I. Project Title **Logjam Restoration in the Stillaguamish Estuary / Port Susan Bay Large Wood Project**

II. Reporting Period 4/1/05 – 6/30/09

III. Project Narrative

The Stillaguamish estuary and Port Susan Bay were identified as a priority area for biodiversity conservation in the Willamette Valley-Puget Trough-Georgia Basin Ecoregional Assessment (Floberg et al. 2004) and represent a focal landscape-scale conservation area for The Nature Conservancy's Washington Field Office. The Stillaguamish estuary and Port Susan Bay support key nursery habitat for Dungeness and red rock crabs, English sole, starry flounder, and other species of groundfish. In addition, multiple species of salmon, including the ESA-listed Chinook as well as chum, pink, and coho, rely on the estuarine tidal marshes, channels, and flats for juvenile rearing and foraging. The Stillaguamish estuary offers critical habitat attributes for bull trout and other estuarine fishes, including migratory corridors with minimal impediments, permanent water of sufficient quantity and quality, and abundant food resources. Harbor seals, too, take advantage of the abundant food resources in the estuary, frequently hauling out at a state-documented site.

Although it supports great biological diversity and productivity, like most other estuaries, the Stillaguamish has experienced significant habitat loss and degradation due to human activities in the watershed (Collins 1997). Estuary restoration has been identified as a priority strategy for recovering threatened fish species (SIRC 2005) and improving the viability of other estuarine conservation targets (Fuller 2004). Watershed activities such as logging and bank armoring have dramatically reduced the delivery of very large wood to the estuary (Collins 1997). Large wood is thought to serve a variety of functions in the estuary, including modifying water velocities, trapping sediments, stabilizing shorelines, increasing habitat complexity, providing refuge for fish and invertebrates, and disturbing marsh vegetation; however, these functions have not yet been sufficiently well documented (Simenstad et al. 2003).

Two studies in coastal Oregon (van de Wetering 2005; Cornu et al. 2007) began to narrow this information gap, documenting links between estuarine large wood and habitat quality for juvenile salmon through targeted monitoring of fish, benthic invertebrates, and channel morphology. Results suggested that subtidal large wood provides locations of velocity refuge where juvenile salmon aggregate to hide and feed, particularly during low tides. In addition, large wood appeared to benefit fish indirectly by increasing the local density of benthic invertebrate prey. Large wood also created significant changes in channel morphology; however, the channels were highly dynamic and morphologic features changed after the large wood moved away from the sites.

To compensate for the reduced supply of large wood from modified watersheds in the Pacific Northwest, estuary restoration programs frequently incorporate the addition of large wood in project designs (Simenstad et al. 2003). However, the effect of large wood on fish use and fish habitat attributes of recovering tidal marshes remains a significant question. In fact, it was identified as a research question for demonstration projects by the Puget Sound Nearshore Partnership's (PSNP's) Nearshore Science Team (Gelfenbaum et al. 2006), as part of their effort to reduce uncertainties associated with restoration planning in Puget Sound. The PSNP is charged with developing a science-based plan to restore and protect nearshore ecosystems in Puget Sound, requiring that they not only design large-scale restoration programs but also coordinate and prioritize individual restoration and protection projects. The PSNP currently recommends implementing demonstration projects and incorporating hypothesis-based research and monitoring into the design of existing restoration projects (Gelfenbaum et al. 2006). The results of these activities can then be included in tools developed by the PSNP to evaluate outcomes of proposed actions and make better informed restoration decisions (Fresh et al. 2004).

This project evaluated the response of intertidal channels in the Stillaguamish estuary to large wood placed for the purpose of enhancing juvenile salmon rearing habitat. In August 2007, we experimentally placed large wood in two intertidal channels to enable testing of the following hypotheses: 1) large wood promotes estuarine habitat attributes that are beneficial to juvenile salmonids and other fishes, including areas for low tide refuge and areas of new tidal marsh development, and 2) large wood of greater size and complexity induces greater habitat response. We also monitored the wood complexes for large and small scale movements.

IV. Methodology

The originally funded project aimed to implement a low-cost, low-impact method for catalyzing the natural formation of estuarine logjams as part of the watershed's estuary restoration plan for Puget Sound salmon recovery (SIRC 2005). The project was based on several hypotheses: 1) logjams historically occurred in the estuary and functioned to stabilize channels, accrete sediments, and promote marsh development, 2) large wood currently entering the estuary is too small to remain in place and form logjams, and therefore 3) channels are currently unstable and the marsh has little opportunity for expansion.

Because few studies have actually documented the ecological functions of large wood in estuaries (Simenstad et al. 2003), at the suggestion of our local NOAA Restoration Ecologist, we gathered and synthesized a variety of information to test the rigor of our hypotheses and restoration design prior to implementation. This effort included the collection and analysis of three years of data on naturally occurring large wood at the river mouth, reported on by Selleck (2006). This study found that smaller and less complex wood generally decreased in abundance along Hat Slough, but that large wood (> 2 ft diameter) appeared to be more stable. There was also apparent progression in channel and marsh development that may have been associated with the large quantity of wood deposited in 2003. Thus, the monitoring report provided anecdotal evidence that estuarine LWD may currently be associated with certain geomorphic features that support estuarine fishes, including distributary channels, blind tidal channels, and nascent marshes. Given these findings, the restoration project was redesigned to experimentally test 1) whether large wood promotes the formation of geomorphic features that are beneficial to juvenile salmonids and other fishes and 2) whether large wood size and complexity affects the size of geomorphic response. Our project focused on monitoring changes in channel morphology as a surrogate parameter for sediment accretion and erosion processes, as suggested by NOAA's Minimum Monitoring Program (Cereghino 2004).

Large Wood Enhancement

On August 28, 2007, The Nature Conservancy enhanced estuarine rearing habitat for juvenile salmonids by placing a total of 26 pieces of large woody debris in two intertidal channels north of Hat Slough in the Stillaguamish River estuary (Fig. 1). Large wood was placed in the intertidal channels in six small complexes of two to seven pieces each. Concrete anchors were used to help keep the wood in place, with roughly one anchor for every two logs in a complex.

We accumulated large wood in a staging area south of two sheds in the diked uplands of the Port Susan Bay Preserve. Due to the lift capacity of the contracted Boeing Vertol 107-II helicopter, the maximum weight of each log was limited to 8,500 lb. Logs ranged in breast-height diameter from 16 to 34 inches (with nine logs measuring 16–22 in, eight logs 23–24 in, and nine logs 27–34 in) and in length from 14 to 40 feet, with large diameter logs generally measuring 14–29 ft and smaller diameter logs 30–40 ft.

Twelve 1,200-lb concrete ballasts, each with an exposed rebar hook, were constructed and delivered to the staging area. The ballasts were designed to be of sufficient quantity and weight to withstand anticipated hydraulic forces in the placement sites, based on best professional judgment and standard buoyancy calculations. The ballasts were shaped to fully embed themselves into the sediment when dropped by a contracted helicopter from an altitude of approximately 200 ft.

To the extent possible, all materials and supplies were prepared to facilitate efficient project implementation. Logs were pre-drilled with 1-in diameter holes at all connection points, which were visibly marked with fluorescent paint. The $^{5}/_{8}$-in galvanized cable to be strung through the drilled holes was pre-cut into 15- and 40-ft lengths. Cables, clamps, tools, and other supplies were organized by channel and complex for ready access in the field. Finally, the placement sites and ballast drop sites were visibly marked with PVC poles and fluorescent flagging.

The project was fully implemented during one six-hour low tide work window. The contracted helicopter arrived in the staging area, along with pilots, mechanics, field crew, fuel truck, choker cables, and other supplies. Two six-member ground crews departed for the easternmost placement sites while the field crew prepared each ballast and log for lifting. The first helicopter lift transported two containers of tools and supplies from the staging area to the central placement site of each channel. To embed the concrete ballasts into the channel bottom, the helicopter then dropped the twelve ballasts, working from east to west and alternating between channels. As ballasts were successfully dropped, the ground crews strung them with lengths of 40-ft cable and laid out the two cable ends. Once all the ballasts were in place, the helicopter transported and placed the logs, working west to east and alternating between channels. As logs were placed, the ground crews strung cables through the pre-drilled holes and applied clamps to prevent the cables from backing out. As log connections were completed, ground crews cinched the cables as tight as possible and secured them with several clamps. This initial securement moved quickly to keep pace with the helicopter. Once all the complexes were in place and initially secured, the ground crews returned to each complex and as necessary repositioned individual logs, drilled new holes, and cinched cables tighter. This secondary securement continued until all the complexes were complete, before the incoming tide reached the placement channels. Remaining tools and supplies were then transported back to the staging area by the ground crews.

Large Wood Monitoring

The wood complexes were photographed and GPSed one day after their installation. Two numbered tree tags were attached to each log, one above the rootwad flare and the other near the cut end, and these served as markers for all GPS points. Conservancy staff periodically visited the wood placement sites over the first several months, to assess the overall soundness and stability of each complex and to take photographs from fixed reference points. From mid-December 2007 through mid-March 2008, local volunteers conducted biweekly site visits to photograph and visually inspect the complexes from multiple stations on the Conservancy's sea dike. The volunteers' photo monitoring was designed to document complex locations relative to one another and to enable early detection of major movements.

Large wood locations and orientations were documented again in April 2008 and April 2009, during ground-based elevation surveys. All GPS data were loaded into ArcView 9.3, and log polylines were digitized between the appropriate tags. To track wood movements, we computed the mean center of each complex and input these points into Hawth's Analysis Tools for animal movements.

Channel Monitoring

We employed a before, after, control, impact (BACI) monitoring design at two different scales to evaluate the geomorphic response to large wood placement. The *channel scale* split the placement channels into two zones: the impact zone including all three wood placement sites, and the control zone extending from the control plot to 120 ft upstream of the eastern placement site. The *site scale* included only the vicinity of each wood installation site and each upstream control site. These monitoring plots extended 15, 20, and 25 m upstream and downstream of the two-, four-, and seven-log complexes, respectively, and 10 m onto the marsh plain. The control plots measured 30 m along the channel and 10 m onto the marsh plain.

Boat-based bathymetric surveys were conducted at the channel scale by Snohomish County Surface Water Management staff in August 2007 and August 2008. Using a boat-mounted fathometer linked to an RTK GPS, water depth data were collected as the boat zig-zagged along the channel length. Water depth data were then converted to channel bed elevations based on the measured elevation of the water surface.

Ground-based surveys were conducted at both geographic scales using a survey-grade RTK GPS. Data were collected in July 2007, April 2008, and April 2009. Bankfull channel edges were delineated at the channel scale by marking spot elevations at the transition line between the marsh plain and the channel banks. Channel morphology was characterized at the site scale by creating a grid of points throughout each plot, with particular emphasis on the locations of topographic change.

All datasets were imported into ArcView 9.3. Point elevation data at the channel scale were used as mass points to generate triangulated irregular networks (TINs) for each channel. Polygons representing the bankfull channel edges were used as the TIN extents, and lines at the edges and middle of the boat paths were used as hard breaklines. The TINs were converted to floating grids for calculations of elevation change. Point elevations at the site scale were interpolated to raster layers using a smooth spline technique. Baseline data were subtracted from year one and year two datasets to calculate elevation change.

V/VI. Results / Monitoring and Maintenance Activities

Baseline ground- and boat-based monitoring of channel bathymetry were conducted in July and early August 2007. Wood complexes were installed in late August, enhancing approximately 0.5 miles (5 acres[1]) of intertidal channel habitat. During the following seven months, we qualitatively monitored the wood complexes for structural integrity and for initial ecological responses. Post-implementation ground-based surveys were conducted in April 2008 and April 2009, and boat-based surveys were conducted in August 2008. This final report serves to complete the project.

Large Wood Monitoring

All six of the wood complexes shifted in configuration, and four complexes moved more than 50 ft away from their original installation sites (Fig. 2, Table 1). The two-log complexes (NW2 and SE2) were the most mobile, traveling more than 200 ft on high tides and storm events. Both of these complexes were subsequently replaced in their tidal channels by Conservancy staff during high tides sufficient to float the logs. On the south channel, the seven-log complex (SM7) was pushed onto the marsh plain during a December 2007 storm event, and the four-log complex (SW4) moved onto the marsh plain after one of its ballast cables was cut during the winter of 2008-09. The four- and seven-log complexes on the north channel (NE4 and NM7) experienced the least movement and remain within the tidal channels near their original installation sites.

Table 1. Summary of wood complex movements over two years.

Complex Name	*Year 1 Movement* Distance (ft)	Compass Bearing (deg)	*Year 2 Movement* Distance (ft)	Compass Bearing (deg)	Net Distance from Origin[a] (ft)
NW2	87	327	84	143	7[b]
NE4	37	359	9	293	41
NM7	31	24	12	93	37
SE2	212	351	140	202	116
SW4	27	22	25	19	52
SM7	70	10	16	119	67

a – Logs were GPSed one day after installation.
b – NW2 moved approximately 350 ft upstream of its installation site on the first high tide.

[1] Acreage was calculated in ArcMap using polygons to delineate edges of the channel banks throughout the large wood placement area.

Channel Monitoring

Channel Surveys

Our data suggest that the placement of large wood had minimal effect on channel morphology at the scale of the project area. Delineation of the channel banks was fairly consistent among years (Fig. 3). There was erosion of the north channel bank at complex NM7, but these changes were highly localized around the wood. Discrepancies along the north bank of the south channel are likely due more to human error and less to changes in the bank location, because the bank there gradually slopes from the channel bed to the marsh plain, with very little definition of the edge.

Baseline data for generating TIN layers included the NM7 and NE4 sites on the north channel and all impact and control sites on the south channel. Baseline elevations ranged from 0.6 to 6.5 ft NAVD88 (mean 3.7 ft) on the north channel and from 3.9 to 6.7 ft (mean 5.0 ft) on the south channel (Table 2). One year after wood placement, point data captured all sites on the north channel and the three upstream sites on the south channel (SM7, SE2, and SC0). The north channel ranged in elevation from 1.1 to 7.1 ft (mean 4.1 ft) and the south channel from 3.2 to 7.0 ft (mean 5.4 ft). Because the data extent differed for each channel in different years, analysis of elevation change was restricted to the areas of data overlap (Fig. 4). Mean channel elevations seem to have increased slightly (≤ 0.3 ft), particularly in the upstream control areas (Table 2). However, it is unclear that this change is in response to wood placement. For example, the south channel showed the greater difference between impact and control areas, but the two wood complexes (SM7 and SE2) were out of the channels (on the marsh plain) for seven months prior to data collection. Points of apparent sediment accretion and erosion (i.e., increases and decreases in elevation) were present throughout the channels, but no pattern relative to the wood complexes or the impact/control areas was evident.

Table 2. Mean (s.d.) elevation of intertidal channels before and after wood placement, and mean (s.d.) elevation change.

Channel	***Area***	***Baseline Elevation (ft NAVD88)***	***Year 1 Elevation (ft NAVD88)***	***Elevation Change (ft)***
North	Data Extent	3.7 (1.0)	4.1 (1.0)	
	Impact (Wood)	3.7 (0.9)	3.8 (0.9)	0.2 (0.7)
	Control	3.9 (1.2)	4.2 (1.2)	0.3 (0.9)
South	Data Extent	5.0 (0.4)	5.4 (0.6)	
	Impact (Wood)	5.0 (0.4)	5.2 (0.6)	0.0 (0.4)
	Control	5.2 (0.5)	5.5 (0.6)	0.3 (0.5)

Site Surveys

Where they remained within the tidal channel, wood complexes had substantial localized effects on channel morphology, and complexes of greater size and complexity generally induced greater habitat response (Fig. 5). Changes in channel morphology primarily included formation of pools around the wood and development of sandbars downstream. However, the channel bed was highly dynamic, and morphological features moved or nearly disappeared with shifts in the wood complexes.

In the first year of monitoring, four complexes remained at least partially within the channels: NW2, NE4, SW4, and NM7. The four- and seven-log complexes caused 1.5 to 2.5 ft of erosion under the wood structures, forming deeper pools in the channel bed. NW2 may have also caused up to 0.5 ft of erosion; however, this complex moved upstream soon after installation, and therefore, the post-implementation dataset was collected at a different location than the baseline. In addition, both four-log complexes modified the channel thalwegs, with the one in the north getting deeper and the one in the south gaining definition. Furthermore, NE4 induced 1.0-1.5 ft of sediment deposition downstream of the structure, forming an elevated sandbar, as well as 1.5-2.0 ft of deposition upstream. In contrast, monitoring sites without wood in the channels demonstrated very little (<0.5 ft) channel bed erosion and a more uniform accretion pattern, generally of less than 0.5 ft.

In year two, four complexes were at least partially within the channels: NW2, SE2, NE4, and NM7. The seven-log complex NM7 had moved little from the previous year, and sediment erosion/deposition patterns accumulated over time. The pool around the wood measured 20 x 35 ft in area and nearly 3.5 ft deep. The sandbar downstream was 20 x 50 ft and nearly 2.5 ft high. NE4 shifted slightly downstream from the previous year, and the new pool was 10 x 32 ft in area and 3 ft deep. Sediment accretion did not follow a clear pattern in the second year. The locations of the two-log complexes differed each year, and the sampling areas did not overlap much from year to year. Both complexes appeared to be forming shallow pools – one up to 15 x 40 ft in area at NW2, and one less discrete at SE2. Monitoring sites without wood generally demonstrated less erosion and more uniform accretion. However, in the control plot on the south channel (SC0), a lodged shrub created a 10 x 50 ft sandbar in the middle of the channel.

Lessons Learned

Many lessons have been learned and reported during the lifetime of this project, spanning the realm of giant lawn darts to helical screw anchors. The greatest challenges and opportunities of this project, however, fall into three general areas: 1) keeping large wood in place, 2) monitoring elevation change, and 3) assessing ecological benefits.

It was difficult to prevent the large wood from moving after it was placed in the intertidal channels of Port Susan Bay. Naturally occurring large wood was observed to remain stable at similar elevations; however, the conditions for its stability may be highly specific to arrival timing and location. After two years, only two of the six large wood complexes remained within 50 ft of their original installation sites. Due to logistical constraints and uncertainties during project implementation, only one concrete ballast was fully buried in the channel bed. The remainder were only partially embedded. The latter were generally capable of holding the buoyant wood complexes in place under normal tidal conditions. However, wind storm and freshwater flood events put great force on the floating complexes, causing most of them to lift and drag their ballasts during those events. Helical screw anchors were used one year after project implementation to better secure two of the wood complexes. They have proven effective as the only anchors on complex SE2, raising the question as to how well they would function to anchor the larger complexes. The screw anchors were easy to install using inexpensive, multi-purpose supplies. In addition, they can theoretically be adjusted, or even moved, in the future if channel conditions change. Looking to the future, it is inevitable that the structural integrity of the complexes will eventually begin to degrade. As such, a long-term adaptive management plan should be developed to inform future monitoring and maintenance activities.

It was challenging to identify an elevation monitoring program appropriate to the scale of anticipated changes. The boat-based surveys seemed appropriate for characterizing broad-scale changes in channel bathymetry. Side-scan sonar could have potentially provided better coverage than the point data; however, this equipment is more expensive and requires greater water depths for coverage of the entire channel. For fine-scale changes in morphology, many estuary and stream channel monitoring protocols utilize ground-based cross-sectional transects at particular locations. However, we did not know the exact location of wood complexes during our baseline data collection, and unless transects were spaced closely together, there was a high likelihood that transects could miss the locations of greatest change. Thus, to document fine-scale changes, we chose to develop grids of points at each placement site based on topographic features observed in the field. This approach worked relatively well for capturing elevation changes larger than 6 x 6 ft. However, some apparent changes in the GIS layers may be due to 1) differences in the location and density of data points or 2) byproducts of the point interpolation method rather than true on-the-ground differences. The first type of error might be reduced by incorporating standardized data collection locations and densities into the flexible data collection protocol based on actual features. In addition, the ground-based monitoring was somewhat time-intensive, requiring five long days in the field each year for two people. Now that the wood complexes are in place, it may be possible to switch to a less intensive, cross-sectional transect monitoring approach. Transects for previous years could be digitized in ArcView, and the elevations populated using existing elevation points.

The benefits of large wood on fish use and fish habitat attributes in recovering tidal marshes remain in question, and the answer may depend on the scale of ecological benefits desired. We documented the formation of large pools immediately surrounding the large wood, and these pools were observed to be utilized by estuarine fishes. The pools appear to be beneficial as thermal refuges during summer low tides, and could potentially be beneficial additions to channel complexity during other parts of the year. If the limiting factor to fish use of estuarine habitats is determined to be reduced channel complexity, then the addition of large wood to channels and the enhancement of small-scale complexity is likely beneficial. If, however, the limiting factor is determined to be extensive habitat loss, then addition of large wood to channels, even at a broad scale, may not be worthwhile. Given the uncertainties surrounding wood stability and morphologic feature retention, greater long-term benefits to fish habitat could likely be achieved through traditional habitat restoration.

VII. Community Involvement

Enhancing wood functions in the estuary is a priority for the Stillaguamish Implementation Review Committee (SIRC), the local community-based council that is charged with overseeing voluntary habitat restoration projects in the watershed. This project pilot-tested one approach and characterized the resultant habitat benefits, such that lessons learned can inform future restoration projects in the Stillaguamish and other watersheds. Two SIRC members contributed significantly to the project: Snohomish County Surface Water Management and the Stillaguamish Tribe Natural Resources Department. As described above, Snohomish County collected and processed bathymetric data for the placement channels both before and after project implementation. In addition, County staff provided guidance on implementation techniques and sequencing, based on lessons learned during their upstream wood enhancement

XI. References Cited

Cereghino, P. 2004. NOAA Damage Assessment and Restoration Center, Seattle, Washington, written communication.

Collins, B. 1997. *Effects of land use on the Stillaguamish River, Washington, ~1870 to ~1990: Implications for salmonid habitat and water quality and their restoration*. Report to The Tulalip Tribes, Snohomish County, Stillaguamish Tribe, and Washington State Department of Ecology. University of Washington, Seattle.

Cornu, C., S. van de Wetering, R. French, A. Gray, J. Lemke, M. Koehler, and B. Miller. 2007. *Effectiveness monitoring for LWD placement in South Slough tidal wetlands*. Final report submitted to the Oregon Watershed Enhancement Board.

Floberg, J., M. Goering, G. Wilhere, C. MacDonald, C. Chappell, C. Rumsey, Z. Ferdana, A. Holt, P. Skidmore, T. Horsman, E. Alverson, C. Tanner, M. Bryer, P. Iachetti, A. Harcombe, B. McDonald, T. Cook, M. Summers, D. Rolph. 2004. *Willamette Valley-Puget Trough-Georgia Basin Ecoregional Assessment, Volume One: Report.* Prepared by The Nature Conservancy with support from the Nature Conservancy of Canada, Washington Department of Fish and Wildlife, Washington Department of Natural Resources (Natural Heritage and Nearshore Habitat programs), Oregon State Natural Heritage Information Center and the British Columbia Conservation Data Centre.

Fresh, K., C. Simenstad, J. Brennan, M. Dethier, G. Gelfenbaum, F. Goetz, M. Logsdon, D. Myers, T. Mumford, J. Newton, H. Shipman, C. Tanner. 2004. *Guidance for protection and restoration of the nearshore ecosystems of Puget Sound.* Puget Sound Nearshore Partnership Report No. 2004-02. Published by Washington
Sea Grant Program, University of Washington, Seattle, Washington. Available at http://pugetsoundnearshore.org.

Fuller, R.N. 2004. *The Greater Skagit Delta Biodiversity Assessment and Conservation Plan*. The Nature Conservancy, Mount Vernon, Washington.

Gelfenbaum, G., T. Mumford, J. Brennan, H. Case, M. Dethier, K. Fresh, F. Goetz, M. van Heeswijk, T.M., Leschine, M. Logsdon, D. Myers, J. Newton, H. Shipman, C.A. Simenstad, C. Tanner, and D. Woodson, 2006. *Coastal Habitats in Puget Sound: A research plan in support of the Puget Sound Nearshore Partnership.* Puget Sound Nearshore Partnership Report No. 2006-1. Published by the U.S. Geological Survey, Seattle, Washington. Available at http://pugetsoundnearshore.org.

Selleck, J.R. 2006. *Characteristics of large woody debris in the Hat Slough distributary channel of the Port Susan Bay Preserve: Results from 2004-2006 monitoring data.* The Nature Conservancy, Seattle, Washington.

Simenstad, C.A., A. Wick, S. Van de Wetering, and D.L. Bottom. 2003. Dynamics and ecological functions of wood in estuarine and coastal marine ecosystems. Pages 265-277 in S.V.

Gregory, K. Boyer, and A. Gurnell, editors. *The Ecology and Management of Wood in World Rivers.* American Fisheries Society Symposium 37. Bethesda, Maryland.

Stillaguamish Implementation Review Committee (SIRC). 2005. *Stillaguamish Watershed Chinook Salmon Recovery Plan.* Snohomish County Department of Public Works, Surface Water Management Division, Everett, Washington.

Van de Wetering, S. 2005. Confederated Tribes of Siletz Indians, Siletz, Oregon, personal communication.

NOAA Restoration Center

Community-based Restoration Program (CRP)

Project Data Form

OMB Approval No. 0648-0472
Expires 03/31/2008

CONTACT INFORMATION

Contact Name: **Danelle Heatwole**

Contact Title: **Estuarine Ecologist**

Organization (Grantee): **The Nature Conservancy**

Street Address: **1917 First Ave**

City: **Seattle** State: **WA** Zip: **98101**

Phone: **206.343.4345 x393** Fax: **206.343.5608**

E-mail: **dheatwole@tnc.org**

Organization website (if applicable): **http://www.nature.org/washington**

PROJECT INFORMATION

Project Title: **Logjam restoration in the Stillaguamish estuary**

Project Award Number: Project Reporting Period: **4/1/05 – 6/30/09**

Project Location

City: **Stanwood**

County: **Snohomish** State: **WA** Zip Code: **98292**

Congressional District(s): **2nd District**

Landmark (e.g. road intersection, beach): **Port Susan Bay**

Land Ownership (check one): Public: Private: **X** Both:

Geographic Coordinates (in decimal degrees)

Longitude (X-coord): **48°12′08″ N**

Latitude (Y-coord): **122°22′16″ W**

Are there multiple project sites for this award?* Yes No **X**

River Basin: **Stillaguamish**

Geographic Identifier (e.g. Chesapeake Bay): **Puget Sound**

Project Start Date: **04/01/05** Project End Date: **6/30/09**

Project Volunteers

Number of Volunteers: **19** Volunteer Hours: **171**

* If multiple project sites are part of the same award, please duplicate this form and submit required information for each site

Brief Project Description** (1-2 sentences) **describing project and what it hopes to accomplish:
Large woody debris is frequently used as a component of estuary restoration projects, based on the assumption that it not only provides refuge areas for juvenile salmonids but also contributes to channel formation, sediment retention, and marsh development. This project will experimentally place large woody debris in the Stillaguamish estuary to scientifically evaluate the geomorphic benefits of alternative wood sizes and complexities.

List of Project Partners and their contributions (e.g. cash, in-kind, goods and services, etc.)
Snohomish County Public Works collected and processed bathymetric data for the placement channels both before and after project implementation. In addition, County staff provided guidance on implementation techniques and sequencing, based on lessons learned during their upstream wood enhancement projects. The Stillaguamish Tribe Natural Resources Department advised the Conservancy on project design and implementation planning, and because of their advanced knowledge about the project and the project site, they were eventually contracted to lead one of the ground crews during project implementation.

If permits are required, please list the permits pending and those acquired to date:
Acquired permits:
- Hydraulic Permit Approval from WA Department of Fish and Wildlife
- Nationwide Permit 27, including concurrence from NOAA and USFWS on compliance with Section 7 of the Endangered Species Act and Essential Fish Habitat, and concurrence from the Washington Department of Archaeology and Historic Preservation on compliance with Section 106 of the National Historic Preservation Act.

Acquired exemptions:
- 401 Water Quality Certification and Coastal Zone Management Consistency Determination from WA Department of Ecology
- State Environmental Policy Act (through Streamlined Process for Fish Habitat Enhancement Projects)
- Snohomish County Development and Planning permits (through Streamlined Process for Fish Habitat Enhancement Projects)
- Private Aids to Navigation

RESTORATION INFORMATION- Please complete this section to the best of your ability. Information below will be confirmed via site visit or phone call by NOAA staff before the close-out of an award.

List the habitat type(s) and acres restored/enhanced/protected or created to date (cumulative) and remainder to be restored/enhanced/protected or created (projected) with CRP funds by the end date of the award. If the project restores fish passage, list the stream miles opened upstream and downstream for fish access. Actual and Projected columns should add up to the total(s) for acreage to be restored with CRP funds indicated in the approved proposal.

Habitat Type (e.g. tidal wetland, oyster reef, mangrove)	**Actual Acres Restored** (To date- cumulative)	**Projected Acres** (i.e. Remainder to be restored with CRP funds by award end date)	**Actual Stream Miles Opened for Fish Access**	**Projected Stream Miles Opened for Fish Access** (i.e. Remainder to be restored with CRP funds by award end date)
Large wood	**0.2**			
Tidal channel	**5**			

What indirect benefits resulted from this project? (e.g. improved water quality, increased awareness/stewardship):

The project has provided opportunities to interact with the Stillaguamish watershed council and to hone relationships with particular members of the watershed council, including Snohomish County Public Works and the Stillaguamish Tribe Natural Resources Department. The project has also increased our collaboration with restoration practitioners at the South Slough National Estuarine Research Reserve in Charleston, Oregon. Visitors to the Port Susan Bay Preserve have learned about the project as well as the broader context of large wood in estuaries.

List of species (fish, shellfish, invertebrates) benefiting from project (common name and/or genus and species):

1. **Chinook salmon**
2. **coho salmon**
3. **chum salmon**
4. **sea run cutthroat trout**
5. **bull trout**
6. **forage fish**
7. **English sole**
8. **dunlin**
9. **western sandpiper**
10.

MONITORING ACTIVITIES

List of monitoring techniques used (e.g. salinity, fish counts, vegetation presence/absence):

1. **large wood, individual size**
2. **large wood, abundance**
3. **large wood, GPS location**
4. **large wood, photo**
5. **intertidal channels, GPS location**
6. **intertidal channels, GPS bathymetry**
7. **intertidal channels, photo**
8. **fish, presence/absence**
9.
10.

Report Prepared By: ______________________________ ________________

Signature Date

Please send semi-annual and final progress reports and supporting materials to:

NOAA Restoration Center F/HC3
1315 East-West Highway
Silver Spring, MD 20910
ATTN: NOAA Community-based Restoration Program Progress Reports

The Progress Report Narrative Format and Project Data Form are available on the NOAA Restoration Center website at: http://www.nmfs.noaa.gov/habitat/restoration/community. Electronic submissions are encouraged. Please submit electronic progress reports on PC compatible floppy disk or CD ROM in Microsoft Word, WordPerfect or PDF formats.

Be sure to save a copy of each report for your records; subsequent submissions of the Project Data Form need only add outstanding information, so that the form is completed in its entirety as part of the final comprehensive progress report.

Questions? Please call 301-713-0174 and ask to speak with NOAA Community-based Restoration Program staff

NOTICE

Responses to this collection are required of grant recipients to support the NOAA Community-based Restoration Program. The information provided will be used to evaluate the progress of the work proposed under the grant/cooperative agreement and determine whether the project conducted under the grant/cooperative agreement was successfully completed. Public reporting burden for completing the progress report narrative and project data form is estimated to average fifteen hours per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the information needed and completing and reviewing the collection of information. Responses to this information collection are required to retain funding provided by the NOAA Community-based Restoration Program. Confidentiality will not be maintained – the information will be available to the public. Send comments regarding this burden estimate or any other aspects of this collection of information, including suggestions for reducing this burden, to the NOAA Fisheries Office of Habitat Conservation, Restoration Division, F/HC3, 1315 East West Highway, Silver Spring, MD 20910.

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to penalty for failure to comply with, a collection of information subject to the requirements of the Paperwork Reduction Act, unless that collection of information displays a currently valid OMB Control Number.

The information collected will be reviewed for compliance with the NOAA Section 515 Guidelines established in response to the Treasury and General Government Appropriations Act, and certified before dissemination.