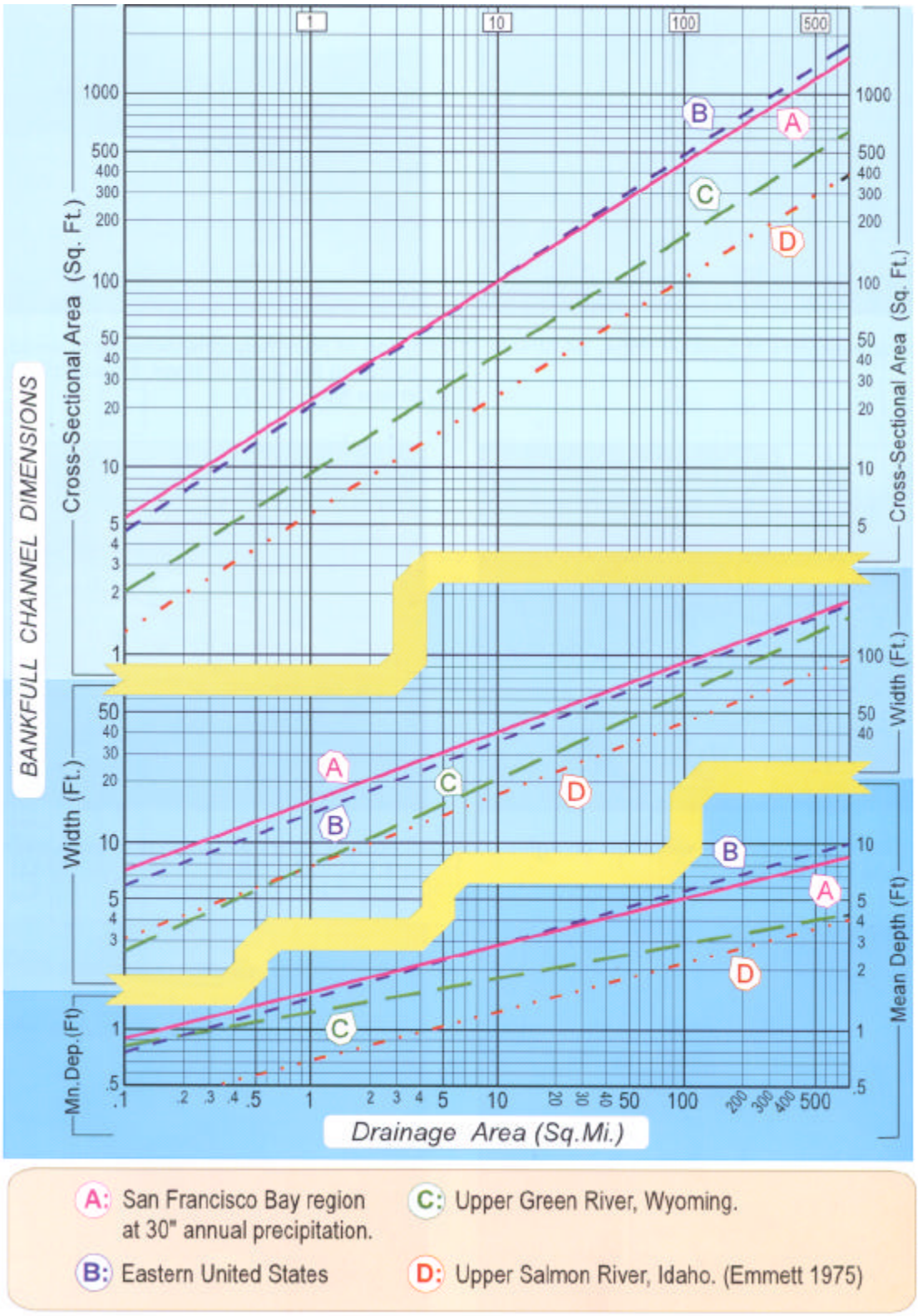


Figure 22. Rating curve to assist in identifying bankfull height.
(from Rosgen 1996, used with permission)

The program will calculate average wetted depth. If a zero depth is encountered, record the zero on the form. When a width/depth transect is in a split channel, use one of two methods:

- If the area between the channels is above the ordinary high water level, take measurements in the channel with the most discharge.

- If the area between the channels is below the ordinary high water level, take measurements across both of the channels and indicate that it is a split channel in the Comments section.

Record the habitat type. This is a mandatory, single selection field; choose only one for each transect.

3.3.8.2 Canopy Closure

anopy closure is the percentage of ground or water covered by shade from the outermost perimeter or natural spread of foliage from plants (Armantrout 1998).

Use a concave spherical densiometer to determine canopy cover. DEQ uses a densiometer modified with tape to show only 17 grid intersections (Bauer and Burton 1993). The 17 grid intersections are marked with dots in the illustration in Figure 23. Hold the densiometer level. You should just see the top of your head in the reflection (see Figure 23). Count the number of densiometer grid intersections obstructed by overhead vegetation. Take densiometer readings at all three riffle habitat unit transects (T1, T2, and T3, where the macroinvertebrate samples were taken). Take one to four readings per cross-section: right bank, left bank, stream center facing upstream, and stream center facing downstream. When moving to change from the stream center facing upstream to stream center facing downstream, make sure the densiometer remains in the same spot. Hold the densiometer one foot above the water surface for all measurements. When measuring at right and left wetted edges, face the bank and position the densiometer one foot in from the streambank and one foot above the water surface (Figure 24).

This is a right justified field, for numeric characters only.

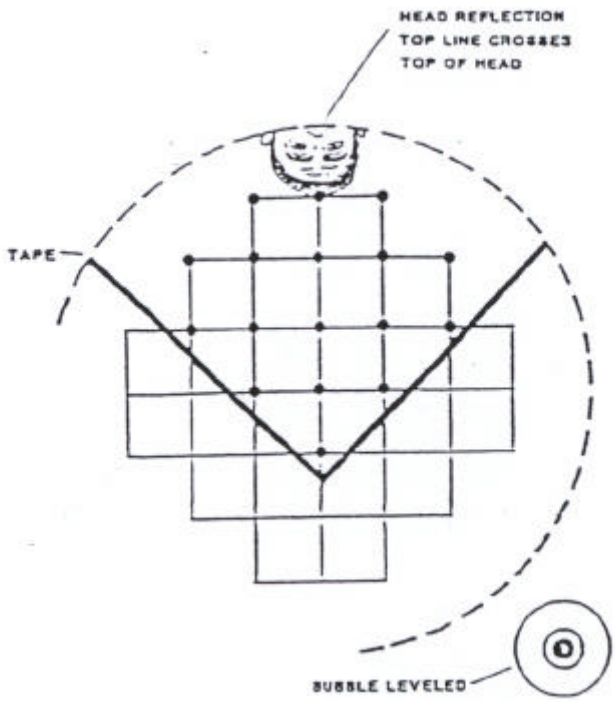


Figure 23. Reflection seen in densiometer.

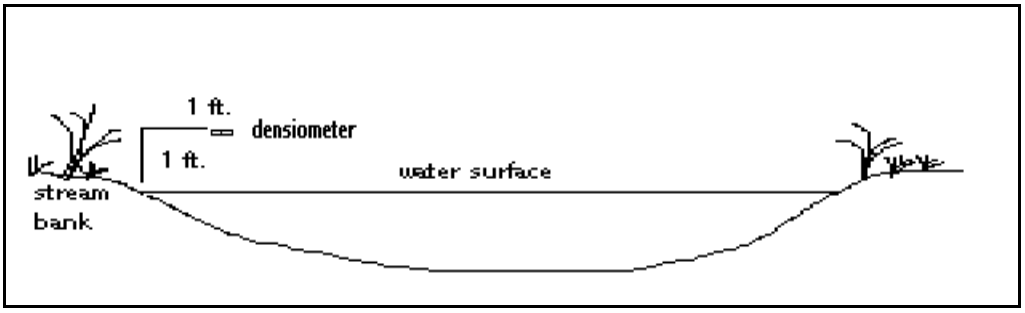


Figure 24. Position of densiometer.

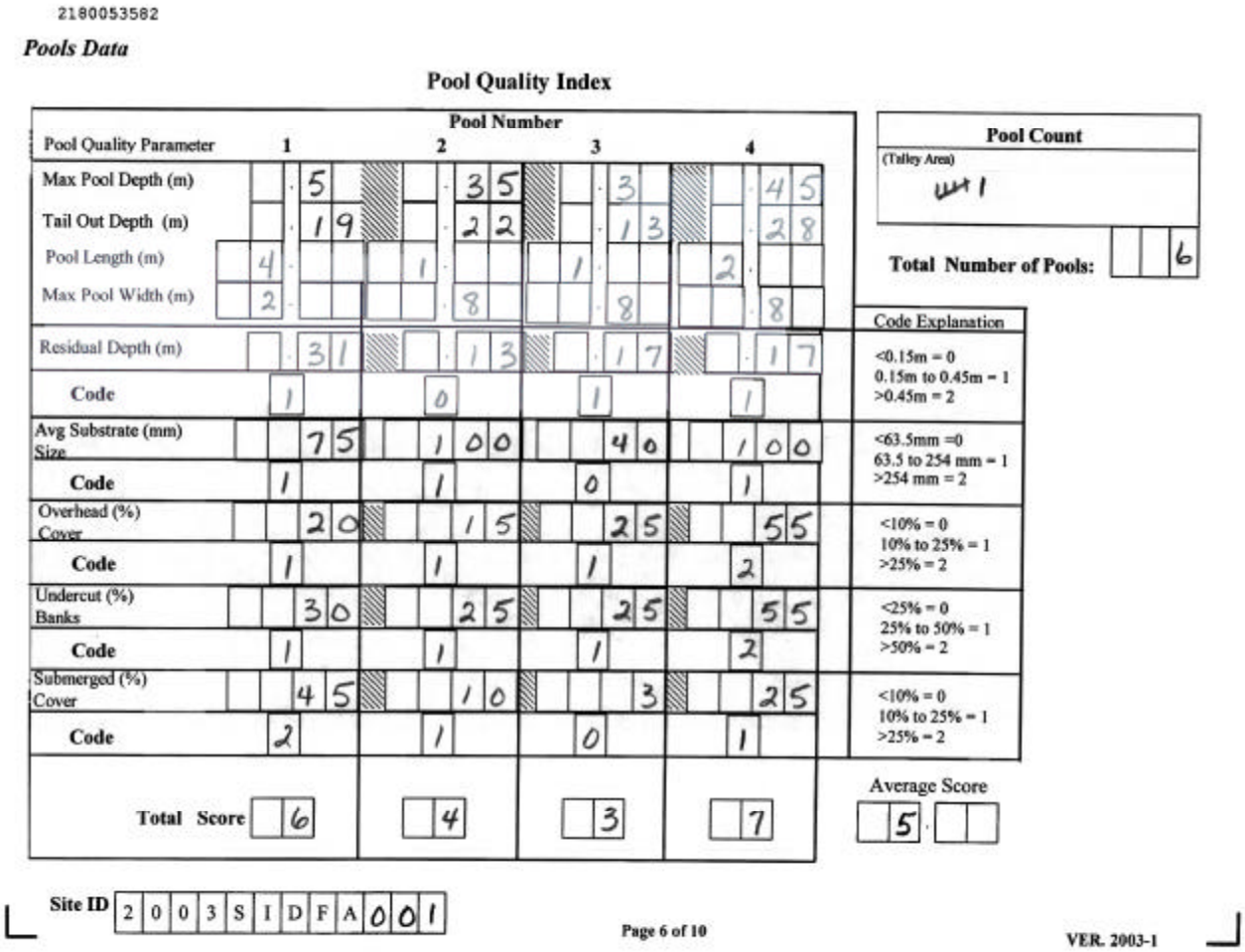
3.3.8.3 Bank Angle

Measure and record the bank angle. Bank Angle is not part of the BURP database; it is measured only to help with determination of Channel Shape, which is covered in section 3.3.10.3.3.5.

3.3.8.4 Horizontal Distance of Undercut Banks

Measuring the horizontal distance of undercut banks is discussed in section 3.3.10.3.1.5 and should be done when at the end of the tape when measuring width/depth.

3.3.9 *Pools Data Page*



2180053582

Pools Data

Pool Quality Index

Pool Quality Parameter	Pool Number 1	2	3	4
Max Pool Depth (m)	.5	.35	.3	.45
Tail Out Depth (m)	.19	.22	.13	.28
Pool Length (m)	4.	1.	1.	2.
Max Pool Width (m)	2.	.8	.8	.8
Residual Depth (m)	.31	.13	.17	.17
Code	1	0	1	1
Avg Substrate (mm) Size	75	100	40	100
Code	1	1	0	1
Overhead (%) Cover	20	15	25	55
Code	1	1	1	2
Undercut (%) Banks	30	25	25	55
Code	1	1	1	2
Submerged (%) Cover	45	10	3	25
Code	2	1	0	1
Total Score	6	4	3	7

Pool Count (Talley Area): ~~1~~

Total Number of Pools: 6

Code Explanation
<0.15m = 0 0.15m to 0.45m = 1 >0.45m = 2
<63.5mm =0 63.5 to 254 mm = 1 >254 mm = 2
<10% = 0 10% to 25% = 1 >25% = 2
<25% = 0 25% to 50% = 1 >50% = 2
<10% = 0 10% to 25% = 1 >25% = 2

Average Score: 5.

Site ID 2003SIDFA001

Page 6 of 10

VER. 2003-1

Figure 25. Pools Data page example.

3.3.9.1 *Pool Quality Index*

Pool quality refers to the diversity of habitats within a pool, which is largely a function of the amount of cover available in slow velocity waters (Bauer and Burton 1993). The Pool Quality Index (PQI) is a calculation that incorporates measures of pool length, substrate, overhead cover, submerged cover, percentage of undercut banks, maximum pool depth, maximum pool width, and depth at pool tailout.

In a study of streams that differed by the amount of management in their watersheds, Overton et al. (1993) found pools in less impacted watersheds were more frequent, had higher volumes, and were of greater depth than those in more impacted watersheds. Beschta and Platts (1986) suggested that pool quality is equally as important as the number of pools in describing a healthy stream from a fisheries standpoint. DEQ may calculate the pool to riffle ratio, a measure of pool

quantity, to evaluate and compare stream impacts. Figure 26 is a general illustration showing where some of the pool variables are measured**.**

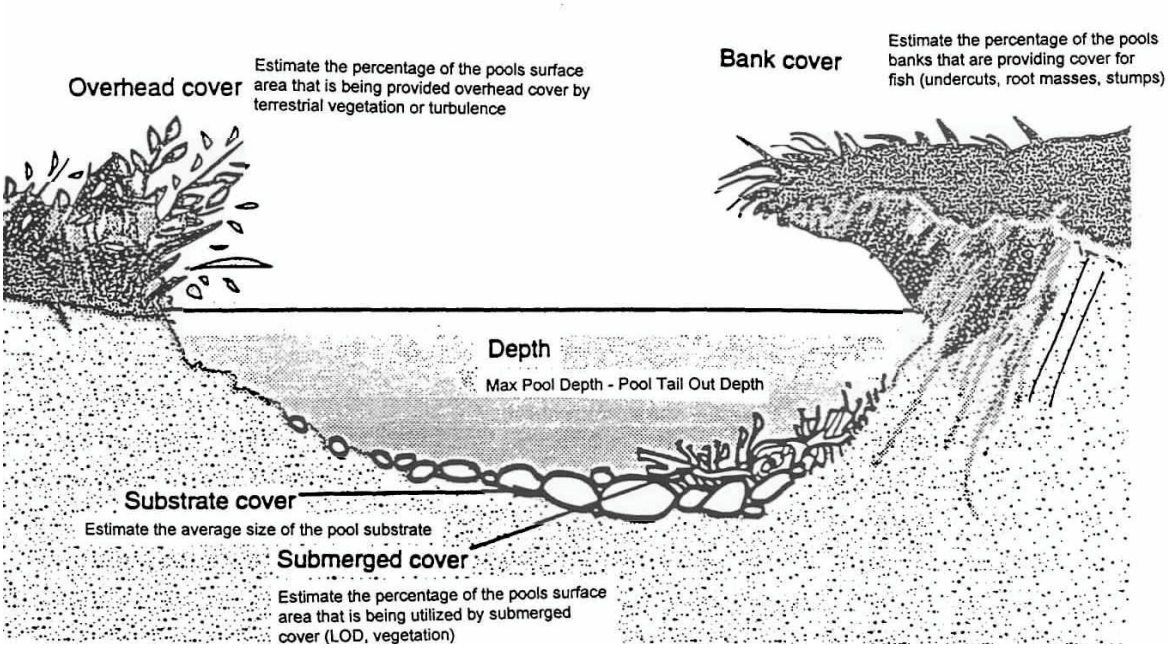


Figure 26. Where to measure some of the PQI variables at each pool.

If multiple pools are present, select four representative pools that characterize the variety of pool types found within the BURP reach, randomly distributed throughout the reach. If there are fewer than four pools in the reach, measure what exists and explain this in the Comments section of the field forms. Use pools that are less than 50% of the channel width for determining pool quality.

Measure the variables of maximum pool depth, tail out depth, pool length, maximum pool width, and undercut banks. Estimate the average (dominant) substrate size and the percentages for overhead cover and submerged cover. Calculate the residual pool depth. Each of these is described below. Enter all values in the appropriate field in the Pool Quality Index table. All of these field are decimal justified. Record the actual measurements. The program will fill in the codes. (For information, codes are given in the last column of the Pool Quality Index table.)

- Maximum Pool Depth (m) **–** The deepest point in the pool as measured from the water surface (Figure 27).

- Tail Out Depth (m) – The deepest point at which the water flows from the pool. This point is usually located along the downstream perimeter of the pool (Figure 27).

- Pool Length (m) – The distance from the upstream perimeter to the downstream perimeter of the pool (Figure 27).

- Maximum Pool Width (m) – The distance between the left and right perimeters of the pool when looking upstream (Figure 27).

Figure 27 shows where the depth, length, and width measurements are taken.

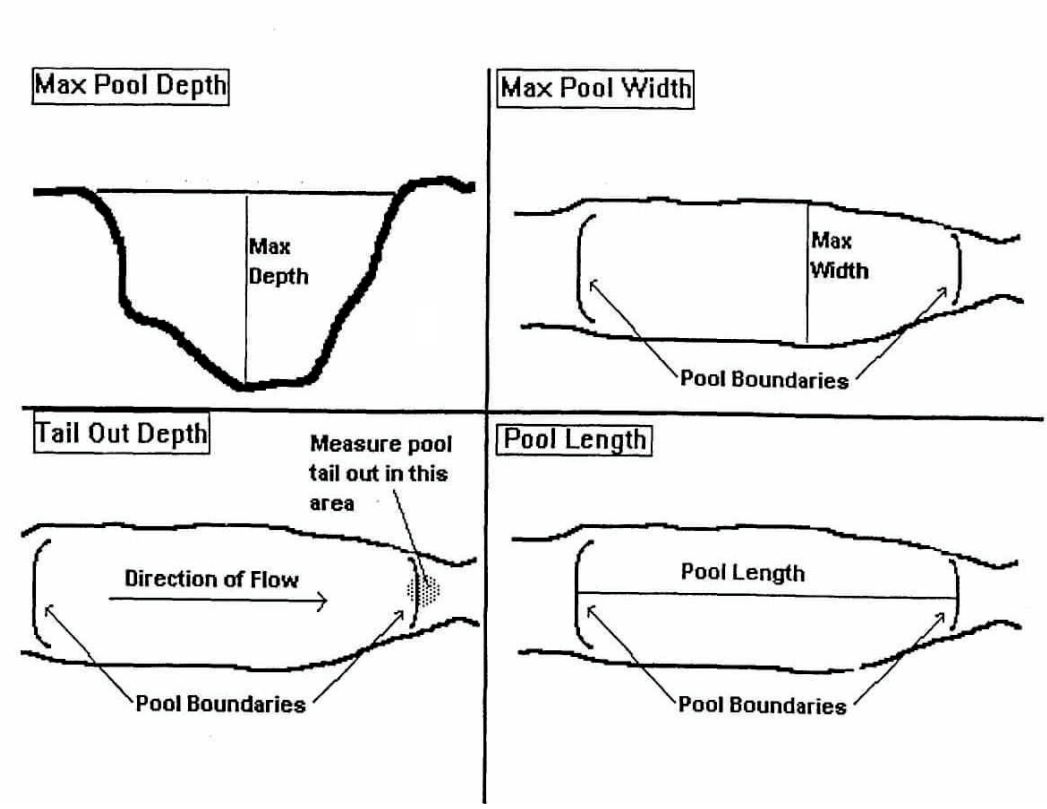


Figure 27. Where to measure pool depths (maximum and tail out), length, and width.

- Residual Depth (m) **–** The maximum depth of the pool under no-flow conditions. Calculate by subtracting tail out depth from maximum pool depth.

- Average Substrate Size (mm) – The size of the dominant substrate within the pool.

Overhead Cover (%) – Any cover within one foot (0.3 meters) of the pool surface, which tends to obscure the view of the pool surface. Overhanging banks and vegetation are typical examples; turbulence of sufficient magnitude to obscure the view into the water column is also considered overhead cover. Estimate this as percent of total pool surface area covered (See Figure 26).

- Undercut Banks (%) – The percent of undercut banks serving as cover along the pool's perimeter. Caution: One side of an evenly proportioned pool represents 50% of the possible total for undercut banks; some pools contact the bank on only one side (or less) of their perimeter.

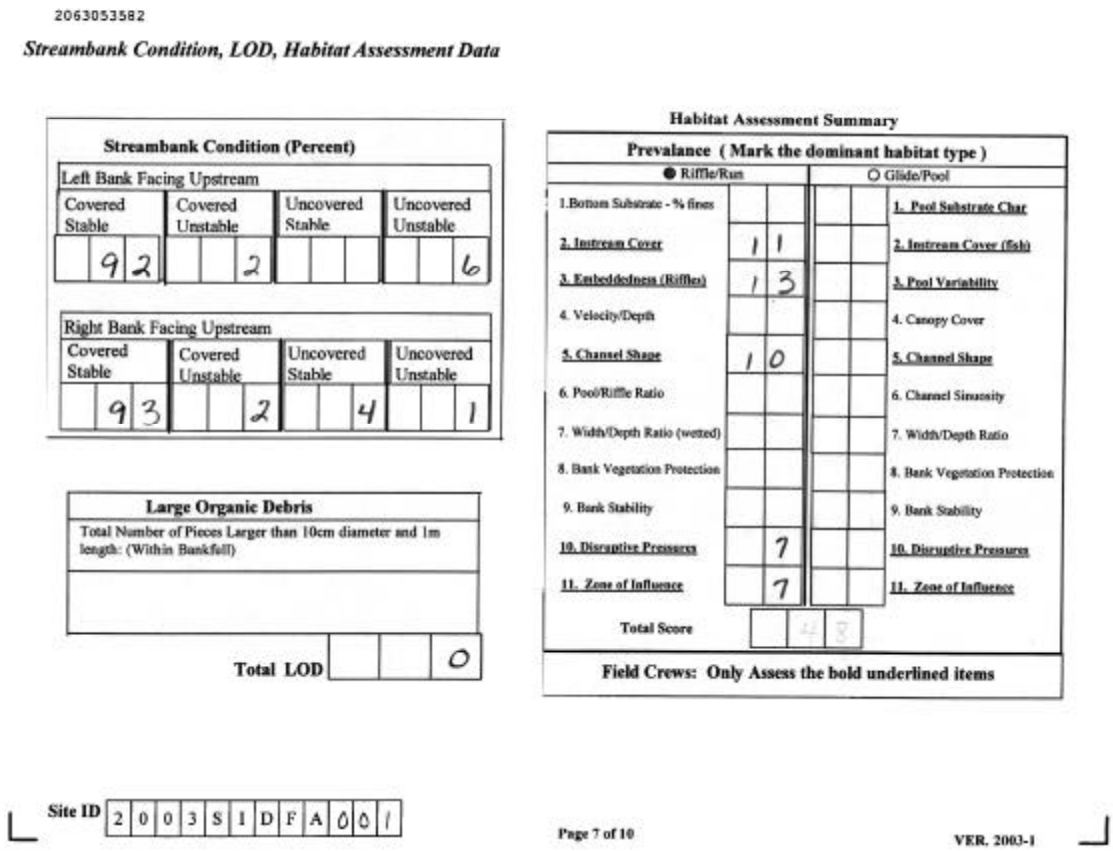
- Submerged Cover (%) – Under surface cover as represented by plants, woody debris, boulders, cobble, geologic morphology, or any relatively permanent structure that provides refuge for aquatic fauna. Estimate as a percent of the pool bottom area providing or under the influence of subsurface cover.

The program will calculate total scores for each pool and the average score for the reach.

3.3.9.2 Pool Count

Count all the pools in the reach. Make tally marks (tick marks or hash marks) in the Tally Area of the Pool Count box. Record the total number of pools. This is a right justified field.

3.3.10 *Streambank Condition, Large Organic Debris, Habitat Assessment Data Page*



2063053582

Streambank Condition, LOD, Habitat Assessment Data

Streambank Condition (Percent)

Left Bank Facing Upstream			
Covered Stable	Covered Unstable	Uncovered Stable	Uncovered Unstable
92	2		6

Right Bank Facing Upstream			
Covered Stable	Covered Unstable	Uncovered Stable	Uncovered Unstable
93	2	4	1

Large Organic Debris

Total Number of Pieces Larger than 10cm diameter and 1m length: (Within Bankfull)

Total LOD 0

Habitat Assessment Summary

Prevalance (Mark the dominant habitat type)					
● Riffle/Run			○ Glide/Pool		
1.Bottom Substrate - % fines					**1. Pool Substrate Char**
2. Instream Cover	1	1			**2. Instream Cover (fish)**
3. Embeddedness (Riffles)	1	3			**3. Pool Variability**
4. Velocity/Depth					4. Canopy Cover
5. Channel Shape	1	0			**5. Channel Shape**
6. Pool/Riffle Ratio					6. Channel Sinuosity
7. Width/Depth Ratio (wetted)					7. Width/Depth Ratio
8. Bank Vegetation Protection					8. Bank Vegetation Protection
9. Bank Stability					9. Bank Stability
10. Disruptive Pressures		7			**10. Disruptive Pressures**
11. Zone of Influence		7			**11. Zone of Influence**
Total Score		48			

Field Crews: Only Assess the bold underlined items

Site ID 2003S1DFA001

Page 7 of 10

VER. 2003-1

Figure 28. Streambank Condition, Large Organic Debris, Habitat Assessment Data page example.

3.3.10.1 *Streambank Condition*

The streambank is defined as that part of the channel most susceptible to erosion during high water events. Streambanks are important transition zones between aquatic and terrestrial systems (Stevenson and Mills 1999). When in good condition, these habitats are well vegetated, resistant to erosion, and provide cover and refuge for fish species. Banks stabilized by deeply rooted vegetation, rocks, logs, or other resistant materials are less susceptible to flow-related erosion, reduce water velocity along the stream perimeter, and aid in beneficial sedimentation (Bauer and Burton 1993). Human impacts and natural disturbances reduce bank vegetation, erosion resistance, structural stability, and fish cover value. Eroding streambanks support little or no riparian vegetation, resulting in a loss of stream shading, undercut banks, and nutrient loading, and a reduction in terrestrial insects dropping into the stream (important fish food source) (Overton et al. 1995). The removal of streambank vegetation and soils reduces the structural stability of the stream channel and negatively affects fish productivity (Platts 1990, Platts and Nelson 1989).

Bank cover refers to the percent surface protection (Stevenson and Mills 1999). It is generally viewed at the vegetative green line located below the bankfull level but above any natural undercutting bank scour.

Using a modified version of Burton (2002), the streambank is categorized as covered and stable, covered and unstable, uncovered and stable, or uncovered and unstable.
Determine the streambank condition on the left bank and the right bank (when facing upstream). Using a two-meter stick, a tape, or a laser rangefinder, measure the total number of meters of streambank that fall into each of the four categories. These values are used to calculate what percent of the reach is characterized by each of the four bank conditions.

Identify the streambank located between the scour line and the floodplain line. The bank is that portion of the channel margin above the scour line at the steepest angle to the water surface. View the scour line level along the entire length of the stream reach. The scour line can be located by examining features in the channel. For instance, the ceiling of undercut banks, the limit of sod forming vegetation, and the limit of perennial vegetation all clearly identify the scour line level. Evaluate streambank cover when water is at or below the scour line. If a vertical bank is greater than two meters high, examine only the first two meters. The floodplain line is the upper limit of the streambank. It is defined by that elevation where water first spills onto the lowest floodplain terrace. On gravel and sand bars, the bank is often defined by the limit of sod or perennial vegetation or by an indentation in the bar (local steepened area) just above the scour line. That small indentation or lip is the bank as defined in the procedure.

Evaluate streambank cover and stability according to the following descriptions.

3.3.10.1.1 Streambank Cover

Streambanks are considered covered if any of the following are true: (Burton 2002):

- Perennial vegetation ground cover is greater than 50%.
- Roots of vegetation cover more than 50% of the bank (deep rooted plants such as willows and sedges provide such root cover).
- At least 50% of the bank surfaces are protected by rocks of cobble size (150 mm) or larger.
- At least 50% of the bank surfaces are protected by logs with 10 centimeter (4 inch) or larger diameter.
- At least 50% of the bank surfaces are protected by a combination of the above.

3.3.10.1.2 Streambank Stability

Bank stability pertains to the resistance of a bank to erosion (Armantrout 1998). Banks are considered stable if they **<u>do not show</u>** indications of **any** of the following features (Burton 2002):

- Breakdown – obvious blocks of bank broken away and lying adjacent to the bank breakage.

- Slumping or false bank – the bank has obviously slipped down, cracks may or may not be obvious, but the slump feature is obvious.

- Fracture – a crack is visibly obvious on the bank indicating that the block of bank is about to slump or move into the stream.

- Vertical and eroding – the bank is mostly uncovered as defined above and the bank angle is steeper than 80 degrees from the horizontal.

3.3.10.1.3 Streambank Condition Categories

Classify each streambank into the following four condition categories. For each condition category, record a percentage with the total not exceeding 100% for each streambank (i.e., the left streambank equals 100% and the right streambank equals 100%, not 50 percent each). These are right justified fields.

- Covered and Stable (non-erosional) – Streambanks are covered and stable (according to Burton 2002, as defined above). Banks associated with gravel bars with perennial vegetation above the scour line are in this category.

- Covered and Unstable (vulnerable) – Streambanks are covered as defined above and not stable as defined above. These banks are typically observed in meadows where breakdown, slumping, and/or fracturing is present along the bank, yet vegetative cover is abundant.

- Uncovered and stable (vulnerable) – Streambanks are not covered as defined above and stable as defined above. Uncovered, stable banks are typical of streamsides trampled by concentrations of ungulates. Such trampling flattens the bank so that slumping and breakdown do not occur even though vegetative cover is significantly reduced or eliminated.

- Uncovered and unstable (erosional and depositional) – Streambanks are not covered as defined above and not stable as defined above. These are bare, eroding streambanks and include all banks mostly uncovered that are at a steep angle to the water surface.

3.3.10.2 Large Organic Debris

In the Pacific Northwest, organic debris, such as a dead log or a tree, is considered LOD if it has a diameter greater than 10 centimeters (4 inches) and a length greater than one meter (39 inches) (Armantrout 1998, Davis et al. 2001). The term LOD is synonymous with large woody debris (LWD) described in other literature.

Large organic debris adds complexity to stream habitats, retains allochtonous matter and sediment, and imparts stability to streams under high flow conditions. Some species of salmonids show a high affinity for LOD (Rieman and McIntyre 1993). Further, LOD reduces the export of organic matter and nutrients and provides protection and habitat for invertebrates and fish (Davis et al. 2001). Experimental studies done by Braudrick and Grant (2000) have shown

that the two most important factors in the entrainment of LOD are the orientation of the LOD pieces and the presence/absence of rootwads.

Count each piece of LOD that is predominantly greater than 10 centimeters in diameter and 1 meter in length and is not alive. Count all LOD within the bankfull channel throughout the site. Occasionally, sites will be encountered with large accumulations of LOD. At these sites, it is acceptable to count up to 100 pieces then estimate thereafter. Specifically, if there are less than 100 pieces of LOD in the site, count them individually; if there are more than 100 pieces in the site, count by tens. When dealing with large amounts of LOD, each piece counted **must meet** the minimum size requirement, which are noted on the field form. If there is an accumulation of pieces that do not meet the minimum size requirement, take a photo of the pile and make note of it in the Comments section of the field forms. Count material naturally recruited from the drainage.

This is a right justified field.

3.3.10.3 Habitat Assessment Summary

Habitat is a specific type of place within an ecosystem occupied by an organism, population, or community that contains both living and nonliving components with specific biological, chemical, and physical characteristics including the basic life requirements of food, water, and cover or shelter. The habitat assessment is a combination of quantitative and qualitative measures of several habitat variables. Specifically, it is a modification of the habitat assessment method in the EPA Monitoring Handbook (Hayslip 1993). DEQ has modified the Hayslip 1993 approach to quantitatively calculate several of the variables. The variables used in the habitat assessment are sometimes different depending on the dominant habitat type (riffle/run versus glide/pool).

Physical habitat quality can significantly influence the biological condition of aquatic communities. Under contract to DEQ, Fore and Bollman (2000) developed a stream habitat index (SHI) as an analytical tool for assessing aquatic life beneficial uses for wadeable streams. Some of the BURP habitat assessment variables are components of the SHI.

The Habitat Assessment assesses the entire reach. The entire crew assesses habitat. At the end of the BURP survey, gather all the crew members and review the questions for the qualitative variables.

3.3.10.3.1 Designating Riffle/Run or Glide/Pool Prevalence

Determine if the stream is primarily riffle/run or glide/pool by looking at the data in the Longitudinal Habitat Distribution section of the field forms (see section 3.3.11.1). Choose the appropriate habitat assessment category (either riffle/run or glide/pool).

This is a mandatory, single selection field; choose only one.

3.3.10.3.2 Assessing the Qualitative Variables in the Habitat Assessment Summary

Refer to the appropriate DEQ laminated flip chart, also found in an appendix of this manual (Appendix F for riffle/run or Appendix G for glide/pool). As a group, discuss each of variables that are underlined on the field form and decide on a score for each. Evaluate the habitat for the present condition of the stream, without considering historical or future conditions. Record the scores in the appropriate cells in the Habitat Assessment Summary section on the right side of this page. All these fields are right justified.

3.3.10.3.3 Reaches With Riffle/Run Prevalence

3.3.10.3.3.1 Bottom Substrate - % fines

The proportion of fine sediments on the substrate surface of a stream can provide a good estimate of substrate habitat quality for salmonids. Excess fines can reduce embryo survival and impede emergence of fry (Bauer and Burton 1993).

Percent fines is a measurement of stream bed particles of 2.51 mm or less. The BURP process calculates percent fines from the pebble count. See section 3.3.7.1, Pebble Count, for further discussion.

3.3.10.3.3.2 Instream Cover Type

Instream cover consists of areas with structure (e.g., boulders, rocks, logs, etc.) in a stream channel that provide aquatic organisms with shelter or protection from predators or competitors. These are also places with low water velocity where organisms can rest and conserve energy (American Fisheries Society 1988). The availability of instream cover is important in sustaining a variety of fish throughout their life cycles. It provides refuge from predators, such as birds, terrestrial mammals, and other aquatic species. It also provides protection from sunlight and increased current velocities. (American Fisheries Society 1999).

Determine pool substrate composition and characteristics, then rate according to type and variety. A mix of substrate types including root masses, aquatic plants, and sands and gravels receive a higher score. Substrates with only one substrate type receive a lower score and those dominated by mud receive the lowest score. Rate the amount of instream cover based on the following types:

- Vegetation Cover –Vegetation that provides cover for protection of fish and other aquatic organisms, such as algal mats, macrophytes, and overhanging riparian vegetation. Cowley et al. (1992) is helpful in evaluating vegetation cover.

- Clump – Irregular accumulation of debris along a stream channel that does not form major impediments to stream flow.

- Log – In general, a tree trunk or large limb, with or without the roots attached.

- Substrate – The mineral or organic material forming the bottom of the water body. See section 3.3.7.1, Pebble Count, for further discussion.

- Large Organic Debris – Large woody material (e.g., log or tree) with a diameter greater than 10 centimeters (4 inches) and a length greater than 1 meter (39 inches).

- Turbulence – Stream flows in which the velocity at a given point varies erratically in magnitude and direction and disrupts reaches with laminar flow. Turbulence causes disturbance of the water surface and produces uneven surface levels which results in poor visibility and good protective cover because air bubbles are entrained in the water.

- Root Wad – Root mass from a tree. Synonymous with butt ends.

3.3.10.3.3.3 Embeddedness

Embeddedness is the degree to which very coarse pebbles and larger sizes of particles (cobbles and boulders) are surrounded or covered by fine sediment. For BURP monitoring, fine sediments are defined as 6.35 mm or less and larger particles are 45 mm to 300 mm (Burton and Harvey 1991). Fine sediment particles fill the small interstitial spaces between larger particles causing reduced water flow and a reduction of habitat that is important for the over wintering of small fish, some fish spawning, and sediment-intolerant macroinvertebrates (Bain 1999). See the pebble count section (3.3.7.1) for further discussion of substrate considerations.

This variable is primarily qualitative, since the quantitative methods provide little additional information for the purposes of beneficial use support and are very time consuming. To reduce the variability in qualitative assessments of embeddedness, DEQ provides centralized training to BURP crews on the ranges of embeddedness.

Determine the percentage of particles larger than very coarse pebbles that are surrounded or covered by sediment of 6.35 mm and less. Assign scores from 0 to 20 based on the percentage of embeddedness; bedrock is considered 100% embedded (score of 0). For streams with no embeddedness, the site will receive a score of 20. For every 5% increase in embeddedness, reduce the score one point (see Table 4).

Table 4. Embeddedness Scores Based on Embedded Percentage

% Embed-dedness	0	5	10	15	20	25	30	35	40	45
Score	20	19	18	17	16	15	14	13	12	11
% Embed-dedness	50	55	60	65	70	75	80	85	90	95
Score	10	9	8	7	6	5	4	3	2	1

3.3.10.3.3.4 Velocity/Depth

The velocity/depth ratio represents patterns of velocity and depth in a stream. The best streams in most high-gradient regions will have all four of these patterns present: slow-deep, slow-shallow, fast-deep, and fast-shallow (Barbour et al. 1999). This variable is calculated using the

presence and absence of different habitat types. To determine habitat types, refer to the Longitudinal Habitat Distribution section (3.3.11.1).

3.3.10.3.3.5 Channel Shape

Channel shape is the angle formed by the downward sloping streambank as it meets the horizontal water's edge. Fish often congregate near the streambank for the cover it provides. If the bank has been cut away and moved back from the water column, valuable rearing habitat has been lost. Measuring the channel bank angle is effective for monitoring land uses that can change the morphology and relative location of the streambank (Platts et al. 1987).

At a minimum of three locations along the reach, lay a straight edge of appropriate length against the left bank with one end at the water's edge. Lay the clinometer on the straight edge and read the bank angle in degrees from the external score on the clinometer (Peck et al. 1999). A vertical bank is 90 degrees. Undercut banks have angles greater than 90 degrees, approaching 180 degrees. Gradually sloping banks have angles less than 90 degrees. To measure bank angles greater than 90 degrees, turn the clinometer over and subtract the reading from 180 degrees. If the bank is undercut, measure the horizontal distance. Repeat this procedure for the right bank. Record the bank angles for left and right banks on the Width, Depth, Canopy, Banks data page and use the DEQ flip chart (Appendix F) to determine the appropriate score for the channel shape. The key is to include the midpoint of the dominant undercut in the bank profile.

3.3.10.3.3.6 Pool/Riffle Ratio

This is the ratio of the surface area or length of pools to the surface area or length of riffles in a given stream reach, expressed as the relative percentage of each category.
This ratio is used to predict the stream's capability of providing resting and feeding pools for fish and riffles to support their spawning and food production (Platts et al. 1983).
The total meters of pool present is divided by the total meters of riffle present. This variable is calculated using the Longitudinal Habitat Distribution data. See section 3.3.11.1 for further discussion.

3.3.10.3.3.7 Width/Depth Ratio (wetted)

This is the ratio of wetted water width to average water depth. This is a good indicator of channel cross-section shape.

Generally, deeper, narrower channels provide better habitat for various aquatic species. As streams become wider and shallower, they provide less habitat for organisms such as salmonids (Bauer and Burton 1993).

This variable is calculated using the width/depth ratio data. See the Width/Depth Ratio section (3.3.8.1) for further discussion.

3.3.10.3.3.8 Bank Vegetation Protection

This is a measure of the amount of vegetative protection afforded to the streambank and the near stream portion of the riparian zone.

The root systems of plants growing on streambanks help hold soil in place, thereby likely reducing the amount of erosion. This variable supplies information on the ability of the bank to

resist erosion as well as some additional information on the uptake of nutrients by the plants, the control of instream scouring, and stream shading (Barbour et al. 1999).

This variable is calculated using the Streambank Condition data. See the Streambank Condition section (3.3.10.1) for further discussion.

3.3.10.3.3.9 Bank Stability

This is a measurement of the stability of streambanks using vegetative cover and substrate cover.

Steep banks that don't have adequate cover are more likely to collapse and erode than gently sloping banks, and are therefore considered to be unstable. Stable, undercut banks provide better fish habitat than slumping, unstable banks. Stable banks contribute less sediment into the stream system than unstable, eroding banks (Barbour et al. 1999).

This variable is calculated using the Streambank Condition data. See the Streambank Condition section (3.3.10.1) for further discussion.

3.3.10.3.3.10 Disruptive Pressures

Disruptive pressure pertains to the anthropogenic impacts to the riparian zone. The measurement of disruptive pressures at each BURP site is a qualitative variable of the Habitat Assessment. This variable is used to determine seasonal human impacts on riparian zones. Seasonal impacts can include recreational activities (camping, hiking, fishing, hunting) and livestock grazing.

Rate disruptive pressures according to the descriptions provided on the DEQ flip charts (see Appendix F).

3.3.10.3.3.11 Zone of Influence

The zone of influence pertains to the width of the riparian vegetation zone. This area is directly affected by nearby ditches, channels, or other drainage features. The presence and condition of the riparian vegetation is important to the overall ecological health of the river and its floodplain. Healthy stands of riparian vegetation provide habitat for aquatic and terrestrial animals and perform important physical functions (e.g., erosion control, sediment catchment). Stands of naturally occurring riparian vegetation can vary from river to river depending on climate and geomorphology.

The zone of influence is used to determine the overall human impacts on a riparian zone such as roads, logging, lawns, campgrounds, and urban areas. Rate the zone of influence (the width of the riparian vegetative zone) based on the least buffered side. Use descriptions provided in the DEQ laminated flip charts (Appendix F) to select an appropriate rating. Due to geology, climate, vegetation, flow regimes, and other natural conditions, sometimes the zone of influence is naturally very narrow (less than one stream width). Examples of this are the deep, V-shaped valleys found in north central Idaho. Do not try to adjust ratings for natural conditions, (e.g., geology, climate, vegetation, flow-regime) as the DEQ classification system already considers these factors.

3.3.10.3.4 Reaches With Glide/Pool Prevalence

3.3.10.3.4.1 Pool Substrate Characteristic

Firm 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 (Barbour et al. 1999). This variable is a visual estimate of the substrate materials that make up the pool (Hayslip 1993).

3.3.10.3.4.2 Instream Cover

See the discussion of Instream Cover under Riffle/Run Prevalence above, section 3.3.10.3.1.2.

3.3.10.3.4.3 Pool Variability

A pool is a portion of the stream with reduced water velocity and water deeper than the surrounding areas. The bottom of a pool is often concave, forming a depression in the profile of the stream's thalweg that retains water if there is no flow. 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. According to Hayslip (1993), the greater the pool type diversity, the better the habitat. Conversely, streams with low sinuosity (few bends) and monotonous pool characteristics do not have sufficient quantities and types of habitat to support a diverse aquatic community.

Determine the proportion of large and small pools and the proportion of shallow and deep pools in general. In general, if any pool dimension (i.e., length, width, oblique) is greater than half the cross-section on the stream the pool is large. Give a high score if the stream is dominated by an even mix of all four sizes of pools. Give a lower score if the stream is dominated by large deep pools. Give an even lower score if the stream is dominated by shallow pools. Give the lowest score if the stream is dominated by small shallow pools or has no pools. In general a one-meter depth separates shallow and deep pools (Barbour et al. 1999).

3.3.10.3.4.4 Canopy Closure

Canopy closure is the area of the sky over the stream channel covered by vegetation. The amount of sunlight entering a stream determines, to a large extent, the rate of water warming. Well canopied streams have less water temperature fluctuation and provide better protected habitat for aquatic species (Bauer and Burton 1993).
This variable is calculated using the densiometer data. See the Canopy Closure section (3.3.8.2) for further discussion.

3.3.10.3.4.5 Channel Shape

See the discussion of Channel Shape under Riffle/Run Prevalence above (section 3.3.10.3.3.5).

3.3.10.3.4.6 Channel Sinuosity

This is a measurement of the meandering or sinuosity of the stream. A high degree of sinuosity provides for diverse habitat and fauna, and the stream is better able to handle surges when it fluctuates as a result of storms (Barbour et al. 1999). This variable is calculated using the sinuosity data. See the Sinuosity section (3.3.5.7) for further discussion.

3.3.10.3.4.7 Width/Depth Ratio

See the discussion of Width/Depth Ratio under Riffle/Run Prevalence above, section 3.3.10.3.3.7.

3.3.10.3.4.8 Bank Vegetation Protection

See the discussion of Bank Vegetation Protection under Riffle/Run Prevalence above, section 3.3.10.3.3.8.

3.3.10.3.4.9 Bank Stability

See the discussion of Bank Stability under Riffle/Run Prevalence above, section 3.3.10.3.3.9.

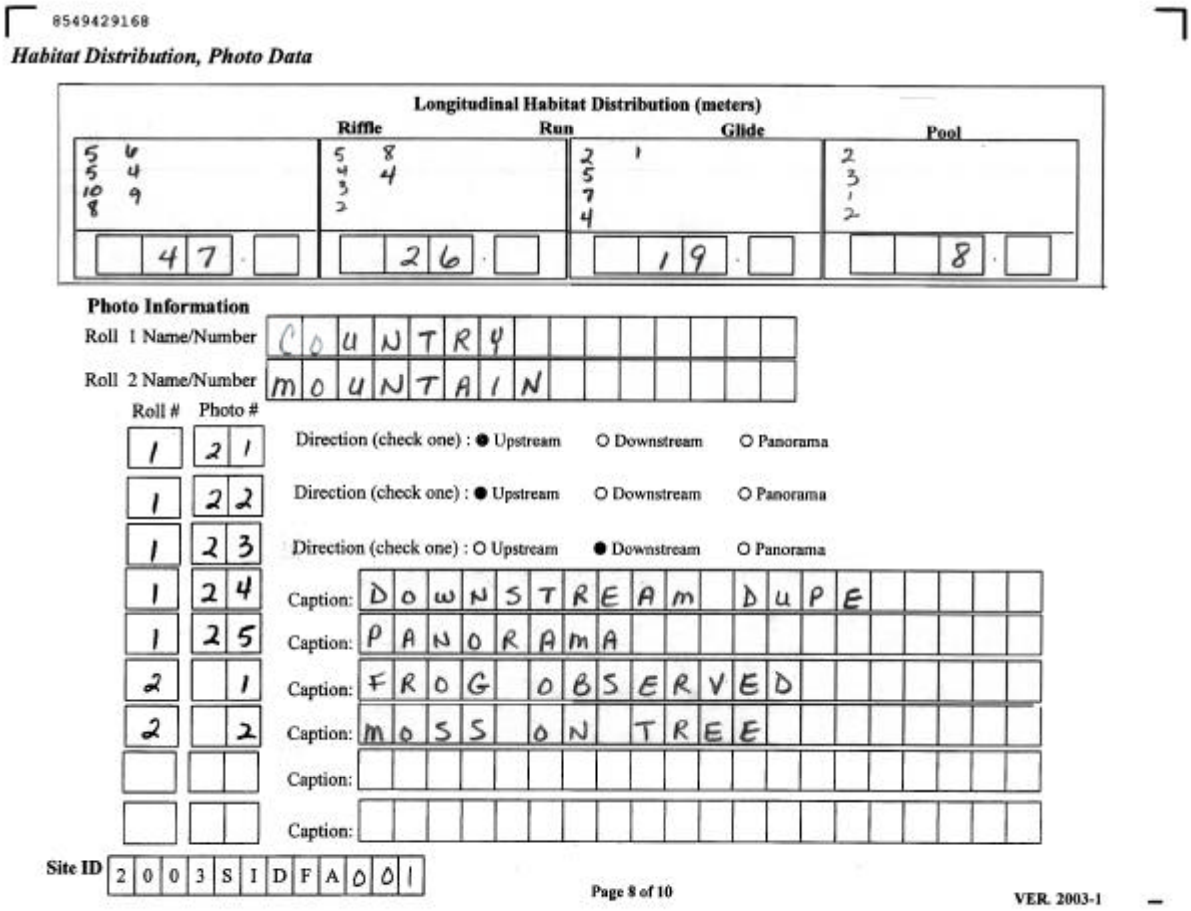
3.3.10.3.4.10 Disruptive Pressure

See the discussion of Disruptive Pressure under Riffle/Run Prevalence above, section 3.3.10.3.3.10.

3.3.10.3.4.11 Zone of Influence

See the discussion of Zone of Influence under Riffle/Run Prevalence above, section 3.3.10.3.3.11.

3.3.11 *Habitat Distribution and Photo Data Page*


8549429168

Habitat Distribution, Photo Data

Longitudinal Habitat Distribution (meters)

Riffle	Run	Glide	Pool
5 6 5 4 10 9 8	5 8 4 4 3 2	2 1 5 7 4	2 3 1 2
47	26	19	8

Photo Information

Roll 1 Name/Number: COUNTRY

Roll 2 Name/Number: MOUNTAIN

Roll #	Photo #	Direction (check one)	Caption
1	21	● Upstream ○ Downstream ○ Panorama	
1	22	● Upstream ○ Downstream ○ Panorama	
1	23	○ Upstream ● Downstream ○ Panorama	
1	24		DOWNSTREAM DUPE
1	25		PANORAMA
2	1		FROG OBSERVED
2	2		MOSS ON TREE

Site ID: 2003SIDFA001

Page 8 of 10

VER. 2003-1

Figure 29. Habitat Distribution and Photo Data page example.

3.3.11.1 Longitudinal Habitat Distribution

The longitudinal habitat distribution is defined as the proportions of the channel represented by relatively homogeneous areas whose depth, velocity, and substrate characteristics differ from adjoining areas (Armantrout 1998).

DEQ identifies these main habitat types in the stream channel:

Riffle and Run Habitats – Areas of the stream with fast current and shallower depth; typically much of the water surface is visibly broken. Look for in Rosgen A type channels and higher gradient streams with coarser substrate. Can have numerous pools.

Pool and Glide Habitats – Usually few riffles and slower water column velocity. Generally but not always deeper than riffle-run streams. Number of pools can vary. Look for in lower gradient stream segments, often seen in wide, flat valleys. Usually more depositional in character.

Following are the descriptions used by BURP to distinguish these types of habitat.

Pool – A portion of the stream with reduced water velocity, water deeper than the surrounding areas, and the bottom often concave in shape forming a depression in the profile of the stream's thalweg that would retain water if there were no flow. Pools usually occur at outside bends (e.g., lateral scour) and around large obstructions (e.g., plunge pool). Pocket water pools refer to groups of small pools often in areas of otherwise fast or turbulent flow, usually caused by eddies behind boulders or other obstructions. Eddies are also associated with backwater pools. Water impounded upstream from channel blockage, typically caused by a log jam or beaver dam, is classed as a dammed pool. Flats are actually wide shallow pools often confused with glides. Pools end where the stream bottom approaches the water surface, also known as the pool tailout.

Glide – An area of the stream with slower current velocity and depth greater than riffles; the stream bed can be concave or flat and the channel width is frequently the greatest. The water surface gradient is nearly zero and the substrate tends to be finer than in runs. Is common to most modified stream channels that do not have distinguishable pool, run, and riffle habitats; current and flow are similar to that of a canal with smooth, laminar flow.

Riffle – A portion of the stream with swiftly flowing, shallow water with a turbulent water surface. The turbulence is caused by completely or partially submerged obstructions, often the stream bottom. Cascades are one class of riffle characterized by swift current, exposed rocks and boulders, and considerable turbulence, and consisting of stepped drops over steep slopes. Riffles that are swift, relatively deep, and have considerable surface turbulence, sometimes represented by standing waves, are called rapids. Rapids at high flow may be confused with runs.

Run – Areas of the stream that have swift, uniform, nonturbulent flow; runs are deeper than riffles with a faster current velocity than pools and (typically) glides; the stream bed can be flat beneath a run and the water surface is seldom broken. Surface gradient tends to roughly parallel overall stream gradient and substrate particle size can vary but tends to be coarser than in glides.

An evaluation of habitat diversity is critical to any assessment of ecological integrity. Water velocity, in conjunction with depth, has been demonstrated to have a direct influence on the structure of benthic communities (Osborne and Hendricks 1983; as cited in Plafkin et al. 1989) and fish communities (Oswood and Barber 1982).

Chapman (1966) stated that physical habitat regulates fish abundance. Researchers have correlated various components of physical habitat with fish abundance and denoted habitat type as an important factor (Hunt 1969, Graham et al. 1980, Fraley et al. 1981, Shepard et al. 1982, Shepard 1983, Pratt 1984, Irving 1987, Hoelscher and Bjornn 1989, Moore and Gregory 1989). Gorman and Karr (1978) took this relation one step further and found fish diversity, as well as abundance, increased with habitat diversity.

The classification of habitat units is geomorphic and flow dependent and may change with a change in discharge. Form a mental image of the various habitat types that should persist given the current conditions, then determine the type of habitat units present along the longitudinal stream axis. Assign wetted portions of the main channel to one of the four habitat types. Complexes of multiple habitat units may be encountered. In these cases measure and record the habitat type **occupying more than 50%** of the wetted channel width. Minor habitat units should be combined with adjacent units.

3.3.11.2 Photo Information

Photographic records provide visual details concerning riparian conditions and stream geomorphology. This visual information shows important stream characteristics such as land use, geomorphic channel units, habitat features, and bank conditions (Meador et al. 1993). Such visual details complement field notes and habitat measurements. This type of documentation may also provide baseline information concerning qualitative changes of riparian conditions and land use and stream channel modifications.

Take photographs at each reach to document its present condition. Each crew should have a compass and either slide film and a date-back camera or a digital camera. If slide film is used, take a minimum of four photos of the stream site from the center of the reach bottom, two facing upstream and two facing downstream (duplicate photos).

Photos are extremely valuable to individuals reviewing or assessing the data. Therefore, be sure to photograph anything unusual, beneficial uses, pollution sources, etc. Consider taking photos at the upper end of the reach as well. A panoramic view of the stream, riparian vegetation, and floodplain is also very helpful. Using a small hand-held location sign such as a dry erase board or chalk board is optional.

3.3.11.2.1 Roll Name

These are left justified fields, for alpha or numeric characters.

3.3.11.2.2 Roll Number and Photo Number

These are right justified fields (single digit for roll number) for numeric characters.

3.3.11.2.3 Direction

Generally, take the upstream photos first. In any event, indicate the direction for each of the first three photos. These are single selection fields; choose only one in each field.

3.3.11.2.4 Caption

These are left justified memo fields.