

Riparian Enhancement Plan Example

RCO developed the following riparian enhancement plan using *Manual 18: Salmon Recovery Grants* appendix M guidelines. It provides a fictional account of a project west of the Cascade Mountains (Forested Ecoregion). In this example, the site is heavily impacted by invasive plants and lacks a functional native riparian community. The site is on the west bank of a fish-bearing stream in a reach with data showing elevated water temperatures that impact rearing and over-summering juvenile Endangered Species Act-listed coho salmon. A section for stewardship work was not provided at this time but may be included in a future version.

Table of Contents

- 1. Existing Conditions Assessment..... 2
- 2. Restoration Objectives..... 4
- 3. Plan Maps..... 5
- 4. Site Preparation Methods..... 6
- 5. Riparian Planting Methods 6
- 6. Implementation Monitoring..... 8
- 7. Post-Implementation Maintenance..... 8
- 8. Adaptive Management..... 9
- 9. As-Built Documentations..... 10
- 10. Stewardship Activity Report 10

1. Existing Conditions Assessment

Overview: This privately owned residential parcel includes a 4.36-acre riparian zone that is 190 feet wide and about 1,000 feet long, on the left bank of Eagle Creek. The left bank is on the west side of the stream and is sparsely vegetated, providing little functional afternoon shade to the stream. About one-third acre of the riparian zone contains single-age-class, native deciduous trees (maple, alder) with the entire site dominated by nonnative reed canarygrass (*Phalaris arundinacea*). Scattered patches of Armenian blackberry (*Rubus armeniicus*) are within twenty feet of the stream edge. Landowners use the riparian area predominantly for access to Eagle Creek and do not mow or manage vegetation on site other than to maintain a walking path to Eagle Creek.

Target species: The salmonid species of concern in Eagle Creek basin is Endangered Species Act-listed (Threatened) coho salmon. Washington Department of Fish and Wildlife Statewide Washington Integrated Fish Distribution data show documented coho presence occurs from river mile zero to four, while recent department spawning surveys show documented spawning between river miles one to three and a half, with rearing presumed from river miles zero to five based on intrinsic potential modeling completed as part of the Eagle Creek limiting factors analysis.

Environmental Setting: The Eagle Creek watershed is in the Western Hemlock Zone. The dominant climax species is western hemlock due to past logging and land management actions; historically the dominant climax species before intense logging would have been western red cedar and Sitka spruce. Widely distributed in western Washington, this zone occurs in all lowlands west of the Cascade Crest, except for areas dominated by human activities. Western hemlock, (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*), western red cedar (*Thuja plicata*), grand fir (*Abies grandis*), Sitka spruce (*Picea sitchensis*), and western white pine (*Pinus monticola*) are common canopy species. Red alder (*Alnus rubra*), bigleaf maple (*Acer macrophyllum*), and black cottonwood (*Populus balsamifera* ssp *trichocarpa*) occur on disturbed riparian sites. Ocean-spray (*Holodiscus discolor*), red huckleberry (*Vaccinium parvifolium*), Oregon grape (*Mahonia nervosa*), sword fern (*Polystichum munitum*), and salal (*Gaultheria shallon*) are common in the uplands understory. The seral community consists of red alder in floodplains; Douglas-fir, salal, and ocean-spray in gaps; salmonberry (*Rubus spectabilis*), devil's club (*Oplopanax horridum*), skunk cabbage (*Lysichiton americanus*), and various sedges and rushes in wetlands; and red huckleberry and Pacific rhododendron (*Rhododendron macrophyllum*) on forest edges. Western red cedar dominates the climax plant associations in the wettest microclimates and Douglas-fir and grand fir dominate the driest sites. Due to the presence of reed canarygrass, the likelihood of natural establishment of native riparian species typical of this watershed is highly unlikely without substantial site preparation and enhancement.

Land use: The site is near river mile three of Eagle Creek main stem. Land use along the lower three miles of the watershed to Eagle Creek's confluence with Rushing River is 30 percent mixed forested uplands, 40 percent mixed rural residential development, and 40

percent small farms development. Above mile three to the headwaters is predominantly commercially managed timber (85 percent) with a few waterfront scattered homesites, mostly seasonal cabins (15 percent) with cleared views of the stream and park-like open grassy stretches with scattered trees. The adjacent upstream property is a rural residential property where the sponsor organization planted a 1.5-acre riparian enhancement project about ten years ago (see project 14-9999, Smith Home on Eagle Creek Riparian Restoration). The Smith site had similar pre-enhancement conditions and a similar recommended treatment approach to the current proposed project. The 1.5-acre enhanced site met performance measures for survival, stems per acre, absolute cover, and species diversity. Species planted and maintenance activities mirror those proposed for this project. The rural residential property downstream-adjacent of the project is in a similar ecological condition to the proposed project. Across from the proposed project, on the right bank on the east shoreline of Eagle Creek, is a forested county park with mature (more than eighty years old) native conifer and deciduous tree species but it contains significant nonnative understory shrub and grass species.

Soils: U.S. Department of Agriculture (1989) mapped soils as silty loam through this section of Eagle Creek floodplain. Silt loam consists of very deep, well-drained soils formed in mixed alluvium. Larush soils are found on floodplains and low terraces with slopes of 0 to 5 percent. They are well drained, with slow runoff and moderate permeability. The sponsor surveyed eight, eighteen-inch deep, randomly located pits on April 25, 2023. Textures were consistent throughout the soil profile. Our experience is that survivorship is high in silty loams.

Hydrology/Water Quality: Eagle Creek is a rain dominated sub-watershed, with some snow melt feeding Rushing River from higher elevations. On the project site, the depth to the water table measured in the summer is greater than forty inches. The floodplain portion of the site is subject to occasional brief periods of flooding from November through April.

Eagle Creek is not listed on the 303 (d) list for temperature, nor does it have an established Total Maximum Daily Loads, but five years of water quality monitoring by the conservation district along this reach show summer temperatures regularly exceed 25°C in late summer and early fall. These temperatures detrimentally impact juvenile coho rearing.

Site Constraints: The primary enhancement challenges include preserving native plants during site preparation and securing a stewardship commitment for more than ten years to ensure canopy closure. Longer term stewardship will help trees establishment and shade out invasive weeds from propagules upstream of the property. Floods greater than a ten-year magnitude completely inundate the site, which poses a risk of damage to plants younger than three years old. Beavers are not evident on site but are known to exist in the basin. Significant ungulate pressure is expected given local populations of deer and elk.

2. Restoration Objectives

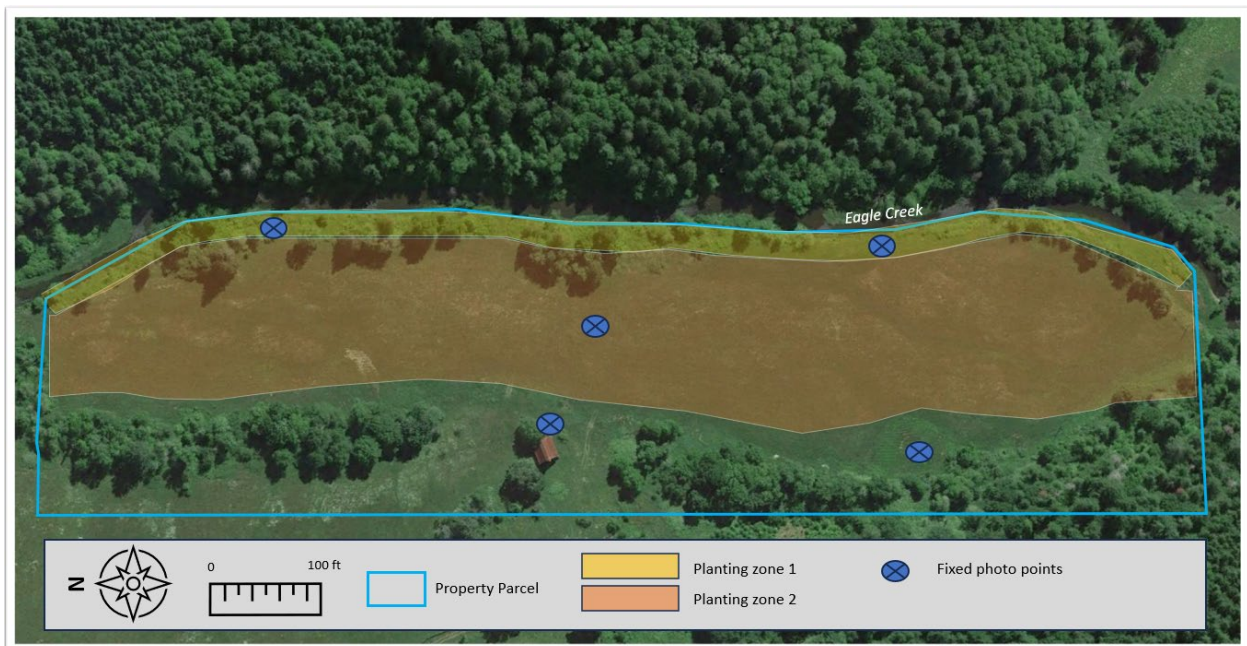
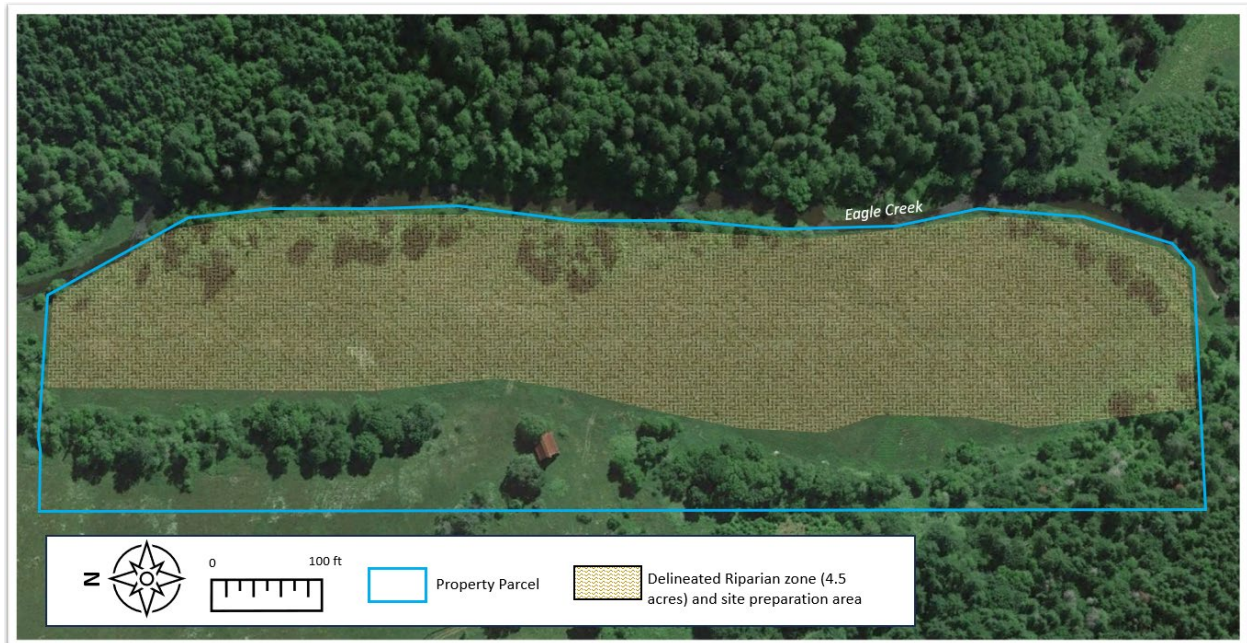
The goal of this restoration plan is to enhance and restore self-sustaining functioning riparian habitat that supports Endangered Species Act-listed coho salmon. The objective is to improve Eagle Creek juvenile coho rearing habitat conditions, specifically by planting native trees on the west bank to reduce summer stream temperatures and to recruit trees for large wood complexity that will increase in-stream habitat. The specific objectives of this project include:

1. Eradicate or suppress on-site invasive weeds across the site through mechanical and chemical control.
 - a. Before planting native species, treat all the site populated with nonnative plants to aid with native plant installation.
 - b. Following initial planting, maintain invasive weed aerial cover of less than 50 percent across the site for the first ten years. The sponsor expects this will allow native species to suppress nonnative cover to less than 30 percent beyond year fifteen.
2. Establish native riparian plant composition on the site using the following guidelines:
 - a. Achieve the Washington Department of Fish and Wildlife-defined 200-year site potential tree height buffer width for this site, which is a 185-foot Douglas fir tree, with the proposed 190-foot planting width.
 - b. Plant tree species at ten feet spacing on center across entire site maintaining 80 percent survival at year five. Expect 80 percent canopy cover at year ten with need to thin for health between years ten and twenty, to optimize native tree growth and vigor.
 - c. Establish native shrub density across entire site with five-foot spacing on center within a twenty-foot buffer from the shoreline (zone 1), to inhibit bank erosion, widening to ten-foot spacing beyond that buffer (zone 2). Maintain 50 percent survival to year five. Native shrub component will be the dominant understory and exceed nonnative cover by year ten.
3. Provide thermal protection of stream to reduce summer rearing mortality of coho salmon. A 190-foot-wide riparian forest along Eagle Creek, with a bankfull width of 25 feet, that runs north and south along this reach, is expected to provide increasing incremental thermal input protection over the course of its maturation.
4. Provide a source of large woody materials from dying or flood-recruited trees on site that will add to in-stream habitat complexity along or downstream of this reach, to

benefit adult coho spawning and passage. Compared with nearby reference sites, the site should provide adequately sized inputs by year eighty.

5. Track performance of enhancement efforts through monitoring in years one, three, five, seven, ten, fifteen, and twenty0 as outlined in monitoring plan found in section 6.

3. Plan Maps



4. Site Preparation Methods

The sponsor will secure funding and hire and supervise field crews to complete site preparation work. The sponsor will secure any permits and licenses needed to complete work, including aquatic noxious weed control permits or land-use permits, and will ensure field crews possess necessary licenses and qualifications. The sponsor will provide forty-eight-hour notice before accessing the property and a minimum of one week notice before completing any herbicide application.

Reed Canarygrass (*Phalaris arundinacea*): Initial site preparation of reed canarygrass will involve a fall treatment of a 5 percent aquatic formula glyphosate in calendar year one, a following spring mow of any remaining thatch, followed by a fall spot herbicide retreatment in calendar year two. Planting of native species will occur either in winter year two or spring year three. Care will be taken to shield native shrubs and forbs on site during initial herbicide treatment.

Armenian blackberry (*Rubus Armeniacus*): Initial site preparation of blackberry will include a calendar year two spring treatment of mechanical mastication using brush cutter of all above ground material and tool-based grubbing to remove large underground crowns. Resprouts site will be spot treated with a 2 percent aquatic formula triclopyr in the following fall and spring, after about three feet of regrowth.

Further control and treatment of these species will be included in the Post-Implementation Maintenance section 7 below.

5. Riparian Planting Methods

Planting will consist of live stakes, bareroot, and potted plant stock. The sponsor will source plant stock using available tools such as the seed-lot selection tool ([seed-lot selection tool](#)) to choose material to increase resilience under the climate change scenario for the region. Bareroot material size will depend on species and availability. The sponsor will install potted stock no later than the end of December. Bareroot material will be planted no later than March. Live stakes will be collected at nearby locations in winter and planted during the same time as bareroot. Any bareroot material remaining will be grown in containers and reserved to replace future mortality during post-implementation maintenance and stewardship. A draft planting plan is included in Table A. It includes a species list for each planting zone. This list is subject to change based on plant availability and landowner input.

Plant stock installation will occur with a power augur when needed, otherwise by digging holes eighteen to twenty-four inches deep by hand with appropriate tool based on soil composition. Shrubs plantings will include a three-by-three square of weed cloth and all plants will receive a three-inch-deep by three-foot layer of weed free mulch at their bases. Vinyl tree protectors with stake support will be installed to prevent herbivory and plant damage during maintenance. Vinyl tree protectors will be removed and properly disposed of

no later than year five of monitoring. Orange or pink flagging will be tied onto the stake to assist in location during post-implementation maintenance. Supplemental watering is expected during the driest months of the year for this site and is accounted for in the Adaptive Management plan (section 8).

Table A: Species List

Zone 1 (Stream Bank to Twenty Feet)		
Trees planted ten feet on center		
Shrubs planted five feet on center		
<i>*Western red cedar and hemlock planted only in areas with existing alder canopy cover</i>		
Species	Count	Stock type
Western red cedar (<i>Thuja plicata</i>)*	50 trees	1 gallon potted
Western hemlock (<i>Tsuga heterophylla</i>)*	50 trees	1 gallon potted
Western red alder (<i>Alnus rubra</i>)	100 trees	1 gallon potted
Salmonberry (<i>Rubus spectabilis</i>)	150 shrubs	12"-18" bareroot
Pacific ninebark (<i>Physocarpus capitatus</i>)	50 shrubs	12"-18" bareroot
Sitka willow (<i>Salix sitchensis</i>)	300 shrubs	24-36" live stake
Red-osier dogwood (<i>Cornus stolonifera</i>)	300 shrubs	24-36" live stake
Subtotal		1,000 plants
Zone 2 (Twenty to One Hundred Ninety Feet)		
Trees planted ten feet on center		
Shrubs planted ten feet on center		
Species	Count	Stock type
Western red cedar (<i>Thuja plicata</i>)*	50 trees	1 gallon potted
Western hemlock (<i>Tsuga heterophylla</i>)*	25 trees	1 gallon potted
Douglas fir (<i>Pseudotsuga menziesii</i>)	1,425 trees	1 gallon potted
Bigleaf maple (<i>Acer macrophyllum</i>)	200 trees	1 gallon potted
Vine maple (<i>Acer circinatum</i>)	200 trees	12"-18" bareroot
Indian plum (<i>Oemleria cerasiformis</i>)	200 shrubs	12"-18" bareroot
Snowberry (<i>Symphoricarpos albus</i>)	400 shrubs	12"-18" bareroot
Red elderberry (<i>Sambucus racemosa</i>)	100 shrubs	12"-18" bareroot
Salmonberry (<i>Rubus spectabilis</i>)	400 shrubs	12"-18" bareroot
Nootka rose (<i>Rosa nutkana</i>)	200 shrubs	12"-18" bareroot
Baldhip rose (<i>Rosa gymnocarpa</i>)	200 shrubs	12"-18" bareroot
Subtotal		3,400 plants

6. Implementation Monitoring

To evaluate if the enhancement activities meet the restoration objectives (section 2), the sponsor will perform implementation monitoring in years one, three, five, seven, and ten after installation and potentially year fifteen and twenty if funding and capacity exist. Percent survival of tree stock will be based on quantitative counts from year one through five. Naturally regenerating species will be included in this count. Starting at year five and beyond, counts will be replaced with percent cover using a minimum of four fixed transects, with percent cover of native and nonnative species determined using the point-intercept method as described by Merritt, et al. 2017. The National Riparian Core Protocol.¹ Alternatively, the sponsor may substitute high resolution drone imagery to determine the percentage of canopy cover of trees, possibly other species, using an off-the-shelf analysis software.

- Percent survival of tree and shrub species (quantitative), years one through five
- Percent canopy cover of native and nonnative vegetation (quantitative), year seven and beyond. Includes planted and naturally regenerating species.
- Vigor and health assessment of species (qualitative)

Monitoring results will allow sponsor to assess the need for adaptive management of the restoration site. Monitoring likely will occur between May and July, to target growing season and correspond with annual maintenance activities. As part of quantitative and qualitative monitoring efforts, the sponsor will take a minimum of three photos at six established photo stations. Drone imagery of the entire site also may be captured. The sponsor will provide a summary of data to RCO in the final report and as part of future stewardship grant requests.

7. Post-Implementation Maintenance

Table B: Maintenance Schedule

Work	Timing
Chemical spot treatment of invasive nonnative plants	Years 1-5 in spring and fall Years 6-10, and 15 in spring only
Replant native species to maintain survival/cover objectives	Years 1-10 in winter
Replace herbivory protection	Years 1-5 in spring
Mulch as needed	Years 1, 3, and 5 in spring
Irrigation	Years 1-3 in summer
Remove herbivory protection	Year 10 in summer
Thin trees to maintain healthy density	Years 10, 15, and 20 in summer

¹Merritt, David M.; Manning, Mary E.; Hough-Snee, Nate, eds. 2017. The National Riparian Core Protocol: A riparian vegetation monitoring protocol for wadeable streams of the conterminous United States. Gen. Tech. Rep. RMRS-GTR-367. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 37 p.

Maintenance will occur until plants reach a stage where natural suppression of invasive species and forest succession appear to be self-sustaining. Control methods of most invasive vegetation will include chemical spot treatment with possible mechanical mowing (hand-held brush cutter) or grubbing as needed. Irrigation will occur via tank mounted truck system, weekly or biweekly depending on precipitation conditions, between July and September.

In addition to sponsor maintenance, the landowner agreed to perform a visual inspection of a portion of the planting area annually for ten years to inform the sponsor of potential challenges including beaver browse, flood damage, plant mortality, or significant site disturbances. The visual inspection may occur any time throughout the year as the landowner is available, although the growing season (March to October) is the best time to inspect plants for mortality. The landowner inspection is intended to be qualitative and limited in nature and will supplement the annual implementation monitoring completed by the sponsor. The landowner may request copies of vegetation monitoring data and reports.

8. Adaptive Management

Ungulate, rodent, flooding, and poor stock source mortality is expected at this site. Replanting from these impacts will occur to maintain survival and cover performance metrics. Under heavier loss conditions, the following adaptive management will be considered.

Ungulate: if grazing pressures cause more than 25 percent mortality and/or significant defoliation of plants, the sponsor will consider use of a spray deterrent. If grazing pressures cause more than 50 percent mortality and/or significant defoliation of plants, the sponsor will consider metal cage protection of highest value species (conifers).

Rodent: if beaver activity causes more than 10 percent mortality of conifers and/or deciduous trees, chicken wire will be applied to tree bases in a to-be determined area from the shoreline and extend further as needed.

Flooding: if any single flood causes more than 25 percent mortality, additional stakes may be added directly to the upstream side of plants in the impact zone.

Irrigation: irrigation will be considered if there are drought conditions after year three or drought conditions during critical normal precipitation seasons (spring) in the growing season during years one through three.

Poor or inappropriate stock: if there is more than 50 percent mortality of a single species from other than the causes listed above, the sponsor will assess plant stock type and source when considering whether to replant or replace if a more suitable species appears warranted.

9. As-Built Documentations

Update the riparian enhancement plan if implementation resulted in significant changes from what was proposed. Be sure to update design drawings, maps, site preparation, planting method, and monitoring elements of the plan as necessary.

No example provided.

10. Stewardship Activity Report

This is a written report that documents activities implemented as part of the stewardship project. If adaptive management was a significant factor, document the changes implemented on site. Provide implementation monitoring results to show how the site is achieving restoration objectives.

No example provided.