CHAPTER 2. INSTRUCTIONS FOR ASSESSING THE STREAM SITE (INCLUDING SETTING UP THE SITE, SITE DOCUMENTATION, AND GUIDELINES FOR COMPLETING THE STREAM ASSESSMENT FORMS)

Overview

The most important aspect of sampling that the Watershed Assessment Branch (WAB) does is the careful documentation of the location and conditions during a sampling event. This may be as simple as documenting the general conditions of the water (*e.g.,* was it turbid, did it smell, did it rain recently). Or it may be as complex as physically measuring various aspects of the stream habitat.

The following is an instruction of how use the Wadeable Benthic Stream Assessment Form to evaluate various stream assessment parameters. This chapter is intended to provide information on interpreting each parameter as well as identifying the value(s) of resultant data. Some of the parameters from other assessment procedures (*e.g.,* Benthic Sampling, Sonde Readings, GPS, *etc*.) are recorded on the form as well. You should consult the appropriate chapters and sections of this SOP to gain further knowledge about those parameters.

Also, since the Wadeable Benthic Stream Assessment Form is the most complex and complete that WAB uses (others like the TMDL forms are more limited in that they may only contain certain elements of what is seen on the Wadeable Benthic form), this chapter should adequately cover how to fill out the other forms as well.

Section A. Setting up the Site

Part 1. Initial Site Survey

A field crew typically consists of two individuals charged with collecting habitat and biological/physicochemical data (*i.e.*, water quality). In the case of some sampling that involves only physiochemical and some limited habitat data (*e.g.,* TMDL sampling) the field crew may consist of just one individual operating on a solo basis. This usually only occurs after the sampling station has been thoroughly established after some sort of initial visit.

Throughout the following discussions, the term "Geomorph" will be used to describe the crewmember in charge of collecting habitat information. "Biomorph" is the term used to describe the crewmember in charge of collecting biological and physicochemical data. In the case of a solo sampler, these roles are both played out by the same individual.

USGS topographic maps with a 1:24,000 scale will be used to navigate to sampling sites (GIS or Geographic Information System maps on Laptop, County Maps, or Gazetteer Maps are supplemental). The map coordinator should have marked all

sites or stations (pink for random sites, yellow for targeted sites) before sampling begins. After the location of the stream site has been confirmed, the Geomorph is responsible for establishing a 100-meter assessment area and will actively traverse the stream from one end to the other taking note of pertinent habitat information and measuring the 100-m reach.

NOTE: The Geomorph will avoid walking in the stream until physicochemical samples have been collected and avoid stepping in riffles that may be used in macroinvertebrate and periphyton sampling.

IMPORTANT: There should be no deviation from the above protocol. The Geomorph must cover the entire 100-m stream reach to accurately complete the habitat form. **This cannot be done standing at one end of the reach or from the vehicle!**

The Geomorph will perform other duties concurrent with the establishment of the 100-m assessment reach (***outlined in CHAPTER 2. Section C. Part 1. Wadeable Benthic Stream Assessment Form starting on page 2-30***. Procedures specific to each sample type are discussed below.

Part 2. Accessing the Site

Due to the remoteness of some sites (usually reference and random), traversing to the sample site may require long strenuous hikes over difficult terrain; NOT DANGEROUS TERRAIN! If a long hike is necessary to get to a site, carefully consider the terrain and your personal ability and health to access the site. If you feel it is too difficult (*e.g.,* too far to hike or too deep to wade) or dangerous (*e.g.,* steep banks) to get to the site or assess it, do not attempt it. Discuss it with other sampling teams who may be willing to try to get the site later**.**

WARNING: DO NOT NAVIGATE TO ANY ASSESSMENT SITE THAT PRESENTS A DANGEROUS SITUATION TO YOU OR ANOTHER TEAM MEMBER!

Random Sites (Probabilistic Sites)

Beginning in 2007 the Random Sampling Program switched from a statewide watershed-based sampling effort to a statewide ecoregional effort based on Omernik's ecoregions. The state has been divided into 3 major ecoregions going west to east:

70-Western Allegheny Plateau
69-Central Appalachians
67-Ridge and Valley

Note: Due to the limited size of 66-Blue Ridge Mountains in WV, it has been combined with Ecoregion 67.

The **Target Population** is all flowing wadeable streams and rivers (1st-4th Strahler orders at 100k scale) within West Virginia. Samples are selected by computer using USGS's NHD Plus (a stream network coverage at the 100k scale) as a **Sample Frame**. A Generalized Random Tessellation Stratified (GRTS) **Survey Design** for a linear resource was used. **Multi-Density Categories** were set up by Ecoregion and Strahler orders 1-4. **Unequal weighting** was used on Strahler order. Specifically, Strahler order 1 was weighted by 1.3 to make approximate sample proportions (by order) of 71%, 15%, 9%, and 5%, which approximates the true abundance by stream order found in WV and yet compensates for the estimated 30% of 1st order sites that are too small to be sampled using WAB methodology (*e.g.*, Non-Target ephemeral and non-flowing intermittent stream reaches). Sites were deselected automatically as Non-Target if the watershed area above the sites was less than 100 acres (based on best professional judgment and past probabilistic sampling efforts). Sites were sampled in order so that there was equal sampling effort amongst the three ecoregions. Five **Panels** were setup; one for each year of sampling round. The **Expected Sample Size** for the 2013-2018 5-year cycle is 195. Since not all sites that are selected turn out to be target, an **Oversample** of 195 sites are selected to serve as alternate sites to replace those on the main list found to be non-target.

Before the field season begins each year, the map coordinator will review the proposed sampling sites for the year and attempt to eliminate any that do not match the target population.

> ***IMPORTANT: For random (probabilistic) sites, our target stream sites must have riffle/run habitat, be wadeable, and can be sampled using kick protocols that result in comparable data.***

Twenty-six (Thirteen new sites and Thirteen revisits from 5 years prior) in each of the 3 ecoregions must be fully sampled for water quality, benthos, periphyton, and habitat each year. Additionally, we will be conducting fish surveys at sites that have drainage areas of 2000 acres (+/- 10%) or greater. Target sites are defined as riffle/run habitat, wadeable, and can be sampled using kick protocols that result in comparable data.

The site lists will consist of about 5 to 8 samples. ***See Table 2-1 on page 2-5 for an example of a site list***. Since you know you will be visiting all the sites on the list, they may be sampled in any order. This will allow you to work more efficiently, as some sites may not be adjacent on the list but not necessarily in numerical order. For example (***referring to Table 2-1 on page 2-5***): If you were working the stream list from the mouth up, you might sample Job Run and Badger Fork first, since they are close to each other, but not in random order.

Coordinates for the site are included in the stream list. In addition, GIS data of the sites will be available for use on the field laptops. These coordinates should approximately

match what is plotted out on topographical maps. Unfortunately, these coordinates are based on stream GIS data that is not updated as quickly as a stream can cut or move through the landscape (naturally or human assisted). So, you must do your best (*i.e.,* use best professional judgment) to translate the coordinates to a real stream site on the ground. ***See Locating the X-Site on page 2-6 for more information****.*

> ***IMPORTANT:*** ***Every attempt should be made to access random sites no matter how far the hike unless it appears dangerous or too difficult to do so. The map coordinator should be notified and consulted about all sites which were not accessed due to dangerous or difficult conditions so that a visit may be attempted by another sampling team that may be better physically able to reach the site.***

Alternate Sites

During the process of visiting the sites on the list, there will be a few that cannot be sampled for various reasons (*e.g.,* dry, too deep, landowner access denial or extreme physical barriers, *etc*.). To replace these sites, new alternate sites will be added to the work load. These sites are from the same randomly selected pool of sites as the primary sites and will be chosen to replace sites bumped off the primary list by ecoregion (*e.g.,* a site not done in ecoregion 70 will be replaced by a site in ecoregion 70). In addition, new sites will replace new sites and revisit sites will replace revisit sites. Some alternate sites may be handwritten on to site lists that have not yet been taken to the field. Others will be assembled into alternate site lists after the primary lists are completed (a deviation from prior random sampling efforts) to prevent inefficiencies that may arise from multiple teams working in one ecoregion and not being able to communicate what sites have been sampled.

> **NOTE: At some point, there will be a final alternate sampling list for each ecoregion that will be used to obtain the final sites needed to meet the per ecoregion goal of twenty-six sites. It is important to note that these lists will need to be completed in the order of the random numbers to maintain the unbiased probabilistic design.**

Table 2-1. An example of a typical Random Site List

Random List C

E-Reg	R#	ANCODE	STREAM NAME	Latitude			Longitude			TOPONAME	Date	Initials
R & V	**6003**	**PSB-16-B-2-{0.2}**	**UNT/Brushy Run RM 0.46**	**39**	**12**	**13.02**	**78**	**51**	**0.38**	**Sector**		
	Shows as an intermittent stream on topo, should be done early (Late April early May)											
R & V	**6019**	**PSB-21-0.21A-{0.7}**	**UNT/So Fork RM 3.39/South Br**	**39**	**1**	**23.51**	**78**	**57**	**41.74**	**Moorefield**		
	Shows as an intermittent stream on topo, should be done early (Late April early May)											
R & V	6015	PC-20-{4.4}	Moores Run	39	7	32.20	78	35	41.32	Yellow Spring		
	Wardensville topo also included to aid in navigation. May require a hike. Fish will be collected here later.											
R & V	6031	PC-16-A-{2.9}	Dry Run	39	8	57.91	78	28	33.78	Capon Springs		
R & V	2051-R2	P-19-D-{4.9}	Crooked Run	39	22	22.30	78	35	20.40	Hanging Rock		
R & V	2077-R2	P-19-E-2-{0.1}	UNT/Graybill Hollow RM 1.21	39	25	36.60	78	35	30.90	Levels		
Perform Duplicate Sampling Each Week! Duplicate Name: Elm Creek PC-76-X-{8.6}												
Perform Dfield Blanks Weekly! Field Blank Name: Buzzard Fork PC-76-Y-{4.6}												
Four Cubitainers and one Fecal bottle:												
Hot Acidity, Alkalinity, Sulfate, TDS, TSS, Chloride, Bromide, Total P, TKN, NO2-NO3-N, Fecal Coliform												
[Total Mg, K, Na, Al, Fe, Mn, Ca, Se Be] and [Diss. Al, Cu, Fe, Zn]												
Note: Two new parameters: Beryllium (Be) a metal, and Bromide (Unfixed) You'll have to write in Be on the COC												

Bold/Green text indicates potential fish sites.

Locating the X-Site

Random sampling stations are marked with an **X (highlighted in pink)** on USGS 1:24,000 scale topographic maps. This spot is referred to as the **X-site** and is the downstream end of a 100-m reach that is to be assessed.

> **NOTE: These maps are recycled and older sites (both targeted and random) may appear on the topographic maps. Therefore, you should take great care in matching up the stream name, AN-Code, and random number written next to the site with what is on the stream list.**

Site Verification

Sampling teams should use all available means to ensure that they are at the correct location; including Laptop GIS programs, topographic, county, and/or gazetteer maps, or (as in the case of revisit sites) previous visit photocopies which include directions to the site, hand-drawn maps, and photos. GPS units should also be used to confirm the X-site latitude and longitude that is provided on the list for each random station. Using your GPS, if you can get one half of the coordinates to match almost exactly and the other half within a reasonable distance (no more than a couple of seconds), and then you have adequately located the random site. If the GPS coordinates and the given X-site coordinates differ by more than a couple of seconds, re-check your position. **You should try to get an exact match if possible.**

> **NOTE: Always collect physicochemical samples and GPS coordinates at the X-site for random stations. If possible, get coordinates from the center of the stream channel and let the GPS run for several minutes (5-10) before recording the latitude and longitude.**

> ***IMPORTANT: For revisit sites, use the coordinates provided on the site list only. The coordinates on the previous visit photocopy may be in a different datum. Nevertheless, the hand-drawn map from the previous visit photocopy will be very useful to locating the exact same X-site that was established during the previous visit. You should try to get an exact match to the previous visit's X-site.***

There will be stations where the GPS unit will not track satellites and thus electronic confirmation of the X-site coordinates may be impossible. Team members should collaborate in these instances and utilize their best professional judgment (BPJ) to decide where the X-site is located. In such a case, finely tuned map reading skills are important.

Some situations require sliding the reach and thus the X is not at the downstream end (***see Sliding the Reach on next page for details***).

Sometimes it is possible a stream site will not be physically visited. If you are denied access to a site either by landowners (*i.e.,* direct verbal communication or by best professional judgment that you should not ignore posted signs or fences) or by physical barriers (not gates or fences, but natural obstacles that involve dangerous conditions like steep gorges, forest fires, or floods), classify the site as "target" or "not-target" based on best professional judgment and clues that may be gathered about the stream. A good example is an agriculture stream where you are denied permission to the site but can see it well enough to properly classify it. If you cannot see the site, use GIS coverage data, information from locals, what you know about other streams nearby, and what you can gather about the stream from other accessible points up or downstream. It is better that you make an educated guess in the field rather than someone making a wild guess in the office.

> ***IMPORTANT: If you get coordinates at your current location (e.g., a locked gate) and it is not at the X-site, put the coordinate information in the drawing and site verification notes. DO NOT PUT COORDINATES FROM A LOCKED GATE OR A LANDOWNERS HOUSE IN THE COORDINATES SECTION FOR THE X-SITE!***

Several questions must be answered for site verification of a probabilistic site:

X-site Field Verified?: Answer appropriately; **YES** or **NO**. **This must be answered at all sites.**

If no, why?: Sometimes it is possible a stream site will not be physically visited. This may be due to one of two things: Landowner access denial or a physical barrier. **Landowner denial** could come in the form of a ***verbal denial***, which is absolute, or in the form of ***implied denial***. Implied denial simply means that the crew has seen evidence that the property owner would not be agreeable to our presence in the stream and used best professional judgment to not trespass to sample the site. This evidence can come in the form of an abundance of **posted signs** (*e.g.,* at every fence post), by conversation context talking to a neighbor (*e.g.,* "He likes to shoot at trespassers."), **heavily fenced** and secured areas, or simply a **private property** (*e.g.,* the site is in the back yard of a house). **Physical Barriers** are those that may be **temporary** (*e.g.,* a water flooded road) or **permanent** (*e.g.,* high cliffs).

> **NOTE: There have only been one or two instances in 15 years of probabilistic sampling where a physical barrier prevented access to a site. Physical barriers are not gated roads or fences as these are better classified as types of landowner denial.**

Is site target and kick sampleable?: Answer appropriately; **YES** or **NO**.

> ***IMPORTANT: This field must be answered even if the site was not seen or physically visited by the field crew!!! An educated guess out in the field is far better than a wild one made in the office! Photos of non-target sites (or evidence of non-target status) must also be included!!***

If not, why?: Sometimes a stream site will not be sampled for one reason or another. The following are possible reasons:

- **Low Flow**
  - **Permanent** (*i.e.*, non-drought, *e.g.,* subsidence) or
  - **Low Flow-Temporary** (*i.e.,* drought)
- **Ephemeral**
- **Too Deep**
  - **Permanent** (*e.g.,* a larger stream or river that has a riffle/run habitat that is flowing but always will be over the net) or
  - **Temporary** (*e.g.,* a smaller stream that is over the net at that time possibly due to recent rainfall, but would potentially be at base flow at another time)
- **No Riffle/Run** habitat present (*i.e.,* MACS type habitat/low gradient)
- **Wetland** (*e.g.*, stream is dominated by cattails and has no real channel)
- **Filled** by one of the following:
  - **Mining** (valley fills, reclaimed concrete channels),
  - **Farm** (stream plowed under for farm land; this is more common in the Eastern Panhandle of WV),
  - **Urban/Residential** (stream is culverted to make room for houses/yards/residential roads/airports),
  - **Road** (stream is culverted or filled for a major road like and interstate or 4 lane expressway), or
  - **Industry** (*e.g.*, landfills, fly ash dumps, culverted or filled under an industrial facility)
- **Impounded** by one of the following:
  - **Lake** (recreational lakes or reservoirs),
  - **Mining** (sediment or treatment ponds),
  - **Farm** (farm ponds),
  - **Beavers** (stream is impounded by beaver dams and activities),
  - **Navigation** (stream is inundated by the backwaters of a river with locks and dams used for barge navigation; *applies to Ohio, Kanawha, and Monongahela River backwaters only*), or
  - **Industry** (landfill treatment ponds)
- **No Stream Present (Map Error)** (this is extremely rare and has only truly occurred one time)
- And **Other**. If other reasons arise, please comment in sk*etc*h area on PAGE 1 when appropriate.

Detailed notes on verification, access, and sampleability of site: Notes concerning the above four items and the process that led to the answers above.

Sampled?: Answer appropriately; **YES** or **NO. This must also be answered.** In some instances, you may be sampling some aspect (*e.g.,* WQ only) even if the site is declared to be non-target.

After the X-site has been confirmed (or located via best professional judgment), the Geomorph will establish a 100-meter assessment area based on the X-site. If there are no riffle/run habitats within 100-m reach, the site is considered non-target for random sites and should not be sampled.

> ***IMPORTANT: For random (probabilistic) sites, our target stream sites must have riffle/run habitat, be wadeable, and can be sampled using kick protocols that result in comparable data.***

Sliding the Reach

There are some conditions that may require "sliding" the 100-m stream reach around features we do not wish to sample across. Do not proceed upstream into a lower order stream or downstream into a larger order stream when laying out the stream reach. The map coordinator will note on the stream list any random 100-m reach that might require sliding due to the confluence of streams. If such confluence is encountered, note the distance and mark the confluence as the reach end. Make up for the loss of the reach length by sliding the other end of the reach an equivalent distance away from the X-site, ***as shown in Figure 2-1 on the next page.***

> **NOTE: The confluence must be within the proposed 100-m reach for this sliding to apply. Confluences above or below the proposed 100-m reach do not require sliding but may require some considerations when sampling within in the reach (*e.g.,* not sampling the benthos at the upstream end of the reach where the water has not yet adequately mixed).**

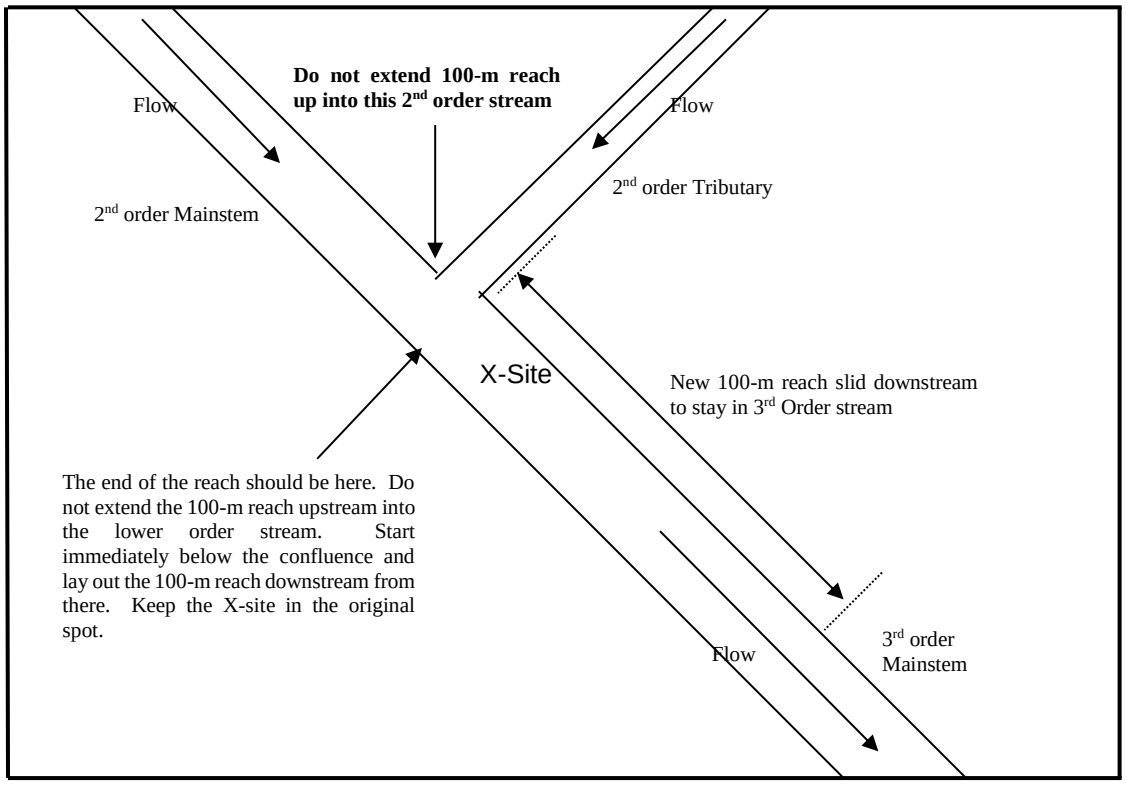


Figure 2-1. An example of sliding the reach to avoid larger/small confluences, lakes, ponds, *etc*. (used FOR RANDOM SITES ONLY).

Do not slide the reach to avoid human disturbances like bridges, culverts, rip/rap, or channelized areas. If you must slide the reach, make sure it is documented on the stream assessment form and include why it was moved and where. Include this information in the sk*etc*h of the assessment area.

Additionally, if the reach contains a lake, reservoir, or pond, mark the water body as the reach end and make up for the loss of the reach length by moving the other end of the reach an equivalent distance from the X-site (***See Figure 2-1 above***). However, if the X-site is completely within a lake, pond, or valley fill, no sampling can occur and only the front page of the habitat form needs to be filled out describing the situation thoroughly.

IMPORTANT: Take photographs of the situation necessitating the sliding of the reach and the areas above and below the new reach.

In some cases, a randomly site's X-site is located below a source or tributary with a significant water quality impact to the stream and there is inadequate room to collect benthos in the area below the sources. In such situations, it would be best to treat the source or tributary with significant water chemistry issues using the same rules as sliding the reach downstream around the X-site to avoid crossing stream orders **(*see Figure 2-1 on page 2-10*)** so that the X-site and benthic collection area are in similar water quality.

It is important to describe in detail on the assessment form any deviations from the standard layout.

To determine the stream reach, the Geomorph will need to actively traverse the stream from one end to the other taking note of pertinent habitat information and measuring the 100-m area.

> **NOTE: the Geomorph will avoid walking in the stream until physicochemical samples have been collected and avoid stepping in riffles that may be used in macroinvertebrate and periphyton sampling).**

The Geomorph will perform other duties concurrent with the establishment of the 100-m assessment area (***outlined in Section B. Site Documentation and Section C. Guidelines for Completing the Stream Assessment Forms***). Random sites have specific requirements for physicochemical sampling. ***The list of parameters that must be collected at all random sites can be found under CHAPTER 3. Section B. Part 3. Common Water Quality Parameter Suites starting on page 3-51 and on the QUICK REFERENCE GUIDE in CHAPTER 16 starting on page 16-1.***

Targeted Sites

Targeted sites are preselected in the office either from a pool of known sampleable locations or from staff knowledge of the stream. They are usually located at the mouth of tributaries, on the mainstem above the confluence of a tributary, or bracketing pollution sources or areas of interest. Targeted sites allow more latitude with relocating the site for better sampling conditions and stream access, if all directions provided on the stream list are observed. Targeted sites should be assessed if possible, even if they are more than one mile from the vehicle, unless it appears dangerous or too difficult to do so. Some sites that are suspected of this may have notes relating to the acceptable distance and conditions under which the site may be moved. The map coordinator should be notified and consulted about all sites which were not accessed due to dangerous or difficult conditions as an alternate site may be inserted to replace that site.

Targeted sampling stations are marked with an **X (highlighted in yellow)** and with the sample year on USGS 1:24,000 scale topographic maps.

> **NOTE: These maps are recycled and older sites (both targeted and random) may appear on the topographic maps. Therefore, you should take great care in matching up the stream name, AN-Code, and sample year written next to the site with what is on the stream list.**

If possible, the assessment reach for targeted sites should be established above bridges. Additionally, bridges should not be included in the assessment reach, if possible. Targeted sites include high quality, severely impaired, moderately impaired, non-

impaired, unassessed, and 303(d) listed streams. These sites differ from random sites as indicated by the following:

1) There are no predetermined coordinates for the X-site unless otherwise noted on the stream list. The latitude and longitude will be determined after the sample site has been chosen.
2) There is more latitude in making decisions on where to conduct the stream assessment (*i.e.,* you can more easily and readily make micro adjustments to the stream reach location).
3) Latitude and longitude (coordinates) and physicochemical samples are always collected at the downstream terminus of the 100-m assessment reach (sliding the reach is not applicable).
4) In general, streams are sampled at the first readily accessible riffle/run upstream from the mouth and/or above tributaries or potential sources of interest.
5) Assessments are conducted upstream of and should not include road bridges/culverts if possible.

It is important to keep in mind that riffle/run sites are preferable to MACS sites when it comes time to report data as they are more abundant and only riffle/run data can be used to calculate a comparable benthic MMI/IBI scores. For example, if a riffle/run site can be found a ¼ mile further upstream without going above a significant tributary or changing land use (agriculture, *etc*.), then go and sample the riffle/run site. In general, do not collect a MACS sample unless the stream list indicates that the site is of special concern and should be sample regardless of the habitat type present. Describe in detail the MACS habitat types present in case a future visit is scheduled.

IMPORTANT: If a site is moved from the location marked on the map then the form should be filled out appropriately noting why the original intended site was not suitable (see Section C. Part 1. PAGE 1-Site Verification starting on page 2-31 for more info). In addition, you should also indicate on the topographic maps provided in the stream list packet where the site was moved to with an arrow drawn from the original site to the new site.

Some conditions may require establishing the stream reach around features we do not wish to sample across. Do not establish a 100-m reach that includes a nasty discharge (*e.g.,* AMD tributary, point source outfall, *etc*.). If a water quality impaired tributary is encountered within the chosen stream reach, move above the confluence a short distance, establish a new 100-m reach, and perform all WAB protocols. Additionally, fill out a form and collect appropriate physicochemical samples downstream of the confluence and from the mouth of the polluted tributary or outfall/source. If the water quality impaired tributary is not on your stream list or the stream list for other sampling crews, conduct a full WAB assessment on the nasty tributary. **Provide detailed notes and document the specifics of the assessments and samples collected**.

There is no definitive list of physicochemical parameters for targeted sites other than field readings (water quality sonde parameters) and fecal coliform bacteria. Sampling for specific parameters either indicated on the stream list or is determined on-site and is based on the surrounding land usage (*e.g.,* total phosphorus in agricultural areas when a problem is suspected, or metals in areas of mining). GIS software and data on laptops detailing the land use of each stream will be provided to the team with the topographic maps and stream list. These maps should be consulted to provide insight as to what parameters should be measured at the site. Another important way to get information about the land use is to ask and start a dialogue with local landowners and listen carefully to what they say about the stream and its upstream uses. These talks will often provide vital clues as to what may be occurring in the stream. You may also observe what is in the upstream watershed if you pass through it on the way to the site or the next site.

In some instances, a stream may appear to have an excellent water quality and habitat upstream of the targeted site. If this is the case, make all attempts to sample the segment as a potential reference site or make notes about the stream segment and report it to other sampling teams and personnel to determine if it is a possible reference site candidate later **(*see Reference Sites and Potential Reference Sites on next page*)**.

Duplicate Sites

To fulfill quality assurance and quality control or QA/QC requirements (***see CHAPTER 14. Section A. Blanks and Duplicates starting on page 14-1***), a select number of sites will be assessed in each watershed in duplicate. The stream list will indicate where to conduct a duplicate sample. However, it should be noted that the stream listed is only a randomly picked site at which to complete a duplicate and serves as a reminder to conduct a duplicate sample. In fact, a duplicate can be performed at any site that meets certain needs. The assessment area should contain a large enough riffle/run area to obtain two complete benthic macroinvertebrate samples without any overlap (4 kicks versus 4 kicks). Make sure the instream substrate & velocity of the duplicate benthic sampling sites match as closely as possible (*e.g.,* do not have one person kick all gravel/sand riffles, and the other kick all boulder/cobble riffles). If the stream does not have an adequate amount of riffle/run habitat to collect two full samples, it will be necessary to substitute a replacement at the next stream that does have adequate habitat. If the first site you visit on a list provides enough good habitat to do a duplicate, then sample it as a duplicate. Do not wait until the end of a week or list to sample for a duplicate stream.

During a duplicate, both team members will complete the habitat forms, collect benthic macroinvertebrates, collect water samples, and obtain appropriate physicochemical samples as if they are the only person there.

IMPORTANT: Do not put your benthic sampling data on the other person's form when conducting duplicate sampling!

Water quality sonde and flow readings should be recorded on the DUP 1 assessment form only. GPS coordinates can be shared between the two duplicates. **All Water**

samples and COCs are marked as blind duplicates (with a false stream name and AN-Code and no indication that it is a duplicate sampling event occurring). The field habitat forms and sampling list will contain the true identities of the Blind Duplicates based on the WQ ID, Date/Time of the sample, and name of the sampler. If for some reason the designated duplicate is not sampleable, the team should replace the duplicate site with another stream in the same week.

Reference Sites and Potential Reference Sites

WARNING: POTENTIAL REFERENCE SITES AND ESTABLISHED REFERENCE SITES SHOULD BE ASSESSED NO MATTER HOW FAR THE HIKE UNLESS IT APPEARS DANGEROUS OR TOO DIFFICULT TO DO SO.

Reference conditions are thought to represent the characteristics of stream reaches that are least disturbed by human activities and are used to define attainable chemical, biological and habitat conditions for a region. The development of reference conditions is a key component of environmental impact evaluations. In most West Virginia streams, historic data were not collected prior to human disturbances and activities. A logical method of determining the health of streams is to compare them to established reference conditions. **Therefore, it is extremely important for sampling teams to conduct assessments on several (as many as possible) undisturbed streams that meet reference conditions**.

The map coordinator will provide each team with a list of potential reference sites and already established reference sites. A considerable amount of time is invested each year in the process of selecting candidate reference sites, conducting field assessments on them, analyzing resultant data, and elevating them to full reference site status. This includes time spent to maintain the reference site database and improve methodologies used to identify them. Candidate reference sites were established by examining GIS land use data and marking the stream segments that appear to have the least amount of disturbance. Preference is often given to sites with minimal disturbance such as agriculture and urban land cover. Because the GIS data may not be current or complete, many of these candidate sites will not meet reference criteria **(*see Reference Site Criteria below*)** and, thus, should not be assessed unless otherwise directed on the stream list.

Reference Site Criteria

The following selection criteria are used to determine reference site status after assessments have been conducted and all the chemical, habitat, biological, and reconnaissance information is entered into a database. Each site is evaluated to see if it meets these reference site criteria. If all the criteria are met, the site is given reference site status.

NOTE: It will be impossible to utilize all these criteria while in the field. However, it will be useful to consider these criteria while making decisions on whether to conduct an assessment on a candidate reference site.

*** *Indicates criterion that can be determined in the field.***

1. *Point source discharges* - Because reference sites presumably represent least disturbed conditions, point source discharges (NPDES) located upstream of an assessment site generally disqualify it from becoming a reference site. GIS data provides easy access to the locations of many permitted point sources. However, extra effort is taken in the field to ensure that point sources do not exist above the site.*****

2. *Anthropogenic disturbances* within the stream assessment area are evaluated visually. Best professional judgment is employed when making reference site determinations based on the number and type of disturbance(s). For example, a surface mine site would generally be considered a greater disturbance than an ATV trail and small road combined and could exclude the site from reference condition consideration. However, impacts from the ATV trail and/or road may be considered so minor that they do not exclude the site from reference consideration. The information gathered in the field on anthropogenic disturbance helps validate the GIS data used to select the candidate sites (***see Section C. Part 1. PAGE 2-Site Activities and Disturbances (Including Roads) starting on page 2-38***).

3. ***** *NPS* - Obvious sources of NPS are documented within the assessment area. If sources of NPS are documented for areas above the assessment site, they are also considered. Livestock feedlots, parking lots, and road runoff are common sources of NPS. Best professional judgment is employed when making reference site determinations based on the type and intensity of the NPS. For example, a livestock feedlot with direct drainage to the stream would likely exclude the site from reference consideration. In contrast, a small road drain may not be significant enough to exclude a site from consideration.

4. ***** *Primary WQ criteria*:
   a. *D.O.* ≥ 5.0 mg/l - The criterion for dissolved oxygen was taken from "WV Water Quality Standards" as developed by the State Water Resources Board (SWRB).
   b. *pH* between 6.0 and 9.0 Standard Units (S.U.) - The criterion for pH was taken from "WV Water Quality Standards" as developed by the State Water Resources Board (SWRB).

5. *Secondary WQ criteria*: (used as flag values)
   a. ***** *Conductivity* < 500 µmhos/cm – Criterion for conductivity was established from analysis of WVDEP data and from best professional judgment of several

experienced field employees. A value greater than 500 may indicate the presence of dissolved ions (such as sulfate, chlorides, and metals) exceeding the background levels for the area. It is important to note that a full water quality analysis that includes all possible chemical constituents is not within the resource pool of the program. Consequently, the conductivity reading of a site can be used as a means of flagging the site for further investigation before it can be considered a reference site. Note: Region specific criteria for conductivity are currently being examined to address natural differences in ambient conductivity. This may result in having lower or higher conductivity thresholds based on ecoregion, watershed (8-digit HUC), *etc*. Currently, best professional judgment is used when conductivity for a site is conspicuously higher than expected for the area.

b. *Fecal coliform bacteria* < 800 colonies/100 mL - The fecal coliform value of 800 colonies/100 mL is double the maximum set by the WV Environmental Quality Board (WV EQB) which states that fecal coliform shall not exceed 400/100 mL in more than 10 percent of all samples taken during the month. This value was raised to 800/100 mL for reference criteria due to the lengthy holding times of fecal samples (24 hours in many cases). Additionally, experienced field personnel have encountered fecal coliform bacteria counts exceeding the standard in streams where no human impacts were apparent or known. Thus, a value of 800/100 mL would decrease the possibility of excluding some anthropogenically undisturbed streams from reference consideration. Like the criterion for conductivity, fecal coliform bacteria can be used as a means of flagging the site for further investigation before it can be considered a reference site.

6. *No known violations of state water quality standards* – If there is a violation of a water quality criterion standard as established by the (WV EQB), the site is eliminated from reference site consideration. Because of their toxicity, metals are the primary consideration when evaluating data for violations.

NOTE: Note: This violation rule does not include fecal coliform bacteria for the reasons described above.

7. ***** *RBP habitat metric scores*: The habitat criteria below are adapted from the USEPA-RBP habitat assessment procedures (***see Section C. Part 1. PAGES 5, 6, 5a, and 6a-USEPA's Rapid Bioassessment Protocol*** Visual-Based Habitat Assessment ***starting on page 2-65***). These criteria were selected because they are considered most indicative of anthropogenic disturbance.

≥ 11 (lowest score possible for sub-optimal rating) for following:

a. Epifaunal Substrate
b. Channel Alteration
c. Sediment Deposition

≥ 6 (lowest score possible for marginal rating) for following:
   a. Bank Vegetative Protection (right bank & left bank scored separately)
   b. Riparian Vegetative Zone Width (right bank & left bank scored separately)

≥ 130 (mid-suboptimal score) for Total Habitat Score

A value >10 indicates that stream habitat is at least sub-optimal for a given parameter. The WAB sampling strategy dictates that many assessments are conducted at or near the mouths of streams. This strategy tends to bias the habitat scores (many sites are roadside accessible or below bridges) and in many cases, results in relatively low scores for those parameters that are most indicative of human disturbance. It is for this reason that the minimum values are set to 11 (7 through 10) and 6 (parameter 11). Otherwise, few streams (if any) would meet the selection criteria.

All samples that meet these criteria can be elevated to what is called a **Level I** reference status as it passed all the needed criteria. However, it must be understood that absolute pristine habitat conditions do not exist in most areas. Therefore, decisions must be made on what is an acceptable level of disturbance to represent reference condition. Additionally, acceptable conditions may differ among watershed regions because of factors such as local geology, vegetation, and predominant land use. In heavily disturbed watershed regions, undisturbed conditions may not exist. A large proportion of reference samples currently in the database are on first and second order streams because the potential for anthropogenic disturbance generally increases as stream size increases. Consequently, reference conditions may need to be determined based on the best available conditions. Because of this, a second tier of reference samples called **Level II**, it has been established**.** Level II reference samples meet most of the criteria above but may barely fail to meet some of the criteria. A third tier of reference samples, called **Level III,** represent the best available conditions in a geographical area or stream size class and generally fail to meet as many of the criteria of Level II reference status. Generally, Level III reference samples are on larger order streams where it is more difficult to meet all the reference criteria.

Also, note that reference status is declared on a sample basis and not a site basis. The reasoning for this is: 1) the station may become altered to the point that it would no longer meet any of the above reference categories; 2) the station may meet reference criteria in one season but fail to meet it on other seasons. When multiple samples are available, every effort is made to consider the other samples in deciding on the status of the one. For example, the chronologically first sample may seem to meet all the reference criteria, but future sampling efforts may reveal something that was missed during the first evaluation. In this case, the reference status may be downgraded or stripped entirely based on subsequent visits. In a situation where the site has been altered between the earlier and subsequent samples, the earlier samples may maintain reference status while the subsequent samples do not gain reference status.

Determining Candidate Reference Sites While in the Field

Aside from the numeric criteria that can be evaluated while in the field (*i.e.* Water Chemistry and RBP Habitat Scores), determining if a site is a candidate reference site can seem like a daunting task. As individuals visit more and more in the different regions of the state and becomes familiar with what is the best possible condition for an area, this task becomes easier. It also helps to pay careful attention when sampling a site that is already established as reference quality and try to imprint a visual of the characteristics of that site into one's mind.

Determine human disturbances by reconnaissance and using GIS land use maps. Choose stream segments with no major (or as little as possible) human disturbance, (*e.g.,* eliminate sites with strip mines, refuse piles, towns, major roads, active open fields or agriculture), impoundments, power-lines, non-point sources, *etc*. **Consult current and historic GIS land use, aerial photos, and topographic maps for determination of upstream disturbances.** Some of these disturbances are indicated on topographic maps. If possible, choose candidate sites located within a State Park or other static land use type. In most cases, it will be necessary to choose candidate sites with limited accessibility (obviously due to the nature of the condition we are searching for) that requires some long hikes. If passable jeep trails or hiking trails are indicated on the map, try and choose sites within their paths and make the hiking distance as short as possible.

Anthropogenic disturbances within the stream assessment area should be evaluated visually. Best professional judgment is employed when making reference site determinations based on the number and type of disturbance. For example, a surface mine site would generally be considered a greater disturbance than an ATV trail and small road combined and would exclude the site from reference condition consideration. However, impacts from the ATV trail and/or road may be considered minor so that they do not exclude the site from reference consideration. For example, do not immediately eliminate a site as potential reference if it has a small road following along much of its length unless there is obvious erosion or areas of high sediment deposition. Many of our established reference sites do have roads running parallel to them or crossing them at some point(s). Also, consider where you are in the state when deciding on potential reference sites. The northwestern portion of West Virginia (Western Allegheny Plateau – Ecoregion 70) should not be held to the same standard as the eastern mountainous section (Ridge and Valley – Ecoregion 67). In other words, the least disturbed conditions in Ecoregion 70 are not equal to those of Ecoregion 67. For example, some streams in the Upper Ohio South watershed in Ecoregion 70 have hilltop farms that may offer little if any impact to the stream located a down in the valley below. Some of these are established reference sites and represent the best possible conditions for the Ecoregion. In Ecoregion 67, there are many streams without any recent land disturbance (entirely forested). Many of these are established reference sites. A concerted effort should also be made to recognize some candidates on streams with larger watershed areas since the potential for anthropogenic disturbance generally increases as stream size increases.

All potential reference sites and already established reference sites should be reconned by vehicle to provide additional information about the watershed not available thru GIS data.

Sampling teams should note that they are by no means limited to the list of potential reference sites provided by the map coordinator. If a potential reference site is encountered while in the field, every effort should be made to conduct a full WAB assessment on that stream segment. If a potential reference site is also designated as a targeted site, then you should search for a place to sample that will satisfy the potential reference conditions. In other words, if a small disturbance is encountered at or near the mouth of a stream that is not designated potential ref on the stream list, move the site above the disturbance to conduct the assessment.

***IMPORTANT*: Always collect "Random Site" physicochemical parameters at all potential and established reference sites.**

Because of the nature of reference sites (undisturbed), traversing to the sample site may require long strenuous hikes over difficult terrain; NOT DANGEROUS TERRAIN! This should not be a reason for eliminating the site for assessment. If you personally feel it is too difficult (or too far to hike) to get to the site, do not attempt it. Discuss it with other sampling teams who may be willing to give it a try**.**

***WARNING*: DO NOT NAVIGATE TO ANY ASSESSMENT SITE THAT PRESENTS A DANGEROUS SITUATION TO YOU OR ANOTHER TEAM MEMBER!**

Section B. Site Documentation

Part 1. Coordinates and Global Positioning Systems (GPS)

GPS Overview

GPS units use satellite communications to accurately determine the latitude and longitude of a specific location. Since the GPS units use triangulation to determine location, the more satellites it is in contact with, the more accurate the data. To function efficiently the GPS must be used in an unobstructed area and must have good signals with at least four satellites for a reading. In addition, taking a longer time for a reading will generally result in a better reading as sometimes the first four satellites selected are not necessarily the best ones. But one must be careful as sometimes there is often only a brief window where there are enough satellites above at certain sites. It is suggested that you attempt to obtain GPS coordinates first upon arrival at the site and try repeatedly during the duration of the sampling.

Figure 2-2. Example of GPS being used to locate and document the X-site.

The Watershed Assessment Branch uses a variety of GPS unit models under the Garmin brand because of their ease of use, low cost, and rugged design (***see Figure 2-2 above***). However, unlike some other, more expensive GPS units, Garmin GPS units do not store the readings to be differentially corrected later. Recent advances in GPS technology have compensated for this somewhat (*e.g.,* the removal of Selective Availability, WAAS enabled receivers, *etc*.). To further compensate for this, Watershed Assessment Branch takes great care to QA/QC its coordinate data (***See GPS Quality Assurance/Quality Control on page 2-23***).

It is standard procedure to take GPS readings at all sites visited. The GPS reading location should be noted on PAGE 1 of the Habitat Form (***see Section C. Part 1. PAGE 1-Site Verification starting on page 2-31***). Specifically, the coordinates should be taken

at the location where the water quality parameters and constituents are collected. Should you take coordinates at a location other than the water quality sampling area (*e.g.,* because of poor GPS reception), be sure to thoroughly note this discrepancy on the paperwork and reach map.

Because of the frequency of visitation of some sites, it may not be necessary to take GPS readings during each visit. ***Table 2-2 on the next page*** outlines some typical frequency of GPS readings for various sample types.

In addition, there may be some survey sampling designs that require multiple GPS coordinates for one sampling event because they involve the use of variable reach lengths (*e.g.,* Fish Surveys, Non-Wadeable Stream Surveys, *etc*.). In such cases, it will be necessary to take GPS coordinates at the following locations: the water quality collection location or X-site, the downstream terminus of the reach, and the upstream terminus of the reach. Should the X-site coincide with either the downstream or upstream terminus of the reach, then make a note as such and just collect GPS coordinates for the downstream and upstream terminus of the reach.

Table 2-2. Typical Frequency of GPS Readings for various Watershed Assessment Branch Activities

Sample Type	Frequency of GPS Readings
Wadeable Benthic (Random, Targeted, and associated TMDL visit) and Fish Surveys	Every Visit
Long Term Monitoring Sites	Every Visit
Special Surveys	Every Visit
Lakes & Large Rivers (or other boatable activities)	Every Visit
TMDL	1st, 2nd, and Final Visits
Special Projects	1st, 2nd, and Final Visits
Deployable Sondes	1st, 2nd, and Final Visits (*i.e.,* Installation, 1st Retrieval, Last Retrieval)
Ambient Network	Old Sites-Only when the site is moved (*e.g.,* moved us 30 m because of a new bridge) New Sites-1st and 2nd visit

GPS Manufacturer Manuals

For more complete descriptions of the care and operation of the various GPS units, consult the instruction manual provided by the manufacturer at the following locations:

Garmin GPS V	http://static.garmin.com/pumac/GPSV_OwnersManual.pdf
Garmin GPSMap 64 & 64st	http://static.garmin.com/pumac/GPSMAP64_OM_EN.pdf
Garmin GPSMap 76Cx	http://static.garmin.com/pumac/GPSMAP76Cx_OwnersManual.pdf
Garmin GPSMap 76CSx	http://static.garmin.com/pumac/GPSMAP76CSx_OwnersManual.pdf
Garmin GPSMap 76 & 76S	http://static.garmin.com/pumac/GPSMAP76_OwnersManual.pdf
Garmin GPSMap 78s	http://static.garmin.com/pumac/GPSMAP78_QuickStartManual.pdf
Garmin Oregon 450t & 550t	https://static.garmincdn.com/pumac/Oregon_x50_Series_OM_EN.pdf
Garmin Oregon 600t	https://static.garmincdn.com/pumac/Oregon_6xx_OM_EN.pdf
Garmin eTrex 20	https://static.garmincdn.com/pumac/eTrex_10-20-30_OM_EN.pdf
Garmin eTrex Vista HCx	http://static.garmin.com/pumac/eTrexLegendHCx_OwnersManual.pdf

Any information provided in this SOP is not meant to supersede the instructions or guidance provided in the manual provided by the manufacturer.

Quick Operation of the Garmin III+ or V GPS Unit

These instructions are meant to be only meant to offer quick, basic guidance in the operation of GPS units. Consult the owner's manuals for specifics or information on configurations other than these and for details on maintenance and trouble-shooting. These procedures assume the user has a basic knowledge of the instrument.

These directions are not intended for first-time users. Individuals with no prior experience should operate the unit with the assistance of an experienced user.

Procedures for obtaining coordinates with a GARMIN GPS III+ or V

A) Unfold the antenna.
B) Press the red-light bulb button to turn unit on.
C) At the warning screen, press enter to proceed to the satellite screen.
D) Wait an adequate amount of time while the unit locks onto the satellites. The bars at the bottom of the screen will rise with increasing signal strength and will turn black when the signal is locked for that satellite.
E) When the unit has locked into enough satellites to get any reading it will display a map.
F) Push the “quit” button twice to get back to the satellite screen. If the reading is adequate, record the EPE (Ellipsoid Precision Error) or accuracy. This is a number in feet that ranges generally from 15-100 with a lower number being more

accurate. Imagine a circle represents your location that is as wide in feet as the number. The larger the number, the larger the circle and the less sure you are of your exact position. An EPE of 20-30 feet is good and an EPE of 100 feet is bad. The unit will also display accuracy by stating if it was in 2-D or 3-D. A 2-D reading is a one with only three satellites available. Therefore, elevation information is not available, and your position may be inaccurate on a two-dimensional plane. 3-D means that four or more satellites were available and the elevation and your position in three-dimensional space are relatively accurate. Be sure to indicate on the habitat form if the reading is in 2-D in addition to the EPE number.

G) If the EPE is not very good or in 2-D wait some more to see if it improves. If it does not, then proceed with what is available or utilize alternative means to determine coordinates (*e.g.,* GIS, Previous Visit, *etc*.).
H) Push the “quit” button until the latitude and longitude are displayed in the lower third of the screen.
I) Record the latitude and longitude as "field readings" on the habitat sheet.

Procedures for checking/changing the datum with a GARMIN GPS III+ or V

Sometimes it may be necessary to check the datum being used by the unit (*e.g.,* when a unit has been without batteries for an extended amount of time or with the purchase of a new unit). Each datum is different and will dictate how the coordinates be displayed or recorded. Since most of our GIS needs in the office are fulfilled through an application called WCMS (Watershed Characterization and Modeling System), we need to make sure that any data taken or recorded in the same datum used by WCMS. The older 2.8 version of WCMS used NAD 1927 CONUS for a datum. The newer WCMS version (9.x and above) uses NAD 1983 CONUS. Watershed Assessment transitioned to NAD 1983 CONUS as the standard in July 2006.

A) Unfold the antenna.
B) Press the red-light bulb button to turn unit on. Wait for the “Acquiring Sats” screen to appear.
C) Press Menu twice to get the Main Menu.
D) Scroll down to Setup and press ENTER.
E) Scroll right along the tabs to Position or Location.
    1. Make sure that the Position or Location Format is “hddd^0 mm’ ss.s”.
    2. If “NAD83 CONUS” or “NAD83” is not displayed under Map Datum, then scroll down and select whatever is listed under Map Datum. This will cause a list to pop up on the left. Scroll down and select “NAD83 CONUS” or “NAD83”; press Enter. The proper datum should now be selected. Press QUIT twice to get back to the “Acquiring Sats” screen and turn off the unit.
    3. If “NAD83 CONUS” or “NAD83” is not displayed under Map Datum, then scroll down and select whatever is listed under Map Datum. This will cause a list to pop up on the left. Scroll down and select “NAD83 CONUS” or “NAD83”; press Enter. The proper datum should now be selected.
F) Press QUIT twice to get back to the “Acquiring Sats” screen and turn off the unit.

GPS Quality Assurance/Quality Control

Before use, each GPS unit should be examined for proper datum and battery levels and adjustments should be made as required.

The accuracy reading of the GPS coordinates is observed and recorded in the field to help in obtaining the best possible reading as well as indicate if there may have been an issue with the unit's ability to report the correct location.

The location of each GPS coordinate is checked and validated by the sampling team immediately after sampling or later during data entry and proofing. The coordinates are plotted on GIS topographic and aerial photo basemaps and then compared to the field documentation notes (*e.g.,* hand drawn site map, directions to the site, site descriptions, accuracy reading, *etc*.). Those coordinates that do not fall within a reasonable distance of the expected location are more extensively cross checked and researched. Any position that does not meet these expectations is recalculated by using the field documentation notes about the site to approximate the site location and using the Watershed Characterization and Modeling System ArcGIS extension to generate coordinates for that location.

Stations or sites that are visited more than once (*e.g.,* TMDL sampling, special projects, *etc*.) will have multiple GIS coordinates obtained to help reassure that the coordinates do indeed match the sampling location.

In addition, spatial GIS queries are used to filter out potential "bad" coordinates. These bad coordinates are double checked and either corrected by using field documentation notes about the site (*e.g.,* site map, directions to site, and location description) to or documented as to why they appear "bad".

Once a year, all field participants in the WAB attend mandatory training sessions. The purpose of these sessions is to ensure that all field personnel are familiar with sampling protocols and calibrated to sampling standards. A hands-on session concerning the use and collection of GPS coordinates is included. Individuals who are more experienced in using GPS units will be teamed up with the less experienced to ensure reinforcement of training and accurate results before they can collect coordinates. This document is also provided to all program personnel for review and use in the field.

Part 2. Photographic Documentation

Photography Overview

The Watershed Assessment Branch needs quality photographs from every site to use as illustrations for our reports, presentations, and for general use. They are vital for illustration and clarification of the ideas presented as well as visual relief from all the words in the text. To achieve this, we need the field personnel to take a variety of pictures while they are in the field. Along with the pictures we need a way to keep track of these photos on our field forms as well as in our database.

This "photography log" is essential for four reasons:

1. We need to know who took the picture
2. We need to know where the picture was taken
3. We need to know what the picture is of
4. We need to know what to call the photo

For information about how to take a photograph, use various features, and download the photos to a computer, consult the operation manual of the given camera model.

Procedures for In the Field

Don't hesitate to take more than one picture of the same scene or activity. Even pictures taken at non-target or dry sites are considered useful and valuable.

Also, feel free to experiment by varying the picture by using the settings feature on the camera (*e.g.,* flash level, aperture speed, exposure, wide angle/telephoto, *etc*.). Always use the highest image size setting on the camera. This will take up more space, but it will provide us with the most useable pictures.

Obviously, all pictures will not be used in the report for the watershed where they were taken. Or any other report for that matter. But they may be used later in a presentation, brochure, or report we haven't thought of yet. In addition, these photos may be valuable for the 303(d) narrative criteria listings, 303(b) assessments, or TMDL process (*e.g.,* clarify and extent of hydroxides in stream). We cannot have too many pictures to choose from.

We need pictures of such items as:

- Stream alteration or management practices
- Stream disturbances
- Waterfowl or other wildlife in or near streams
- Silt laden streams flowing into clear streams
- Scenic Views
- Field crews at work
- Distinctive views of streams, buildings along streams, industry along streams, dams, boats or barges or other water related pictures.

- Pollution sources and features (*e.g.,* point and non-point sources, metal hydroxides, poorly constructed roads, feedlots, *etc*.)

All pertinent information about a photo should be recorded on the field sheet under the photography log section (***see CHAPTER 2. Section C. Part 1.* PAGE 12-*Photography Log on page 2-114***). This information includes:

Camera Type: The type of camera used (*e.g.,* Canon, Olympus, or Sony).

Camera Number: The assigned number of the camera used. This is usually marked on the camera with a black sharpie. **Do not confuse this with the jeep number often marked on the camera in white ink.** If for some reason the camera's instrument identification number is not apparent, then write down the manufacturer's Serial Number on the instrument so that the proper identification number can be tracked down later and remarked onto the camera. **This is required for all photos taken!**

Disk-Photo #: Each camera assigns these unique file names to photos in series from 0-99999 in a format associated with some letters (*e.g.,* a photo will have a file name of DSV-00456). Write down the number portion of the file name on the form. **Do not confuse this number with the photo count numbers on the cameras that indicate how many photos have been taken or can be taken, which reset once photos are removed or deleted from the camera.** In addition, it is important to note that how the photos are removed from the camera may change this file name.

Stream Name and/or AN-Code: The name of the stream featured in the photo. ***This is only required if the photo was not taken at a sample site. If a lake or other waterbody is sampled, use this space to put in this space.*** If known, write down the AN-Code of the waterbody featured in the photo.

Photo Description: A description of the photo as it relates to the stream (*e.g.,* looking upstream from X-site) and the features that may be found in the photo (*e.g.,* AMD, eroded bank, channelization, an optimal score for bank vegetative protection, a poor score for sediment deposition, *etc*.). **This is required for all photos taken!**

Date: The date the photo was taken. **This is only required if the photo was not taken on the same date as the sample or if it is not at a sample site.**

Photographer: The person who took the photo. **This is required for all photos taken!**

Procedures for In the Office

Downloading the Photos for tagging

2018 Photos should be downloaded to the following location:
Q:\WATER RESOURCES\WAB\PHOTOS\Unclaimed Unprocessed Photos\2018

Upon opening the folder, you will see a subfolder with each person's name. It has been found that the **Photographers Name** works best for naming the subfolder. If your name is on the field form as the photographer, then store the photos in your folder. For example – if person John Doe oversees taking photos while doing an assessment then the photos should be stored in the **Unclaimed Photos\2018\Doe** folder. This applies even if the person is not using a camera that has assigned them. If there is more than one photographer for a group of photos, then you can use either name.

The procedure for creating a date subfolder under your name is as follows

1. **Find the oldest date for the list of photos you are downloading**
2. **Create a directory corresponding to that date using this format YYYY DD MM under your name. For example: if the oldest date in a list of photos to download is April 29, 2018 – then the subfolder would look like this – 2018 4 29. If the photos were taken by John Doe, the final folder would look like this: Q:\WATER RESOURCES\WAB\PHOTOS\Unclaimed Unprocessed Photos\2018\John Doe\2018 4 29. There are single spaces between the 2018 4 29**.

The camera can be brought to the photo coordinator for download or be downloaded directly by the photographer.

***IMPORTANT*: Do not put the photos in any other location on the network!**

Tagging the Photos with a Photo ID

To keep track of so many photos, at the end of each sampling week each team will need to tag each photo with a unique photo ID number that is maintained in the database. The following are the steps required for to not only tag each photo with this photo ID, but also ensure that each photo ID will have a description in the database as well.

Photos that are taken at sampling sites

Most of the photographs that we take are of this type and require the least amount of time to prepare for the database.

A. Open the WABbase.
B. From the main switchboard, select the Form called “Photo Data Entry”.
C. Press the button called “Get New Photo ID”.
D. Enter “Yes” into the box called “Number Used”. Press the “Get Number” button. Once this button is pressed, a number will appear in the box called Assigned Photo ID.
E. Rename the photo using this number as the name (*e.g.,* 136.jpg, 456.jpg, *etc*.)
F. On your field sheet, write this number under Photo ID on the line where your photo information is recorded.
G. Go to step C above and repeat for more photos or close the database if done.
H. Copy/Cut/or Move all the photos from your computer onto the network server at the following directory:

   Q:\WATER RESOURCES\WAB\Photos\Coded Photos

   In this directory, there are folders for each group of 1000 photos based on Photo ID. Put the photos in the appropriate folder. If a message appears asking if you want to replace a file, press no. If this happens, then someone has already named a photo by that name and the two photo names (yours and the one already on the server) need to be investigated and resolved.

All the information on your field sheet will be entered in during the data entry process and can be linked to your photo by the photo ID. The data entry person will write the appropriate sample ID next to each photo taken at that site.

Photos that are not taken at sampling sites

Only a handful of photos that we take are of this type. Since they will not be tied into a Sample ID all data entry for these photos is the responsibility of those who took the pictures.

A. Open the WABbase.
B. From the main switchboard, select the Form called “Photo Data Entry”.
C. Press the button called “Get New Photo ID”.
D. Enter “Yes” into the box called “Number Used”. Press the “Get Number” button. Once this button is pressed, a number will appear in the box called Assigned Photo ID.
E. Rename the photo using this number as the name (*e.g.,* 136.jpg, 456.jpg, *etc*.)
F. On your field sheet, write this number under Photo ID on the line where your photo information is recorded.
G. Press the button called “Non-Sample Related Photo Info”.
H. Begin entering the data in the red box at the top of the form (*i.e.,* Photo Description, Photographer, Camera Type, and Camera Number).
I. Enter the applicable site information in the orange box at the bottom of the form (*i.e.,* Stream Name, AN-Code, Mile Point, Descriptor, Date, Watershed, Latitude and Longitude).
J. If you have more photos, press the “Go to New Photo” button and repeat steps D thru J.
K. Copy/Cut/or Move all the photos from your computer onto the network server at the following directory:

   Q:\WATER RESOURCES\WAB\Photos\Coded Photos

   In this directory, there are folders for each group of 1000 photos based on Photo ID. Put the photos in the appropriate folder. If a message appears asking if you want to replace a file, press no. If this happens, then someone has already named a photo by that name and the two photo names (yours and the one already on the server) need to be investigated and resolved.

Again, because these photos are not taken at a site, they will not be entered during the data entry process and assigned a Sample ID. They only way the information about these sites will be entered is if the crew who took them enters the data. And a photo without this information is not very useful.

Photography Quality Assurance/Quality Control

Before use, each camera should be examined for proper date, resolution settings, and battery levels and adjustments should be made as required.

Once a year, all field participants in the WAB attend mandatory training sessions. The purpose of these sessions is to ensure that all field personnel are familiar with sampling

protocols and calibrated to sampling standards. A hands-on session concerning the use and collection of photos is included. Individuals who are more experienced in taking photos will be teamed up with the less experienced to ensure reinforcement of training and accurate results. This document is also provided to all program personnel for review and use in the field.

Section C. Guidelines for Completing the Stream Assessment Forms

This section explains the various data components found on the Wadeable Benthic Stream Assessment Form and its appendices. Other forms (*e.g.,* TMDL-Initial Visit, TMDL-Secondary Visit, TMDL-Final Visit, TMDL-Source, Ambient Network, Lake, and General WQ) share many of the same components (*e.g.*, Site Verification, Field Water, and Photography) and have some unique components not found on the Wadeable Benthic Assessment Form (indicated as such). Nevertheless, the following instructions on how to fill out the sections are the same as presented here unless specifically stated/presented otherwise in subsequent chapters.

Important Notice about Personnally Identifiable Information

Personally Identifiable Information (PII) is information that can be used on its own or in conjunction with other information to identify, contact, or locate a single person or to identify and individual in context. The types of PII that the Watershed Assessment Branch may collect, and use include the name, address, phone number, and email address of landowner(s) or interested parties next to, adjacent to, or near a stream sampling location.

Even though much of this information can easily be extracted from public sources (*e.g.*, phone books, web listings), we are obligated to protect this information. Therefore, any PII documented by the Watershed Assessment Branch will be restricted to one section of the form (for easy redaction during data and FOIA requests) and maintained in one location in the database. Any references to an individual on the form in other sections must appear in an anonymous format only (*e.g.*, Landowner 1, Neighbor 2, etc.) to protect the identity of the landowner/interested party. Corporations (permitted or not) and public entity landowners (*i.e.*, Federal, State, County, or Municipal Property) are exempted from this and may be referred to in other sections by their name.

Part 1. Wadeable Benthic Stream Assessment Form

The quality and quantity of habitat is a major determinant of aquatic community potential. Consequently, a thorough habitat characterization is essential for proper interpretation of biological (benthic macroinvertebrate, periphyton, & fish) assessment results.

Front Side of All Pages

PHYSICAL & SEDIMENT CHARACTERIZATION>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>		Reviewers Initials	
AN-Code		Date	

Figure 2-3. Example of identification fields on front top of each field form.

REVIEWER'S INITIALS: All habitat forms must be reviewed and initialed for completeness by a second crew member. This review must be performed on-site. The Biomorph should point out any omissions to his/her partner and initial the page when all the data are complete. In the case of duplicate sites, this is an opportunity for each field worker to discuss discrepancies between the forms. However, all results should be

considered final and should not be changed to match the other person's results.

AN-CODE: It is extremely important that the **correct** AN-Code be recorded on each sheet as this is one way to link all the sheets for a sample together if accidentally separated. ***See PAGE 1-Site Verification on below for more details about AN-Codes***.

Date: Use mm/dd/yyyy format: *e.g.,* 04/29/1999. It is extremely important that the date be recorded on each sheet as this is another way to link all the sheets for a sample together if accidentally separated.

PAGE 1

Site Verification

IMPORTANT INSTRUCTIONS

Always fill out the PAGE 1 (Site Verification) of the habitat assessment form, regardless of whether any type of sampling was conducted (i.e., even if the stream site is deemed "Not Target", dry, impounded, or inaccessible)! This includes:

1) **Coordinates of the site or location near the site (*e.g.,* bridge downstream of site, locked gate, landowner's house),**
2) **A detailed explanation of why it was not sampled,**
3) **Photographs that display the reason why it was not considered target,**
4) **Precise directions to the site**

This is important information and assists in database management. *See Figure 2-4 on the next page for an example of this page.*

If water quality only is collected, you must at least complete PAGES 1-4, 8 and 10, as best as you can and take plenty of photographs.

SITE VERIFICATION >>								Reviewers Initials			
Stream Name (with location)											
AN-Code				Date		Time		Geo		Bio	
Basin		County				Quad					
GPS Type		EPE		Random #		XY's Proofed				By	
Provided/Prev. Lat at X			N	Provided/Prev. Long at X					W		
Field Lat X-site			N	Field Lon X-site					W		
X-site field verified?	☐ Yes ☐ No	If no, Why?	☐ No Access-Physical Barrier (☐ *Permanent* / ☐ *Temporary*) ☐ No Access-Landowner Denial (☐ *Verbal Denial* / ☐ *Posted* / ☐ *Fenced* / ☐ *Private*) ☐ Other:								
Is site target and kick sampleable? ANSWER EVEN IF YOU DID NOT SEE THE SITE!	☐ Yes ☐ No	If no, Why?	☐ Low Flow (☐ *Permanent-Not Drought* / ☐ *Temporary-Drought*) ☐ Ephemeral ☐ Too Deep (☐ *Permanent-Not Wadeable* / ☐ *Temporary*) ☐ No Riffle/Run ☐ Wetland ☐ Filled (☐ *Mining* / ☐ *Farm* / ☐ *Urban/Residential* / ☐ *Road* / ☐ *Industry*) ☐ Impounded (☐ *Lake* / ☐ *Mining* / ☐ *Farm* / ☐ *Beavers* / ☐ *Navigation* / ☐ *Industry*) ☐ No Stream Present (Map Error) ☐ Other:								
Detailed notes on verification, access, & sampleability of site.											
Sampled?	☐ Yes ☐ No	Sample Type	☐ YSI ☐ Lab ☐ Fecal ☐ Habitat ☐ Bugs ☐ Fish ☐ Flow ☐ BE/CP ☐ Other								
Dup Type	☐ YSI ☐ Lab ☐ Fecal ☐ Habitat ☐ Bugs	Dup WQ ID		Was site moved (non-random)?	☐ Yes ☐ No						
Explanation?											
Directions To Site											
Sketch of Assessment Reach & Comments: Identify North with (↑ & N), flow direction (→ or ←), upper end (US) and lower end (DS) of reach, transects (A-K) and riparian plots (box), bug samples (b), water sample location (wq), X-site lat and long (X).											
Notes								Single WQ Sample ID			

Page 1 WVDEP WAB Wadeable Stream Assessment Form (2/15/2013)

Figure 2-4. Example of the Site Verification section (PAGE 1) of the field form

Stream Name and Location Description: Make sure the stream name on the map corresponds with the assigned AN-Code from your printed stream list. If they do not match, make a note of it on the habitat sheet and printed list. Include a detailed description of the location such as: Greenbrier River US (abbreviation for Upstream) of Big Run at Hilldale Bridge, New River DS (abbreviation for Downstream) Lick Run at Glen Lynn, Red Creek Between Oak Run and Pine Run at Laneville, Piney Creek Upstream Beckley PSD 50m, Pinnacle Creek DS right UNT 0.5 miles south of Pineville, Bear Run near mouth south of Sissonville Upstream first bridge, Camp Creek at mouth in Camp Creek St. Forest at Campsite #2, *etc*. Be sure to include the receiving stream in the name of any source discharges (*e.g.,* Beckley PSD outfall discharging into Piney Creek US of Smock Run).

AN-Code: It is extremely important that the **correct** AN-Code (Alpha-Numeric Code) be recorded for each stream site. Mistakes in translation from the printed stream list to the habitat sheet must be avoided. Mistakes in this step create mass confusion and plenty of extra work during data entry. All streams will have an AN-Code with the mileage designated between brackets (*e.g.,* - {3.6}). If you are going to sample at a location other than those listed, create a unique AN-Code such as KG-3- {#1}. The mileage can be assigned to this AN-Code later using GIS by the field personnel or the map coordinator.

Date: Use mm/dd/yyyy format: *e.g.,* 04/29/2006

Time: Use military time (*e.g.,* 1315). This time stamp should reflect the time of WQ sample collection. In cases where multiple samples are being collected during one sample event, then this time represents the general start of sampling activities.

Geomorph: Initials of the team member completing the habitat form.

Biomorph: Initials of the team member collecting benthic macroinvertebrate, periphyton and water samples.

Basin: *e.g.,* Upper Kanawha, West Fork, Lower New

County: *e.g.,* Hardy, WV

Quad: Enter the topographic quadrangle name, *e.g.,* Cass, Mt. Nebo, and Panther

GPS Type: If a Gamin unit is being used, record the word **Garmin**. If GIS software is used to determine the coordinates, indicate **GIS** on the form. If coordinates from a previous visit are being used, indicate **Previous Visit** on the form. If coordinates from a subsequent visit are being used, indicate **Subsequent Visit** on the form.

EPE: Record the Ellipsoid Precision Error (EPE) from the Garmin GPS after the coordinates have been recorded.

Random #: Probabilistic (Random) sites are designated by a special number. This number (which will be on the stream list or topographic map) is entered here.

XY's Proofed: The type of basemaps used as a reference when the coordinates were cross-checked in GIS to ensure their location is accurate to what was indicated in the directions, hand-drawn map, and location descriptions. Common answers would be the use of the **24k-DRG** (24k topographic GIS coverage), or **03-DOQs** and **96-DOQs** (2003 and 1996 vintage aerial photos). ***See Section B. Part 1. GPS Quality Assurance/Quality Control starting on page 2-23 for more information about proofing coordinates***. This step is usually done in the office by an experienced GIS person.

By: The person that double-checks the coordinates for accuracy in the office

Provided/Prev. Latitude and Longitude at X-site: Either the coordinates provided on the stream list for Probabilistic sites (random), LTMS, TMDL, WAB, *etc*. or enter the coordinates from a photocopy of a previous visit to this sampling station.

NOTE: This field set is only on the Wadeable Benthic Stream Assessment Form.

Field Latitude and Longitude: Enter for all sites after obtaining readings in the field using Garmin or Trimble GPS units (***see CHAPTER 2. Section B. Part 1. Coordinates and Global Positioning Systems (GPS) starting on page 2-20***)

Corrected Lat: Enter the corrected versions of the coordinates here. Correction is done in the office after they are proofed (see XY's Proofed above).

NOTE: This field set is only on the Wadeable Benthic Stream Assessment Form.

X-site Field Verified?: Answer appropriately; **YES** or **NO**. **This must be answered at all sites.**

If no, why?: Sometimes it is possible a stream site will not be physically visited. This may be due to one of two things: Landowner access denial or a physical barrier. **Landowner denial** could come in the form of a ***verbal denial***, which is absolute, or in the form of ***implied denial***. Implied denial simply means that the crew has seen evidence that the property owner would not be agreeable to our presence in the stream and used best professional judgment to not trespass to sample the site. This evidence can come in the form of an abundance of **posted signs** (*e.g.,* at every fence post), by conversation context talking to a neighbor (*e.g.,* "He likes to shoot at trespassers."), **heavily fenced** and secured areas, or simply a **private property** (*e.g.,* the site is in the back yard of a house). **Physical Barriers** are those that may be **temporary** (*e.g.,* a water flooded road) or **permanent** (*e.g.,* high cliffs).

NOTE: There have only been one or two instances in 15 years of probabilistic sampling where a physical barrier prevented access to a site. Physical barriers are not gated roads or fences as these are better classified as types of landowner denial.

Is site target and kick sampleable?: Answer appropriately; **YES** or **NO**.

IMPORTANT: This must be answered even if the site was not seen or physically visited by the field crew!!! An educated guess out in the field is far better than a wild one made in the office! Photos of non-target sites (or evidence of non-target status) must also be included!!

If not, why?: Sometimes a stream site will not be sampled for one reason or another. The following are possible reasons:

- **Low Flow**
  - **Permanent** (*i.e.*, non-drought, *e.g.,* subsidence) or
  - **Low Flow-Temporary** (*i.e.,* drought)
- **Ephemeral**
- **Too Deep**
  - **Permanent** (*e.g.,* a larger stream or river that has a riffle/run habitat that is flowing but always will be over the net) or
  - **Temporary** (*e.g.,* a smaller stream that is over the net at that time possibly due to recent rainfall, but would potentially be at base flow at another time)
- **No Riffle/Run** habitat present (*i.e.,* MACS type habitat/low gradient)
- **Wetland** (*e.g.*, stream is dominated by cattails and has no real channel)
- **Filled** by one of the following:
  - **Mining** (valley fills, reclaimed concrete channels),
  - **Farm** (stream plowed under for farm land; this is more common in the Eastern Panhandle of WV),
  - **Urban/Residential** (stream is culverted to make room for houses/yards/residential roads/airports),
  - **Road** (stream is culverted or filled for a major road like and interstate or 4 lane expressway), or
  - **Industry** (*e.g.*, landfills, fly ash dumps, culverted or filled under an industrial facility)
- **Impounded** by one of the following:
  - **Lake** (recreational lakes or reservoirs),
  - **Mining** (sediment or treatment ponds),
  - **Farm** (farm ponds),
  - **Beavers** (stream is impounded by beaver dams and activities),
  - **Navigation** (stream is inundated by the backwaters of a river with locks and dams used for barge navigation; *applies to Ohio, Kanawha, and Monongahela River backwaters only*), or
  - **Industry** (landfill treatment ponds)

- **No Stream Present (Map Error)** (this is extremely rare and has only truly occurred one time)
- And **Other**. If other reasons arise, please comment in sk*etc*h area on PAGE 1 when appropriate.

Detailed notes on verification, access, and sampleability of site: Notes concerning the above four items and the process that led to the answers above.

Sampled?: Answer appropriately; **YES** or **NO. This must also be answered.** In some instances, you may be sampling some aspect (*e.g.,* WQ only) even if the site is declared to be non-target.

Sample Type: Indicate which of the data types were collected (1) **YSI** (represents any type of water quality sonde), (2) **Lab Water**, (3) **Fecal**, (4) **Habitat** (*i.e.,* RBP Habitat), (5) **Bugs**, (6) **Fish**, (7) **Flow**, (8) **BE/CP** (*i.e.,* the Stream Bank Erodibility Factors/Estimated Channel Profile Form), (9) **Other. Do not include sonde readings as part of the lab water data. This refers to laboratory-analyzed samples only.**

NOTES:
⇒ **Other forms may have specific lab water suites as options (*e.g.,* AMD, Acid Rain, Nutrients, Orthophosphate, etc.). Yet others may have a place to put a suite number. Please fill out accordingly.**
⇒ **Periphyton has been removed as an option until it again becomes a common Sample Type.**

Dup Type: If the site is assessed by each team member independently, the site is a duplicate site. **These sites should be treated as if each person was the only person assessing the site.** Indicate the type of duplicate it is 1) **None**, 2) **YSI**, 3) **Lab Water**, 4) **Fecal**, 5) **Habitat**, 6) **Bugs**. Water quality sonde readings should be recorded on the DUP 1 assessment form only **UNLESS two different sondes are present with the sampler(s).** GPS coordinates can be shared. Make sure all sample containers are labeled with the person's name that made the collection, not both team members. This allows for tracking potential sampling errors resulting from poor technique or improper training.

Duplicate WQ ID: The WQ ID number of the duplicate sample, if applicable.

Was site moved (non-random)?: Used mainly for Non-Random sites. However, it could be used to indicate if a random site's reach was slid around the x-site (***see CHAPTER 2. Section A. Part 2. Sliding the Reach starting on page 2-9***). Answer **YES** or **NO.**

Explanation?: Explain why the site was moved and where the site was moved to. This may apply to random sites where sliding the reach is necessary. It can also apply to other sites that might be moved upstream or downstream from the point marked to obtain riffle/run habitat, *etc*.

***IMPORTANT*: If the site is moved, it is important to identify and mark the location of the new assessment site on a topographic map with date and initials of team and fill out a form for both sites.**

Directions to Stream Site: Give a detailed description on how the stream site was accessed. Include highway names & numbers, distances from prominent landmarks (manmade and/or natural), proximity to towns, *etc*. Indicate if contact with landowner/stakeholder/groundskeepers, *etc*., are necessary and note where, when, and why they should be contacted. Addresses of and other specifics about the landowner/stakeholder/groundskeepers can be written down on PAGE 8 under the section called Landowner/Stakeholder Information.

Bird's-eye-view Sk*etc*h of 100 meter Stream Assessment Area and General Comments: Provide a detailed sk*etc*h of the area and include stream flow direction, stream morphology (*e.g.,* riffles, runs, pools, bends, falls, large boulders, erosion scars), land use on left and right bank, upstream activities (if possible), proximity to permanent land marks, indicate direction by drawing a North arrow (**N**←), and any observations which may provide pertinent information to the assessment and location of the stream area. Indicate where GPS coordinates are collected by marking the spot in the stream with an (**X**).

***IMPORTANT*: Coordinates should be obtained at the "EPA provided" latitude and longitude for random sites (usually downstream terminus). Coordinates should be obtained at the downstream terminus at all other sites if possible.**

Indicate direction of flow with an arrow (↑). Mark the areas where benthic macroinvertebrates (**b**) are collected. If periphyton samples are collected, mark the locations (**p**). Mark water sample collection areas with a (**WQ**). Indicate the location of the preceding descriptive drawings within the 100-m assessment area and provide visual estimates of distance (try drawing it to scale). Indicate the upper end of the reach with an "**US"** and the downstream end with "**DS**" and attempt to correlate these with permanent landmarks.

***IMPORTANT*: Keep in mind that a different field crew may be revisiting the site in 5 years and will rely heavily on your description/drawing to get back to the same location. In other instances, it may be necessary to determine the location using GIS programs.**

General comment/notations on the map can be very important when interpreting sample data. Therefore, any anomalies or outstanding attributes should be noted. If it is a random site and sliding the reach was necessary, indicate on the map the changes that were made and place an X in the drawing of the reach to indicate the X-site location.

Some common map/note abbreviations that can be used include:

RF = Riffle	**AV** = Aquatic Vegetation
RN = Run	**SAV** = Submerged Aquatic Vegetation
PL = Pool	**ROW** = Right-of-Way
CMP = Corrugated Metal Pipe (*e.g.* Culvert-type pipe)	Any of the Substrate Abbreviations on *PAGE 3* (***page 2-51***).

NOTES:

⇒ **Other forms (*e.g.,* TMDL, General WQ) are more concerned with the more general area of the stream site and not necessarily concentrating on the 100m assessment reach.**

⇒ **The information generated from drawing a stream map should help one keep track of various features and more accurately fill out other portions of the form (*e.g.,* the Total Habitat Type % Coverage for Reach, Riparian Intensities, RBP metrics, etc.).**

Notes: General notes about the sample or sample location (*e.g.,* the site is on a 303(d)-listed stream, this site is taken at a previously sampled bad IBI site, *etc*.). If this is a duplicate sample, this is the location where Dup #1 vs. Dup #2 can be documented. Additional personnel and their role or capacity in which they worked on the site can be documented here.

Single WQ Sample ID: If used, document the pre-assigned Water Quality Sample ID used with this sample. This ID is unique and comes pre-printed on labels. It is used whenever a lab water sample is collected. If multiple water quality samples are taken during the sampling event (*e.g.,* a waterbody profile), then this information will be documented on another page with the specific collection information (*e.g.,* depth, distance, transect, *etc*.).

PAGE 2

Site Activities and Disturbances (Including Roads)

The information obtained from these measurements will aid in providing insight as to what organisms may be present or are expected to be present, and the presence of stream impacts. This information is also invaluable when conducting 303(d)/305(b) assessments of streams, during stressor identification, and when analyzing the random data. ***See Figure 2-5 on the next page for an example of what this section looks like****.*

Reviewers Initials		*ACTIVITIES AND DISTURBANCES* >>		
Local Watershed Erosion	☐ None	☐ Slight	☐ Moderate	☐ Heavy
Recent Stream Scouring	☐ None	☐ Slight	☐ Moderate	☐ Heavy
Atmospheric Odors (Rate 0-4 or NR)		Odor Description		
Local NPS Pollution	☐ None ☐ Potential ☐ Obvious	If obvious, magnitude?	☐ Slight ☐ Moderate	☐ Heavy
Specify Obvious or Potential NPS (feedlot, etc.) other than Siltation/Sedimentation!				
Point Source Discharges	☐ Yes ☐ No	Pt. Source(s)		

Stream Reach Activities & Disturbances (Rate 1-Low, 2-Moderate, 3-High, 4-Extreme In Each Box That Applies)

Residential		Recreational		Agricultural		Industrial		Management	
	Residences		Parks/ Campground		Annual Row Crops		Industrial Plants		Liming
	Lawns		Parking Lots		Pasture		Surface Mine		Rip/Rap or Bank Stabilization
	Power Lines		Boat Access/ Dock		Hay Production		Deep Mine		Dredging
	Construction		Swimming		Orchards		Coal Prep		Channelized
	Pipes/Drains		Fishing		Poultry		Quarries		Fill
	Bridges/Culverts		Pipes/Drains		Livestock Access		Railroad		Dams/Impounded
Width	Surf Type / Road Intensity		Foot Trails		Irrigation		Logging	Multipurpose State or County Maintained Roads	
			ATV, Horse, Bike Trails		Pipes/Drains		Power lines	Width	
Codes for Width and Surface Type are Displayed on the Right Under Multipurpose State or County Maintained Roads.			Bridges/Culverts		Bridges/Culverts		Woodyards/ Sawmills		A=Single Lane
		Width	Surf Type / Road Intensity	Width	Surf Type / Road Intensity		Sanitary Landfill		B=Double Lane
							Waste H2O Treatment		C=Multi-Lane
Elaborate on any of the Stream Reach Activities & Disturbances checked above. Which of the above is the greatest detriment to the stream?							Drinking H2O Treatment	Surface Type	
							Pipes/Drains		A=Dirt
							Parking Lots		B=Rutted Dirt
							Bridges/Culverts		C=Applied Limestone
							Gas/Oil Well		D=Applied Non-Limestone
							Gas/Oil Lines		E=Asphalt
						Width	Surf Type / Road Intensity		F=Concrete
									Road Intensity

If known, what is the predominant land use(s) in this stream's drainage? Is it mostly forested, agriculture, mining, logging, houses, urban? If mining present, is it active or abandoned, deep or strip, valley fills, etc. What is the predominant NPS pollution? Are there point sources above the reach? Indicate if you used maps (GIS) or field verified comments. <u>DO NOT LEAVE THIS BOX BLANK!</u>	Road Notes:

Page 2 WVDEP WAB Wadeable Benthic Stream Assessment Form (4/23/2010)

Figure 2-5. Example of the Site Activities & Disturbances section (PAGE 2) of the field form

Local Watershed Erosion: In the 100-m reach, note the **existing or potential** detachment of soil within the local watershed (that portion of the watershed that drains directly into the stream upstream and including the reach that you can visually see) and its movement into the stream. Indicate whether there is **None** or if erosion is **Slight**, **Moderate**, or **Heavy**. Look for roads, drains, tilled ground, hillside slips, staging areas, *etc*. **Do not confine your observations to the local stream banks in the reach.** If observations are made upstream of the 100-m reach, note them in the large "Comments Box" on the bottom left of the page.

Recent Stream Scouring: In the 100-m reach, note the **existing or potential** scouring of the substrate from recent high flow events and mark as **None**, **Slight**, **Moderate**, or **Heavy**. Look for scared or abraded substrate particles or the absence of periphyton in seemingly OK streams. Confer with the Biomorph after the first kick to determine if the benthos seems normal. Also, consider other streams visited in the area. Information from locals can also be invaluable. If the stream does appear to be moderately or heavily scoured, confer with other crews or the office to determine if benthic sampling should continue or be postponed at the site.

Atmospheric Odors: Rate the any atmospheric odors based on the following scale: **0-None, 1-Low, 2-Moderate, 3-High, 4-Extreme, or NR-Not Rated.**

Odor Description: Describe the nature of the odor. Examples include sulfates, creosote, manure, sewage, septic, dead animals, soap, *etc*.

Local NPS Pollution: Refers to problems and potential problems ***other than siltation/sedimentation*** within the sampling reach (the siltation/sedimentation aspect of NPS pollution should be addressed above under Local Watershed Erosion). Non-point source pollution is typically defined as runoff from broad landscapes such as agricultural lands and urban areas (*e.g.,* shopping center parking lots). However, we are more concerned with the **regulatory definition of Non-point source pollution** which includes any pollution that is not regulated thru a permitting process or permitted outfall (*i.e.,* pipes that aren't required to have a permit number posted near it). This would include the typical NPS types as well as others that may affect water quality are feedlots, artificial wetlands, septic systems, dams and impoundments, oily strips in center of roads, mine seepage and pre-law mine portals, gob-pile runoff, quarry runoff, landfill leachate, wood-yard runoff and leachate, acid deposition, *etc*. Indicate **None**, **Potential**, or **Obvious** sources. ***See CHAPTER 18. FREQUENT TERMINOLOGY starting on page 18-1 for a description and examples of Nonpoint Sources of pollution.***

NOTE: Any NPS pollution outside of the sampling reach should not be considered here. Instead it can be mentioned in the Comments Box at the bottom of the page where upstream activities and disturbances can be noted.

If obvious, magnitude?: If the Nonpoint-Source Pollution is obvious, indicate how intense it is by checking **Slight**, **Moderate**, or **Heavy**.

Specify Obvious or Potential Sources of NPS (feedlot, *etc*.): Indicate the obvious or potential source of NPS that you observed in the 100-m reach. If it is located above the assessment reach, describe it in the large "Comments Box" on the bottom left of the page.

Point Source Discharges: Since Non-Point source pollution is covering the **regulatory definition of Nonpoint source pollution**, Point Source (PS) pollution includes any pollution that is regulated thru a permitting process or permitted outfall (*i.e.,* the pipe should have a permit number posted near it). Indicate the presence any permitted discharges entering the streams within the 100-m reach? Indicate **Yes** or **No**. ***See CHAPTER 18. FREQUENT TERMINOLOGY starting on page 18-1 for a description and examples of Point Sources of pollution.***

Figure 2-6. Example of a Point Source Discharge

Pt. Source(s)**:** If there is a point source or sources located in the assessment reach describe it here. If it is located above the assessment reach, describe it in the large "Comments Box" on the bottom left of the page.

NOTE: If you are unsure about if a source is Nonpoint vs. Point, describe it thoroughly it in the large "Comments Box" on the bottom left of the page.

Stream Assessment Area Activities & Disturbances: Rate the intensity of any of the following disturbances that were observed in the 100-m stream assessment area in the corresponding box. The intensity scale is as follows: **1-Low**, **2-Moderate**, **3-High**, and **4-Extreme and is exclusive of any other stream reach activity (*e.g.,* a 4-extreme rating for Foot Trails does not equal a 4-extreme rating for a parking lot).** If the disturbance type was not observed, leave the box blank. Please be careful to consider if the activity listed is impacting the stream reach. For example, a road or house may be adjacent to a stream site but drains into the stream upstream or downstream of the site. Additionally, a house ½ mile up on a ridge line separated by forest from the stream will not have any impact on the stream even though you know it is up there. If one of the disturbances is observed above or immediately below the 100-m reach or needs further explanation, record it in the large "**Elaborate on any of the Stream Reach Activities & Disturbances checked above. Which of the above is the greatest detriment to the stream?"** box mid-page on the left side.

The Stream Assessment Area Activities & Disturbances section of the form is divided into the following major categories:

RESIDENTIAL: Note the presence of any of the listed residential disturbances adjacent to or near the stream.

RECREATIONAL: Record the presence of organized public or private parks, campgrounds, beaches, or other recreation areas around the stream assessment area. Look for evidence of informal areas of camping, swimming, or boating around the stream (*e.g.,* swimming hole).

AGRICULTURAL: Note the presence of cropland, pasture, orchards, poultry, and/or livestock. Small gardens should be included in this category as row crops and rated per its size and activities (*e.g.,* pesticide applications). The presence and extent of livestock access to the stream is very important to document (***see Figure 2-7 on next page***) as it contributes to bank erosion and localized sedimentation as well as nutrient runoff. In most cases, the livestock will not be directly observed in the stream, but rather the signs of livestock (hoof prints, wallows, droppings, lack of fence keeping the livestock from the stream, *etc*.). In general, agriculture activity can also be considered a Nonpoint Source since it is not explicitly covered under a permit and can occur over a broad landscape (***see Local NPS Pollution above***).

INDUSTRIAL: Record any industrial activity (*e.g.,* chemical, pulp), commercial activity (stores, businesses) or logging/mining activities around the stream

assessment area. This includes high-tension power lines. Businesses like Wal-Mart and strip malls should be considered as parking lots.

Figure 2-7. Examples of Livestock Access to a stream.

MANAGEMENT: Note any evidence of liming activity, water treatment, dredging or channelization, flow control structures, *etc*.

ROADS/TRANSPORTATION: The **RESIDENTIAL, RECREATIONAL, AGRICULTURAL**, and **INDUSTRIAL** categories each have a block for documenting the presence of roads. Roads under these categories have specialized uses. For example, residential driveways, access roads to fishing sites (recreational), farm roads (agricultural), or mine haul roads (industrial). State and county-maintained highways are usually roads that serve numerous purposes. If you cannot determine what the specific use of a road is this category will mostly likely best apply. It may also be helpful later to write down a description of the road (*e.g.,* haul-road, I-77, C.R. 52/3) under the box called Road Notes.

Using the key on the right side of the page under "Multipurpose State or County Maintained Roads", indicate the width and surface type of the road.

Width: Record the road size as **A=Single**, **B=Double**, or **C=Multi-Lane**. Use best professional judgment to judge the size of roads. If you think two cars can pass one another without steering onto the shoulder, designate the road as double lane. A single lane would require steering onto the shoulder to pass one another. Multi-lanes are large roads such as Interstate highways and some U.S. routes. Large industrial roads such as the ones built on strip mine operations may also be considered multi-lane.

Surface Type: Record the road type as **A=Dirt**, **B=Rutted Dirt**, **C=Applied Limestone**, **D=Applied Non-Limestone** (*e.g.,* some roads use red dog- a type of coal refuse as a surface), **E=Asphalt**, or **F=Concrete**.

Elaborate on any of the Stream Reach Activities & Disturbances checked above. Which of the above is the greatest detriment to the stream?: This area is provided for notes about any of the Stream Assessment Area Activities & Disturbances checked above. ***See CHAPTER 18. FREQUENT TERMINOLOGY starting on page 18-1 for examples of terms that can be used to describe Stream Reach Activities & Disturbances.***

Comments Box: "If known, what is the predominant land use(s) in this stream's drainage? Is it mostly forested, agriculture, mining, logging, houses, urban? If mining present, is it active or abandoned, deep or strip, valley fills, *etc*. What is the predominant NPS pollution? Are there point sources above the reach? Indicate if you used maps (GIS) or field verified comments. ***See CHAPTER 18. FREQUENT TERMINOLOGY starting on page 18-1 for examples of terms that can be used to describe the predominant land uses in the watershed above the site.*** **DO NOT LEAVE THIS BOX BLANK!"**

> **NOTE: This area is a good place to put comments about the land use observed from recon trips or gleaned from the GIS land use or topographic maps. If comments are based on the map, note them as such. Landowner comments about the upstream activities should also go here. The source of each bit of information should also be noted (*e.g.,* GIS, Topo, Recon, or Local or Landowner).**

PAGE 3

Physical Characterization

PHYSICAL & SEDIMENT CHARACTERIZATION>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>						Reviewers Initials			
AN-Code				Date					
Stream Width (m)				Total Habitat Type % Coverage for Reach	Riffle	%	Run	%	Pool	%

Figure 2-8. Example of the Physical Characterization section (Top of PAGE 3) of the field form

Average Stream Width (m): Measure the wetted width of the stream at three transects representative of the 100-m assessment area. In general, the three measurements should be made at the downstream terminus, middle, and upstream terminus of the 100-m assessment area. These measurements will be used to calculate (40 x average width) the reach length for sites with substrate characterization (pebble counts) scheduled. Streams greater than 30 m in width will require a visual estimate at three points following the above protocols (if stream conditions permit, try to get one actual reading). Record the measurements and calculate the average stream width (for pebble counts only). The **Geomorph** will take the measurements while establishing the 100-m assessment area (Note: do not walk in stream or take stream measurements until physicochemical data has been collected). A tape measure or measuring stick (Thalweg pole) is provided for taking the measurements. The **Geomorph** must conduct this part of the assessment. The gathering of this information is important for several reasons. First, it provides data that is necessary to classify streams by size. Additionally, it requires the Geomorph to cover the entire 100-m reach that will allow for increased accuracy and consistency in the assessment of habitat.

Total Habitat Type % Coverage for Reach: Estimate the percent coverage of each habitat type (**Riffle**, **Run**, & **Pool**) for the 100m reach. **When considering the Pool coverage, remember to count biologically functional pools in smaller streams (*i.e.,* do not use the <0.5 m cutoff used in the deep flow regimes in the RBP). This parameter is best evaluated after completing the Dominant Substrate Type and Reach Characterization as described on *page 2-52*.**

Sediment Characterization

Sediment Odors		Sediment "Oils"		Sediment Deposits			
	Normal		Absent		Overall Silt		Relic Shells
	Sewage		Slight		Overall Sand		Marl (See Note at Left)
	Petroleum		Moderate		Overall Fine Gravel		Limestone Chunks or Fines
	Chemical		Profuse		Coal Chunks and Fines		Paper Fiber
	Anaerobic (Septic)	Rate Sediment Deposits: 0-None, 1-Low, 2-Moderate, 3-High, 4-Extreme, NR-Not Rated			Red Dog		Sludge
	Other:				Iron (Orange Hydroxide)	Probable Source: ☐ Mining ☐ Natural ☐ Other	
Note: Marl (crumbly, grayish, lightweight) *** Potomac Direct Drains Only*** Place Marl In Proper Size Class Under "Inorganic Substrate" on Page 9					Aluminum (White Hydroxide)	Probable Source: ☐ Mining ☐ Natural ☐ Other	
					Manganese (Black Hydroxide)	Probable Source: ☐ Mining ☐ Natural ☐ Other	
					Other:		
Sediment Notes & Comments (Describe other or intensity):							

Figure 2-9. Example of the Sediment Characterization section (Middle of PAGE 3) of the field form

Sediment Odors: Disturb the sediment and note any odors described (**Normal**, **Sewage**, **Chemical**, **Petroleum**, **Anaerobic (Septic)**, or **Other**) which are associated with sediment in the sampling reach. Examine depositional areas for this parameter and collaborate with the Biomorph in making the decision.

Sediment "Oils": Disturb the sediment and choose the term (**Absent**, **Slight**, **Moderate**, or **Profuse**) that best describes the relative amount of sediment oils observed in the stream sampling area. Examine depositional areas and collaborate with the Biomorph before making the decision.

NOTE: It should be noted that Manganese compounds will often form sheens on the surface of waters and in the sediment that can resemble oil (*see Figure 2-10 on next page*). Therefore, this category has oils in quotation marks.

Figure 2-10. Example of Manganese sheen that resembles a true oil sheen in its rainbow coloration.

Sediment Deposits: Note the presence of and rate the following sediment deposits:

- Overall Silt,
- Overall Sand,
- Overall Fine Gravel,
- Coal Chunks or Fines (***see Figure 2-12 on page 2-47***),
- Red Dog (***see Figure 2-12 on page 2-47 and Figure 2-13 on page 2-49***),
- Relic Shells,
- Marl (***see box on next page and Figure 2-11 on page 2-47***),
- Limestone Chunks or Fines (fines to boulders),
- Paper Fiber,
- Sludge,
- Iron Hydroxides or FeOH (***see Figure 2-13 and Figure 2-14 on page 2-49, Figure 2-19 on page 2-53, and Figure 2-24 on page 2-59***),
- Aluminum Hydroxides or AlOH (***see Figure 2-24 on page 2-59***),
- Manganese Hydroxides or MnOH and other Manganese compounds (***see Figure 2-10 on previous page and Figure 2-15 & Figure 2-16 on page 2-50***),
- Any other deposits not listed which are present in the sampling area.

NOTE: Sediment deposits may be counted more than once. For example, Limestone Fines may be rated as Overall Sand as Limestone Chunks or Fines.

Rate each as **0-None, 1- Low, 2- Moderate, 3-High, 4-Extreme, and NR-Not Rated (used if for some reason the substrate cannot be seen like when visiting a TMDL site during high turbidity events).** Limestone Chunks and Fines should include any non-native limestone (*e.g.,* road gravel, rip-rap, *etc*.) that is found in the stream.

Rate the intensities of each type of metal hydroxide (Iron=Orange/Yellow/Red), Aluminum=White, Manganese=Black). Also, indicate the probable source of any metal hydroxide as Mining, Natural or Other. If the probable source it is not known, do not guess natural. If both Mining and Natural seem likely, indicate both.

If other is indicated as a sediment deposit, then describe further under Sediment Notes & Comments. Collaborate with the Biomorph before making final rating decisions.

WHAT IS MARL?
Marl is a lime-rich mud or mudstone material that is considered transitional between Lime/Limestone (which is >75% Calcium carbonate) and Mud/Mudstone (which is >75% clay). Specifically, it is 65- 35% Calcium carbonate and 35-65% clay. It is rather light in color (greyish, like limestone) and soft/crumbly & lightweight (like clay). In West Virginia, it is found almost exclusively in certain streams in the extreme Eastern Panhandle (Potomac Direct Drains Watershed). This area is underlain by large limestone deposits. It often appears as sand or fine gravel size pieces but can also be apparent as a clay-like deposit on the stream bank.

Figure 2-11. Example of a layer of Marl under a layer of soil in a stream bank.

Figure 2-12. Example of Red Dog and Coal Chunk Sediment Deposits.

HOW TO IDENTIFY RED DOG:
An intern or new field worker may not be familiar with what exactly Red Dog is. Red Dog is a material created from the inadvertent slow burning of small bits of rock and coal in a refuse pile. It is characterized by the red color from minerals containing iron, which is brought out by the burning in a low oxygen environment. Sometimes hard to distinguish from crushed red brick or iron hydroxide coated rocks by a novice. The first photo below (***Figure 2-13 left***) shows the similarity (iron coated rock on left, Red Dog on right). The second (***Figure 2-13 right***) shows the striking difference in cross section. To a new field worker these phenomena are often novel and interesting. Also, see ***Figure 2-19*** on ***page 2-53*** for an illustration of heavy to extreme iron (orange/yellow/red) metal hydroxides coating the substrate of a stream.

Figure 2-13. Iron Hydroxides versus Red Dog
Left: An iron coated rock on left and a piece of red dog on right. Right: A cross section of the same rocks (the iron coated rock on left and a piece of red dog on right).

Figure 2-14. Examples of streams coated with Iron Hydroxides.

Figure 2-15. Example of rocks stained black with Manganese Hydroxides.

Figure 2-16. Examples of Manganese Hydroxides rubbing off a piece of substrate.

Sediment Notes & Comments: Provided as a space to describe unusual substrates or qualities of the substrate. Use this area to elaborate on metal hydroxide sources, limestone chunks and fines sources, trash like bricks, concrete, or asphalt chunks that are serving as benthic substrate.

Substrate Particle Layer Profile

Substrate Particles	Particle Codes	Size Class
Bedrock	BR	Smooth surface rock/hardpan (>4000 mm –bigger than a car)
Boulder	BL	Basketball to car (>250-4000 mm)
Cobble	CB	Tennis ball to basketball (>64-250 mm)
Coarse Gravel	CG	Marble to tennis ball (>16-64 mm)
Fine Gravel	FG	Ladybug to marble (>2-16 mm)
Sand	SA	Gritty – up to ladybug (>0.06-2 mm)
Silt & Fines	ST	Fine – not gritty (<0.06 mm)
Clay	CL	Slick/ hard clay or hard-pan clay
Metal Hydroxide	MH	Any Metal Hydroxide Deposits (Use only in the Substrate Layer Profile)

Substrate Particle Layer Profile				
Location[1]	Habitat Type[2]	Substrate Particle[3]	Sand & Silt Thickness (cm)[4]	
				Top
Special Instructions: *1) Sample riffle habitat if available. 2) The location (left, middle, or right) is to be kept consistent for each consecutive visit if possible (e.g., High Flows).*				
		Notes:		Bottom
R M L RDB LDB				Box above is 1cm wide

1. Location (left, middle, right) along a transect across the stream. 2. Habitat type (riffle, run, pool). 3. Substrate Particle (use Particle Codes) is determined by removing one particle at a time (documenting each as a separate layer) starting from the uppermost layer and working down to the bottom. Only one layer profile is required per visit. 4. The thickness in cm of the sand & silt layers present in the profile. *DO NOT LABEL TWO CONSECUTIVE LAYERS OF SAND OR SILT (e.g., 1-Sand, 2-Sand or 1-Silt, 2-Silt)!!!!!*

Figure 2-17. Example of the Substrate Particle Layer Profile section (Middle of PAGE 3) of the field form

> ***IMPORTANT*: The purpose of this evaluation is to document the colonization potential of the substrate relative to sedimentation. Therefore, it is important to include Metal Hydroxides in the layer profile as they may have a smothering/cementing effect on the stream substrate in some situations. In addition, it is essential that the habitat, location, and silt/sand layer depths be recorded to calculate the final Substrate Layer Profile Score.**

Find a riffle habitat, if available, near the X-site as this is the preferred habitat for this measurement. Document the habitat type (Riffle, Run, and Pool) of the measurement. Choose a location along the cross-section (Right, Middle, or Left facing downstream) that is convenient and will be consistently available for measurement in future visits during all possible flow regimes. It is preferred that this is the Middle if possible. This exact location is to be kept consistent for each consecutive visit if possible. An example of an instance where the same location may not be available for a sample would be a high flow that prevents measurement in the same location as prior visits. If you do need to move to an alternate location, be sure that you are still within the normal stream channel (look for a lack of vegetation). If high flows keep you on the bank, do not take this measurement. Next, begin to remove and document the substrate (***using the Substrate Size Classification outlined in Figure 2-17 on the previous page or Table 2-3 below***) one layer at a time. If any sand or silt is documented, record the depth of that layer in cm.

***IMPORTANT*: Do not document two layers of sand or silt in succession (e.g., Layer 1=SA-Sand, Layer 2=SA-Sand). Instead, document the thickness of these layers.**

Repeat this until the top five layers are documented or until you reach the bottom of the biologically inhabitable zone (no more than 5-10 cm). Record any notes that may be necessary.

Table 2-3. Substrate Size Classification for Substrate Layer Profile and Dominant Substrate Type and Reach Characterization

Class	Code	Size	Description
Bedrock	BR	>4000 mm	Bigger than car
Boulder	BL	>250-4000 mm	Basketball to car
Cobble	CB	>64-250 mm	Tennis ball to Basketball
Coarse Gravel	CG	>16-64 mm	Marble to Tennis ball
Fine Gravel	FG	>2-16 mm	Ladybug to marble
Sand	SA	>0.06-2 mm	Gritty between fingers
Silt & Fines	ST	<0.06 mm	Smooth, not gritty (silt & muck)
Clay	CL	>4000 mm	Slick/ hard clay or hard-pan clay bottom
Metal Hydroxides	MH		Any Metal Hydroxide Deposit (Use this class only in the Substrate Layer Profile)

Dominant Substrate Type and Reach Characterization

Dominant Substrate Type - Reach Characterization (See Above for Substrate Particle Size Codes)

Reach Location (m)	Habitat Type	Depth (m)	Dom Sub 1	% age 1	Dom Sub 2	% age 2	Reach Location (m)	Habitat Type	Depth (m)	Dom Sub 1	% age 1	Dom Sub 2	% age 2

1. Reach Location (from d.s. end), 2. Habitat type (riffle = rf, run = rn, pool = p), 3. Dom substrate (class codes), 4. %age (estimate in the habitat)

Figure 2-18. Example of the Dominant Substrate Type and Reach Characterization section (Bottom of PAGE 3) of the field form

NOTE: The information generated from this task should help one more accurately fill out other portions of the form (*e.g.,* the Total Habitat Type % Coverage for Reach, Sediment Deposit Intensities, and *the USEPA's Rapid Bioassessment Protocol Visual-Based* Habitat Assessment *parameters Epifaunal Substrate, Sediment Deposition, and Riffle*

At various points along the stream reach where there is a sudden change in habitat type, substrate type, or depth, measure the stream depth (m) using the Thalweg pole and

document the position (relative to the downstream end of the reach) along the stream reach in meters, the habitat type (riffle, run, or pool), the 1st dominant substrate type (***using the Substrate Size Classification in Table 2-3 on the previous page***) and its percent aerial coverage (what you see on top in your "cone of vision"), and then the 2nd dominant substrate type and percent aerial coverage. Take measurements throughout the reach (Geomorph responsibility). Some streams sites may not have all three habitat types (usually pools are missing). **When considering the Pool areas, remember to count biologically functional pools in smaller streams (*i.e.,* do not use the <0.5m deep flow regime cutoff used in the RBP).**

IMPORTANT: ***Do not use Metal Hydroxides as a class when evaluating the dominant substrate type; only use the functional size classes (i.e., those that have size ranges). Instead evaluate how the metal hydroxide is functioning structurally in the stream. Does the metal hydroxide just coat some cobble or gravel and does not prevent them from functioning structurally as cobble or gravel; or does the metal hydroxide fuse the substrate to the point of being structurally more like bedrock? See Figure 2-19 on next page for an illustration.***

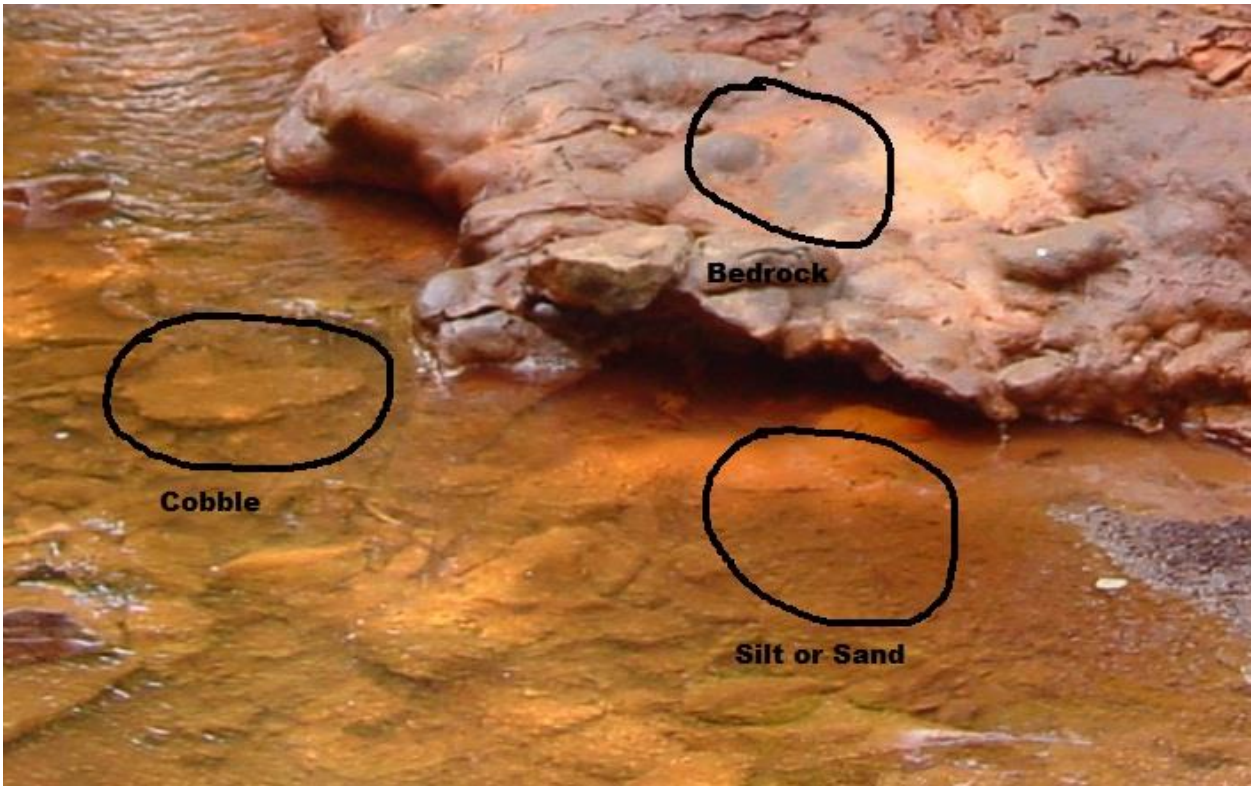


Figure 2-19. An example of Heavy to Extreme Iron (Orange/Yellow/Red) Metal Hydroxides coating the substrate

The area labeled cobble is just cobble coated with the metal hydroxide, but still functions like cobble. The area labeled silt or sand is metal hydroxide that has coated or settled out like silt or sand; it is still loose. However, the area in the upper right functions like bedrock due to fusing/armoring of the substrate by the metal hydroxides.

PAGE 4

Stream Debris (Not found on the Wadeable Benthic Assessment Form)

This data component is not found on the Wadeable Benthic Assessment Form (except for the Periphyton and Filamentous Algae ratings) but is found on the TMDL and Ambient Network forms.

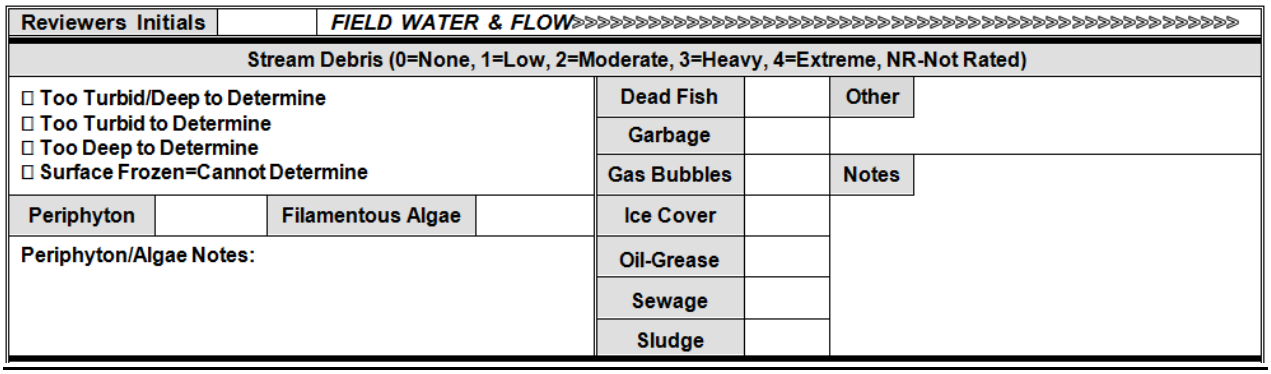


Figure 2-20. Example of Surface Debris Section (TMDL and Ambient Network Forms)

Dead Fish: Indicate the abundance of dead fish in and near the stream assessment area as **0-None, 1-Low, 2-Moderate, 3-High, 4-Extreme, and NR-Not Rated**.

Garbage: Indicate the abundance of garbage in and near the stream assessment area as **0-None, 1-Low, 2-Moderate, 3-High, 4-Extreme, and NR-Not Rated**. Be sure to consider all garbage than may be moved into the channel during high flows/flooding.

Gas Bubbles: Indicate the abundance of gas bubbles in the stream in the assessment area as **0-None, 1-Low, 2-Moderate, 3-High, 4-Extreme, and NR-Not Rated**.

Ice Cover: Indicate the abundance of ice cover on the stream in the assessment area as **0-None, 1-Low, 2-Moderate, 3-High, 4-Extreme, and NR-Not Rated**.

Oil-Grease: Indicate the abundance of oil or grease in the stream in the assessment area as **0-None, 1-Low, 2-Moderate, 3-High, 4-Extreme, and NR-Not Rated**.

Sewage: Indicate the abundance of sewage in the stream assessment area as **0-None, 1-Low, 2-Moderate, 3-High, 4-Extreme, and NR-Not Rated**.

Sludge: Indicate the abundance of sludge in the stream assessment area as **0-None, 1-Low, 2-Moderate, 3-High, 4-Extreme, and NR-Not Rated**.

Other/Notes: Indicate the abundance of any other notable Stream Debris (*e.g.,* recently fallen leaves) not mentioned as **0-None, 1-Low, 2-Moderate, 3-High, 4-Extreme, and NR-Not Rated**. Also, make notes regarding any of the above.

Field Water Quality Measures

Reviewers Initials		*FIELD WATER & RIPARIAN VEGETATION ZONE MEASURES>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>*											
WQ Sample Location	☐ Mid-Stream ☐ Bank (☐ Left ☐ Right) ☐ Thalweg (☐ Left ☐ Middle ☐ Right) ☐ Left Channel ☐ Right Channel ☐ Cross Section ☐ Other:									WQ Type	☐ Single ☐ Profile ☐ Other:		
Sonde Method	☐ Grab ☐ Sample Tube ☐ Bucket						Lab Water Method	☐ Grab ☐ Sample Tube ☐ Bucket					
Flag	Physicochemical Parameters (for a Single Water Quality Sample)		Seasonal Water Level		Water Odors		Surface "Oils"		Turbidity				
		Temperature ℃		Below Normal		Normal		None		Clear			
		pH (std. Units)		Normal		Sewage (Not Septic)		Flecks		Slightly Turbid			
		Dissolved Oxygen (mg/L)		Above Normal		Petroleum		Sheen		Moderately Turbid			
		Conductivity (µmhos/cm)		Flooding		Chemical		Globs		Highly Turbid			
Sonde I.D. #:_____ If any problems occur with the Water Meter or any readings are suspect, record notes in the space to the right.			Foam (Non-Soap)	Suds (Soap)		Anaerobic (septic)		Slick	Water color:				
						Other:	Notes:						
			Rate 0-4 or NR										
ABOVE: Record readings in box for corresponding physicochemical parameter. Insert a √ in the box for other categories.													
Precipitation Status and History													
Current			Past 24 Hours (If Known)				Major Rain Event in past week?	☐ Yes ☐ No					
If it is raining or has rained recently, which of the following best describes the peak runoff (flush) condition of the stream at the site when water samples were collected? If the runoff condition is in response to snowmelt, please indicate as such above.													
N/A		< 1 Hour		1 to 4 Hours		4 to 12 Hours		12 to 24 Hours		1 to 2 Days		2 to 4 Days		4 to 7 Days		Unknown	
Is the stream level rising, falling, or at baseflow at the time of visit?						☐ Unknown		☐ Baseflow		☐ Rising		☐ Falling	

Figure 2-21. Example of the Field Water Quality Measures section (Top of PAGE 4) of the field form

WQ Sample Location: Indicate the cross-sectional location of the water quality sampling: 1) **Mid-Stream**, 2) **Bank** (**Left** or **Right**) (Note that selecting this implies that you are taking the sample from the bank without entering the stream), 3) **Thalweg** (**Left**, **Middle**, or **Right**), 4) **Left Channel**, 5) **Right Channel**, 6) **Vertical** (*i.e.,* vertical profiles done on lakes or rivers where samples are taken at multiple depths), 7) **Cross Section-Lateral** (*i.e.,* samples are taken across a stream channel at Left Bank, Mid-Stream, and Right Bank or specific measured distances), 8) **Cross Section-Longitudinal** (*i.e.,* samples are taken along the distance of a stream reach at specific measured distances), 9) **Other** (please describe).

> **NOTE: There is a subtle distinction between Mid-Stream and Thalweg-Middle. Mid-Stream means that you are selecting your location based on the width between the two wetted banks. Thalweg-Middle means that you explicitly sought out the Thalweg and it happens to be closer to the middle rather than near a bank.**

WQ Type: Indicate type of water quality sampling: 1) **Single** (*i.e.,* a single discrete sample is taken at only one of the first five WQ Sample Locations described above = 1 WQ ID), 2) **Profile** (*i.e.,* discrete samples are taken at multiple locations based on varying depth, width, or length of the reach locations, but kept separate as distinct water samples with unique time stamps = > 1 WQ IDs), 3) **Composite** (*i.e.,* discrete samples are taken at

multiple locations, based on varying depth, width, or length of the reach locations, but combined into one sample = one WQ ID), 4) **Other** (please describe).

Sonde Method: Indicate the type of collection method used with the water quality sonde: 1) **Grab** (*i.e.,* direct stream or water column measurement), 2) **Bucket with Crane**, 3) **Van-Dorn Bottle**, 4) **Sample Tube with Rope**, 5) **Bucket with Rope**, 6) **Deployable**, 7) **Other** (please describe).

Lab Water Method: Indicate the type of collection method used to obtain the lab water: 1) **Grab** (*i.e.,* direct stream or water column measurement), 2) **Bucket with Crane**, 3) **Van-Dorn Bottle**, 4) **Sample Tube with Rope**, 5) **Bucket with Rope**, 6) **Clean Hands** (*e.g.,* Mercury sampling), 7) **Other** (please describe).

Flag: Indicate if one of the recorded values was not accurate or suspected of being in error. This field may also be marked in by the data entry person (in pen) if they suspect inaccuracy of the instrument readings. ***Examples of Flag Codes used in the fields are in Table 2-4 below***.

Table 2-4. Examples of Flag values used on the field forms

I	Parameter not recorded or deleted due to instrument problems or maintenance issues
L	Parameter recorded but suspected to be incorrect value; There is a low probability that the value is incorrect
M	There is a moderate probability that the value is incorrect
H	There is a high probability that the value is incorrect

Physicochemical Parameters - Temperature, pH, D.O., Conductivity: Record the values for each of the physicochemical parameters indicated from the water probe. 1) **Temp**-^{O}C, 2) **pH**-Standard Units, 3) **D.O.**-mg/l, and 4) **Conductivity**-μmhos/cm.

Sonde I.D.: Record the sonde instrument identification number. This is usually marked on the sonde with a black sharpie. Do not confuse this with the old jeep number (often marked on the camera in white ink).

IMPORTANT: Do not record the number written on the display unit as this unit does not store calibration information.

If for some reason the instrument identification number of the sonde is not apparent, then write down the WV Property Tag number (found on a blue tag) or the manufacturer's Serial Number on the instrument so that the proper identification number can be tracked down later and remarked onto the sonde.

Seasonal Water Level: Indicate the water level relative to the season as 1) **Below Normal**, 2) **Normal**, 3) **Above Normal**, or 4) **Flooding**. **Example**: in general, high water in autumn would be Above Normal.

NOTE: Starting in 2016, Foam and Suds are to be evaluated separately. Before this, they were evaluated together.

Foam (Non-Soap): Rate the any Foam on the surface of the water based on the following scale: **0-None**, **1- Low**, **2- Moderate**, **3-High**, **4-Extreme**, and **NR-Not Rated.** The presence of foam in streams is usually a product of nature. The most common cause of "natural" foam streams is turbulence via riffles and runs. Foam may also occur when plants and small aquatic organisms decompose and release a variety of organic compounds. Organic compounds leached from the soil also cause foam. Natural foam has a somewhat earthy or fishy smell, and it breaks down rather quickly. Foam from silt or erosion will usually have a brown color (***see Figure 2-22 on right***). Foams formed in the presence of acid mine drainage will often take on the color of any metal hydroxides in the stream (most commonly orange from iron hydroxides).

Figure 2-22. Example of Foam.

Suds (Soap): Rate the any Suds on the surface of the water based on the following scale: **0-None**, **1- Low**, **2- Moderate**, **3-High**, **4-Extreme**, and **NR-Not Rated.** Suds, unlike foam, originate from soaps and detergents entering the stream via straight pipes and drainages. They can be easily distinguished from foam by their scent (*i.e.,* they smell like soap) and the bubbles often have an iridescence.

Water Odors: Record the odors described (include any odors not listed) that are associated with water in the sampling area: 1) **Normal**, 2) **Sewage**, 3) **Petroleum**, 4) **Chemical**, 5) **Anaerobic (Septic)**, or 6) **Other**. Collaborate with the Biomorph in making the decision.

Surface Oils: Note the term(s) that best describes the relative amount of water surface oils present: 1) **None**, 2) **Flecks**, 3) **Sheen**, 4) **Globs**, or 5) **Slick**. Collaborate with the Biomorph in making the decision. These are generally associated with urban, industrial, or oil/gas activities.

Turbidity: Indicate the term that best describes the amount of material suspended in the water column:

1. **Clear** – Little to no apparent material is suspended and does not obscure visibility through in the water column.
2. **Slightly Turbid** – Some material is suspended in the water column that which to a minor degree obscures visibility & may prevent seeing the bottom substrate.
3. **Moderately Turbid** – Material is suspended in the water column which noticeably obscures visibility & mostly prevents seeing the bottom substrate.
4. **Highly Turbid** (or Turbid) – Material is suspended in the water column which highly obscures visibility & the bottom substrate.

> **NOTE: There can often be situations in which riffle/run areas appear to have drastically different turbidities than deeper pool areas. If this is the case, base the rating on the average turbidity found across the reach.**

See Figure 2-23 below and Figure 2-24 on next page for examples of turbidity. Also, you can look at the water samples collected to help gage the turbidity extent of low turbidity water (*i.e.*, the difference between Clear and Slightly Turbid).

Figure 2-23. Example of a Highly Turbid Stream with a brownish color.

Water Color: Indicate whether the water color is normal (clear) or colored (*e.g.,* orange for iron impacted streams, milky white in aluminum impacted streams). ***See Figure 2-23 above and Figure 2-24 on below for examples of water color***. The color of the water will often indicate the types and origin of the suspended material in the stream (*e.g.*,

brownish water is likely sediment, red/orange may be from FeOH in mine drainage, white may be from AlOH in mine drainage, *etc.*).

Precipitation Status: Describe **precipitation events only** for the area during the time of visit and within the last 24 hours if possible. Comment on any heavy rainfall events, snowmelt, or storms that might have an impact on the water quality during sampling. This information can also be gathered by questioning locals you encounter, especially if you are just arriving to the area at the beginning of the week.

Figure 2-24. Example of a Moderately Turbid stream. Note the presence of FeOH on the rocks and milky white color of the water caused by AlOH.

Major Rain Event in past week?: If there were any major rain events in the past week answer **YES** or **NO.** A major rain event is defined as a precipitation event that would result in the rise of stream level and/or drastic change in the turbidity of the stream (clear to muddy). For example, in a small 1st order stream, a brief light shower will probably not result in a change of the water level or turbidity, but light showers that last all day might. However, in a large stream or river, the same all-day light showers would probably not affect the water level or turbidity to any great extent.

Peak Runoff: If it is raining or has rained recently, which of the following best describes the peak runoff (flush) condition of the stream at the site when water samples were collected**:** 1) **N/A**, 2) **<1 hour**, 3) **1 to 4 hours**, 4) **4 to 12 hours**, 5) **12 to 24 hours**, 6) **1 to 2 Days**, 7) **2 to 4 Days**, 8) **4 to 7 Days**, or 9) **Unknown**. Unless you have monitored the rainfall prior to arriving, the most likely answer is **Unknown** during your first day in the area. If you are experiencing a drought period, then **N/A** may be the most appropriate answer.

Is the stream level rising, falling, or at baseflow at the time of visit?: Indicate if the stream level is 1) at **Baseflow**, 2) **Rising**, or 3) **Falling**. This can be hard to judge if a major rain event has occurred in the past week or if you are just arriving to the area at the beginning of the week. Attempt to answer the best that you can.

NOTE: This box is not on the Wadeable Benthic form. This is because a benthic sample would never be collected under most of these "No Flow" conditions. However, this box is found on the TMDL and General WQ forms.

Flow Information (Not found on the Wadeable Benthic Assessment Form)

FLOW INFORMATION	If using an OTT MF Pro meter, then record information here. If using a Marsh-McBirney meter or conducting a gage reading, put info on a Flow Appendix sheet.						
No Flow?: If a flow was scheduled for the site and not performed, then indicate if one of the following applies	☐ Dry ☐ Low Flow ☐ Too Deep/Too Fast ☐ Instrument Failure ☐ Frozen/Ice ☐ Safety ☐ Substrate						
Profile Name		Measurer		Flow Method	☐ Flow Meter ☐ Timed-Bucket ☐ Gage ☐ Estimate	Flow Meter ID	
File Name		Time					
Do you think that this flow measurement is comparable?	☐Yes ☐No	If not comparable, Why? (Write Below)		Final Discharge Reading (cfs or ft^3/s)=			
Flow Notes:							

Figure 2-25. Example of Flow Information Section (TMDL and Ambient Network Forms)

This data component is not found on the Wadeable Benthic Assessment Form but is found on the TMDL and Ambient Network forms. The main purpose of this section is to allow for a place for flow measurement metadata to be documented on paper when using the ***OTT MF Pro*** Flow Meter, which stores the individual stream flow measurement information (distance, depth, velocity, *etc*.) electronically to a file.

No Flow?: If a flow was scheduled for the site and not performed, then indicate if one of the following applies: 1) **Dry**, 2) **Low Flow**, 3) **Too Deep/Too Fast**, 4) **Instrument Failure**, 5) **Frozen/Ice**, or 6) **Safety**.

Profile Name: The name of the flow profile keyed into the ***OTT MF Pro*** Flow Meter. **This should be the same as the WQ ID.**

File Name: The name of the file (.csv) for the profile keyed into the ***OTT MF Pro*** Flow Meter. **This should be the same as the WQ ID.**

Measurer: Record the flow measurer.

Time: The time of the flow measurement.

Flow Method: The method used to assess the flow: 1) **Flow Meter**, 2) **Timed Bucket**, 3) **Gage**, or 4) **Estimate**.

Flow Meter I.D.: The assigned number of the flow meter used. **Do not confuse this with the old jeep number often marked on the flow meter in white ink.** If for some reason the flow meters' instrument identification number is not apparent, then write down the WV Property Tag number (found on a blue tag) or Manufacturer's Serial Number on the instrument so that the proper identification number can be tracked down later and remarked onto the flow meter.

Do you think that this flow measurement is comparable?: Answer **Yes** or **No**. Do you think that there were enough unusual circumstances that would make you want to consider the flow measurement not comparable (*e.g.,* too many shallow measurements below 0.1 ft. depth, too many changes in the direction of flow vectors across the transect, *etc*.)?

If not, why?: Why it is believed the flow measurement is considered not comparable; elaborate under Flow Notes below.

Final Discharge Reading (cfs): Record the total stream discharge by entering in the Distance, Depth, and Velocity data from each increment into the Flow Spreadsheet or record the reading from a gage.

Flow Notes: Any notes about the flow measurement in general (*e.g.,* general substrate type, reasons why not comparable, *etc.*).

Stream Bank/Riparian Buffer Zone Vegetation/Cover Type

Riparian Vegetation Classification

This segment of the stream assessment form was originally developed to address certain objectives proposed in WAB's application for funding under the Wetland's Development Grant Program, 104(b)(3). The principal objective of the project is to assess the integrity of riparian vegetation zones in selected priority watersheds. The following parameters were indicated as possible measures for meeting the proposed objective:

1) Erodibility of riverbank soils
2) Density of bank vegetative cover
3) Riparian disruptive pressure
4) Riparian zone width
5) Percent trees, shrubs, herbs, (bank and riparian zone)

STREAM BANK VEGETATION performs a vital role in the control of erosion to streams. Trees and woody shrubs exhibit deeper and more permanent root systems than grasses and herbaceous plants and are, thus, more effective in reducing erosion throughout the year.

THE RIPARIAN VEGETATIVE ZONE serves as a buffer zone to pollutants that may enter a stream through runoff, controls erosion, and provides stream habitat and nutrient input into the stream. Relatively undisturbed riparian zones with large dominant tree species reflect healthy stream systems and are generally considered indicative of the best possible conditions.

The following visual estimation procedures are a semi-quantitative evaluation of the type and amount of different types of stream bank and riparian vegetation. The assessment will be used to evaluate the health and level of disturbance of the stream corridor.
The following discussion applies only to the <u>Stream Bank / Riparian Buffer Zone Vegetation / Cover Type</u> section on PAGE 4 of the Stream Assessment Form. See Figure 2-26 above for an example of what this section looks like.

Stream Bank/Riparian Buffer Zone Vegetation/Cover Type

→→What is the dominant vegetation type in the reach?
☐ Deciduous ☐ Coniferous (*i.e.*, Spruce, Pine, Hemlock, Rhododendron)
☐ Mixed Deciduous (>10-49% Coniferous) ☐ Mixed Coniferous (>10-49% Deciduous)

Score Codes: 0=Absent (0%) 1=Sparse (0-<10%) 2=Moderate (10-40%) 3=Heavy (>40-75%) 4=Very Heavy (>75%)

Left & Right Bank While Facing Down-Stream	*Determined Within The 1st 18 m (60 Ft) From Stream Edge*	Canopy (>5 M High) (>15 Feet)	Understory (0.5 – 5 M High) (1.5-15 Feet)	Ground Cover (<0.5 M High) (≈1.5 Feet)	Bare / Barren Soil
		Big Trees such as Sycamore, Oaks, Maples, Box Elder, River Birch, Hemlock	*Small trees and shrubby Vegetation such as Willow, Alder, Knotweed (blue devil), Rhododendron, Wingstem*	*Ferns, Grasses, Mosses, Wildflowers*	*Exposed soil surface, Readily erodible – not rock faces or asphalt roads*
LEFT (18 m) (≈60 ft)					
RIGHT (18 m) (≈60 ft)					

Stream Surface Shading (%) Indicate % based on cloudless day in summer at noon. Place a √ in box that applies.

Fully Exposed (0-25%)		Partly Shaded (25-50%)		Partly Exposed (50-75%)		Fully Shaded (75-100%)	

General Comments (include land cover types outside of 18 m zone on left and right side that may impact water quality at the stream site). *Provide your impression of the buffering capacity of the riparian zone in the 100 m reach including width, allochthonous input, topography, and plant composition.*

Amphibian pool in riparian area? ☐ Vernal ☐ Mud Puddle ☐ Sed. Pond ☐ Farm Pond ☐ Ditch ☐ Lake ☐ Cattail Wetland ☐ Other
Comments:

Invasive Species in the reach riparian area?
<u>Trees</u>: ☐ Tree-of-Heaven <u>Vines</u>: ☐ Kudzu ☐ Japan. Honeysuckle ☐ Other:
<u>Bushes</u>: ☐ Autumn Olive ☐ Multi-flora Rose ☐ Japan. Barberry
<u>Herbaceous/Tall GC</u>: ☐ Japan. Knotweed ☐ Bamboo ☐ Mile-A-Minute
<u>Grass/Low GC</u>: ☐ Japan. Stilt Grass ☐ Crown Vetch ☐ Purple Loosestrife ☐ Garlic Mustard

Figure 2-26. Example of the Stream Bank/Riparian Buffer Zone Vegetation/Cover Type section (Bottom of PAGE 4) of the field form

While standing in a position perpendicular to the stream, visually establish an **18-meter** zone from the right and left stream edge. This 18-m zone (one on each side of stream) will run parallel with the stream throughout the entire 100-m assessment area. Aerial coverage (described below) of the vegetation types will be conducted within this 18-m zone.

***IMPORTANT*: Remember, that the Riparian Buffer Zone evaluation is not based on stem density, but rather an aerial coverage estimate.**

What is the dominant vegetation type in the reach?: Determine the dominant vegetation type within the 100-m reach as 1) **Deciduous** (*e.g.,* Oak, Maple, Sycamore, Birch, Beech, *etc*. >90%), 2) **Coniferous** (*e.g.,* Spruce, Pine, Hemlock, Rhododendron, *etc*. >90%), 3) **Mixed Deciduous** (>10-49% Coniferous), or 4) **Mixed Coniferous** (>10-49% Deciduous) Determination is made by considering both banks together.

Right and left riparian areas are scored separately while looking downstream. Conceptually divide each side into three layers: the **CANOPY** layer (> 15 ft. high or 5 m), the **UNDERSTORY** layer (1.5 to 15 ft. high or 0.5 to 5 m), and the **GROUND COVER** layer (< 1.5 ft. high or < 0.5 m). Note that any one individual plant can potentially occur in more than one layer (*e.g.,* a tree with branches at the canopy and understory level or a shrub or herb at the ground cover and understory levels).

The **CANOPY** category includes big trees such as sycamore, silver maple, box elder, river birch, cottonwood, and hemlock. The **UNDERSTORY** layer includes small trees and shrubby vegetation such as willow, alder, rhododendron, knotweed, wingstem, and multiflora rose. **GROUND COVER** vegetation includes ferns, mosses, and grasses.

***IMPORTANT*: If you are evaluating the stream when the leaves are not on the trees (October-April/May), you need to visualize the CANOPY AND UNDERSTORY as if it was summer. This should not be too hard to do since the branches of the tree indicate where the leaves would be. However, the GROUND COVER cannot be visualized like this very well (especially in forested/wooded riparian areas) as many of the species composing the ground cover layer community are not up and fully visible from October to April/May. Therefore, you must evaluate the GROUND COVER as best as you can with what you can see on the day of sampling.**

Estimate the aerial cover provided by each of the three layers separately per side. **The aerial cover can be thought of as the amount of shadow provided by a given layer**. The maximum cover in each layer is 100%, so the sum of the aerial cover for the combined three layers could add up to 300%. The four entry choices for aerial cover within each of the three vegetation layers are: **0 (Absent= Zero Cover)**, **1 (Sparse= <10%)**, **2 (Moderate= 10-40%)**, **3 (Heavy= >40-75%)**, or **4 (Very Heavy= >75%)**. These ranges are provided as a key on the Stream Assessment Form.

Also, indicate the percent of **BARREN OR BARE SOIL** within the same 100-m reach and 18 m zone. This refers to highly erodible surfaces and does not include rock cliff faces or asphalt/concrete roads.

Stream Surface Shading (%): Stream surface shading plays a significant role in maintaining water quality in streams. Exposed streams will often experience increased water temperatures that may be directly or indirectly limiting to some organisms and may be favorable to nuisance algae and result in decreased dissolved oxygen. Light intensity may be favorable to some organisms and limiting to others. In general, a partially shaded (50-75%) stream achieves the greatest diversity. A fully shaded stream may inhibit the growth and reproduction of herbaceous aquatic and riparian plants. This situation can potentially inhibit primary production, cover, and habitat. However, this situation does provide better temperature control and increased allochthonous (organic material from outside sources) food resources.

Estimate the percent of stream surface shading using the following categories: **Fully Exposed (0-25%)**, **Partially Shaded (25-50%)**, **Partially Exposed (50-75%)**, and **Fully Shaded (75-100%)**. Evaluate the shading based on a cloudless day in the summer at noon.

Riparian Vegetation Comments Box: *Describe your impressions of the condition of the riparian zone in the 100-m stream reach.* What is its' buffering ability? How intact is the riparian vegetation? Describe the vegetation species assemblage for both sides. Indicate the presence of human activities. Note the land cover type(s) immediately adjacent to the 18-m riparian vegetative zone on both left and right banks. Again, comments in this section are useful during 305(b) stream assessments. ***See CHAPTER 18. FREQUENT TERMINOLOGY starting on page 18-1 for examples of terms that can be used to describe the human activities in the immediate riparian area and beyond.***

Amphibian Pool Present in riparian area?: Indicate if any of the following amphibian habitat types were present in the riparian area of the stream assessment reach:

1) **Vernal Pools** - Vernal pools are an extremely scarce wetland habitat type occurring only where certain soil conditions are present. In late summer, fall and early winter, vernal pools appear as dry, dusty indentations mostly devoid of vegetation. Look for depressions filled with water along the stream bank and riparian zone.
2) **Mud Puddle** – small depressions in dirt roads are often great habitats for amphibian breeding.
3) **Sediment Ponds** - sediment ponds are built to trap runoff water. Sediment settles to the bottom of these ponds rather than accumulating in local creeks and streams. Typically found below valley fills and other mined areas.
4) **Farm Pond** – livestock watering hole or used for irrigation to crops.
5) **Ditch** – roadside ditches or channel-ways that trap water in low places.
6) **Lake** – larger than a pond.
7) **Cattail Wetland** – typical of waterbodies that are classically considered to be true wetlands (*e.g.,* Greenbottom Swamp or Canaan Valley).
8) **Other** – Include comments in the area provided to elaborate on any of these.

Invasive Plant Species in reach riparian area?: Indicate if any of the following invasive species were present in the riparian area of the stream assessment reach:

Trees:
Tree-of-Heaven
Vines:
Kudzu
Japanese Honeysuckle
Bushes:
Autumn Olive
Multi-flora Rose
Japanese Barberry
Herbaceous/Tall GC (Ground Cover):
Japanese Knotweed
Bamboo
Mile-A-Minute
Grass/Low GC (Ground Cover):
Japanese Stiltgrass
Crown Vetch
Purple Loosestrife
Garlic Mustard
Other: Check this box and write in the name of any other less common invasive species (***see examples Table 2-5 on the next page***).

The following references are to be used in the field to assist in identifying Invasive Plant Species:

Swearingen, J., B. Slattery, K. Reshetiloff, and S. Zwicker. 2010. Plant Invaders of Mid-Atlantic Natural Areas, Fourth Edition. National Park Service and U.S. Fish and Wildlife Service. Washington, D.C. Available online at: *http://www.nps.gov/plants/alien/pubs/midatlantic/midatlantic.pdf*

Pennsylvania's Field Guide to Aquatic Invasive Species. 2013. Pennsylvania State University, Pennsylvania Sea Grant. Available online at: *http://www.anstaskforce.gov/Documents/AIS_Field_Guide_Finalweb.pdf*

If there is any doubt or concerns about the identification, the plant should be either photographed, sampled, or both for confirmation by staff experts.

Table 2-5. A brief list of Invasive Plant Species in WV.

Scientific Name	Common Name	Type
Achillea millefolium	Common Yarrow	Flower
Ailanthus altissima	**Tree of Heaven**	**Tree**
Albizia julibrissin	Mimosa, Silk-Tree	Tree
Alliaria petiolata	**Garlic Mustard**	**Ground Cover**
Berberis thunbergii	**Japanese Barberry**	**Bush**
Cichorium intybus	Chicory	Flower
Cleome hassleriana	Spiderflower	Flower
Commelina communis	Asiatic Day-Flower	Flower
Coronilla varia	**Crown Vetch**	**Ground Cover**
Daucus carota	Queen Anne's Lace, Wild Carrot	Flower
Elaeagnus umbellata	**Autumn Olive**	**Bush**
Glechoma hederacea	Ground-Ivy	Vine
Hedera helix	English Ivy	Vine
Hemerocallis fulva	Common Day Lily	Flower
Lonicera japonica	**Japanese Honeysuckle Vine**	**Vine**
Lotus corniculatus	Birdsfoot Trefoil	Flower/Herb
Lysimachia nummularia	Moneywort	Vine/Ground Cover
Lythrum salicaria	**Purple Loosestrife**	**Tall Herb/Wildflower**
Microstegium vimineum	**Japanese Stiltgrass**	**Grass**
Myriophyllum aquaticum	Parrot's Feather	Aquatic/Submerged
Myriophyllum spicatum	European Water-Milfoil	Aquatic/Submerged
Najas minor	Eutrophic Water-Nymph	Aquatic/Submerged
Paulownia tomentosa	Princess-Tree	Tree
Phyllostachys aurea	**Bamboo**	**Grass**
Polygonum cuspidatum	**Japanese Knotweed**	**Tall Herb**
Polygonum perfoliatum	**Mile-A-Minute**	**Vine**
Potamogeton crispus	Curly Pondweed	Aquatic/Submerged
Pueraria lobata	**Kudzu Vine**	**Vine**
Rosa multiflora	**Multiflora Rose**	**Bush**
Rubus phoenicolasius	Wineberry	Bush
Trifolium pratense	Red Clover	Herb/Flower
Urtica dioica	Stinging Nettle, Common Nettle	Herb
Verbascum blattaria	Moth Mullein	Flower
Verbascum thapsus	Great Mullein	Flower

Note: The plants of major concern are highlighted in Bold and already given as options on the form.

PAGES 5, 6, 5a, and 6a

USEPA's Rapid Bioassessment Protocol Visual-Based Habitat Assessment

Overview

The Visual-Based Habitat Assessment approach (VBHA) used in this protocol is adapted from USEPA's Rapid Bioassessment approach, which was refined from various applications across the country (***see Figure 2-27 on next page***). The approach focuses on integrating information from ten specific parameters (five evaluated within a defined stream reach and fire evaluated beyond the stream reach) relating to the structure of the stream habitat. The parameters are generally considered to be universal physical features in streams throughout the United States and are scored using a standardized scale (0-20) for each. The ten parameter scores are summed for a Total Habitat Score (0-200). Additionally, each parameter and the Total Habitat Score can be categorized into one of four categories based on the standardized scale (*i.e.*, *Optimal*, *Sub-Optimal*, *Marginal*, *Poor*). Standardization allows for a VBHA score taken in one part of the country to be reasonably comparable to one taken in another part of the country.

Refer to the following references for further information about the Rapid Bioassessment Protocols and Visual-Based Habitat Assessment and its evolution thru the years:

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C. *http://water.epa.gov/scitech/monitoring/rsl/bioassessment/download.cfm*

Lazorchak, J.M., A.T. Herlihy, and J. Green. 1998. Section 14 Rapid Habitat and Visual Stream Assessments. *In*: Lazorchak, J.M., D.J. Klemm, and D.V Peck (editors). Environmental Monitoring and Assessment Program-Surface Waters: Field Operations and Methods for Measuring the Ecological Condition of Wadeable Streams. EPA 620-R-94-004F. U.S. Environmental Protection Agency; Office of Water; Washington, D.C. https://archive.epa.gov/emap/archive-emap/web/pdf/mahawadeablestreams-2.pdf

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish. EPA 444-4-89-001. U.S. Environmental Protection Agency; Office of Water; Washington, D.C. *http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=9100LGCA.txt*

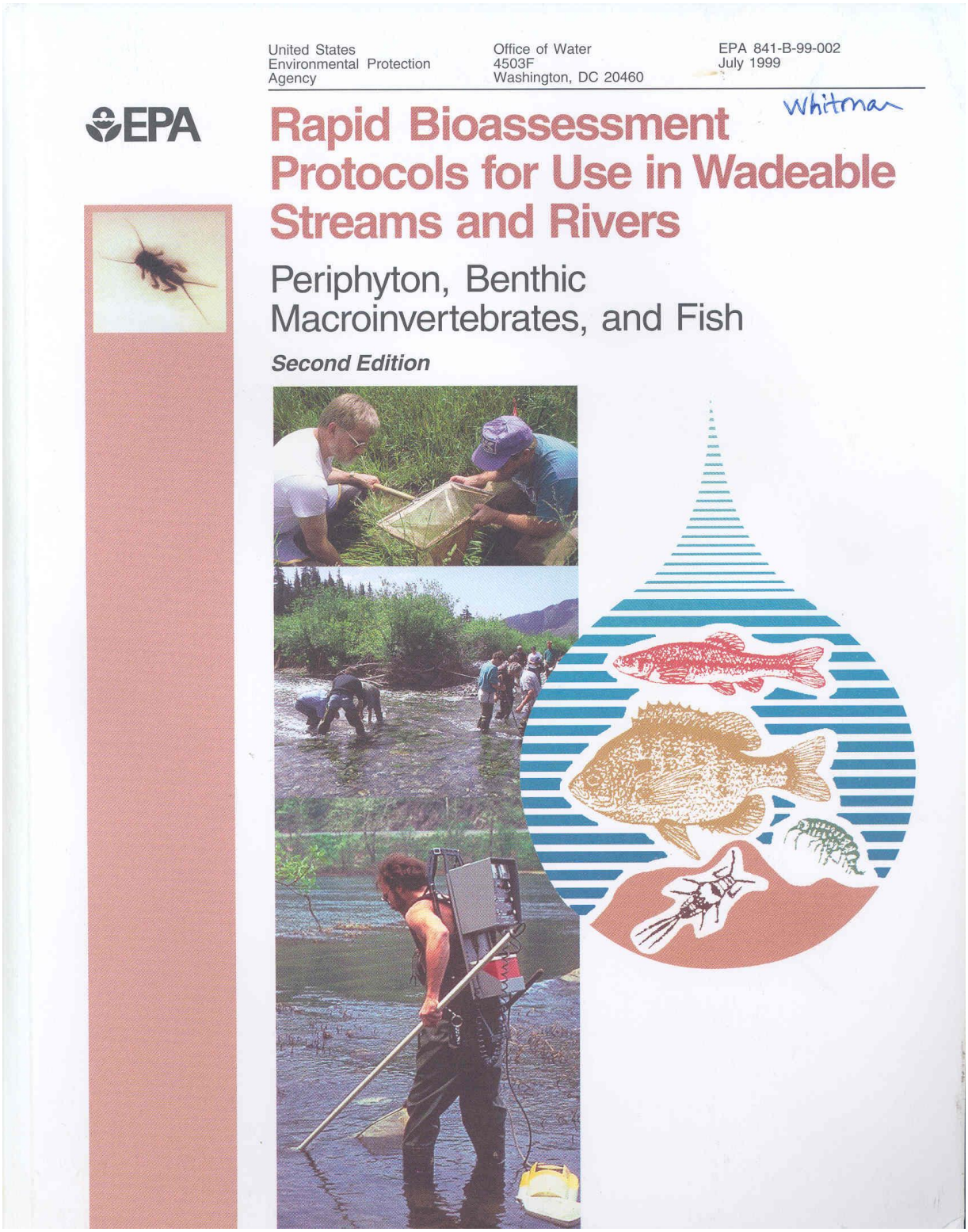


Figure 2-27. Cover of USEPA's Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers (Second Edition)

The Importance of RBP VBHA Instruction and Training

Specific instruction and training are necessary for comparable assessments of habitat quality. An adequately trained individual should be able to perform a habitat assessment that would be deemed comparable to another such trained individual regardless of their affiliation (*i.e.*, state program, NGO, company) or location (*i.e.*, WV, Region III, East Coast). If an individual is not properly trained, the resulting assessment will deviate in accuracy and potentially lead to an incorrect interpretation of paired stream assessment results (*e.g.*, benthic macroinvertebrate vs. habitat results, stressor identification, *etc.*).

See the following for examples of court orders relating to the use of RBP VBHA:

- where differences in habitat assessment led to discrepancies in interpretation of the cause of benthic macroinvertebrate impairment;
  Judge Robert C. Chambers. June 4, 2014. Memorandum Opinion and Order. Ohio Valley Environmental Coalition, West Virginia Highlands Conservancy and Sierra Club v. Elk Run Coal Company, Inc. and Alex Energy, Inc. Civil Action No. 3:12-0785. U.S. District Court for Southern District of WV, Huntington Division.
  http://www.wvsd.uscourts.gov/sites/default/files/opinions/312-cv-00785_1.pdf
- and the importance of adequate training and experience;
  Judge Robert C. Chambers. August 12, 2015. Memorandum Opinion and Order. Ohio Valley Environmental Coalition, West Virginia Highlands Conservancy and Sierra Club v. Fola Coal Company, LLC. Civil Action No. 2:13-21588. U.S. District Court for Southern District of WV, Charleston Division. Page 46 Footnote.
  https://assets.documentcloud.org/documents/2271380/chambers-fola-ruling-august-2015.pdf

WVDEP has observed that untrained individuals using the VBHA will tend to rate a stream's habitat much higher or lower than adequately trained individuals (*e.g.*, up to 20 points). This phenomenon is most likely due to the individual's inexperience with the wide range of conditions that can occur in stream habitats (*i.e.*, they have never seen examples of *Optimal* and/or *Poor* examples of the stream habitat parameters). Therefore, training in the use of VBHA is essential.

VBHA training should include the following elements:

1) **Familiarization:** Introduction to the terminology used in the VBHA, the description of the parameters, and the reasoning behind each parameter that was selected to be measured. This can be accomplished by reading the VBHA section of the EPA RBP manual (***see Figure 2-27 on previous page***). Additional familiarization and training resources may be available online.
2) **Calibration to a Common Standard:** This involves visiting a site with individual(s) trained in VBHA usage. Depending on availability, experienced users should be paired up with new users to help answer questions and guide the assessment. After assessing the reach, all participants should participate in a detailed discussion of each parameter, the reasons why they scored the parameter the way they did, and corrective action/instruction for those that significantly deviate from the normal. This is defined as either a wrong category assignment or +/- 3 points for a parameter. Keep in mind that sometimes parameter comparisons will straddle the boundary between categories (*e.g.*, 12-11 = *Sub-Optimal* & 10-9 = *Marginal*).

- ✓ For the Total Habitat Score, a benchmark range of 15 points amongst the experienced individuals is considered acceptable. Those who score outside this range will likely have received corrective instruction for specific parameters. This benchmark is based on one person scoring each VBHA parameter exactly one point higher than another person, resulting in a difference of 10 points in the Total Habitat Score. In practicality, some people will score a point or two higher or lower than others for some parameters.
- ✓ Large groups (one to two dozen) are advantageous in that the concepts can be more widely communicated and shared quickly. A larger group also allows the opportunity to demonstrate the variability of scores that can occur based on experience and training (*i.e.*, a comparison of the experienced individual score distribution versus novice/inexperienced individual scores.
- ✓ However, larger groups tend to break off into smaller unrelated conversations, hampering communication of the concepts.
- ✓ The number of sites visited as a group is dependent on the local availability of sites with a range of habitat quality and other training activities that may be coinciding with the VBHA training.

3) **Reinforcement:** A form of one-on-one training, inexperienced individuals should be paired up with an experienced individual for conducting actual assessments. Initially they should conduct the VBHA assessment together. Eventually, the less experienced should be allowed to conduct the assessment solo followed by the experienced individual reviewing the results and taking corrective action where necessary. This reinforcement should be ongoing over the course of 20-100 sites and eventually will wane down as the novice gains more experience and sees more of the range in habitat conditions possible.
4) **Quality Control Checks:** This involves at least two experienced individuals conducting the VBHA independently at a common site at the same time. The two individuals should not confer during assessment. Once both assessments are finalized, they need to review and discuss the assessments together. Significant parameter or total score disagreements should be thoroughly discussed and resolved with a corrective action for one or both individuals. While the incorrect assessment(s) should be noted or flagged in some manner, the original parameter or total scores should not be changed after the discussion. The variability (*i.e.*, Standard Deviation [s or σ] or Variance [s^2 or σ^2] in parameter and total scores can be calculated from these paired assessments, but only if the uncorrected scores are left intact. The corrective actions taken will be reflected in future assessments and captured by future paired VBHA assessments (*i.e.*, the overall variability should go down).
5) **Maintenance:** Regardless of experience, all individuals that may conduct VBHA assessments should engage in annual retraining and calibration to a common standard as described above. WVDEP has noticed that even those individuals who have a large amount experience using the VBHA, but who have not conducted assessments with any recent frequency (*i.e.*, field personnel who are now mainly office based) tend to rate parameters slightly higher or lower than those who conduct VBHA assessments with more recent frequency.

RBP VBHA Forms

Different assessment forms are used for streams that are riffle/run prevalent versus those that are pool/glide prevalent. After making the initial survey of the stream assessment area, classify the stream as either riffle/run or glide/pool prevalent based on your visual assessment of the dominant habitat type (Note: glide/pool habitats will require "MACS" macroinvertebrate sampling methods for low gradient streams). The WAB sampling strategy dictates that a riffle/run habitat is sampled **if possible**. If a stream reach is mostly glide/pool but has a small area of riffle/run, sample the riffle /run if there is enough to obtain the 1 m^2 of substrate. Accordingly, fill out the **riffle/run** Rapid Habitat assessment form (***see Figure 2-28 and Figure 2-36 on pages 2-72 & 2-78***). A glide/pool habitat form should only be used when the MACS sampling method is used (***see Figure 2-43 and Figure 2-44 on pages 2-84 & 2-86***).

For each habitat parameter listed on a form, carefully read the description under each ranking category, circle the score, and write the score in the left margin that best describes the condition of the stream assessment area (typically 100-m stream reach).

IMPORTANT: In general, MACS sites are not assessed unless indicated on the stream list or there is a special interest in obtaining data from the site. The MACS technique should only be used in streams that are truly "wetland like", such as sites impounded downstream and offer very little to no observable flow. A general rule of thumb is if you have a difficult time determining which direction the stream is flowing, then MACS methods are probably applicable. MACS methods can also be used on large streams that are too deep to wade. In these larger streams, samples are collected from the bank by jabbing the net into appropriate habitat types. Furthermore, if a stream is heavily embedded with sand but has a perceivable flow; it should not be sampled by MACS methods. Riffle/run protocols should be followed (i.e., benthic samples should be collected by kicking the sand). Also, MACS methods should only be used if there are enough good habitats to collect all 20 jabs/sweeps.

NOTE: In low water conditions, many of the RBP parameters will be rated lower than their potential. Do not try to envision a full stream channel (bank to bank) when rating the parameters. Rate the stream conditions as they exist on that day. For example, in low flow conditions the epifaunal substrate/available fish cover parameter would be rated lower than its potential simply because the habitat components are not covered with water during that visit.

Riffle/Run Prevalence Form (High Gradient)

RAPID HABITAT ASSESSMENT; RIFFLE/RUN>>>			Reviewers Initials	
AN-Code			Date	
HABITAT PARAMETER	CATEGORY			
	Optimal	Sub-optimal	Marginal	Poor
1. EPIFAUNAL SUBSTRATE/ AVAILBLE FISH COVER	**Greater than 70% of substrate** favorable for epifaunal colonization and fish cover; **mix of snags, submerged logs, undercut banks, cobble or other stable habitat** and at a stage to allow full colonization potential (i.e., logs and snags that are **not new fall** and not transient.)	**40 to 70%** mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of **new fall**, but not yet prepared for colonization (may rate at high end of scale).	**20 to 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.
			Consider Benthic Macroinvertebrate Substrate and Fish Habitat on Page 7 before rating here.	
SCORE:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. EMBEDDED-NESS	Gravel, cobble and boulder particles are between **0 and 25%** surrounded by **fine sediment**; layering of cobble provides a diversity of niche space. **NOTE: Clean Bedrock is not considered embedded!**	Gravel, cobble, and boulder particles are between **25 and 50%** surrounded by **fine sediment**.	Gravel, cobble and boulder particles are between **50 and 75%** surrounded by **fine sediment**.	Gravel, cobble and boulder particles are **over 75%** surrounded by **fine sediment**.
		Rate in Riffles or Runs **Remember to consult with Biomorph**		
SCORE:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. VELOCITY/ DEPTH REGIMES	Slow (<0.3 m/S or ≈1 FT/S), deep (>0.5 m or ≈1.5 FT); slow, shallow (<0.5 m); fast (>0.3 m/S), deep; fast, shallow habitats all present.	Only **3 of 4** habitat types present (if fast-shallow is missing, score lower than if other types are missing).	Only **2 of the 4** habitat types are present (if fast-shallow or slow-shallow are missing, score low).	Dominated by **one velocity/depth regime** (usually slow-deep).
SCORE:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. CHANNEL ALTERATION	Channelization or dredging **absent or minimal**; stream with normal pattern.	**Some** channelization present, usually in areas of bridge abutments; **evidence of past channelization**, i.e. dredging, (**> than past 20 years**) may be present, but no evidence of recent channelization.	Channelization may be **extensive**; embankments or shoring structures **present on both banks**; and **40% to 80%** of the stream reach channelized and disrupted.	Banks shored with **gabion or cement**; **over 80%** of the stream reach is channelized and disrupted. Instream habitat greatly altered or entirely removed.
SCORE:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. SEDIMENT DEPOSITION Upstream Watershed Total Score:	**Little or no** enlargement of island or point **bars** and **less than 5%** of the bottom is affected by sediment deposition.	**Some new** increase in bar formation, mostly from **gravel, sand, or fine sediment**; **5 to 30%** of the bottom is affected; slight deposition in pools.	**Moderate** deposition of **new gravel, sand or fine sediment on old and new bars; 30-50%** of bottom is affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition in pools prevalent.	**Heavy** deposits of fine material; increased bar development; **more than 50%** of bottom is changing frequently; pools almost absent due to substantial sediment deposition.
	Rate in Pools & Depositional Areas			
SCORE:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Page 5 WVDEP WAB Wadeable Stream Assessment Form (4/18/2012)

Figure 2-28. Example of the Riffle/Run Rapid Habitat Assessment Part 1 (PAGE 5) of the field form

1. EPIFAUNAL SUBSTRATE/AVAILABLE FISH COVER: Epifaunal substrates are essentially the amount of niche space or hard substrates (stones, snags) available for insects and snails. Numerous types of insect larvae attach themselves to rocks, logs, branches, or other submerged substrates. The greater the variety and number of available niches or attachments, the greater the variety of macroinvertebrate life will exist in the streams. Rocky bottom areas are critical for maintaining a healthy variety of insects in most high-gradient streams.

   Fish cover includes the relative quantity and variety of natural structures in the stream such as fallen trees, logs, and branches, large rocks, and undercut banks, that are available for refugia, feeding, or laying eggs. A large variety of submerged structures in the stream provide aquatic organisms with many niches, thus increasing the diversity (***see Figure 2-29 below***).

Figure 2-29. Examples of good fish habitat. Left shows tree roots hanging over the bank that provide good cover for fish in the stream. Right shows a pool with submerged logs and over-hanging branches

> **NOTE: The Benthic Macroinvertebrate Substrate and Fish Habitat parameters at the top of *PAGE 7-Non-RBP Parameters* should be considered when rating this parameter as the combination of the two is essentially the same as this parameter.**

2. EMBEDDEDNESS: refers to the extent to which rocks (gravel, cobble, and boulders) are covered or sunken into the silt, sand, or mud of the stream bottom (***see Figure 2-30 and Figure 2-31 on next page***). Generally, as rocks become embedded the surface area available to macroinvertebrates and fish (shelter, spawning, and egg incubation) is decreased. To estimate the percent of embeddedness, observe the amount of silt or finer sediments overlying and surrounding the rocks. If kicking does not dislodge the rocks or cobble, they may be greatly embedded. It is useful to observe the extent of dark area on the underside of a few rocks.

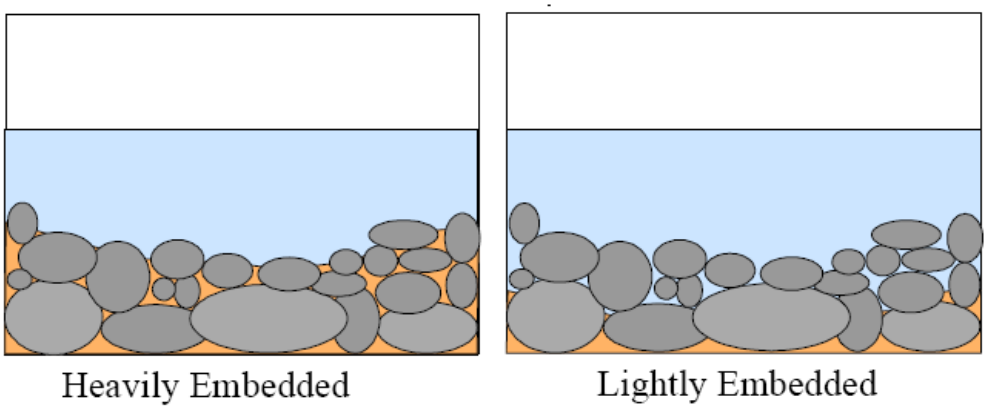


Figure 2-30. Visualization of Embeddedness.

NOTE: To avoid confusion with SEDIMENT DEPOSITION (habitat parameter number 5), observations of EMBEDDEDNESS should be taken in the upstream and central portions of riffles and cobble substrate areas. Collaborate with the biomorph on this parameter. Clean Bedrock is not considered embedded!

Figure 2-31. Example of cobble that is partially embedded.

3. VELOCITY/DEPTH REGIMES: examines the availability of each of the four-primary current/depth combinations: (1) slow-deep, (2) slow-shallow, (3) fast-deep, and (4) fast-shallow. The best streams in high gradient regions will have all four habitat types present. The presence or availability of these four habitats relates to the stream's ability to provide and maintain a stable aquatic environment. The general guidelines

are 0.5m depth to separate shallow from deep, and 0.3 meters/second to separate fast from slow.

4. CHANNEL ALTERATION: is a measure of large-scale changes in the shape of the stream channel. Many streams in urban and agricultural areas have been straightened, deepened, or diverted into concrete channels often for flood control purposes. Such streams have far fewer natural habitats for fish, macroinvertebrates, and plants than do naturally meandering streams. Channel alteration is present when a stream runs through a concrete channel; when artificial embankments, riprap, and other forms of artificial bank stabilization or structures are present; when the stream is very straight for significant distances; when dams and bridges are present; and when other such changes have occurred (***see Figure 2-32 below and Figure 2-33 on the next page***). Scouring is often associated with channel alteration. In some instances, channel alteration may benefit the stream (*e.g.* K-dams). This parameter should be rated regardless of the intent of the channel alteration.

Figure 2-32. Examples of varying degrees of Channel Alteration (concrete channel on left and rip/rap channel on right).

NOTE: Note that in the example of K-dams, the channel alteration would be depressed by the presence of these structures, but the Epifaunal Substrate/Available Fish Cover and/or Velocity/Depth Regime score could possibly benefit from their presence.

Figure 2-33. Example of Channel Alteration actively occurring due to an installation of sewage pipes across a stream channel.

5. SEDIMENT DEPOSITION: measures the amount of sediment that has accumulated and the changes that have occurred to the stream bottom because of the deposition. Deposition occurs from large-scale movement of sediment caused by watershed erosion. Sediment deposition may cause the formation of islands; point bars (areas of increased deposition usually at the beginning of meanders that increase in size as the channel is diverted toward the outer bank (***see Figure 2-34 and Figure 2-35 on next page***); shoals; or results in the filling of pools. Increased sedimentation also results in increased deposition. Usually this is evident in areas that are obstructed by natural or man-made debris and areas where the stream flow decreases, such as bends. High levels of sediment deposition create an unstable and continually changing environment that becomes unsuitable for many organisms.

> **NOTE: To avoid confusion with EMBEDDEDNESS (habitat parameter number 2), observations of sediment deposition should be taken in pools and slow water depositional areas.**

Figure 2-34. Examples of Sediment Deposition.

Figure 2-35. Example of sediment deposition. Note the large amount of sand on the bank.

Reviewers Initials		RAPID HABITAT ASSESSMENT: RIFFLE/RUN >>>

HABITAT PARAMETER	CATEGORY			
	Optimal	Sub-optimal	Marginal	Poor
6. RIFFLE FREQUENCY SCORE:	Occurrence of riffles is relatively frequent; **ratio of distance between riffles divided by the width of the stream is <7:1 (generally 5 to 7); variety of habitat is key in streams where riffles are continuous; placement of boulders or other large natural obstruction is important. Rate lower in this category accordingly!**	Occurrence of riffles is infrequent; distance between riffles divided by the width of the stream equals **7 to 15**.	Occasional riffle or bend; bottom contours provide some habitat; distances between riffles divided by the width of the stream is **between 15 to 25**.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by width of the stream is **greater than 25**.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. CHANNEL FLOW STATUS SCORE:	Water reaches the base of both banks and a **minimal** area of channel substrate is exposed.	Water fills **more than 75%** of the available channel; **or less than 25%** of the channel substrate is exposed.	Water fills **25 to 75%** of the available channel; and/or riffle substrates are mostly exposed.	Very little water in channel, and mostly present as **standing pools**.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. BANK STABILITY Upstream Watershed Total Score: SCORE:	Banks stable; evidence of erosion or bank failure **absent or minimal**; little potential for future problems (<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; **high potential** during floods.	Unstable; many eroded areas; "raw" areas **frequent** along straight sections and bends; obvious bank sloughing; **60-100%** of bank has erosional scars.
	Determine left/right by facing downstream			
LEFT:	10 9	8 7 6	5 4 3	2 1 0
RIGHT:	10 9	8 7 6	5 4 3	2 1 0
9. BANK VEGETATIVE PROTECTION Upstream Watershed Total Score: SCORE:	**More than 90%** of the stream bank surfaces and immediate riparian zones **(crest-over)** covered by vegetation including trees, understory shrubs, and non-woody plants (herbs, grasses, ferns, mosses); vegetative **disruption** through grazing or mowing minimal or **not evident**; almost all plants allowed to grow naturally.	**70-90%** of the stream bank surfaces are covered by vegetation, but **one class of plants is not well represented; disruption evident**, but not affecting plant growth potential to any great extent; **more than one-half** of the **potential plant** stubble height remaining.	**50-70%** of the stream bank surfaces are covered by vegetation; **disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble** height remaining.	**Less than 50%** of the stream bank surfaces are covered by vegetation; **disruption** of stream bank vegetation **very high; vegetation has been removed to 2 inches or less in average stubble height.**
	Rate from bottom of bank to crest-over at top of bank-large roots count			
LEFT:	10 9	8 7 6	5 4 3	2 1 0
RIGHT:	10 9	8 7 6	5 4 3	2 1 0
10. WIDTH OF UNDISTURBED VEG. ZONE Upstream Watershed Total Score: SCORE:	Width of undisturbed vegetative zone is **>18 meters; human activities** (parking lots, roadbeds, clear cuts, lawns, or crops) have **not impacted** this zone.	Zone width is between **12 and 18 meters; human activities** have only **minimally impacted** this zone.	Zone width is between **6 and 12 meters; human activities** have **impacted** the zone a **great deal.**	Width of zone is **less than 6 meters; little or no un-disturbed** vegetation due to **man-induced activities.**
	Rate from top of bank crest-over out into the flood plain/adjacent areas **Undisturbed veg. is trees, shrubs, & non-woody macro-phytes**			
LEFT:	10 9	8 7 6	5 4 3	2 1 0
RIGHT:	10 9	8 7 6	5 4 3	2 1 0
TOTAL:	Optimal=160-200	Sub-Optimal=110-159	Marginal=60-109	Poor=0-59

Estimated Mileage of Upstream Watershed Evaluated	

Page 6 WVDEP WAB Wadeable Stream Assessment Form (4/18/2012)

Figure 2-36. Example of the Riffle/Run Rapid Habitat Assessment Part 2 (PAGE 6) of the field form

6. RIFFLE FREQUENCY: is a way to measure the sequence of riffles occurring in a stream. Riffles are a source of high quality habitat and diverse fauna. Therefore, an increased frequency of occurrence greatly enhances the diversity of the community. The types and variety of riffles should also be considered once the riffle distance to stream width ratio is determined.

7. CHANNEL FLOW STATUS: is the degree to which the channel is filled with water (***see Figure 2-37 below***). The flow status will change as the channel enlarges or as flow decreases because of dams and other obstructions, diversions for irrigation, or drought. When water does not cover much of the streambed, the amount of useable substrate for aquatic organisms is limited. Do not count extremely large substrate (giant boulders) particles that would rarely if ever be submerged or used by aquatic organisms.

Figure 2-37. Examples of streams with poor Channel Flow Status.

8. BANK STABILITY: measures whether the stream banks are eroded (or have the potential for erosion). Steep banks are more likely to collapse and suffer from erosion than gently sloping banks and are therefore considered unstable. Signs of erosion include: crumbling, unvegetated banks, exposed tree roots, and exposed soil (***see Figure 2-38, Figure 2-39 and Figure 2-40 on the following pages***). However, exposed cliff faces, or rocks provide a stable, non-erodible bank. In addition, the extent to which the bank has healed over with vegetation and roots (*i.e.,* the age of the erosional scars) must be considered.

> ***IMPORTANT: This parameter is scored by considering right and left banks separately throughout the entire 100-m assessment area. For example, after observing the right bank, it was determined that less than 5% of the total bank area in the 100-m assessment reach exhibited erosional scars. This would result in an optimal score in the range of 9-10.***

Figure 2-38. Erosion is slight to moderate because roots are holding the bank intact.

Figure 2-39. Example of an unstable bank. Note the lack of trees (and roots) to provide soil stabilization.

Figure 2-40. Example of heavy erosion (photo right).

9. BANK VEGETATIVE PROTECTION: measures the amount of the stream bank that is covered by ***native vegetation*** for the area (large trees, small trees, herbaceous layer for most of WV streams). **For WAB assessments, the stream bank extends from the edge of the channel floor up to the crest-over at top of bank (*see Figure 2-41 on next page*).** The top or "crest-over" of the bank can be determined by looking for an obvious slope break that differentiates the channel from a flat floodplain higher than the channel. **This parameter does not evaluate the same area as the Width of Undisturbed Vegetation Zone parameter below!** The root systems of plants (trees, shrubs, grasses) growing on stream banks helps hold soil in place, thereby reducing the amount of erosion that is likely to occur. **Large roots should be considered when rating this parameter.** The Bank Vegetative Protection parameter supplies information on the ability of the bank to resist erosion, as well as additional information on the uptake of nutrients of by the plants, the control of in-stream scouring, and stream shading. Consideration must be given to the abundance and diversity of trees, shrubs, or grasses (grazed/mowed and un-grazed/un-mowed). *The native/non-native/invasive status of the vegetation must also be considered since non-native plants generally do not perform as well as native vegetation in erosion control or uptake of nutrients and should be rated lower than an equivalent coverage of native vegetation.* The frequency or age of mowing and grazing can also be considered. Banks that have full, diverse, natural plant growth are better for fish and macroinvertebrates than are banks without vegetative protection or those shored up with concrete or riprap. However, the presence of exposed cliff faces, or rocks should not detract from this score as they are natural structures that normally do not support vegetation.

Figure 2-41. Examples of poor bank vegetative protection.

> ***IMPORTANT*: This parameter is scored by considering right and left banks separately throughout the entire 100-m assessment area.**

10. WIDTH OF UNDISTURBED VEGETATION ZONE: is a measure of disruptive changes to the natural vegetative zone (big trees, small trees, shrubs, & non-woody macrophytes or herbaceous layer for most of WV streams) because of grazing or human interference (*e.g.* mowing) (***see Figure 2-42 below***).

Figure 2-42. Examples of good width of undisturbed vegetation zone on left and poor on the right. Notice the rip-rap in the left photo that would increase the bank stability score but decrease the channel alteration score.

> ***IMPORTANT*: This parameter does not evaluate the same area as the Bank Vegetative Protection parameter! For WAB assessments, this parameter is measured from the crest-over at top of bank out into the flood plain and adjacent areas.**

The top or "crest-over" of the bank can be determined by looking for an obvious slope break that differentiates the channel from a flat floodplain higher than the channel. In areas of high grazing pressure from livestock or where residential and urban development activities disrupt the riparian zone, the growth of a natural plant community is impeded. Residential developments, urban centers, golf courses, and pastureland are the common causes of anthropogenic effects on the riparian zone.

***IMPORTANT*: This parameter is scored by considering right and left banks separately throughout the entire 100-m assessment area.**

TOTAL: Total all the scores for a final RBP score from 0-200. ***See Table 2-6 below for the Total RBP Score Categories.***

Table 2-6. Total RBP Score Categories

RBP Total Score	Category
160-200	Optimal
110-159	Sub-Optimal
60-109	Marginal
0-59	Poor

Glide/Pool Prevalence Form (Low Gradient MACS-Type Sites Only)

RAPID HABITAT ASSESSMENT: GLIDE/POOL »»»»»»»»»»»»»»»»»»»»»»»»»»»»	Reviewers Initials			
AN-Code			Date	
HABITAT PARAMETER	**CATEGORY**			
	Optimal	**Sub-optimal**	**Marginal**	**Poor**
1. EPIFAUNAL SUBSTRATE/ AVAILBLE FISH COVER	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other habitat and at a stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient.	30 to 50% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall; but not yet prepared for colonization (may rate at high end of scale.	10 to 30% mix of stable habitat; habitat availability is less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. POOL SUBSTRATE CHARACTER-IZATION	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation are common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation are present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. POOL VARIABILITY DEEP >1 m (3FT); SHALLOW <1m	Even mix of large[1] –shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. CHANNEL ALTERATION	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, (> than past 20 years) may be present, but no evidence of recent channelization.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40% to 80% of the stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach is channelized and disrupted. Instream habitat greatly altered or entirely removed.
SCORE:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. SEDIMENT DEPOSITION Upstream Watershed Total Score:	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand, or fine sediment; 20 to 50% of the bottom is affected; slight deposition in pools.	Moderate deposition of new gravel, sand, or fine sediment on old and new bars; 50 to 80% 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 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	Rate in Pools & Depositional Areas			
SCORE:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Page 5b WVDEP WAB Wadeable Benthic Stream Assessment Form (4/12/2010)

[1] Large if length, width, or oblique dimension is greater than ½ of the stream width.

Figure 2-43. Example of the Glide/Pool Rapid Habitat Assessment Part 1 (PAGE 5a) of the field form

1. EPIFAUNAL SUBSTRATE/AVAILABLE FISH COVER: See No. 1 under PAGE 5a - RIFFLE/RUN PREVALENCE. In low gradient streams with muddy bottoms, the epifaunal substrate consists mostly of submerged logs or snags, and aquatic vegetation.

2. POOL SUBSTRATE CHARACTERIZATION: evaluates the type and condition of bottom substrates found in pools. Firmer sediment types (*e.g.,* gravel, sand) and rooted aquatic plants support a wider variety of organisms than a pool substrate dominated by mud or bedrock and no plants. In addition, a stream that has a uniform substrate in its pools will support far fewer types of organisms than a stream that has a variety of substrate types.

3. POOL VARIABILITY: rates the overall mixture of pool types found in streams, per size and depth. The four basic types of pools are large shallow, large-deep, small-shallow, and small-deep. A stream with many pool types will support a wide variety of aquatic species. Rivers with low sinuosity (few bends) and monotonous pool characteristics do not have sufficient quantities and types of habitat to support a diverse aquatic community. As a general guideline, consider a pool deep if it is greater than 1 meter in depth and large if its length, width, or oblique dimension is greater than half the stream width.

4. CHANNEL ALTERATION: ***See No. 5 under Riffle/Run Prevalence***.

5. SEDIMENT DEPOSITION: ***See No. 6 under Riffle/Run Prevalence***.

6. CHANNEL SINUOSITY: evaluates the meandering or the relative frequency of bends in the stream. Streams that meander provide a variety of habitats for aquatic organisms, whereas straight stream segments are characterized by monotonous habitats that are prone to flooding. A high degree of sinuosity creates a variety of pools and reduces the energy from surges when the stream flow fluctuates. The absorption of this energy by bends protects the stream from excessive erosion and flooding.

7. CHANNEL FLOW STATUS: determines the percent of the channel that is filled with water. The flow status will change as the channel enlarges or as flow decreases because of dams and other obstructions, diversions for irrigation, or drought. The water will not cover as much of the streambed, thus decreasing the amount of living space for aquatic organisms. In muddy bottom streams, the decrease in water level will expose logs and snags, thus reducing the areas with good habitat.

8. BANK STABILITY: ***See No. 8 under Riffle/Run Prevalence***.

9. BANK VEGETATIVE PROTECTION: ***See No. 9 under Riffle/Run Prevalence***.

10. WIDTH OF UNDISTURBED VEGETATION ZONE: ***See No. 10 under Riffle/Run Prevalence***.

Reviewers Initials		*RAPID HABITAT ASSESSMENT:* GLIDE/POOL>>>		
HABITAT PARAMETER	**CATEGORY**			
	Optimal	**Sub-optimal**	**Marginal**	**Poor**
6. CHANNEL SINUOSITY	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line.	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length up to 2 times longer than if it was in a straight line.	Channel is straight; waterway has been channelized for a long distance.
SCORE:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. CHANNEL FLOW STATUS **SCORE:**	Water reaches the base of both banks and a minimal area of channel substrate is exposed.	Water fills more than 75% of the available channel; or less than 25% of the channel substrate is exposed.	Water fills 25 to 75% of the available channel; and/or riffle substrates are mostly exposed.	Very little water in channel, and mostly present as standing pools.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. BANK STABILITY Upstream Watershed Total Score:	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems (<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; high potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE:	**Determine left/right by facing downstream**			
LEFT:	10 9	8 7 6	5 4 3	2 1 0
RIGHT:	10 9	8 7 6	5 4 3	2 1 0
9. BANK VEGETATIVE PROTECTION Upstream Watershed Total Score:	More than 90% of the stream bank surfaces and immediate riparian zones (crest-over) covered by vegetation including trees, understory shrubs, and non-woody plants (herbs, grasses, ferns, mosses); vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the stream bank surfaces are covered by vegetation, but one class of plants is not well represented; disruption evident, but not affecting plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the stream bank surfaces are covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the stream bank surfaces are covered by vegetation; disruption of stream bank vegetation very high; vegetation has been removed to 2 inches or less in average stubble height.
SCORE:	**Rate from bottom of bank to crest-over at top of bank-large roots count**			
LEFT:	10 9	8 7 6	5 4 3	2 1 0
RIGHT:	10 9	8 7 6	5 4 3	2 1 0
10. WIDTH OF UNDISTURBED VEG. ZONE Upstream Watershed Total Score:	Width of undisturbed vegetative zone is >18 meters; human activities (parking lots, roadbeds, clear cuts, lawns, or crops) have not impacted this zone.	Zone width is between 12 and 18 meters; human activities have only minimally impacted this zone.	Zone width is between 6 and 12 meters; human activities have impacted the zone a great deal.	Width of zone is less than 6 meters; little or no un-disturbed vegetation due to man-induced activities.
SCORE:	**Undisturbed veg. is trees, shrubs, & non-woody macro-phytes**			
LEFT:	10 9	8 7 6	5 4 3	2 1 0
RIGHT:	10 9	8 7 6	5 4 3	2 1 0
TOTAL:	Optimal=160-200	Sub-Optimal=110-159	Marginal=60-109	Poor=0-59
Estimated Mileage of Upstream Watershed Evaluated				

Page 6b WVDEP WAB Wadeable Benthic Stream Assessment Form (4/12/2010)

Figure 2-44. Example of the Glide/Pool Rapid Habitat Assessment Part 1 (PAGE 6a) of the field form

TOTAL: Total all the scores for a final RBP score from 0-200. ***See Table 2-6 on page 2-83 for the Total RBP Score Categories.***

Strategies for Filling out RBP VBHA Forms

Filling out the RBP VBHA form can seem like a daunting task, especially to a newcomer. Using the following strategies can help:

- ✓ **First Impressions**: Upon arrival at the sampling location, go ahead and underline the category (*i.e.*, *Optimal*, *Sub-Optimal*, *Marginal*, *Poor*) or number (0-20) that you would give the habitat parameter based on your first impression of the site. As you traverse/explore the stream reach and riparian area (filling out other sections of the form), raise or lower your score appropriately.
- ✓ **Category over Number**: It is much easier to assign habitat parameter to an appropriate category than a specific number. Concentrate on getting the category settled first, then begin to adjust from there to the final number score. Remember, habitat parameters will often straddle the line between categories (*e.g.*, 12-11 = *Sub-Optimal* & 10-9 = *Marginal*).
- ✓ **Cue in on Category Description Keywords**: To help clarify which category to select, underline keywords found in the category descriptions of the parameter that match the sampling site and cross out those that are keywords that are absent or do not match. For many parameters, this will help clarify the decision-making process for you as well as provide documented insight into your reasoning for the final rating.
- ✓ **Make Informed Decisions**: Most of the parameters are best evaluated after conducting the other data collection activities at the sample site. Therefore, it is important to finalize this section of the form (*i.e.*, circle a number and write the number into the parameter score box on the left) at the end of the assessment. For example:
  - **Epifaunal Substrate/Available Fish Cover, Velocity/Depth Regimes**, **Sediment Deposition, Riffle Frequency** rating decisions are better informed after conducting the *Dominant Substrate Type and Reach Characterization* (***see page 2-52***).
  - **Embeddedness** rating decisions are better informed after conducting the *Substrate Particle Layer Profile* (***see page 2-51***) and consulting with the person who is doing the benthic sampling (kicks) (***see CHAPTER 5. BENTHIC MACROINVERTEBRATE COLLECTION PROTOCOLS starting on page 5-1***) since they are spending a large amount of time sampling in the riffles substrate.
  - **Channel Alteration, Bank Stability**, **Bank Vegetative Protection**, and **Width of Undisturbed Vegetation Zone** rating decisions are better informed after sketching the reach (***see Site Verification on page 2-31***), including the erosional bank scars and riparian zone, and evaluating the *Stream Bank/Riparian Buffer Zone Vegetation/Cover Type* (***see page 2-61***).

- ✓ **Gut-Check Your Scores**: Sum all 10 VBHA parameters into a **Total Habitat Score** (0-200 possible) and match it to category. Does this match your overall impression (gut-instinct) about the sample site?
  - If it seems too high or low, review the parameter scores to see if they make sense. Pay attention to those parameters that scored outside the norm for the site (*e.g.*, **Channel Alteration** was the only parameter in *Marginal*, but everything else was *Sub-Optimal*). Does this make sense?
  - It is not uncommon for a few parameters to be driving the total score down. These parameters may be diagnostic of a specific habitat issue at the site (*e.g.*, Sedimentation can be indicated by **Embeddedness** and **Sediment Deposition** scores).
  - Some parameters are co-related and are very likely to score in the same category at a site (*e.g.*, **Bank Stability**, **Bank Vegetative Protection**, and **Width of Undisturbed Zone**) because they are evaluating closely related areas/aspects of the stream. For example, a resident that mows their stream-adjacent yard right to the edge of the water or bank will likely have low bank parameter scores.
- ✓ **Know the Regional Total Habitat Scoring Range and Variation due to Stream Size and Sampling Season**
  - Even though the RBP VBHA **Total Habitat Score** can theoretically score from 0-200, in practicality, WV streams will mostly range from 60-190 with the majority (2/3) between 110-159 (*Sub-Optimal*). Only a handful of samples have ever scored <60 (*Poor*) or >190.
  - The upper limit of 190 is mostly driven by the **Velocity/Depth Regimes** parameter. Most undisturbed streams that score that high (reference-type reaches) are small streams (1st-2nd Order Streams). Because they are so small, these streams seldom can score better than 10 (Highest Marginal Score) as they usually are missing both the >0.5 m depth fast and slow velocity/depth regimes.
  - The RBP VBHA **Total Habitat Score** can also vary by season. A given stream site that is sampled during higher Early Spring flows often will score one or two categories higher for **Channel Flow Status** than if it were sampled during the lower flows of Late Summer.

PAGE 7

Non-RBP Parameters

BENTHIC & FISH HABITAT, AESTHETIC, & REMOTENESS RATINGS & EXTRA SPACE >>>		**Reviewers Initials**	
AN-Code		**Date**	

PARAMETER	Optimal	Sub-optimal	Marginal	Poor
BENTHIC MACRO-INVERTEBRATE SUBSTRATE	Preferred substrate **abundant**; stable, & at full colonization potential (riffles well developed & **dominated by cobble**; substrate **not** new or **transient**).	Substrate **adequate** for maintenance of populations; **abundance of cobble** with coarse gravel &/or boulders **common**; small areas of new &/or **transient** substrate particles (sand and fine gravel) **may be present**.	Preferred substrate **uncommon**; **some cobble** present but gravel or large boulders & bedrock **prevalent**; **transient** substrate areas may be **frequent**.	Preferred substrate **virtually absent**; gravel or large boulders & bedrock **dominant**; **transient** areas may be **dominant**.
	Rate for entire reach even if the reach is not representative of benthic sample area		Remember to consult with Biomorph	
SCORE:	**20 19 18 17 16**	**15 14 13 12 11**	**10 9 8 7 6**	**5 4 3 2 1 0**
FISH HABITAT	Variety of **stable fish habitat** is available in **≥ 75%** of the reach: boulders, undercut banks, woody debris, submerged roots and trees, macrophytes, overhanging veg.(<1m from water surface), filamentous algae, and artificial structures	Fish habitat available in **40 to 75%** of reach; adequate for maintenance of populations; small, **unstable or transient** areas **present**	Preferred habitat less common, available in **10 to 40%** of reach; **featureless** and/or **unstable** areas **more common**	**Less than 10%** of reach with stable, usable habitat; **dominated by featureless** and/or **transient** areas
		Score lower if dominated by filamentous algae or artificial structures		
SCORE:	**20 19 18 17 16**	**15 14 13 12 11**	**10 9 8 7 6**	**5 4 3 2 1 0**
TRASH INDEX	**Little or no** evidence of **human refuse** present.	Human refuse present in **small amounts**.	Human refuse present in **Moderate amounts**.	Human refuse **abundant and unsightly**.
SCORE:	**20 19 18 17 16**	**15 14 13 12 11**	**10 9 8 7 6**	**5 4 3 2 1 0**
REMOTENESS RATING	Stream assessment site **more than ¼ mile** from nearest Road; access difficult and little or **no** evidence of **human disturbance**.	Stream assessment site **within ¼ mile** of roadside; site with **moderately wild** character.	Stream **within ¼ mile** of roadside; **development** activities **evident**.	Segment **immediately adjacent** to roadside access; visual, olfactory, and/or auditory **displeasure experienced**.
SCORE:	**20 19 18 17 16**	**15 14 13 12 11**	**10 9 8 7 6**	**5 4 3 2 1 0**

Figure 2-45. Example of the Non-RBP Parameter section (Top of PAGE 7) of the field form

BENTHIC MACROINVERTEBRATE SUBSTRATE: This parameter measures the quality of the benthic macroinvertebrate substrate throughout the 100m assessment reach. ***This measure is like the Epifaunal Substrate half of the Epifaunal Substrate/Available Fish Cover parameter at the top of PAGES 5, 6, 5a, and 6a.*** **Only the benthic macroinvertebrate substrate quality should be considered with this parameter.** The benthic macroinvertebrate substrate is essentially the amount of niche space or hard substrate (*e.g.,* stones, snags) available for insects, snails, worms, clams, and crustaceans to colonize. Numerous types of benthic organisms attach themselves to rocks, logs, branches, or other submerged substrates. The greater the diversity and abundance of available niches for attachment the greater the diversity and abundance of benthic macroinvertebrates in the stream. Rocky bottom areas are critical for maintaining a healthy variety of benthic macroinvertebrates in most high-gradient streams.

The relative amount of cobble drives this parameter as it is the most productive and optimal substrate size-class for benthic macroinvertebrates in riffle/run samples. As the

prevalence of the benthic substrate drifts into size classes larger (boulder and bedrock) or smaller (gravels, sand, and silt) than cobble, the productivity decreases. Boulders and bedrock may be stable but do have as much potential niche space as cobble. However, it is important to consider the size and texture of the boulders and bedrock as smaller boulders provide more niche space than larger boulders and rough/fissured boulders and/or bedrock provide more niche space than smooth boulders and/or bedrock. Gravels, especially coarse gravel, may provide niche space, but are more transient (*i.e.,* unstable and susceptible to scouring) than cobble. Fine gravel, sand, and silt are especially bad as they provide minimal niche space and are extremely transient. Therefore, the relative amount and sizes of the transient particles is also important to consider when rating this parameter.

> ***IMPORTANT: Rate this parameter for the entire reach, even if the reach is not representative of benthic sample area. For example, you may have a stream reach that is 95% bedrock, but you can do all the benthic samples in an isolated cobble-dominant riffle with the best benthic habitat you have ever seen. Since the reach is so dominated by bedrock, you would probably score the Benthic Macroinvertebrate Substrate Score in the Marginal to Poor categories (depending on the quality of bedrock as discussed above). The quality of the actual benthic macroinvertebrate substrate area that was sampled will be described in better detail in the middle of PAGE 9-Benthic Substrate Sample Composition.***

FISH HABITAT: This parameter measures the quality of the fish habitat throughout the assessment reach. ***This measure is like the Available Fish Cover half of the Epifaunal Substrate/Available Fish Cover PAGES 5, 6, 5a, and 6a.*** **Only the fish habitat quality should be considered with this parameter.** The fish habitat is essentially the amount of stable habitat (*e.g.*, boulders, undercut banks, woody debris, submerged roots and trees, macrophytes, overhanging vegetation, filamentous algae, and artificial structures) available for fish to use as refuge from predators, breeding and feeding grounds. The greater the diversity and abundance of available habitats translates into a greater diversity and abundance of fish that the stream could support.

> ***IMPORTANT: Rate this parameter for the entire reach which is 100m in most cases but may be longer if an actual fish sampling event is occurring (see CHAPTER 6. FISH COLLECTION PROTOCOLS Establishing the Sample*** Reach ***on page 6-4).***

TRASH INDEX (AESTHETIC RATING): Record the aesthetic character of the stream assessment area **(NOT JUST IN THE STREAM)** based on the abundance of human refuse that is present in and around the stream bank. Consider any piece of trash that could potentially be washed into the stream by high flows or floods.

REMOTENESS RATING: Record the remoteness of the stream assessment area based on its wild character, proximity to roads, and development activities.

PRS and Stressor Info

Is Site A Potential Reference?	☐ Yes ☐ No (Consider Water Chemistry, Benthos, Habitat, Human Disturbance, Location (i.e., Ecoregion), Level I vs. Level II vs. Level III Reference Condition, etc.)
If not a Potential Reference, why?	
Stressor Info (Check all that apply and only those that are definite stressors).	☐ Sediment ☐ Fecal ☐ Nutrients ☐ Metals ☐ pH ☐ Sulfate ☐ Conductivity ☐ Other:
Please check Other if the site is located 1-2 miles downstream of any impoundment (e.g., lakes, ag. or mining ponds, flood control dams, beaver dams, low water ford/bridge dams) or a valley fill (mining or road) structures. Be sure to include type of structure (with type of impoundment release), distance upstream to the structure, number and size of tributaries in between that may alter the water chemistry (including dilution effects), and size of impoundment in m x m.	☐ Impoundment: ☐ Lake ☐ Ag Pond ☐ Mining Pond ☐ Flood Control ☐ Beaver ☐ Instream Pool ☐ Concrete Low Water Ford/Bridge Impoundment Release Type: ☐ Bottom ☐ Spillover ☐ Valley Fill: ☐ Mining ☐ Road (i.e., refuse from highway construction)
	Distance Upstream from Sample Site to Structure (Miles)
	Number of Tributaries Between Structure and Sample Site
	Size of Impoundment (m x m)

Figure 2-46. Example of the PRS and Stressor Info section (Middle of PAGE 7) of the field form

Is Site a Potential Reference?: Answer **Yes** or **No**. Consider the Water Chemistry, Benthos, Habitat, Human Disturbance, Location (*e.g.,* Ecoregion), Level I vs. Level II Reference Condition, *etc.* ***Refer to Determining Candidate Reference Sites While in the Field under CHAPTER 2. Section A. Part 2. Determining Candidate Reference Sites While in the Field starting on page 2-18 for more information.***

If not a Potential Reference, why?: Indicate whether this site appears to be relatively undisturbed and may be considered as a potential reference site (see reference site criteria). Also, make notes as to why the stream does not satisfy reference site criteria in the space provided.

> **NOTE: A yes answer here will not necessarily mean the site will achieve reference status as many other criteria that cannot be determined in the field are considered. Many sites that a person would typically say no to as a potential reference site still meet all the reference criteria. Therefore, it is important to consider only those criteria that can absolutely be determined in the field when answering this question. *Refer to CHAPTER 2. Section A. Part 2. Determining Candidate Reference Sites While in the Field starting on page 2-18 for more information.***

Stressor Info: Indicate all definite stressors that are believed to have an impact on the benthic macroinvertebrate community at the site. Options include: **Sediment**, **Fecal** and/or **Nutrients** (both considered Organic Enrichment), **Metals** (or acid metals which represent toxicity), **pH** (low pH playing a role in metal toxicity and high pH playing a role in ionic stress), **Sulfate** and/or **Conductivity** (both considered ionic stressors), and **Other** stressors.

Please check Other if the site is located 1-2 miles downstream of any impoundment (e.g., lakes, agriculture or mining ponds, flood control dams, beaver dams, low water ford/bridge dams) or a valley fill (mining or road) structures. Be sure to include type of

structure (with type of impoundment release), distance upstream to the structure, number and size of tributaries in between that may alter the water chemistry (including dilution effects), and size of impoundment in m x m.

EXTRA SPACE FOR SPILL-OVER COMMENTS AND NOTES BELOW. ***See Figure 2-47 below***. When using this space, please indicate from which section of the form this is a continuation. For example, "More Sediment Notes" or "More Stream Reach Activities & Disturbances Notes" will allow the data entry person to associate this to the appropriate subform in the database. Also, be sure to indicate that there are additional notes here under the appropriate section (*e.g.*, "More Notes on PAGE 7")."

EXTRA SPACE FOR SPILL-OVER COMMENTS AND NOTES BELOW. When using this space, please indicate from which section of the form this is a continuation. For example, "More Sediment Notes" or "More Stream Reach Activities & Disturbances Notes" will allow the data entry person to associate this to the appropriate subform in the database. Also be sure to indicate that there are additional notes here under the appropriate section (*e.g.*, "More Notes on Page 7").

Figure 2-47. Example of the Extra Space for Comments and Notes section (Bottom of PAGE 7) of the field form

PAGE 8

<u>Wildlife & Freshwater Mussel Observations</u>

Note actual wildlife or plants observed or indications of their presence (*e.g.,* minnows are common, kingfisher observed, frog observed, *etc*.). **List any organisms/wildlife that were observed at the sample site that may be of interest. Any organisms observed and put into the Benthic Sample Jar should be noted on PAGE 9 under Benthic Sample Notes. PLEASE NOTE ANY NON-TROUT FISH OR SALAMANDERS RELEASED FROM THE BENTHIC SAMPLE HERE! <u>ALL TROUT SHOULD BE NOTED ONLY IN THE SECTION BELOW</u>. INVASIVE PLANT SPECIES SHOULD BE NOTED ON PAGE 4 IN THE RIPARIAN VEGETATION SECTION. REMEMBER TO DOCUMENT ANY SPECIMENS COLLECTED FOR OTHER GROUPS HERE!** ***See Figure 2-48 below for an example of this section of the form.***

Reviewers Initials		*WILDLIFE OBSERVATIONS* >>>			
List organisms/wildlife that you observed at the sample site. Any organisms observed and put into the Benthic Sample Jar should be noted on page 9 under Benthic Sample Notes. PLEASE NOTE ANY NON-TROUT FISH OR SALAMANDERS RELEASED FROM THE BENTHIC SAMPLE HERE! <u>ALL TROUT SHOULD BE NOTED ONLY IN THE SECTION BELOW</u>! INVASIVE PLANT SPECIES SHOULD BE NOTED ON PAGE 4 IN THE RIPARIAN VEGETATION SECTION. REMEMBER TO DOCUMENT ANY SPECIMENS COLLECTED FOR OTHER GROUPS HERE!					
Common Name	*Genus Species*	*Comments*	*Number Observed*	*Invasive?*	*Observer*
Did you see freshwater mussels?	☐ Yes ☐ No	☐ Alive ☐ Dead	Did you collect dead shells?	☐ Yes ☐ No	

Figure 2-48. Example of the Wildlife & Freshwater Mussel Observations section (Top of PAGE 8) of the field form

<u>Common Name:</u> The common name of the organism observed.

Genus/Species: The genus or species of the organism observed.

Comments: Specific notes concerning the organism or evidence of organism observed.

Number Observed: The number of individuals of that organism observed.

Invasive?: Was the organism observed an invasive species (fauna only)? Some examples are listed below in ***Table 2-7 below.***

Table 2-7. Some examples of Invasive fauna in WV.

Scientific Name	Common Name	Type
Corbicula fluminea	**Asiatic Clam**	**Mollusca**
Dreissena polymorpha	Zebra Mussel	Mollusca
Lymantria dispar	Gypsy Moth	Caterpillar
Agrilus planipennis	Emerald Ash Borer	Beetle
Adelges tsugae	Hemlock woolly adelgid	Aphid-like

Observed: The initials of the observer.

Did you see fresh water mussels?: Answer **Yes** or **No**.

Alive or Dead?: Answer **Alive** or **Dead**.

Did you collect dead shells?: Answer **Yes** or **No**. Dead shells are submitted to Doug Wood for identification or further identification by WVDNR.

Trout Observations (For Sites that are not actively being sampled for Fish!)

Trout Observations (For Sites that are not actively being sampled for Fish!)					
Did you see trout? ☐ Yes ☐ No	Comments				
Observation Method (i.e., Benthic Net, Free Swimming, Rod & Reel)	Species ID (i.e., Brook Trout, Brown Trout, or Rainbow Trout)	Count	Size (cm)	Notes (e.g., YOY, DELTs)	Photo #'s (Enter Photo Details on Page 10)

Figure 2-49. Example of the Trout Observations (Non-Fish Sites) section (Bottom of PAGE 8) of the field form

IMPORTANT: This section is only for documenting passive observations of trout (e.g., casual sightings, trout that were inadvertently caught in the benthic net, etc.) and not for use with any sort of active fish sampling activities (e.g., electrofishing, netting, etc.). All data from active fish sampling activities are documented via a different protocol and set of forms. See Figure 2-49 on the next page for an example of this section of the form.

This section is provided to help WVDEP obtain more information about the status and location of trout populations in the state. From this information, WVDEP can more effectively determine which streams would be good candidates for intensive surveying and monitoring of trout populations and ultimately if the stream qualifies for Trout Stream Status and Protection. This information will also be shared with the WVDNR (West Virginia Division of Natural Resources) which is charged with the management of all fish in West Virginia.

Did you see any trout?: Answer **Yes** or **No**. Do not answer if you were not positive you saw a trout.

Comments: Comments regarding what was or not observed. Would you expect to see trout at this stream reach based on the habitat and water quality information available?

Observation Method: How was the trout observed? Was it passively caught in the benthic net during a kick? Was it observed freely swimming in the stream? Was it caught by an

angler in the stream reach?

Species ID: List the Common Name of the trout species (*i.e.,* Brook Trout, Brown Trout, Rainbow Trout, or Cutthroat Trout).

Count: The number of specimens of each trout species observed.

Size (CM): The size of the trout specimens in centimeters.

Notes: Notes about the trout specimens (*e.g.,* reproductive or life stage, DELTs (Deformities, Erosions, Lesions, or Tumors).

Photo #'s: Any photo numbers associated with the trout specimens. If the identification of the trout specimens is unsure, a photo may be a means of identifying the specimens later.

***IMPORTANT*: All photo description information should still be entered on PAGE 12-Photography Log (see page 2-114). This field just links a photo to an individual or group of specimens.**

PAGE 9

Benthic Macroinvertebrate Collection Information

BENTHIC MACROINVERTEBRATE & PERIPHYTON/ALGAE/AQ. PLANT INFO>>>>>>>>>>>>					Reviewers Initials		
AN-Code				Date			
Benthic sample collected?	☐ Yes ☐ No	If no, why?					
Benthic collection device	☐ Kicknet ☐ D-net ☐ Hand		Benthic habitat type & #	*Riffles*		*Runs*	
Benthic sample comparability	Was benthic sample comparable with respect to riffle/run depth and velocity?					☐ Yes	☐ No
Is there evidence that the stream channel was scoured by recent flooding or high flows?						☐ Yes	☐ No
Is it possible that sample areas were dry or partially dry for an extended period before sample was taken?						☐ Yes	☐ No
Is there evidence that the stream is "wet-weather" and flowing only in response to recent rainfall?						☐ Yes	☐ No
Benthic kick area depths	m	m	m	m			
Use the space below to describe the site and explain responses to the previous questions. USE PAGES 10 & 11 TO DOCUMENT THE BENTHIC MACROINVERTEBRATES FOUND IN THE SAMPLE!!! PLEASE NOTE ANY FISH, TROUT, OR SALAMANDERS RELEASED FROM THE BENTHIC SAMPLE ON PAGE 8!!!! Comment on the abundances and diversity of the organisms captured/observed and the overall benthic quality of the site.							

Figure 2-50. Example of the Benthic Macroinvertebrate Collection Information section (Top of PAGE 9) of the field form

Benthic Sample Collected?: Answer **Yes** or **No**.

If no, why?: Provide reason why benthic sample was not collected.

Benthic collection device: Indicate which device was used to collect benthic macroinvertebrate samples (bugs). ***See CHAPTER 5. Section A.*** **Benthic Macroinvertebrate Sampling** ***starting on page 5-6 for a more detailed description of each device and its applicability.*** Describe any deviations from the protocols below. 1) **Kick-Net** (*i.e.,* Rectangular frame dip-net), 2) **D-Net**, or 3) **Hand** (*i.e.,* Hand pick).

> ***IMPORTANT: Hand-pick methodology is not a comparable method and should only be used if indicated as an alternative on the stream list.***

Habitat Sampled and # of Each: ***See CHAPTER 5. Section A.*** **Benthic Macroinvertebrate Sampling** ***starting on page 5-6 for a more detailed description***. 1) **Riffle**, 2) **Run**, 3) **Woody snags (MACS)**, 4) **Vegetated banks (MACS)**, 5) **Aquatic plants (MACS)**.

Benthic Sample Comparability: Was benthic sample comparable with respect to riffle/run depth and velocity?: Answer **Yes** or **No**. Sampling should generally occur only if the depth is at least 0.05 m deep and has enough velocity to push debris into the net.

Evidence of scouring?: Answer **Yes** or **No**. Consider asking locals, look at new or recently deposited materials on banks, consider recent precipitation and flood events for the area.

Evidence of dry conditions?: Answer **Yes** or **No**. Look for indications that the stream was dry or partially dry recently). Consider asking locals, past weather conditions, benthic macroinvertebrate density and diversity, and stream conditions while you are there.

Evidence of wet-weather stream?: Answer **Yes** or **No**. Consider asking locals, look for dirt channel, vegetation and roots in channel growing across the stream, jagged rocks in the stream, no easily definable U-shaped channel, overabundance of leaves in the stream for the season. Consider watershed area, consider benthic density, diversity, and community composition while collecting sample.

Kick Area Depths (m): Record the measured depth of water at each kick sample location (usually four locations).

A blank space is provided to describe the site and explain responses to the previous questions regarding the benthic sample comparability. **Use PAGES 10 & 11 to document the benthic macroinvertebrates found in the sample!!!** ***Please note any fish, trout, or salamanders released from the benthic sample on PAGE*** 8***-Wildlife & Freshwater Mussel Observations!!!!*** **Comment on the abundances and diversity of the organisms captured/observed and the overall benthic quality of the site.**

Benthic Substrate Sample Composition

Inorganic Substrate Components: Provide a visual estimate of the relative proportion of each of the seven particle types listed in ***Figure 2-51 below***.

> ***IMPORTANT: This assessment should be conducted only within the actual benthic collection area and should be done by the Biomorph.***

Estimate the proportion of each substrate type within the $1m^2$ riffle/run area that was sampled using the following scale provided in ***Figure 2-51 below.***

Inorganic Substrate (1 m² Of Kicked Substrate)	Class Codes	Size Class	% Composition
Bedrock	BR	Smooth surface rock/hardpan (>4000 mm – bigger than a car)	%
Boulder (BL)	BL	Basketball to car (>250-4000 mm)	%
Cobble (CB)	CB	Tennis ball to basketball (>64-250 mm)	%
Coarse Gravel (CG)	CG	Marble to tennis ball (>16-64 mm)	%
Fine Gravel (FG)	FG	Ladybug to marble (>2-16 mm)	%
Sand (SA)	SA	Gritty – up to ladybug (>0.06-2 mm)	%
Silt & Fines (ST)	ST	Fine – not gritty (<0.06 mm)	%
Clay (CL)	CL	Slick/ hard clay or hard-pan clay	%
Enter estimated % composition for each substrate type. ****MACS SITES: estimate over entire 100 meter stream reach.****			
Describe the benthic sampling substrate quality in terms of relative sizes (e.g., small-sized vs. large-sized cobble or boulders), shapes (globular vs. flat vs. angular), texture (e.g., rough vs. smooth bedrock), layering (i.e., was the cobble stacked) and embeddedness (embedded by pea gravel vs. sand/silt). Also mention any unusual substrate features (e.g., trash or unnatural substrate that was sampled as substrate) and provide general comments about the benthic sample substrate.			

Figure 2-51. Example of the Benthic Substrate Sample Composition section (Middle of PAGE 9) of the field form

Low gradient (MACS) streams will require a visual estimate of the entire 100-m assessment area

Describe Quality of Benthic Substrate: Describe the benthic sampling substrate quality in terms of relative sizes (*e.g.,* small-sized vs. large-sized cobble or boulders), shapes (globular vs. flat vs. angular), texture (*e.g.,* rough vs. smooth bedrock), layering (*e.g.,* was the cobble stacked) and embeddedness (embedded by pea gravel vs. sand/silt). Also, mention any unusual substrate features (*e.g.,* trash or unnatural substrate that was sampled as substrate) and provide general comments about the benthic sample substrate. Note outstanding features like “nice stacked flat medium-sized cobble”, “very sandy with lots of fine gravel”, “large–sized boulders with some coarse gravel here and there”, “large amounts of partially broken-down leaf packs among the cobble”, “embedded with pea gravel rather than sand”, “lots of rough, fissured bedrock”. Indicate if you think the benthic sample substrate is stable and capable of maintaining benthic populations.

Visual Estimation of Periphyton and Aquatic Plant Density

Indicate abundance of each: 0=None, 1=Low, 2=Moderate, 3=High, 4=Extreme, NR=Not Rated	Periphyton (*Brown-slick; Diatoms*)		Filamentous Algae (*Green; Long*)		Blue-Green Algae (*Blueish-Green Slime; Not Long*)		Aquatic Mosses	
	Submerged Aquatic Plants (*e.g., Stargrass, Hydrilla*)		Emergent Aquatic Plants (*e.g., Water Willow*)		Floating Aquatic Plants (*e.g., Lily Pads, Duckweed*)		Total Aquatic Plants	
Periphyton/Algae/Aquatic Plants & Mosses Notes:								

Figure 2-52. Example of the Visual Estimation of Periphyton & Aquatic Plant Density section (Middle of PAGE 9) of the field form

Periphyton are algae, diatoms, fungi, bacteria, protozoa, and associated organic matter associated with stream channel substrates. They are useful indicators of water quality because they respond rapidly and are sensitive to many human disturbances, including habitat destruction, contamination by nutrients, metals, herbicides, and acids.
Although generally included in the broad class of periphyton, filamentous algae (macroalgae) and blue-green algae (cyanobacteria) will be rated separately from the (microalgae) in this section. Note: during Periphyton collection, all three of these groups are collected together (***see CHAPTER 7. PERIPHYTON COLLECTION PROTOCOLS. starting on page 7-1***).

Aquatic plants are generally associated with larger streams such as the New River and Cacapon River. Stargrass and Water Willow are examples that would be included in the aquatic plant category. Aquatic plants provide stream habitat for both macroinvertebrates and fish as well as being a sink for nutrients found in the water column (*i.e.*, the aquatic plants can absorb and fix excess nutrients). The roots of aquatic plants can also provide some level of stabilization to fine sediments.

Indicate Abundance of each Periphyton and Aquatic Plant category:

Indicate the abundance of each in the stream assessment area as **0-None, 1- Low, 2-Moderate, 3-High, 4-Extreme, and NR-Not Rated.** ***See Figure 2-52 above for an example of this section of the form.***

> **Periphyton (Brown-slick; Diatoms):** In this section of the WAB assessment, "periphyton" will include only the microalgae (*e.g.*, diatoms). These are the microscopic organisms that make the substrate slick and slimy. They usually leave a brownish-yellow stain on your hand when rubbed. ***See Figure 2-53, Figure 2-54, Figure 2-56, and Figure 2-55 on the following pages and on page 2-102 for examples of Periphyton.***

Figure 2-53. Example of heavy periphyton coating substrate.

Figure 2-54. Example of Periphyton (Diatoms) on rocks removed from the water column for sampling (Dark Circles are where the Periphyton has been sampled).

Figure 2-56. Example of Periphyton growing on rock.

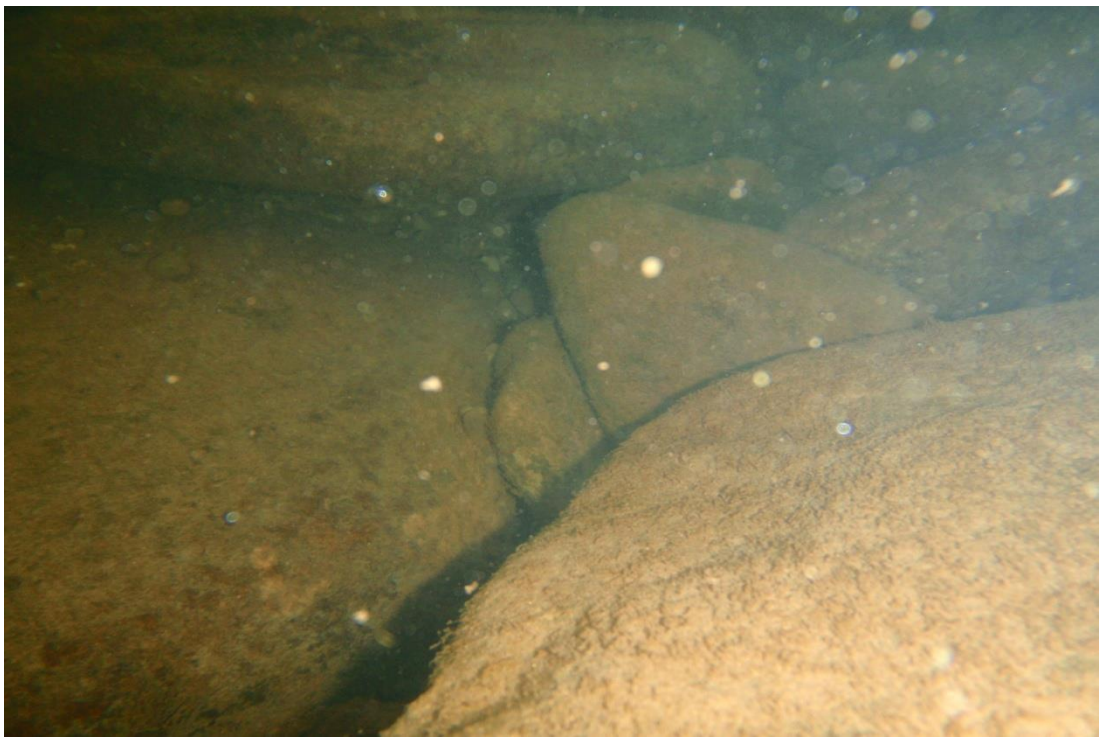


Figure 2-55. Underwater view of periphyton growing on substrate. Note that some of material is silt that is trapped by the periphyton.

Filamentous Algae (Green; Long): Filamentous algae include the long stringy algae that are green in coloration and exhibit wavy undulations in stream currents. Sometimes filamentous algae are associated with low pH, high iron mine seeps and discharges (***See Figure 2-57 on right***. Other times, it is found in larger streams with a more open canopy and sun exposure that allows for its growth. In the case of larger rivers, filamentous algae may coincide with an abundance of submerged aquatic vegetation (***See Figure 2-60 on page 2-105 for an example***). Excessive Filamentous Algae can become a nuisance and impede recreational use like fishing, swimming, and boating. ***See CHAPTER 8. FILAMENTOUS ALGAE MONITORING and Figure 8-7 thru Figure 8-19 on pages 8-9 thru 8-15 for further examples of varying degrees of Filamentous Algae coverage.***

Figure 2-57. Ferraphylic (meaning Iron-loving) filamentous algae are found in low pH streams with high iron concentrations.

Blue-Green Algae (Blueish-Green "Slime"; Not Long): Also known as Cyanobacteria; a photosynthesizing group of bacteria (***see Figure 2-58 on right & Figure 2-59 on next page***). Colonies can be found as short filaments, sheets or hollow balls.

Figure 2-58. Close-up of Blue-Green Algae growing on rock. Notice the absence of long filaments.

Figure 2-59. Example of Blue-Green Algae (edges) and Periphyton growing on rock.

Aquatic Mosses: Aquatic mosses are those mosses found growing naturally in the water. They should not be confused with terrestrial mosses that are growing near the stream or under the water level in a stream that is typically dry for extended periods (Note: that terrestrial mosses can be a good indicator of stream intermittency as well as an excellent benthic macroinvertebrate habitat). True aquatic mosses are much darker and look like they have a different texture compared to terrestrial mosses.

Submerged Aquatic Plants (*e.g.*, Stargrass, *Podostemum*, *Hydrilla* or Waterweed): Aquatic vegetation that has stems and leaves that grow entirely underwater. These plants are adapted to be permanently submerged. However, in some cases of drought, what may be typically called submerged aquatic plants appear to be emergent or floating due to the lower than normal flows. ***See Figure 2-60 and Figure 2-61 on the next page for examples of Submerged Aquatic Plants.***

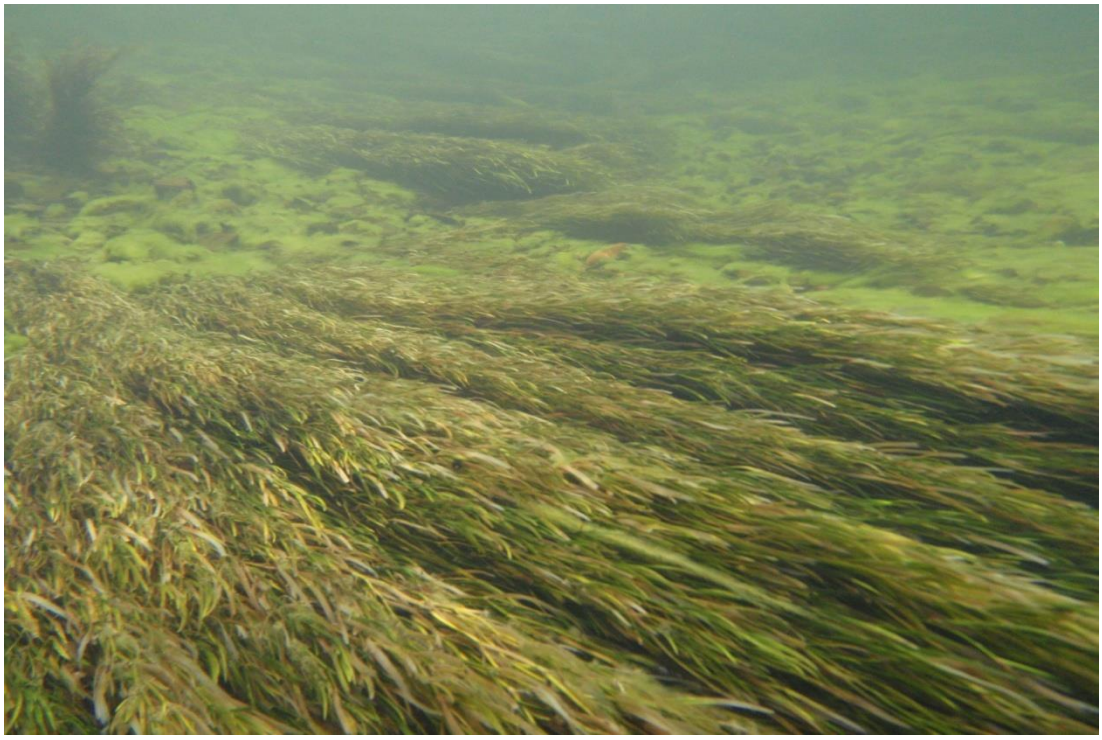


Figure 2-60. Underwater view of Submerged Aquatic Vegetation. Note the Filamentous Algae growing among the submerged vegetation.

Figure 2-61. Example of Submerged (Dark Green is a *Hydrilla sp*.) and Floating (Light Green is Duckweed) Aquatic Vegetation.

Emergent Aquatic Plants (*e.g.*, Water Willow): Aquatic vegetation that is rooted in the stream or lake bottom, but the leaves and stem extend out of the water. Cattails and, in some cases, purple loosestrife (an invasive aquatic plant) are examples. ***See Figure 2-62 below, Figure 2-64 & Figure 2-63 on the next page and Figure 2-65 on page 2-108 for examples of Emergent Aquatic Plants.***

Figure 2-62. Example of Emergent Aquatic Plants (Water Willow) growing in backwater and gravel bars.

Figure 2-64. Example of Emergent Aquatic Plants (Cattails) adjacent to the stream channel.

Figure 2-63. Emergent Aquatic Plants (Cattails) surrounding a mining discharge.

Floating Aquatic Plants (*e.g.*, Lily Pads, Duckweed): Aquatic vegetation that are rooted in the stream or lake bottom, but their leaves and flowers float on the water's surface. ***See Figure 2-60 on page 2-105 and Figure 2-65 below for examples of floating aquatic vegetation.***

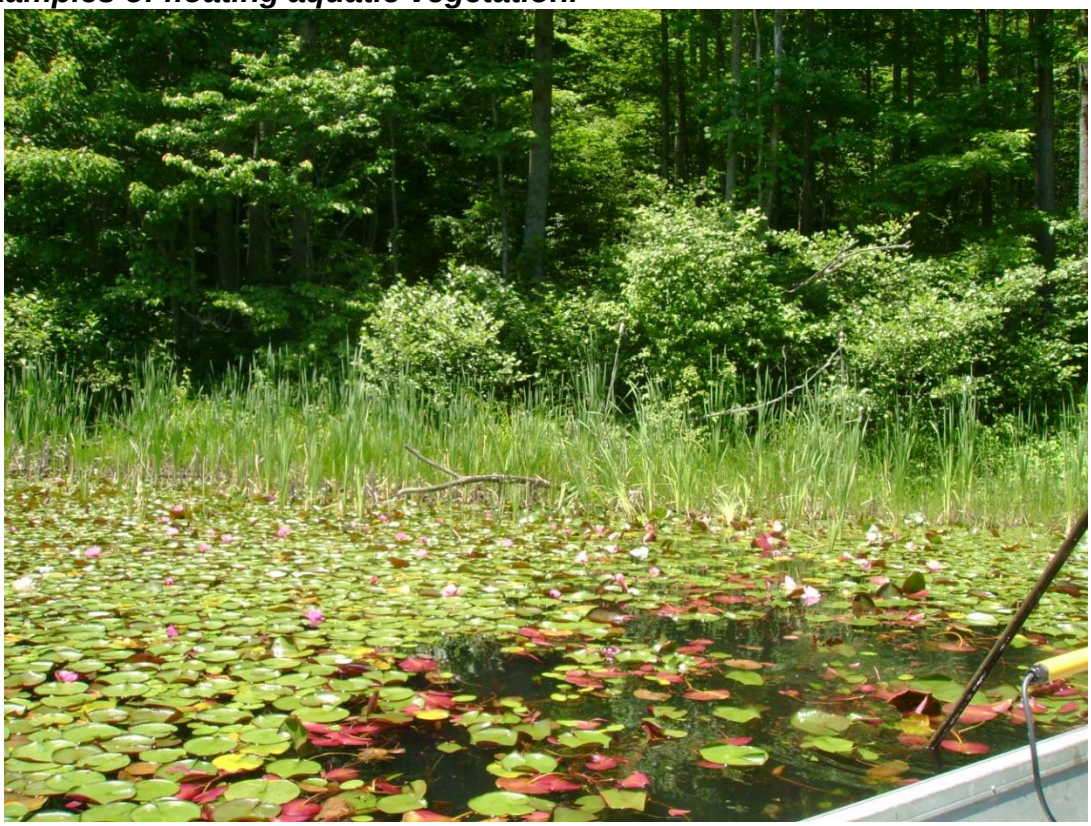


Figure 2-65. Examples of Floating Aquatic Plants (*i.e.*, Lilly pads) and Emergent Aquatic Plants (*i.e.*, Cattails) on a lake.

Total Aquatic Vascular Plants: Combine the three subtypes of aquatic plants into an overall rating.

> ***IMPORTANT*: This should not be done in an additive fashion (i.e., a 2 rating for emergent and submerged aquatic vegetation does not equal a 4 rating for Total Aquatic Vascular Plants.**

Periphyton Collection Information

Periphyton sample collected?	☐ Yes ☐ No	If no, why?						
Periphyton Habitat & #	*Riffles*		*Runs*		Shade and number of each	*Fully exposed (0-25%)*		*Partly shaded (25-50%)*	
						Fully shaded (75-100%)		*Partly exposed (50-75%)*	
Periphyton sample comparability	Was periphyton sample comparable? *(Consider questions above about benthic comparability)*						☐ Yes ☐ No	
Use the space below to describe the Periphyton sample. Explain any variances from the collection protocol that may affect comparability. Was the substrate stable and undisturbed? Could the substrate have been scoured? Dry?								

Figure 2-66. Example of the Periphyton Collection Information section (Bottom of PAGE 9) of the field form

NOTE: This section has been removed from PAGE 9 starting April 2011 due to a lack of Periphyton Collection in the last few years. Should Periphyton Collection resume, this section will be added back to the field form.

Periphyton Sample Collected?: Answer **Yes** or **No.**

If no, why?: Provide reason why periphyton sample was not collected.

Periphyton Habitat and #: Record the number of rocks selected from riffles and from runs during periphyton collection.

Shade and number of each: Record the number of rocks selected from the various shade categories during periphyton collection: **Fully Exposed (0-25%)**, **Partly Shaded (25-50%)**, **Partly Exposed (50-75%)**, **Fully Shaded (75-100%)**. Example: 2 in Fully Exposed, 1 in Fully Shaded, and 2 in Partly Shaded. The shading ratings are estimates of the amount of shade (or conversely sunlight) at the stream site on the day of sampling throughout the duration of the day.

Periphyton Sample Comparability: Was periphyton sample comparable? (Consider questions above about benthic comparability): Answer **Yes** or **No**.

Periphyton Sample Notes: Use the space below to describe the Periphyton sample. Explain any variances from the collection protocol that may affect comparability. Was the substrate stable and undisturbed? Could the substrate have been scoured? Dry?

PAGE 10 & 11

A Visual Guide to Stream Macroinvertebrates

Document the benthic macroinvertebrates found in the sample by putting check marks next to the names/drawings of the organisms (***see Figure 2-67 & Figure 2-68 below the next two pages***).

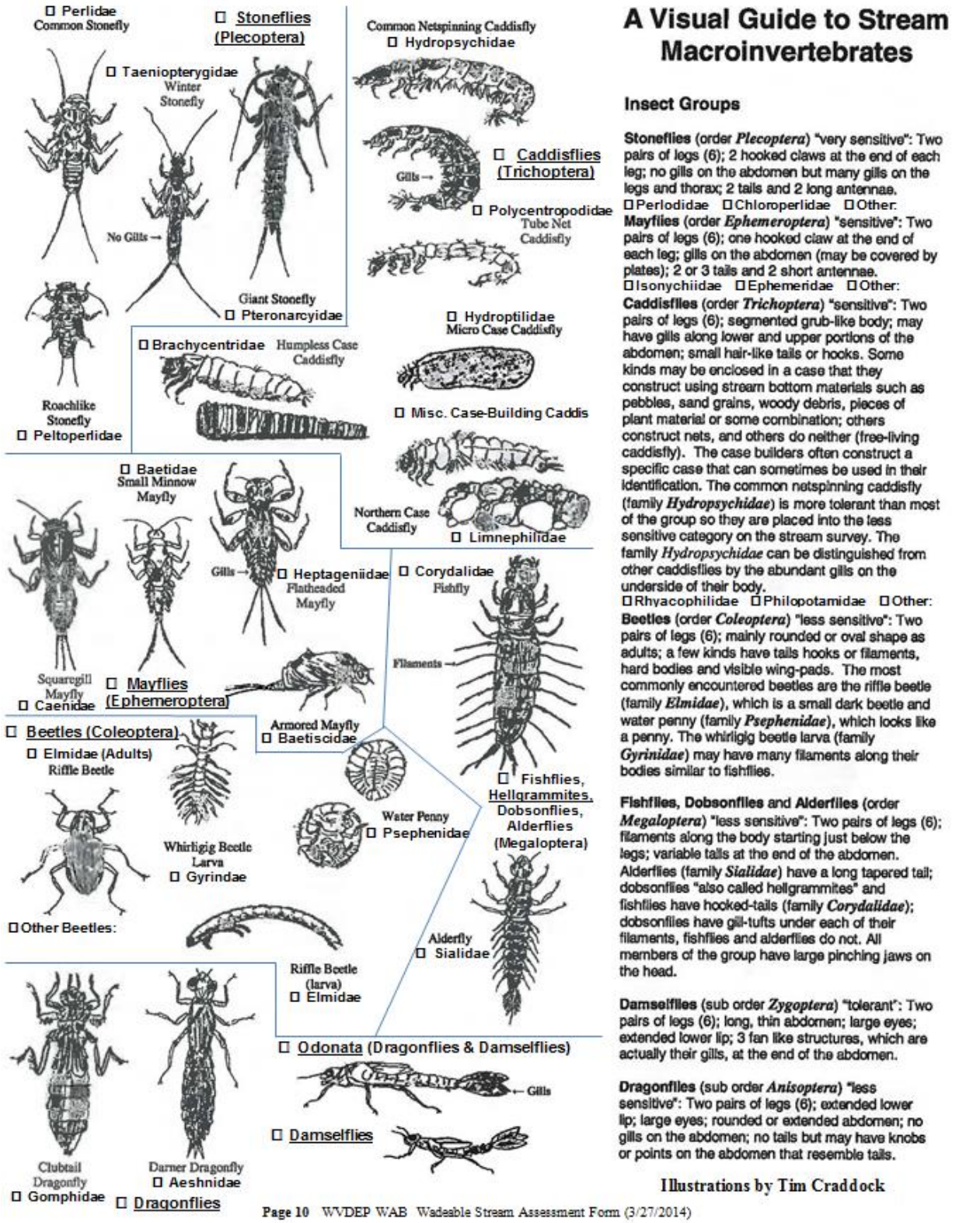
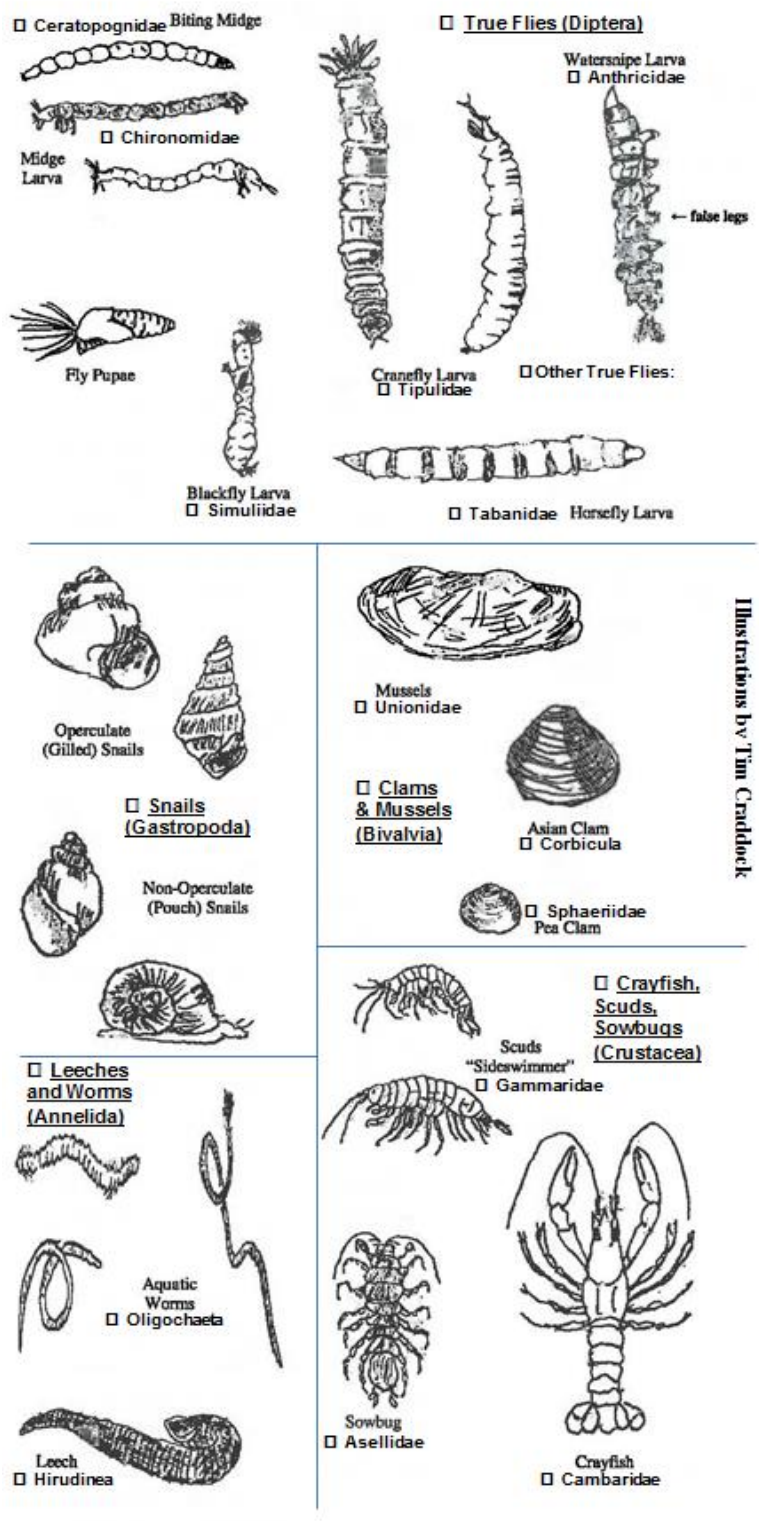


Figure 2-67. Example of the Visual Guide to Stream Macroinvertebrates section (PAGE 10) of the field form



Insect Groups Continued

True Flies (order ***Diptera***) "less sensitive to tolerant": No legs or may have structures that look like legs (false-legs); mainly segmented grub-like or worm-like bodies; tiny hair-like tails, lobes, tentacles or other structures at the end of their abdomen (or no tails); often a distinct head can be seen, but on others no head is visible. Many different kinds of flies are encountered, the more common kinds include the cranefles (family ***Tipulidae***), which have no legs, a plump segmented body and numerous tentacles; watersnipes (family ***Athericidae***) have false legs and look like a caterpillar with a forked tail; midge fly larva (family ***Chironomidae***) are very small with a thread-like body (some are red in color) and a very erratic wriggling motion; blackfly larva (family ***Simuliidae***) have a bowling pin shape and fan-like structure on their head. There are many other kinds of Diptera larva that are sometimes collected, but only a few more examples are illustrated here.

Non-Insect Groups

Operculate Snails (class ***Gastropoda***) "less sensitive": Single coiled shell that mostly opens to the right when the point is held facing towards you. These snails have an operculum "a door that shuts the shell" and are commonly known as gilled snails.

Non-Operculate Snails (class ***Gastropoda***) "tolerant": Single shell that on some kinds opens to the left when the point is held facing towards you; shells also may be rounded flat or coiled. These snails do not have an operculum and are commonly known as pouch or pond snails.

Clams and Mussels "less sensitive" (class ***Pelecypoda***): Two cup-shaped shells connected by a hinged structure; the shell is made of calcium carbonate and is usually very strong and hard to open. Mussels (family ***Uenoidae***) have an oblong rough, often dark color shell. Most clams are smaller and have a rounded shell. The Asian clam can be distinguished from the native pea clam (family ***Sphaeriidae***) by the raised ridges; pea clams are often smaller and its shell feels smooth to the touch.

Crustaceans "less sensitive to tolerant": More than two pairs (more than 6) of legs; claws on the first several pairs of legs may be enlarged; long antenna. This group includes the crayfish (family ***Cambaridae***), which looks like a small lobster, scuds "also called sideswimmer" (order ***Amphipoda***) resemble a shrimp, and the aquatic sowbugs (order ***Isopoda***) resemble a pill bug. Freshwater shrimp (family ***Palaemonidae***) are rarely encountered.

Annelids "tolerant": Worm-like appearance; no legs and many segments along the entire length of the body. This group includes the aquatic worms (class ***Oligochaeta***) and leeches (class ***Hirudinea***). The suckers on both ends of their body distinguish the leeches from other annelids.

Figure 2-68. Example of the Visual Guide to Stream Macroinvertebrates section (PAGE 11) of the field form

PAGE 12

Landowner/Stakeholder Information, Recon, & Photos

Reviewers Initials		*LANDOWNER/STAKEHOLDER INFORMATION, RECON, & PHOTOS >>>>>>>>>>>>>>>>>>>>>>>*	
Landowner/ Stakeholder Name		Landowner/ Stakeholder Name	
Address		Address	
1°Phone #	( )	*1°Phone #*	( )
ALT #	( )	*ALT #*	( )
Stream Data Requested [ ]	WS Report Requested [ ]	Stream Data Requested [ ]	WS Report Requested [ ]
Other Pertinent Landowner Information (e.g., email) & Comments:		Other Pertinent Landowner Information (e.g., email) & Comments:	

Figure 2-69. Example of the Landowner/Stakeholder Information section (Top of PAGE 12) of the field form

If a landowner or stakeholder is encountered during the sampling event, you can keep track of contact information here by recording name address and/or phone numbers. ***See Figure 2-69 below for an example of this section of the form.***

> ***WARNING: ALL THE INFORMATION COLLECTED LISTED HERE IS CONSIDERED PERSONNALLY IDENTIFIABLE INFORMATION (PII) AND MUST ONLY BE DOCUMENTED HERE. ANY REFERENCES IN ANY OTHER SECTION OF THE FORM MUST BE IN AN ANONYMOUS FORMAT ONLY (E.G., LANDOWNER 1, NEIGHBOR 2, ETC.).***

> **NOTE: If a landowner/stakeholder is interested in getting information about the stream, you must fill out a Landowner Data Request Card. This card has two portions, one on which you write down the mailing/email information and turn in with the paperwork to the map coordinator, and one on which you write down some of the instantaneous readings (*i.e.,* Sonde readings) and Total RBP score and give to the landowner/stakeholder before leaving the site. The cards were designed to speed up the process of returning information to the landowners**.

Landowner/Stakeholder Name: Name of the landowner/stakeholder(s) or company that own, use, or manages the land.

Address: Mailing address of the landowner/stakeholder(s).

Phone: The primary phone number of the landowner/stakeholder(s).

Alt #: A secondary phone number of the landowner/stakeholder(s) (cell phone or work phone).

Stream Data Requested?: Were the results from this sample requested by the landowner/stakeholder(s)? Check if **Yes**. Again, checking this box will not ensure prompt delivery of the stream data, so also use the **Landowner Data Request Card.**

Watershed Report Requested?: Was a future watershed report from the watershed being sampled requested by the landowner/stakeholder(s)? Check if **Yes**.

Other Pertinent Landowner Information (*e.g.*, email) & Comments: A blank field is provided to document "other" pertinent landowner info (*e.g.*, how to find the landowner/stakeholder). This location is also a good place to keep track of people you talked to while trying to track down the landowner. In the case of a mistake landowner identity, this chain of information will help alleviate any misunderstandings between the field crew and true landowner, who is usually very angry that you did not talk to them to get access to the stream.

Recon/Accessibility Information

Discuss the accessibility to the site including accessibility, posted property, fenced, beside road, long walk over treacherous terrain, hike length, 4 x 4 needed, get key from landowner, etc.	
Check all that apply:	☐ Easy Access ☐ Difficult Access ☐ Private Property ☐ Posted ☐ Fenced ☐ Gated ☐ Get Key from Landowner ☐ Beside Road ☐ Short Hike ☐ Long Hike ☐ 4x4 Needed ☐ Other (explain)
Recon/Accessibility Notes:	

Figure 2-70. Example of the Recon/Accessibility Information section (Top of PAGE 12) of the field form

Site Accessibility: A set of check boxes is provided to give a quick indication of what may be involved in getting to the site. Check all that apply. These boxes include: **Easy Access**, **Difficult Access**, **Private Property**, **Posted**, **Fenced**, **Gated**, **Get Key from Landowner**, **Beside Road**, **Short Hike**, **Long Hike**, **4x4 Needed**, **Boat Ramp**, or **Other (explain)**.

Recon/Accessibility Notes: A blank field is provided to discuss the accessibility of the site including elaborations on the Site Accessibility check boxes discussed above.

> ***IMPORTANT: Any information about the watershed that may affect the stream water quality or sampling should be recorded on the bottom left of PAGE 2 under the Comment Box describing the source of the information as "Landowner".***

Photography Log

Photography Log >>>>>>>>>>>>>>>>>		Camera Type		Camera Number	
#	Photo ID (office)	Disk Photo # (field)	Stream Name and/or AN-Code	Photo Description (Use Key Words)	Date	Photographer
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Figure 2-71. Example of the Photography Log Section (Bottom of PAGE 12) of the field form

A more detailed description of the photography process can be found in ***CHAPTER 2. Section B. Part 2. Photographic Documentation starting on page 2-25. See Figure 2-71 below for an example of this section of the form.***

Camera Type: The type of camera used (*e.g.,* Canon, Olympus, or Sony).

Camera Number: The assigned number of the camera used. This is usually marked on the camera with a black sharpie. **Do not confuse this with the jeep number often marked on the camera in white ink.** If for some reason the camera's instrument identification number is not apparent, then write down the Manufacturer's Serial Number on the instrument so that the proper identification number can be tracked down later and remarked onto the camera.

Photo ID # (Office): Obtained in the office after getting a unique identification number from the WABbase.

Disk-Photo # (Field): Each camera assigns these unique file names to photos in series from 0-99999 in a format associated with some letters (*e.g.,* a photo will have a file name of DSV-00456). Write down the number portion of the file name on the form. **Do not confuse this number with the photo count numbers on the cameras that indicate how many photos have been taken or can be taken, which reset once photos are removed or deleted from the camera.** In addition, it is important to note that how the photos are removed from the camera may change this file name. ***This is required for all photos taken!***

Stream Name and or AN-Code: The name of the stream featured in the photo. If known, write down the AN-Code of the waterbody featured in the photo.

NOTE: This is only required if the photo was not taken at a sample site. If a lake or other waterbody is sampled, use this space to put in this space.

Photo Description: A description of the photo as it relates to the stream (*e.g.,* looking upstream from X-site) and the keyword features that may be found in the photo (*e.g.,* AMD, eroded bank, channelization, an optimal score for bank vegetative protection, a poor score for sediment deposition, *etc*.). ***This is required for all photos taken!***

Date: The date the photo was taken.

NOTE: This is only required if the photo was not taken on the same date as the sample or if it is not at a sample site.

Photographer: The person who took the photo. ***This is required for all photos taken!***

Part 2. Appendix Forms

In addition to the main form, there are several appendix forms that cover observations and parameter sets that are not as commonly used. When needed, these additional appendix forms should be attached to the main form upon completion of sampling.

APPENDIX #1 - Stream Discharge (Flow)

NOTE: This appendix form is used whenever a flow measurement is required during sampling (Mainly TMDL sites and Special Surveys or Projects, but also at some Wadeable Monitoring Sites). Be sure to fill out the AN-Code, Date, and Reviewer Initials just like the front of all form pages so that it can later be attached to the appropriate form by the map coordinator.

This area is provided to record measurement made with a flow meter and the resulting CFS (cubic feet per second). Record the Flow Meter I.D., measurer and the time of measurement. ***Instructions for determining stream discharge (flow) are presented in CHAPTER 4. STREAM FLOW MEASUREMENT. See Figure 2-72 on the next page for an example of this section of the form.***

WQ Sample ID: The pre-assigned Water Quality Sample ID used with this sample (***see PAGE*** 1 ***Site Verification***). This may be used as a profile and file name if using a meter that records the measurement data electronically.

Measurer: The person doing the flow measurements.

Recorder: The person recording the flow measurements (if applicable).

Time: The time of the flow measurement.

Flow Meter I.D.: The assigned number of the flow meter used. **Do not confuse this with the old jeep number often marked on the flow meter in white ink.** If for some reason the flow meters' instrument identification number is not apparent, then write down the WV Property Tag number (found on a blue tag) or Manufacturer's Serial Number on the instrument so that the proper identification number can be tracked down later and remarked onto the flow meter.

Measurement: The number of the measurement.

Location Description: Record the Left and Right Descending Banks (LDB and RDB) and EEF (Left vs. Right) designations here. Also, document if different channels were measured (Left vs. Middle vs. Right) for braided streams.

FLOW MEASUREMENTS>>				Reviewers Initials	
AN-Code		Date		WQ Sample ID	

Stream Discharge Measurement (Calculated In Cubic Feet Per Second – cfs)							
Measurer		Recorder		Time		Flow Meter ID	

IMPORTANT: The flow rod is calibrated for readings to be taken at 0.4 (60%) depth.
To set the flow rod to read at 0.2 depth, divide the depth by 2 and then set the rod to that value.
To set the flow rod to read at 0.8 depth, multiply the depth by 2 and then set the rod to that value.

Measurement	Location Description (e.g., LDB, RDB, EEF, Left Channel LDB, Left Channel EEF, Left Channel RDB)	Distance (ft)	Depth (ft)	Velocity (ft/s) at X distance from bottom (or % from top)			Measurement Notes
				0.2 (80%)	0.4 (60%)	0.8 (20%)	
1			0	0	0	0	
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							

Final Discharge Reading (cfs) =			
Do you think that this flow measurement is comparable?	☐Yes ☐No	If Not, Why?	

U.S.G.S. Gage Name:		U.S.G.S. Gage Number:		Gage Height or Control:	

Appendix Page 1 WVDEP WAB Flow Form (10/06/2016)

Figure 2-72. Example of the Flow Measurements Appendix PAGE 1 field form

Distance: Record distance from one bank along the flow transect (using a tape measure) where the flow measurement is occurring. Also, indicate which ends of the tape measure are the Left and Right Descending Banks (LDB and RDB) by checking the appropriate box.

Depth: Record the depth at the point of the flow measurement.

Velocity: Record the velocity(s) at the point of the flow measurement. When the total depth is < or = 1.5 feet, then only one velocity measurement is taken at 0.4 of the depth from the stream bottom. When the depth is greater than 1.5 feet, two velocity measurements are taken at 0.2 and 0.8 of the depth from the stream bottom. In rare cases (>1.5 feet depth and obstructions on bottom or top of water column), all three may be taken.

Measurement Notes: Any information (*e.g.*, an obstruction, soft substrates) regarding the individual flow readings at the give vertical (measurement).

Final Discharge Reading (cfs): Record the total stream discharge by entering in the Distance, Depth, and Velocity data from each increment into the Flow Spreadsheet or record the reading from a gage.

Do you think that this flow measurement is comparable?: Answer **Yes** or **No**. Do you think that there were enough unusual circumstances that would make you want to consider the flow measurement not comparable (*e.g.,* too many shallow measurements below 0.1 ft. depth, too many changes in the direction of flow vectors across the transect, *etc*.)?

If not, why? Flow Notes: Why it is believed the flow measurement is considered not comparable or any general information about the flow documentation.

USGS Gage Name: The name (usually the name of the closest town) of the USGS gage queried for flow data.

USGS Gage Number: The ID number of the USGS gage queried for flow data.

Gage Height or Control: The Height of the water on the USGS Gage.

APPENDIX #2 - Stream Bank Erodibility and Channel Profile Measurements

NOTE: This appendix form is used whenever information about stream erodibility and channel profile is needed. It is mostly used in cases where changes can be tracked thru time (*e.g.,* at Long Term Monitoring Sites once per visit) or when additional information about sediment potential from erosion is required (*i.e.,* at TMDL sites once to twice over the course of 11-12 visits). Be sure to fill out the AN-Code, Date, and Reviewer Initials just like the front of all form pages so that it can later be attached to the appropriate form by the map coordinator.

Stream Bank Erodibility Factors

Bank erosion potential is determined by using the diagrams and descriptions provided (***see Figure 2-73 on the next page***) to evaluate the conditions of the stream banks within your reach. Score (1-3 scale) the various factors that have a role in bank erosion **for each bank (left and right descending banks)**. Choose the illustration and descriptions that most closely matches what you see. Compare your selection with to the scale (Increasing numbers mean increasing erodibility; lower scores indicate better conditions) to determine the proper category. All measurements are broad generalizations about both banks in the 100m reach. These scores will be combined to calculate a Stream Bank Erodibility Index.

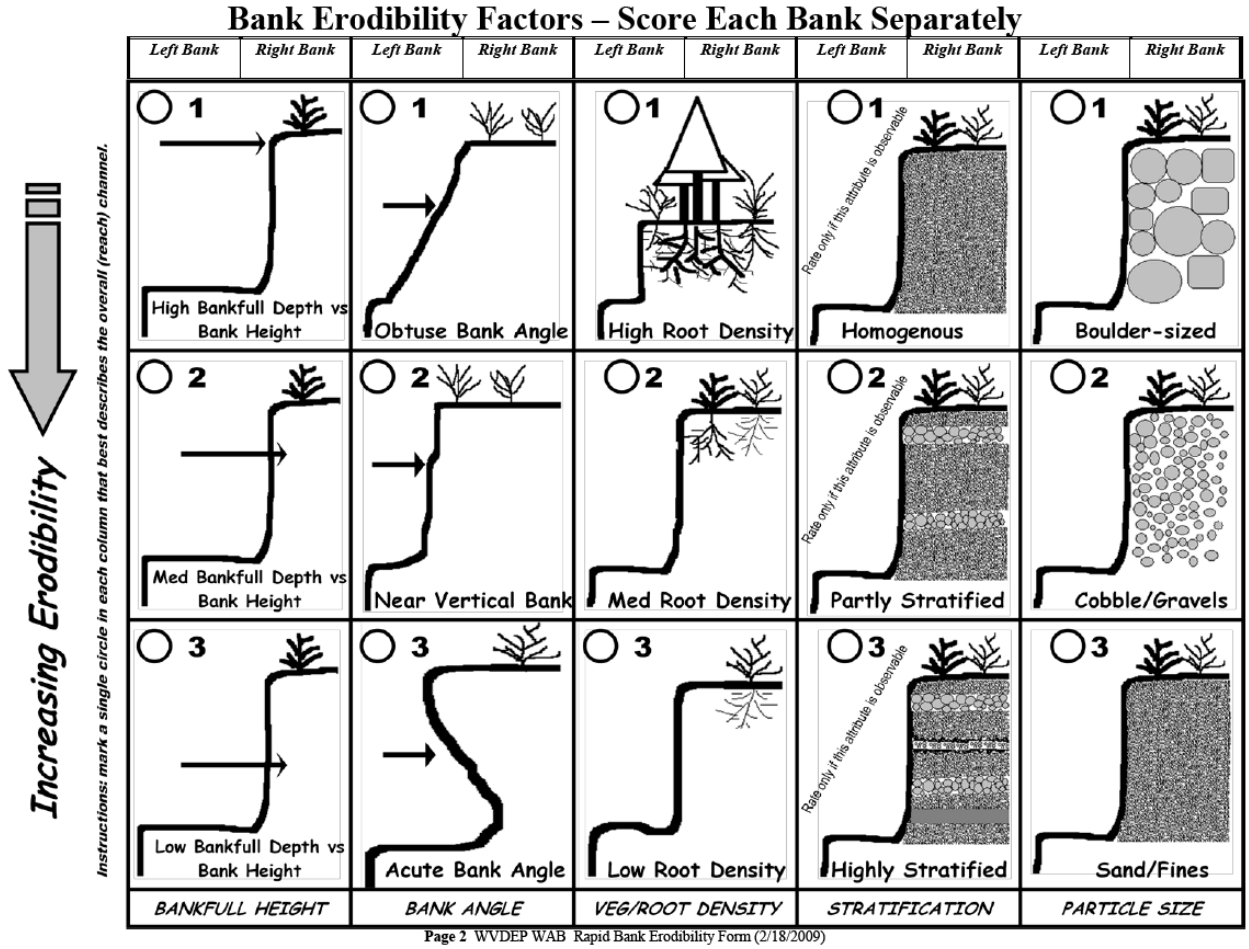


Figure 2-73. Example of the Stream Bank Erodibility Appendix field form

> ***IMPORTANT:*** ***Do not attempt to rate these factors in atypical sections of the stream. You should record the most dominant bank condition by mentally averaging the bank condition for the reach.***

Bankfull Height: Score the overall ratio of the Bankfull Depth vs. the Bank Height

1-High=Bankfull indicators very common throughout the reach; their elevations are mostly at or near the top of the bank; stream has access to its floodplain during high water and bankfull flow events as shown by leaf lines or debris in the floodplain.

2-Medium=Bankfull indicators somewhat common along portions of the reach; their elevations are usually below the top of the bank and more commonly at the middle or lower portions of the bank; channel may be somewhat incised.

3-Low=Bankfull indicators very infrequent throughout the reach; if observed, their elevations are in the middle and lower portions of the bank; channel is usually deeply incised.

Bank Angle: Score the overall angle of the banks. Note that undercuts should be considered for their erosion potential. Many undercuts are shallow enough and associated with heavy root balls so that their erosion potential is minimal.

1-Obtuse=Banks have a slight to moderate angle throughout most of the reach; may have some areas of erosion (< 30%) but mostly the reach shows little sign of disturbance.

2-Near Vertical=Banks have a moderate to steep slope throughout much of the reach; some erosion is occurring (30-60%) within the reach. Note: some banks are often steep but very stable especially is covered by hard surfaces or vegetation.

3-Acute=Banks have a steep angle or are undercut to the extent that potential for sloughing is very high) throughout much of the reach (> 60%); there are obvious signs of erosions such as bare soils, exposed roots, *etc*. along with many depositional features (point bars, islands, lateral bars, *etc*.) in the channel.

Veg/Root Density: Score the overall root density in and on the banks

1-High=More than 90% of the banks are covered by natural undisturbed vegetation (all layers are well represented); most roots systems probably extend to the lower portions of the bank.

2-Medium=60-90% of the banks are covered by natural vegetation (most layers represented but some may be absent); some disturbances such as mowed areas, pastures, trails, *etc*. are evident; most root systems probably extend to the lower or middle sections of the bank.

3-Low=<60% of the banks covered by natural vegetation (only one or two layers represented but most are missing); areas of disturbance obvious throughout most of the reach or non-native species dominate.

Stratification: Score the overall stratification of the bank's materials (*i.e.,* layering). This factor is only rated if the bank is exposed and can be observed

1-Homogenous=Where visible, banks have an almost uniform composition with no apparent layering.

2-Partly Stratified=Where visible, banks have some level of distinct layering into differing size classes.

3-Highly Stratified=Where visible, banks have extremely obvious alternating layers of size class particles.

Particle Size: Score the overall particle size of the bank

1-Boulder=Banks consist primarily of large sized materials (large cobble and boulder); smaller materials may be present, but these can be seen only at the tops of the banks or on floodplain or terrace surfaces.

2-Cobble/Gravel=Banks consist primarily of a mix of materials from large to smaller sizes (cobble to fine gravel); some sand may be intermixed, but it usually makes up < 20%.

3-Sand/Fines=Banks are primarily made up of small materials (mostly fine gravel and sand); silts and clay may be present.

Estimated Channel Profile (Width to Depth Ratio)

Widths to depth ratios (W/D) are defined as the ratio of the bankfull surface width to the mean depth of the bankfull channel. W/D is a key measurement in understanding the energy dynamics within a stream channel. If a stream has a high W/D (*i.e.,* an exceptionally wide stream that is shallow), the distribution of energy within the channel is such that the stress is placed near the banks. As W/D increases, hydraulic stress against the bank increases and erosion will accelerate making the stream wider in respect to its depth. In turn, the erosion increases the sediment supply to the stream. Since the stream is overly wide and shallow, it does not have enough power to move the excess sediment out and sediment deposition occurs in its center. This in turn reduces its depth, thus increasing the W/D and creating a feedback loop.

Using the diagrams provided on the form for guidance, measure the estimated Bankfull Width and Depth (*i.e.,* Height) and the estimated Channel Width and Depth of the stream reach (***see Figure 2-74 on page 2-122***).

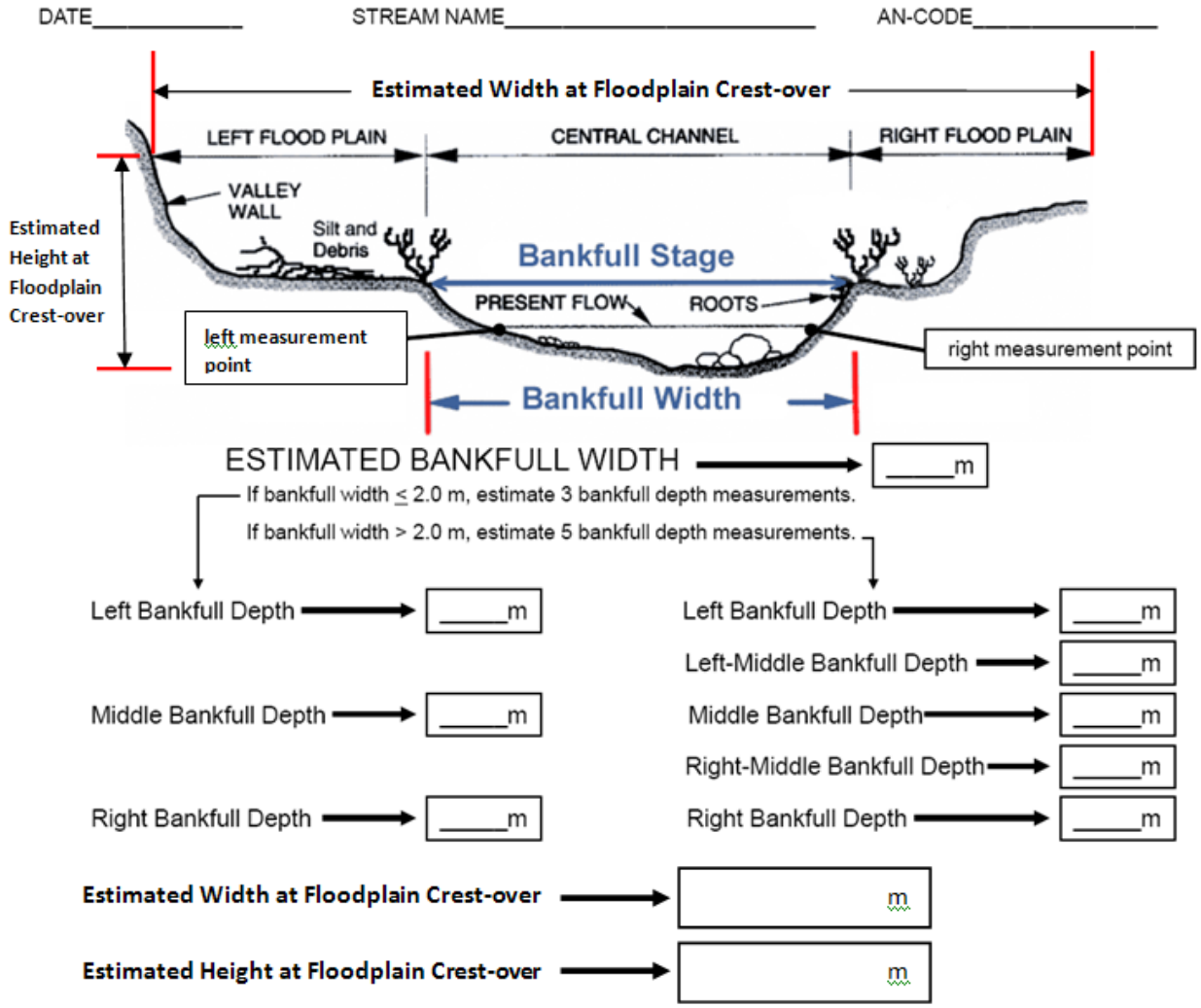


Figure 2-74. Example of the Channel Profile Measurements Appendix Field Form

Bankfull is defined as the water level that is achieved by moderate-sized flood events that occur every one or two years. A bankfull event will fill a portion of the stream channel to a certain width and depth (or height). Look for a variety of bank characteristics to determine the extent of the bankfull event. First, determine the location of the active floodplain. Next, look for an obvious slope break in the banks that differentiates the channel from a flat floodplain higher than the channel. A transition zone often exists between exposed substrate and vegetation, which marks the bankfull height. Look for a change from water-loving and scour-tolerant vegetation to more drought-tolerant vegetation. Also, it may be determined by moss or vegetation growing on rocks along the banks. A change from well-sorted stream sediments to unsorted soil materials is also a good indicator. In addition, indicators from the previous season's flooding are may be used if there have been no recent large floods or prolonged droughts: the presence of drift material (*e.g.,* leaves, trash) along the bank or on overhanging branches from the previous seasons flooding, the level where deciduous leaf-fall is absent on the ground because it was swept into the stream by flooding since the last leaf-fall, and unvegetated sand, gravel or mud deposits from previous seasonal flooding.

The channel depth (*i.e.,* height) can be determined by the vertical distance from the bottom of the channel up to the level of the first major valley depositional surface that the stream channel would spill into during a greater than bankfull flooding event. This measure is an indicator of the degree of incision or down cutting of the stream below the general level of its valley. The channel width is how wide the stream channel is when it begins to spill out into the flood plain.

In cases where the channel is cutting a valley side slope and has over steepened and destabilized that slope, the bare "cut-bank" against the steep hillside is not necessarily an indication of recent incision. In such a case, the opposite bank may be lower and a more obvious indicator of bankfull and channel heights and widths.

In streams in deep V-shaped valleys, the difference between the bankfull and channel depth may be indistinguishable due to a lack of stream incision.

> ***IMPORTANT: Remember that the channel depth may be equal to the bankfull depth, (an indication that the stream channel is not incised or down cutting) but it should never be less than the bankfull height.***

All height and width measurements are in meters (tenths) and should be conducted in an area that is representative of the overall reach condition (*i.e.,* do not pick the one excessively wide or narrow section of the reach for these measurements). These estimates will assist in sediment load modeling.

> ***IMPORTANT: Do not confuse Bankfull Depth and Bankfull Height (a measure used in Relative Bed Stability classification). The Bankfull Depth=Bankfull Height + the Stream Depth at the observation location. In this instance, we are including the depth below the water surface in the bankfull estimates.***

Estimated Bankfull Width: Measure the estimated bankfull width for the reach in meters.

Estimated Bankfull Depth:

If the Estimated Bankfull Width is <=2.0 meters, then estimate 3 bankfull depth measurements at the following locations:

1) Left Bankfull Depth: Measure the estimated Bankfull Depth in meters at the left (descending) edge of the wetted stream channel.
2) Middle Bankfull Depth: Measure the estimated Bankfull Depth in meters at the mid-point of the wetted stream channel.
3) Right Bankfull Depth: Measure the estimated Bankfull Depth in meters at the right (descending) edge of the wetted stream channel.

If the Estimated Bankfull Width is >2.0 meters, then estimate 5 bankfull depth measurements.

1) Left Bankfull Depth: Measure the estimated Bankfull Depth in meters at the left (descending) edge of the wetted stream channel.
2) Left-Middle Bankfull Depth: Measure the estimated Bankfull Depth in meters at the midpoint between the left (descending) edge of the wetted stream and the middle of the wetted stream channel.
3) Middle Bankfull Depth: Measure the estimated Bankfull Depth in meters at the mid-point of the wetted stream channel.
4) Right-Middle Bankfull Depth: Measure the estimated Bankfull Depth in meters at the midpoint between the right (descending) edge of the wetted stream and the middle of the wetted stream channel.
5) Right Bankfull Depth: Measure the estimated Bankfull Depth in meters at the right (descending) edge of the wetted stream channel.

Estimated Channel Height: Measure the estimated channel height for the reach in meters.

Estimated Channel Width: Measure the estimated channel width for the reach in meters.

APPENDIX #3 – TMDL/Wadeable Benthic Appendix Form

NOTE: This appendix form is used whenever a benthic survey is concurrently with a TMDL sampling event. There are just a few parameters that are rated at a TMDL site that are not covered on the Wadeable Benthic Form. Be sure to fill out the AN-Code, Date, and Reviewer Initials just like the front of all form pages so that it can later be attached to the appropriate form by the map coordinator. *See Figure 2-75 on the next page for an example of this section of the form.*

Sk*etc*h of Assessment Reach and Comments: Indicate North with (↑), indicate flow direction, indicate water sample (wq), indicate lat and long site with (X). Draw the sk*etc*h with a coarse resolution to give an overall idea of the sample area beyond the typical 100m reach.

NOTE: You only need to do this sketch if you are conducting a TMDL-Initial assessment concurrently with a Wadeable Benthic Assessment. *See CHAPTER 2. Section C. Part 1. PAGE 1-Site Verification on page 2-31 to contrast the needs of this coarse resolution sketch versus the detailed sketch for the Wadeable Benthic Assessment form.*

TMDL-Wadeable Benthic Appendix Form

STREAM VERIFICATION >>		**Reviewers Initials**	
AN-Code		**Date**	

Sketch of Assessment Reach and Comments: Indicate North with (↑), indicate flow direction, indicate water sample (wq), indicate lat and long site with (X). Draw the sketch with a coarse resolution to give an overall idea of the sample area beyond the typical 100m reach.

Stream Debris (0=None, 1=Low, 2=Moderate, 3=Heavy, 4=Extreme, NR-Not Rated)			
Dead Fish		Oil-Grease	
Garbage		Sewage	
Gas Bubbles		Sludge	
Ice Cover		Other/Notes	

WVDEP WAB TMDL-Wadeable Benthic Appendix Form (4/23/2010)

Figure 2-75. Example of the TMDL-Wadeable Benthic Appendix Field Form

APPENDIX #4 – Water Quality Profile

NOTE: This appendix form is used whenever a more than one water quality sample occurs during a single sampling event (*i.e.,* a water profile). Be sure to fill out the AN-Code, Date, and Reviewer Initials just like the front of all form pages so that it can later be attached to the appropriate form by the map coordinator. *See Figure 2-76 below for an example of this section of the form.*

WQ Profile Appendix Form

Reviewers Initials		ANCode			Date			SONDE PROFILE READINGS PART 1>>>									
Measurement	WQ Sample ID	Depth Description (e.g., Top, Middle Bottom, Thermocline, etc.)	Depth (in feet)	Distance Description (e.g., Left, Middle, Right)	Distance (in meters)	Reach Location (in meters)	Transect (e.g., A, B, C, etc.)	Time (Mandatory for each reading)	Temperature Flag	Temp (°C)	pH Flag	pH (S.U.)	Dissolved Oxygen Flag	Dis. Oxygen (mg/L)	Conductivity Flag	Specific Conduct (umhos/cm)	Measurement Notes
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	
18																	
19																	
20																	

Page 1 WVDEP WAB WQ Profile Appendix Form (5/13/2010)

Figure 2-76. Example of the WQ Profile Appendix Field Form

WQ Sample ID: This ID is unique and comes pre-printed on labels. It is used whenever a lab water sample is collected.

Depth Description: Record a general depth description (*e.g.,* Top, Middle, Bottom, Surface, Subsurface, *etc*.) of the water sample.

Depth: Record the depth of the water sample in feet.

Distance Description: Record a general distance description (*e.g.,* Left Bank, Middle, Right Bank, Left Channel, Right Channel, *etc*.) of the water sample.

Distance: Record the distance of the water sample from the left descending bank in meters.

Reach Location: Record the distance of the water sample relative to the X-site in meters.

Transect: Record the transect designation (*e.g.,* A, B, C, D, *etc*.) of the water sample.

Time: Record the time the water sample was taken. This is mandatory for all water samples.

Temperature Flag: Record any temperature flags.

Temperature: Record the temperature measurement in ^{0}C.

pH Flag: Record any pH flags.

pH: Record the pH measurement in S.U.

Dissolved Oxygen Flag: Record any dissolved oxygen flags.

Dissolved Oxygen: Record the dissolved oxygen measurement in mg/L.

Specific Conductivity Flag: Record any specific conductivity flags.

Specific Conductivity: Record the dissolved specific conductivity in μmhos/cm.

Measurement Notes: Document any notes concerning the water quality measurements.

APPENDIX #5 – Relative Bed Stability (Pebble Count) including Gradient

> **NOTE: This appendix form is used whenever a Substrate Characterization (or Pebble Count). This type of survey is very infrequent, but when it does occur, it will often accompany the Wadeable Benthic Form. Be sure to fill out the AN-Code, Date, and Reviewer Initials just like the front of all form pages so that it can later be attached to the appropriate form by the map coordinator. *See Figure 2-77 on page 2-130 for an example of this section of the form.***

This form is provided to record measurements made on the stream substrate and stream channel. Record the measurements in the spaces provided and make comments as necessary. ***See CHAPTER 10. RELATIVE BED STABILITY/SUBSTRATE CHARACTERIZATION PROTOCOLS* (INCLUDING GRADIENT) *on page 10-1 for instructions on completing this section.***

Measurer: Record the measurer's initials

Recorder: Record the recorder's initials

Gradient Method: Check the box corresponding to the gradient method used (**Water-Filled Tube** or **Hand-Level**)

Wetted Width: Record the wetted width in m for that transect

Left, Left Mid, Middle, Right Mid, and Right: Record the substrate classification scores for these locations on the transect using the scale in ***Figure 2-77 on the next page.***

Thalweg: Record the Thalweg depth in m for that transect

Bankfull Height: Record the bankfull height in m for that transect

Rise: Record the stream rise in m for the distance between transects

Reach Length: Record the total reach length in meters (100m minimum to 500m maximum)

RELATIVE BED STABILITY (PEBBLE COUNT) >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>	Reviewers Initials	
AN-Code	Date	

Relative Bed Stability (Pebble Count)

Reach length	m	Measurer		Recorder		Gradient Method	☐ Water-filled tube	☐ Hand-level

Transect	Wetted Width (m)	Left	Left Mid	Middle	Right Mid	Right	Thalweg (m)	Bankfull Height (m)	Rise (m)
A									
B									
C									
D									
E									
F									
G									
H									
I									
J									
K									

Notes:

Substrate Classification

Class	Code	Size	Description
Bedrock	BR	>4000 mm	Bigger than car
Boulder	BL	>250-4000 mm	Basketball to car
Cobble	CB	>64-250 mm	Tennis ball to basketball
Coarse Gravel	CG	>16-64 mm	Marble to Tennis ball
Fine Gravel	FG	>2-16 mm	Ladybug to marble
Sand	SA	>0.06-2 mm	Gritty between fingers
Silt & Fines	ST	<0.06 mm	Smooth, not gritty (silt & muck)
Clay	CL	>4000 mm	Slick/ hard clay or hard-pan clay bottom
Leaves	LD	Regardless of size	Leaf packs
Wood	WD	Regardless of size	Root wads, snags, logs, sticks

Appendix WVDEP WAB Relative Bed Stability Form (4/12/2010)

Figure 2-77. Example of the Substrate Characterization (Pebble Count) including Gradient Appendix Field Form

Assessment Form Quality Assurance/Quality Control

During sampling, the team member who did not conduct the initial assessment performs an on-site review of every habitat assessment. The reviewer determines completeness and verifies that the information is correct through discussion with the other crew member. If the sampling team consists of one person, as is often the case during a TMDL assessment, the form is reviewed by the sampler for completeness before leaving the site. There is no need to submit a duplicate habitat form if working alone as you will be unable to duplicate habitat evaluations.

Duplicate samples will be collected from 2.5% of the sites sampled and only when at least two people are on a sampling team. Habitat data will be collected at wadeable benthic sites along with other activities at the designated duplicate sites **and must include *the PAGE 1-Site Verification (minus the stream reach sketch), PAGES 5, 6, 5a, and 6a-USEPA's Rapid Bioassessment Protocol Visual-Based Habitat Assessment, .Non-RBP Parameters, and PAGE 9-Benthic Macroinvertebrate Collection Information and Benthic Substrate Sample Composition*.** Both duplicates are collected at the same date and approximate time (as equipment sharing will allow) by different individuals. Duplicate habitat sampling consists of each individual sampling the site as if no one else was there to help (*i.e.,* one person serves as both Biomorph and Geomorph). Sampling occurs in the usual fashion with the Geomorph doing the habitat assessment and the Biomorph collecting benthos. To duplicate, these individuals reverse roles while keeping their data and samples separate. The duplicate data will be analyzed to ensure precision and repeatability of the sampling technique. Every effort is made to ensure that different teams perform the duplicate sampling throughout the sampling season to ensure that all variability is being captured. The variances between individual techniques will be documented and used in future training sessions or individual re-training. In addition, the duplicate data is looked at by Watershed Assessment Branch staff and scrutinized to find any possible discrepancies, contamination, or faults in the sampling methods and techniques. Any problems are brought to the attention of the program management and steps are made to immediately correct the problem. Data that is related to the problem are flagged with notes concerning the details of the situation so that decisions can be made whether to include the data in any further assessments or analysis. ***See CHAPTER 14. Section A. Blanks and Duplicates starting on page 14-1 for additional information.***

Once a year, all field participants in the WAB attend mandatory training sessions. The purpose of these sessions is to ensure that all field personnel are familiar with habitat sampling protocols and calibrated to sampling standards. WAB members will visit one or two stream sites and each person will complete a habitat assessment form at each site. The results of these evaluations will be compared, and the group will discuss problems with variability. Retraining will be conducted, if major discrepancies are encountered. Individuals who are more experienced in evaluating habitat data will be teamed up with the less experienced to ensure reinforcement of training and accurate results. This SOP document is also provided to all program personnel for review and use in the field.

Forms Used in the Watershed Assessment Branch

The forms used by the Watershed Assessment Branch (WAB) are available internally via the WVDEP computer network at:

Q:\WATER RESOURCES\WAB\FIELD FORMS\BLANK FORMS\2018 Forms.zip

and externally via the web at:

http://www.dep.wv.gov/WWE/watershed/Pages/WBSOPs.aspx