Susquehanna River Basin Commission

a water management agency serving the Susquehanna River Watershed

Policy No. 2009-01
June 18, 2009

APPLICATION FEE POLICY FOR MINE DRAINAGE WITHDRAWALS

BACKGROUND

All withdrawal applications are subject to an application review fee as provided for in the project fee schedule maintained by the Susquehanna River Basin Commission (Commission), except where the Commision exercises its discretion to waive or reduce any such fee set for good cause shown.[1] This policy describes the use of application fee waivers as an incentive to project sponsors for the beneficial reuse of mine drainage, since the occurrence of mine degraded water is a longstanding, major problem in the Susquehanna River Basin, and actions to mitigate its effects would further the public interest.

The Commission has always encouraged the use (or reuse) of the lowest quality waters that will satisfy a proposed use, particularly when that use is consumptive with respect to waters of the basin. At their December 4, 2008, business meeting, the commissioners discussed incentives for the use of waters impacted by mining activities. All agreed that, although application fees need to continue to fairly reflect the true costs of doing business as set forth in the fee schedule, the Commission is empowered to waive a fee for other reasons consistent with the public policies of the Commission. The Commission approved a motion to support application fees/waivers for projects that utilize mine degraded water, and directed staff to develop appropriate guidance on the kinds of projects for which fees are waiveable, with criteria for scaling the application fee.

Mine drainage results when the mineral pyrite (FeS_2) contained in many formations throughout the coal regions of the basin is exposed to air and water. This combination of pyrite, water, and air results in the formation of sulfuric acid and iron hydroxide. The most common source of the water in this three-part mixture is groundwater.

Groundwater is impacted when clean or non-impacted groundwater comes into contact with the iron-sulfur containing bedrock and oxygen. In some cases, the impacted water resides for long periods of time within underground mine voids and mine pools created by earlier deep mining activities.

[1] The current project fee schedule was approved by the Commission on December 4, 2008, pursuant to Resolution No. 2008-10. The fee waiver or reduction discretion is set forth in Item 14 of that resolution.

If impacted water within these voids and pools drains to the ground surface by gravity or is actively pumped to the surface for any reason (including beneficial reuse), the problem of mine drainage is not eliminated. The removal of impacted groundwater from these voids will simply create a gradient within the local groundwater system which, in turn, will encourage clean or non-impacted groundwater from the surrounding aquifer to migrate into the same pyrite and oxygen-rich voids and pools from which the original impacted water was drained or pumped, thereby creating additional mine impacted groundwater.

Beneficial uses of mine drainage waters considered for application fee waivers, including use by the gas well industry, are typically sporadic in nature. These irregular schedules of groundwater withdrawals (via active pumping) from mine pools can create irregular fluctuations in groundwater levels within the mine pools. During the withdrawal (or pumping) phase, air can move into the evacuated mine voids. This periodic introduction of air can provide an unintended oxygen supply to the same pyritic environment and accelerate the rate at which more impacted groundwater is formed within the pumped mine pool. While it may take many months or even years to "recreate" the same level of sulfuric acid and iron hydroxide in the "replacement" groundwater as that contained in the groundwater previously pumped from the voids, the process of creating more impacted water will very likely continue. Only by isolating the local groundwater system from the pyrite-rich materials and oxygen will the formation of future impacted water be interrupted or eliminated. The removal of impacted water (by active pumping) without concurrent subsurface isolation efforts will simply create more impacted water and result in more mine drainage. Efforts to isolate groundwater systems from pyrite-rich environments (such as pressure grouting programs) have realized only limited success and are very expensive to undertake.

POLICY

It shall be the policy of the Commission to allow, on a case-by-case basis, for the waiver or partial waiver of application fees for projects using surface water or groundwater degraded by past or present mining activities, to the extent such projects conform with any and all criteria established by the Commission as part of this policy and that the use of these waters benefits the environment.

This policy describes the specific criteria for identifying withdrawal applications that qualify for an application fee waiver. In general terms, these withdrawals are from sources of mine drainage intercepted at the land surface where they emanate from underground and before they become part of a stream, or from surface waters (e.g., streams) impacted by mine drainage that will result in an improvement in downstream water quality directly related to the withdrawal. Withdrawals from subsurface waters, whether from mine pools, mine workings, or natural aquifers, where the waters meet the classification of mine drainage but have points of taking below the land surface, may qualify for an application fee waiver or reduction under this policy, when reviewed by Commission staff on a case-by-case basis. As noted herein, groundwater systems are far more hydraulically complex than are surface water systems. Therefore, greater care must be exercised when considering the withdrawing of subsurface waters impacted by mining activities.

For purposes of this policy, mine drainage (MD[2]) is considered to be all discharges of waters impacted by mines or mined materials, whether by gravity flow or by active pumping. MD can be acid or alkaline, and emanate from abandoned, active, or orphaned mines. In addition, MD can be in the form of surface seepage associated with certain stockpiled (mined) materials or stockpiled mine waste products.

The Commission anticipates that many projects involved in the exploration and development of natural gas in the Marcellus shale may be able to use waters impacted by or containing MD that qualify for the application fee waivers. However, waivers may be requested for any type of project (including non-natural gas projects) involving a surface or subsurface withdrawal of MD that meets the criteria set forth on pages 3-4. Withdrawals of other types of impaired waters unrelated to mining activities are excluded from consideration under this policy. Further, this policy is not intended to apply to application fees related to consumptive water use.

Some MD and streams impaired by MD may be of suitable quality to support aquatic life and satisfy a variety of uses. In addition, the quantity of water affected by MD may be beneficial to protect stream uses if the water is available for assimilative capacity of pollutants downstream and, conversely, the removal of any quantity of even such impaired water may impact the downstream assimilative capacity and other stream uses. A determination as to whether a withdrawal of any specific waters of the basin qualify for an application fee waiver or partial waiver will be determined based on specific water quality parameters, location of the withdrawal, the impact on receiving waters, and beneficial attributes of the quantity of flow within the subject stream.

Projects where a protective passby is required must adhere to the Commission's passby flow guidance, Policy No. 2003-01[3]. On streams impaired by MD in which some aquatic life exists, the project sponsor is generally required to allow a passby flow of 15 percent of average daily flow downstream from the point of taking whenever withdrawals are made.

CRITERIA

Only withdrawals from waters meeting the criteria below will qualify for consideration of an application fee waiver or partial waiver. The fee waiver or partial waiver will depend upon the specific criteria set forth below.

1. Withdrawal application fee may be waived if the proposed withdrawal is directly from MD, the withdrawal is expected to have a demonstrable downstream benefit, and all of the following criteria are met:

[2] Because the acronym AMD can be confusing, the Commission will use mine drainage without adjective to include all discharges (whether by gravity flow or active pumping) from mines or mined materials. AMD has been commonly linked to acid mine drainage and abandoned mine drainage, yet it is possible to have an acid discharge from an active mine.

[3] Policy No. 2003-01, Guidelines for Using and Determining Passby Flows and Conservation Releases for Surface-Water and Ground-Water Withdrawal Approvals, November 8, 2002.

a. Water is net acidic or has no alkalinity;
b. Manganese (Mn), iron (Fe), aluminum (Al), and sulfate (SO4) concentrations do not meet their respective water quality standards[4];
c. pH is less than or equals 6.0; and
d. No aquatic life, exclusions for midges/worms, as determined by a survey of aquatic resources.

2. Withdrawal application fee may be partially waived (50 percent of the applicable fee) if the proposed withdrawal is directly from MD or from a stream impacted by MD, the withdrawal is expected to have a demonstrable downstream benefit, and the following criteria are met:

   a. Alkalinity below water quality standards (less than 20 milligrams per liter [mg/l] as calcium carbonate [CaCO3]);
   b. Concentrations of one or more of the parameters–manganese (Mn), iron (Fe), aluminum (Al), or sulfate (SO4)–does not meet its respective water quality standard[3];
   c. pH does not meet its water quality standard[3]; and
   d. Limited aquatic life, as determined by a survey of aquatic resources.

REQUEST PROCEDURE

A project sponsor may request a waiver or partial waiver of the application fee, provided the request is made in writing at the time the withdrawal application is submitted. It is the responsibility of the project sponsor to demonstrate that its proposed project meets the criteria set forth above, and must include necessary supporting documentation to justify the waiver. This includes, but is not limited to, the point of taking, water quality analysis from a certified laboratory, description of the expected downstream benefit, and survey of aquatic resources. Project sponsors must submit information to the Commission as detailed in the attached technical guidance.

Commission staff will review a request for an application fee waiver only for applications that are otherwise administratively complete. Upon completion of its review, Commission staff will make a preliminary determination as to whether the request satisfies the criteria established by this policy, which shall serve as the basis for recommending approval or denial of the request to the Commission at the time it takes action on the underlying application.

[4] Water quality standards as follows:
   a. Manganese (Mn) equals or exceeds 1.0 mg/l, as total recoverable (Chapter 93.7 [Specific Water Quality Criteria] of the Pennsylvania Code);
   b. Iron (Fe) equals or exceeds 1.5 mg/l, as total recoverable (30-day average) (Chapter 93.7 [Specific Water Quality Criteria] of the Pennsylvania Code);
   c. Sulfate equals or exceeds 250 mg/l (Chapter 93.7 [Specific Water Quality Criteria] of the Pennsylvania Code);
   d. Aluminum (Al) equals or exceeds 0.75 mg/l, as total recoverable (National Recommended Water Quality Criteria, Office of Water, U.S. Environmental Protection Agency, 2006); and
   e. pH from 6.0 to 9.0, inclusive (Chapter 93.7 [Specific Water Quality Criteria] of the Pennsylvania Code).

Commission staff shall notify the project sponsor of its preliminary determination. If the preliminary determination is that the request fails to satisfy the criteria, the project sponsor shall be required to tender the appropriate application fee in order for review of the underlying application to proceed. Such fee shall be refunded if, and only if, the Commission subsequently acts to approve the request for waiver or partial waiver in accordance with this policy.

Any requests for a waiver may be subject to an aquatic survey by the Commission and, if so, fees associated with that work effort are not waived.

This policy may be updated by the Commission as necessary.

Susquehanna River Basin Commission

a water management agency serving the Susquehanna River Watershed

Technical Guidance

SRBC Stream Survey Protocols for Mine Drainage Impacted Segments Associated with Water Withdrawal Locations

Purpose: To collect biological, habitat, water quality, and discharge data on mine drainage impacted stream segments associated with surface water withdrawals.

Location Information:

Location information must be collected using a GPS unit in decimal degrees. If the sampling reach is associated with a mine drainage discharge, the receiving stream must be noted. Additionally, a written description and photographs of the proposed water withdrawal location must be submitted to SRBC.

Fish Sampling:

Electrofishing will be conducted at wadeable riffle locations using a backpack electroshocker unit with either two hand held probes or a probe and a rat-tail. All available habitats in the stream will be sampled. Electrofishing will begin at a shallow riffle, where available, and will terminate at a similar habitat at the upstream end of the reach. One (1) run will be made per station on each of the specified locations. Each station will consist of at least 100 meters, measured with a surveyor's tape, and at least five (5) width measurements will be taken per 100 meters of stream with the surveyor's tape. The exact length of sampling time (the time that the electricity is running as well as total time) will be recorded at each site. The upstream and downstream limits of sampling will be recorded using a GPS unit and noted on the field data sheet.

If the stream width is greater than 20 meters, the electrofishing path will be sinuous to cover the entire stream width. For these larger locations, three (3) sinuous passes over the entire width of the stream will constitute the electrofishing effort.

Preferably, a three person crew will be used at each station, with one team leader running the shocker and using a net, one person with a net, and one person with a bucket and a net. However, especially in smaller systems, a two-person team will be sufficient.

Nets and holding cages (if used) will have 0.25 inch mesh netting to prevent escape. All fish will be collected, identified to species, and counted in each electrofishing run. All fish will be measured, up to 50 of each species, to provide an estimate of the overall population. All fish will be returned to the stream after the electrofishing is completed, unless there is question regarding

identification, when the fish will be returned to the laboratory and identified. Digital photographs will be taken of all unknown specimens, as well as voucher (reference) photographs of each species. Measurements of fish collected will be recorded in millimeters, and weight will be recorded in grams. Any deformities or indications of disease will be noted on the field form. All data will be recorded on a field form (Attachment A). All data will be entered into an Excel spreadsheet and, along with field forms and photographs, will be provided to SRBC staff.

Macroinvertebrates:

Benthic macroinvertebrate samples will be collected using a D-frame net with 500-micron mesh in the best available habitat in the stream reach. Samples will consist of a composite of six (6) kicks from riffle areas in a 100-meter stream reach, with each kick disturbing approximately one (1) square meter immediately upstream of the net for approximately one (1) minute, while directing the disturbed substrate towards the front of the net. The composite samples will be preserved in 95% ethanol in the field and returned to the laboratory for processing. After sampling has been completed at a given site, all equipment that has come in contact with the sample will be rinsed thoroughly, examined carefully, and picked free of algae or debris before sampling at the next site. Reference photographs will be taken. Additional organisms that are found inside the net are placed into the sample containers. Macroinvertebrate bottles will be labeled with the station and date. A logbook will be kept for all sites, containing information on the macroinvertebrate sample collection, such as station number, stream name, date, the number of bottles, and the person who collected the sample. In the laboratory, additional information such as dates of subsampling and identification and the personnel associated with each activity will be added to the logbook. Log sheets (Attachment B) will be used to record the number of specimens for each genus identified. This information will be transcribed into Excel spreadsheets and verified.

During processing, each composited sample will be placed into a pan marked with 28 grids. Debris from four grids will be randomly selected from the pan, extracted using a four-square-inch circular "cookie cutter," and placed into another identical empty pan. From this second pan, identifiable[1] organisms will be picked from randomly selected grids until a 200-organism sub-sample (± 40 organisms) is obtained. The number of grids picked will be entered onto the bench sheet. Organisms in the sub-sample will be identified to genus level, when possible, and enumerated, with the following exceptions. Midges will be identified to the family level of Chironomidae. Roundworms and proboscis worms will be identified to the phylum levels of Nematoda and Nemertea, respectively. Flatworms will be identified to the class level of Turbellaria. Segmented worms, aquatic earthworms, and tubificids will be identified to the class level of Oligochaeta. All water mites will be identified as Hydracarina. All data will be entered into an Excel spreadsheet and provided, along with the bench sheets and photographs, to SRBC.

Habitat Assessment:

Physical habitat conditions at each station are assessed using a slightly modified version of the habitat assessment procedure outlined by Barbour and others (1999). Eleven habitat parameters are field-evaluated at each site and used to calculate a site-specific habitat assessment score.

[1] Identifiable – excludes pupae, larval bodies missing too many critical structures to confidently identify, extremely small instar larvae, empty shells or cases, and non-benthic taxa.

Physical habitat assessments are performed for riffle/run or glide/pool areas, depending on stream type. Attachments C and D show habitat assessment forms and the criteria used to evaluate habitat in riffle/run streams, respectively, and Attachments E and F show forms and criteria used to evaluate habitat in glide/pool stream types, respectively. Photos of upstream and downstream reach areas, overbank (left and right bank) areas, and other notable features, such as wetlands, riparian areas, stream crossings, roadside pull-off areas, etc., will be taken. All data will be entered into an Excel spreadsheet and provided, along with all forms and photographs, to SRBC.

Field Water Quality:

Dissolved oxygen, pH, specific conductance, and temperature will be measured in the field using hand-held meters calibrated according to manufacturer specifications. Dissolved oxygen may be determined by using field test kits. Total alkalinity will be measured using field test kits or by titration. The probes of all meters will be rinsed with distilled water and sample water prior to collection of water quality data. All data will be provided to SRBC.

Laboratory Water Quality:

A laboratory certified for drinking water parameters by Pennsylvania Department of Environmental Protection or U.S. Environmental Protection Agency must be used for water quality data analysis. Parameters are located in Table 1.

If the taking point is associated with a mine drainage discharge, the water quality sample may be collected directly at the discharge point. If the withdrawal point is associated with an in-stream location, a depth- and width-integrated sample must be collected. For in-stream locations, at least three vertical samples must be collected using a depth-integrated sampler, composited in a churn splitter, and churned while the sample bottle is filled. A copy of all original data sheets from the laboratory must be submitted to SRBC.

Table 1. Monitoring Parameters

Parameter	STORET Code	Reporting Limit
Alkalinity, Total	00410M	0 mg/l
Manganese, Total	01055A	10 µg/l
Iron, Total	01045A	20 µg/l
Aluminum, Total	01105A	200 µg/l
Sulfate, Total	00945A	20 mg/l
pH	00403M	0 units
Hot Acidity	70508	0 mg/l

Discharge Measurements:

At all stream reaches, discharge measurements will be made by field personnel using a pygmy or AA meter (or a FlowTracker), a flow rod, headset, and standard USGS procedures (Buchanan and Somers, 1969). Photographs of the stream cross-section, including upstream, downstream, and across the profile, will be taken. Field personnel will be required to complete computer-

assisted training provided by USGS entitled "Measurement of Stream Discharge by Wading," Water Resources Investigations Report 00-4036, by K.M. Nolan and R.R. Shields. Discharge will be computed and, along with stream profiles and photographs, will be provided to SRBC.

References

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Buchanan, T.J., and W.P. Somers. 1969. Discharge Measurements at Gaging Stations. USGS Techniques of Water-Resources Investigations, Book 3, Chapter A8.

Hartle, M.A. 2006. Aquatic Biological Investigation in Response to the June 30, 2006 Norfolk Southern Train Derailment and Sodium Hydroxide Release: Sinnemahoning Portage Creek, Driftwood Branch of Sinnemahoning Creek, and Sinnemahoning Creek, McKean and Cameron Counties. Pennsylvania Fish and Boat Commission, Division of Environmental Services. http://www.fish.state.pa.us/water/streams/sinnemahoning/norfolk_report.pdf

Nolan, K.M., and R.R. Shields. Measurement of Stream Discharge by Wading Water. USGS Resources Investigations Report 00-4036.

Pennsylvania Department of Environmental Protection. 2007. Bureau of Water Standards and Facility Regulation Instream Comprehensive Evaluation Surveys. http://www.depweb.state.pa.us/watersupply/lib/watersupply/PCice.pdf

Plafkin, J.L., M.T. Barbour, D.P. Kimberly, S.K. Gross, and R.M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish. U.S. Environmental Protection Agency, Office of Water, Washington, D.C., EPA/440/4-89/001.

Attachment A: Fish Sampling Field Data Sheet (Front)

Stream Name:		Location (including GPS coordinates for top and bottom of reach):		
Station Number:				
GPS Coordinates:				
Date:	Time:	Crew:		
SAMPLE COLLECTION (include electrofisher settings)	How were fish captured?	Backpack	Tote Barge	Other
	Block nets used?	Yes	No	
	Sampling Duration	Start Time	End Time	Duration
HABITAT TYPES	Indicate the percentage of each habitat type present			
	Riffles %	Pools %	Runs %	Snags %
	Submerged Macrophytes %		Other %	
GENERAL COMMENTS (include conductivity and flow conditions)				

Fish Taxa Data (document any DELTS including a digital photograph)						
Species	Total	Optional: Length (mm)/Weight (g)				

Attachment A: Fish Sampling Field Data Sheet (Back)

Species	Total	Optional: Length (mm)/Weight (g)				

Attachment B. Benthic Macroinvertebrate Enumeration Sheet

MACROINVERTEBRATE ENUMERATION LIST

SITE _____ **DATE SAMPLED_____**

IDENTIFIED BY: _____ **DATE IDENTIFIED: _____**

FAMILY/GENUS	NUMBER OF INDIVIDUALS
1.	
2.	
3.	
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Attachment C: Riffle/Run Habitat Assessment Sheet

Riffle/Run Habitat Assessment Sheet

Stream	**Date**
Station ID	**Time**
Sample #	**Crew**
Location Description:	

Stream type: Limestone Sandstone Valley Headwater Large River Glacial Other _____

Habitat Assessment	
Parameter	Score
1. Epifaunal Substrate	
2. Instream Cover	
3. Embeddedness	
4. Velocity/ Depth Regimes	
5. Sediment Deposition	
6. Channel Flow Status	
7. Channel Alteration	
8. Frequency of Riffles	
9. Condition of Banks (Score each bank)	
Left Bank	
Right Bank	
10. Vegetative Protective Cover (score each bank)	
Left Bank	
Right Bank	
11. Riparian Vegetative Zone Width (score each bank)	
Left Bank	
Right Bank	

Weather Conditions

Air Temperature © _____

Current Conditions: Sunny Cloudy Partly Cloudy

Present Precipitation: None Rain Snow Mixed Precip.

Heavy? (> 1 inch) Yes No

Precip. Within last 24 hours: None Rain Snow Mixed Precip.

Heavy? (> 1 inch) Yes No

Ice Present at Site? Yes No

Functionally Important Stream Characteristics

Predominant Substrate Material (circle one)

Bedrock (> 160 inches in diameter)
Boulder (10 – 160 inches in diameter)
Cobble (2.5 – 10 inches in diameter)
Gravel (0.1 – 2.5 inches in diameter)
Sand/Silt/Clay (< 0.1 inches in diameter)

Residential		Commercial	
Industrial		Cropland	
Nursery		Pasture	
Abd. Mining		Old Fields	
Forest		Other	

Comments:

Temp.	**Cond.**	**D.O.**
pH		**Alk.**

Attachment D

HABITAT PARAMETER	CATEGORY			
	OPTIMAL (20-16)	SUBOPTIMAL (15-11)	MARGINAL (10-6)	POOR (5-0)
1. Epifaunal Substrate	Well-developed riffle/run; riffle is as wide as stream and length extends 2 times the width of stream; abundance of cobble	Riffle is as wide as stream but length is less than 2 times width; abundance of cobble; boulders and gravel common	Run area may be lacking; riffle not as wide as stream and its length is less than 2 times the stream width; some cobble present	Riffle or run virtually nonexistent; large boulders and bedrock prevalent; cobble lacking
2. Instream Cover	> 50% mix of boulders, cobble, submerged logs, undercut banks or other stable habitat	30–50% mix of boulder, cobble, or other stable habitat; adequate habitat	10–30% mix of boulder, cobble, or other stable habitat; habitat availability less than desirable	<10% mix of boulder, cobble, or other stable habitat; lack of habitat is obvious
3. Embeddedness	Gravel, cobble, and boulder particles are 0–25% surrounded by fine sediments	Gravel, cobble, and boulder particles are 25–50% surrounded by fine sediments	Gravel, cobble, and boulder particles are 50–75% surrounded by fine sediments	Gravel, cobble, and boulder particles are >75% surrounded by fine sediments
4. Velocity/ Depth Regimes	All 4 velocity/depth regimes present (slow/deep, slow/shallow, fast/deep, fast/shallow)	Only 3 of 4 regimes present (if fast/shallow is missing, score lower than if missing other regimes)	Only 2 of 4 regimes present (if fast/shallow or slow/shallow are missing, score low)	Dominated by 1 velocity/depth regime
5. Sediment Deposition	Little or no enlargement of islands or point bars and <5% of the bottom affected by sediment deposition	Some new increase in bar formation, mostly from coarse gravel; 5–30% of the bottom affected; slight deposition in pools	Moderate deposition of new gravel, coarse sand on old and new bars; 30–50% of the bottom affected; sediment deposits at obstructions; moderate deposition of pools prevalent	Heavy deposits of fine material, increased bar development; >50% of the bottom changing frequently; pools almost absent due to sediment deposition
6. Channel Flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed	Water fills >75% of the available channel; or <25% of channel substrate exposed	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	Very little water in channel and mostly present as standing pools
7. Channel Alteration	No channelization or dredging present	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 yr) may be present, but not recent	New embankments present on both banks; and 40-80% of stream reach channelized and disrupted	Banks shored with gabion or cement; >80% of the reach channelized and disrupted
8. Frequency of Riffles	Occurrence of riffles relatively frequent; distance between riffles divided by the width of the stream equals 5 to 7; variety of habitat	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream equals 7 to 15	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the stream width is between 15-25	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is >25
9. Condition of Banks (score each bank 0-10)	Banks stable; no evidence of erosion or bank failure; 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 banks in reach have areas of erosion; high erosion potential during floods	Unstable; many eroded areas; “raw” areas frequent along straight sections and bends; on side slopes, 60-100% of bank has erosional scars
10. Vegetative Protective Cover (score each bank 0-10)	>90% of the streambank surfaces covered by vegetation; vegetative disruption through grazing or mowing minimal	70-90% of the streambank surfaces covered by vegetation; disruption evident but not affecting full plant growth potential to any great extent	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation	<50% of the streambank surfaces covered by vegetation; disruption is very high; vegetation removed to 5 cm or less
11. Riparian Vegetative Zone Width (score each bank 0-10)	Width of riparian zone >18 meters; human activities (i.e. parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally	Width of riparian zone 6-12 meters; human activities have impacted zone only minimally	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities

Attachment E: Glide/Pool Habitat Assessment

Glide/Pool Habitat Assessment Sheet

Stream	**Date**
Station ID	**Time**
Sample #	**Crew**
Location Description:	

Stream Type: Limestone Sandstone Valley Headwater Large River Glacial Other __

Habitat Assessment		**Weather Conditions**
Parameter	Score	Air Temperature (^{o}C)
1. Epifaunal Substrate		Current Conditions: Sunny Cloudy Partly Cloudy
		Present Precipitation: None Rain Snow Mixed Precip.
		Heavy? (> 1 inch) Yes No
2. Instream Cover		Precip. within last 24 Hours: None Rain Snow Mixed Precip.
		Heavy? (>1 inch) Yes No
		Ice Present at Site? Yes No
3. Pool Substrate Characterization		**Functionally Important Stream Characteristics**
4. Pool Variability		
5. Sediment Deposition		
6. Channel Flow Status		
7. Channel Alteration		**Predominant Substrate Material (circle one)**
8. Channel Sinuosity		Bedrock (>160 inches in diameter) Boulder (10-160 inches in diameter) Cobble (2.5 – 10 inches in diameter) Gravel (0.1 – 2.5 inches in diameter) Sand/Silt/Clay (<0.1 inches in diameter)
9. Condition of Banks (Score each bank)		
Left Bank		Residential % Commercial %
		Industrial % Cropland %
Right Bank		Nursery % Pasture %
		Abd. Mining % Old Fields %
10. Vegetative Protective Cover (score each bank)		Forest % Other %
		Comments:
Left Bank		
Right Bank		
11. Riparian Vegetative Zone Width (score each bank)		
Left Bank		**Temp.** **Cond.** **D.O.**
Right Bank		pH **Alk.**

Attachment F

HABITAT PARAMETER	CATEGORY			
	OPTIMAL (20-16)	SUBOPTIMAL (15-11)	MARGINAL (10-6)	POOR (5-0)
1. Epifaunal Substrate	Preferred benthic substrate abundant throughout stream site and at stage to allow full colonization (i.e. log/snags that are not new fall and not transient)	Substrate common but not prevalent or well suited for full colonization potential	Substrate frequently disturbed or removed	Substrate unstable or lacking
2. Instream Cover	> 50% mix of snags, submerged logs, undercut banks or other stable habitat; rubble, gravel may be present	30-50% mix of stable habitat; adequate habitat for maintenance of populations	10-30% mix of stable habitat; habitat availability less than desirable	Less than 10% stable habitat; lack of habitat obvious
3. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation 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
4. Pool Variability	Even mix of large-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
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of island or point bars	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial movement during storm events	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to substantial sediment deposition
6. Channel Flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed	Water fills >75% of the available channel; or <25% of channel substrate exposed	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	Very little water in channel and mostly present as standing pools
7. Channel Alteration	No channelization or dredging present	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 yr) may be present, but not recent	New embankments present on both banks; and 40-80% of stream reach channelized and disrupted	Banks shored with gabion or cement; >80% of the reach channelized and disrupted
8. 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 1 to 2 times longer than if it was in a straight line	Channel straight; waterway has been channelized for a long time
9. Condition of Banks (score each bank 0-10)	Banks stable; no evidence of erosion or bank failure; side slopes generally <30%; little potential for future problems; <5% of bank affected	Moderately stable; infrequent, small areas of erosion mostly healed over; side slopes up to 40% on one bank; slight erosion potential in extreme floods; 5-30% of bank in reach has areas of erosion	Moderately unstable; moderate frequency and size of erosional areas; side slopes up to 60% on some banks; high erosion potential during extremely high flow; 30-60% of bank in reach has areas of erosion	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; on side slopes; side slopes >60% common; 60-100% of bank has erosional scars
10. Vegetative Protective Cover (score each bank 0-10)	>90% of the streambank surfaces covered by vegetation; vegetative disruption through grazing or mowing minimal	70-90% of the streambank surfaces covered by vegetation; disruption evident but not affecting full plant growth potential to any great extent	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation	<50% of the streambank surfaces covered by vegetation; disruption is very high; vegetation removed to 5 cm or less
11. Riparian Vegetative Zone Width (score each bank 0-10)	Width of riparian zone >18 meters; human activities (i.e. parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally	Width of riparian zone 6-12 meters; human activities have impacted zone only minimally	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities