

Red Salmon Slough Restoration Project Phase 3 – Lessons Learned

Overall:

This project entailed two major elements to continue the work of Red Salmon slough restoration. The surge plain forest restoration revegetated the lands along the inter-tidal river and just above salt marsh elevation, and the design of the last dike removal in the slough. Two biologist with the Nisqually Tribe worked on these elements. Lessons were gained during the process on how to do it best, what to consider and what not to do.

Lesson learned during planting projects:

Overall this was an easy place to plant, and survival of planted plants is extremely high, well over 90%. The site included fertile soils with sub-irrigation due to the numerous springs and tidal influence. We prepared the site using various techniques, i.e. disking, plowing, and herbicide treatments, which were mostly meant to reduce grass competition in this former pasture. The extensive site prep made for easy and trouble-free planting especially by the numerous volunteers and school children. After the planting was completed, 2 foot tree protection tubes were used, which seemed to have helped with the high survival of the plants. It made for easier post-planting mowing and herbicide treatments since the plants were protected and more visible.

It was a learning experience to plant this close to saltwater and with year-round water influence on the site. Micro site conditions varied drastically due to sun, shade, groundwater influence, freshwater and saltwater influence. Planting each species at a time was very successful since we were able to respond by matching each species preferred growing conditions to those micro conditions. Very high winter tides in the area coincided sometimes with the preferred planting times, and made access to the site very difficult at times.

Dike removal design:

We contracted most of the design work to Wiltermood Associates Inc. and much of the engineering drawings were completed by them and their sub-contractors. A few lessons that were learned was mostly in the form of getting a better understanding of the site conditions, such as soil conditions, it's history: how were those dikes built, for what purpose, and new regulatory hurdles such how to fill wetlands to make them better and how to close of a county road temporarily.

Red Salmon Slough Restoration Project Phase 3 – Dike Removal design

Goal:

To activate and improve on-going passive restoration at the Red Salmon Slough area by enhancing hydrologic connections to surrounding water bodies, removing artificial structures that constrict tidal currents and/or impair water quality, and by restoring any impacted areas to known historic conditions.

- Obj.1** Enhance hydrologic connection to surrounding water bodies by removing 6700 feet of river dike and slough entrance dike and reconnect at least three (3) historic independent Red Salmon sloughs.
- Obj.2** Remove the Red Salmon Slough creosote bridge, any other creosote pilings and fill at least 1000 feet of accessible remnants ditches.
- Obj.3** Restore historic vegetation in project disturbance area, i.e. footprint and fill areas in approximately 2.5 acres.

Alternatives:

Passive Restoration (do nothing) Alternative

Advantage: Low cost, natural evolution if historic processes are in place

Disadvantage: Very long timeline for recovery (100-1000 years), unnatural evolution if historic processes are not place, risk of invasive species,

Phase 3 Restoration

Advantage: short time for recovery (1-100 years), lower risk for invasive species due to higher intensity of management and habitat form manipulation, assist with restoring more natural/historic processes

Disadvantages: Potentially changing evolutionary process due to manipulation, some short-term impact

Full restoration of anthropogenic structures

Description: Same as Phase 3 restoration plus restoring all straightened ditches including less accessible and biologically functioning ditches. It would also include complete removal of site access road.

Advantage: same as Phase 3 alternative

Disadvantages: High impact on site; no private and public access for PR and monitoring efforts.

Site-specific limitations/uncertainties

Some of the site specific limitation to implementing the project and uncertainties are:

1. Reliance on passive restoration

The project restarts the habitat-forming processes and not the habitat forms and it is relying on the passive restoration to do most of the work. Although this is the preferred way to restore habitat, if the process are not restored correctly, evolution might not progress as smoothly and anticipated. Estuaries very dynamic systems and therefore it is hard to predict the exact outcome of any project. In addition, the 700 acre refuge restoration is being implemented at the same time, which dwarfs Red Salmon Slough and will ultimately have an impact on not just the refuge itself but it surrounding area. It is uncertain how this large project will affect this phase of the Red Salmon slough project, although it does have the potential to divert the entire river away from the slough project and therefore make the environment more saline, less river influenced and less dynamic.

2. Challenging site conditions for construction work

Navigating heavy machinery in wetlands is very delicate work. Operating heavy machinery in wetlands with tidal fluctuations is a daunting task. While working in such conditions, compromises have to be made to achieve the goals, and complete them safe and with limited impact to the environment. Predictions of tide height, that determines the construction schedule, are not 100% temporally and spatially accurate. Although many areas seem to support construction equipment, in actuality the substrate will not and therefore adjustments need to be made. Also, Phase 3 does not have large interior pasture sites that make access and staging of equipment easy. Instead we are removing dikes with sensitive areas on both sides that restrict movement considerably.

3. Upland/vs. intertidal vegetation restoration

Actively restoring upland vegetation to prevent invasive plant establishment on the footprint of the dikes will be a difficult task. Any areas that support salt marsh habitat will be left to passive recolonization, but areas above that will be replanted to provide historic riparian habitat. The salinity sensitivity of native woody estuary vegetation will make the exact extent of the plantings hard to define. In most areas for this phase, the salinity will not be determined by the tide height, but by the dynamics of the Nisqually River freshwater pathways. This could result in changes in suitability of these locations over many months.

Rationale for alternative

The Phase 3 alternative will provide the goals and objectives with the less impacts than the full restoration, more certainty than the “do-nothing” alternative, and still will let the restored processes do most of the restoration. Phase 3 alternative is not proposing to fill every straightened and dug channel on the east side of the slough due to existing functioning habitat within and surrounding those channels. The full alternative would fill those naturalized ditches, which would have a higher impact on site with little extra benefit, and uncertainty about navigation of heavy machinery in established salt marsh.

The only other human impact / structure that won't be addressed is the access road. We won't restrict our access road since we will need to continue accessing the site for monitoring, adaptive management, and environmental education and public relations purposes. The road might also serve as a public access in the future and will serve the cause much more remaining in place than the minor benefit reaped from removing it.

The implementation of the chosen alternative will have to include close supervision to ensure changes to the plan can be made when unexpected situations arise. We are planning on almost 100% construction supervision by a project biologist, with the authority to adjust elements of the project.

Extent and nature of treatments of preferred alternative

To achieve the goal and the above-mentioned three objectives, this project will include these action items:

Obj.1 Enhance hydrologic connection to surrounding water bodies by removing 6700 feet of river dike and slough entrance and reconnect at least three (3) historic independent Red Salmon sloughs.

Action #1: Remove the river dikes by excavating to a common elevation for either side and either remove all fill material completely or leave some behind thinly spread or mounded as riparian planting surfaces.

Action #2: Reconnect the low point in the Phase 1 restoration site with a channel to the riverine tidal channel guided by historic conditions.

Action #3: Remove the Red Salmon Slough entrance dikes common elevation and reconnect obvious tidal channels on either side.

Obj.2 Remove the Red Salmon Slough creosote bridge, any other creosote pilings and fill at least 1000 feet of accessible remnants ditches.

Action #1: Remove the remnants of the collapsed Red Salmon slough bridge, including all creosote pilings and dispose of the material properly at the Hawks Prairie Landfill. Cap any piling holes with clean sand.

Action #2: Remove the old hay barn / highway sign made of creosote dispose of the material properly at the Hawks Prairie Landfill.

Action #3: Fill at least 1000feet of accessible remnant ditches on the east side of the project area. Reconnect obvious tidal channel through this area but do not fill every single ditch due to low benefit/high impact to surrounding salt marsh ratio to fill every ditch in that area. Use dike material, if clean, to fill the ditches.

Obj.3 Restore historic vegetation in project disturbance area, i.e. footprint and fill areas in approximately 2.5 acres.

Action #1: Replant any area that is projected to be freshwater riparian, guided by reference conditions nearby. Overplant and assume some loss to salt water.

Action #2: Let natural re-colonization of native salt marsh species take over areas below presumed freshwater riparian habitat elevation

Predictions

We predict that achieving Objective 1 will allow for more frequent tidal inundation from the river with freshwater rather than the highly saline water from Red Salmon Slough. This will initiate changes in the composition of salt marsh species and allow for more freshwater tolerant species to colonize the restoration areas. An increase in sedimentation is also to be expected due to the closer connection with the river that supplies the suspended sediment that is needed for marsh surface accretion. In addition, a distributary could potentially form through the Red Salmon Slough, which would be the first true distributary channel from the Nisqually River in the delta. This would most likely happen during a high tide connected with a flood event, and could happen rather quickly and not in a slow progression over months and years.

The improved connection to the lower Red Salmon Slough due to removal of the dikes on the east side of the slough could potentially increase tidal penetration into the slough, increase sedimentation and tidal channel network in the marshes downstream of the dike and increase sheet flow and marsh accretion upstream.

We predict that the vegetation we plant on the footprint of the dike will take some time to establish until annual tide and river flow cycles will provided the exact conditions for the native species. Some species will not survive and others will thrive, since it will be hard to predict exact inundation level, frequency and salt content. Salt marsh will be recruited within the first 3 years and we predict that most conducive areas will be covered within less than 10 years.

Hypotheses

Several hypotheses could test the prediction through monitoring. These three we find particular interesting and potentially useful for adaptive management:

1. Will removal of the dike change the salt content of tidal prisms and therefore increase the diversity of salt marsh species in Red Salmon Slough?
2. Will the tidal prism increase in volume in Red Salmon Slough?
3. Will the fish and wildlife species utilization change due to the change in hydrologic conditions in Red Salmon Slough?

Red Salmon Slough Restoration Project - Phase 3

Riparian Re-vegetation Design

“Surge Plain” Re-vegetation Conceptual Design Report

This portion of the project will restore 50+ acres of rare salt/fresh transitional forest (“Surge Plain”) at the upper edge of tidal inundation along the Nisqually River and Red Salmon Slough.

Goal

1. Re-establish a diverse self-sustaining native forest and shrub-scrub plant community on 50+ acres of “surge plain” riparian habitat at the Nisqually Tribe’s property along Red Salmon Slough, Nisqually River, and associated tidal marsh.

Objectives

1. Plant 750 native trees and shrubs per acre over 50+ acres
2. Increase diversity of native species in the “surge plain” habitat
3. Plant appropriate plant species for the various hydrologic regimes at the site (wetlands and uplands both present with brackish influence at the lowest elevations)
4. Maintain the planting site for 3 years
5. Ensure successful establishment of at least 600 trees/shrubs per acre after 3 years, and 400 trees/shrubs per acre after 10 years

Alternatives

1. *Passive restoration* – No actions taken
 - a. Advantages – Low/no cost
 - b. Disadvantages – Passive restoration is unlikely to achieve project goals in a reasonable amount of time. Extreme competition from well established pasture grasses would likely inhibit woody plant establishment for many years to come. This approach would likely also result in a relatively low diversity plant community of only the most vigorous and prolific pioneer species, with other later successional species taking decades to establish.
2. *Introduce disturbance then passive restoration* – A treatment of using a combination of tilling and disking and/or herbicide application to disturb the site and allow colonization of native woody species from adjacent forested areas.
 - a. Advantages – Low cost
 - b. Disadvantages – This treatment would run a high risk of colonization by invasive undesirable species and a high degree of uncertainty that a diverse community of native species would colonize the site due to the

lack of adequate seed sources and/or species specific seed dispersal limitations.

3. Full planting (trees) – This approach would involve controlling grass competition as site preparation with plowing and disking and/or herbicide use and planting trees across the entire site. After the trees are established other native understory species would colonize.
 - a. Advantages – Moderate cost, reestablish some ecosystem processes, would establish site on a trajectory to full recovery faster than passive restoration
 - b. Disadvantages – The main disadvantage would be that many of the appropriate shrub species would be slow to colonize and others are not locally present to colonize the site. There is also a greater risk that invasive species would colonize the understory.
4. **Full planting (trees & shrubs)*** - Control grass competition through plowing/disking and/or herbicide application. Plant 50+ acres with a diverse assemblage of native trees and shrubs. Provide maintenance for 3-5 years (competition control). There will possibly be some minor herbaceous plantings in discrete areas as determined by site conditions.
 - a. Advantages – Reestablish wide range of ecosystem processes and structures. Provides high quality habitat for a diverse array of species. Provides a diverse assemblage of woody species. Restores natural sediment transport processes and nutrient cycling.
 - b. Disadvantages – Moderate cost
5. Full planting (trees, shrubs, and herbaceous species) – Control grass competition through plowing/disking and/or herbicide application. Plant 50+ acres with a diverse assemblage of native trees, shrubs, and appropriate herbaceous species. Provide maintenance for 3-5 years (competition control).
 - a. Advantages – Most complete option as far as restoring native species assemblages, fully restoration of ecosystem processes,
 - b. Disadvantages – Very high cost, hard to maintain woody species and control competition with desirable herbaceous species in understory.

Preferred alternative*

Spatially explicit site specific factors affecting achievement of goals and uncertainties

A variety of site specific factors have the potential to influence the achievement of project goal, objectives, and overall success. These include grass competition with woody species, hydrology of the site, flooding from the river, browse and girdling from ungulates/rodents, and the influence of tidal action and potential saline influence. Future sea-level rise is another concern that may affect the project in the longer term.

Each of these uncertainties and ways to mitigate them are discussed below.

- **Grass competition** – Competition for water, light, and nutrients between planted woody species and herbaceous species (especially rhizomatous pasture grasses) can greatly impede the success of plantings. The past land use at the site (livestock pastures) encouraged a pasture-grass dominated vegetation community that has the potential to impact the success of the woody plantings. This uncertainty will be managed by performing adequate site preparation to reduce pasture grasses and manage competing vegetation for three years to ensure the successful establishment of the intended woody plant community.
- **Herbivory** – Damage to woody plantings due to both browse by ungulates and damage from rodents can impact the success of planting projects. There are ungulates in the area that have the potential to impact woody plantings, but it is not likely to be of an intensity to affect overall project success. Potential impacts from rodent activity are a much larger risk at this site. Beaver are established in adjacent wetlands and active on the edges of the site along I-5. There is also a large population of small rodents that currently inhabit the site largely due to past land use and favorable habitat. They can girdle young woody plants at the base causing high levels of mortality. These risks will be managed by placing plant protection around all woody plantings at the site. These will provide a physical deterrent to both beaver and small rodent activity. Mowing of the site or other methods to reduce cover for small rodents will also discourage their activity.
- **Hydrology** – The hydrology of the site in general and at specific locations within the site has a large influence on which species of woody plants are appropriate and will establish at a given location. This site has a particularly complex array of hydrologic influences. There is a large spring fed wetland complex on the eastern edge of the site that provides significant fresh water inputs to the site through out the year. The tidally influenced Nisqually River runs along the western edge of the site. Its water level fluctuates depending on combination of tides and river flow and has the potential to flood over the entire site during wet season flood events. The tidal influence extends to the northern edge of the planting area. This adds additional complexity as predicting an exact line of tidal influence and matching appropriate salt tolerant woody species to the various elevations can be tricky.
- **Sea level rise** – The planting area being entirely on low lying lands skirting the upper level of saline influence will be susceptible to future sea level rise. Over time the plant community will likely evolve to adapt to changes in tidal and sea-level changes. Establishing a diverse resilient native plant community will help the system adjust to future changes in sea level, by providing a buffer of woody vegetation between the marine environment, tidal salt marsh, tidal freshwater marsh, and adjacent infrastructure (I-5).

Preferred Alternative Details

Site preparation – Reduce the influence of existing introduced pasture grasses at the site and prepares the site for planting. This will be accomplished by a combination of tillage and/or herbicide treatment. Any herbicide use will be with aquatic approved herbicide and adjuvant. An aquatic approved formulation of glyphosate and an aquatic approved surfactant will be applied to the site with broadcast spray equipment. All herbicide will be applied by a licensed applicator with aquatic endorsement during the dry season. The site may be plowed and disked after the herbicide treatment to further prepare the site for planting.

Planting – 50+ acres will be planted with native woody species. The plant materials will be a mixture of trees and shrubs that are appropriate for the various hydrologic regimes and the potential for brackish tidal influence. This work will occur over two planting seasons with roughly half the area planted each year. A minimum of 750 plants per acre will be installed.

There are two primary target habitats at the site - uplands that are only inundated when the river floods and wetlands which are a combination of freshwater wetlands fed by springs along the eastern edge of the site and to the east of I-5, and wetlands that are fed by ground water and rainfall along the central and western portions of the site. All along the northern edge of the site interaction with brackish water is another factor in species selection. Species on the wetland plant list were selected for salt tolerance and can stand some level of brackish influence during extreme winter high tides. This are is the trickiest to plan for as recent dike removals have altered hydrology and tidal prism and site conditions continue to evolve and equilibrate. The strategy we have chosen is to plant slightly into the brackish areas and let the plants adjust to their preferred zones.

Table 1.

Wetlands - Salt-Fresh Transition Forested Wetland (~22.5 acres)	
Trees (33%) 225/ac	Shrubs (66%) 550/ac
Malus fusca (crabapple)	Salix hookeriana (Hooker's willow)
Fraxinus latifolia (Oregon ash)	Rosa pisocarpa (Swamp rose)
Alnus rubra (red alder)	Salix sitchensis (Sitka willow)
Salix lucida (Pacific willow)	Myrica gale (sweet gale)
Picea sitchensis (Sitka spruce)	Lonicera involucrata (twinberry)
Uplands - Surge Plain Forest (~22.5 acres)	
Trees (50%) 387/ac	Shrubs (50%) 388/ac
Acer macrophyllum (big-leaf maple)	Oemlaria cerasiformis (Indian plum)
Prunus emarginata (bitter cherry)	Physocarpus capitatus (ninebark)
Populus balsamifera (cottonwood)	Sambucus racemosa (red elderberry)
Alnus rubra (red alder)	Symphoricarpus albus (snowberry)
Thuja plicata (red cedar)	Rubus spectabalis (salmonberry)
Picea sitchensis (Sitka spruce)	Salix scouleriana (Scoulers willow)
Frangula purshiana (cascara)	Acer circinatum (vine maple)

Plant materials will be a combination of 1-gallon containers for volunteer plantings (approximately 8000), bare-root plant materials (approximately 18500), and live-stakes (approximately 10000). The volunteers will be recruited from a variety of sources including public week end events, targeted group events (i.e. Intel, Ft Lewis), and school groups (3rd grade through high school). The bare-root and live-stake plants will be primarily installed by a crew of Nisqually tribal members. Species to be planted are listed in Table 1.

Small trial plantings of herbaceous species may be included in this work if site conditions are favorable. This may include sedges and/or rushes that may not have local seed sources to re-establish viable populations and are important cultural plants for Tribal members.

The existing forested wetland systems along the river, the Nisqually National Wildlife Refuge across the river, and other local tidal fringe plant communities were used as reference sites to determine appropriate plant species and elevations.

Protection – In order to protect the plantings from damage by beavers, small rodents, and to some extent ungulates - tree tubes will be installed around all woody plantings. These will consist of 18” recycled plastic tubes secured to the ground with 24” wooden stakes. The tubes will also help to protect the plants from damage that may result from maintenance activities (mowing/vegetation management) and help them to remain visible for monitoring activities. The tubes will be removed and recycled after three to five years when the plants are established.

Maintenance – Managing competing vegetation is planned to occur for three years after plant installation to ensure that the plants get a good start and are not out competed by weeds and/or pasture grasses. Mechanical control and spot herbicide treatments are both being considered as options to manage competing vegetation and invasive species at the site.

Predict how the proposed action will result in changes to structures processes and functions and what factors external to, prior to, or subsequent to the action will affect that prediction

Changes to Site Structure, Function, and Processes

Structures

The 45-acre planting site will change from a pastured agricultural area dominated by introduced pasture grasses with no woody cover to a multi-layer forested community dominated by a diverse array of native woody species including. Small plantings or seeding of native emergent plants may be installed as appropriate. Maintaining the plantings for a period of three years will greatly improve the likelihood of successful establishment.

Over time the site will develop into three distinct habitats: upland riparian forest, forested wetlands, and scrub-shrub wetland. Small areas along the fringes may develop into emergent wetland or high salt marsh depending on tidal actions, sea level rise, and hydrologic changes at the site. Since this site is still in active recovery from recent dike removals, has a complex hydrologic regime influenced by beaver activity, is slightly above the current tidal prism, and is in the active river deposition and meander zones - it will continue to evolve over the long term. Re-establishing the historic woody plant community will allow the site to be more resilient while also providing greatly improved habitat for a broad array of fish and wildlife species.

Processes

Woody Debris Recruitment – As the planted riparian vegetation matures wood will become available as debris that can be recruited into the estuary. The current pasture condition does not provide a source of wood for Red Salmon Slough, Nisqually River Estuary, and adjacent nearshore. Adequate maintenance to ensure the survival of the planted tree species will be critical to providing a source of woody debris.

Shade – The plantings along the river will increase the shading of the channel and help to moderate channel temperatures in the lowest reach of the river. The wetland areas of the site will also benefit from the shade provided by the forest and shrub-shrub plant community as well as any future tidal channels that may form in the transition zone.

Erosion/Sediment Transport – Restoring the surge plain forest will allow natural erosion and deposition processes to re-establish. These processes will facilitate the rebuilding of tidal marsh elevations in adjacent tidal marsh restoration that has been subject to subsidence, as well as supplying an additional source of sediment to build marsh elevations in the adjacent Nisqually National Wildlife Refuge restoration project.

Litterfall/Nutrients – Re-establishing forested conditions at the site will restore natural nutrient cycling and litter fall in a habitat is directly adjacent to the estuary. Restoring these processes will help provide food web support and nutrients to the estuary.

Carbon Storage – Woody vegetation will provide longer term carbon storage than the pastures that currently exist at the site.

Restore Habitat Forming Processes – Restoring the surge plain habitat to a forested condition will re-establish a wide range of habitat forming processes. These processes will allow the surge plain and delta to be a dynamic system where natural disturbance regimes are allowed to create diverse habitats that will benefit a wide range of species.

Functions

Providing a functional riparian buffer for the Nisqually River, Red Salmon Slough and tidal marsh is the primary function of this project. Establishing woody vegetation across the site will provide the various functions listed below.

Food Chain Support – The organic matter and litterfall provided by the target plant community will provide nutrients to support the food web at the site and adjacent estuary.

Water Quality – The proposed actions will provide improved water quality function that will benefit the adjacent Nisqually River, Red Salmon Slough, and estuary when compared to the prior condition as livestock pasture.

Noise Buffer – As it matures the woody plant community will provide a buffer from the noise of I-5, which runs directly adjacent to the site. This will allow wildlife to utilize the site without the disturbance of observing vehicles on the highway and lower decibel levels along the river and estuary. These changes should improve the utility of the site for wildlife and allow greater use.

Habitat Linkages - Restoring both linkages of the upland/aquatic ecotone and of the saltwater/freshwater ecotone because it is riparian and well as forested transition habitat will increase the value of the site.

Identify opportunities to answer questions important for improving capacity of regional restoration planning or design via monitoring.

There are a number of interesting questions that can be answered while restoring the native woody plant community at this site. The first being: at what elevations can various species of woody plants survive adjacent to a tidal salt marsh? This question can be answered by planting a range of woody species at the edge of tidal influence and monitoring to see which will survive limited exposure to brackish water. This information will be helpful in determining the appropriate elevations for woody plantings on other surge plain re-vegetation projects. Another question that can be answered is: What management/maintenance actions are most successful at establishing native woody plantings in former agricultural fields?

Construction Sequence for project actions

2007

Summer – Fence Removal

Late Summer – Site Preparation

Early Fall – Layout

Fall – Volunteer Plantings

Fall/Early Winter – Live Stake Plantings

2008

Winter – Bare-Root Plantings and Protection Installation

Early Spring – Finish Plant Protection Installation

Spring/Early Summer – Seedling Release Mowing or Spraying

Summer – Mowing and Monitoring

Late Summer – Site Preparation for Second Phase

Fall – Volunteer Plantings

Late Fall/Early Winter – Live-Stake Planting

2009

Winter – Bare-Root Planting and Protection Installation

Early Spring – Finish Plant Protection Installation

Spring/Early Summer – Seedling Release Mowing or Spraying and Herbaceous Plantings (if determined appropriate)

Summer – Mowing and Monitoring

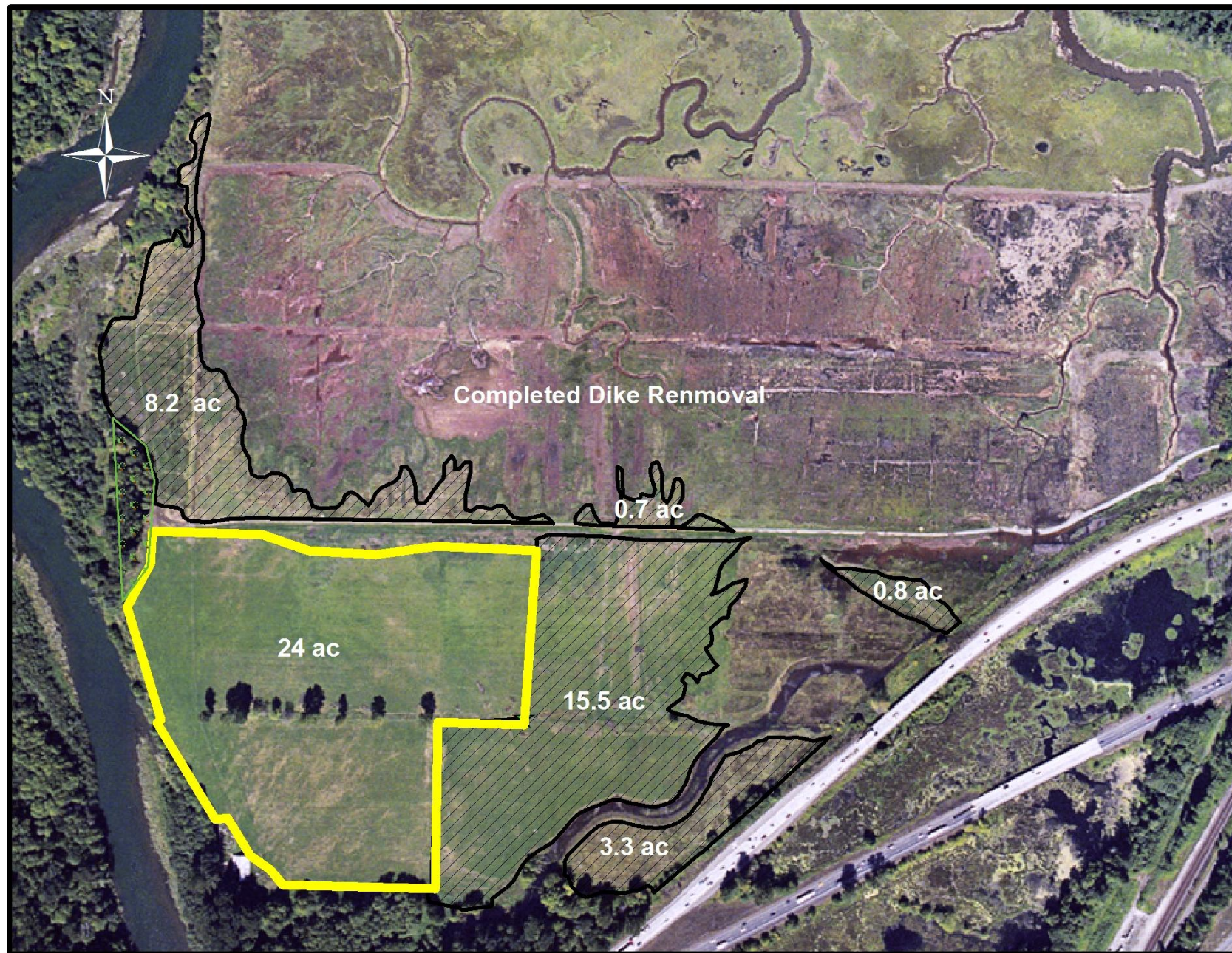
2010

Summer – Mowing and Monitoring

2011

Summer – Mowing and Monitoring

Braget Surge Plain Plantings 2007-2009



Yellow box is 2007-08 planting area
Black hatched area is 2008-09 planting area

390 195 0 390 780 1,170 1,560 Feet

Planting, Maintenance and Monitoring Plan for

Nisqually Basin Riparian Re-vegetation Projects



**Nisqually Indian Tribe
Department of Natural Resources**



Salmon Recovery Program Technical Report No. 3

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Maintenance and Monitoring Plan for Nisqually Basin Riparian Re-vegetation Projects

1. Introduction

Lack of a mature and healthy riparian buffers along streams is a major limiting factor to healthy aquatic ecosystems. Riparian vegetation provides various attributes such as shade, input of organic debris, bank stabilization and others, which influences fish and especially salmon habitat. Re-planting native vegetation in previous cut riparian forests is a major tool to restore depressed salmon runs in the Nisqually River Basin and other Pacific Northwest basins. Although only native and site appropriate vegetation will be replanted, it is important to monitor and maintain the seedlings to ensure successful establishment. This Plan will outline appropriate a monitoring and maintenance (m&m) regime which will ensure high survival for riparian re-vegetation. It will also act as a log book to track any riparian plantings and m&m efforts in the Nisqually River basin.

2. Planting Goals and Methods

Goal

The goal for riparian planting projects is to restore the natural riparian buffer along stream that has been altered in the past. Alteration can range from complete eradication of any plants to selective or past logging that has diminished the desired riparian species. The most desired species are, in most case, a wide array of shrubby species, and tree species typical for the treatments site.

Planting methods

Several ready available guides describe and illustrate methods and techniques of setting up and implementing a riparian planting. This chapter will only explain Nisqually basin specific methods and considerations.

Plant protection

Depending on budget available for the project is desired to include Plant Protection Tubes for most plants. These tubes protect the seedlings from wildlife damage, provides the seedling with a hard shell that protects it from being engulfed by competing plants and at the same time acts as a mini greenhouse. It also protects the plants from being cut by mowers or weeding equipments used in maintenance efforts. Studies have shown that these tubes significantly increase the growth and survival of newly planted seedlings. These tubes, stay on medium to large trees until the tree trunk destroys the by then bridle plastic. The tubes on small trees or shrubs should be removed after 3-5 years when the plant has outgrown competing grasses and the danger of animal browse has significantly decreased. If the budget for a planting project does not allow for 100% of plants to be tubes it is recommended tubes these plant groups in order of importance:

1. Coniferous trees
2. Large deciduous trees (rooted)
3. Small deciduous trees and shrubs (rooted)
4. Large deciduous trees (live stakes)
5. Small deciduous trees and shrubs (live stakes)
6. Rhizomatous shrubs (i.e. Nootka Rose; Snowberry, Oregon grape, etc.)

Planted ground cover, grasses, rushes or sedges should never be tubed.

It is also recommended to use full tubes rather than rolled and stapled tubes due to their lesser need of maintenance and durability.

Passive Weed control

To keep competitive weeds and grasses away from the planted tree or shrub, various weed control methods can be employed. Before planting, weeds and grasses should be mechanically or chemically treated to give the seedlings a few years of advantage over the competing plants. At planting time, weed mats or mulch should be laid out around the plants to give the plant the competitive advantage. Mulch should not be employed if the area has a high flood risks. If the budget for a planting project does not allow for 100% of plants to be matted, it is recommended that these plant groups should be matted, in order of importance:

1. Coniferous trees
2. Large deciduous trees
3. Small deciduous trees and shrubs (rooted)
4. Large deciduous trees (live stakes)
5. Small deciduous trees and shrubs (live stakes)

Planted ground cover, grasses, rushes, sedges, and rhizomatous shrubs (i.e. nootka rose; snowberry, etc.) should not be matted since it will impede the proliferation of the plant.

Plastic weed mats do not need to be removed after establishment, since they will break down after several years, especially they are not covered with mulch.

Prairie ecosystems

A large part of the Nisqually basin is part of the South Puget Sound Prairie ecosystem that function differently than most western Washington lowland forest ecosystems. The riparian vegetation community is different than along other rivers, and the soils are distinctly different, excessively drained and poor in nutrients. Reed Canary grass is very prevalent along many of these streams due to the prairie stream run-off regime. Due to the disadvantages conditions along these streams, survival and growth will most likely be lower than other streams. Special care should be taken when planting along these streams to insure high success and establishment rates.

3. Maintenance

Monitoring

To enumerate success of the planting, monitoring should occur once a year during the late spring months (preferable May, when no maintenance is needed and most plants are not dormant anymore). Monitoring is an integral component of adaptive management, which will lead to better decision-making about planting projects in the future. Key components of adaptive management are:

1. Identifying indicators for ecological functions and habitat values
2. Setting measurable objectives for the indicators
3. Planning and implementing actions
4. Monitoring the indicators
5. Evaluating the measurable objectives and reporting results and
6. Revisiting and altering rules and laws of implementations.

Our indicator is plant survival, which is the main data point that needs to be collected during monitoring procedures. Our objectives are:

- 80% first year survival and 70% three year establishment rate of the total number of plants
- In prairie streams, it is 80% first year and 60% three year establishment of the total number of plants

The annual monitoring procedure will include a tally of the alive vs. dead plants by species, number of stressed plants, and if possible, measurement of growth on all or some of the species. Maintenance needs and time commitment needed should be recorded at the same time or at an initial walk-through. Reporting occurs through annual monitoring report sheet (see appendix 1) for each planting site. These reports will be helpful for the maintenance staff as well as the analysis of meeting the objectives.

After three years the plant is considered established and needs no more regular maintenance, although periodically the site should still be monitored. This include visual inspection of all plant condition and check for maintenance needs of the planting site.

Maintenance methods

Maintenance of planting can be accomplished using a variety of methods depending on the needs and condition of a site. The three main elements of that the seedling need to survive to establish them selves is sunlight and water and nutrients. The first will be provided by planting them the appropriate way and protecting them with tree shelters (see above). Competing grasses and weeds that might shade the plant will be passively suppressed by the weed mats, but in many cases also needs to be actively managed and controlled. The surrounding weeds and grasses also compete for nutrients and therefore needs to be controlled in the early years. The need for additional nutrients (i.e. fertilizer) is considered a non-issue since the species selection should be adapted to the natural availability of nutrients. It also might promote the growth of competing vegetation if not applied properly. Irrigation is also needed to be supplemented during the first several establishment years, especially in the summer months. The lack of water is probably the leading cause of non-establishment / early mortality in planted seedlings and should be avoided above all else.

Active weed control

Competing weeds and grasses can actively be controlled by various methods appropriate for the site. These suppressive methods include: chemical control, physical control through mowing, trimming, cutting or trampling, or biologically through grazing, etc. Each method has its dis- and advantages and is more appropriate at some sites than at another.

Chemical control is expensive and requires care not to negatively affect the surrounding environment, i.e. existing beneficial vegetation and water quality. It is highly effective for noxious and nuisance weeds such as reed canary grass, non-native blackberry shrubs, or poison hemlock. If uniform stands of such weeds are encountered, it is recommended to treat those chemically before plantings begin. After riparian plants are planted it is only recommended if treatment will not compromised those plants.

The easiest physical control of weeds and grasses is mowing the grass at least once during the growing cycle. During the first summer, and at places where weeds are dominated by fast growing grasses (e.g. reed canary grass) the areas should be mowed at least twice during the growing cycle to keep them from competing with the plants. The mowing can be accomplished using a lawnmower, brush mower, weed eater, or even hedge shears. Care should be taken that only the grass is cut not the planted native trees and shrubs.

Trampling can be effective if the grasses are high enough to break once stepped on. It requires a lot of labor and is less effective than mowing.

Grazing is an option if livestock is in the area and the plant large or it is protected from trampling or grazing damage. It is and especially easy way of preparing a site for plantings in the fall months before the grasses and weeds have disappeared. Livestock can compact sensitive soils and should only be used before a planting and after several years after the planting and if water quality can be protected at the same time.

Irrigation

During the first year after planting it is critical that the planted trees and shrubs get watered. Irrigation can occur starting in May and last until October. The objective is to supply the plant with enough water through the normal rainfall or through irrigation that each plant receives 4 inches of water per month. During the middle of the summer, the Nisqually basin receives almost no precipitation and all the water needs need to be addressed through irrigation.

The second year, the plant should be more established and more deeper root network to supply its water needs by itself. Irrigation should still be applied to ensure 2 inches of month throughout the May to October growing season.

During the final and last year of maintenance, the plants should still be irrigated to ensure 1 inch of rainfall to the plant each month. On average, all months except July and August do provide enough rainfall to reach that goal.

4. Idealized Schedule

Monitoring	1st Year	2nd year	3rd year	4th+ Year
Walk-through	Early May ; check for maintenance needs	Early May ; check for maintenance needs	Early May ; check for maintenance needs	not needed
Survival goal	80 % establishment rate	Min. 70% survival rate	Min. 70% survival (60% in prairie)	Planting report
Maintenance				
Mowing	Very important; at least two times	Important; at least once	Once before growing cycle	
Watering	4+ inches	2+ inches	1+ inch	
Others	Ensure tubes are still in place	Ensure tubes are in place	Ensure tubes are in place	Start removing tubes

5. Record keeping

In the Appendix of this document a separate section for each planting in the Nisqually River Basin should be provided. Each section includes a RIPARIAN PLANTING DATA SHEET and a seperate RIPARIAN PLANTING MAINTENANCE SHEET for each year. The beginning of the appendix should include a table that chronological lists all plantings in the Nisqually River watershed.

The RIPARIAN PLANTING DATA SHEET included information about the planting; i.e. the planting plan. This includes: general information about the site, a sketch of the planting site with sections, dates of when each section was planted, the species and type of protection used in each section.

The RIPARIAN PLANTING MAINTENANCE SHEET needs to be filled out each May during the intial walk-through and information will be provided on: maintenance and monitoring needs, special considerations, and work and monitoring performed.

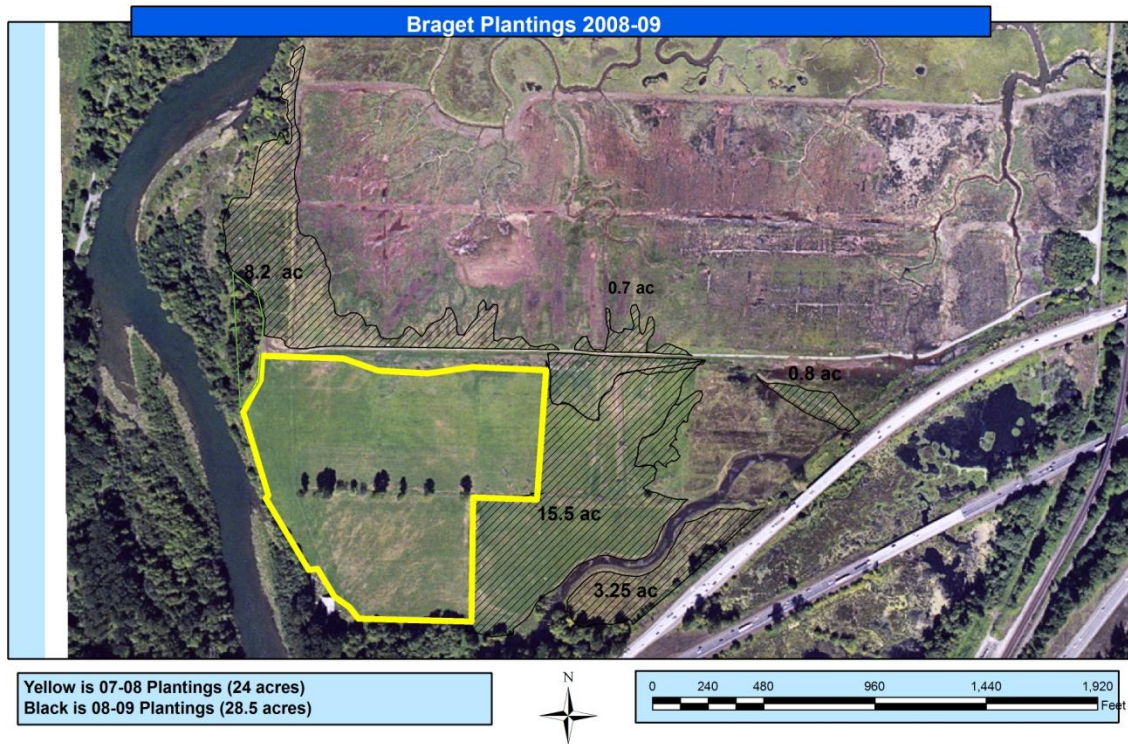
After three years the planting chapter should include a one-page end report which will show if and how the goals and objectives were achieved and if additional work is needed after the 3-year period.

Appendix A

Revegetation As-built design

Red Salmon Slough Restoration Project Phase 3

	30 ac	24 ac	total = 54 ac
Total Braget March Surge Plain Plantings	2008-2009	2007-2008	
Acer circinatum (vine maple)	63	585	
Acer macrophyllum (big-leaf maple)	526	535	
Alnus rubra (red alder)	1784	2230	
Cornus sericea	200	245	
Corylus cornuta	100	0	
(Crataegus douglasii) black hawthorne	0	60	
Fraxinus latifolia (Oregon ash)	735	891	
Lonicera involucrata (twinberry)	980	528	
Malus fusca (crabapple)	2574	1151	
Oemlaria cerasiformis (Indian plum)	1002	268	
Myrica californica (wax myrtle)	0	100	
Physocarpus capitatus (ninebark)	263	336	
Picea sitchensis (Sitka spruce)	1242	1057	
Pinus contorta (shore pine)	0	487	
Populus blasamifera (cottonwood)	1900	850	
Psuedotsuga menziesii (Doug. Fir)	0	500	
Rhamnus purshiana (cascara)	326	423	
Ribes divaricatum (swamp gooseberry)	100	0	
Rosa nutkana (Nootka rose)	0	577	
Rosa pisocarpa (Swamp rose)	1330	600	
Rubus spectabalis (salmonberry)	1002	535	
Salix hookeriana (Hooker's willow)	2500	1650	
Salix sp (Pacific/Sitka willow)	1650	1325	
Salix scouleriana (Scoulers willow)	526	1625	
Sambucus racemosa (red elderberry)	852	571	
Spirea douglasii (spirea)	0	500	
Symphoricarpus albus (snowberry)	1402	220	
Thuja plicata (red cedar)	1752	738	
Tsuga hertophylla (Western hemlock)	0	200	
Vaccinium ovata (evergreen huckleberry)	0	90	
Totals	22809	18877	41686



Feb 2008 after planting of yellow area:



August 2008:



Summary:

From 2007 to 2009 over 41,000 plants were planted as part of the Red Salmon Slough Restoration Project Phase 3. This planting is restoring over 54 acres of critical surge plain forest habitat in the Nisqually Estuary. With a combination of tribal crews and volunteers, 30 different species of native shrubs and trees were planted using a variety of plant stock type, including live cuttings, bare-root plants and potted plants. Almost all plants are being protected from grass mowing operations and from the large rodent population in the former pasture with the help of temporary plastic tubes. Besides mowing, grass and weed competition is being suppressed using chemical means.

Nisqually Indian Tribe crew: February 2009:



Volunteer planting event November 2008:

