the rubbing of rocks for twenty seconds immediately upstream of the net. The final five seconds will be announced and for that time the "rubber" will scratch the stream bottom with their fingers or a garden cultivator type tool to collect any organism that live in the substrate.

6) Rub the "anchor" stones to remove any critters that may have attached themselves and with a forward and scooping motion remove the net from the stream. Examine the net for any organisms that are not macroinvertabrates (minnows or salamanders) and return them to the stream.

7) Take the net to the streamside and place it on a sheet that will allow for identification of any organisms that may pass through the mesh. Use ice cube trays and dishes to pick ALL organisms. Examine both sides of the net and the sheet beneath to obtain a rigorous count of all aquatic macroinvertabrates that were caught.

8) Repeat this procedure until a composite of all nets yields a total of organisms in excess of 200. Remember to thoroughly pick each net and add the total to the previous total. The time devoted to rubbing can be modified according to the judgment of the monitors but can not exceed 90 seconds per "dip". Also, no more than 4 "dips" can be made in pursuit of exceeding 200 organisms. If the monitors fail to find 200 organisms in 4 "dips" the calculation shall be made with the total that is obtained. Special note of this fact should be made in reporting the data.

9) With the individual counts of the organisms according to the categories as listed on the Va. SOS identification sheet and the total of all categories, calculate the six percentages (metrics) and combine them into one index value using the Va. SOS field calculation sheets. Be sure to report your results to Va. SOS ASAP.

Do this four times a year (every 3 months). Thank you for being a Va. SOS monitor!!!

SAFETY

Four things to remember when monitoring your stream…

1. Always remember to wash your hands after getting into any stream. The VA SOS method can not detect bacteriological pollution.
2. Glass may be hidden in the bottom of the stream - watch out for it!
3. If you do get a cut or scrape while in the stream, use peroxide to clean the wound. Again, bacteriological pollution...
4. Always sample in pairs!

POLLUTION

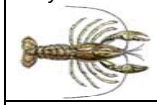
Sources of Pollution

When people talk about water, they talk about *point source pollution* and *nonpoint source pollution*

1. Point source pollution comes from a specific source: a pipe, a ditch, a container. It has a beginning point and an end point. Here's an easy way to remember, you can point to the pipe that's causing the problem.
2. Nonpoint source pollution comes from many scattered sources. It occurs when water (runoff) moves across and under the ground (think rain storm). The runoff picks up natural and man-made pollutants as its moves across the land. Then the runoff deposits the pollutants at the bottom of the watershed, into streams, rivers, lakes, estuaries, and even underground aquifers. Can you point to the problem? You might be able to point to different sources - but you can't tell if, when, or how the source is getting into the waterbody.

Types of Pollution

1. Toxic pollution, like DDT or other chemicals that cause organisms to die and can threaten human health. Toxic pollution can come from pipes or barrels (point source), but it can also come from runoff (nonpoint source).
2. Sediment pollution can clog our waterways, ruin habitat and clog the gills of organisms in the stream. Lack of vegetative cover and impervious surfaces both have an impact on sedimentation.
3. Nutrient pollution can cause plant life in a stream to overgrow; depleting oxygen and sometimes causing the temperature of the stream to get too high. Nutrients can come from fertilizers used in lawns and gardens and animal waste or human waste (nonpoint source or point source).
4. Bacteria pollution can cause human health problems - usually gastrointestinal. Bacteria pollution comes from animal and human waste (nonpoint source or point source).

Macroinvertebrate	Tally	Count
Worms 		
Flat Worms 		
Leeches 		
Crayfish 		
Sowbugs 		
Scuds 		
Stoneflies 		
Mayflies 		
Damselflies and Dragonflies 		
Hellgrammites, Fishflies, and Alderflies 		

Macroinvertebrate	Tally	Count
Common Netspinner 		
Most Caddisfly 		
Beetles 		
Midges 		
Blackflies 		
Most True Fly 		
Gilled Snail 		
Lunged Snail 		
Clams 		
Other Subsurface Invertebrates		
TOTAL NUMBER OF ORGANISMS IN SAMPLE 1		

Individual Metrics

Metric Number	Metric Organism Group	Number of metric organism		Total number of organisms in the sample		Percent (This is your value for this metric)
1	Mayflies + Stoneflies + Most Caddisflies		÷		Multiply by 100	%
2	Common Netspinners		÷		Multiply by 100	%
3	Lunged Snails		÷		Multiply by 100	%
4	Beetles		÷		Multiply by 100	%

Metric 5 - % Tolerant

Taxon	Number
Worms	
Flatworms	
Leeches	
Sowbugs	
Scuds	
Dragonflies and Damselflies	
Midges	
Black Flies	
Lunged Snails	
Clams	
Total Tolerant	
Total Tolerant divided by the total number of organisms in the sample	
Multiply by 100 **This is your Value for Metric 5**	

Metric 6 - % Non-Insects

Taxon	Number
Worms	
Flatworms	
Leeches	
Crayfish	
Sowbugs	
Scuds	
Gilled Snails	
Lunged Snails	
Clams	
Total Non-Insects	
Total Non-Insects divided by the total number of organisms in the sample	
Multiply by 100 **This is your Value for this Metric 6**	

EXAMPLE

Metric	Metric Organism Group	Number of metric		Total number		Percent
1	Mayflies + Stoneflies +	80	÷	204	X 100	39.2%
2	Common Netspinners	40	÷	204	X 100	19.6%
3	Lunged Snails	0	÷	204	X 100	0%
4	Beetles	9	÷	204	X 100	4.4%

METRIC 5 - % Tolerant

Taxon	Number
Worms	10
Flatworms	0
Leeches	0
Sowbugs	5
Scuds	0
Dragonflies and Damselflies	5
Midges	20
Black Flies	10
Lunged Snails	0
Clams	10
Total Tolerant	60
Total Tolerant divided by the total number of organisms in the sample	204
Multiply by 100 - This is your Value	29.4

Metric 6 - % Non-Insects

Taxon	Number
Worms	10
Flatworms	0
Leeches	0
Crayfish	5
Sowbugs	5
Scuds	0
Gilled Snails	10
Lunged Snails	0
Clams	10
Total Non-Insects	40
Total Non-Insects divided by the total number of organisms in the sample	204
Multiply by 100 - This is your Value	19.6

Metric Number	Metric Organism	Your Metric Value	2	1	0
1	% Mayflies + Stoneflies + Most	39.2	Greater than 32.2 X	16.1 - 32.2	Less than 16.1
2	% Common Netspinners	19.6	Less than 19.7 X	19.7 - 34.5	Greater than 34.5
3	% Lunged Snails	0	Less than 0.3 X	0.3 - 1.5	Greater than 1.5
4	% Beetles	4.4	Greater than 6.4	3.2 - 6.4 X	Less than 3.2
5	% Tolerant	29.4	Less than 46.7 X	46.7 - 61.5	Greater than 61.5
6	% Non-Insects	19.6	Less than 5.4	5.4 - 20.8 X	Greater than 20.8
	Subtotals:		Total # of 2s: 4	Total # of 1s: 2	Total # of 0s: 0
			Multiply by 2: 8	Multiply by 1: 2	Multiply by 0: 0

Now add the 3 subtotals to get the Save Our Streams Multimetric Index score: 10

_X_ Acceptable ecological condition (9 to 12)

_____ Ecological conditions cannot be determined at this time (Gray Zone) (8)

_____ Unacceptable ecological condition (0 to 7)

Save Our Streams Multimetric Index

Write your metric value from the previous page in the 2nd column (Your Metric Value). Determine whether each metric should get a score of 2,1, or 0 – depending upon the range of your metric value. Put a check in the appropriate box for your metric value under 2,1, or 0. Count the total number of 2's, 1's, and 0's. Follow the multiplication at the bottom of the chart to determine your Save Our Streams Multimetric Index score and determine whether the site has acceptable or unacceptable ecological condition.

Metric Number	Metric Organism	Your Metric Value	2	1	0
1	% Mayflies + Stoneflies + Most Caddisflies		Greater than 32.2	16.1 - 32.2	Less than 16.1
2	% Common Netspinners		Less than 19.7	19.7 - 34.5	Greater than 34.5
3	% Lunged Snails		Less than 0.3	0.3 - 1.5	Greater than 1.5
4	% Beetles		Greater than 6.4	3.2 - 6.4	Less than 3.2
5	% Tolerant		Less than 46.7	46.7 - 61.5	Greater than 61.5
6	% Non-Insects		Less than 5.4	5.4 - 20.8	Greater than 20.8
			Total # of 2s:	Total # of 1s:	Total # of 0s:
		Subtotals:	Multiply by 2:	Multiply by 1:	Multiply by 0:

Now add the 3 subtotals to get the Save Our Streams Multimetric Index score:_____

_____Acceptable ecological condition (9 to 12)

_____ Ecological conditions cannot be determined at this time (Gray Zone) (8)

_____Unacceptable ecological condition (0 to 7)

Please send data sheets to your regional coordinator or VA SOS, P.O. Box 8297, Richmond, Va 23226. If you have any questions about the modified method or this particular collection, please call 804-615-5036 or e-mail stacey@vasos.org

Fish water quality indicators scattered individuals scattered schools trout (pollution sensitive) bass (somewhat sensitive) catfish (pollution tolerant) carp (pollution tolerant)	**Barriers to fish movement** beaver dams man-made dams waterfalls (>1ft.) other none	**Surface water appearance** clear milky clear, tea colored black colored sheen (oily) foamy other _____ muddy gray
Stream bed deposit (bottom) gray orange/red yellow black brown silt sand other _____	**Odor**: none musky oil sewage other _____	**Stability of steam bed**: Bed sinks beneath your feet in: no spots a few spots many spots
Algae color: light green dark green brown coated matted on stream bed hairy	**Algae located**: everywhere in spots ____ % bed covered	**Stream Channel Shade**: >75% full 50%-74% high 25%-49% moderate 1%-24% slight none
Stream bank composition ____% trees ____% shrubs ____% grass ____% bare soil ____% rocks ____% other _____	**Stream bank erosion potential** >75% severe 50%-75% high 25%-49% moderate 1% - 24% slight none	**Riffle composition** (=100%) ___ % silt (mud) ___ % sand (1/64"-1/4" grains) ___ % gravel (1/4"-2" stones) ___ % cobbles (2"-10" stones) ___ % boulders (>10" stones)

Land uses in the watershed: Record all land uses observed in the watershed area upstream and surrounding your sampling site. Indicate whether the following land uses have a high (H), moderate (M), or slight (S) potential to impact the quality of your steam. (Leave the space blank if there is no impact or if the land use is not present in your watershed.) Refer to the SOS standard operating procedures to determine how to assess H, M, or S.

___ Oil & gas drilling ___ Housing developments ___ Forest ___ Logging ___ Urban uses (parking lots, highways, etc.	___ Sanitary landfill ___ Active construction ___ Mining (types) _____ ___ Cropland (types) _____	___ Trash dump ___ Fields ___ Livestock pasture ___ Other _____ _____ _____

Describe the amount of litter in and around the stream. Also describe the type of litter in and around the stream.

_____
_____

Comments: Indicate what you think are the current and potential threats to your stream's health. Feel free to attach additional pages or photographs to better describe the condition of your stream._____
_____

Appendix B

Training Session Checklist

Training Agenda: Initial VA SOS Training

I. Introduce self and the VA SOS program -- Describe the VA Division of the Izaak Walton League of America

II. Provide Background information and Describe the VA SOS method
- Explain what a watershed is
- Describe point source vs. non-point source pollution
- Explain difference between chemical and biological monitoring
- Explain macroinvertebrates
- Types of pollution
  - Toxic
  - Sediment
  - Nutrients
  - Bacteria – Health hazard not readily identifiable with macroinvertebrate biomonitoring

III. Safety – Stress especially with children
- Wash hands – gastro-intestinal problems
- Cuts and scrapes – use peroxide
- Sample in pairs
- Watch for glass

IV. Discuss critters and their identification individually

V. Discuss the importance of uniformity of method – QA/QC issues

VI. Demonstrate metric calculation and multimetric calculation

VII. Demonstrate and describe method
- Inspect net
- Pick riffle
- Approach from downstream
- Anchor net – rocks from outside sample area
- Rub cobbles & dig substrates – 1 ft^2, 20 sec
- Wash anchors
- Scoop forward
- Release vertebrates
- Careful to table
- Sort and ID ALL
- Count – need 200
- Additional nets if necessary
- Max 4 nets
- Max 90 secs/net

X. Demonstrate Books, Resources, Discuss Partners

- DEQ
- DCR
- DGIF
- Dept. of Forestry
- SWCDs & NRCS
- IWLA Chapters
- Local Colleges
- Regional Trainers
- VA SOS staff

XI. Cooperate with state and local decision makers

XII. Why do we need to monitor?

XIII. What happens to the data & how to choose sites (contact DEQ so don't duplicate efforts)

XIV. Establish monitoring councils & join watershed roundtables – encourage diverse participation. Everyone has a skill to contribute even if they don't want to be a "front line monitor"

XV. What volunteers should do next
- Get certified
- Monitor & report data to VA SOS
- Become a Regional Trainer or Quality Assurance Auditor

Appendix C

Certification Tests

March 2003

Score:_____

Virginia Save Our Streams Program
Modified Method Macroinvertebrate Identification
Quality Assurance Procedure

Name:_____ Date:_____
Address:_____
_____
Phone:_____E-mail:_____

Using the macroinvertebrate groupings found on your tally sheet and bug identification card, identify the organisms in the lettered test vials. You may use whatever written resources you wish; however you may not discuss the organisms with a friend during this procedure. You must get at least 17 correct to pass.

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. _____

J. _____

K. _____

L. _____

M. _____

N. _____

O. _____

P. _____

Q. _____

R. _____

S. _____

VA Save Our Streams Program
VA Division of the Izaak Walton League of America
P.O. Box 8297
Richmond, VA 23226
(804) 615-5036 www.vasos.org

Score:_____

Virginia Save Our Streams Program
Modified Method Field Collection Quality Assurance Procedure

Name(s):_____
_____

Date:_____

This form has been designed for reviewing the field collection skills of monitors in the Virginia Save Our Streams Program. This form is only to be filled out by official Virginia Save Our Streams Program trainers. A minimum score of eleven must be received in order to pass.

1. Monitor chose the most appropriate riffle? Y N
2. Monitor disturbed sample area prior to monitoring? Y N
3. Monitor anchored net firmly to stream bottom and checked bottom of net for holes or gaps? Y N
4. Anchor rocks were collected from outside the sampling area and washed outside the net before being used? Y N
5. Monitor positioned net to collect maximum flow? Y N
6. Monitor collected organisms only for the specified length of time? Y N
7. Monitor dug into substrates under rocks during specified time? Y N
8. Monitor allowed water to flow over top of net? Y N
9. Monitor cleaned anchor rocks when removing them from the net? Y N
10. Monitor correctly scooped net from water, preventing water from flowing over the top and sample from falling off the bottom? Y N
11. Monitor quickly picked all organisms from the net and sheet? Y N
12. Monitor showed adequate field identification skills? Y N
13. Monitor correctly filled out field sheets? Y N

Test administered by:_____

Appendix D

Quality Assurance Audit Documents

Virginia Save Our Streams Program

Quality Assurance Audit

Date:_____

Name(s) and address(es) of volunteer(s) being audited:

Equipment - check for completeness, cleanliness, and condition

Were there any problems (circle one, explain in comments if yes)? Y N

Please circle any missing equipment:

- Net with poles
- White sheet
- Sorting containers
- Current field sheets
- ID card
- Monitor's Guide book
- Magnification
- Thermometer
- Calculator
- Forceps

Methods

Please circle any parts of the method that volunteer(s) had trouble with, then explain in comments:

- Chose the most appropriate riffle
- Entered downstream of sampling area
- Anchored net firmly to stream bottom
- Anchor rocks came from outside of sampling area
- Anchor rocks were washed prior to use
- Positioned net to collect maximum flow
- Collected organisms for specific amount of time
- Washed rocks and dug into substrates
- Water did not flow over top of net
- Anchor rocks were washed as removed
- Net was correctly scooped from stream
- All organisms were collected from sheet and net
- Monitor correctly handled unknown specimens
- Monitor took the proper number of nets
- Monitor did not exceed the maximum sampling time
- A habitat assessment was completed

Comments (continue on back if needed): _____

_____

_____

_____

_____

_____

_____

Quality Assurance Auditor:_____

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Appendix E

VA SOS observation of regional trainer form

Virginia Save Our Streams Program
Regional Trainer Observation Form

Date of Observation:_____

Date of Training Session:_____
Name and address of regional trainer being observed:

Methods
Please circle the area the regional trainer did not adequately cover in the training session and explain in the comments section.

Introduction of self and program
Background on Monitoring/ watersheds/ pollution
Why monitor?
What happens with the data
Safety
Identification of Macroinvertebrates
Quality Assurance
Collection Methods
Analysis of Methods
Habitat Assessment
Conducted in-stream event
Reference collection
Resources/Books/Partners
Cooperation with decision makers
Establishing councils/roundtables
What to do next

Personal Conduct
Please circle the area with which the regional trainer did not meet standards and explain in the comments section.

Personal appearance
Effectively delivered information
Used appropriate tone and language
Properly represented the views of SOS

Comments (continue on back if needed):
_____
_____

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Appendix F

Sign In Sheet

Virginia Save Our Streams Program Sign-in Sheet

Event: _____ Location: _____

Date: _____ Event Leader/ Trainer: _____

Name	Address	Phone	E-mail
		( )	
		( )	
		( )	
		( )	
		( )	
		( )	
		( )	
		( )	
		( )	

Appendix G

Quality Assurance Lab Record

Virginia Save Our Streams Program
Laboratory Identification Sheets

Date of Sample:_____ Collector:_____

Stream_____ Station_____ County_____

Latitude_____ Longitude_____

Location (please be specific)_____
_____

Date of Identification:_____ Who IDed:_____

Organism	Number in Sample	Number volunteer found	# MisIDed
Worms			
Flatworms			
Leeches			
Crayfishes			
Sowbugs			
Scuds			
Stoneflies			
Mayflies			
Dragonflies & Damselflies			
Hellgrammites, Fishflies, & Alderflies			
Common Netspinners			
Most Caddisflies			
Beetles			
Midges			
Black Flies			
Most True Flies			
Gilled Snails			
Lunged Snails			
Clams			
Other			

% Incorrect:_____

Identification Check Passed? Y N

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Appendix H

Unknown Specimen Submittal Form

Virginia Save Our Streams Program
Unknown Sample Submittal

Date:_____
Name and Address of submitting volunteers:

Sample Information:

Stream_____ Station_____ County_____

Latitude_____ Longitude_____

Location (please be specific)_____
_____

Do you have any thoughts about what this organism might be?_____
_____

Please fill out completely, preserve your specimen – don't forget your label, and send your unknown and this form to the VA SOS program (address at bottom).

For office use:
Identification of organism:_____

Who identified it:_____

Please fill out in pencil and include in your unknown preservation jar:

Date_____
Name of submitter:_____

Stream_____ Station_____ County_____

Latitude_____ Longitude_____
Location (please be specific)_____
_____

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Appendix I

Equipment & Approved Suppliers List

Supply List for VA Save Our Streams Modified Method

Essential equipment

Basins, ice trays, pencils, sharpener, peroxide, clipboards, rubber bands, scotch tape, sewing kit, white sheet, and a lidded container for the kit (local dollar stores) cost - max $25

Net----------VA SOS ----------about $25

Poles ----------Local hardware ---------- each 2.00

Magnifier boxes ----------VA SOS ---------- check website for pricing

Waders &Boots ---------- Orvis Outlet (Roanoke) ---------- 20.00-30.00
Orvis Outlet: 31-B Campbell Ave., Roanoke VA 24010
(540) 344-4520

Monitors guide ----------VA SOS ---------- check website for pricing

Basic handout ----------VA SOS ---------- free

Thermometer ----------VA SOS ---------- check website for pricing

Forceps ---------- VA SOS ---------- check website for pricing

Basic Calculator ---------- Local Office Supply Store---------- 1.00-5.00

Nice, but not necessary

Neoprene gloves ----------Gempler's ----------13.00-28.00
Gempler's: P O Box 270, Belleville WI 53508
(800) 382-8473 http://www.gemplers.com/

Trainer's guide ----------National IWLA SOS ----------check for pricing
National Izaak Walton League: 707 Conservation Lane, Gaithersburg MD 20878-2893
(800) BUG-IWLA http://www.iwla.org

70% ethyl alcohol ---------- Local Drugstore ----------quart 2.00-3.00

Teacher's guide ----------National IWLA SOS ----------check for pricing

National Izaak Walton League: 707 Conservation Lane, Gaithersburg MD 20878-2893
(800) BUG-IWLA http://www.iwla.org/iwlastore/index.htm

Glycerin----------local pharmacist----------pint 4.50

Wash bottle ---------- Nasco ---------- 5.00
Nasco: P O Box 901, Fort Atkinson, WI 53538-0901
(800) 558-9595 http://www.nascofa.com/prod/Home

Tackle box ---------- K-Mart ----------15.00-25.00

Luxurious

Field Microscope ---------- Acorn Naturalist (magiscope)---------- check for pricing
Nasco (Walter Explorer Microscope)----- check for pricing
Acorn Naturalists: 17300 E. 17th St. #J236, Tustin CA 92780
(800) 422-8886 http://acorn-group.com
Nasco: P O Box 901, Fort Atkinson, WI 53538-0901
(800) 558-9595 http://www.nascofa.com/prod/Home

Field Case for above scopes---Nasco (item #SB26153M)---------- check for pricing
Nasco: P O Box 901, Fort Atkinson, WI 53538-0901
(800) 558-9595 http://www.nascofa.com/prod/Home

Aquatic Entomology by McCafferty -------- Acorn Naturalist --------- check for pricing
Acorn Naturalists: 17300 E. 17th St. #J236, Tustin CA 92780
(800) 422-8886 http://acorn-group.com

Roll-a-table ---------- NRS (item#2717)---------- check for pricing
North West River Supplies (NRS): 2009 S. Main St., Moscow ID 83843
(800) 635-5202 www.nrsweb.com

Other useful contacts

Acme Vial: (805) 239-2666
http://www.acmevialglass.thomasregister.com/olc/acmevialglass/

Delta Education: (800) 442-5444 http://www.delta-education.com/

Forestry Suppliers: (800) 360-5368 http://www.forestry-suppliers.com/

Lamotte Company: (410) 778-3100

Water Monitoring Equipment and Supply: www.watermonitoringequip.com

The coolest jewelry made from caddisfly cases:
Kathy Stout, Wildscape Inc.: (888) 751-3305 www.wildscape.com

Appendix J

Macroinvertebrate Identification Card

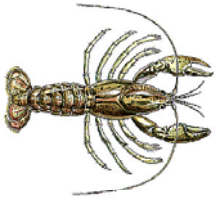
Also available for download at www.vasos.org

Lines under picture indicate the relative size of organisms

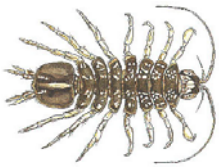
Aquatic Worm:
Class Oligocheata
¼" – 2", can be very tiny; thin, wormlike body, tolerant of impairment

Flat Worm:
Family Planaridae
Up to ¼", soft body, may have distinct head with eyespots, tolerant of impairment

Leech:
Order Hirudinea
¼" – 2", segmented body, suction cups on both ends, tolerant of impairment

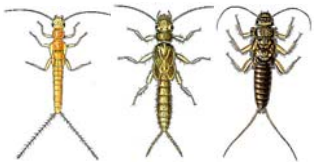


Crayfish: Order Decapoda
Up to 6", 2 large claws, 8 legs, resembles a small lobster, somewhat tolerant of impairment

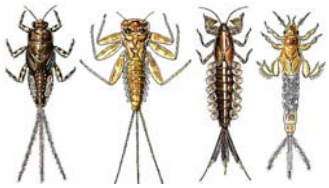


Sowbug: Order Isopoda
¼" – ¾", gray oblong body wider than it is high, more than 6 legs, long antennae, somewhat tolerant of impairment

Scud: Order Amphipoda
¼", white to gray, body higher than it is wide, swims sideways, more than 6 legs, resembles small shrimp, somewhat tolerant of impairment

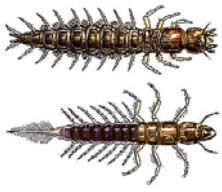


Stonefly: Order Plecoptera
½" – 1 ½", 6 legs with hooked tips, antennae, 2 hair-like tails, no gills on abdomen, very intolerant of impairment



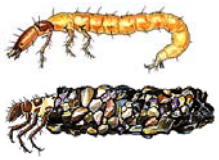
Mayfly:
Order Emphemeroptera
¼" – 1", plate-like or feathery gills on abdomen, 6 hooked legs, 2 or 3 long hair-like tails, tails may be webbed together, very intolerant of impairment

Dragonfly and Damselfly:
Order Odonata
½ " – 2", large eyes, 6 hooked legs, large protracting lower jaw, 3 broad oar-shaped tails OR wide oval to round abdomen, somewhat tolerant of impairment



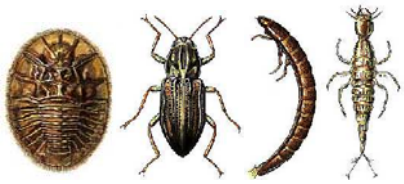
Hellgrammite, Fishfly, and Alderfly:
Order Megaloptera
¾" – 4", 6 legs, large pinching jaws, 8 pairs of feelers along abdomen, 2 hooks on tail end OR 1 single spiky tail, somewhat tolerant of impairment

Common Netspinners:
Family Hydropsychidae
Up to ¾", 6 hooked legs on upper 1/3 of body, 2 hooks at back end, underside of abdomen with white tufts of gills, somewhat tolerant of impairment



Most Caddisfly:
Order Trichoptera
Up to 1", 6 hooked legs on upper 1/3 of body, may be in stick, rock or leaf case, no gill tufts on abdomen, intolerant of impairment

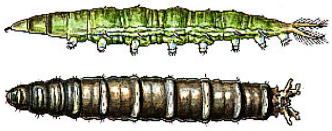
Lines under picture indicate the relative size of organisms



Beetles: Order Coleoptera
¼" – 1", disk-like oval body with 6 small legs and gill tufts on underside OR small black beetle crawling on streambed OR comma-like brown "crunchy" body with 6 legs on upper 1/3 and possibly gill tuft on back end, OR (miscellaneous body form – rare), somewhat tolerant of impairment

Midges:
Family Chironomidae
Up to ¼", distinct head, worm-like segmented body, 2 leg-like projections on each side, often whitish to clear, occasionally bright red, tolerant of impairment

Black Fly: Family Simuliidae
Up to ¼", end of body wider (like bowling pin), distinctive head, sucker on end, tolerant of impairment



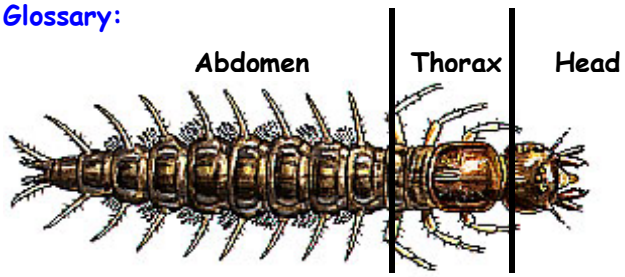
Most True Flies:
Order Diptera
¼" – 2", bodies plump and maggot-like, may have caterpillar like "legs" along body, may have lobes or conical tails on end, tolerant of impairment

Gilled Snails:
Class Gastropoda
Up to ¾", shell opening covered by a thin plate called an operculum, with helix pointed up shell opens to the right, intolerant of impairment

Lunged Snails:
Class Gastropoda
Up to ¾", no operculum, with helix pointed up shell opens to the left, tolerant of impairment

Clams:
Class Bivalvia
Up to ¾", fleshy body enclosed between two clamped together shells (if clam is alive, shells cannot be pried apart without harming clam), somewhat tolerant of impairment

Glossary:



Tails: There are many different kinds of macroinvertebrate tails. The thin thread-like tails found on stoneflies and mayflies are called cerci. The oar-shaped tails found on a damselfly are not really tails - they are actually gills called caudal lamellae!

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These sheets are modified from the National Izaak Walton League of America SOS Program Stream Insects & Crustaceans ID Card.
http://www.iwla.org/SOS/index.html

Appendix K

The effectiveness of using volunteers for biological monitoring of streams

Thesis submitted to the Faculty of the Virginia Polytechnic and State University in partial fulfillment of the requirements for the degree of Masters in Entomology

Sarah Rose Engel

Abstract

An increase in public environmental awareness and a decrease in resources within government regulatory agencies have led to a larger interest in volunteer biomonitoring programs. Government agencies are currently using volunteer data for official purposes with increasing frequency, but questions have been raised about the validity of the data collected by volunteers who have only limited training and experience. Therefore, we conducted a detailed study to assess, modify, and validate the Virginia Save Our Streams (SOS) program, which is a volunteer organization collecting macroinvertebrate data. Sites were sampled using professional methods concurrently with volunteers who utilized the SOS protocol. The volunteer samples were retained for further laboratory analysis. In addition, numerous sites previously sampled by volunteers were re-sampled using professional methods. The data were statistically analyzed to determine if the results of volunteers and professional aquatic biologists were correlated and if they arrived at the same conclusions about ecological condition. It was determined that the Virginia SOS method, and probably other similar volunteer methods, consistently overrate ecological condition. This means that streams impaired by pollution could go unreported, if they are monitored exclusively by volunteers. The cause of this overestimation was determined to be the overly simplistic SOS metric, which is based solely on the presence or absence of taxa. The SOS protocol for data analysis was made more quantitative by developing a multimetric index that is appropriate for use by volunteers. The SOS sampling protocol was modified slightly to obtain actual counts of the different kinds of macroinvertebrates, which allowed for calculation of metrics. Sorting effort and taxonomic level of identification were not changed so that currently participating volunteers would not be excluded because of the need for expensive equipment or advanced technical training. The modified SOS protocol was evaluated by a different set of concurrent samples taken by volunteers and professionals, but using the same statistical techniques. The modified SOS protocol proved to be feasible for volunteers. The new SOS multimetric index correlated well with a professional multimetric index. The conclusions about ecological condition derived from the volunteer multimetric index agreed very closely with those made by professional aquatic biologists. This study demonstrated that volunteer biomonitoring programs can provide reliable data, but every volunteer program needs to be thoroughly validated by statistical comparisons to the professional methods being used in that area.

Appendix L

Reference Materials for Virginia Save Our Streams Volunteer Monitors

Barbour, M.T., J. Gerritsen, and B. Synder. 1999. Rapid bioassessment protocols for use in wadeable streams and rivers: periphyton, benthic macroinvertebrates, and fish, 2nd edition. EPA 841-B-99-002 Office of Water, Washington, D.C.

Engel, S.R. 2000. The effectiveness of using volunteers for biological monitoring of streams. Masters Thesis, Department of Entomology, Virginia Polytechnic Institute and State University.

Kellogg, L. 1994. Monitor's guide to aquatic macroinvertebrates. The Izaak Walton League of America, Gaithersburg, Maryland.

United States Environmental Protection Agency. 1997. Volunteer stream monitoring: A methods manual. EPA 841-B-97-003 Office of Water, Washington, D.C.

Voshell, J. Reese. 2002. A guide to common freshwater invertebrates of North America. Illustrated by Amy Bartlett Wright. The McDonald & Woodward Publishing Company. Blacksburg, Virginia.

Appendix M

Virginia Save Our Streams Site Selection Guide

Selecting a Monitoring Location

Selecting representative sites is one of the most important elements in designing a monitoring program. Before selecting monitoring sites, you should determine two things: where and what kind of monitoring is already being done in your watershed and what question would you like your monitoring to answer. The answers to both of these questions will help you map out the most effective monitoring locations.

Site locations will depend on the goal of your monitoring program. If you want to know what the water quality is of a particular stream, you might select a site close to the mouth of the stream. If you want to know the water quality at a particular fishing spot, you might want to select a site within that fishing spot. If you want to know if a development is impacting a stream you might want to have one site upstream of the development and one site downstream of the development. If you want to collect data to assist the state in developing water quality assessment reports, you might want to select a site within a watershed that is not currently monitored.

Virginia Save Our Streams can help you locate your sites by:

- determining which streams are currently monitored in your watershed
- finding out the natural resource questions professionals would like to have answered in your watershed
- providing a map with natural resource characteristics to assist in developing a monitoring plan
- making a site visit to potential monitoring sites to evaluate access and habitat

Your monitoring site should have good access and you should always get landowner permission (unless in a public right of way).

Defining Monitoring Stations

Monitoring should be done at one station, defined as a single stretch of stream not more than 100 yards long. If you wish to assess a longer section of a stream, select two monitoring stations at the top and bottom of the stretch, or multiple sites along the length of the stretch at quarter-mile or greater intervals. Be sure to revisit the same station each time so that your results will be comparable. Carefully record the location of your monitoring station on your VA SOS Stream Survey form. If you do not know the latitude and longitude coordinates when you monitor, use an accurate description of the site (i.e. Site located on north side of route 660, 1 mile east of route 607) that enables you or another monitor to return to the same location. The regional coordinator or VA SOS staff will help you identify the coordinates at a later date.

Select a riffle typical of the stream, that is, a shallow, fast-moving area with a depth of 3 to 12 inches (8 to 30 cm) and stones which are cobble-sized (2 to 12 inches) or larger. Stone size is important since the macroinvertebrates surveyed prefer these stones for protection and food supply. In addition, the bubbling of the water over the rocks provides needed oxygen for healthy growth.

Documenting Monitoring Stations

Stations should be properly documented by including the stream name, county, and location. The location should be specific and should allow someone to find the property using a road map. For instance the site location could be: East side of route 630 bridge, 2 miles north of route 29. This location is easy to find for anyone using a road map. The following is a poor example of location: at northwest corner of Mr. Earl's property. Unless you know Mr. Earl, you will not be able to find the site! Include latitude and longitude if possible. If you have more than one site on a stream, identify the sites with a station number and always use the same station number for a site! If you cannot remember site number, consider using a descriptive name for the site such us "downstream", "upstream", or "route11".

Appendix N

2006 Validation Studies from Virginia Tech and Virginia Commonwealth University

Comparison of Virginia Save Our Streams and Virginia Stream Condition Index Scores in Streams of the Eastern Piedmont of Virginia

Andrew L. Garey and Leonard A. Smock
Department of Biology
Virginia Commonwealth University
Richmond, Virginia
February 2007

Executive Summary

The objective of this study was to determine if the results of stream macroinvertebrate assessments conducted by amateur volunteer monitors were appropriate for use by the Virginia Department of Environmental Quality (DEQ) in its 303 (d)/305 (b) integrated report. Rapid biological assessments of 20 wadeable stream sites in the eastern part of Virginia's Piedmont Physiographic region were conducted. The macroinvertebrate communities at the study sites were sampled and assessed using two separate protocols; the protocol of Virginia Save Our Streams (SOS), a volunteer monitoring group, and the protocol currently employed by Virginia Department of Environmental Quality (DEQ) biologists. The latter, which produces Stream Condition Index (SCI) scores, is based on EPA Rapid Bioassessment Protocols for high-gradient streams (Plafkin et al. 1989, Barbour et al. 1999) and the Virginia Stream Condition Index report (Burton and Gerristen 2003). Pearson product-moment correlation analysis indicated a weak ($r^2 = 0.24$) but statistically significant ($p < 0.05$) correlation between SOS and SCI scores. The qualitative ratings derived from the two scoring systems were in agreement at 11 out of 16 (69 %) of the study sites. A chi-square goodness of fit test indicated that the proportion of sites receiving acceptable ratings was significantly different ($p < 0.001$) between SOS and SCI scores. The SOS system employs a zone of uncertainty, or "grey zone," where no final judgment of ecological condition is made. Additional correlation models were constructed to determine the effect of excluding grey zone sites on the strength of the correlation between SOS and SCI scores. In these additional analyses, the range of values considered to be grey zone SOS scores was varied in an attempt to reduce variability in the data set and thus to strengthen the correlation. The correlation between SOS and SCI scores was maximized ($r^2 = 0.75$, $p < 0.05$) when a grey zone of 6-8 was employed, where all sites receiving SOS scores of 6, 7 or 8 were excluded from the correlation analysis. This increased grey zone, however caused an increase in the proportion of sites where SOS and SCI ratings were in disagreement. Identifications of macroinvertebrates in the field by SOS personnel were determined to be generally accurate based on a re-analysis of the samples by VCU personnel. The effect of the few incorrect identifications on the results of the SOS scoring was minimal. The results and conclusions of this study were limited by the low number of sites sampled that were categorized as being of good to excellent

quality according to the SCI. In addition, the total number of sites sampled (20) was relatively low for investigations of this type. A larger sample set of eastern Piedmont streams that reflect a wider range of ecological conditions would be helpful in making a more complete evaluation of the usefulness of SOS volunteer monitoring data in DEQ water quality monitoring projects.

Validation of the Modified Virginia Save-Our-Streams Protocol

J. Reese Voshell, Jr.
Stephen W. Hiner
Department of Entomology
Virginia Tech
Blacksburg, VA 24061
August 1, 2006

Summary and Recommendations

The modified SOS protocol that was developed by Engel and Voshell (2002) does not need to be changed in regard to sampling, identification, enumeration, and calculation of the multimetric index called the Virginia Save-Our-Streams Index (VSOSI). The volunteers made very few mistakes in the identification of macroinvertebrates. These mistakes were considered minor and would not produce any substantive difference in the VSOSI calculation, certainly not a difference in the ecological condition classification. The VSOSI correlates very strongly with the Virginia Stream Condition Index (VSCI) used by professional biologists at the Virginia Department of Environmental Quality. However, in this validation study the VSOSI did not agree satisfactorily with the classification of stream ecological condition done by professional biologists using the VSCI. The VSOSI overrated too many streams (*i.e.*, classified them as acceptable, when the VSCI classified them as impaired). A simple solution to this situation was found: raise the numerical value required for the VSOSI to classify a stream as acceptable. Using a cutoff of 9 for a stream to be classified as acceptable by the VSOSI agreed very closely (81%) with the VSCI classification of the same streams. In addition, the disagreement of site classification was equally split between classifying reference as unacceptable and classifying impaired as acceptable. We recommend that Virginia Save-Our-Streams continue to use the existing protocol as modified by Engel and Voshell (2002) and to calculate the same VSOSI, but to shift the criterion for acceptable ecological condition to 9. If an uncertain ("gray zone") is desired for the VSOSI to be comparable to recently suggested modifications of the VSCI, then we recommend that the gray zone be the VSOSI unit score of 8. Classification of the ecological condition of streams by the VSOSI with a gray zone of 8 agreed very well with the VSCI with a gray zone of 55-63. With or without the gray zone, all data collected since the modification by Engel and Voshell (2002) are still valid. The ecological condition classifications merely need to be reassigned based on an acceptable cutoff of 9 and possibly a gray zone of 8 in order to be in agreement with the VSCI classification of reference conditions. The results of the current validation study are not unexpected because the VSCI was not available at the time of the previous study. Lastly, we recommend that Virginia Save-Our-Streams periodically revalidate the performance of the VSOSI against the VSCI because VDEQ is still analyzing and validating the VSCI.

Appendix O

VA SOS Annual Habitat Assessment

Virginia Save Our Streams Habitat Assessment

Acknowledgments

This presentation is based upon the publication of the U.S. Environmental Protection Agency: Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers (Second Edition, July 1999).

Document #: EPA 841-B-99-002

Habitat Concepts

- In the truest sense, "habitat" incorporates all aspects of physical and chemical constituents along with the biotic interactions of the subwatershed.

- In these protocols, the definition of "habitat" is narrowed to the quality of the instream conditions and riparian habitat at the monitoring site.

Implementation Guidelines

- Walk the entire site before beginning the assessment program.
- The assessment reach is 100 meters (m), starting at your sampling riffle and working upstream.
- Channel width is the space available to hold water and indicating frequent water movement (look for indicators). It is *not* wetted area nor bankfull (Rosgen).
- Consider the stream bank to be the relatively steep surface that connects the available stream channel to the floodplain.
- Habitat assessment is to be performed once each year at your regular monitoring site.
- When in doubt – ask if stream conditions are truly available and suitable for habitat.

Remember – it may be easier to eliminate category choices (for example if the stream definitely isn't poor or optimal, concentrate on determining whether it fits into the suboptimal category or the marginal category.)

Equipment Checklist

- Data sheets, clipboard, pencil
- Metric measuring tape (100 meters)
- Metric (metal) measuring tape (5 meters)
- Volumetric measuring device or system
- Topographic map
- Engineering scale or ruler

Site or Reach ID:		Stream Name:
Latitude:		Longitude:
Watershed:		
Date:	Time:	Investigators:
Weather last 72 hours		
Description of Site Location		
Description of 100 meter assessed		
Predominant Surrounding Land Use		
Average Stream Width:		Average Stream Depth:
Stream Velocity (measured or defined as slow, moderate, or fast):		
Other Notes:		

Site or Reach ID used to identify the site you are scoring. If this habitat assessment is completed at a regularly monitored site, please use that site identification.

Description of site location – please provide directions to the site so that someone else might be able to find it!

Description of 100 meter assessed – note the downstream point of the assessed section (should be the riffle that is biomonitored) and any changes to the length of the assessed section of stream.

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover (attachment sites for macro-invertebrates and overhead cover for fishes)	Greater than 70% stable habitat; mix of snags, submerged logs, undercut banks, cobble or other stable habitat (logs and snags are not new fall).	40-70% mix of stable habitat; presence of additional substrate that may not yet be prepared for colonization.	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	18	13	8	3

#1 – Epifaunal Substrate & Available Cover

- Why is this important?
  - As variety and abundance of cover decreases:
    - Habitat structure becomes monotonous
    - Diversity decreases
    - Potential for recovery following disturbances decreases

- Definition of terms
  - Epifaunal – organisms that live on aquatic substrate
  - Substrate – organic & inorganic material in streambed

- Extent
  - 100 meters upstream from top of riffle
  - Width of riparian zone based on vegetation

- Includes the relative quantity and variety of natural structures in the stream:
  - Cobbles – Do not count cobbles that are embedded
  - Large rocks
  - Fallen trees - Do not count logs/snags that are new fall or transient
  - Logs and branches - Do not count logs/snags that are new fall or transient
  - Undercut banks

- Provides for aquatic macrofauna:
  - Refugia (hiding places)
  - Feeding sites
  - Sites for spawning or nursery functions

- Variety or abundance of submerged structures in the stream serves to:
  - Provide a large number of niches
  - Increase habitat diversity

- Riffles and runs
  - Offer a diversity of habitat through a variety of particle size
  - Help keep water oxygenated
  - Provide most stable habitat in many small, high gradient streams
  - Are critical for maintaining a variety and abundance of insects in high gradient streams

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
2. Embeddedness	Gravel, cobble, and boulder particles in riffles and runs are 0-25% surrounded by fine sediment (e.g. – sand or silt).	Gravel, cobble, and boulder particles in riffles and runs are 25-50% surrounded by fine sediment (e.g. – sand or silt).	Gravel, cobble, and boulder particles in riffles and runs are 50-75% surrounded by fine sediment (e.g. – sand or silt).	Gravel, cobble, and boulder particles in riffles and runs are >75% surrounded by fine sediment (e.g. – sand or silt).
SCORE	18	13	8	3

#2 – Embeddedness

- Refers to the extent to which rocks – gravel, cobbles, and boulders – and snags within riffles and runs are covered by or sunken into the silt, sand, or mud of the stream bottom.

- Why is this important? Generally, as rocks become embedded, the surface area available to macroinvertebrates and fish – shelter, spawning, and egg incubation – is decreased.

- Embeddedness is a result of large-scale sediment movement and deposition.

- To avoid confusion with sediment deposition – habitat parameter #4 – observations of embeddedness should be taken in the upstream and central portions of riffles and cobble substrate areas.

- The rating of this parameter may be variable depending on where the observations are taken.

Challenges

- Distinguishing from Parameter #4: Sediment Deposition

- Developing a sense of the term – visual and other clues

- Being consistent in making observations

- Extent – 100 meters upstream from top of riffle

- Estimating percentages – avoid visual bias

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
3. Velocity/Depth Regime	All four velocity/depth combinations present (slow-deep, slow-shallow, fast-deep, fast-shallow).	Only 3 of the 4 combinations are present.	Only 2 of the 4 combinations are present.	Dominated by 1 velocity/depth regime.
SCORE	18	13	8	3

#3 – Velocity/Depth Regime

- Patterns of velocity & depth relationships are important to habitat diversity. The best streams in most high gradient regions will have all 4 patterns present:
  - Slow & deep
  - Slow & shallow
  - Fast & deep
  - Fast & shallow

- Why is this important?
  - The occurrence of these 4 patterns relates to the stream's ability to provide and maintain a stable aquatic environment.
    - Dispersion of energy
    - Movement of materials
    - Distribution of nutrients, oxygen

- How deep is deep water?
  - The general guideline is 0.5 meter depth to separate shallow from deep. In smaller streams – this guideline may not be applicable and you should look for areas that are deeper than the average stream depth.

- How fast is fast water?
  - The general guideline is 0.3 meters per second to separate fast from slow.

- Extent upstream
  - How far do you have to go to find riffles and runs, pools and glides?

- Identifying features – where does a riffle turn into a run, and a pool transition to a glide?

- Measuring depth and velocity
  - Equipment needed
  - Units – use metric or convert metric to standard

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increases in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	18	13	8	3

#4 – Sediment Deposition

- Measures the amount of sediment that has accumulated in channel.

- Why is this important? High levels of sediment deposition are symptoms of an unstable and continually changing environment that becomes unsuitable for many organisms.

- Examines the changes that have occurred to the stream bottom as a result of deposition.
  - Deposition (accumulation) occurs from large-scale movement of sediment.
  - Sediment deposition may cause the formation of islands, point bars (deposits on the inside of a meander), or shoals.
  - Deposition may fill in runs and pools.
  - Deposition occurs when the energy of the flow decreases.
  - Usually deposition is evident in areas that are obstructed by natural features (such as bends) or manmade structures (such as bridges) or debris.

Challenges

- Distinguishing between a stream's natural, balanced deposition pattern and a pattern that is out of balance
- Measuring the deposits
  - Areal extent
  - Location
  - Size and percentages of particles
- Evidence of new deposition compared to what and when?
  - Effect of water level on perceived size of deposits

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
5. Channel Flow Status	Water reaches base of both banks, and minimal amount of channel substrate is exposed.	Water fills over 75% of the available channel; or less than 25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	18	13	8	3

#5 – Channel Flow Status

- Refers to the degree to which the channel is filled with water.

- Why is this important?
  - Cobble substrates can become exposed, reducing the areas of good habitat.
  - Channel flow is especially useful for interpreting biological conditions under abnormal or low flow conditions.
- The flow status will change as the channel enlarges (e.g. aggrading stream beds with actively widening channels).

- The flow status will change as flow decreases (e.g. as a result of dams, diversions, or drought).

Challenges

- Traversing 100 meters upstream

- Delineating the stream channel – think of available channel width below floodplain

- Estimating percentage of channel filled with water and over what area?

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channel straightening or dredging absent or minimal; stream with normal pattern	Some channel straightening present, usually in areas of bridges; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channel straightening may be extensive. Man-made materials – hard engineering, large rocks, cement channels, pipes, riprap, etc. present on both banks; and 40-80% of stream reach channelized and disrupted.	Banks covered with man-made materials including hard engineering, large rocks, cement channels, pipes, riprap, etc.; over 80% of reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	18	13	8	3

#6 – Channel Alteration

- A measure of large-scale changes in the shape of the stream channel.

- Why is this important?
  - "Engineered" streams have far fewer natural habitats for fish, plants, and macroinvertebrates than do naturally meandering streams.
  - "Engineered" streams have unnatural shape, energy distribution, structures, flow regimes, and "behavior" – they solve and create problems.

- Human impacts include:
  - Stream straightening
  - Stream deepening
  - Stream diversion
  - Stream channelization

- Signs of "engineered" streams:
  - Artificial embankments
    - Riprap
    - Gabions
  - Presence of dams, bridges, or other large structures
  - Very straight channel over significant distance
  - Evidence of channel scouring
  - Other changes that do not appear "natural"

Challenges

- Traversing 100 meters upstream

- Identifying mitigating effects over time – has Nature reasserted itself to some degree?

- Restrictions to access to examine the stream bottom or to observe biota

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
7. Frequency of Riffles (or bends) Measure distance between riffles – top of downstream riffle to the bottom of upstream riffle. If there are more than two riffles, take the average distance.	Occurrence of riffles relatively frequent. The distance between the riffles divided by the width of the stream is less than 7.	Occurrence of riffles infrequent. The distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat The distance between riffles divided by the width of the stream is between 15-25.	Generally all flat water or shallow riffles - poor habitat. The distance between riffles divided by the width of the stream is greater than 25.
SCORE	18	13	8	3

#7 – Frequency of Riffles

- A way to measure the sequence of riffles and thus the heterogeneity present in a stream.

- For high gradient streams where distinct riffles are uncommon, a run/bend ratio can be used as a measure of meandering or *sinuosity*.

- Why are riffles important? Riffles are a source of high quality habitat and diverse fauna, so the greater the frequency of riffles, the better the diversity of the stream community.

- Why is sinuosity important? A high degree of sinuosity provides for:
  - Diverse habitat and fauna
  - The stream to be better able to handle surges in water volume as a result of storms
  - The absorption of storm energy by the bends protects channel from excessive erosion
  - Refugia for fauna during storm events

Challenges

- Traversing 100 meters upstream

- Need ability to sketch the stream OR ability to read a topographic map (sinuosity)

- Measuring distances between riffles – top of riffle to top of riffle and varying stream widths

- Determining the ratios: distance between riffles divided by width of the stream

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream	Banks stable; evidence of erosion or bank failure absent or minimal. Less than 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious wearing away of bank; 60-100% of bank has erosional scars.
SCORE ____Left	9	6.5	4	1.5
SCORE ____Right	9	6.5	4	1.5

#8 – Bank Stability

- Measures whether the stream banks are eroded, or have the potential to erode.

- Why is this important?
  - Steep banks are more likely to:
    - Erode and collapse than gently sloping banks
    - Promote channel widening (changing flow regime)

  - Eroded banks indicate problems of:
    - Sediment movement and deposition
    - Scarcity of cover and organic input to stream

- Each bank is evaluated separately.
  - Left bank is on your left facing downstream
  - Right bank is on your right facing downstream
  - Use cumulative score (right + left)

- Signs of erosion:
  - Crumbling of stream bank
  - Undercutting of stream bank
  - Scarcity of or lack of vegetation
  - Exposed tree roots
  - Exposed soil (raw look)

Challenges

- Examining both banks over 100 meters

- Estimating percentages of erosion:
  - Severe
  - Healed

- Estimating degree of stability:
  - Unstable – moderately stable – mostly stable

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
9. Bank Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by vegetation, including trees, understory shrubs, wetland plants; vegetative disruption through grazing or mowing minimal or not evident.	70-90% of the streambank surfaces covered by vegetation but one class (trees, shrubs, grasses) of plants is not well represented.	50-70% of the streambank surfaces covered by vegetation; patches of bare soil or closely cropped vegetation common.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters (or less) in height – ex. Mowed or grazed.
SCORE ____Left	9	6.5	4	1.5
SCORE ____Right	9	6.5	4	1.5

#9 – Bank Vegetative Cover

- Measures the amount of vegetative protection afforded to the streambank and the near-stream portion of the riparian zone.
- Supplies information on the capability of the bank to resist erosion.
- Some stream banks may be covered by riprap or concrete – stabilized but offer nothing to fauna
- Why is this important? Root systems of plants growing on stream banks help to:
  - Hold soil in place, reducing erosion
  - Control instream scouring
  - Slow runoff from land into the stream
  - Provide habitat
  - Provide shade; moderate water temperatures
- What about native versus exotic species?
  - Exotic vegetation provides some protection and is better than no vegetative cover
  - Native vegetation – especially of diverse kinds – is superior to exotic
    - Woody vegetation – trees & shrubs
    - Herbaceous vegetation
- Evaluate each bank separately and record cumulative score (right bank + left bank).

Challenges

- Examining both banks over 100 meters
- Estimating percentages of cover and Identifying disruptions to vegetation
- Identifying native versus exotic species
- Determining degree of diversity of species

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roads, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ____Left	9	6.5	4	1.5
SCORE ____Right	9	6.5	4	1.5

#10 – Riparian Vegetative Zone Width

- Measures the width of *natural* vegetation from the edge of the stream bank out through the riparian zone.

- Why is this important? The vegetative zone:
  - Removes pollutants from runoff
  - Helps control erosion by reducing volume and velocity of runoff
  - Provides habitat for many kinds of organisms
  - Promotes biological diversity
  - Provides nutrient input to the stream
  - Provides shade – cools water

- For variable size streams, the specified width of a desirable riparian zone may also be variable; may best be determined by some multiple of stream width (e.g. 4x stream channel width).

- Evaluate each bank separately and add the scores (right bank + left bank).

- Threats to the vegetated riparian buffer:
  - Hardscaping – roadways, parking lots, hard-packed ground surfaces, riprap or concrete embankments
  - Buildings, levees, other structures
  - Golf courses, lawns, athletic fields, pasture or rangeland
  - Denuded areas – construction sites, timbered lands, agricultural lands

Challenges

- Evaluating both banks over 100 meters

- Ability to access, view, or examine one or both banks (e.g. private property, too much vegetation, safety issues)

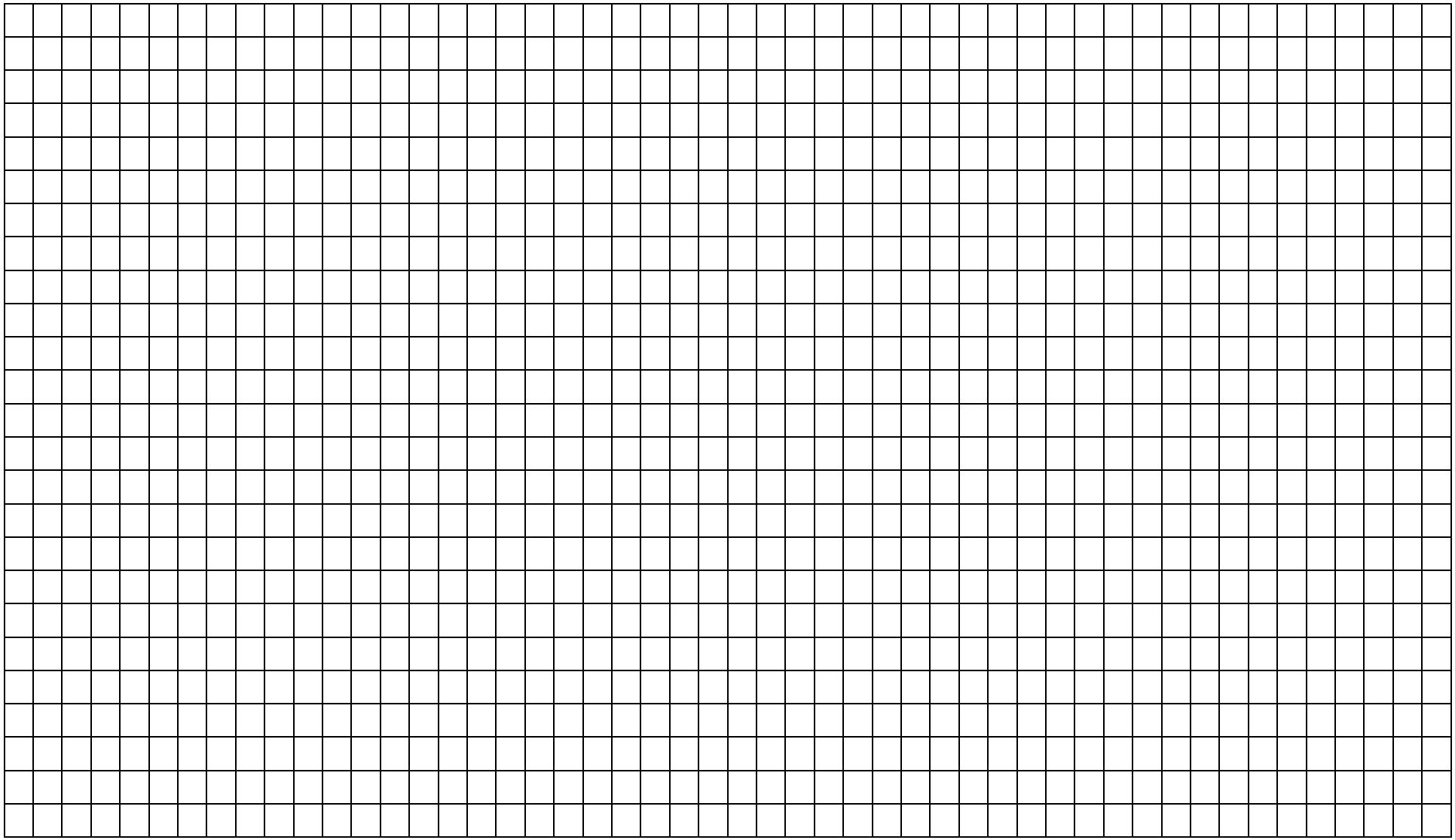
- Measuring the zone – thick underbrush

Summary of Challenges to Habitat Assessment

- Subjectivity – in spite of the "matrix"
- Accessing the full reach of stream
  - Deep or swift water; barriers
- Estimating percentages – visual bias
- Developing a "sense" of the parameters
- Measuring and calculating parameters
- Need for equipment, assistance

Stream Name: _____ Reach ID _____ Date: _____

Monitor Name: _____



HIGH GRADIENT STREAM HABITAT ASSESSMENT FORM
VIRGINIA SAVE OUR STREAMS
(Modified wording and metric scores from Plafkin et al. 1989)

Site or Reach ID:		**Stream Name:**
Latitude:		**Longitude:**
Watershed:		
Date:	**Time:**	**Investigators:**
Weather last 72 hours		
Description of Site Location		
Description of 100 meter assessed		
Predominant Surrounding Land Use		
Average Stream Width:		**Average Stream Depth:**
Stream Velocity (measured or defined as slow, moderate, or fast):		
Other Notes:		

Instructions:

1. Select 100-meter stretch to be evaluated. You may find it helpful to split the 100 meters up into easily definable sections for evaluation. Note the top and bottom of your stretch to be evaluated.
2. Review the 10 habitat parameters that you will be evaluating in this assessment.
3. Walk or otherwise visually inspect the entire 100-meter stretch to be evaluated. You may find it helpful to sketch your site on the graph paper provided, making note of the riffle areas, pools, runs, glides, and other features (log jams/debris, etc)
4. Begin the habitat assessment. You may want to use the graph paper to help estimate percentages needed to make the assessment. You may also want to use a process of elimination – eliminating the condition categories that do not describe your site.
5. Add all of the sub scores together to get a final score at the bottom of page 4.

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Site or Reach ID:		**Stream Name:**		
Latitude:		**Longitude:**		
Date:	**Time:**	**Investigators:**		
Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover (attachment sites for macro-invertebrates and overhead cover for fishes)	Greater than 70% stable habitat; mix of snags, submerged logs, undercut banks, cobble or other stable habitat (logs and snags are not new fall).	40-70% mix of stable habitat; presence of additional substrate that may not yet be prepared for colonization.	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	18	13	8	3
Comments:				
2. Embeddedness	Gravel, cobble, and boulder particles in riffles and runs are 0-25% surrounded by fine sediment (e.g. – sand or silt).	Gravel, cobble, and boulder particles in riffles and runs are 25-50% surrounded by fine sediment (e.g. – sand or silt).	Gravel, cobble, and boulder particles in riffles and runs are 50-75% surrounded by fine sediment (e.g. – sand or silt).	Gravel, cobble, and boulder particles in riffles and runs are >75% surrounded by fine sediment (e.g. – sand or silt).
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Comments:				
3. Velocity/Depth Regime	All four velocity/depth combinations present (slow-deep, slow-shallow, fast-deep, fast-shallow).	Only 3 of the 4 combinations are present.	Only 2 of the 4 combinations are present.	Dominated by 1 velocity/depth regime.
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Comments:				
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increases in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
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Comments:				

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Habitat Parameter	Condition Category			
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SCORE	18	13	8	3
Comments:				
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream	Banks stable; evidence of erosion or bank failure absent or minimal. Less than 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious wearing away of bank; 60-100% of bank has erosional scars.
SCORE ____Left	9	6.5	4	1.5
SCORE ____Right	9	6.5	4	1.5
Comments:				

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SCORE ____Right	9	6.5	4	1.5
Comments:				
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roads, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ____Left	9	6.5	4	1.5
SCORE ____Right	9	6.5	4	1.5
Comments:				

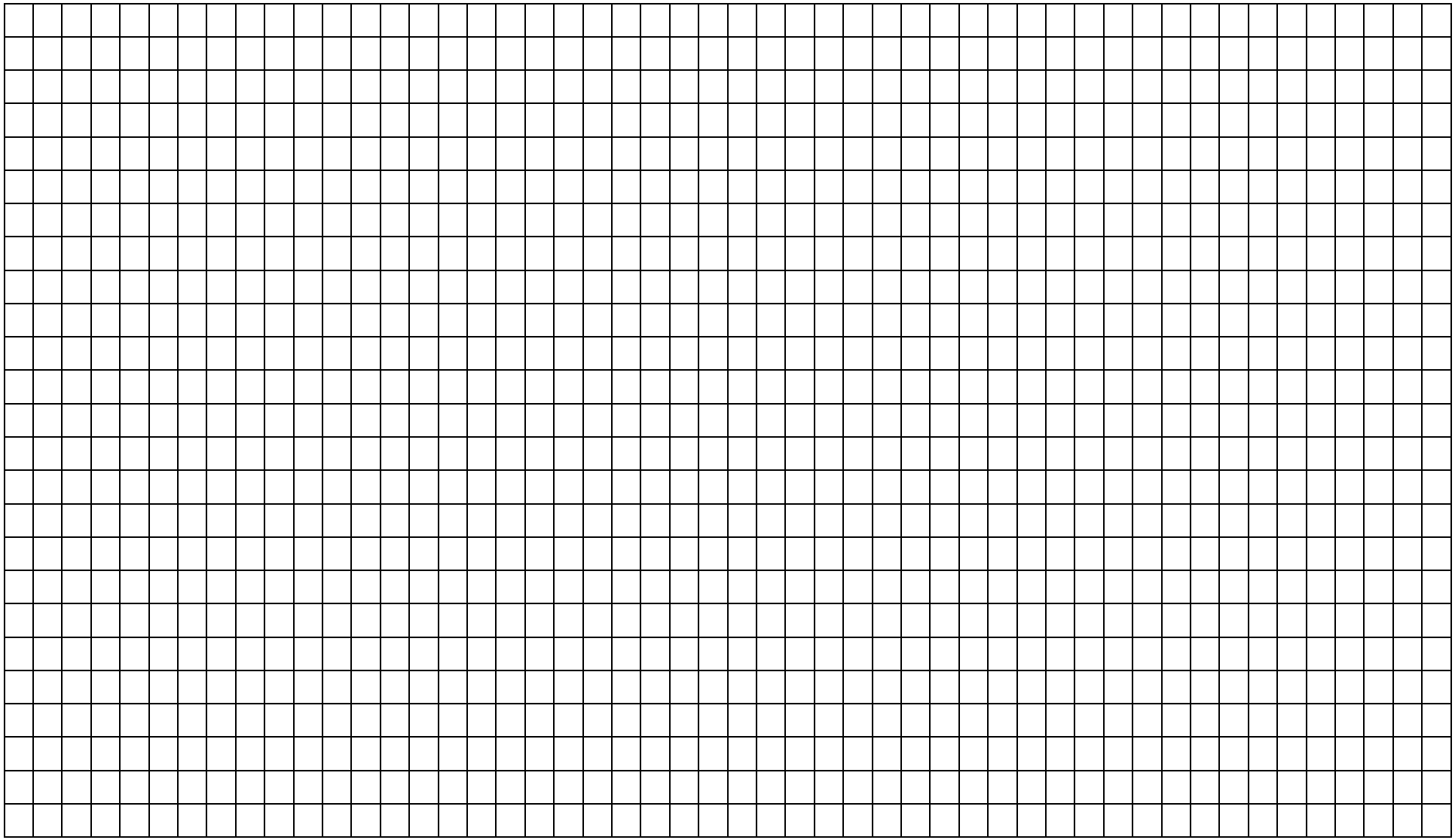
TOTAL SCORE: _____

What does this mean?

- You can compare the total score to itself each year.
- You may also want to compare the habitat score of your site to the habitat score at a "pristine" stream within your watershed.
- General habitat conditions:
    - Total Score greater than 153 = Optimal Habitat Conditions
    - Total Score between 130 and 152 = Suboptimal Habitat Conditions
    - Total Score between 80 and 129 = Marginal Habitat Conditions
    - Total Score less than 80 = Poor Habitat Conditions

Stream Name: _____ Reach ID _____ Date: _____

Monitor Name: _____



Stream Name: _____ Reach ID _____ Date: _____

Monitor Name: _____