

# **MONITORING AND MAINTENANCE PLAN**

**Associated with the  
Whatcom Creek Restoration Plan  
Developed for the June 10, 1999  
Olympic Pipe Line Gasoline Spill**

December 2006

City of Bellingham



# 1. Introduction

This monitoring and maintenance plan has been developed in association with the Restoration Plan and Environmental Assessment for the June 10, 1999, Olympic Pipe Line gasoline spill into Whatcom Creek, Bellingham, Washington. The purpose of this monitoring and maintenance plan is to establish the protocols for documenting environmental recovery, evaluating long-term performance, and providing a routine for appropriate maintenance activities using an adaptive management approach. The Natural Resource Trustees (Trustees) for the Olympic Pipe Line incident are: the United States Department of Commerce as represented by the National Oceanic and Atmospheric Administration (NOAA); the United States Department of the Interior (DOI) as represented by the United States Fish and Wildlife Service; the State of Washington (the State) as represented by the Department of Ecology; the City of Bellingham; the Lummi Nation of Washington; and the Nooksack Tribe of Washington. The Trustees and the Olympic Pipe Line Company have established a fund of \$500,000 from which all long-term monitoring and maintenance activities related to this incident are supported. This monitoring and maintenance plan will be implemented by the City of Bellingham, with oversight by all of the Trustees.

## 2. Restoration Strategy

The goals of this monitoring and maintenance plan are to ensure that restoration projects implemented under the Restoration Plan function as designed and are maintained as necessary. The proposed maintenance and monitoring activities will use typical maintenance practices and commonly accepted monitoring protocols. The designed projects are not anticipated to have significant implementation problems, or any deleterious environmental or socio-economic impacts. Unless a need for unanticipated activities is identified, the actions associated with this plan are expected to cause only minimal disturbance to the restoration sites, primarily foot traffic by scientific and maintenance crews. The occasional removal of hazardous trees may require the use of appropriate vehicles. Maintenance crews will attempt to minimize impacts to sensitive areas when such an activity is required.

The goals of this plan will be achieved by ensuring that the injured natural resources are returned to their pre-incident condition, and by ensuring interim losses of natural resources and services are compensated for during the period of recovery.

### **3. Summary of Restoration Activities**

Of 34 potential restoration alternatives and/or restoration locations, seven have been identified as preferred and are summarized in Table 1. Implementation of those projects was completed in December 2006. This monitoring plan focuses on evaluating: 1) the long-term effectiveness of physical habitat restoration projects; and 2) actions taken during the emergency phase of the incident, including streambed alterations and placement of habitat structures in Whatcom Creek and revegetation of the burn zone. In combination, these activities address injuries related to vegetation, wildlife, water quality, and recreation. Monitoring and maintenance activities include regular sampling of biological and physical parameters, the establishment of permanent photo points at each restoration and monitoring site to document seasonal and annual changes during the ten-year monitoring period, and appropriate maintenance of restoration actions.

### **4. Sampling Tasks and Contingencies**

Monitoring and maintenance activities are subdivided between monitoring recovery within the area directly affected by the pipeline leak, subsequent fire (burn zone monitoring) and emergency response plan and monitoring of restoration projects implemented as part of the long-term recovery plan (restoration monitoring). Detailed descriptions of monitoring tasks to be completed for each of these areas are presented in Appendix A – Burn Zone Monitoring and Appendix B –Restoration Monitoring.

A post-fire assessment of the burn zone will be completed in 2007. Monitoring of the burn zone would consist of completion of a one-time “snapshot” assessment of current conditions in the affected area. Where possible, existing data that have been collected by the City of Bellingham over the 7-years since the original incident will be used to complete the assessment. Additional data will be gathered to describe vegetation recovery (plot surveys), instream habitat conditions and erosion/slope stability. The contractor responsible for planting and monitoring during the emergency response phase will complete vegetation monitoring. Habitat mapping and evaluation of current erosion and slope stability concerns (if any) will be conducted by City of Bellingham Environmental Department Staff who assisted with data collection during the emergency response phase. Recommendations on additional monitoring and/or maintenance of the burn zone will be developed based on the snapshot assessment and presented to the Trustees for approval.

Monitoring of restoration projects will continue over a 10-year period following completion of construction. Monitoring will occur in post-construction years 1, 2, 3, 5, 7, and 10, corresponding to the years 2007, 2008, 2009, 2011, 2013, and 2016, respectively. Each monitoring year will begin January 1 and end December 31.

## **5. Monitoring Program Administration**

### **5.1. Responsibility**

By agreement between the Trustees, the City of Bellingham has been given the responsibility for implementing this monitoring plan. The responsibility includes the implementation of monitoring and maintenance tasks, data management, preparation of monitoring, maintenance, and budget reports, and distribution of reports. Should the City of Bellingham not be willing or able to fulfill the responsibilities described in this plan, the Trustees shall replace the City with a suitable substitute for the remainder of the plan's implementation.

The City will accomplish monitoring activities using a combination of city staff, Washington Conservation Corps Independent Placement interns and crew members, and specialized consultants.

### **5.2. Implementation Schedule**

Planting of the restoration sites is expected to be completed by January 2007. Year 1 monitoring will begin in 2007. Monitoring activities will be repeated annually in years 2 and 3, and thereafter at 2-year intervals through year 2013. The final year of monitoring will occur in year 10 (2016).

### **5.3. Reporting**

A report describing current conditions and including recommendations for additional monitoring/maintenance/restoration within the burn zone (if any) will be completed in by December 2007. A draft end-of-year report will be distributed to the Trustees for their review within one month after the completion of the annual sampling period. The Trustees shall have 30 days to provide comments to the City on the report. A final report will be prepared for distribution by the City of Bellingham within one month after the receipt of the comments from the Trustees. The Burn-zone monitoring and maintenance report shall include recommendations, if necessary, as to additional monitoring or contingency measures which may need to be taken. If there are issues which need resolution by the Trustees based on the Burn-Zone monitoring report, the Trustees shall call a meeting to resolve any necessary issues. If no issues or ongoing monitoring requirements are identified, formal monitoring of the burn zone as part of this Monitoring and Maintenance Program will be considered to be complete.

In each year that restoration project monitoring occurs, the City of Bellingham will prepare a report which presents a summary and evaluation of the monitoring results and maintenance activities. At a minimum, each report will summarize:

- Monitoring tasks completed as outlined in this plan (methods, sampling locations, dates);
- Monitoring results (descriptive statistics such as mean, standard deviation or error depending on data type, range, and variance);
- Status of project sites;

- Trends shown by data, for individual sites and overall;
- Locations triggering contingency measures and measures taken;
- Recommendations for alternative actions;
- Reporting of any externalities that may be influencing monitoring results;  
and
- Budget status.

Raw data will be maintained using EXCEL spreadsheets, Access database(s) and GIS. Raw data will be provided to the Trustees on request.

By May 1<sup>st</sup> of each monitoring year, the City of Bellingham will provide a mid-year monitoring and maintenance report. The mid-year monitoring and maintenance report shall consist of a summary of the monitoring and maintenance activities up to that point, with recommendations, if necessary, as to contingency measures which may need to be taken. If there are issues which need resolution by the Trustees based on the mid-year report, the Trustees shall call a meeting to resolve any necessary issues.

A draft end-of-year report will be distributed to the Trustees for their review within one month after the completion of an annual sampling period. The Trustees shall have 30 days to provide comments to the City on the report. A final report for each sampling year, incorporating Trustees' comments and identified contingency measures, will be prepared for distribution by the City of Bellingham within one month after the receipt of the comments from the Trustees. The monitoring and maintenance report associated with the final year of monitoring and maintenance will also include a summary of all results for all monitoring years.

#### **5.4. Program Modifications**

Given the long-term nature (10 years post-construction) of the monitoring plan, it is important to provide a clear description of the tasks. It is also important to maintain a continuous data series that allows inter-site and inter-annual comparisons. In addition to the need for long-term monitoring consistency, it is also important to recognize a potential need to modify the monitoring plan based on conditions encountered in the monitoring area.

Modifications to the monitoring plan may include changes in monitoring protocols due to improvements in field and laboratory techniques or equipment, or due to on-site experience. Elimination and/or addition of monitoring tasks may be considered if determined by the Trustees that a task was not returning useful information. The potential need to modify the monitoring plan in the future is recognized by the Trustees and will be considered as necessary. Justification must be given to and accepted in writing (signatures required) by the Trustees regarding the elimination, addition, or modification of monitoring tasks before such a change can occur.

## 6. Budget

The budget presented in Table 2 provides estimated labor, material and consultant needs pursuant to each biological, physical, and chemical sampling parameter associated with this plan. Costs are identified for field personnel, field supplies, analysis, and reporting for the first sampling year (2007). Monitoring will be conducted under the oversight of the City of Bellingham Environmental Coordinator, who will serve as Project Manager. The City will hire a special projects intern to lead monitoring field efforts. Wherever possible, trained volunteers from the Washington Conservation Corps (WCC), Northwest Indian College, and Western Washington University will be encouraged to assist with field work.

A detailed cost proposal for monitoring to be undertaken in 2007 is provided in Table 2. Monitoring of the burn zone is assumed to be a one-time assessment. Estimated monitoring costs for ongoing monitoring of restoration sites are assumed to be equal to the 2007 costs, plus a 3 percent annual inflation rate except where noted. No detailed cost estimate is provided for years 2008-2016, as the distribution of funding may change depending on preliminary results.

By May 1<sup>st</sup> of each monitoring year, the City of Bellingham will provide a mid-year budget report as part of its interim monitoring and maintenance report. The mid-year budget report shall consist of a summary of expenses of costs, which have occurred up to that point, tracked and reported by line item as identified in Table 2. If there are issues which need resolution by the Trustees based on the mid-year report, the Trustees shall call a meeting to resolve any necessary issues.

The City of Bellingham will include an end-of-year final budget report and a proposed monitoring budget for the next annual cycle as part of its final end-of-year monitoring and maintenance report. The report will be completed within two months after the completion of the annual sampling period ending in December of identified sampling years per the schedule provided in the preceding section (i.e., draft report within one month of sampling period end; comments within 30 days of draft; final within one month of comments). The City of Bellingham will track and report its monitoring and maintenance expenditures by line item as identified in Table 2. The draft end of year report shall also include a request for authorization for expenses the City expects to incur over the next sampling period. If the City's request for authorization for the next sampling period in the draft end of year report is within the amount shown in Table 2, the City's request shall be deemed approved by the Trustees unless the City receives a letter from the Trustees requesting a meeting for review within 30 days of the Trustees' receipt of the City's draft report. If the City's request for authorization exceeds the amount shown in Table 2, review and acceptance of the budget report by the Trustees in writing (signatures required) is required prior to the next year's authorization of funds for continuation of monitoring and maintenance activities.

Table 1. Injuries and Preferred Restoration Alternatives for the Whatcom Creek long-term restoration plan

<b>Project Number</b>	<b>Preferred Alternative</b>	<b>Injury Categories</b>	<b>Description and Benefits</b>
<b>1</b>	Completion of planting and invasive species control	Vegetation, Wildlife, Salmonids, Water Quality, Recreation	The vegetation projects implemented during Emergency Restoration Phase will be completed. The burn zone was replanted and areas dominated by invasive vegetation prior to spill were restored using native vegetation. The planting of trees and removal of invasive vegetation will have multiple benefits to the park, terrestrial wildlife, and help to protect water quality in Whatcom Creek.
<b>2</b>	Acquisition of 4-acre parcel along Whatcom Creek near confluence with Cemetery Creek	Vegetation, Wildlife, Salmonids, Water Quality, Recreation	Acceptance of the transfer of this parcel will help protect Whatcom Creek. This parcel was selected for acquisition for protection from development, connectivity of wildlife habitat, parks and greenways, and to leverage future restoration projects. Restoration projects conducted on this site will be specifically designed to benefit fish, wildlife and riparian habitat. Trails along the edge of the parcel will provide recreational benefits.
<b>3</b>	Acquisition of 9.5-acre parcel along Whatcom Creek at Woburn Street	Vegetation, Wildlife, Salmonids, Water Quality, Recreation	Acceptance of the transfer of this parcel will expand Whatcom Falls Park. The additional land will provide increased access to park trails and creek for public use such as hiking, nature watching, and fishing. The acquisition of the riparian area will preclude development and protect an important spawning and rearing area for salmonids. The acquisition will also benefit water quality, vegetation, and wildlife.
<b>4</b>	Recreational Improvements to 9.5-acre parcel	Recreation	Construction of a small parking lot and restrooms facility. These improvements will benefit recreational use of the park, but will use an existing access road and be designed to minimize impacts on fish and wildlife habitat.
<b>5</b>	Salmon Park Project	Fish, Aquatic Biota, Recreation, Wildlife, Water Quality	Construction of off-channel salmonid habitat near Racine Street will improve winter refuge habitat for juvenile salmonids and provide benefits to aquatic and terrestrial wildlife. Creation of backwater channel will also benefit public uses such as nature watching and tribal and recreational fisheries.
<b>6</b>	Cemetery Creek Project	Fish, Aquatic Biota, Recreation, Wildlife, Water Quality	Construction of pools, wetlands and salmonid rearing habitat on lower Cemetery Creek will benefit salmon and also provide public uses such as nature watching and tribal and recreational fisheries.
<b>7</b>	Monitoring and Maintenance	All	Funding for long-term monitoring of Whatcom Creek and restoration projects. Funding for maintenance of the restoration projects and parklands injured by the Incident



Table 2 Proposed budget for Whatcom Creek Long-term monitoring and maintenance.

Parameter	Supplies	ER Staff <sup>1</sup>	Intern <sup>2</sup>	Contractor	2007	2008 <sup>3</sup>	2009 <sup>3</sup>	2011 <sup>3</sup>	2013 <sup>3</sup>	2016 <sup>3</sup>	Totals	
<b>Burn Zone Monitoring</b>												
Vegetation		\$288	\$256	\$16,800							\$17,344	
Fish Community		\$576	\$1,280								\$1,856	
Aquatic Macroinv.		\$288	\$576								\$864	
Wildlife <sup>4</sup>												
In-Stream		\$288	\$480								\$768	
Erosion & Slopes		\$288	\$384								\$672	
Water Quality		\$288	\$128								\$416	
Data Analysis		\$1,440	\$1,280								\$2,720	
Photopoints		\$72	\$128								200	
Reporting		\$1,440	\$2,560								\$4,000	
<b>SUBTOTALS</b>		\$4,968	\$7,072	\$16,800							\$28,840	
<b>Restoration Site Monitoring</b>												
Vegetation	\$200	\$144	\$960								\$1,304	
Fish Community	\$500	\$2,160	\$1,920								\$4,580	
Aquatic Macroinv.	\$500	\$144	\$320	\$6,000							\$6,964	
Wildlife <sup>3</sup>	\$100	\$144	\$1,280								\$1,524	
In-Stream	\$500	\$864	\$640								\$2,004	
Water Quality	\$2,400	\$144	\$640								\$3,184	
Photopoints		\$72	\$80								\$152	
Data Analysis		\$1,440	\$1,920								\$3,360	
Reporting	\$500	\$2,880	\$1,920								\$5,300	

Parameter	Supplies	ER Staff <sup>1</sup>	Intern <sup>2</sup>	Contractor	2007	2008 <sup>3</sup>	2009 <sup>3</sup>	2011 <sup>3</sup>	2013 <sup>3</sup>	2016 <sup>3</sup>	Totals
<b>SUBTOTALS</b>	\$4,700	\$7,992	\$9,680	\$6,000	\$28,372	\$27,739 <sup>5</sup>	\$28,571	\$29,428	\$33,920	\$37,064	
OVERSIGHT (8%)		\$1,036	\$1,340	\$1,824	\$4,200	\$2,219	\$2,286	\$2,354	\$2,714	\$2,965	
<b>MONITORING TOTALS</b>	\$4,700	\$13,996	\$18,092	\$24,624	\$61,412	\$29,958	\$30,857	\$31,782	\$36,633	\$40,029	\$230,671
<b>MAINTENANCE TOTALS</b>	WCC Crew (1/2 annual cost) and IP				\$90,000	\$90,000	\$90,000				\$270,000
<b>GRAND TOTALS</b>											<b>\$500,671</b>
<sup>1</sup> Assumes ER coordinator salary/benefits @ \$36 per hour <sup>2</sup> Assumes intern (salary only) @ \$16/hr <sup>3</sup> The distribution of funds allocated to specific parameters in years 2008 through 2016 may changed based on monitoring results from the previous years, thus no specific cost breakdown is provided for these years. <sup>4</sup> Monitoring of wildlife within the burn zone will consist of a list of species observed during other monitoring activities at no additional cost. <sup>5</sup> Reduced costs in Year 2 reflect reduced reporting costs once report template has been established.											

# Appendix A

## Burn Zone Monitoring Plan

# 1. Introduction

The 2007 Burn Zone monitoring plan is a component of the overall Whatcom Creek Monitoring and Maintenance Plan (hereafter referred to as the M&M Plan). The original M&M Plan was developed in association with the Restoration Plan and Environmental Assessment for the June 10, 1999, Olympic Pipe Line gasoline spill into Whatcom Creek, Bellingham, Washington. Implementation of the original M&M plan was intended to occur in 2002 and continue for 10 years, but was delayed as the result of bankruptcy proceedings. The ensuing delay precluded documentation of ecosystem recovery in the burn zone as it happened. The 2007 Burn Zone monitoring plan is intended to provide a point-in-time re-evaluation of environmental conditions in the burn zone in 2007 as compared to post-burn conditions and the original restoration plan goals. Data generated by this “snapshot” assessment will be used to develop recommendations for ongoing monitoring and or maintenance activities (if any) in the burn area. The post-burn evaluation of the burn zone will focus on three aspects of the environment: 1) Biological Monitoring; 2). Physical and Chemical Monitoring; and 3. Photodocumentation. Detailed descriptions of specific monitoring parameters and sampling methods are provided in Sections 2, 3 and 4.

The goals of this plan will be achieved by ensuring that the injured natural resources are returned to their pre-incident condition, and by ensuring interim losses of natural resources and services are compensated for during the period of recovery.

## 2. Biological Monitoring

### 2.1. *Vegetation*

#### **Objective:**

Confirm that post-burn planting efforts completed during the emergency restoration phase have resulted in the development of a thriving riparian plant community dominated by native species.

#### **Parameters Measured:**

- Number and species of trees
- Understory species composition
- Understory cover (% native and percent non-native)

#### **Methods:**

Vegetation surveys will be conducted within the burn zone to assess the current species composition and canopy cover. Vegetation surveys of the burn zone will be conducted following the general methodology used to survey vegetation immediately following replanting in 1999 (OPLC 2000). A total of fifty 20-foot diameter plots will be surveyed within the burn zone. The plots will be distributed evenly throughout the burn area, and

stratified within the 1999 vegetation polygons. Plot sample centers will be located using GPS. The species, number and size class of trees and the species and percent cover of understory vegetation will be recorded at each plot. Surveys will be conducted by professional biologist/botanists with expertise in native plant identification. Vegetation monitoring will be conducted by Cantrell and Associates, the firm responsible for completing emergency response planting and the original 1999 vegetation surveys.

**Data Analysis:**

Data collecting from vegetation plots will be used to document the current stand conditions in each of the four basic vegetation classes identified within the burn zone during the original post burn assessment. Major vegetation classes identified for that study include:

- Evergreen dominated mature second growth forest;
- Deciduous dominated closed canopy forest;
- Deciduous dominated narrow riparian forest; and
- Invasive weed dominated shrub/low growing vegetation

The data will be compared to post-burn information collected for each class to determine whether current vegetation stands within the burn zone are on the desired trajectory towards recover.

**Success criteria:**

- Native tree and shrub composition should be comparable to existing baseline information for the vegetation community class and should not contain more than 10% composition of non-native or invasive plant species.
- Areal extent of ground cover should cover not less than 90% of the upland vegetated area for each vegetation community class.

**Contingency:**

- Any occurrence of invasive species that exceeds more than 10% will be treated with control measures by WCC crews within or prior to the next growing season. Physical removal will be given preference over herbicide use.
- Areas where planted vegetation is considered to be failing to meet expectations for the desired recovery trajectory will trigger implementation of additional restoration or maintenance actions by the City of Bellingham. Depending on the hypothesized reason for failure to meet success criteria, response could include additional planting, soil amendments, herbivore exclusion and/or focused stewardship efforts.

**References:**

Olympic Pipe Line Company. 2000. *Draft Whatcom Creek Long-Term Restoration Plan and Appendices*. Prepared by Polaris Consultants, Kirkland, WA.

## **2.2. Fish Community**

### **Objective:**

Document spawning by anadromous fish in Whatcom Creek within the burn area.

### **Parameters Measured:**

- Number of redds
- Number of live fish
- Number of carcasses

### **Methods:**

Anadromous fish use of Whatcom Creek for spawning will be evaluated using spawning survey data collected by the City of Bellingham and others from 1999 through 2005. This information will be supplemented with data on hatchery releases and returns to the Whatcom Falls Hatchery for those years. Additional spawning surveys in Whatcom Creek will be conducted through the 2006-2007 spawning season (September 2006-May 2007). Parameters of interest for each species include number of live spawners, number of carcasses and number of redds.

Spawning surveys are conducted using a protocol developed by Nooksack Salmon Enhancement (NSEA). Walk through surveys of Whatcom Creek are completed at seven to ten-day intervals from August through May. The species of primary interest include Chinook salmon, coho salmon and steelhead. The survey reach extends from the pipeline crossing at the mouth of Lincoln Creek (RM1.2) to Middle Falls (RM 2.2). Surveys are conducted by a trained and specifically-assigned staff member supported by seasonal technicians. Spawning surveys in Whatcom Creek will continue through 2007, and longer if determined desirable by the Trustees.

### **Data Analysis:**

The post burn report will summarize available historic data through May of 2007. The analysis will consider hatchery releases, hatchery returns, live fish/carcass counts and streamflow. Criteria proposed to evaluate the success of emergency restoration activities implemented immediately following the burn will be utilization of the project area by resident and anadromous fish for migration and spawning.

### **Success criteria:**

- Resident and anadromous fish successfully utilize the project site for migration and spawning.

### **Contingency:**

In the absence of other factors, the abundance of resident and anadromous spawners would be expected to show an increasing trend over the period following the burn, although a temporary decrease associated with the brood years that would have been present during the event would not be unexpected. However, changes in hatchery practices and other external factors may confound the results. Information on fish use of

Whatcom Creek for spawning since the burn will be discussed with the Trustees to determine whether adaptive management and/or ongoing monitoring are warranted.

Failure to document an increasing trend, if it is reasonably attributable to the burn, will trigger a re-examination by the Trustees of the project design, implementation, and site management. Additional maintenance or restoration alternatives (if needed) will be defined and agreed upon by the Trustees, followed by the implementation of the accepted design by the City of Bellingham.

### **2.3. Aquatic Macroinvertebrates**

#### **Objective:**

Document colonization and survivorship by the macroinvertebrate community in Whatcom Creek within the burn area.

#### **Parameters Measured:**

- Taxa richness
- EPT index
- % by FFG
- BIBI
- HBI
- % Dominant Taxa

#### **Methods:**

Aquatic benthic macroinvertebrates have been collected annually at three sites within the Whatcom Creek watershed since 1998. From 1999 through 2000, immediately following the burn, Olympic Pipeline Company collected macro invertebrate samples quarterly from five sample sites in Whatcom Creek, two of which were located within the burn zone. From 2001 through 2003 the City of Bellingham collected samples at the same two sites within the burn zone. In all cases samples were collected following Washington State Department of Ecology protocols (Plotnikoff and Wiseman, 2001).

The assessment of macroinvertebrate populations in Whatcom Creek will rely on existing data (1999-2003). If trends in community composition and structure, functional feeding groups, taxa abundance, species richness, and other appropriate indices have improved or remained stable over the 7-year post fire period as compared to previously known baseline population information, macroinvertebrate monitoring in Whatcom Creek as part of the M&M plan will be considered complete.

#### **Data Analysis:**

Data from each source will be collated and transformed to produce comparable summary statistics. Charts depicting temporal trends will be produced for each variable to assess recovery.

**Success criteria:**

- Trends in community composition and structure, functional feeding groups, taxa abundance, species richness and other relevant criteria should remain stable or show an overall increasing trend since the burn.

**Contingency:**

Failure to meet the macroinvertebrate success criteria will trigger additional macroinvertebrate sampling and/or water quality and a re-examination by the Trustees of the project design, implementation, and site management.

**References:**

Plotnikoff, R.W. and C. Wiseman. 2001. *Benthic Macroinvertebrate Biological Monitoring Protocols for Rivers and Streams*. Pub. No. 01-03-028, Environmental Assessment Program, Olympia, WA.

## **2.4. Riparian & Terrestrial Wildlife**

**Objective:**

Document on-going wildlife use within the burn zone.

**Parameters Measured:**

- Species observed
- Location/type of use

**Methods:**

Monitoring use of the site by riparian and terrestrial wildlife will be integrated with other monitoring activities, and will consist of compilation of a list of species observed to be using the site. Observations that would document wildlife use would include direct sightings, tracks, scat or browse patterns. If habitat utilization by Washington State Priority Species and/or Federally listed or candidate species is identified, sightings will be reported and measures taken to protect these sites. Priority species likely to be found at this site are listed in Attachment A.

Instances of wildlife harm due to human disturbance or site degradation by invasive mammals (if any will also be noted). When wildlife is identified as causing damage, photos and a description of the impacts will be collected, and the information passed to the appropriate agency. WCC crews and staff working at the sites will be provided with a photo key of common wildlife species that would be likely to utilize habitats associated with the restoration sites.

The wildlife sighting list will be updated monthly starting in December 2006. Sightings will be compiled throughout 2007. An updated list including a description of key sightings (e.g. priority species, evidence of denning or breeding, damage) will be included in the final monitoring report.



**Data Analysis:**

Not Applicable

**Success Criteria:**

- Presence and habitat utilization by native mammal species at the restoration sites over the 10-year period following restoration construction.
- Absence of major site damage from mammals throughout the monitoring period.

**Contingency:**

- If there is evidence that human use is causing disturbance that is detrimental to wildlife community, access will be reviewed and limited.
- If beaver, deer, or other mammals are identified as causing significant damage to habitat or water quality within the restoration area, a protection and deterrent program may be implemented
- If habitat utilization by priority species is identified, sighting will be reported and measures taken to protect these sites.

### 3. Physical and Chemical Monitoring

#### 3.1 *In-Stream Habitat*

**Objectives:**

- Confirm that habitat conditions developed during the emergency restoration phase have been maintained or improved throughout the affected reach.
- Confirm that engineered features created during the emergency phase of the restoration (e.g. engineering log jams) continue to perform as designed and maintain structural integrity.

**Parameters Measured:**

- Location, configuration and function of engineered structures in Whatcom Creek
- Pool frequency
- Pool spacing
- Percent pool by length
- Number of holding pools (>1m deep)
- LWD frequency (pieces/channel width)
- Key piece frequency (pieces per channel width)
- Channel complexity (CV of thalweg depths)
- Spawning gravel area

**Methods:**

Surveys will be conducted following TFW protocols for habitat units (Pleus et al. 1999) and LWD (Schuett-Hames et. al. 1999). The current area of potential salmonid spawning gravels will be characterized for each habitat unit using visual identification. Habitat

surveys will replicate mesohabitat level surveys completed following the burn in 1999 and 2000 (OPLC 2000).

The current condition of engineered features created during the emergency restoration phase will be evaluated by comparing photographs and plans of each structure. Habitat conditions currently associated with each structure will also be measured (i.e. pool depth, pool area, spawning gravel area). This information will be collected concurrently with stream habitat surveys.

**Data Analysis:**

Habitat data will be summarized simple statistics (mean, standard deviation, coefficient of variation) and compared to data from 2000. Data comparisons will be presented using tables and charts. Where appropriate habitat data will also be compared to relevant habitat condition diagnostics (i.e. WFPB 1997; NMFS 1999).

The assessment of structure integrity and function will be assessed qualitatively. Structures that remain intact and that continue to influence habitat characteristics as intended will be considered to be performing as designed. Structures that are substantially altered in terms of location and configuration, or that are not producing desirable habitat conditions will be considered to be non-functions.

**Success criteria:**

The long-term effectiveness of restoration activities implemented during the emergency response phase will be evaluated by comparing current values for each of the habitat metrics listed above to the values documented in the 1999 and 2000 post-restoration surveys. The restoration will be considered a success from a physical standpoint if the combined effect of natural processes and created habitat features has resulted in habitat metrics that have remained stable or improved over time.

**Contingency:**

Some deterioration of engineered features over time is expected. However, data on which types of features have remained functional and which types of features have deteriorated can be used to guide future restoration efforts in Whatcom Creek or other streams with comparable channel morphology.

Reduced habitat conditions as compared to conditions observed immediately following the emergency response actions will lead to reexamination of original design and possible redesign of low impact replacement of woody debris or water diversion structures. Additional maintenance alternatives will be defined and agreed upon by the Trustees, followed by the implementation of the accepted design by the City of Bellingham.

**References:**

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

Olympic Pipe Line Company. 2000. *Draft Whatcom Creek Long-Term Restoration Plan and Appendices*. Prepared by Polaris Consultants, Kirkland, WA.

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

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

Washington Forest Practices Board. November 1997. *Standard Methodology for Conducting Watershed Analysis Manual*, Version 4.0. Available at: [http://www.dnr.wa.gov/ResearchScience/Topics/WatershedAnalysis/Pages/fp\\_watershed\\_analysis\\_manual.aspx](http://www.dnr.wa.gov/ResearchScience/Topics/WatershedAnalysis/Pages/fp_watershed_analysis_manual.aspx).

### **3.2. Erosion and Slope Stability**

#### **Objective:**

Confirm that erosion control measures implemented as part of the emergency restoration phase are effective and that on-going erosion within the burn zone is comparable to background levels.

#### **Parameters Measured:**

- Area of eroding soils
- Area and mechanism of unstable slopes

#### **Methods:**

An erosion inspection and mitigation plan was implemented rapidly following the burn. Anecdotal evidence suggests that the mitigation plan was successful in prevent large-scale erosion. A brief walk-through survey of current erosion conditions in the burn zone will be conducted by a geomorphologist and City staff familiar with the original post-fire conditions. Eroding sites will be flagged and measured in the field. Factors responsible for ongoing erosion (i.e. lack of vegetation; emergent groundwater etc.) at each site will be identified. Areas of eroding soils will be mapped using GPS or delineated on large-scale aerial photos. Photographs will be taken of each site.

#### **Data Analysis:**

A table and brief narrative description will be prepared summarizing current erosion issues in the burn zone (if present). Recommendations for further monitoring or treatment will be provided based on this assessment.

**Success criteria:**

- Eroding areas within the burn area will not exhibit surface erosion resulting from conditions generated by the fire (e.g. sparse cover in planted areas, compacted soils).
- Unstable slopes located within the burn area will not be related to conditions caused by the spill/burn incident or restoration activities

**Contingency:**

Identification of erosion or slope stability that is believed to be related to the spill/burn incident or subsequent restoration activities will trigger appropriate treatment actions and /or additional evaluation and monitoring. Treatment actions could include, planting of vegetation, placement of soil dams, limitation of public access and or a more detailed geotechnical evaluation.

### **3.3. Water Quality**

**Objective:**

Confirm that conditions within the burn zone are on a recovery trajectory that will support attainment of Washington State surface water quality standards in Whatcom Creek.

**Parameters Measured:**

- Temperature
- pH
- DO
- Turbidity

**Methods:**

Water quality in Whatcom Creek has been monitored monthly as part of the City of Bellingham's Urban Stream Monitoring program since 1996. Data collected from Whatcom Creek upstream and downstream of the burn area will be summarized for the pre-burn and post-burn periods. Water quality sampling will be conducted by the City of Bellingham state certified laboratory.

**Data Analysis:**

Simple summary statistics (i.e. mean, standard deviation) will be generated on a seasonal basis. Pre- and post-burn values for each site and differences between the sites will be compared to assess general trends in water quality. Data collected as part of the USM program represent spot measurements and thus cannot be used to draw conclusions regarding cause and effect in the burn area. However, they are expected to be sufficient to highlight ongoing water quality issues that may be associated with the burn and will be used to develop recommendations regarding additional future monitoring (if needed).

**Success criteria:**

- The difference between upstream and downstream water temperatures in Whatcom Creek should show a stable or decreasing trend over the seven years since the burn incident. Seasonal average temperatures within the burn zone for the post-burn period should be comparable or less than seasonal averages from the pre-burn period.
- The difference between upstream and downstream turbidity levels in Whatcom Creek should show a stable or decreasing trend over the seven years since the burn incident. Seasonal average turbidity values within the burn zone for the post-burn period should be comparable or less than seasonal averages from the pre-burn period.
- The difference between upstream and downstream pH in Whatcom Creek should show a stable or decreasing trend over the seven years since the burn incident. Seasonal average pH within the burn zone for the post-burn period should be comparable or less than seasonal averages from the pre-burn period.
- The difference between upstream and downstream DO in Whatcom Creek should show a stable or decreasing trend over the seven years since the burn incident. Seasonal average DO within the burn zone for the post-burn period should be comparable or less than seasonal averages from the pre-burn period.

**Contingency:**

If water quality parameters as measured over the seven years since the burn do not exhibit the desired general trends, additional, more intensive monitoring will be initiated. Recommendations for intensive or targeted monitoring will be presented to the Trustees to determine the desired course of action. Project design, maintenance, and current conditions that may be contributing to perceived water quality problems would be reexamined.

## 4. Photodocumentation

**Objective:**

Provide a visual resource documenting long-term recovery within the burn zone.

**Parameters Measured:**

- Paired photos of pre-and post burn conditions

**Methods:**

Identify recognizable locations on photos taken within the year following the spill/burn incident and re-photograph conditions from the same location at approximately the same season.

**Data Analysis:**

Photo pairs depicting post-burn conditions and 2006 conditions at each site will be prepared to illustrate recovery.

**Success criteria:**  
Not applicable

**Contingency:**  
Not applicable

# **Appendix B**

## **Restoration Project Monitoring**

# 1. Restoration Project Monitoring

The Cemetery Creek and Salmon Park habitat restoration projects are located at the confluence of Cemetery Creek and Whatcom Creek (Figure 1). The Salmon Park project covers over 100 meters of the Whatcom Creek streambank to the north, while Cemetery Creek encompasses approximately 75 meters along the south bank of Whatcom Creek and over 400 meters along the east and west forks of Cemetery Creek.

These projects were implemented to mitigate damages following the release of gasoline and subsequent fire along Whatcom Creek in 1999. During this event, the fishery and aquatic resources of Whatcom Creek were severely impacted. The goals for rehabilitation and enhancement center on mitigating damages by creating and improving salmonid habitat associated with Whatcom Creek.

Specific habitat objectives implemented in the projects included: increased salmonid summer rearing habitat by creating off-channel pools in Cemetery Creek; increased salmonid winter rearing habitat by creating backwater habitats during frequent floods in Salmon Park and Cemetery Creek; improved habitat complexity for all life stages of salmonids in the lower portion of Cemetery Creek; reduced erosion in the lower portion of Cemetery Creek; removed human of placed gravel berms, where appropriate, to restore geomorphic function of stream processes, within the confines of Salmon Park and Whatcom Creek; provided enhanced habitat conditions, while minimizing impacts to surrounding vegetation and ground surfaces.

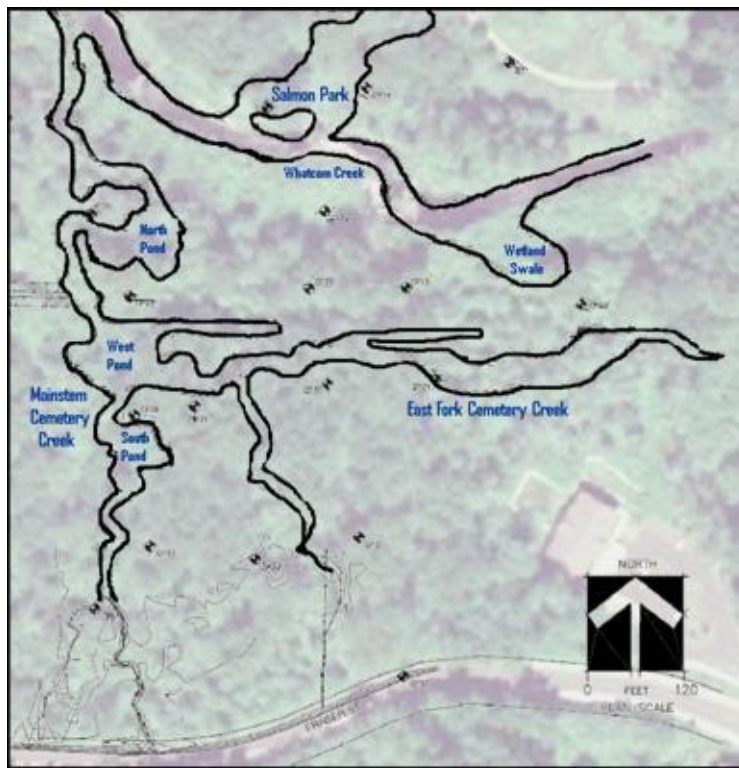


Figure 1. Schematic & aerial map of Cemetery Creek and Salmon Park Restoration Areas.



Monitoring for these projects focuses on seven elements (vegetation, fish, macro invertebrates, riparian/terrestrial wildlife, hydrology/habitat, water quality and photopoints. Monitoring programs to evaluate each of these elements are described below. Specific protocols are incorporated by reference. Copies of those protocols will be provided by the City of Bellingham on request.

## 2. Biological Monitoring

### 2.1. *Vegetation*

**Objective:** To document establishment and success of native riparian species, while ensuring that invasive species are not interfering with native plants.

**Parameters Measured:**

- Vegetation community type
- Species
- Condition
- Height class
- Plant origin
- Invasive (% cover)

**Methods:**

Riparian vegetation surveys will be conducted within all cleared and planted areas at the Cemetery Creek and Salmon Park restoration sites. The survey will describe the vegetation community type (emergent wetland, shrub-scrub or riparian forest), the number of native and nonnative species, and the status (dead or alive), origin (planted/natural) and height class of each shrub or tree. The survey will also record the proportion of the survey plot covered by invasive species. For emergent wetland community type, information on the ground cover by species will be recorded in lieu of information on individual plants. Qualitative notes will be recorded describing plant condition. If areas where plant survival has not been successful are identified, the species of dead plants and reason for the lack of success (e.g. erosion, unsuitable hydrology, etc) will be identified.

Plots will be established following the methodology used in “Protocol for monitoring effectiveness of riparian planting projects” (WSRFB, 2004, pg.14 – 16) with some alterations. A total of 20 transect plots will be established perpendicular to the stream throughout the restoration site (Figure 2). Each plot will be 10-meters wide and will extend back to the edge of the project area. The plot center will be marked using rebar and located using GPS.

Data collection will begin once all plants have been installed at the restoration site. Repeat surveys will commence in July 2007 and continue on an annual basis for the first three years, then every other year through year 10. The survey will be conducted by City

of Bellingham staff and Washington Conservation Corps crew members with training in native and invasive plant identification.

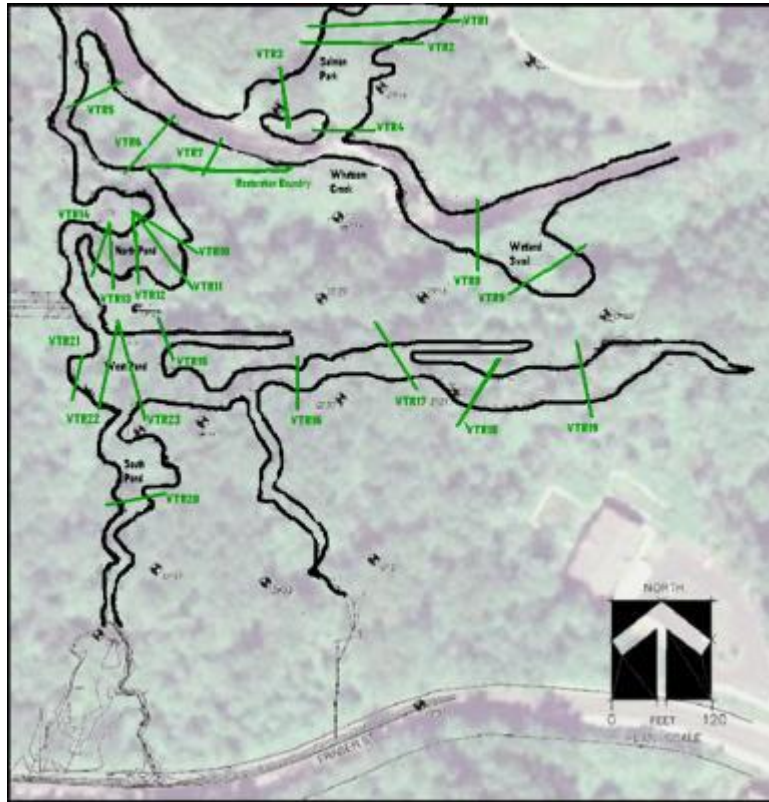


Figure 2. Vegetation survey transects for the Salmon Park and Cemetery Creek Project.

### Data Analysis:

The initial surveys will be used to document baseline conditions within each plot. Subsequent annual surveys will be compared to baseline data to document vegetation establishment and growth. This includes tracking of invasive species and survival of restoration plantings. Thresholds for the success criteria will be monitored.

### Success Criteria:

- Native tree and shrub species composition should not consist of greater than 10% (by area) of non-native/invasive plant species at the end of 10 years.
- Survival of plantings should be at least 75% at the end of three years and through the lifetime of the monitoring plan.

### Contingency:

- Any occurrence of invasive species that exceeds the threshold established will be met with an immediate response of control measures as identified by the City of Bellingham. Physical removal will be undertaken prior to consideration of herbicide use.
- Evidence that planted vegetation fails to meet expectations will trigger consideration by and implementation of additional restoration maintenance

activities by the City of Bellingham. Depending on the hypothesized reason for failure to meet success criteria, responses could include additional planting, soil amendments, herbivore exclusion, and/or focused stewardship efforts.

- Assumptions about appropriate plant species, transplantation locations, and property use will be applied in the redesign and implementation of additional restoration maintenance activities by the City of Bellingham.

### **References:**

Crawford, B. 2004. *Protocol for monitoring effectiveness of riparian planting projects*. Report MC-3, Washington Salmon Recovery Funding Board, Olympia, Washington.

## **2.2. Fish Community**

Monitoring of the fish community in the Salmon Park and Cemetery Creek restoration areas will focus on two life history stages. Use of the areas for spawning by adult anadromous salmonids will be evaluated by walk-through spawning surveys. Habitat utilization by juvenile salmonids and other native fishes will be evaluated using a combination of smolt-trapping and seine netting.

### **2.2.1. Spawner surveys**

**Objective:** Confirm that habitat within the restoration area is being used for salmonid spawning.

### **Parameters Measured:**

- Number of live fish
- Number of carcasses
- Number of redds

### **Methods:**

Spawning surveys will be conducted to assess spawning habitat use. Monitoring will cover the reconstructed stream channels of Cemetery Creek and one undisturbed channel segment upstream of the South Pond. The survey will enumerate the number of live fish, carcasses and redds, by species. Surveys will be conducted following the methodology used by NSEA with some adaptation. The survey will commence at the downstream end of the project area and will cover each tributary stream within the project area. Spawning surveys will be conducted from September through March each season, repeated at seven to ten day intervals. Survey timing may be adjusted based on run time, but at least one survey will be conducted prior to the beginning of spawning each year to ensure complete run coverage. The survey will be completed by trained COB and WCC staff.

Live fish will be identified to species (if possible) and observed to determine if the fish is building or guarding a redd. Redds will be associated with a species (if possible) and marked with flagging denoting the survey date and location. Carcasses will be identified

by species (if possible) and assessed to determine whether eggs or milt has been released. If there is a large amount of either it is noted that the fish died before successfully spawning. The caudal tail is then cut off or cut partially to indicate that the carcass has been counted.

### 2.2.2. Juvenile rearing in ponds and streams

**Objective:** Document seasonal use of constructed habitats by juvenile salmonids.

**Parameters Measured:**

- Species
- Size class
- Cemetery Creek flow
- Cemetery Creek stage
- Water temperature

**Methods:**

Use of the pond and stream network for rearing habitat by juvenile salmonids will be monitored using a smolt trap. The smolt trap will be installed on the Cemetery Creek mainstem downstream of the restoration site (Figure 3).

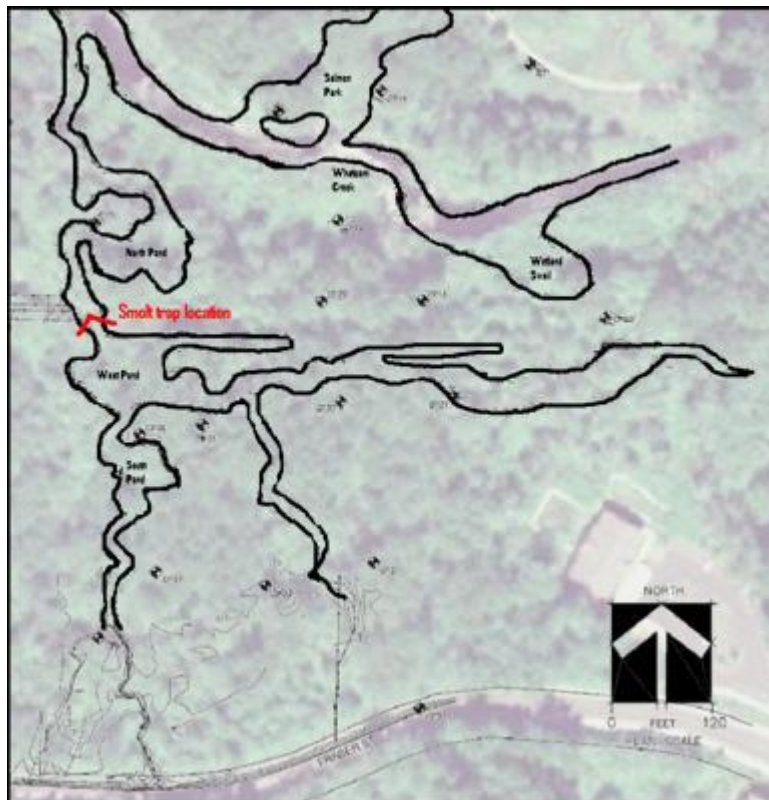


Figure 3. Location of smolt trap for the Salmon Park and Cemetery Creek monitoring.

The smolt trap will be used to enumerate the species and number of juvenile salmon outmigrating to Whatcom Creek. Smolt trap surveys will be conducted following the methodology used in “Relationship of salmonid outmigration to environmental factors in a disturbed, urban stream, Squalicum Creek, WA” (Mark Downen, 1999, pg. 27-30), with some adaptation. A stream wide smolt trap will be built in accordance to the WDFW design. The trap consists of a V-shaped corral that would point downstream. The structure funnels fish into the vertex and box while allowing flow to continue downstream. The holding box is used so fish can be safely held onsite until they are identified and then released. An upstream trap/pipe will be installed to allow passage of spawning fish. The traps will be checked daily monitoring at which time fish intercepted by the trap will be identified and counted, debris cleared, and trap assessed for damage. Smolt traps will be checked twice daily and may require more frequent monitoring and modification during storm events. Data will be collected from March 15 through May 31. This will be done annually in years 1, 3, 6 and 10. The survey will be conducted by trained COB and WCC staff member or qualified contractors, assisted by volunteers from the Northwest Indian College and Lummi tribe.

### **References:**

Downen, M.R. 1999. *Relationship of salmonid outmigration to environmental factors in a disturbed, urban stream, Squalicum Creek, WA*. Master’s Thesis. Western Washington University, Bellingham, Washington, 187 p.

### **2.2.3. Juvenile rearing in backwater habitats**

#### **Parameters Measured**

- Species
- Size class
- Whatcom Creek flow (from Dupont Street gauge)
- Water temperature

#### **Methods**

Use of backwater habitats by juvenile salmonids will be assessed qualitatively by seasonal seining. Backwater habitats represent limited areas and are consistently less than 1-meter deep. Seine netting will be conducted using the “small net” beach seining methodology (Skagit System Cooperative Research Department, 2003). A 2-m by 20-m net with 1/8 inch knotless nylon mesh will be utilized. The net will be set in “round haul” fashion, fixing the downstream end on the downstream end of the backwater habitat and sweeping the upstream end through the backwater, returning to the shore in a ½ circle. Three passes will be conducted at each backwater.

Fish collected in the seine net will be immediately transferred to holding containers equipped with portable aeration devices. Fish will be identified to species and classified by size as follows:

- 0-50mm
- 50-100mm
- 100-200mm

- 200mm

After measurement fish will immediately be returned to Whatcom Creek at least 20 meters downstream of the backwater habitat.

### **Data Analysis**

Data collected from the baseline conditions and confirm use of the restoration site by salmonid species. The annual surveys will be compared to baseline data collected during the design and construction phase to illustrate changes in composition, specific habitat use activity, and to identify general trends in fish numbers. Data may also be correlated to the results of water quality monitoring and other in stream habitat assessments.

### **Success Criteria**

- Resident and anadromous fish utilize all features of the restoration site for migration, spawning and rearing.

### **Contingency:**

- Failure to meet the fish success criteria will trigger a re-examination by the Trustees of the project design, implementation, and site management. Failure could indicate problems associated with riparian vegetation, hydrologic regime, water quality, harvest management, sedimentation, or other disturbance factors unrelated to the project site.
- Additional maintenance alternatives will be defined and agreed upon by the Trustees, followed by the implementation of the accepted design by the City of Bellingham.

### **References:**

Skagit System Cooperative Research Department. March 2003. *Estuarine Fish Sampling Methods*. Available at: [http://www.skagitcoop.org/documents/EB1592\\_SSC\\_2003.pdf](http://www.skagitcoop.org/documents/EB1592_SSC_2003.pdf).

## **2.3. Aquatic Macroinvertebrates**

**Objective:** To document colonization and survivorship by the macroinvertebrate community in ponds and reconstructed channels in the restoration site.

### **Parameters Measured:**

- Community composition
- Functional feeding groups
- Taxa abundance
- Species richness and abundance

### **Methods:**

The macroinvertebrate community will be monitored to assess health of community and habitat use, while providing a possible indicator for water quality. Macro invertebrate samples will be collected from riffles within the reconstructed Cemetery Creek channel,

and in one undisturbed tributary draining to the ponds. and will measure community composition, abundance and richness of taxa/species, and functional feeding groups.

Macroinvertebrate sampling of Cemetery Creek and tributaries within the project area will follow the methodology found in “Benthic Macroinvertebrate Biological Monitoring Protocols for Rivers and Streams” (Plotnikoff and Wiseman, 2001), with some adaptation. Three substrate samples will be taken from riffles within each stream reach depicted in Figure 3. Samples will be collected using a D-frame Kick net with a 2.0 ft<sup>2</sup> delineation square. Rocks covering over half the stream will be brushed for collection and sediment disturbed to release a larger number of macroinvertebrates.

Samples will be kept separate and preserved in 85% ethanol. Replicates will be subsampled (500 count) and keyed to the lowest practical level as defined by Plotnikoff and White (1996). Data collection will begin in September 2007 and continue for a 10 year period. Macroinvertebrate sampling will be conducted annually for the first three years, then every other year through year 10. Sample collection will be conducted by trained COB and WCC staff, with processing being completed by the WWU Huxley IWS.

**Data Analysis:**

Biometric indices will be calculated for each site as follows:

- Taxa Richness
- EPT Index
- Percent by functional class
- Dominant Taxa

Data will be used to confirm site colonization by the macroinvertebrate community. The undisturbed tributary will be used as a reference site. Data collected in 2007 will be considered to represent baseline conditions. Analysis will begin with the creation of a species diversity list and then consolidation into more general taxa. This will provide species richness and abundance, while also assessing taxa abundance. Unidentifiable specimens that are damaged or immature are assumed to be representatives of the next highest taxonomic level. Correspondence can then be done with habitat and water quality information to assess overall health of the community. Data may also be used in an annual population trend analysis.

**Success Criterion:**

- Trends in community composition and structure, functional feeding groups, taxa abundance, species richness, and other indices should show improvement or remain stable over a 10-year post-construction period as compared to baseline population information.

**Contingency:**

- Failure to meet the macroinvertebrate success criteria will trigger a re-examination by the Trustees of the project design, implementation, and site

- management. Failure could indicate problems associated with riparian vegetation, hydrologic regime, water quality, sedimentation, and other disturbance factors.
- Additional alternatives will be defined and agreed upon by the Trustees, followed by the implementation of the accepted maintenance design by the City of Bellingham.

**References:**

Plotnikoff, R.W. and J.S. White. 1996. *Taxonomic laboratory protocol for stream macroinvertebrates collected by the Washington State Department of Ecology*. Pub. No. 96-323, Washington State Department of Ecology, Olympia, WA.

Plotnikoff, R.W. and C. Wiseman. 2001. *Benthic Macroinvertebrate Biological Monitoring Protocols for Rivers and Streams*. Pub. No. 01-03-028, Environmental Assessment Program, Olympia, WA.

## **2.4. Riparian & Terrestrial Wildlife Community**

Monitoring of the riparian and terrestrial wildlife community will focus primarily on amphibians and birds and will rely heavily on assistance by volunteers or students from Western Washington University (WU) to minimize costs.

### **2.4.1. Amphibians**

**Objective:** To document successful re-colonization of the restoration sites by amphibians.

#### **Parameters Measured**

- Species composition
- Species abundance
- Habitat Characterization Use

#### **Methods**

The amphibian community will be monitored to assess species composition and abundance. Surveys will focus on the three ponds and will consist of a combination of transects surveys of terrestrial environments and a perimeter survey of each pond to locate egg masses. Transect monitoring will follow “Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians” (Heyer et al., 1994) with some adaptations. Terrestrial habitats will be sampled along the same transects utilized for pond habitat monitoring (Section 3.1.1). Surveyors will randomly select the right or left bank of each transect for sampling by flipping a coin. A total of 20 transects will be surveyed each year (Figure 4).

Sample areas will be 5-meters wide, and will extend from the waters edge to one meter beyond the slope break. The amphibian survey will be completed by turning over objects



and sifting through leaf litter within each of the designated transects up to the water line. The transect search will be constrained to 20 minutes per transect. When an amphibian is found the species and transect location will be identified.

A perimeter search will be used to find and identify egg masses. The survey will be completed by walking along the water line for each pond and backwater with a 30 minute time constraint per pond. When an egg mass is found, species will be identified and location described and mapped. Survey will begin in March 2007 and will cover a four month period during each year monitoring is conducted. Sampling periods will be separated by at least 21 days to allow for site and time to allow seasonal activity to be triggered. Surveys will be conducted annually for years 1 through 3, then every other year through year 10. The data will be collected by trained COB and WCC staff, along with volunteers from WWU.

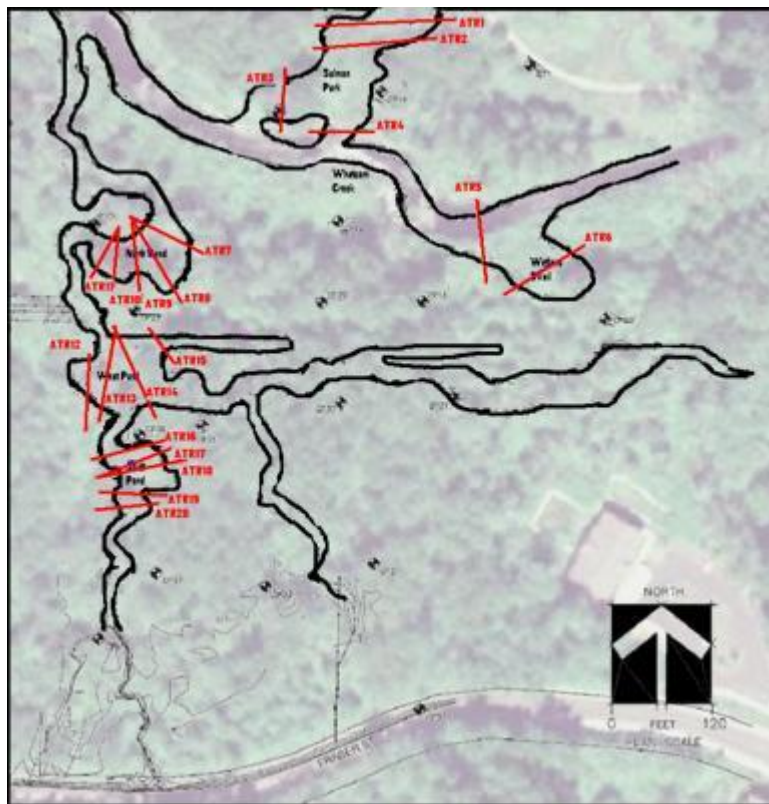


Figure 4. Location of amphibian monitoring transects for the Salmon Park and Cemetery Creek project.

### Data Analysis:

Data will be used to compile a list of amphibian species encountered at the restoration sites each year and will provide a quantitative description of restoration site use by amphibians.

**Success Criteria:**

- Presence and habitat utilization by native amphibian species at the restoration sites over the 10-year period following restoration construction.
- Absence of non-native species (i.e. bull frog) within the restoration site over the monitoring period

**Contingency:**

- If there is evidence that human use is causing disturbance that is detrimental to wildlife community, public access will be reviewed and limited.
- If bullfrogs or other nonnative predatory species are identified, a removal or control program may be implemented
- If habitat utilization by state-listed priority species is identified, sighting will be reported to the Priority Species and Habitats database and measures taken to protect these sites. Priority amphibian species likely to be found at the sites includes but is not limited to: western toad, red-legged frog, ensatina salamander.

**References:**

Heyer, W. R., M. A. Donnelly, R.W. McDiarmid, L.C. Hayek, and M.S. Foster (eds.). 1994. *Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians*. Smithsonian Institution Press, Washington, D.C.

**2.4.2. Avians**

**Objective:** To document avian use of the restoration areas.

**Parameters Measured**

- Species composition
- Species abundance

**Methods**

Avian monitoring will be used to assess composition and general abundance of bird species within the restoration site. Monitoring protocol will follow “Handbook of field methods for monitoring landbirds” (Ralph, 1993) with some adaptations. Point counts will be conducted at three sites within the project area that are separated by at least 200meters (Figure 5). Point counts will begin within 30 minutes after sunrise and will be completed no more than 5 hours after sunrise. Weather conditions should be calm, with no rain or high winds. Upon arriving at the sample site, observers will wait at least one minute before starting the count. Counts are conducted over a 3-minute interval, then repeated over a 6 minute interval (waiting at least one minute between counts). Birds will be identified by primary song, other calls, and sight. Within each interval observers tally every individual bird detected. Surveys will begin in April and be conducted monthly through June. Surveys will be conducted annually for three years, then every other year through year 10. Sampling periods will be separated by 30 days to allow for seasonal

activity to be triggered. The data will be collected by trained COB and WCC staff, along with volunteers from WWU and the Audubon Society, if available.

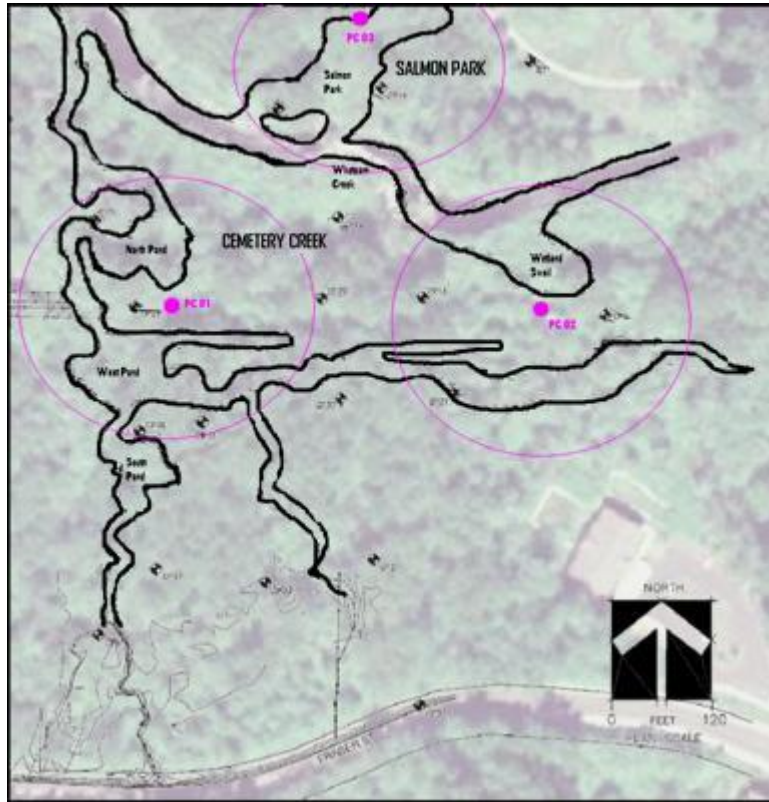


Figure 5. Location of avian point count sites for the Salmon Park and Cemetery Creek project.

### Data Analysis:

Point count surveys will provide a quantitative estimate of the species and number of birds present in the restoration area during the breeding season. Repeat surveys will be used to make annual comparison and signal significant general changes in avian use (e.g. decrease in woodpeckers, increase in raptors).

### Success Criteria:

- Presence and persistent habitat utilization by native avian species at the restoration sites over the 10-year period following restoration construction.
- Absence or continued low levels of non-native species (starling, house sparrow, brown cowbird, Canada goose).

### Contingency:

- If there is evidence that human use is causing disturbance that is detrimental to the avian community, access may be reviewed and limited.
- If habitat utilization by WA state and/or federal priority species is identified, sightings will be reported and measures taken to protect these sites. State-listed Priority avian species likely to be found at this site include, but is not limited to: pileated woodpecker, ruffed grouse, great blue heron, olive-sided flycatcher.

- If habitat utilization by non-native species is documented and believed to be interfering with priority species, WDFW will be notified.

### **References:**

Ralph, C. John, USDA. 1993. *Handbook of field methods for monitoring landbirds*. Gen. Tech. Rep. PSW-GTR-144-www. California: Pacific Southwest Research Station. Available at: <http://www.fs.fed.us/psw/publications/documents/gtr-144/publisher.html>.

### **2.4.3. Mammals**

**Objective:** Document use of the restoration area by mammals.

### **Parameters Measured**

- Species composition
- Species abundance

### **Methods**

Monitoring of mammals at the restoration sites will be qualitative and used primarily to document presence and to track damage of project components by wildlife if applicable. Monitoring use of the site by mammals will be integrated with other monitoring activities, and will consist of compilation of a list of species observed to be using the site. Observations that would document mammal use would include direct sightings, tracks, or browse patterns. If habitat utilization by state and/or federal priority species is identified, sightings will be reported and measures taken to protect these sites. Priority mammal species that may possibly be found at the sites include, but are not limited to: mountain beaver, northern flying squirrel, porcupine, black bear.

Instances of wildlife harm due to human disturbance or site degradation by invasive mammals (if any will also be noted). When wildlife is identified as causing damage, photos and a description of the impacts will be collected, and the information passed to the appropriate agency. WCC crews and staff working at the sites will be provided with a photo key of common wildlife species that would be likely to utilize habitats associated with the restoration sites.

The wildlife sighting list will be updated monthly starting December 2006. Sightings will be compiled for the duration of the 10-year monitoring period. An updated list and a description of key sightings (e.g. priority species, evidence of denning or breeding, damage) will be included in each annual monitoring report.

### **Data Analysis:**

Not Applicable

**Success Criteria:**

- Presence and habitat utilization by native mammal species at the restoration sites over the 10-year period following restoration construction.
- Absence of major site damage from mammals throughout the monitoring period.

**Contingency:**

- If there is evidence that human use is causing disturbance that is detrimental to wildlife community, public access will be reviewed and limited.
- If beaver, deer, or other mammals are identified as causing significant damage to habitat or water quality within the restoration area, a protection and deterrent program may be implemented.
- If habitat utilization by state-listed priority species is identified, sightings will be reported to the state Priority Species and Habitats database and measures taken to protect these sites.

## 3. Physical Monitoring

### 3.1. *Hydrology and Habitat*

#### 3.1.1. Ponds

**Objective:** Document that ponds and back water habitats maintain designed depth, volume, and cover characteristics for the duration of the monitoring period

**Parameters Measured:**

- Pond water surface elevation
- Depth
- Cover
- LWD

**Methods:**

Pond hydrology and habitat will be monitored within the three constructed ponds on Cemetery Creek. A staff gauge will be installed in each pond to facilitate tracking of fluctuations in pond water surface elevation (WSE). The staff gauge will be linked to the restoration site survey control network established by Interfluve during the design phase. Pond water surface elevation will be recorded seasonally during water quality sampling, and each time the site is visited for other monitoring tasks.

The survey will map depth of each pool across a series of five to six transects per pool (Figure 6). The WSE will be recorded at the start and end of each survey. Pond depth from the WSE will be measured at 0.5-meter intervals across each transect using a stadia rod. Subsequent surveys will be conducted at approximately the same WSE. If the WSE differs, depth measurements will be corrected for comparison to the original pond survey. Changes in pond depth will be tracked along each transect to determine whether the pond habitat is maintained, filling, or scouring.



Pond transects and GPS will be used to develop a schematic map of each pool. Large woody debris features will be sketched onto the pond schematic during the first surveys. The length, diameter and condition of each piece of LWD<sup>1</sup> will be recorded. Subsequent surveys will compare the original schematic to current conditions. Newly recruited pieces of large woody debris will be added to the database. Changes in previously mapped LWD due to breakage, decay or transport will be recorded.

Data collection will begin in January 2007 and be measured on an annual basis during the same month in year 2 and 3. Thereafter pond habitat will be assessed at two-year intervals through year 10. The survey will be conducted by trained City of Bellingham and Washington Conservation Corps staff.

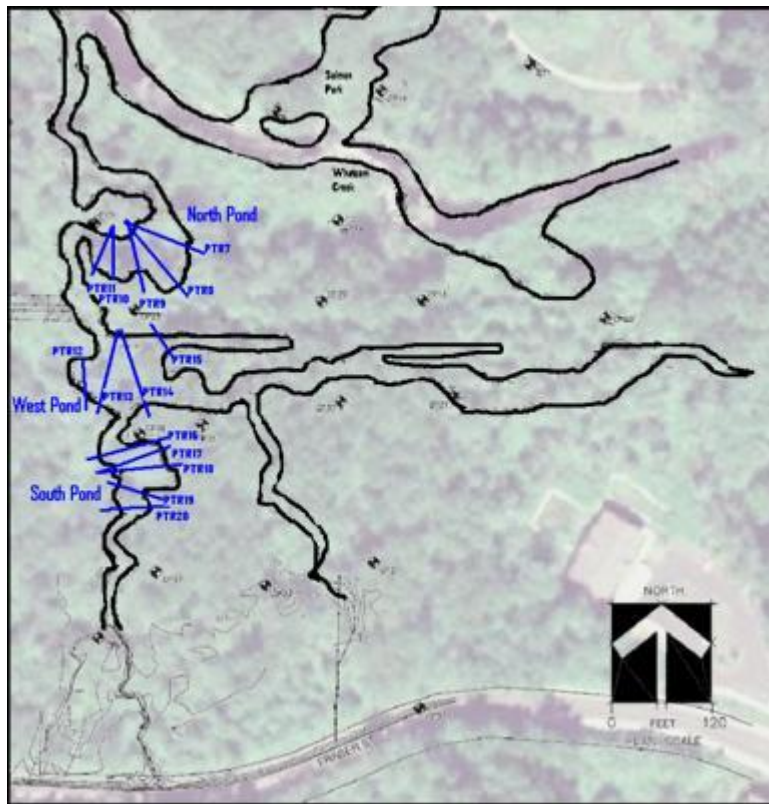


Figure 6. Pond transect locations at the Salmon park and Cemetery Creek restoration sites.

### Data Analysis:

Collected data will be used to characterize the hydrology and surrounding habitat of the ponds. Seasonal fluctuations in pond water surface elevation will be plotted for each year. Pond depths will be plotted for each transect to provide a visual representation of pond bathymetry. The net change in depth will be calculated for each transect by summing the change for each measurement point. Positive changes in depth will be considered

<sup>1</sup> Large Woody Debris (LWD) is defined as pieces of wood that are at least 2 meters (6.6 ft) long and 10 cm (4 in) in diameter at the smallest end (Schuett-Hames et al. 1999)

evidence that the pond is scouring. Negative changes in overall transect depth will be considered evidence that the pond is filling.

The schematic map of each pond and the current LWD distribution will be updated following each survey. A table of LWD loading and condition (i.e. decay class) will be produced for each survey. Placed LWD consists of large sound logs that were anchored in place, thus LWD loading is not anticipated to decline over the 10-year monitoring period.

**Success Criteria:**

- Created ponds maintain designed hydrologic and habitat forming functions such as seasonal wetted area, adequate cover, and structural stability
- Pond LWD loading remain constant or increase over the 10-year monitoring period.

**Contingency:**

- Failure to meet either of the physical criteria will lead to reexamination of original design and possible redesign.
- Additional maintenance alternatives will be defined and agreed upon by the Trustees, followed by the implementation of the accepted design by the City of Bellingham.

**References:**

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

**3.1.2. Stream Channels**

**Objective:** To document that reconstructed streams channels are functioning as designed and provide suitable habitat for salmonids

**Parameters Measured:**

- LWD
- Habitat Units (pool/riffle ratio)
- Substrate size distribution
- Thalweg Profile
- Channel cross section
- Bank stability

**Methods:**

Habitat mapping, LWD inventory and spawning availability will be completed for the entire length of stream channel within the restoration area. Habitat mapping will be conducted following the TFW Manuals for Habitat Unit Survey (Pleus et al. 1999), Level

2 Large Woody Debris Survey (Schuett-Hames et al. 1999) and Spawning Gravel Availability (Schuett-Hames et al. 1999) with some adaptation. Bank stability will be assessed by measuring the length and height of actively eroding areas. Bank stability will be assessed separately for each side of the channel.

Data collection will begin in January 2007 and will be repeated annually for the first three years, then every other year through year 10. Repeat surveys will be conducted at a consistent flow level (within  $\pm 10\%$ ) to facilitate between year comparisons. Habitat surveys will be conducted by trained City of Bellingham and Washington Conservation Corps staff or a contractor specializing in fisheries assessments.

Thalweg profiles and cross-sections will be surveyed to track changes in channel configuration. The profile survey will be conducted using EMAP protocols (Peck et al. 2001), with some adaptations. Surveys will be conducted using an autolevel and stadia rod or Total Station. Survey data will be linked to the control network established by Interfluve during project design. Thalweg measurement points will be established every 10 meters; additional points will be placed at major grade changes. The distance between thalweg survey points will be measured using a 50-meter fiberglass tape. A series of twelve cross-sections will be established covering each stream segment within the restoration area. The general location of cross-sections is depicted in Figure 6. Cross-section end points will be marked with wooden stakes, and located using GPS. Thalweg profiles and cross-sections will be re-surveyed annually for the first three years and every other year thereafter through year 10. Surveys will be conducted during the winter when visibility is enhanced due to leaf fall.

#### **Data Analysis:**

Habitat data will be summarized using simple statistics (mean, standard deviation, coefficient of variation) and compared to data from 2007. The following metrics will be calculated:

- Pool frequency (pools/100-m)
- Pool spacing (pools/channel width)
- Percent pool by length
- LWD frequency (pieces/channel width)
- Key piece frequency (pieces per channel width)
- Channel complexity (CV of thalweg depths)
- Spawning gravel area
- Unstable banks (length of actively eroding areas)

Between year data comparisons will be presented using tables and charts. Where appropriate habitat data will also be compared to relevant habitat condition diagnostics (i.e. WFPB 1997; NMFS 1999).

Plots of the thalweg profile and each cross-section will be generated for each survey. Data from previous years will be included on each plot to illustrate change over time.



**Success Criteria:**

Restored stream channels habitat features will maintain designed hydrologic and habitat forming functions such as pools, LWD loading, suitable spawning areas, and stable banks.

**Contingency:**

- The long-term effectiveness of restoration activities will be evaluated by comparing current values for each of the habitat metrics listed above to the values document in 2006 baseline surveys. The restoration will be considered a success from a physical standpoint the if the combined effect of natural processes and created habitat features has resulted in habitat metrics that have remained stable or improved over time.
- If deteriorating habitat conditions are observed, additional maintenance alternatives will be defined and agreed upon by the Trustees, followed by the implementation of the accepted design by the City of Bellingham.

**References:**

- National Marine Fisheries Service. August 1996. *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale*. Prepared by the Environmental and Technical Services Division, Habitat Conservation Branch.
- Peck, D.V.; Lazorchak, J.M.; Klemm, D.J., eds. 2001. *Environmental monitoring and assessment program—surface waters: Western pilot study field operations manual for wadeable streams*. Washington, DC: U.S. Environmental Protection Agency.
- Pleus, A.E., D. Schuett-Hames and L. Bullchild. June 1999. *TFW Monitoring Program: Method Manual for the Habitat Unit Survey*. Prepared for the Washington State Dept. of Natural Resources under the Timber, Fish, and Wildlife Agreement. TFW-AM9-99-003. DNR #105.
- Schuett-Hames, D., A.E. Pleus, J. Ward, M. Fox, and J. Light. June 1999. *TFW Monitoring Program: Method Manual for the Large Woody Debris Survey*. Prepared for the Washington State Dept. of Natural Resources under the Timber, Fish, and Wildlife Agreement. TFW-AM9-99-004. DNR #106.
- Schuett-Hames, D, A.E. Pleus, D. Smith. 1999. *TFW Monitoring Program: Method Manual for the Salmonid Spawning Habitat Availability Survey*. Prepared for the Washington State Dept. of Natural Resources under the Timber, Fish, and Wildlife Agreement. TFW-AM9-99-007. DNR #109.
- Washington Forest Practices Board. November 1997. *Standard Methodology for Conducting Watershed Analysis Manual*, Version 4.0. Available at: [http://www.dnr.wa.gov/ResearchScience/Topics/WatershedAnalysis/Pages/fp\\_watershed\\_analysis\\_manual.aspx](http://www.dnr.wa.gov/ResearchScience/Topics/WatershedAnalysis/Pages/fp_watershed_analysis_manual.aspx).

## **3.2. Water Quality**

### **3.2.1. Ponds**

**Objective:** Document that ponds provide suitable year round habitat conditions for native salmonids.

**Parameters Measured:**

- Water Temperature
- pH
- Dissolved Oxygen
- Conductivity

**Methods:**

Water temperature, pH, DO, and conductivity will be measured in situ on a monthly basis (spring, summer, fall winter) in each of the three Cemetery Creek ponds. Three water quality monitoring stations will be designated in each pond (Figure 7), creating nine sampling locations. Water quality parameters will be measured at 0.5 foot intervals across a vertical profile at each station. Survey stations will be spaced throughout each pond and will focus on the deepest areas in each pond. Water quality parameters will be measured using a Hydrolab, which reads each parameter simultaneously for each depth. The Hydrolab will be calibrated before each survey session, and audited before and after sampling to ensure data accuracy. Before measurement at each profile point the Hydrolab will be allowed to equilibrate by waiting for at least two minutes, or until DO has stabilized). Measurements and calibrations will be collected by trained COB and WCC staff.

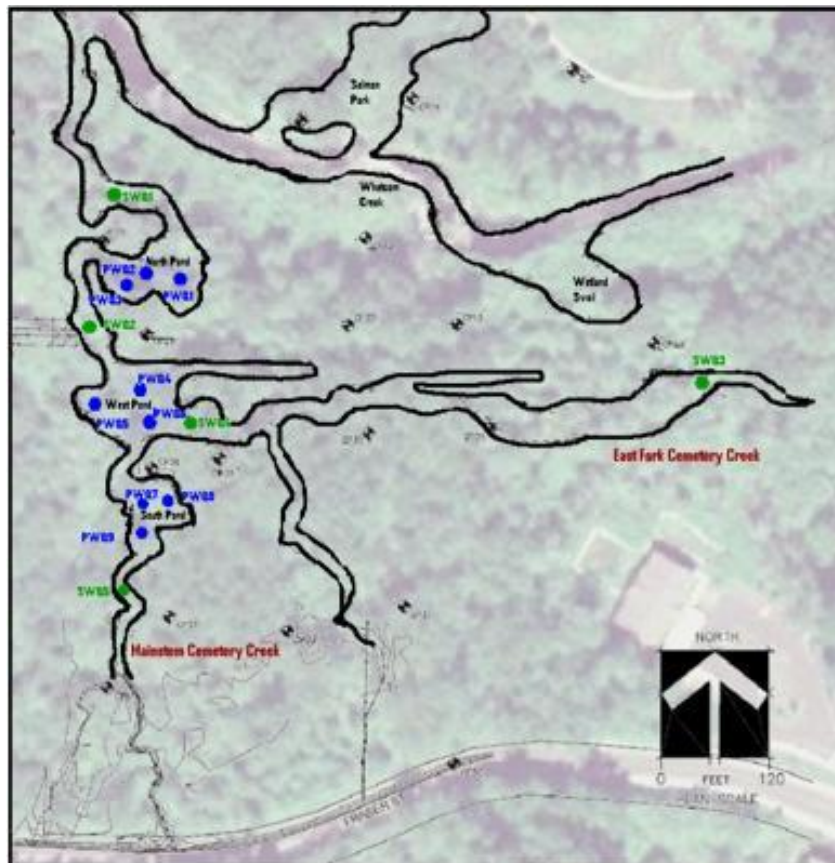


Figure 7. Approximate locations of pond and stream water quality monitoring stations at the Salmon Park and Cemetery Creek restoration sites.

**Data Analysis:**

Water temperature, pH, DO, and conductivity will be compared to current Washington State Water Quality standards. Parameters not meeting these standards will be noted. Comparison of each parameter will be done as additional data is collected. Seasonal water quality measurements will be plotted over time to identify temporal trends.

**Success Criteria:**

- Water temperature, pH, and dissolved oxygen in restoration sites will meet current Washington State water quality standards during the 10-year monitoring period

**Contingency**

- If any of the water quality criteria are not met, additional more intensive water quality monitoring may be initiated. Increased monitoring or other adaptive management measures will be determined in cooperation with the Trustees to determine the best course of action. Project design, maintenance, and current conditions would be reexamined

### 3.2.2. Streams

**Objective:** To ensure reconstructed streams meet minimum water quality criteria for Class A standards and create temporal documentation of water quality data.

**Parameters Measured:**

- Water Temperature
- pH
- Dissolved Oxygen
- Conductivity
- Fecal coliform

**Methods:**

Water temperature, pH, DO, and conductivity will be monitored monthly in each of the tributaries of Cemetery Creek within the Restoration Area. A total of five sampling sites were established, representing each stream (see Figure 7, above). Data will be collected from the middle of the stream so it is equally spaced top to bottom and side to side. Water quality parameters (with the exception of fecal coliform) will be measured in-situ using a Hydrolab, which will read each parameter simultaneously. The Hydrolab will be calibrated before each survey session, and audited before and after sampling to ensure data accuracy. Before measurement at each profile the Hydrolab will be allowed to equilibrate by waiting for at least two minutes, or until DO has stabilized. Fecal coliform grab samples will be obtained at each sampling station for fecal coliform analysis (Figure 8). Samples will be immediately stored on ice, and delivered to the City of Bellingham's Post Point Lab or other local state accredited water quality lab for analysis within 4-hours of sample collection. Measurements and calibrations will be collected by trained COB and WCC staff.

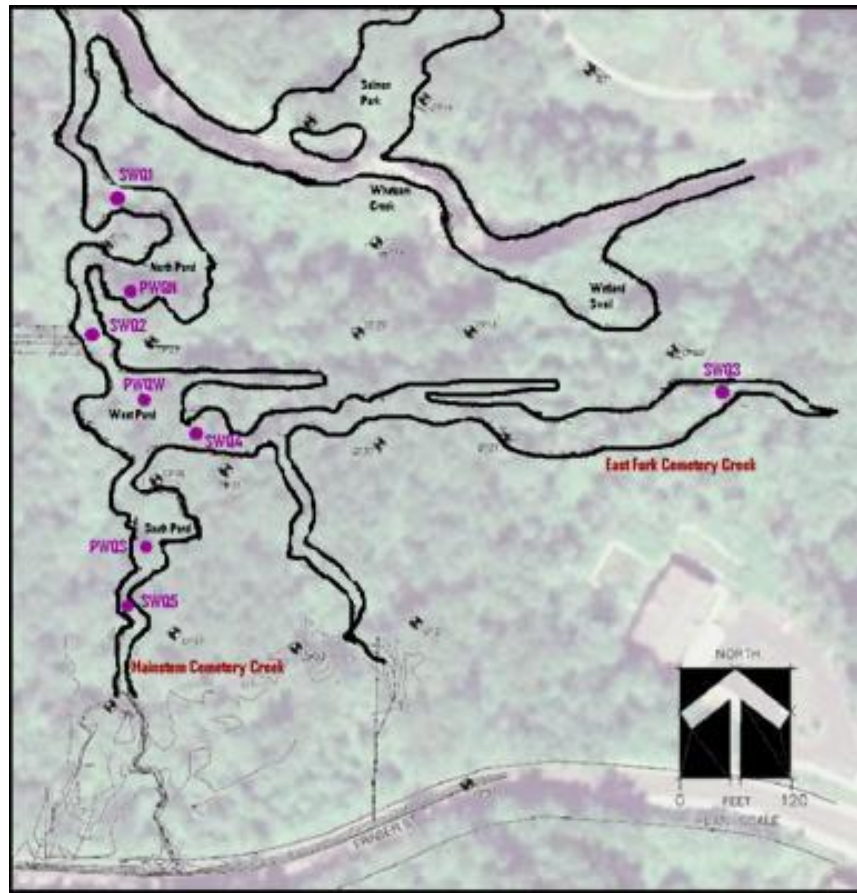


Figure 8. Approximate locations of fecal coliform grab sites at the Salmon Park and Cemetery Creek restoration sites.

**Data Analysis:**

Water temperature, pH, DO, conductivity and fecal coliform will be compared to current Washington State standards. Parameter not meeting these standards will be noted. Comparison of each parameter will be done as additional data is collected. Data will be analyzed to note changes or trends of parameters over time or space within the restoration area..

**Success Criteria:**

- Water temperature, pH, and dissolved oxygen in restoration sites will meet current Washington State water quality standards during the 10-year monitoring period

**Contingency**

- If any of the water quality criteria are not met, additional more intensive water quality monitoring may be initiated. Increased monitoring or other adaptive management measures will determined in cooperation with the Trustees to determine the best course of action. Project design, maintenance, and current conditions would be reexamined



## 4. Photodocumentation

**Objective:** Provide a visual record of habitat recovery within the restoration sites

**Parameters Measured:**

Temporal sequence of photos

**Methods:**

Permanent photo points will be established at 16 locations throughout the restoration project area (Figure 9). Photopoint locations will be selected to represent the range of habitat features within the project area. Each photopoint will contain an easily recognizable feature that could reasonably be expected to remain in place throughout the 10-year monitoring period. Photopoint locations will be documented using rebar or metal tags on trees or LWD. GPS coordinates will be collected at each site to facilitate future relocation.

Photos will be taken at each designated point using a digital camera. Photos will be taken during June (full canopy) and December (after leaf fall). Photodocumentation will commence in December 2006, and will be repeated twice annually for the first three years, then every other year through year 10.

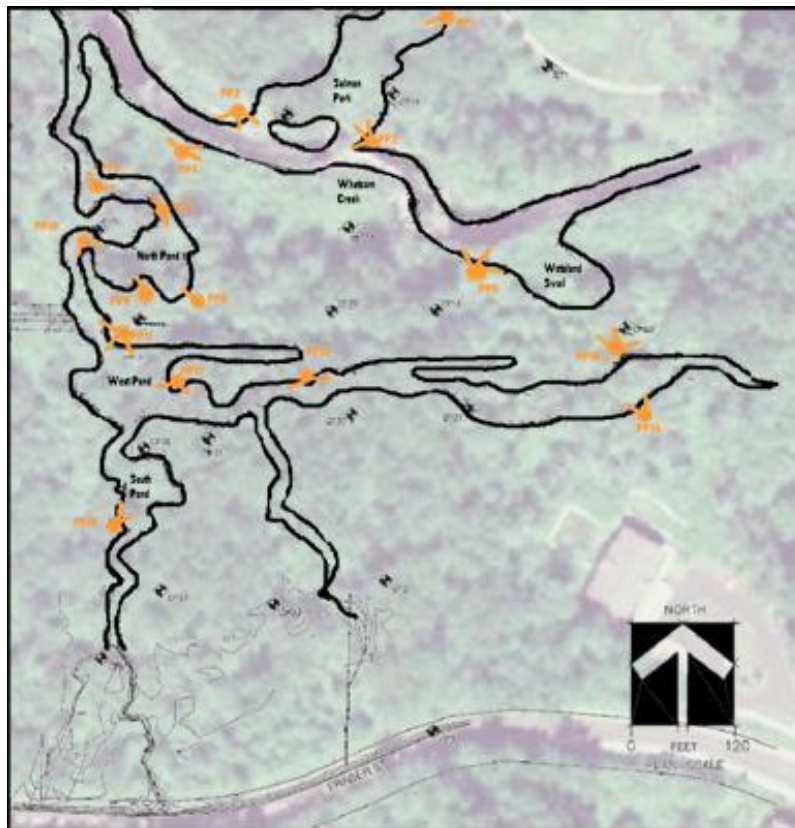


Figure 9. Location of permanent photo points established within the Salmon Park and Cemetery Creek restoration areas.

**Data Analysis:**

Temporal sequence of photos will be developed for each site depicting recovery over time.

**Success Criteria:**

Not applicable

**Contingency:**

Not applicable