Recommended Protocol for Evaluating Fisheries Resources for Washington State Department of Transportation Projects

Prepared for:

Washington State Department of Transportation
Environmental Services
310 Maple Park Avenue SE
Olympia, Washington 98504-7331

Prepared by:

Herrera Environmental Consultants, Inc.
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
Telephone: 206/441-9080

February 12, 2009

Table of Contents

Recommended Protocol for Evaluating Fisheries Resources for Washington State Department of Transportation Projects 3

1 Preliminary Research and In-Office Analysis 3

Review of Project Description and Determination of Study Area 3

Review of Available Information 3

Preparation of Instream Habitat Base Map 4

2 Field Verification of Habitat Types 6

Existing Channel Morphology 6

Instream Habitat Type 7

Riparian Vegetation 7

Substrate Composition 8

Abundance of Large Woody Debris 8

Pool Quality 9

Ordinary High Water Mark 9

Establishment of Reference Points 9

Photographic Documentation 10

3 Website Information Sources 10

References 11

Appendix A: Habitat Data Sheets A-13

Recommended Protocol for Evaluating Fisheries Resources for Washington State Department of Transportation Projects

This document describes the protocol for evaluating stream habitat and determining the fish species that are likely to inhabit a project area. The protocol was developed to provide a standard framework for evaluating fisheries resources during the preparation of environmental review documentation required by the National Environmental Policy Act for Washington State Department of Transportation (WSDOT) projects. The following protocol consists of guidelines for compiling existing background information, mapping riverine habitat, and evaluating habitat units for the presence of target fish species. The protocol is based on the stream habitat and structural elements identified in the National Marine Fisheries Service matrix of pathways and indicators as measures of environmental baseline conditions (NMFS 1996). The protocol includes an office-based research phase and a field verification phase.

1 Preliminary Research and In-Office Analysis

Review of Project Description and Determination of Study Area

The project description should discuss the purpose of the project and the need for the project, the project footprint, and the project study area. Typically, the study area includes both the existing right-of-way and any new right-of-way and should extend a minimum of 300 feet outside the boundaries of the project footprint. The study area should also include the extent of any expected indirect impacts outside the project footprint (e.g., construction noise, downstream turbidity or sedimentation, and construction traffic) and any buffer zones established around sensitive areas.

Review of Available Information

Potential fish species likely to occur in the study area should be identified by reviewing information from applicable federal, state, and local natural resources agencies. Lists of endangered, threatened, sensitive, or candidate species at either the federal or state level can be obtained from the U.S. Fish and Wildlife Service, the Washington Department of Fish and Wildlife (WDFW), the Washington Department of Natural Resources, National Marine Fisheries Service, or other relevant jurisdictions (e.g., local tribes, the U.S. Forest Service, the National Park Service, or local agencies). The National Marine Fisheries Service maintains a list of all fish species in the state of Washington. The U.S. Fish and Wildlife Service lists fish species by county, and WDFW provides a statewide map identifying endangered, threatened, sensitive, and candidate fish species. The Washington Conservation Commission publishes a limiting factors analysis for salmonids and other fish for most of the water resource inventory areas in Washington. A list of species of local importance in the project vicinity should be requested from the appropriate jurisdictional agency.

After potential fish species within the study area have been identified, local wildlife biologists should be contacted to discuss any specific sightings of endangered, threatened, sensitive, or

candidate species in or adjacent to the study area, as well as other species that are considered locally unique, rare, or of local importance.

From this species research, a list of species that are likely to occur in the study area should be developed. The habitat and life-cycle requirements of each species on the list should be compared to the potential project impacts (e.g., vegetation clearing, noise, and shoreline or channel modifications) and documented in a matrix showing the species of concern, their habitat needs, and potential risks to the species resulting from the project. These risks might include the disruption of habitat access, permanent habitat loss, adverse effects on water quality, fish handling and relocation, and disruption of spawning and rearing activities. As indicated, the matrix should address spatial impacts (such as loss of desirable habitat or loss of proximity to connecting habitats) as well as temporal impacts (such as disturbances during sensitive life-cycle periods). This matrix will provide guidance for assessing the need for additional, field-based fisheries surveys.

Useful websites with additional information for the fisheries resources discipline report are indicated at the end of this document.

Preparation of Instream Habitat Base Map

A base map of the study area (including the existing right-of-way, the new right-of-way, and 300 feet on either side the project footprint boundary) should be created to show the project impact areas as defined by the project description. The base map should include roads, trails, easements, local jurisdictional boundaries, and property boundaries, as well as natural features such as lakes and wetlands. The base map should include relevant geographic information system (GIS) data as discussed below.

A GIS-based assessment of potential fish habitat requires the collection and analysis of data from a variety of available sources. These data can vary in level of detail, spatial scale, age, and level of completeness. The data sources described in the following paragraphs should be considered in the preliminary analysis of habitat. The data sources used in the habitat analysis and during the development of the base map will depend on the specific project needs.

Topographic Maps – The U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles can be used as base maps to check aerial imagery features, vegetation extents, and the gross topography of the study area. The USGS provides digital topographic quadrangles as digital raster graphic (DRG) files. The DRG maintains the horizontal precision of the 7.5-minute source map that meets National Map Accuracy Standards (NMAS), and the scanned raster image is available in GeoTIFF format.

High-resolution topography obtained from laser altimetry (lidar) is rapidly becoming available for urban and outlying areas of the Puget Sound basin. These maps are typically produced with a horizontal resolution of 6 feet and a vertical resolution of less than 1 foot. The bare-earth topography is produced by removing laser returns from vegetation. Lidar data for Puget Sound are available from the Puget Sound Lidar Consortium. Lidar may also be available from various governmental agencies and private utilities.

Aerial Photography – Rivers are dynamic systems that evolve morphologically and change position over time. A review of historical aerial photographs can be used to reconstruct historical channel alignments and estimate the potential for future channel migration into or within the study area. Channel migration studies have been completed for most major rivers in western Washington and should be consulted before proceeding with a historical study. Historical aerial photographs should also be used to delineate the spatial extent of alluvial features (e.g., thalweg, gravel or sand bars, or terraces) and the extent of riparian vegetation. Each alluvial feature and vegetation type should be delineated and digitized into polygons for subsequent field verification.

Aerial photography (both color and black and white) is available in different formats and spatial resolutions. Historical photographs dating back to the 1930s and 1940s are available for limited areas. USGS digital orthophoto quarter quadrangles have an approximate spatial resolution of 1 meter and cover the entire state of Washington. The USGS also distributes color aerial photography for most urban areas in the central Puget Sound. Color photographs were taken in June 2002 with a pixel resolution of 1 foot. Local photography is also available from various local sources such as cities, counties, the Washington Department of Natural Resources, other public and private agencies, and the University of Washington Libraries aerial photograph collection.

SalmonScape – SalmonScape is an interactive, web-based mapping application maintained by WDFW. Data on fish distribution and habitat use included in the SalmonScape application were collected by state, federal, tribal, and local biologists as well as regional fisheries enhancement groups. SalmonScape is designed to display and report a wide range of data related to salmon distribution, status, and habitats. The data sources used by SalmonScape include stream-specific fish and habitat data and information about stock status and recovery evaluations.

StreamNet – The StreamNet database is a cooperative information management and dissemination project focused on fisheries and aquatic-related data in the Columbia River basin and the Pacific Northwest. The project provides various types of data related to fish resources and maintains the 1:100,000-scale hydrography layer for the Pacific Northwest. Information is available through the online database query or by custom request. The database is continually updated as new data are received.

WDFW Salmon Surveys – WDFW maintains a database of salmon spawning ground surveys and juvenile salmonid out-migration surveys for various water bodies. Data from the WDFW surveys that are pertinent to the study area should be researched and included in the compiled GIS data.

Priority Habitat and Species – Digital fish and habitat data are available through WDFW. Priority Habitats and Species data were compiled on 1:24,000-scale USGS 7.5-minute topographic maps and contain shapefile polygons of fish and wildlife resources based on research and field surveys conducted over the past 30 years. Any Priority Habitats and Species data related to the study area should be added to the compiled GIS data.

Salmon Stock Inventory – WDFW maintains an inventory of Washington's 11 species and subspecies of native salmonid fish. The inventory is a compilation of data on all wild stocks and

a scientific determination of the status of each stock: healthy, depressed, critical, unknown, or extinct. Data from the Salmon Stock Inventory should be included in the compiled GIS data.

Washington Lakes and Rivers Information System – The Washington Lakes and rivers Information System (WLRIS) database includes statewide priority fish distribution, streams/rivers, lakes, and reservoirs at a scale of 1:24,000 and a facilities layer at a scale of 1:100,000. Fish distribution information is based on a limiting factors analysis for defining the documented, presumed, and potential presence categories. Known spawning and rearing information is also included, where available. Data from the WLRIS database should be included in the compiled GIS data.

Impaired and Threatened Water Bodies – Streams included in the Section 303(d) list are considered polluted and should be an integral part of any aquatic habitat assessment to identify habitat of low quality. The Washington Department of Ecology has mapped the Section 303(d) threatened and impaired water bodies for Washington based on the statewide 1:100,000-scale hydrography layer. Maps are updated every even-numbered year.

2 Field Verification of Habitat Types

Existing Channel Morphology

Information pertaining to the existing channel morphology should be collected according to the physical habitat protocols in U.S. Environmental Protection Agency's (U.S. EPA's) report *Quantifying Physical Habitat in Wadeable Streams* (Kaufmann et al. 1999). These same field protocols for wadeable streams can readily be adapted to unwadeable streams and rivers by experienced personnel using appropriate watercraft. Measurement times for field crews working in unwadeable streams are typically longer and can be highly variable depending on the conditions.

This report describes the concepts, rationale, and analytical procedures for characterizing physical habitat in streams based on raw data generated from methods similar or equal to those of Kaufmann and Robison (1998) that are used by the U.S. EPA in its Environmental Monitoring and Assessment Program (EMAP). Guidance is provided for calculating indices of stream size and gradient, sinuosity, substrate size, habitat complexity and cover, riparian vegetation cover and structure, and anthropogenic disturbances. Two-person crews typically complete EMAP habitat measurements in 1.5 to 3.5 hours of field time per sampling reach. Whereas this time commitment is greater than that required for more qualitative methods, these more quantitative methods are more repeatable (i.e., more precise).

Variables to be surveyed using the physical habitat protocols include the following:

- Bankfull width
- Bankfull depth
- Reach slope
- Reach length

- Presence of multiple channels
- Confinement
- Bank conditions (e.g., material composition and erosion).

Instream Habitat Type

Instream habitat type should be quantified using the *TFW Monitoring Program Method Manual for the Habitat Unit Survey* (Pleus et al. 1999) and the U.S. EPA's *Rapid Bioassessment Protocols for Use in Streams and Rivers* (Barbour et al. 1999).

The manual for habitat unit surveys provides methods for identifying habitat units, measuring their surface area, and collecting information on residual pool depth and pool-forming factors. Other information includes pool-to-riffle ratio, the length of side channels, and the frequency distribution of residual pool depths and pool-forming factors.

Variables to be surveyed using the habitat unit survey include the following:

- Map of habitat unit polygons (surface areas measured in GIS)
- Residual pool depths
- Pool-forming factors (e.g., riffles, large woody debris, boulders, and plunge pools)
- Pool density (e.g., pools per kilometer).

The bioassessment protocols were originally developed in the 1980s to provide cost-effective, efficient techniques for biological surveys. According to these protocols, the assessment is performed using a visual approach for characterizing the physical habitat structure of the stream site. The concepts underlying the bioassessment protocols are the following:

- Cost-effective, scientifically valid procedures for biological surveys
- Provisions for multiple site investigations in a field season
- Quick turn-around of results for management decisions
- Scientific reports that can be easily translated for management and the public.

Variables to be surveyed using the bioassessment protocols include the following:

- Epifaunal substrate/available cover
- Percentage of unerodible bank armoring.

Riparian Vegetation

Riparian vegetation should be quantified using a combination of protocols from *Quantifying Physical Habitat in Wadeable Streams* (Kaufmann et al. 1999) and *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers* (Barbour et al. 1999).

Variables to be surveyed using these protocols include the following:

- Dominant and subdominant riparian vegetation for the right and left banks:
  - Forest (greater than 6 meters in height): coniferous, deciduous, or mixed
  - Shrubs and/or vines
  - Herbaceous species: tall or short
  - Impervious surface (e.g., buildings or paving)
  - Residential landscaped areas.
- Percentage of canopy cover (densiometer values)
- Riparian zone width.

Substrate Composition

Information related to substrate composition will be collected using protocols in *Sampling Surface and Subsurface Particle-Size Distributions in Wadeable Gravel- and Cobble-Bed Streams for Analyses in Sediment Transport, Hydraulics, and Streambed Monitoring* (Bunte and Abt 2001).

These substrate sampling protocols are a comprehensive compilation of field methods and analytical procedures for sediment sampling in wadeable streams. As discussed previously, field protocols for wadeable streams can readily be adapted to unwadeable streams and rivers by allocating additional resources and field time.

Variables to be surveyed using the substrate sampling protocols include the following:

- Surface pebble count (size classes of 100 particles)
- Substrate embeddedness.

NOTE: In unwadeable systems, substrate composition should be evaluated on gravel and sand bars that are exposed during low-flow conditions or by using the drag method as prescribed by Lazorchak et al. (2000) in *Field Operations and Methods for Measuring the Ecological Condition of Non-Wadeable Rivers and Streams*.

Abundance of Large Woody Debris

The abundance of large woody debris should be quantified using the Level 1 survey method from *TFW Monitoring Program Method Manual for the Large Woody Debris Survey* (Schuett-Hames et al.1999). Large woody debris includes pieces with a diameter greater than or equal to 10 centimeters and a length greater than or equal to 2 meters or rootwads of any size.

This manual provides protocols for documenting the number, volume, and characteristics of large woody debris pieces in stream channels. The Level 1 survey involves a rapid tally of pieces by size category and produces information on total number and number of key pieces of large woody debris per a specified channel length.

Variables to be surveyed using this survey method include the following:

- Piece size (diameter at breast height and length)
- Rootwad presence
- Classification of key stability
- Percentage of each piece below the ordinary high water mark (OHWM)
- Location (determined by global positioning system [GPS] unit)
- Organization (number of pieces of large woody debris in a group or logjam)
- Density of large woody debris (pieces per 100 meters and wood volume per 100 meters).

Pool Quality

The quality of pools should be assessed using the methods described in *Methods for Evaluating Stream, Riparian, and Biotic Conditions* (Platts et al. 1983), which provides methods for measuring physical pool attributes and assigning a habitat rating in terms of a pool quality index. Pools receive a higher rating if they are deep and large in relation to the size of the channel, or if they have additional features that provide cover for fish (such as woody debris, steep banks, or vegetation). The variables collected in previous surveys should be used to determine the pool quality index.

Ordinary High Water Mark

The OHWM should be delineated in accordance with applicable regulations pertaining to the hydraulic code rules (WAC 220-110-020), the Shoreline Management Act rules (WAC 173-22-030), the forest practices rules (WAC 222-16-010), and the requirements of the U.S. Army Corps of Engineers (33 CFR 329.11). A survey of the OHWM should be requested from the WSDOT project office.

The OHWM should be delineated and marked in the field, where it falls within 60 lineal feet of the project foorprint. In instances where the OHWM is located more than 60 lineal feet from the project footprint, the OHWM should not be marked; it should be documented in a technical memorandum that the distance to the OHWM exceeds 60 lineal feet. The extent of the wetted channel should be mapped in the field (preferably during low-flow conditions) and distinguished from the delineation of the OHWM.

Establishment of Reference Points

Reference points delineating the extents of each stream survey should be collected using a handheld GPS unit. Reference points should be collected at the upstream and downstream end of each surveyed stream reach and at tributary confluences to allow future surveys to be conducted within the same reach.

Photographic Documentation

Digital photographs should be taken at the upstream end, downstream end, and midpoint of each surveyed reach. Significant features (e.g., large woody debris jams, culvert outlets, side channels, channel confluences, and examples of riparian vegetation and habitat features) should also be photographed.

3 Website Information Sources

The following online sources may provide useful information:

- National Marine Fisheries Service listed species
  http://www.nwr.noaa.gov/Species-Lists.cfm
- Northwest Habitat Institute
  http://www.nwhi.org/
- Salmonid Stock Inventory
  http://wdfw.wa.gov/fish/sassi/intro.htm
- Section 303(d) listed water bodies
  http://www.ecy.wa.gov/programs/wq/303d/index.html
- StreamNet
  http://www.streamnet.org/
- University of Washington Libraries aerial photograph collection
  http://geo.lib.washington.edu/website/aerials/viewer.htm
- U.S. Fish and Wildlife Service listed species
  http://www.fws.gov/westwafwo/speciesmap.html
- Washington Department of Fish and Wildlife Priority Habitats and Species
  http://wdfw.wa.gov/hab/phspage.htm

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. 2nd ed. EPA/841-B-99-002. U.S. Environmental Protection Agency, Office of Water, Assessment and Watershed Protection Division, Washington, D.C.

Bunte, K. and S.R. Abt. 2001. Sampling Surface and Subsurface Particle-Size Distributions in Wadable Gravel- and Cobble-Bed Streams for Analyses in Sediment Transport, Hydraulics, and Streambed Monitoring. General Technical Report RMRS-GTR-74. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Kaufmann, P.R. and E.G. Robison. 1998. Physical Habitat Characterization. pp 77–118 in: Environmental Monitoring and Assessment Program—Surface Waters: Field Operations and Methods for Measuring the Ecological Condition of Wadeable Streams. Edited by J.M. Lazorchak, D.J. Klemm, and D.V. Peck. EPA/620/R-94/004F. Office of Research and Development, U.S. Environmental. Protection Agency, Washington, D.C.

Kaufmann, P.R., P. Levine, E.G. Robison, C. Seeliger, and D.V. Peck. 1999. Quantifying Physical Habitat in Wadeable Streams. U.S. Environmental Protection Agency, Regional Ecology Branch, Western Ecology Division, National Health and Environmental Effects Research Laboratory, Corvallis, Oregon.

Lazorchak, J.M., Hill, B.H., Averill, D.K., and D.J. Klemm, eds. 2000. Environmental Monitoring and Assessment Program—Surface Waters: Field Operations and Methods for Measuring the Ecological Condition of Non-Wadeable Rivers and Streams. U.S. Environmental Protection Agency, Cincinnati, Ohio.

NMFS. 1996. Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale. National Marine Fisheries Service, Environmental and Technical Services Division, Habitat Conservation Branch.

Platts, W.S., W.F. Megahan, and G.W. Minshall. 1983. Methods for Evaluating Stream, Riparian, and Biotic Conditions. General Technical Report INT-183. U.S. Department of Agriculture, Forest Service.

Pleus, A.E., D. Schuett-Hames, and L. Bellchild. 1999. TFW Monitoring Program, Method Manual for the Habitat Unit Survey. TFW-AM9-99-003. DNR 105. Prepared for the Washington State Department of Natural Resources under the Timber, Fish, and Wildlife Agreement.

Schuett-Hames, D., A.E. Pleus, J. Ward, M. Fox, and J. Light. 1999. TFW Monitoring Program, Method Manual for the Large Woody Debris Survey. TFW-AM9-99-004. DNR 106. Prepared for the Washington State Department of Natural Resources under the Timber, Fish, and Wildlife Agreement.

Appendix A

Habitat Data Sheets

Appendix A: Habitat Data Sheets

- Fisheries Resources Survey Protocol Key
- Channel Morphology Data Sheet
- Riparian Vegetation Data Sheet
- Pool Quality Data Sheet
- Large Woody Debris Data Sheet
- Pebble Count Data Sheet
- Photo Documentation

Fisheries Resources Survey Protocol Key

General instructions for field data sheets: This key is to be used with the following field data sheets: Channel Morphology, Riparian Vegetation, Pool Quality, and Large Woody Debris.

Slope Measurement:
Slope = (Downstream Rod - Upstream Rod) / Reach Length

Confinement:	(Floodplain Width / Bankfull Width)
C (Confined)	< 1.5
MC (Moderately Confined)	1.5 - 4.0
UC (Unconfined)	> 4.0

Bank Condition:	Criteria
S (Stable)	Vegetated or bars to level of low flow
E (Eroding)	Steep, unvegetated banks showing erosion
A (Armored)	Artificial bank protection

Channel Pattern:	
ST	Single thread, meandering
SC	Secondary channels
AN	Anastomosing (multiple channels, vegetated banks)
BR	Braided (multiple channels, unvegetated bars)

Habitat Type:	
S (Slough)	Slow-moving water under backwater influence
G (Glide)	Shallow, pool-like reach, little turbulence
R (Run)	Swiftly flowing reach, little turbulence
RI (Riffle)	Swiftly flowing shallow reach, turbulent
P (Pool)	Deep, slow-moving water upstream of riffle
C (Cascade)	Steep, plunging flow over cobbles and boulders
SP (Step-pool)	Steep, closely spaced alternating steps/pools
BR (Bedrock)	Bedrock exposed on bed, lacking alluvial cover

Forest Type (trees > 6 m in height):	
C	Coniferous
D	Deciduous
M	Mixed

Pool Measurements:
Residual Pool Depth = (Pool Depth - Outlet Depth)

Fish Cover (pools):	(Percent pool cover by vegetation)
A (Abundant)	> 50%
I (Intermediate)	25% - 50%
E (Exposed)	< 25%

Pool Quality Index:	Description	Go to	Pool Rating
1A	Maximum pool diameter is within 10% of the average stream width of the study area	2A,2B	
1B	Maximum pool diameter exceeds the average stream width of the study area by 10% or more	3A,3B,3C	
1C	Maximum pool diameter is less than the average stream width of the study area by 10% or more	4A,4B,4C	
2A	Maximum pool depth is less than 2 feet	5A,5B	
2B	Maximum pool depth is greater than or equal to 2 feet	3A,3B,3C	
3A	Maximum pool depth is greater than or equal to 3 feet regardless of cover conditions or greater than 2 feet with abundant fish cover [a]		Rate 5
3B	Maximum pool depth is less than 3 feet with intermediate to abundant fish cover or between 2 and 3 feet with a lack of abundant cover		Rate 4
3C	Maximum pool depth is less than 2 feet and fish cover is rated as exposed		Rate 3
4A	Maximum pool depth is greater than or equal to 2 feet with intermediate[b] or better cover		
4B	Maximum pool depth is less than 2 feet but fish cover is intermediate or better, or depth is greater than or equal to 2 feet with exposed cover conditions		Rate 2
4C	Maximum pool depth is less than 2 feet and pool cover is rated as exposed [c]		Rate 1
5A	Pool with intermediate to abundant cover		Rate 3
5B	Pool with exposed cover conditions		Rate 2

[a] If cover is abundant, the pool has excellent instream cover and most of the perimeter of the pool has fish cover.
[b] If cover is intermediate, the pool has moderate instream cover and one-half of the pool perimeter has fish cover.
[c] If cover is exposed, the pool has poor instream cover and less than one-fourth of the pool perimeter has fish cover.

Large Woody Debris Key Stability:	
EB	Embedded in bank
BB	Buried in bed
PP	Pinned
RR	Rootwad
AS	Artificial anchor (e.g., cables, chains, ballast)

Channel Morphology Data Sheet

Stream:		Project:		Page ____ of ____	
Reach:		GPS point (finish):		Date:	
Sampler:		GPS point (start):		Weather:	
Crew:		Water Temp.:		Air Temp:	

Physical Habitat

GPS Points	Distance	Bankfull		Slope Measurement				Habitat Type	Confinement	Bank Conditions: S/U/A		Channel Pattern	Fish or Invertebrate presence
		Width	Depth	Rod1	Rod2	Reach Length	Slope			LB	RB		

Riparian Vegetation Data Sheet

Stream:		Project:		Page ____ of ____	
Reach:		GPS point (finish):		Date:	
Sampler:		GPS point (start):		Weather:	
Crew:		Water Temp.:		Air Temp:	

Riparian Vegetation														
	Dominant and Subdominant Riparian Vegetation													
		Left Bank					Right Bank							
GPS Point		Forest (note type)	Shrubs and/or Vines	Herbaceous; Tall or Short	Impervious (e.g., buildings, paving)	Residential Landscaped	Forest (note type)	Shrubs and/or Vines	Herbaceous; Tall or Short	Impervious	Residential Landscaped	Percent Canopy Cover (densiometer values)	Riparian Zone Width	Invasives Present
	Sub-Dominant													
	Dominant													
	Sub-Dominant													
	Dominant													
	Sub-Dominant													
	Dominant													
	Sub-Dominant													
	Dominant													
	Sub-Dominant													
	Dominant													
	Sub-Dominant													
	Dominant													
	Sub-Dominant													
	Dominant													
	Sub-Dominant													
	Dominant													
	Sub-Dominant													
	Dominant													
	Sub-Dominant													
	Dominant													

Pool Quality Data Sheet

Stream:		Project:		Page ____ of ____	
Reach:		GPS point (finish):		Date:	
Sampler:		GPS point (start):		Weather:	
Crew:		Water Temp.:		Air Temp:	

Pool Quality

GPS Point	Pool Measurements			Pool Forming Factors		Bankfull Width	Fish Cover	Pool Quality Index
	Pool Depth	Outlet Depth	Residual Pool Depth	Dominant	Sub-Dominant			

Large Woody Debris Data Sheet

Stream:		Project:		Page ____ of	
Reach:		GPS point (finish):		Date:	
Sampler:		GPS point (start):		Weather:	
Crew:		Water Temp.:		Air Temp:	

Large Woody Debris Survey

Distance	GPS Point	DBH	Length	Rootwad Presence (Y/N)	Classification of Key Stability	Percent of each Piece Below the OHWM	Number of LWD Pieces (if in a group or logjam)

Pebble Count Data Sheet

Stream:									Project:								Date:						
Reach:									GPS Point:								Weather:						
Sampler:									RB / LB (circle one)								Photos:						
Crew:									Surface / Subsurface (circle one)														Psi = $\log_2$(mm)
25																							25
24																							24
23																							23
22																							22
21																							21
20																							20
19																							19
18																							18
17																							17
16																							16
15																							15
14																							14
13																							13
12																							12
11																							11
10																							10
9																							9
8																							8
7																							7
6																							6
5																							5
4																							4
3																							3
2																							2
1																							1
mm (≤)	<4	4	5.66	8	11.31	16	22.63	32	45.25	64	90.51	128	181.0	256	362.0	512	724.08	1,024	1,448.2	2,048	2,896	4,096	
psi	<2	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11	11.5	12	
Totals																							

Photo Documentation

Date: _____ Photographer: _____ Camera: _____

Stream: _____ Location: _____

Photo-Point	GPS Point	File Name	Photo No.	Comments
1				
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				
31				
32				
33				
34				
35				