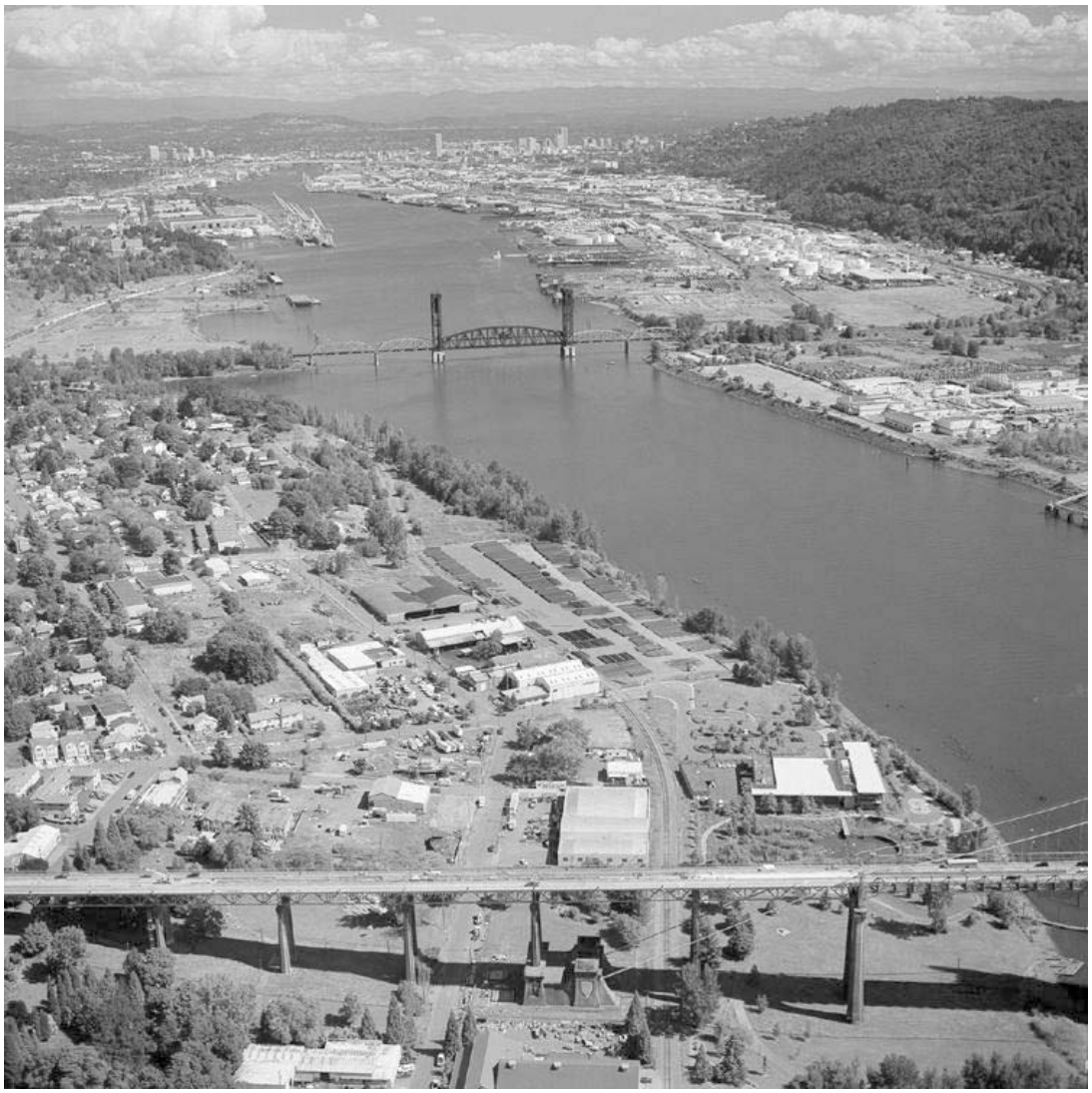
APPENDIX C: WILLAMETTE RIVER MITIGATION IN-LIEU FEES



RIVER PLAN / NORTH REACH
WILLAMETTE RIVER
MITIGATION IN-LIEU FEES

TECHNICAL REPORT

OCTOBER 2010

Prepared for:
City of Portland Bureau of Planning and Sustainability

TETRA TECH, INC.

Table of Contents

Table of Tables

Appendices

1.0 INTRODUCTION

This memo highlights the methodology for calculating the mitigation in-lieu-fee for five habitat types identified in the North Reach of the Willamette River: riverine, riparian, upland forest, stream, and wetland. This methodology is a three step process. The first step estimates the capital (up-front) costs (cost per area) of habitat restoration in order to identify the monetary value of each habitat type in the North Reach. The second step follows the North Reach Habitat Valuation methodology developed by the City in order to determine the quantity and quality of habitat at a given site (habitat unit per area). The final, third step combines the first two to deduce the River Plan mitigation in-lieu-fee (cost per habitat unit) for each of the five habitat types.

2.0 STEP 1: COSTS

This section presents the methods and results of the first step in calculating the River Plan in-lieu-fee: estimating the costs of habitat restoration. Five habitat types were considered in this process: riverine, riparian, upland forest, stream, and wetland.

Habitat types and corresponding habitat restoration features are defined as follows:

Riverine

Riverine habitat is defined as the portion of the Willamette River bank below ordinary high water (OHW) and 20 feet below ordinary low water (OLW). OHW at this region of the Willamette River is 20 feet NAVD88 based on OHW references of 14.7 feet to 15.2 feet Columbia River Datum (CRD) according to USACE (1991), and a conversion of + 5.03 feet between CRD and NAVD88, and is based on FEMA floodplain maps. Restoration measures include removing structures such as docks and piers, removal of pilings, regrading the banks, and the creation of shallow water habitat.

Riparian

Riparian habitat includes the region of the river bank between OWH and the 100-year flood elevation of approximately 32 feet NAVD88. This elevation was confirmed with FEMA Flood Insurance Rate Maps (FIRM) maps and observation of existing riparian species on the banks of the Willamette River. Riparian restoration measures include: removal of non-native and invasive species, revegetation with native riparian species, regrading banks, removal of structures and hardened ground surfaces such as riprap and pavement. Soil amendment may be required in some areas.

Upland Forest

Upland forest includes the region of the river bank above the riparian zone, from elevation 32 feet NAVD88 to the project boundary or property boundary. Restoration measures include: removal of non-native and invasive species, revegetation with native

upland species, removal of structures and hardened ground surfaces such as riprap and pavement. Soil amendment may be required in some areas.

Stream

Stream habitat includes tributary streams to the North Reach of the Willamette River and is where instream and bank habitat restoration would occur. Restoration measures include day-lighting culverted streams to natural channels, regrading the channel alignment, removing of fish passage barriers, enhancing instream habitat by placing large woody debris, stabilizing banks, and replanting the riparian zone.

Wetland

Wetland habitat includes, by definition, those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Restoration measures include removal of non-native and invasive species, manipulation of hydrological features to promote wetland features, and revegetation with native species.

The methodology for identifying the costs for wetland is different than the other habitat types and will be described separately at the end of this section.

2.1 Methods for Determining Riverine, Riparian, Upland Forest and Stream Restoration Costs

Potential restoration sites were identified from the River Plan / North Reach and were evaluated for their restoration potential for each of the habitat types. To estimate the costs of restoring each habitat type, three sites where restoration of that particular habitat type appeared feasible were selected, and restoration measures and unit costs were assessed for each. Based on site visits and background information, conceptual restoration site plans were developed. Habitat types were delineated through GIS mapping, and quantities were determined through CAD designs and quantity take-offs. Quantity take-offs are an estimation of construction item quantities required for a project.

The costs presented here include design and construction costs of the restoration features described at individual North Reach sites. Cost estimates reflect 2010 unit costs and labor rates and may vary with market value fluctuations and inflation. Capital costs do not include real estate acquisition, although real estate acquisition costs are reflected in the final calculation of the in-lieu fee. Costs also assume that excavated riverbank soils are non-contaminated. Thus, costs presented here do not include the clean-up or remediation of contaminated or toxic soils. Contaminated soils in the North Reach are common, and this cost is assumed to be incurred by the determined responsible party for the site.

Construction costs were determined based primarily on recent cost estimates developed for similar restoration projects in the region. Other primary cost references include:

- U.S. Army Corps of Engineers (USACE) and City of Portland Bureau of Environmental Services (BES) projects
- City of Portland Transportation Engineering and Development bid tabs
- 2010 local landfill disposal fees for clean material, and trucking company and construction contractor quotes.

2.1.1 Assumptions

Several important assumptions were made in developing unit costs for the various habitat types. At each project site soils were assumed to be non-contaminated. The cost of hauling and disposal of clean soils to a local landfill are included in the costs. Accordingly, the unit costs of restoring these sites presented herein may be lower than what is required to fully restore the sites, as they likely do contain contaminated soils. However, the cost of remediation at the sites is assumed to be incurred by the responsible party and not borne by the City or permittee.

Another significant factor in the costs of each project is the quantity of excavation required to regrade the bank slopes. This quantity is dependent on the steepness of the existing banks. Design bank slope targets were 7:1 below ordinary high water for riverine habitat restoration and 5:1 above ordinary high water for riparian restoration.

Thus, at sites with steep (near vertical) existing banks, regrading resulted in very large excavation quantities per unit area.

General markups were included in the costs as a percent markup of the construction subtotal including site preparation. Markups included a 75% design contingency, 50% for project pre-design and design, 30% for construction management, and 10% for operation and maintenance. These general markups may be somewhat higher than other similar restoration projects; however they are standard City markup rates for conceptual level design. These markups are based on experience from existing built projects and the City's CIP manual. A memo analyzing the costs and markups of similar projects built by the City is included in Appendix E.

Other assumptions used in developing the cost estimates are summarized below:

1. Unit costs include equipment, labor, materials, construction contractor's overhead and profit.
2. Real estate acquisition costs are not included. A separate real estate evaluation is needed on a site-by-site basis. For the in-lieu fee $5.50/sq. ft. was used.
3. Operations and maintenance are included as a 10% general mark up.
4. Site preparation costs include: mobilization and demobilization, permitting, erosion and pollution control, demolition, traffic control and utilities.

5. Excavation and offsite haul costs assume non-contaminated upland disposal at a local landfill.
6. Where applicable, unit prices are based on prior USACE or BES projects and City of Portland Transportation Engineering and Development bid tabs.
7. Costs do not account for phased construction (multiple mobilizations).
8. Costs are in 2010 dollars. Escalation costs for anticipated period of construction are not included and would need to be added depending on time of construction.

2.1.2 Results

Riverine

Sites selected to represent riverine habitat include MarCom, University of Portland-Triangle Park, and Willamette Cove. Conceptual restoration designs were developed for these sites and are presented in Appendix A.

Restoration treatments for near-shore in-water habitat restoration at these sites include:

1. Demolition of existing land-based and in-water structures.
2. Creation of in-water shallow water habitat (<20 feet) by excavating and regrading banks.
3. Revegetating with native riparian species.
4. Installing large woody debris for in-water habitat structure.
5. Placing sand substrate in-water at Willamette Cove.
6. Creating an off-channel habitat alcove at Willamette Cove.

Total construction costs were then estimated for each site based on the conceptual designs. Details of the costs, including quantity take-offs for each site, and a unit cost summary are provided below. Restoration features and cost details are shown for each site on the conceptual design sheets found in Appendix A.

Table 1. Riverine Habitat Restoration Cost Summary

Site Name	Restoration Area (AC)	Total Cost ($)	Restoration Unit Cost ($/AC)	Restoration Unit Cost ($/SF)
MarCom	2.6	$2,926,000	$1,125,000	$25.83
University of Portland Triangle Park	7.3	$21,437,000	$2,937,000	$67.42
Willamette Cove	5.4	$24,949,000	$4,620,000	$106.06
Averages		**$16,437,000**	**$2,894,000**	**$66.44**

Overall, the average estimated capital cost for near-shore in-water restoration was approximately $67 per square foot, and the costs ranged from approximately $26 to $107 per square foot. The range in costs per unit for the three sites is due to the varying amount of material excavated to achieve the desired bank slopes. This is in turn dependent on the steepness of the existing banks. Desired bank slopes are 7:1 below ordinary high water for riverine habitat restoration. The cost per square foot at Willamette Cove is nearly four times that at MarCom, due to nearly a ten-fold difference in material hauled and disposed of between these sites. The amount of material required for removal at Willamette Cove is mostly due to the excavation of an alcove at the site that connects to the river below OHW for the creation of off-channel floodplain habitat.

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Table 2. Riverine Habitat Restoration, MarCom Site: Cost Detail

Line Item	Quantity	Units	Unit Cost	Cost	Notes/Assumptions
Site Preparation	1	LS	$ 241,453	$ 241,453	Standard markups (see cost appendix)
Dewatering & Turbidity Control	1	LS	$ 113,000	$ 113,000	Assumes 1-2' simple cofferdam, limited dewater required, & standard turbidity curtain
Demo of Structures	258	TN	$ 200	$ 51,556	Includes timber piles, piers, and concrete rubble along/below shoreline
Regrade Banks	14,714	TN	$ 35	$ 514,993	Standard excavation, assume 12-mile round-trip haul to landfill disposal site
Place Sandy Substrate	-	CY	$ 60	$ -	Assumes furnish and placement
Place Streambed Material	-	TN	$ 100	$ -	Assumes furnish and placement of boulders, cobbles, gravel and sand
Place Erosion Control Fabric	12,457	SY	$ 3.50	$ 43,601	Place erosion control fabric on any regraded/revegetated banks
Plant Near-Shore Vegetation	2.6	AC	$ 16,000	$ 41,182	Remove invasives and plant native species, including soil treatment
Place Large Woody Debris	98	EA	$ 1,000	$ 98,000	Place buried, non-anchored logs with attached rootballs
General Markups	1	LS	$ 1,821,243	$ 1,821,243	Standard markups (see cost appendix)
Total Cost (Rounded)				**$ 2,926,000**	Total cost of design, construction and maintenance

Table 3. Riverine Habitat Restoration, University of Portland Triangle Park Site: Cost Detail

Line Item	Quantity	Units	Unit Cost	Cost	Notes/Assumptions
Site Preparation	1	LS	$ 1,769,560	$ 1,769,560	Standard markups (see cost appendix)
Dewatering & Turbidity Control	1	LS	$ 825,000	$ 825,000	Assumes 1-2' simple cofferdam, limited dewater required, & standard turbidity curtain
Demo of Structures	347	TN	$ 200	$ 69,432	Includes timber piles, piers, and concrete rubble along/below shoreline
Regrade Banks	132,444		$ 35	$ 4,635,556	Standard excavation, assume 12-mile round-trip haul to landfill disposal site
Place Sandy Substrate	-	CY	$ 60	$ -	Assumes furnish and placement
Place Streambed Material	-	TN	$ 100	$ -	Assumes furnish and placement of boulders, cobbles, gravel and sand
Place Erosion Control Fabric	50,651	SY	$ 3.50	$ 177,279	Place erosion control fabric on any regraded/revegetated banks
Plant Near-Shore Vegetation	7.3	AC	$ 16,000	$ 117,591	Remove invasives and plant native species, including soil treatment
Place Large Woody Debris	495	EA	$ 1,000	$ 495,000	Place buried, non-anchored logs with attached rootballs
General Markups	1	LS	$ 13,347,540	$ 13,347,540	Standard markups (see cost appendix)
Total Cost (Rounded)				**$ 21,437,000**	Total cost of design, construction and maintenance

Table 4. Riverine Habitat Restoration, Willamette Cove Site: Cost Detail

Line Item	Quantity	Units	Unit Cost	Cost	Notes/Assumptions
Site Preparation	1	LS	$ 2,059,389	$ 2,059,389	Standard markups (see cost appendix)
Dewatering & Turbidity Control	1	LS	$ 908,000	$ 908,000	Assumes 1-2' simple cofferdam, limited dewater required, & standard turbidity curtain
Demo of Structures	2,000	TN	$ 200	$ 400,000	Includes concrete removal
Regrade Banks	134,104		$ 35	$ 4,693,630	Standard excavation, assume 12-mile round-trip haul to landfill disposal site
Place Sandy Substrate	9,500	CY	$ 60	$ 570,000	Assumes furnish and placement
Place Streambed Material	1,420	TN	$ 100	$ 142,000	Assumes furnish and placement of boulders, cobbles, gravel and sand
Place Erosion Control Fabric	25,909	SY	$ 3.50	$ 90,681	Place erosion control fabric on any regraded/revegetated banks
Plant Near-Shore Vegetation	5.4	AC	$ 16,000	$ 85,649	Remove invasives and plant native species, including soil treatment
Place Large Woody Debris	465	EA	$ 1,000	$ 465,000	Place buried, non-anchored logs with attached rootballs
General Markups	1	LS	$ 15,533,675	$ 15,533,675	Standard markups (see cost appendix)
Total Cost (Rounded)				**$ 24,949,000**	Total cost of design, construction and maintenance

Table 5. Riverine Habitat Restoration Unit Cost Summary

Cat.	Line Item	Cost/%	Unit	Source	Notes
Site Preparation Markups	Mob/Demob	10%	Site prep markups are shown as percentage of construction subtotal	City BES Std for mob/demob	Includes mob/demob of construction equipment and preparation of site access and staging areas.
	Permitting	7%		Engineer's estimate - average for restoration sites	Includes contractor's construction permits only. All other pre-construction permit costs included in design phase costs.
	Erosion & Pollution Control, BMP's	3%		PDOT Bid Tab #22,30 (1.5% Erosion+1% Pollution)	Includes silt fences, straw bales, inlet protection, biofilter bags, and other BMP's.
	Demolition	3%		PDOT Bid Tab #31 (3% rem of struc. & obstr.)	General demo/disposal of debris/obstructions not including major items listed separately.
	Traffic Control	4%		PDOT Bid Tab #2 (4% temp. traffic control)	General demo/disposal of debris/obstructions not including major items listed separately.
	Utilities	1%		Engineer's estimate - general allowance	Utility locate, marking, survey, protection in place, assumes no major relocation required.
	Sum of Site Preparation Markups	**28%**		Subtotal	Site prep markups are to construction subtotal, non-inclusive of markups.
Construction Items	Demo/Dispose of Concrete & Timber Debris	$ 200	per ton	Engineer's estimate	Demo of in-water grouted rock, concrete, timber piles & piers by long reach excavator.
	Dewatering & Turbidity Control	15%	percent of constr. subtot.	Engineer's estimate - recent restoration projects	Assumes summer contruction wtr levels, no diversion req'd, 1-2' cofferdam, limited dewatering, std turbidity curtain.
	Excavate and Haul Offsite	$ 35	per ton	Jan 2010 quotes from landfill disposal, trucking comp.	Assumes 12 CY dumps, $110/HR dump rental, 12 mi. RT haul to landfill, $6 disposal fee, 40% contractor m/u.
	Place Sandy Substrate	$ 60	per cubic yard	Engineer's estimate	Assumes furnish and placement.
	Place Streambed Material	$ 100	per ton	Engineer's estimate	Assumes furnish and placement, mix of boulders, cobbles, gravels and sand.
	Erosion Control Fabric	$ 3.50	per square yard	Survey of 2009 WSDOT stream/culvert projects	Place fabric on exposed / disturbed areas.
	Plant Near-Shore Vegetation	$ 16,000	per acre	City of Portland BES 2009 Median Reveg Cost	Based on $0.36 per square foot median cost (Ranges from $0.07 to $0.78 per square foot).
	Place Large Woody Debris	$ 1,000	each	Engineer's estimate - average for restoration sites	Place buried, non-anchored logs with attached rootballs.
General Markups	Contingency	75%	General markups are shown as % of construction subtotal, including site prep markups	City BES std for conceptual contingency	Relatively high contingency to account for unknown topography, subsurface conditions, and site conditions.
	Pre-Design & Design Phases	50%		City BES std for Pre-Design/Design	Includes geotech, precon survey, staking, and as-builts.
	Construction Management	30%		City BES std for CM	Includes construction oversight, inspections, administration, and engineering during construction.
	Operation & Maintenance	10%		City BES std for O&M	Per City BES Engineer correspondence.
	Sum of General Markups	**165%**		Subtotal	Markup to construction subtotal, including site preparation markups, but not including individual general markups.

Additional Assumptions:

1. Unit costs include equipment, labor, materials, contractor overhead and profit.
2. Real estate acquisition costs are not included. A separate real estate evaluation is needed on a s ite-by-site basis.
3. Excavation and offsite haul costs assume non-contaminated disposal.
4. Where applicable, general unit prices are based on prior USACE or BES projects and City of Portland Transportation Engineering and Development bid tabs.
5. Costs do not account for phased construction (multiple mobilizations).
6. Costs are in 2010 dollars. Escalation costs for anticipated period of construction are not included and would need to be added dependent on the time of construction.
7. Revegetation costs include topsoil as needed.

Table 6. Riverine Habitat Restoration Site Quantities

Site Name	Demo Misc Concrete		Demo Timber		Demo Timber		Demo Total	Woody Debris		Near Shore Vegetation		Erosion Control Fabric		Place Sand			Streambed Material			Excavate - Offhaul by Land				Assumptions
Unit	Size (SF)	Ton	Size (SF)	Ton	QTY (EA)	Ton	Ton	Unit (EA/ 1K LF)	EA	Area (SF)	Area (AC)	Area (SF)	Area (SY)	Fill Depth (FT)	Fill Area (SF)	Vol (CY)	Fill Depth (FT)	Fill Area (SF)	Vol (TN)	XS Area (SF)	Linear FT	TN	CY	
MarCom			10,400	257	10	1	**258**	150	98	112,117	3	112,117	12,457							382	650	14,714	9,196	
Total				**257**		**1**	**258**		**98**		**3**		**12,457**									**14,714**	**9,196**	
Univ. of Portland Triangle Park			13,900	343	40	4	**347**	150	180	320,142	7	455,860	50,651							300	1,200	21,333	13,333	
								150	135											350	900	18,667	11,667	
								150	180											1,300	1,200	92,444	57,778	
Total				**343**		**4**	**347**		**495**		**7**		**50,651**									**132,444**	**82,778**	
Willamette Cove	35,328	2,000					**2,000**	150	180	233,180	5	233,180	25,909	1	9,070	400				496	1,200	35,271	22,044	150 LWD / 1k LF per BES, June 2010
								150	120											530	800	25,126	15,704	
								150	165	87,280	2	87,280	9,698	1	244,890	9,100				333	1,100	21,707	13,567	
Off-channel Region																	2	14,966	1,420			52,000	32,500	Off Channel CY taken from plan view depth (sf) avarage X depth of excavation.
Total		**2,000**					**2,000**		**465**		**7**		**35,607**			**9,500**			**1,420**			**134,104**	**83,815**	

Notes:

Assume Misc Concrete 12" thick & 0.67 CY/TN

Assume Timber Pier 2' ave thick & 3 CY/TN

Assume Timber Piles 8' ave length & 3 CY/TN

Assume Streambed mat'l/Excavated fill 1.7 TN/CY

Riparian

Three sites were selected due to the riparian habitat potential they each offered, as well as the adjacent riverine and upland restoration potential at each site. Those sites include MarCom, University of Portland-Triangle Park, and Willamette Cove. Conceptual restoration designs were developed for these sites and are presented in Appendix B.

Restoration treatments for riparian habitat restoration at these sites included:

1. Regrading banks.
2. Demolition of existing land-based structures and hardened ground surfaces.
3. Removal of non-native and invasive species.
4. Revegetation with native riparian species.
5. Soil amendment may be required in some areas.

Total construction costs were then estimated for each site based on the conceptual designs. Details of the costs, including quantity take-offs for each site, and a unit cost summary are provided in below. Restoration features and cost details are shown for each site on the conceptual design sheets found in Appendix B.

Table 7. Riparian Habitat Restoration Cost Summary

Site Name	Restoration Area (AC)	Total Cost ($)	Restoration Unit Cost ($/AC)	Restoration Unit Cost ($/SF)
MarCom	3.5	$4,607,000	$1,316,000	$30.21
University of Portland Triangle Park	14.1	$5,988,000	$425,000	$9.76
Willamette Cove	6.1	$25,708,000	$4,214,000	$96.74
Averages		**$12,101,000**	**$1,985,000**	**$45.57**

Overall, the average estimated capital cost for riparian restoration was approximately $46 per square foot, and the costs ranged from approximately $10 to $97 per square foot. The range in costs per unit for the three sites, like riverine costs, is largely due to the range in amount of material excavated to achieve the desired bank slopes. Desired bank slopes are 5:1 above ordinary high water for riparian habitat restoration.

The cost per square foot at Willamette Cove is nearly ten times that at University of Portland and over three times that at MarCom. The relatively high cost at Willamette Cove is due to the large quantity of material excavated at this site. Large excavation volumes are required to create an alcove that connects to the river below OHW for the creation of off-channel floodplain habitat. The majority of the material that is required for removal to create the alcove

is above OHW and is categorized as riparian habitat. Moreover, the costs at University of Portland are relatively low because the majority of costs for excavation of the steep slopes at this location are accounted for in the riverine habitat section (because this creates shallow water habitat). Relatively less excavation is required to reach the desired slopes in the riparian zone above the shallow water zone.

Table 8. Riparian Habitat Restoration, MarCom Site: Cost Detail

Line Item	Quantity	Units	Unit Cost	Cost	Notes/Assumptions
Site Preparation	1	LS	$ 380,283	$ 380,283	Standard markups (see cost appendix)
Demo of Structures	2,905	TN	$ 200	$ 580,984	Includes timber piles, piers, and concrete rubble along/below shoreline
Regrade Banks - Land-Based Excavation	14,637	TN	$ 35	$ 512,296	Standard excavation, assume 12-mile round-trip haul to landfill disposal site
Place Erosion Control Fabric	53,600	SF	$ 3.50	$ 187,600	Place erosion control fabric on any regraded/revegetated banks
Remove Invasive Vegetation	3.5	AC	$ 6,000	$ 21,074	Remove invasive species
Plant Riparian Vegetation	3.5	AC	$ 16,000	$ 56,198	Plant native species, including soil treatment
General Markups	1	LS	$ 2,868,419	$ 2,868,419	Standard markups (see cost appendix)
Total Cost (Rounded)				**$ 4,607,000**	Total cost of design, construction and maintenance

Table 9. Riparian Habitat Restoration, University of Portland Triangle Park Site: Cost Detail

Line Item	Quantity	Units	Unit Cost	Cost	Notes/Assumptions
Site Preparation	1	LS	$ 494,223	$ 494,223	Standard markups (see cost appendix)
Demo of Structures	3,455	TN	$ 200	$ 690,989	Includes timber piles, piers, and concrete rubble along/below shoreline
Regrade Banks - Land-Based Excavation	14,667	TN	$ 35	$ 513,333	Standard excavation, assume 12-mile round-trip haul to landfill disposal site
Place Erosion Control Fabric	71,400	SF	$ 3.50	$ 249,900	Place erosion control fabric on any regraded/revegetated banks
Remove Invasive Vegetation	14.1	AC	$ 6,000	$ 84,780	Remove invasive species
Plant Riparian Vegetation	14.1	AC	$ 16,000	$ 226,079	Plant native species, including soil treatment
General Markups	1	LS	$ 3,727,852	$ 727,852	Standard markups (see cost appendix)
Total Cost (Rounded)				**$ 5,988,000**	Total cost of design, construction and maintenance

Table 10. Riparian Habitat Restoration, Willamette Cove Site: Cost Detail

Line Item	Quantity	Units	Unit Cost	Cost	Notes/Assumptions
Site Preparation	1	LS	$ 2,122,057	$ 2,122,057	Standard markups (see cost appendix)
Demo of Structures	606	TN	$ 200	$ 121,260	Includes timber piles, piers, and concrete rubble along/below shoreline
Regrade Banks - Land-Based Excavation	182,921		$ 35	$ 6,402,252	Standard excavation, assume 12-mile round-trip haul to landfill disposal site
Place Erosion Control Fabric	265,066		$ 3.50	$ 920,731	Place erosion control fabric on any regraded/revegetated banks
Remove Invasive Vegetation	6.1	AC	$ 6,000	$ 36,690	Remove invasive species
Plant Riparian Vegetation	6.1	AC	$ 16,000	$ 97,840	Plant native species, including soil treatment
General Markups	1	LS	$ 16,006,370	$ 16,006,370	Standard markups (see cost appendix)
Total Cost (Rounded)				**$ 25,708,000**	Total cost of design, construction and maintenance

Table 11. Riparian Habitat Restoration Unit Cost Summary

Cat.	Line Item	Cost/%	Unit	Source	Notes
Site Preparation Markups	Mob/Demob	10%	Site prep markups are shown as percentage of construction subtotal	City BES Std for mob/demob	Includes mob/demob of construction equipment and preparation of site access and staging areas.
	Permitting	7%		Engineer's estimate - average for restoration sites	Includes contractor's construction permits only. All other pre-construction permit costs included in design phase costs.
	Erosion & Pollution Control, BMP's	3%		PDOT Bid Tab #22,30 (1.5% Erosion+1% Pollution)	Includes silt fences, straw bales, inlet protection, biofilter bags, and other BMP's.
	Demolition	3%		PDOT Bid Tab #31 (3% rem of struc. & obstr.)	General demo/disposal of debris/obstructions not including major items listed separately.
	Traffic Control	4%		PDOT Bid Tab #2 (4% temp. traffic control)	General demo/disposal of debris/obstructions not including major items listed separately.
	Utilities	1%		Engineer's estimate - general allowance	Utility locate, marking, survey, protection in place, assumes no major relocation required.
	Sum of Site Preparation Markups	**28%**		Subtotal	Site prep markups are to construction subtotal, non-inclusive of markups.
Construction Items	Demo/Dispose of Misc Structures	$ 200	per ton	Engineer's estimate	Demo of concrete, timber structures along bank within OHW by land equipment.
	Excavate, Regrade Bank & Haul Offsite	$ 35	per ton	Jan 2010 quotes from landfill disposal, trucking comp.	Assumes 12 CY dumps, $110/HR dump rental, 12 mi. RT haul to landfill, $6 disposal fee, 40% contractor m/u.
	Erosion Control Fabric	$ 3.50	per square yard	PDOT Bid Tab #55	Place on exposed / disturbed areas.
	Remove Invasive Species	$ 6,000	per acre	Engineer's estimate	Remove invasives @ $6,000 per acre.
	Plant Shrub / Riparian Vegetation	$ 16,000	per acre	Beaver Lake Nursery, Valley Growers, Scholl's	Plant riparian species @ $3 ea gal mat'l, $6 ea installed at 8' O.C.+ seeding @ $2,500/acre + willow cuttings/alder stakes.
General Markups	Contingency	75%	General markups are shown as % of construction subtotal, including site prep markups	City BES std for conceptual contingency	Relatively high contingency to account for unknown topography, subsurface conditions, and site conditions.
	Pre-Design & Design Phases	50%		City BES std for Pre-Design/Design	Includes geotech, precon survey, staking, and as-builts.
	Construction Management	30%		City BES std for CM	Includes construction oversight, inspections, administration, and engineering during construction.
	Operation & Maintenance	10%		City BES std for O&M	Per City BES Engineer correspondence.
	Sum of General Markups	**165%**		Subtotal	Markup to construction subtotal, including site preparation markups, but not including individual general markups.

Additional Assumptions:

1. Unit costs include equipment, labor, materials, contractor overhead and profit.
2. Real estate acquisition costs are not included. A separate real estate evaluation is needed on a site-by-site basis.
3. Excavation and offsite haul costs assume non-contaminated disposal.
4. Where applicable, general unit prices are based on prior USACE or BES projects and City of Portland Transportation Engineering and Development bid tabs.
5. Costs do not account for phased construction (multiple mobilizations).
6. Costs are in 2010 dollars. Escalation costs for anticipated period of construction are not included and would need to be added dependent on the time of construction.
7. Revegetation costs include topsoil as needed.

Table 12. Riparian Habitat Restoration Site Quantities

Site Name	Demo Misc Paving		Demo Timber Pier		Demo Building		Demo Total	Plant Riparian Vegetation		Remove Invaisives		Erosion Control Fabric	Excavate - Offhaul by Land				Assumptions
Unit	Size (SF)	Ton	Size (SF)	Ton	Size (CF)	Ton	Ton	Area SF (plan)	Area (AC)	Area SF (plan)	Area (AC)	Area (SY)	XS Area (SF)	Linear FT	TN	CY	
MarCom	52,550	2905					**2,905**	153,000	3.5	153,000	3.5	53,600	560	200	6,637	4,148	
													225	600	8,000	5,000	
Total		**2905**					**2905**		**3.5**		**3.5**	**53,600**			**14,637**	**9,148**	
Univ. of Portland Triangle Park	62,500	3455					**3,455**	615,500	14.1	615,500	14.1	71,400	75	3,300	14,667	9,167	
Total		**3455**					**3455**		**14.1**		**14.1**	**71,400**			**14,667**	**9,167**	
Willamette Cove	10,968	606					**606**	266,370	6.1	266,370	6.1	263,066	400	3,100	73,481	45,926	
Off-channel Region															109,440	68,400	Vol. from plan view & ave excav. depth assumed
Total		**606**					**606**		**6**		**6**	**263,066**			**182,921**	**114,326**	

Notes:

Assume Misc Paving 12" thick total, 0.67 CY/TN

Upland Forest

Three sites were selected based on the upland forest habitat potential they each offered, as well as the adjacent riparian restoration potential at each site. Those sites include MarCom, University of Portland-Triangle Park, and Willamette Cove. Conceptual restoration designs were developed for these sites and are presented in Appendix C.

Restoration treatments for upland forest habitat restoration at these sites included:

1. Demolition of existing land-based structures and hardened ground surfaces.
2. Removal of non-native and invasive species.
3. Revegetation with native upland species.
4. Soil amendment may be required in some areas.

Total construction costs were then estimated for each site based on the conceptual designs. Details of the costs, including quantity take-offs for each site, and a unit cost summary are provided below. Restoration features and cost details are shown for each site on the conceptual design sheets found in Appendix C.

Table 13. Upland Forest Habitat Restoration Cost Summary

Site Name	Restoration Area (AC)	Total Cost ($)	Restoration Unit Cost ($/AC)	Restoration Unit Cost ($/SF)
MarCom	8.3	$8,308,000	$1,001,000	$22.98
University of Portland Triangle Park	22.9	$6,931,000	$303,000	$6.96
Willamette Cove	15.9	$1,292,000	$81,000	$1.86
Averages		**$5,510,333**	**$462,000**	**$10.60**

Overall, the average estimated capital cost for upland forest restoration was approximately $11 per square foot, and these costs ranged from approximately $2 to $23 per square foot. The range over the three sites is due primarily to the range in the quantity of structure demolition and pavement removal required. MarCom has significantly more pavement demolition relative to the restoration area. In general, upland forest habitat restoration unit costs are lower than those for riverine and riparian habitat restoration because this habitat type does not require excavation to create habitat.

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Table 14. Upland Forest Habitat Restoration, MarCom Site: Cost Detail

Line Item	Quantity	Units	Unit Cost	Cost	Notes/Assumptions
Site Preparation	1	LS	$ 685,727	$ 685,727	Standard markups (see cost appendix)
Demo of Structures	9,903	TN	$ 200	$ 1,980,652	May include timber piles, piers, paving and concrete rubble
Demo of Existing Buildings	9,500	SF	$ 30	$ 285,000	Demo and removal of existing masonry buildings
Remove Invasive Vegetation	8.3	AC	$ 6,000	$ 50,011	Remove invasive species
Plant Riparian Vegetation	8.3	AC	$ 16,000	$ 133,362	Plant native species, including soil treatment
General Markups	1	LS	$ 5,172,342	$ 5,172,342	Standard markups (see cost appendix)
Total Cost (Rounded)				**$ 8,308,000**	Total cost of design, construction and maintenance

Table 15. Upland Forest Habitat Restoration, University of Portland Triangle Park Site: Cost Detail

Line Item	Quantity	Units	Unit Cost	Cost	Notes/Assumptions
Site Preparation	1	LS	$ 572,120	$ 572,120	Standard markups (see cost appendix)
Demo of Structures	6,501	TN	$ 200	$ 1,300,299	May include timber piles, piers, paving and concrete rubble
Demo of Existing Buildings	8,000	SF	$ 30	$ 240,000	Demo and removal of existing masonry buildings
Remove Invasive Vegetation	22.9	AC	$ 6,000	$ 137,178	Remove invasive species
Plant Upland Vegetation	22.9	AC	$ 16,000	$ 365,809	Plant native species, including soil treatment
General Markups	1	LS	$ 4,315,419	$ 315,419	Standard markups (see cost appendix)
Total Cost (Rounded)				**$ 6,931,000**	Total cost of design, construction and maintenance

Table 16. Upland Forest Habitat Restoration, Willamette Cove Site: Cost Detail

Line Item	Quantity	Units	Unit Cost	Cost	Notes/Assumptions
Site Preparation	1	LS	$ 106,598	$ 106,598	Standard markups (see cost appendix)
Demo of Structures	149	TN	$ 200	$ 29,851	May include timber piles, piers, paving and concrete rubble
Demo of Existing Buildings	-	SF	$ 30	$ -	Demo and removal of existing masonry buildings
Remove Invasive Vegetation	15.9	AC	$ 6,000	$ 95,689	Remove invasive species
Plant Upland Vegetation	15.9	AC	$ 16,000	$ 255,170	Plant native species, including soil treatment
General Markups	1	LS	$ 804,057	$ 804,057	Standard markups (see cost appendix)
Total Cost (Rounded)				**$ 1,292,000**	Total cost of design, construction and maintenance

Table 17. Upland Forest Habitat Restoration Unit Cost Summary

Cat.	Line Item	Cost/%	Unit	Source	Notes
Site Preparation Markups	Mob/Demob	10%	Site prep markups are shown as percentage of construction subtotal	City BES Std for mob/demob	Includes mob/demob of construction equipment and preparation of site access and staging areas.
	Permitting	7%		Engineer's estimate - average for restoration sites	Includes contractor's construction permits only. All other pre-construction permit costs included in design phase costs.
	Erosion & Pollution Control, BMP's	3%		PDOT Bid Tab #22,30 (1.5% Erosion+1% Pollution)	Includes silt fences, straw bales, inlet protection, biofilter bags, and other BMP's.
	Demolition	3%		PDOT Bid Tab #31 (3% rem of struc. & obstr.)	General demo/disposal of debris/obstructions not including major items listed separately.
	Traffic Control	4%		PDOT Bid Tab #2 (4% temp. traffic control)	General demo/disposal of debris/obstructions not including major items listed separately.
	Utilities	1%		Engineer's estimate - general allowance	Utility locate, marking, survey, protection in place, assumes no major relocation required
	Sum of Site Preparation Markups	**28%**		Subtotal	Site prep markups are to construction subtotal, non-inclusive of markups.
Construction Items	Demo/Dispose of Misc Structures	$ 200	per ton	Engineer's estimate	Demo of concrete, timber structures along bank within OHW by land equipment.
	Demo/Remove Existing Buildings	$ 30	per square foot	Engineer's estimate	Demo and removal of existing steel buildings, allow $30/SF demo, haul as conservative estimate.
	Excavate, Regrade Bank & Haul Offsite	$ 35	per ton	Jan 2010 quotes from landfill disposal, trucking comp.	Assumes 12 CY dumps, $110/HR dump rental, 12 mi. RT haul to landfill, $6 disposal fee, 40% contractor m/u.
	Erosion Control Fabric	$ 3.50	per square yard	PDOT Bid Tab #55	Place exposed / disturbed areas.
	Remove Invasive Species	$ 6,000	per acre	Engineer's estimate	Remove invasives @ $6,000 per acre.
	Plant Shrub / Upland Vegetation	$ 16,000	per acre	Beaver Lake Nursery, Valley Growers, Scholl's	.
General Markups	Contingency	75%	General markups are shown as % of construction subtotal, including site prep markups	City BES std for conceptual contingency	Relatively high contingency to account for unknown topography, subsurface conditions, and site conditions.
	Pre-Design & Design Phases	50%		City BES std for Pre-Design/Design	Includes geotech, precon survey, staking, and as-builts.
	Construction Management	30%		City BES std for CM	Includes construction oversight, inspections, administration, and engineering during construction.
	Operation & Maintenance	10%		City BES std for O&M	Per City BES Engineer correspondence.
	Sum of General Markups	**165%**		Subtotal	Markup to construction subtotal, including site preparation markups, but not including individual general markups.

Additional Assumptions:

1. Unit costs include equipment, labor, materials, contractor overhead and profit.
2. Real estate acquisition costs are not included. A separate real estate evaluation is needed on a site-by-site basis.
3. Excavation and offsite haul costs assume non-contaminated disposal.
4. Where applicable, general unit prices are based on prior USACE or BES projects and City of Portland Transportation Engineering and Development bid tabs.
5. Costs do not account for phased construction (multiple mobilizations).
6. Costs are in 2010 dollars. Escalation costs for anticipated period of construction are not included and would need to be added dependent on the time of construction.
7. Revegetation costs include topsoil as needed.

Table 18. Upland Forest Habitat Restoration Site Quantities

Site Name	Demo Misc Paving		Demo Timber Pier		Demo Total	Demo Building	Plant Upland Vegetation		Remove Invasives		Erosion Control Fabric	Excavate - Offhaul by Land			
Unit	Size (SF)	Ton	Size (SF)	Ton	Ton	Size(SF)	Area SF (plan)	Area AC	Area SF (plan)	Area AC	Area (SY)	XS Area (SF)	Linear FT	TN	CY
MarCom	179,150	9,903			**9,903**	9,500	363,079	8	363,079	8	5,000	50	100	296	185
Univ. of Portland Triangle Park	117,612	6,501			**6,501**	8,000	995,914	23	995,914	23					
Willamette Cove	2,700	149			**149**		694,699	16	694,699	16					

Notes & Assumptions:

Misc Paving - 12" thick total, 0.67 CY/TN

Building with interior walls and height of 12'

Stream

Three sites were selected for the in-stream habitat potential they offered, as well as the adjacent upland restoration potential at each site. Those sites include Saltzman Creek, Doane Creek, and Miller Creek. Conceptual restoration designs were developed for these sites and are presented in Appendix D.

Restoration treatments for stream habitat restoration at these sites included:

1. Day-lighting and regrading the channel alignment.
2. Removal of fish passage barriers.
3. Revegetation with native riparian species.
4. Creation of instream habitat such as placing large woody debris.

Total construction costs were then estimated for each site based on the conceptual designs. Details of the costs, including quantity take-offs for each site, and a unit cost summary are provided in below. Restoration features and cost details are shown for each site on the conceptual design sheets found in Appendix D.

Table 19. Stream Habitat Restoration Cost Summary

Site Name	Restoration Area (AC)	Total Cost ($)	Restoration Unit Cost ($/AC)	Restoration Unit Cost ($/SF)
Saltzman Creek	0.5	$531,000	$1,062,000	$24.38
Doane Creek	3.8	$29,816,000	$7,846,000	$180.12
Miller Creek	5.5	$6,854,000	$1,246,000	$28.60
Averages		**$12,400,333**	**$3,385,000**	**$77.70**

Overall, the average estimated capital cost for stream restoration was approximately $78 per square foot, and unit costs ranged from approximately $24 to $180 per square foot. The large range in unit costs is due largely to the range of exaction required for each site. At Doane Creek the stream is currently buried under nearly 20 feet of fill. In order to day-light the stream, this material must be removed. Miller Creek requires re-routing the stream – essentially creating a new channel. However, the restoration area is relatively large, so the unit cost is moderate. Saltzman Creek involves the smallest quantity of excavation, but the restoration area is confined to the original channel footprint. The resulting unit cost is moderate and similar to that of Miller Creek.

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Table 20. Stream Habitat Restoration, Saltzman Creek: Cost Detail

Line Item	Quantity	Units	Unit Cost	Cost	Notes/Assumptions
Site Preparation	1	LS	$ 43,754	$ 43,754	Standard markups (see cost appendix)
Dewatering & Turbidity Control	1	LS	$ 21,000	$ 21,000	Assumes 1-2' simple cofferdam, limited dewater required, & standard turbidity curtain
Demo of Structures	-	TN	$ 200	$ -	Includes concrete rubble & existing culverts
Special Utility Protection/Relocation	-	LS	$ 100,000	$ -	Special utility considerations: protect/relocate gas lines, reconstruct railroad (Doane only)
Place Fish Passable Culvert	-	LF	$ 2,000	$ -	Precast reinforced concrete culvert backfilled with native/streambed substrate
Place Streambed Material	260	TN	$ 100	$ 26,000	Assumes furnish and placement of boulders, cobbles, gravel and sand
Regrade Banks	1,280	TN	$ 35	$ 44,800	Standard excavation, assume 12-mile round-trip haul to landfill disposal site
Road Reconstruction	-	SF	$ 30	$ -	Includes fill, road base, surfacing, striping, guardrail
Place Erosion Control Fabric	4,500	SY	$ 3.50	$ 15,750	Place erosion control fabric on any regraded/revegetated banks
Plant Near-Shore Vegetation	0.5	AC	$ 16,000	$ 7,713	Remove invasives and plant native species, including soil treatment
Place Large Woody Debris	41	EA	$ 1,000	$ 41,000	Place buried, non-anchored logs with attached rootballs
General Markups	1	LS	$ 330,029	$ 330,029	Standard markups (see cost appendix)
Total Cost (Rounded)				**$ 531,000**	Total cost of design, construction and maintenance

Table 21. Stream Habitat Restoration, Doane Creek: Cost Detail

Line Item	Quantity	Units	Unit Cost	Cost	Notes/Assumptions
Site Preparation	1	LS	$ 2,461,197	$ 2,461,197	Standard markups (see cost appendix)
Dewatering & Turbidity Control	1	LS	$ 1,147,000	$ 1,147,000	Assumes 1-2' simple cofferdam, limited dewater required, & standard turbidity curtain
Demo of Structures	1,700	TN	$ 200	$ 340,000	Includes timber piles, piers, and concrete rubble along/below shoreline
Special Utility Protection/Relocation	1	LS	$ 100,000	$ 100,000	Special utility considerations: protect/relocate gas lines, reconstruct railroad (Doane only)
Place Fish Passable Culvert	50	LF	$ 2,000	$ 100,000	Precast reinforced concrete culvert with streambed substrate
Place Streambed Material	1,520	TN	$ 100	$ 152,000	Assumes furnish and placement of boulders, cobbles, gravel and sand
Regrade Banks	168,296		$ 35	$ 5,890,370	Standard excavation, assume 12-mile round-trip haul to landfill disposal site
Road Reconstruction	4,000	SF	$ 30	$ 120,000	Includes fill, road base, surfacing, striping, guardrail
Place Erosion Control Fabric	165,650		$ 3.50	$ 579,775	Place erosion control fabric on any regraded/revegetated banks
Plant Near-Shore Vegetation	3.8	AC	$ 16,000	$ 60,845	Remove invasives and plant native species, including soil treatment
Place Large Woody Debris	300	EA	$ 1,000	$ 300,000	Place buried, non-anchored logs with attached rootballs
General Markups	1	LS	$ 18,564,459	$ 18,564,459	Standard markups (see cost appendix)
Total Cost (Rounded)				**$ 29,816,000**	Total cost of design, construction and maintenance

Table 22. Stream Habitat Restoration, Miller Creek: Cost Detail

Line Item	Quantity	Units	Unit Cost	Cost	Notes/Assumptions
Site Preparation	1	LS	$ 565,732	$ 565,732	Standard markups (see cost appendix)
Dewatering & Turbidity Control	1	LS	$ 242,000	$ 242,000	Assumes 1-2' simple cofferdam, limited dewater required, & standard turbidity curtain
Place Streambed Material	1,670	TN	$ 100	$ 167,000	Assumes furnish and placement of boulders, cobbles, gravel and sand
Regrade Banks	14,341	TN	$ 35	$ 501,926	Standard excavation, assume 12-mile round-trip haul to landfill disposal site
Place Erosion Control Fabric	197,550	Y	$ 3.50	$ 691,425	Place erosion control fabric on any regraded/revegetated banks
Plant Near-Shore Vegetation	5.5	AC	$ 16,000	$ 88,121	Remove invasives and plant native species, including soil treatment
Place Large Woody Debris	330	EA	$ 1,000	$ 330,000	Place buried, non-anchored logs with attached rootballs
General Markups	1	LS	$4,267,237	$,267,237	Standard markups (see cost appendix)
Total Cost (Rounded)				**$ 6,854,000**	Total cost of design, construction and maintenance

Table 23. Stream Habitat Restoration Unit Cost Summary

Cat.	Line Item	Cost/%	Unit	Source	Notes
Site Preparation Markups	Mob/Demob	10%	Site prep markups are shown as percentage of construction subtotal	City BES Std for mob/demob	Includes mob/demob of construction equipment and preparation of site access and staging areas.
	Permitting	7%		Engineer's estimate - average for restoration sites	Includes contractor's construction permits only. All other pre-construction permit costs included in design phase costs.
	Erosion & Pollution Control, BMP's	3%		PDOT Bid Tab #22,30 (1.5% Erosion+1% Pollution)	Includes silt fences, straw bales, inlet protection, biofilter bags, and other BMP's.
	Demolition	3%		PDOT Bid Tab #31 (3% rem of struc. & obstr.)	General demo/disposal of debris/obstructions not including major items listed separately.
	Traffic Control	4%		PDOT Bid Tab #2 (4% temp. traffic control)	General demo/disposal of debris/obstructions not including major items listed separately.
	Utilities	1%		Engineer's estimate - general allowance	Utility locate, marking, survey, protection in place, assumes no major relocation required.
	Sum of Site Preparation Markups	**28%**		Subtotal	Site prep markups are to construction subtotal, non-inclusive of markups.
Construction Items	Demo/Dispose of Concrete Rubble	$ 200	per ton	Engineer's estimate	Demo of in-water structures (culverts, grouted rock, concrete etc.) by long reach excavator.
	Dewatering & Turbidity Control	15%	percent of constr. subtot.	Engineer's estimate - recent restoration projects	Assumes summer contruction wtr levels, no diversion req'd, 1-2' cofferdam, limited dewatering, std turbidity curtain.
	Special Utility Protection / Relocation	$ 100,000	lump sum	Engineer's estimate	Special utility considerations: protect/relocate gas lines, reconstruct railroad (Doane only).
	Excavate and Haul Offsite	$ 35	per ton	Jan 2010 quotes from landfill disposal, trucking comp.	Assumes 12 CY dumps, $110/HR dump rental, 12 mi. RT haul to landfill, $6 disposal fee, 40% contractor m/u
	Road Reconstruction	$ 30	per square foot	Recent 2009 PBOT unit costs	Includes fill, road base, surfacing, striping, guardrail.
	Erosion Control Fabric	$ 3.50	per square yard	Survey of 2009 WSDOT stream/culvert projects	Place fabric on exposed / disturbed areas.
	Place Streambed Material	$ 100	per ton	Engineer's estimate	Assumes furnish and placement, mix of boulders, cobbles, gravels and sand.
	Plant Riparian Vegetation	$ 16,000	per acre	City of Portland BES 2009 Median Reveg Cost	Based on $0.36 per square foot median cost (Ranges from $0.07 to $0.78 per square foot).
	Culvert Replacement	$ 2,000	per linear foot	Engineer's estimate - typical for recent projects	Assumes 3 or 4 sided, precast reinforced concrete culvert w/ streambed material backfill for fish passage.
	Place Large Woody Debris	$ 1,000	per each	Engineer's estimate - average for restoration sites	Place buried, non-anchored logs with attached rootballs.
General Markups	Contingency	75%	General markups are shown as % of construction subtotal, including site prep markups	City BES std for conceptual contingency	Relatively high contingency to account for unknown topography, subsurface conditions, and site conditions.
	Pre-Design & Design Phases	50%		City BES std for Pre-Design/Design	Includes geotech, precon survey, staking, and as-builts.
	Construction Management	30%		City BES std for CM	Includes construction oversight, inspections, administration, and engineering during construction.
	Operation & Maintenance	10%		City BES std for O&M	Per City BES Engineer correspondence.
	Sum of General Markups	**165%**		Subtotal	Markup to construction subtotal, including site preparation markups, but not including individual general markups.

Additional Assumptions:

1. Unit costs include equipment, labor, materials, contractor overhead and profit.
2. Real estate acquisition costs are not included. A separate real estate evaluation is needed on a site-by-site basis.
3. Excavation and offsite haul costs assume non-contaminated disposal.
4. Where applicable, general unit prices are based on prior USACE or BES projects and City of Portland Transportation Engineering and Development bid tabs.
5. Costs do not account for phased construction (multiple mobilizations).
6. Costs are in 2010 dollars. Escalation costs for anticipated period of construction are not included and would need to be added dependent on the time of construction.
7. Revegetation costs include topsoil as needed.

Table 24. Stream Habitat Restoration Site Quantities

Site Name	Demo Misc Concrete			Demo Timber Pier		Demo Timber Piles		Demo Total	Precast Culvert		Woody Debris		Riparian Vegetation		Streambed Material			Erosion Control Fabric	Road Re-construction	Excavate - Offhaul by Land				Assumptions
Unit	LF	LB/LF	Ton	Size (SF)	Ton	QTY (EA)	Ton	Ton	EA	LF	Unit (EA/ 1K LF)	EA	Area SF (plan)	Area AC	Fill Depth (FT)	Fill Area (SF)	Vol (TN)	Area (SY)	Road Area (SF)	XS Area (SF)	Linear FT	TN	CY	
Saltzman Creek											150	41	21,000	0.48	1.5	2,700	260	4,500		80	270	1,280	800	XS area per cad, 150 LWD/1k LF (BES)
Total												**41**		**0.48**			**260**	**4,500**				**1,280**	**800**	
Doane Creek	2000	1,700	1700					**1700**	1	50	150	300	165,650	3.8	1.5	16,000	1,520	165,650	4,000	1,420	2,000	168,296	105,185	Remove exist 5' Dia Conc Culvert
Total			**1700**					**1700**				**300**		**3.8**			**1,520**	**165,650**	**4,000**			**168,296**	**105,185**	
Miller Creek											150	330	239,910	5.5	1.5	17,600	1,670	197,550		25	700	1,037	648	XS area per cad, 150 LWD/1k LF (BES)
																				1,300	50	3,852	2,407	
																				110	1,450	9,452	5,907	
Total												**330**		**6**			**1,670**	**197,550**			**2,200**	**14,341**	**8,963**	

Notes:

Assume Concrete Pipe Culvert - 1700 LB/LF

Assume Timber Pier 2' ave thick & 3 CY/TN

Assume Timber Piles 8' ave length & 3 CY/TN

Assume Streambed mat'l 1.7 TN/CY

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2.2 Methods for Determining Wetland Restoration Costs

Wetland habitat restoration costs are regulated by the federal and state governments. In order, to provide compatibility with federal and state agencies, the cost of restoring wetland habitats will follow the State of Oregon process for determining mitigation in-lieu-fees. This process is outlined below.

> The Oregon Department of State Lands options for mitigation in-lieu fee involve payment into the Oregon Removal-Fill Mitigation Fund.
>
> According to statute, the rate set by DSL "shall be equal to the average cost of credits available from all active mitigation banks in the state" (ORS 196.643). This rate is determined annually.
>
> Effective for all complete applications received on or after July 1, 2010, the rate for payment to the Fund will be **$80,200 per acre**.

2.3 Methods for Determining Total Costs per Area for Each Habitat Type

In order to determine the total cost per area ($/acre), the cost of land acquisition is added to the average total capital cost per habitat type.

Acquisition Costs
Acquisition costs are the cost to purchase the property for habitat restoration and are based on $239,580 per acre ($5.50 per square foot) per City real estate analysis (2010).

Total Capital/Up-Front Costs
Total capital/up-front costs are calculated from the average restoration costs of the three example sites for each habitat type as outlined earlier.

The riverine habitat type will be used as an example for calculating the total cost per area.

Total Capital/Up-Front Costs: The average of total capital/up-front costs for the three example sites (Table 1) was calculated to be $2,894,000 per acre.

Acquisition Costs : The cost for property acquisition per the City's real estate analysis is $239,580 per acre.

Cost per Area: The cost per acre for riverine habitat is calculated to be $2,894,000/AC + $239,580/AC = $3,133,580 per acre.

The cost per area ($/acre) was then calculated for each habitat type and is presented in Table 25.

Table 25. Cost per Area ($/acre) for each Habitat Type.

Habitat Type	Total Capital Costs ($/AC)	Acquisition Costs/AC	Total Cost per Acre	Total Cost per Sq. Ft.
Riverine	$2,894,000 $239,5	80	$3,133,580	$71.90
Riparian	$1,985,000 $239,5	80	$2,224,580	$51.10
Upland	$462,000 $239,5	80	$701,580	$16.10
Stream	$3,385,000 $239,5	80	$3,624,580	$83.20
Wetland	$80,200 $239,5	80	$319,780	$7.30

3.0 STEP 2: HABITAT VALUATION

The second step in calculating the North Reach mitigation fee-in-lieu involves determining the site specific habitat value (quality and quantity) for each habitat type. This step follows the North Reach Mitigation Bank Habitat Valuation methodology. The details of this methodology are presented in the Habitat Valuation Methodology memo. This methodology uses a functional based approach based on Habitat Suitability Indices (HSIs) and Habitat Equivalency Analysis (HEA) models. The output of this system is a habitat value unit of Discounted Service Area Years (DSAYs). Therefore the product of this step calculates the number of habitat units per area (DSAYs/acre).

A modified approach to the North Reach Habitat Valuation methodology was used to calculate DSAYs per acre for each habitat type. In the modified approach habitat value was determined by best professional judgment (see Section 3.1 below).

3.1 Method for Determining DSAYs per Acre

As this analysis is based on the average values of potential restoration sites in the North Reach, best professional judgment was used to determine habitat value. This was expressed in the potential restoration uplift expected in the North Reach. Uplift values (total beneficial increase from restoration) were pre-determined based on average assumed restoration potential. This value was determined by the knowledge of baseline conditions in the North Reach and assumed habitat restoration potential for each habitat type (Table 26).

An additional value needed for the HEA model that required best professional judgment was the Years to Fully Functioning Habitat for each habitat type. Years to fully functioning habitat was determined by the estimated length of time a habitat type will become fully functioning, assuming the creation of the habitat (Table 26).

Table 26. Values used for each habitat type to calculate DSAYs per Acre

Habitat Type	Habitat Value Uplift	Years to Fully Functioning
Riverine	0.4	1
Riparian	0.75 50	
Upland	0.6	40
Stream	0.5	2
Wetland	0.4	5

Both habitat value (uplift) and years to fully functioning habitat were then input into the HEA model in order to assess the number of DSAYs per acres for each habitat type.

The following assumptions were used to run the HEA model and are based on standardized values:

1. *Acres of Habitat* -This value is set at 1 in order to assess the number of DSAYS per Acre.
2. *Discount rate = 0.03*
3. *Base year = 0*
4. *# of years project exists = 300.*

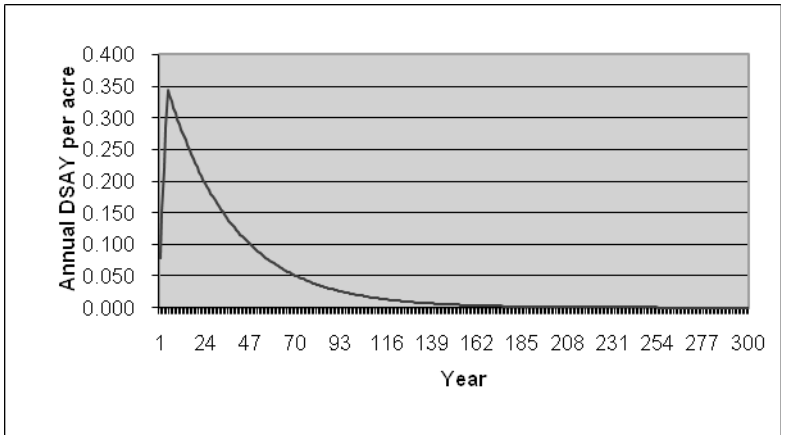
An example of the HEA model run is shown in Table 27, utilizing the average values for riverine habitat. The model results calculate 13.33 DSAYs per acre for riverine habitat. The HEA model spreadsheet was developed and provided to the City by the National Oceanic and Atmospheric Administration (NOAA, Robert Wolotira, pers. com. 2009).

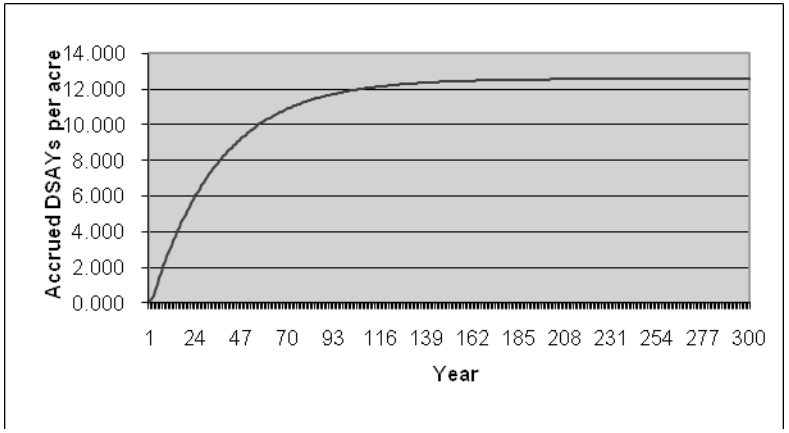
Table 27. HEA Results for Riverine habitat analysis.

HABITAT EQUIVALENCY ANALYSIS SPREADSHEET

To use model, only enter values in highlighted areas.

Initial Value of Habitat:	0.4
Years to a Fully Functioning Habitat:	1
Base Year:	0
Discount Rate	0.03
# Years Project Exists:	300
Value of Restored or Degraded Habitat:	0.8
Total Beneficial Increase from Restoration or Decrease from Other Action:	0.4
Acres of Habitat:	1





TOTAL DSAYs/acre: 13.331

4.0 STEP 3: IN-LIEU-FEE

The unit of currency selected for the River Plan/North Reach Mitigation Bank is based off of the methodology of the North Reach Mitigation Bank Habitat Valuation System, described above. Since the output of this system is DSAY/acre, the unit of currency was determined to be cost ($) per DSAY. This final step in determining the in-lieu fee combines the costs and habitat valuation exercises to derive the cost per unit ($/DSAY) for each habitat type.

4.1 Method for Determining Cost per DSAY

The final step in calculating the North Reach mitigation in-lieu-fee (cost per DSAY) is to divide the cost per acre by DSAYs per acre to arrive at the costs per unit ($ per DSAYs).

Table 28 displays the values used to calculate the cost per DSAY for each habitat type.

Table 28. Fee-In-Lieu Calculations for Each Habitat Type

Habitat Type	DSAYs per Acre	Total Cost per Acre	Cost per DSAY
Riverine	13.33 $3,133,5	80	$235,100
Riparian	13.24 $2,224,5	80	$168,000
Upland	11.90 $701,5	80	$59,000
Stream	16.42 $3,624,5	80	$220,700
Wetland	12.57 $319,7	80	$25,400