Logan Creek Headwaters:

Restoration Basis of Design

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Prepared for:

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TABLE OF CONTENTS

I. Introduction and Objectives 1
A. Project Background 4

II. Elements of the Restoration Design 4
A. In-Channel Large Wood Installation 4
B. Weed Control 4
C. Thinning of Alder Canopy 5
D. Planting Native Trees, Shrubs and Herbs 5

III. Detailed Restoration Plans 5

Zone 1: Riparian Forest Restoration 6
A. Current Conditions 6
B. Site Treatment 6
C. Proposed Planting Specifications for Zone 1 8
D. Zone 1 Project Targets, Project Standards, Success Criteria and Recommended Contingency Measures 9
Zone 2: Conifer/Deciduous Riparian Forest and Channel Restoration 10
A. Current Conditions 10
B. Site Treatment 10
C. Proposed Planting Specifications for Zone 12
D. Project Targets, Project Standards, Success Criteria and Recommended Contingency Measures for Zone 2 13
Zone 3: Conifer/Deciduous Forested Wetland Mosaic 14
A. Current Conditions 14
B. Site Treatment 14
C. Proposed Planting Specifications for Zone 3 16
D. Zone 3 Project Targets, Project Standards, Success Criteria and Recommended Contingency Measures 17
Zone 4: Deciduous Forested Wetland Mosaic 18
A. Current Conditions 18
B. Site Treatment 18
C. Proposed Planting Specifications for Zone 4 20
D. Zone 4 Project Targets, Project Standards, Success Criteria and Recommended Contingency Measures 21
Zone 5 : North Hardwood Forested Upland Zone 22
A. Current Conditions 22
B. Site Treatment 22
D. Project Targets, Project Standards, Success Criteria and Recommended Contingency Measures for Zone 5 25

Reference Cited 25

Appendix A – Photographs

I. Introduction and Objectives

The City of Mount Vernon is required by the State of Washington to review, and if necessary, update the City's "Critical Areas Ordinance" (CAO) on a regular basis. As part of the citywide commitment to protect Critical Areas, the City has made a commitment to establish and operate a waters, including wetlands (waters/wetlands) reserve program. The program includes opportunities for donation of lands or easements, volunteer restoration, acquisition of lands, cooperative management of waters/wetlands, and mitigation of impacts to city-required buffers, etc. As part of the reserve program, Mount Vernon established standards and mechanisms to achieve no net loss of Critical Area ecosystem functions and socioeconomic values, while encouraging cost effective and efficient use of lands within the urban areas. This innovative approach was necessary to accomplish the city's Comprehensive Plan growth management goals. With respect to this proposal, and as an outgrowth of the 2006 – 2007 review and revisions to the city's CAO, the City is proposing to restore approximately 9.7 acres of Category II riverine waters/wetlands and their buffers adjacent to Logan Creek, a Type "F" stream located within City of Mount Vernon (Figures 1 and 2). Logan Creek is a headwaters tributary of Trumpeter Creek, a tributary of Nookachamps Creek, a tributary of the Skagit River.

Objectives of the Logan Creek restoration project include restoring natural stream and riparian forest processes increasing hydrologic, biogeochemical, plant community and faunal support ecosystem functions. To this end, restoration elements will include (1) installation of in-channel large wood grade control structures in Logan Creek to prevent further channel incision and create step-pool aquatic habitat, and (2) restoration of a native conifer-dominated riparian forest.

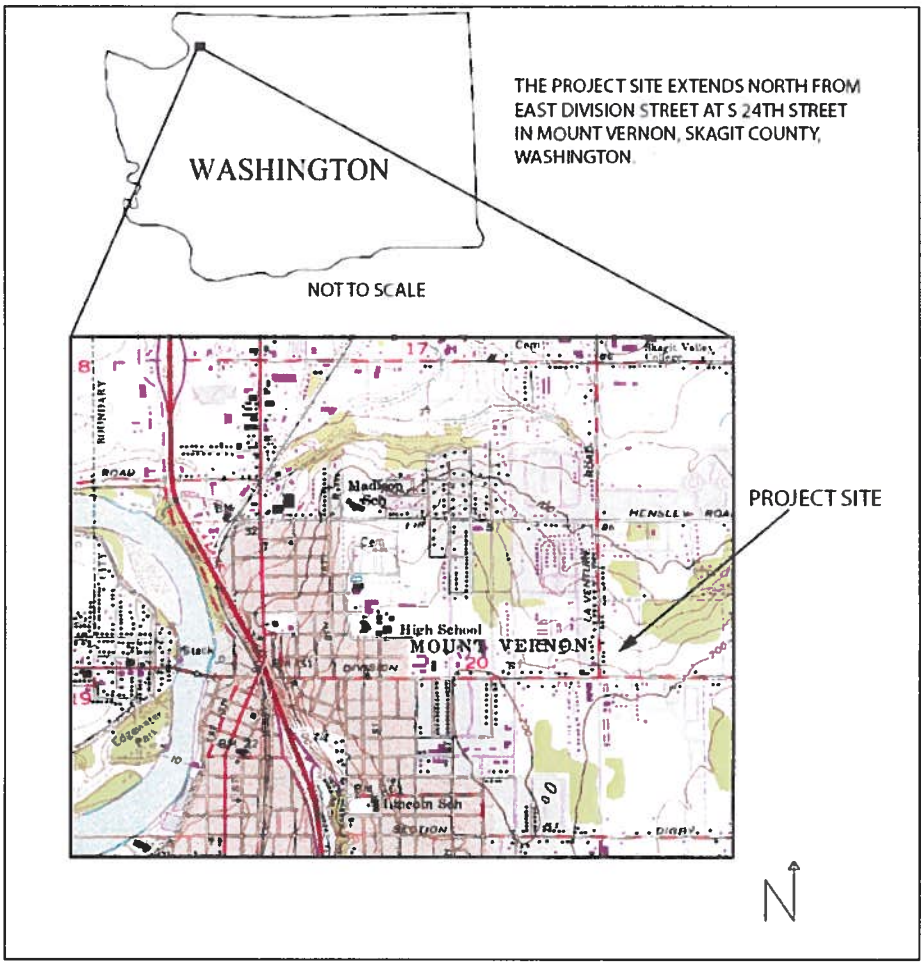


Figure 1. Location of Logan Creek project site.

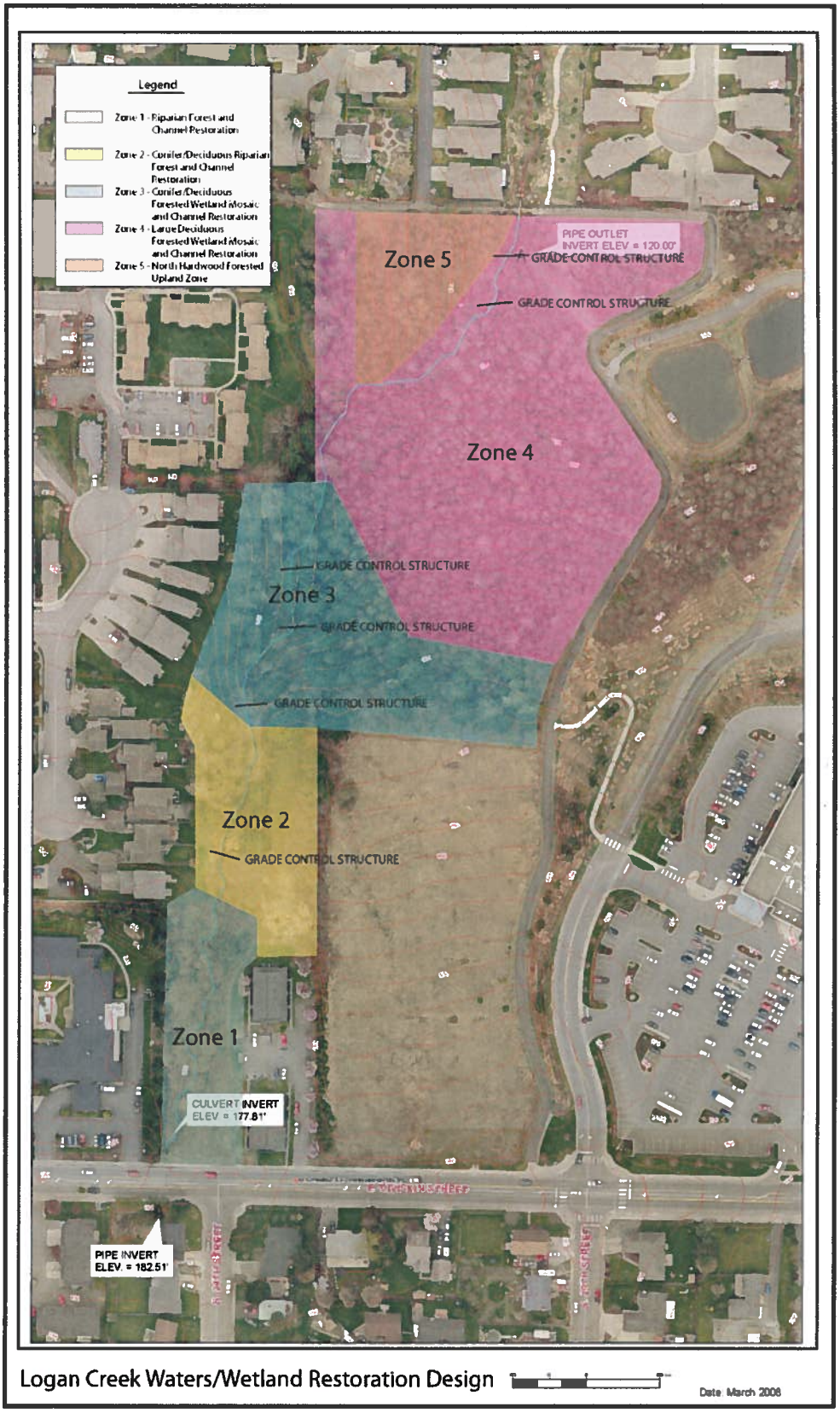


Figure 2. Layout of Logan Creek Project Site.

A. Project Background

The City of Mount Vernon has identified degraded riverine waters/wetlands at the headwaters of Logan Creek, a headwater tributary within the Trumpeter Creek watershed, as a priority waters/wetlands reserve site. The Logan Creek restoration site is a highly incised channel surrounded by moderately degraded wetland/upland forest mosaic. The goal of the Logan Creek restoration is to restore natural processes and waters/wetlands functions within the project area. Specifically, the project will improve ecosystem functioning by enhancing Logan Creek channel and restoring the native riparian vegetative community that has been disrupted by deforestation, urbanization, and invasive species.

II. Elements of the Restoration Design

Upon completion of the restoration design & federal, state, & local permitting, the restoration project will entail: (1) installation of log grade control structures to prevent further channel incision and increase channel complexity, (2) Planting and weed control, (3) Community education and recreation, and (4) maintenance, monitoring, & adaptive management. Interpretive signage describing the restoration project history, objectives and natural history will be placed along the adjacent trail system. Additionally, a web page will be created for the City of Mount Vernon web site will describe the restoration project, while adjacent businesses will be encouraged to "adopt" the project and provide visible local support. Specific restoration project elements are described below.

A. In-Channel Large Wood Installation

Restoring the channel hydrologic complexity, and establishing and maintaining channel geometry will consist of installation of large wood grade control structures. The channel is currently severely incised within the project area and has limited hydrologic complexity. The lack of hydrologic complexity results in a simple, degraded channel structure that will continue to incise over time. The proposed Creek enhancement project will involve 1) installation of large wood grade control structures, and 2) removal of a large discarded culvert located in the Logan Creek channel. Installation of large wood will increase channel complexity, decrease the energy of the system and restore hydrological, biogeochemical and habitat/faunal support ecosystem functions. A JARPA application is being submitted for this proposed in-channel work.

B. Weed Control

Blackberry (*Rubus discolor*) and reed canary grass (*Phalaris arundinaceae*) have invaded extensive areas within the riparian wetlands and buffers adjacent to Logan Creek. Himalayan blackberry is a highly invasive plant which effectively out-competes native understory plants and prevents forest succession by eliminating establishment of shade intolerant trees. Reed canary grass is notorious for being difficult to control and remove once it becomes established at a site. It can tolerate both saturated and dry soils, and has a long-lived seed bank allowing it to re-colonize if weed management efforts are not continued until a dense forest canopy becomes established. Establishing a canopy cover appears to be the most effective, long-term method of control.

Weed control efforts will include: 1) removing current stands of Himalayan blackberry, 2) site maintenance to prevent reestablishment of these invasive plants, and 3) supplemental planting to establish a native riparian forest community that will be resistant to new weed invasions. Blackberry will be controlled by semi-annual cutting all canes off at their bases until the plants senesce, an approximately 3-5 year period. Vegetative material will be removed from the site to the greatest extent possible without damaging desirable native plants to increase success of understory planting. Regular site maintenance will be conducted to control weeds until the tree canopy develops.

C. Thinning of Alder Canopy

Red alder is a native plant in Mount Vernon, but in disturbed, second growth forests, it can dominate and prevent recruitment of conifers. Red alder is a short lived species that grows rapidly and begins to senesce after approximately 60-80 years. Within the project area, senescence of older red alder is already apparent and blackberry is rapidly recruiting within the canopy gaps created beneath these old trees. Healthy riparian forests in this area are composed of a mixture of longer lived conifers and rapidly growing hardwood (alder) trees. This restoration project aims to create a native mixed conifer/deciduous riparian forest within the project area.

Where seedling and sapling understory conifers are present, strategic thinning of red alder canopy will be done (*i.e.*, to release conifers). In areas with dense alder stands and no understory conifer seedlings/saplings, underplanting of conifers (*e.g.*, Douglas fir, western red cedar, western hemlock) will be done in conjunction with thinning. Thinned alders will be sectioned and left in the location in which they fall in order to maximize onsite nutrient recycling.

D. Planting Native Trees, Shrubs and Herbs

Native trees, shrubs and herbs will be installed throughout the project area to increase forest diversity, increase conifer abundance, and diminish coverage and success of invasive species. Plants will be chosen to attain a healthy mixed conifer-hardwood forest. Mulch may be applied in bare soil areas around new plantings. On-going, semi-annual weed control should be conducted.

III. Detailed Restoration Plans

The Logan Creek restoration area has been divided into five zones according to site characteristics and restoration prescriptions as shown in Figure 2. Current conditions, detailed prescriptions, planting specifications, and project targets, standards, success criteria and contingency measures are provided below for each of the five zones.

Zone 1: Riparian Forest Restoration

Figure 3. Zone 1 in green with north orientation. No scale.

A. Current Conditions

Zone 1 is a 0.9 acre area located at the southern most extent of the project with a 365' section of stream channel (Figure 3). The zone is bordered by E. Division Street to the south, an apartment complex to the west, and a retirement center to the east. The vegetation in the area is dominated by Himalayan blackberry (*Rubus discolor)* interspersed with patches of red alder and sparse conifers primarily rooted along the western edge. A steep slope (6:1) forms the right (east) bank of Logan Creek in this zone. The stream buffer is narrow due to encroaching homes and there is a large amount of garbage in and near the channel.

B. Site Treatment

1) Using biodegradable flagging, mark the limit of work and all desirable trees and shrubs rooted within the work area.
2) Using a bush hog, or if necessary by hand, clear blackberry canes throughout the site, taking care to avoid all marked trees and shrubs.
3) Remove trash (*e.g.*, plywood, household refuse, blackberry cane piles) by hand or with a track hoe.
4) Under supervision of a qualified wetland ecologist or landscape architect, determine and mark planting locations according to micro-site conditions.
5) Commence planting in Late October/November or in March. Planting will be stratified according to current micro-site conditions:
    a. In areas currently dominated by blackberries, only trees and shrubs should be planted.
    b. In areas which have a conifer (tree) canopy and are minimally impacted by non-native species, herbs and shrubs should be underplanted to increase habitat diversity.

Plant shrubs, trees, and herbs according to typical planting specifications such as those described in the City of Mount Vernon *CAO Restoration Guidebook* (WSP 2008). Plantings layout should be done for optimum weed management. For example, by planting in aggregated thickets, paths can be mown with a "bush hog" between and

around the plantings. Weed-whacking will be required for weed control immediately around the plantings.

6) Place large wood (logs) in wetland buffer. Logs serve as micro-sites for seedling recruitment, provide a rich nutrient source as they decay, and provide habitat for native animals.
7) Under supervision of a qualified wetland ecologist, on-going maintenance and weed control should be done twice each year, ideally in June and August. If budget constraints will not allow two maintenance visits, one annual site maintenance effort can be done in July.
8) Implement a monitoring plan and provide mid-course correction. Conduct a plant mortality survey at least every 2 years and replace all trees and shrubs that did not survive.
9) Educate public through posting of signage and/or distributing information on the city website, etc about the restoration project and benefits to ecosystem functions.
10) After 5-10 years or after a tree canopy is established and weed species are under control, a suite of herbaceous species should be under planted throughout the zone.
11) Ideally plant material should be 1 gallon container stock. However, 2-3 year seedlings may be substituted.

C. Proposed Planting Specifications for Zone 1

Area		0.9 acres					
Target Plant Community		Riparian/ Upland Transitional Forest					
Goal		200 trees/acres, 100 shrubs/acre					
Strata	**Common Name**	**Scientific Name**	**WIS**	**Plant Material**	**Size (dia.)**	**Density (stems/ acre)**	**Number of Plants**
Tree	Black cottonwood	*Populus trichocarpa*	FAC	1 gallon	1/2 to 1"	10	9
Tree	Red cedar	*Thuja plicata*	FAC	1 gallon	1/2 to 1"	120	108
Tree	Big-leaf maple	*Acer macrophyllum*	FACU	1 gallon	1/2 to 1"	10	9
Tree	Western hemlock	*Tsuga heterophylla*	FACU-	1 gallon	1/2 to 1"	30	27
Tree	Douglas fir	*Pseudotsuga menziesii*	FACU	1 gallon	1/2 to 1"	30	27
Shrub	Black twinberry	*Lonicera involucrata*	FAC+	1 gallon	1/2 to 1"	20	18
Shrub	Indian plum	*Oemleria cerasiformis*	FACU	1 gallon	1/2 to 1"	20	18
Shrub	Snowberry	*Symphoricarpos albus*	FACU	1 gallon	1/2 to 1"	20	18
Shrub	Hooker's willow	*Salix hookeriana*	FACW-	1 gallon	1/2 to 1"	10	9
Shrub	Pacific willow	*Salix lasiandra*	FACW+	1 gallon	1/2 to 1"	10	9
Shrub	Scouler willow	*Salix scouleriana*	FAC	1 gallon	1/2 to 1"	10	9
Shrub	Sitka willow	*Salix sitchensis*	FACW	1 gallon	1/2 to 1"	10	9
Herb	Slough sedge	*Carex obnupta*	OBL	Plug	Plug	100	90
Herb	Panicled bulrush	*Scirpus microcarpus*	OBL	Plug	Plug	100	90

D. Zone 1 Project Targets, Project Standards, Success Criteria and Recommended Contingency Measures

Zone 1	
PROJECT TARGETS	1. Control Himalayan blackberry and other weed species. 2. Establish native plant species. 3. Place large conifer logs in wetland buffer.
PROJECT STANDARDS/ IMPLEMENTAION PROCEDURES	1. Mow, "weed whack", or hand weed the site. 2. Plant native shrubs and trees. 3. Install logs to increase microtopographic variation.
SUCCESS CRITERIA	1. Himalayan blackberry is controlled. 2. Minimum of 80% survival of installed plants. 3. Habitat ("nurse") logs installed adjacent the channel.
RECOMMENDED CONTINGENCY MEASURES	1. Perform continued monitoring and maintenance of weeds. 2. Mow/weed a minimum of 2 times annually following planting. 3. Replace plants which die.

Zone 2: Conifer/Deciduous Riparian Forest and Channel Restoration

Figure 4. Zone 2 in yellow with north orientation. No scale.

A. Current Conditions

Zone 2 is a 1.1 acre area located directly downstream (north) of the Riparian Forest Zone. This zone includes approximately 255' of stream channel (Figure 4). The vegetation in the area is dominated by Himalayan blackberry and red alder, but also includes some areas with sparse western red cedar. Other non-native species observed in this zone include cut-leaf blackberry (*Rubus laciniatus*), English holly (*Ilex aquifolium*), and English ivy (*Hedera helix*). There is large volume of garbage in this zone, including barbed wire and old fence posts, lawn chairs, etc. The channel is considerably incised along this reach.

B. Site Treatment

1) Using biodegradable flagging, mark the limit of work and all desirable trees and shrubs within the work area.
2) Remove non-native and invasive species taking care to avoid all native trees and shrubs.
3) Remove trash (*e.g.*, plywood, household refuse, blackberry cane piles) by hand or with a track hoe.
4) A 20 foot long, 32" diameter corrugated metal pipe culvert has been discarded in the channel within this reach and is no longer serving any purpose. This culvert will be removed using a small track hoe.
5) One grade control structures, consisting of one log (2' diameter, ~ 12 foot long) placed perpendicular to the stream channel, will be installed within Zone 2.
6) Under supervision of a qualified wetland ecologist or landscape architect, determine and mark planting locations according to micro-site conditions.
7) Commence planting in October/November or in March. Planting will be stratified according to current micro-site conditions:
    a. In areas currently dominated by blackberries, only trees and shrubs should be planted.
    b. In areas which have a conifer tree canopy and are minimally impacted by non-native species, herbs and shrubs should be underplanted.

Plant shrubs, trees, and herbs should be installed according to typical planting specifications such as those described in the City of Mount Vernon *CAO Restoration Guidebook* (WSP 2008). Planting layout should be designed for optimum weed management. For example, by planting in aggregated thickets, paths can be mown with a "bush hog" between and around the plantings. Weed-whacking will be required for weed control immediately around the plantings.

8) Place large wood (logs) in wetland buffer. Logs serve as micro-sites for seedling recruitment, provide a rich nutrient source as they decay, and provide habitat for native animals.
9) Under supervision of a qualified wetland ecologist, on-going maintenance and weed control should be done twice each year in June and August, ideally. If budget constraints will not allow two maintenance visits, one annual site maintenance effort can be done in July.
10) Implement a monitoring plan and provide mid-course correction. Conduct a plant mortality survey at least every 2 years and replace all trees and shrubs that did not survive.
11) Educate neighbors on the proposed project and benefits to ecosystem functions.
12) After 10 years or after a tree canopy is established and weed species are under control, a suite of herbaceous species should be under planted throughout the zone.
13) Ideally plant material should be 1 gallon container stock, however, 2-3 year seedlings may be substituted.

C. Proposed Planting Specifications for Zone

Area		1.1 acres					
Target Plant Community		Riparian/Upland Transitional Forest					
Goal		200 trees/acre, 100 shrubs/acre					
Strata	**Common Name**	**Scientific Name**	**WIS**	**Plant Material**	**Size (dia.)**	**Density (stems/ acre)**	**Number of Plants**
Tree	Black cottonwood	*Populus trichocarpa*	FAC	1 gallon	1/2 to 1"	10	11
Tree	Red cedar	*Thuja plicata*	FAC	1 gallon	1/2 to 1"	110	132
Tree	Western hemlock	*Tsuga heterophylla*	FACU-	1 gallon	1/2 to 1"	30	33
Tree	Douglas fir	*Pseudotsuga menziesii*	FACU	1 gallon	1/2 to 1"	30	33
Tree	Sitka spruce	*Picea sitchensis*	FAC	1 gallon	1/2 to 1"	20	22
Tree	Big-leaf maple	*Acer macrophyllum*	FACU	1 gallon	1/2 to 1"	10	11
Tree	Pacific dogwood	*Cornus nuttallii*	NI	1 gallon	1/2 to 1"	10	11
Shrub	Indian plum	*Omelaria cerasiformis*	FACU	1 gallon	1/2 to 1"	10	11
Shrub	Snowberry	*Symphoricarpos albus*	FACU	1 gallon	1/2 to 1"	20	22
Shrub	Serviceberry	*Amelanchier alnifolia*	FACU	1 gallon	1/2 to 1"	20	22
Shrub	Cluster rose	*Rosa pisocarpa*	FACU	1 gallon	1/2 to 1"	10	23
Shrub	Hawthorn	*Crataegus douglasii*	FAC	1 gallon	1/2 to 1"	20	46
Shrub	Black twinberry	*Lonicera involucrata*	FAC+	1 gallon	1/2 to 1"	20	22
Herb	Slough sedge	*Carex obnupta*	OBL	Plug		100	110
Herb	Western swordfern	*Polystichum munitum*	FACU	Bare root	4" ht	40	44
Herb	Oregon grape	*Mahonia aquilfolium*	NL	Bare root	4" ht	40	44

D. Project Targets, Project Standards, Success Criteria and Recommended Contingency Measures for Zone 2

Zone 2	
PROJECT TARGETS	1. Control Himalayan blackberry and other non-native species. 2. Establish native plant species. 3. Establish and maintain cross-sectional and longitudinal channel geometry.
PROJECT STANDARDS/ IMPLEMENTAION PROCEDURES	1. Mow/weed the site regularly. 2. Plant native shrubs and trees. 3. Install 1 large wood grade control structure.
SUCCESS CRITERIA	1. Reed canary grass is controlled. Himalayan blackberry is eliminated. 2. Minimum of 80% survival of installed plants. 3. Relatively stable cross sectional and longitudinal geometry in restoration reach.
RECOMMENDED CONTINGENCY MEASURES	1. Perform continued monitoring and maintenance of weeds. 2. Mow a minimum of 2 times annually following planting. 3. Replace plants which die.

Zone 3: Conifer/Deciduous Forested Wetland Mosaic

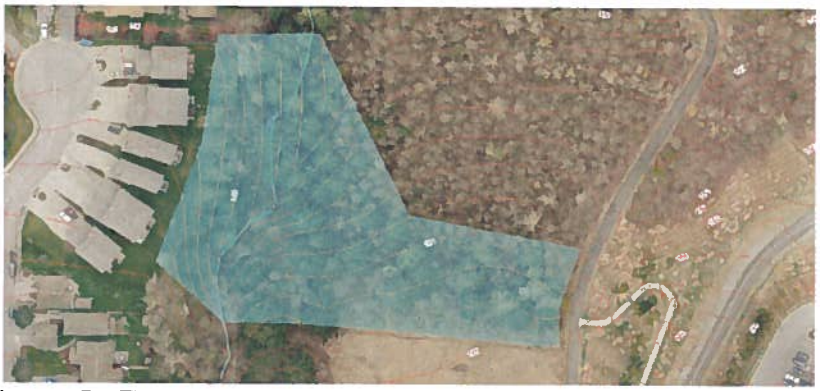


Figure 5. Zone 3 in turquoise with north orientation. No scale.

A. Current Conditions

Zone 3 has an area of 2.2 acres on a north facing slope (Figure 5). The stream channel courses through the zone for approximately 365 feet, going from an elevation of approximately 164' to 134'. The degraded channel is deeply incised (5'-6' depth), with many undercut banks, and a simple channel geometry (no riffle pool sequence). The vegetation in the area currently consists of mostly red cedar and red alder, as well as some Douglas fir. The understory consists of several native species of shrubs ferns and herbs; invasive Himalayan blackberry is also mixed throughout the stand. Zone 3 is characterized by a wetland-upland mosaic with upland areas dominated by red cedar and red alder, and several Douglas fir. The understory consists of several native species of shrubs ferns and herbs; invasive Himalayan blackberry is also mixed throughout the stand. There is garbage of various types including plywood, barb wire and household refuse throughout the zone.

B. Site Treatment

1) Using biodegradable flagging, mark the limit of work and all desirable trees and shrubs rooted within the work area.
2) Remove non-native and invasive species taking care to avoid all native trees and shrubs.
3) Remove trash (*e.g.*, plywood, household refuse, blackberry cane piles) by hand or with a track hoe.
4) Three grade control structures, consisting of one log (2' diameter, ~ 12 foot long) placed perpendicular to the stream channel, will be installed within Zone 3.
5) Under supervision of a qualified wetland ecologist or landscape architect, determine and mark planting locations according to micro-site conditions.
6) Commence planting in October/November or in March. Planting will be stratified according to current micro-site conditions:
    a. In areas currently dominated by blackberries, only trees and shrubs should be planted.
    b. In areas which have a conifer tree canopy and are minimally impacted by non-native species, herbs and shrubs should be underplanted.

Plant shrubs, trees, and herbs according to typical planting specifications such as those described in the City of Mount Vernon *CAO Restoration Guidebook* (WSP 2008). Planting layout should be designed for optimum weed management. For example, by planting in aggregated thickets, paths can be mown with a "bush hog" between plantings. Weed-whacking will be required for weed control immediately around the plantings.

7) Place large wood (logs) in wetland buffer. Logs serve as micro-sites for seedling recruitment, provide a rich nutrient source as they decay, and provide habitat for native animals.
8) Under supervision of a qualified wetland ecologist, on-going maintenance and weed control should be done twice each year in June and August, ideally. If budget constraints will not allow two maintenance visits, one annual site maintenance effort can be done in July.
9) Implement a monitoring plan and provide mid-course correction. Conduct a plant mortality survey at least every 2 years and replace all trees and shrubs that did not survive.
10) Educate neighbors on the proposed project and benefits to ecosystem functions.
11) After 10 years or after a tree canopy is established and weed species are under control, a suite of herbaceous species should be under planted throughout the zone.
12) Ideally plant material should be 1 gallon container stock, however, 2-3 year seedlings may be substituted.

C. Proposed Planting Specifications for Zone 3

Area		2.2 acres					
Target Plant Community		Riparian/Floodplain Forest					
Goal		200 trees/acre, 200 shrubs/acre, 80 herbs/acre					
Strata	**Common Name**	**Scientific Name**	**WIS**	**Plant Material**	**Size (dia.)**	**Density (stems/ acre)**	**Number of Plants**
Tree	Red cedar	*Thuja plicata*	FAC	1 gallon	1/2 to 1"	110	242
Tree	Western hemlock	*Tsuga heterophylla*	FACU-	1 gallon	1/2 to 1"	25	55
Tree	Douglas fir	*Pseudotsuga menziesii*	FACU	1 gallon	1/2 to 1"	25	55
Tree	Sitka spruce	*Picea sitchensis*	FAC	1 gallon	1/2 to 1"	20	44
Tree	Big-leaf maple	*Acer macrophyllum*	FACU	1 gallon	1/2 to 1"	10	22
Tree	Pacific dogwood	*Cornus nuttallii*	NI	1 gallon	1/2 to 1"	10	22
Shrub	Indian plum	*Omelaria cerasiformis*	FACU	1 gallon	12-18"	40	88
Shrub	Snowberry	*Symphoricarpos albus*	FACU	1 gallon	12-18"	40	88
Shrub	Serviceberry	*Amelanchier alnifolia*	FACU	1 gallon	12-18"	40	88
Shrub	Beaked hazelnut	*Corylus cornuta*	FAC	1 gallon	12-18"	40	88
Shrub	Red Elderberry	*Sambucus racemosa*	FACU	1 gallon	12-18"	40	88
Herb	Western swordfern	*Polystichum munitum*	FACU	Bare root	12-18"	40	44
Herb	Oregon grape	*Mahonia aquilfolium*	NL	1 gallon / Bare root	12-18"	40	44

D. Zone 3 Project Targets, Project Standards, Success Criteria and Recommended Contingency Measures

Zone 3	
PROJECT TARGETS	1. Control Himalayan blackberry and other non-native species. 2. Establish native plant species. 3. Establish and maintain cross-sectional and longitudinal channel geometry.
PROJECT STANDARDS/ IMPLEMENTAION PROCEDURES	1. Mow/weed the site regularly. 2. Plant native shrubs and trees. 3. Install 3 large wood grade control structure
SUCCESS CRITERIA	1. Himalayan blackberry is eliminated. 2. Minimum of 80% survival of installed plants. 3. Stable cross sectional and longitudinal geometry in restoration reach.
RECOMMENDED CONTINGENCY MEASURES	1. Perform continued monitoring and maintenance of weeds. 2. Weed control a minimum of 2 times annually following planting. 3. Replace plants which die.

Zone 4: Deciduous Forested Wetland Mosaic

Figure 6. Zone 4 in pink with north orientation. No scale.

A. Current Conditions

Zone 4 consists of most of the northern half of the project site ending at the project site boundaries on the north, east and west sides (Figure 6). The area is a north facing slope of 4.6 acres with 525' of stream channel. The channel gradient lessens within Zone 4 and becomes dominated by cobbles and large gravel. The stream channel is incised, has little woody debris, no key pieces, and little channel complexity. Vegetation is dominated by young (<20 years old) alders, paper birch (*Betula papyrifera*), and sparse bigleaf maple. The forest has a dense birch/alder canopy with few understory conifers. Non-native invasive plants are becoming established but do not dominate the area. Human use is evident, and there is discarded trash throughout the area.

B. Site Treatment

1) Trash (e.g., plywood, household refuse, blackberry cane piles) will be removed by hand or with a track hoe.
2) Two grade control structures, each consisting of one log (2' diameter, ~ 12 foot long) placed perpendicular to the stream channel, will be installed (See sheets 3 and 4 in JARPA application).
3) Non-native (weed) species (e.g., Himalayan blackberry) will be removed by hand or using a small track hoe depending on local accessibility. Weed removal will be supervised by a wetland ecologist. Existing native shrubs and deciduous trees and conifers will be marked and left standing.
4) The red alder canopy throughout the entire area will be thinned by 60% to allow understory conifer plantings to grow. Thinning of alders will be supervised by a wetland ecologist. The felled red alders should be left at the site on or near where they fall and

cut into 4 foot sections or less. Mature cottonwood (Populus trichocarpa), native conifers, native shrubs and paper birch shall be left uncut.

5) Planting layout will be conducted by a wetland ecologist.
6) Commence planting in October/November or in March. Planting will be stratified according to micro-site conditions:
    a. In areas currently dominated by blackberries, only trees and shrubs should be planted.
    b. In areas which have a conifer tree canopy and are minimally impacted by non-native species, herbs and shrubs should be underplanted.

    Plant shrubs, trees, and herbs according to typical planting specifications such as those described in the City of Mount Vernon *CAO Restoration Guidebook* (WSP 2008). Planting layout should be designed for optimum weed management. For example, by planting in aggregated thickets, paths can be mown with a "bush hog" between plantings. Weed-whacking will be required for weed control immediately around the plantings.
7) Place large wood (logs) in wetland buffer. Logs serve as micro-sites for seedling recruitment, provide a rich nutrient source as they decay, and provide habitat for native animals.
8) Under supervision of a qualified wetland ecologist, on-going maintenance and weed control should be done twice each year in June and August, ideally. If budget constraints will not allow two maintenance visits, one annual site maintenance effort can be done in July.
9) Implement a monitoring plan and provide mid-course correction. Conduct a plant mortality survey at least every 2 years and replace all trees and shrubs that did not survive.
10) Educate neighbors on the proposed project and benefits to ecosystem functions.
11) After 10 years, or after a tree canopy is established and weed species are under control, a suite of herbaceous species should be under planted throughout the zone.
12) Ideally plant material should be 1 gallon container stock, however, 2-3 year seedlings may be substituted.

C. Proposed Planting Specifications for Zone 4

Area		4.6 acres					
Target Plant Community		Forested Wetland					
Goal		200 trees/acre, 200 shrubs/acre, 600 herbs/acre					
Strata	**Common Name**	**Scientific Name**	**WIS**	**Plant Material**	**Size (ht, inches)**	**Density (stems/acre)**	**Number of Plants**
Tree	Red cedar	*Thuja plicata*	FAC	1 gallon	Plug	110	242
Tree	Western hemlock	*Tsuga heterophylla*	FACU-	1 gallon	1/2 to 1"	25	55
Tree	Sitka spruce	*Picea sitchensis*	FAC	1 gallon	1/2 to 1"	25	55
Tree	Douglas fir	*Pseudotsuga menziesii*	FACU	1 gallon	1/2 to 1"	20	44
Shrub	Indian plum	*Omelaria cerasiformis*	FACU	1 gallon	12-18"	40	184
Shrub	Beaked hazelnut	*Corylus cornuta*	FAC	1 gallon	12-18"	40	184
Shrub	Red Elderberry	*Sambucus racemosa*	FACU	1 gallon	12-18"	40	184
Shrub	Black twinberry	*Lonicera involucrata*	FAC+	1 gallon	12-18"	40	184
Shrub	Nootka rose	*Rosa nutkana*	FAC-	1 gallon	12-18"	40	184
Herb	Sword fern	*Polystichum munitum*	FACU	Bare root, plug	Plug	200	920
Herb	Slough sedge	*Carex obnupta*	OBL	Bare root, plug	Plug	300	1380
Herb	Small fruited bulrush	*Scirpus microcarpus*	OBL	Bare root, plug	Plug	100	460

D. Zone 4 Project Targets, Project Standards, Success Criteria and Recommended Contingency Measures

Zone 4	
PROJECT TARGETS	1. Control Himalayan blackberry, reed canarygrass and other weed species. 2. Establish native plant species. 3. Place large conifer logs in wetland buffer.
PROJECT STANDARDS/ IMPLEMENTAION PROCEDURES	1. Clear Himalayan blackberry annually. 2. Plant native shrubs and trees. 3. Install logs to increase microtopographic variation, nutrients, and provide micro-site habitat for seedling recruitment and faunal support.
SUCCESS CRITERIA	1. Himalayan blackberry and reed canary grass is controlled. 2. Minimum of 80% survival of installed plants. 3. Habitat ("nurse") logs installed within the slope wetland.
RECOMMENDED CONTINGENCY MEASURES	1. Replace plants which die. 2. N/A. Install additional logs after logs decay.

Zone 5 : North Hardwood Forested Upland Zone

Figure 7. Zone 5 in orange with north orientation. No scale.

A. Current Conditions

This zone is located south of the north most parcel boundary of the project site, and is surrounded by the Deciduous Forest Wetland Mosaic Zone (Figure 7). The relatively flat area consists of 0.8 acres of upland-wetland mosaic. The vegetation is dominated by young red alder. Non-native invasive plants are becoming established, but do not dominate the area yet. Himalayan blackberry is the primary non-native species in this zone. Human use is evident and there is an accumulation of trash throughout the area.

B. Site Treatment

1) Trash (e.g., plywood, household refuse, blackberry cane piles) will be removed by hand or with a track hoe.
2) Non-native (weed) species (e.g., Himalayan blackberry) will be removed by hand or using a small track hoe depending on local accessibility. Weed removal will be supervised by a qualified professional. Existing native shrubs and deciduous trees and conifers will be marked and left standing.
3) Thinning of the alder (*Alnus rubra*) will be conducted over a 5 year period totaling a 60% reduction in alder stem density. Thinning will occur in Years 1 and 5. Thinning of alders will be supervised by a wetland ecologist. Felled red alders should be left at the site on or near where they fall but cut into 4 foot sections or less. Mature cottonwood (*Populus trichocarpa*), big leaf maple, native conifers, native shrubs and paper birch shall be left uncut.
4) Planting will be phased to parallel alder thinning operations. Replanting in thinned "gaps" in the canopy will consist of a suite of species dominated by western red cedar (60%), western hemlock (30%), and Douglas fir (20%).
5) Commence planting in October/November or in March. Planting will be stratified according to micro-site conditions:
    a. In areas currently dominated by blackberries, only trees and shrubs should be planted.
    b. In areas which have a conifer tree canopy and are minimally impacted by non-native species, herbs and shrubs should be underplanted.

Plant shrubs, trees, and herbs according to typical planting specifications such as those described in the City of Mount Vernon *CAO Restoration Guidebook* (WSP 2008).

Planting layout should be designed for optimum weed management. For example, by planting in aggregated thickets, paths can be mown with a "bush hog" between plantings. Weed-whacking will be required for weed control immediately around the plantings.

6) Place large wood (logs) throughout the site. Logs serve as micro-sites for seedling recruitment, provide a rich nutrient source as they decay, and provide habitat for native animals.
7) Under supervision of a qualified wetland ecologist, on-going maintenance and weed control should be done twice each year in June and August, ideally. If budget constraints will not allow two maintenance visits, one annual site maintenance effort can be done in July.
8) Implement a monitoring plan and provide mid-course correction. Conduct a plant mortality survey at least every 2 years and replace all trees and shrubs that did not survive.
9) Educate neighbors on the proposed project and benefits to ecosystem functions.
10) After 10 years, or after a tree canopy is established and weed species are under control, a suite of herbaceous species should be under planted throughout the zone.
11) Ideally plant material should be 1 gallon container stock, however, 2-3 year seedlings may be substituted.

C. Proposed Planting Specifications for Zone 5

Area		0.8 acres					
Target Plant Community		Forested Wetland					
Goal		200 trees/acre, 200 shrubs/acre, 600 herbs/acre					
Strata	**Common Name**	**Scientific Name**	**WIS**	**Plant Material**	**Size (ht, inches)**	**Density (stems/acre)**	**Number of Plants**
Tree	Red cedar	*Thuja plicata*	FAC	1 gallon	Plug	110	88
Tree	Western hemlock	*Tsuga heterophylla*	FACU-	1 gallon	1/2 to 1"	25	20
Tree	Sitka spruce	*Picea sitchensis*	FAC	1 gallon	1/2 to 1"	25	20
Tree	Douglas fir	*Pseudotsuga menziesii*	FACU	1 gallon	1/2 to 1"	20	16
Shrub	Indian plum	*Omelaria cerasiformis*	FACU	1 gallon	12-18"	40	32
Shrub	Beaked hazelnut	*Corylus cornuta*	FAC	1 gallon	12-18"	40	32
Shrub	Red Elderberry	*Sambucus racemosa*	FACU	1 gallon	12-18"	40	32
Shrub	Black twinberry	*Lonicera involucrata*	FAC+	1 gallon	12-18"	40	32
Shrub	Nootka rose	*Rosa nutkana*	FAC-	1 gallon	12-18"	40	32
Herb	Sword fern	*Polystichum munitum*	FACU	Bare root, plug	Plug	200	160
Herb	Slough sedge	*Carex obnupta*	OBL	Bare root, plug	Plug	300	240
Herb	Small fruited bulrush	*Scirpus microcarpus*	OBL	Bare root, plug	Plug	100	80

D. Project Targets, Project Standards, Success Criteria and Recommended Contingency Measures for Zone 5

Zone 5	
PROJECT TARGETS	1. Control Himalayan blackberry, reed canarygrass and other weed species. 2. Establish native plant species. 3. Place large conifer logs in wetland buffer.
PROJECT STANDARDS/ IMPLEMENTAION PROCEDURES	1. Mow the site regularly. 2. Plant native shrubs and trees. 3. Install logs to increase microtopographic variation, add a rich nutrient source, and provide micro-site habitat for seedling recruitment and faunal support.
SUCCESS CRITERIA	1. Himalayan blackberry and reed canary grass is controlled. Coverage weed species decreases. 2. Minimum of 80% survival of installed plants. 3. Habitat ("nurse") logs installed within the slope wetland.
RECOMMENDED CONTINGENCY MEASURES	1. Perform continued monitoring and maintenance of weeds. Mow a minimum of 2 times annually following planting. 2. Replace plants which die. 3. N/A. Install additional logs after logs decay.

Reference Cited

WSP Environment & Energy (WSP) (2008). Critical Areas Ordinance Restoration Guidebook. Prepared for the City of Mount Vernon.

APPENDIX A

Photograph 1. Zone 1 looking north from E. Division Street. Blackberries dominate the steep west-facing slope. A band of conifers lines the western edge of the property.

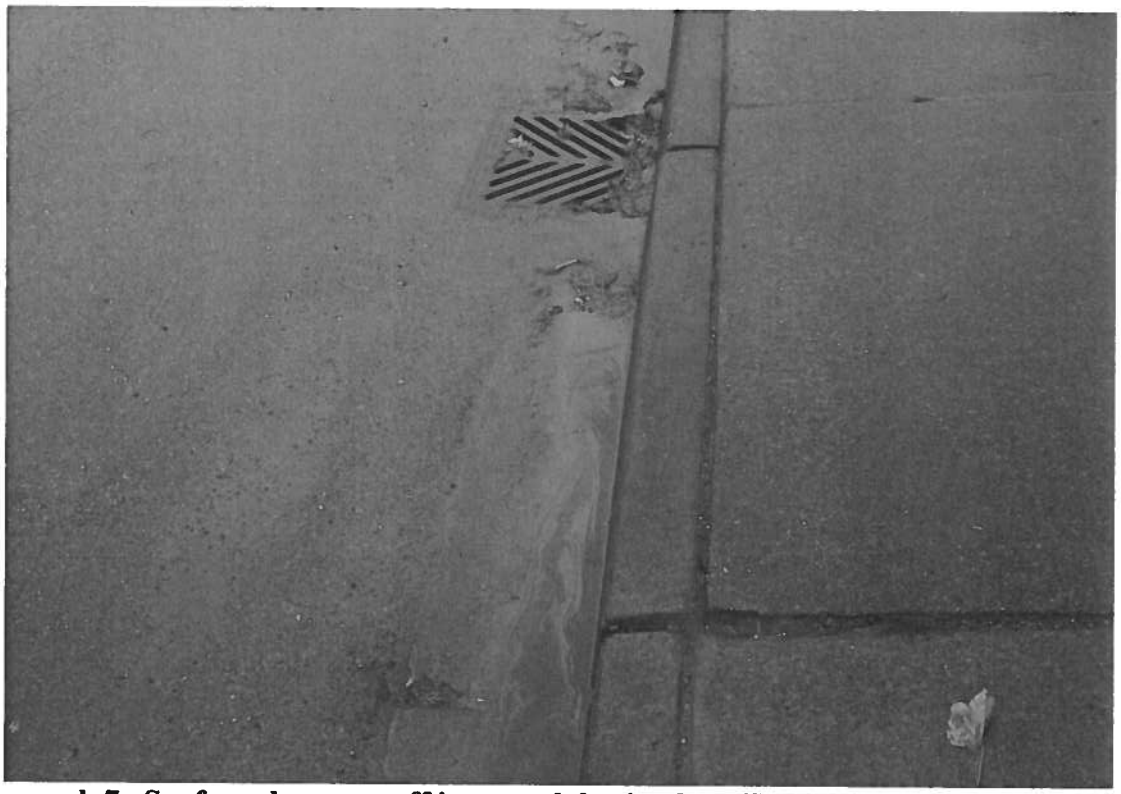
Photograph 2. Zone 2 has several western red cedar trees interspersed within deciduous canopy.

Photograph 3. Eroded, undercut banks line the incised channel within Zones 2 and 3.

Photograph 4. Young alders interspersed with paper birch and few conifers characterize the vegetation community in Zone 4.

Photograph 5. Zone 5 has a relatively diverse plant community including Bigleaf maple, Indian plum, western red cedar, salmonberry, and swordfern.

Photograph 6. Stormwater runoff from E. Division Street drains to the headwater reach of Logan Creek.



Photograph 7. Surface sheen runoff into catch basin along E. Division Street. This water drains directly to Logan Creek.