Appendix E:
CCNRD Mission Creek
Vegetation Management Guide

Lower Mission Creek
Vegetation Management Guide

July 2018
Mission Creek Water Quality Phase 1
Mission Creek Water Quality Restoration Plan

CONTENTS

1.0 INTRODUCTION

Residential and agricultural landowners along Mission Creek and its tributaries currently lack guidance on management options available to them within riparian and wetland buffers. These buffers provide important functions for water quality and fish and wildlife habitat. Vegetation provides shading to streams and wetlands, protects streambanks from erosion and adds nutrients, cover and other benefits to fish and other wildlife species, including amphibians, birds and mammals (Figure 1, 2 and 3). Vegetation within these buffers can pose management concerns for landowners including air flow, shading and drainage issues for growers, invasive and noxious weed issues for all landowners and even fire hazards.

In 1995, the Growth Management Act was amended to require cities and counties to include the best available science in developing policies and development regulations to protect the functions and values of critical areas. Chapters 11 and 13 of the Zoning Code describe critical areas and setback requirements. Chelan County Community Development is responsible for code enforcement, including those pertaining to riparian and wetland buffers. The Washington State Department of Fish and Wildlife and Washington Department of Ecology also have a role in enforcement of regulations pertaining to wildlife habitat and wetlands.

The intent of the vegetation management plan is to provide streamside landowners with guidance for making management decisions (developing a stewardship plan) in consultation with sponsors of proposed restoration actions as well as affected stakeholder groups. This plan does not replace the critical areas ordinances, but is intended to augment those regulations.

Figure 1. Mission Creek with unvegetated buffer between orchard and stream on left of frame and narrow buffer with trees between creek and residences on right. Erosion, weed issues and lack of shade evident.

Figure 2. Looking downstream from same location as Figure 1 where dense native vegetation covers stream. Total riparian width in this area is about 40', including the stream and both banks.

Figure 3. Mission Creek. Google Earth image from 2017 showing bridge where Figure 1 and 2 photos were taken.

Area Description

Mission Creek drains a 59,794 acre area, joins the Wenatchee River at Wenatchee RM 10.4, and contributes 2% of the Wenatchee River's annual flow (Wenatchee Watershed Management Plan, 2006). The sub-watershed receives an average of 19 inches of precipitation per year and ranges in elevation between 795 to 6,800 feet. This highly variable topography has restricted settlement and agriculture (mainly pear and apple orchards) to the valley bottom in the lower elevations of Mission Creek. Irrigation canals cross the area in the lower portion of the sub-watershed and service some orchards, but there are also a significant number of individual water right holders in the Mission Sub-watershed. The sources of water for the canals are the Icicle and Peshastin Sub-watersheds—not Mission Creek. Although agriculture comprises a small percent of the overall land area in the sub-watershed (3%), it is important to the local community, fruit packing industry, and economy.

A large portion of Mission Creek has been channelized to transport flood-flows due to major flood events in the 1940s and 1950s that damaged and jeopardized downstream development. Mission Creek has also been confined by development in its floodplain (Wenatchee Watershed Management Plan, 2006). The lower 8.5 miles of Mission Creek borders on private land with the lowest 1.1 miles along residential development, the next 5.5 miles along active orchard crops and the upper 1.7 miles along rural residential, before it intersects the US Forest Service boundary. The upper portion of the sub-watershed is primarily forestland (77.4% of the sub-watershed) that is managed by the U.S. Forest Service (Wenatchee Watershed Management Plan, 2006). The Mission Sub-watershed is home to 3,895 people (including 64% of the City of Cashmere's population), about 21.0% of the total population in the Wenatchee Watershed. A portion of the City of Cashmere is also located in the Mission Sub-watershed.

Native salmonid species in the Mission Creek Sub-watershed include steelhead, chinook and coho. Bull Trout might also be present, but this has not been identified as Critical Bull Trout habitat. Significant use of Mission Creek by wild steelhead for spawning has been documented in recent years through PIT-Tag Arrays recording passage of adults tagged in the mainstem Columbia. Eight adults visited Sand Creek in 2014 and based on the percentage of tagged fish, 45 adults were estimated to have visited Sand Creek in that year. Biologists consider Mission Creek to be important for preserving spatial and genetic diversity in the context of the entire species.

Mission Issues

Limited water quantity, insufficient instream flow, and diminished quality are the leading issues in the Mission Creek Sub-watershed.

Recommended Actions - Mission Sub-watershed

Actions have been recommended to address water quantity, instream flows, water quality, and habitat issues as they relate specifically to the Mission Sub-watershed.

Water Quality Recommended Actions
Mission, Brender, and Yaksum Creeks have exceeded State and federal water quality standards for DDT. Transport of DDT contaminated soil to these creeks may contribute to water quality problems in the Mission Sub-watershed.

The sub-watershed-specific water quality actions for temperature in the Mission Sub-watershed are listed in Section 7, Water Quality.

DDT MissionQUAL-1: Significant reductions in DDT loads may be achieved by preventing bank erosion or by other means of limiting transport of upland soils to streams. BMPs such as riparian buffers and wetlands can also filter and uptake DDT from surface and groundwater.

Ecological concerns and habitat action recommendations in priority order (UCRTT 2017):
2. Peripheral and Transitional Habitat (Side Channel and Wetland Connections)
    - From the confluence with the Wenatchee River to USFS boundary
3. Sediment Conditions (Increased Sediment Quantity)
    - Assess and reduce road interference with channel function and sediment load.
4. Channel Structure and Form (Instream Structural Complexity)
    - Restore instream habitat diversity by enhancing large wood recruitment, retention, and complexity where feasible.
5. Riparian Condition (Riparian Condition)
    - Re-establish native vegetation where appropriate.

1.1 USER'S GUIDE
This section is a user's guide to help clarify potential conflicts or ambiguity in implementing vegetation management actions. The following prioritized sequence of activities will guide decision-makers:

- Landowner identifies areas of concern (hazard trees, noxious weeds, eroding banks, unwanted vegetation, etc.).
- Initiate technical consultation with Chelan County Natural Resource Department (CCNRD) staff to develop a conceptual design/plan.
- CCNRD conducts site visit to determine issues and opportunities and if the proposed activity requires compliance permitting/consultation with other agencies (WDFW, Chelan County Weed Board and/or Community Development).
- Coordination between appropriate agencies to review conceptual design/plan and make determination of streamlined approach and funding opportunities.
- Plan development and review.
- Implementation.
- Monitoring.

1.2 PURPOSE AND INTENT
The primary purpose of this Plan is to provide a pathway to guide vegetation management on private lands within Mission Creek watershed riparian and wetland buffer zones as identified in the Chelan County Critical Areas Ordinance. The Plan is intended to allow landowners to manage vegetation along stream corridors. The Plan establishes goals for managing vegetation within the watershed, defines specific activities of processes or measures to meet these goals, and

describes how these activities are to be implemented. The overall intent of the Plan is to protect and improve aquatic resources, specifically water quality, stream shading, native plant communities and reduce soil erosion.

1.3 GOALS

To meet the purpose and intent of this Plan, goals and objectives were developed to guide vegetation management activities related to existing conditions and future landowner operations.

Goal 1: Promote the establishment and maintenance of native vegetation communities while allowing for landowner operations in a safe and effective manner.

- **Objective 1a:** Protect existing vegetation in the riparian corridor in a way that increases stream shading, filters overland flow and prevents streambank erosion.
- **Objective 1b:** Promote selective vegetation management to meet landowner operation needs.

Goal 2: Minimize the establishment and spread of noxious and invasive weed species within the riparian corridor.

- **Objective 2a:** Develop procedures consistent with those used by the Weed Board to prevent the establishment of noxious weeds in areas disturbed by landowner operations.
- **Objective 2b:** Coordinate with the Weed Board to control known noxious weed infestations within the riparian corridor using methods consistent with agency and landowner objectives.

Goal 3: Provide for revegetation of disturbed areas resulting from existing conditions and ongoing landowner operations.

- **Objective 3a:** Develop standards and guidelines for landowners to use in plant material selection, site preparation, planting, and monitoring.
- **Objective 3b:** Coordinate with funding entities when applicable to provide support for projects.

Goal 4: Streamline process for managing vegetation as it pertains to landowner operations and safety, controlling weeds, and revegetating disturbed areas within the riparian corridor.

- **Objective 4a:** Coordinate with Community Development and Washington Department of Fish and Wildlife (WDFW) to ensure that vegetation removal and associated revegetation activities are consistent with objectives for maintaining fish and wildlife habitat and riparian function.
- **Objective 4b:** Develop an approach to vegetation management so landowners can participate in a mitigated process of planning and implementation on their land.

1.4 PLAN IMPLEMENTATION ACTIVITIES SUMMARY

The intent of the Plan is to provide private landowners, Chelan County and WDFW with the information needed to implement vegetation management activities associated with landowner operations.

The Plan consists of three related sets of activities and measures, each dealing with a specific aspect of vegetation management:

1) **Vegetation Maintenance -** describes measures for the routine removal and disposal of vegetation that interferes with safe and effective Project operations.

2) **Noxious Weed Prevention and Control** - prescribes methods for the prevention and

control of noxious weeds in the riparian corridor.
3) **Revegetation -** outlines the measures to revegetate sites disturbed by landowner operations.

2.0 OUTREACH AND COORDINATION

The Plan is one component of a larger Restoration Plan and includes outreach to landowners and community groups as well as coordination with other responsible agencies and organizations.

2.1 AGENCY AND LANDOWNER ROLES AND RESPONSIBILITIES

The primary responsibility for implementing the Plan is intended to be the landowner, however, implementation of the Plan is a voluntary activity. The County or other agency role is to provide technical support and assistance, as capacity allows. Below are the overall roles and responsibilities of the primary players involved in the implementation of the Plan.

2.1.1 Landowner

- Responsible for vegetation management actions and maintenance associated with landowner operations.
- Responsible for revegetating sites disturbed by current and future operations.
- Responsible for weed control associated with vegetation actions and revegetation.

2.1.2 Chelan County Natural Resource Department

- Provides technical support for landowners in vegetation management, revegetation plan development and erosion control planning.
- Responsible for coordination with other agencies.
- Provides assistance with grant submittals for project funding when appropriate.
- Coordinates vegetation management activities at sites within the Project boundary that could potentially complement wildlife habitat and native plant restoration objectives for nearby areas on the UNF.

2.1.3 Chelan County Weed Board

- Provides technical assistance for identifying noxious and invasive weeds and control methods.
- Coordinates or conducts weed control and monitoring activities in the riparian corridor.

2.1.4 Washington Department of Fish and Wildlife

- Provides review of proposed vegetation management activities and revegetation efforts.

3.0 VEGETATION MAINTENANCE

This chapter provides a set of measures and procedures to guide the routine removal and disposal of vegetation that potentially interferes with safe and effective landowner operations.

3.1 RIPARIAN CORRIDOR

The following measures will be implemented, as appropriate, for all vegetation maintenance clearance activities associated with the Plan:

• Crews working will observe the Industrial Fire Precaution Level (IFPL) and have proper fire-suppression tools and materials, as required by the Washington State Department of Natural Resources (WDNR).
• Gas power tools will be equipped with approved spark arresters.
• Areas of ground disturbance will be minimized and subject to weed control activities and revegetated according the guidance in Sections 4.0 and 5.0 of this document.
• Heavy mechanical clearing will be conducted only when the ground is dry enough to support the equipment being used.
• Planting to encourage the establishment of appropriate plant communities in riparian/wetland areas will use native species according to the guidance provided in Section 5.0 of this document.

Landowner vegetation maintenance in and along the riparian corridor includes the following six types of activities:
• Hazard tree removal;
• Powerline clearing;
• Air flow drainage (minimizing frost pockets);
• County and access road clearance; and
• Slash and debris management.

3.1.1 Hazard Tree Removal

3.1.1.1 Definition/Objectives

A hazard tree is defined as either: (1) a dead, dying, diseased, deformed, or unstable tree with a high probability of falling and damaging orchard crops, structures, or other infrastructure. The primary objective in managing hazard trees is removal or topping, as safely as possible.

3.1.1.2 Removal/Disposal Methods

Cutting with chainsaws is the primary method for removing or topping hazard trees. To the extent possible, trees will be cut in a manner that minimizes damage to adjacent trees. Considerations include, if the tree should be: (1) felled to preserve commercial value; (2) be converted to a wildlife tree by topping below a height that would negate the hazard if the tree were to fall; or (3) felled and left in place or moved into the riparian corridor to provide habitat for wildlife species that use down wood.

3.1.2 Powerline Clearing

Clearing of powerline corridors will be conducted according to Chelan County Public Utility District standards by their crews and as such do not fall under the jurisdiction of this Plan.

3.1.3 Air Flow Drainage

Air flow drainage is the practice of removing trees that inhibit air flow thru orchards and are believed to contribute to the formation of frost pockets that can damage fruit trees.

Cutting with chainsaws is the primary method for removing trees that impede airflow.

Management Responsibilities, Planning, and Consultation

The landowner is responsible for managing vegetation, but in the case of air flow drainage, there are options to a clearcut approach that can be employed in consultation with the agency(s) providing technical support. This can include, topping to preserve wildlife trees, thinning to

maintain stream shading and underplanting of fast-growing shrub species to encourage dense thickets that do not reach heights that impede airflow.

3.1.4 County and Access Road Clearance

Clearing of County road right of way will be completed by Chelan County Public Works according to their standard procedures and as such does not fall under the jurisdiction of this plan.

3.1.5 Slash/Debris Management

3.1.5.1 Definition/Objectives

Slash is defined as brush and limbs less than 6 inches in diameter that are removed during vegetation management. Debris is woody material greater than 6 inches in diameter, and includes tree trunks and large limbs. The objective of slash/debris management is to ensure that these materials are either left in or near the riparian corridor, chipped, or removed, as determined by resource objectives for the site.

3.1.5.2 Management/Disposal Methods

There are three primary ways of managing slash and debris. It can either be (1) chipped, with the residual chips blown on site or stored for use in a revegetation site; (2) lopped and scattered on site; or (3) piled on site. Leaving slash and debris within the riparian corridor is preferable. Woody debris is typically left on site provided it does not block access or represent a safety or fire hazard. When slash is left on site, stems and limbs should be lopped into lengths which allow for either ground contact or the material is within 2’ of the ground; slash piles should be no more than 2 feet high. Slash and debris left on site should be placed within the riparian buffer or within disturbed areas planned for revegetation.

3.1.6 Ornamental Landscape Management

3.1.6.1 Definition/Objectives

Riparian corridors within the Mission Creek drainage and especially the city of Cashmere include landscaping composed of lawns and native and horticultural tree, shrub, and herbaceous species. These landscapes generally require continual maintenance to ensure that trees and shrubs do not become overgrown or diseased. In addition, some horticultural species, are invasive with a tendency to spread beyond landscape area boundaries. These species need to be managed to ensure that they do not invade nearby native habitats. In the best case scenario, these non-native species would be phased out of riparian corridors and replaced with native species.

3.1.6.2 Management Methods

Manual (i.e., hand pulling, lopping by hand crews) and mechanical (i.e., mowing) methods are used for most landscape maintenance activities in and around home sites. Noxious weeds and invasive ornamental plants (e.g., English ivy) should not be disposed of by composting or chipping. Burning or removal from the site are the preferred disposal methods for these plant materials.

4.0 NOXIOUS WEED PREVENTION AND CONTROL

This chapter outlines the measures that landowners can use to limit the establishment of noxious

weeds within the Project boundary and control the spread of existing populations. This chapter is organized into four main sections. The first section describes the laws and regulations governing noxious weeds and defines priority species. Section 4.2 covers inventory and monitoring methods and responsibilities; Sections 4.3 and 4.4 describe weed prevention and control for the Project.

4.1 POLICIES AND TARGET SPECIES

4.1.1 Laws, Regulations, and Policies

Noxious weeds are non-native plants specified by law as being especially undesirable, troublesome, and difficult to control. See the Chelan County Noxious Weed List.

4.2 Objectives

Preventing establishment and spread is the most cost-effective means of managing noxious weeds. Preventing the establishment of noxious weeds will be one of the primary objectives of any activity within the riparian corridor that involves ground disturbance, erosion control, or maintenance.

4.3 Methods

Best management practices (BMPs) can be implemented to prevent the establishment and spread of noxious weeds during ground disturbance, erosion control, and maintenance activities. BMPs include the following:

- Training to encourage weed awareness and prevention efforts among staff;
- Planning and scheduling construction and maintenance activities;
- Cleaning machinery and other equipment;
- Minimizing ground disturbance, particularly in riparian areas; and
- Revegetating after ground disturbing activities (see Section 5.0).
- Noxious Weed Identification Materials– Technical support from the participating agencies can be used to help identify weeds.

4.3.1 Activity Planning and Scheduling

Minimizing the spread of noxious and invasive weeds by planning and scheduling is particularly applicable to vegetation clearance and erosion control activities, which are generally scheduled in advance. The noxious weed inventory map and GIS database will show the locations of known weed infestations relative to the riparian corridor. Additionally, the following practices are also beneficial:

- Treat existing infestations before the maintenance activity occurs.
- Perform work in and through noxious weed infestations prior to seed set or after dispersal. Seed set times differ for the various noxious weed species in the VMP area. Seed set times of these species generally correspond to summer-fall. Minimize disturbance for plants that reproduce vegetatively, like Japanese Knotweed.

4.3.2 Equipment and Vehicle Cleaning

Vehicles are effective means of spreading noxious weeds and power-washing prior to moving equipment on to your property is one measure to reduce the spread of weeds.

5.0 REVEGETATION

Revegetation is an integral part of vegetation maintenance, noxious weed prevention, and associated site restoration. It is also a key component of stream bank erosion control. This Chapter on revegetation provides standards and guidelines for replanting/reseeding of disturbed areas resulting from landowner operations. The intent of revegetation within the riparian corridor is to maintain and improve stream shading, control erosion, prevent the establishment of weeds, and enhance wildlife habitat.

5.1 ACTIVITIES REQUIRING REVEGETATION

Landowners are encouraged to revegetate the existing disturbed areas and areas that may be disturbed by vegetation management or other activities. Activities related to landowner operations that may involve revegetation include but are not limited to the following:

- Hazard tree removal
- Powerline clearing
- Air flow management identified by the landowner for conversion to a different plant community (trees to shrubs)
- Irrigation, road and other improvements thru the riparian corridor
- Erosion control projects
- Construction of new facilities
- Weed control projects
- Projects to restore wetlands and fish and wildlife habitat
- Post-wildfire rehabilitation projects

Locally collected seed (lower Wenatchee) basin is always the preferred species for use in revegetation. Derby Canyon Natives carries a large variety of local species, appropriate for riparian wetland restoration and other native plant nurseries in the surrounding area often have local native stock on hand as well.

5.2 REVEGETATION PROCESS

The revegetation process involves the following steps:

- Site assessment and planning
- Site preparation/erosion control
- Installation (seeding/planting)
- Monitoring and contingency planning

Guidance for each of the steps in the revegetation process is provided below.

5.2.1 Site Assessment and Planning

Revegetation planning for large scale projects includes many steps designed to maximize the opportunity for success. An excellent resource for in-depth planning can be found in the publication Roadside Revegetation; An Integrated Approach to Establishing Native Plants and Pollinator Habitat by the Western Federal Lands Highway Division.

For the small scale projects proposed on private lands in Mission Creek, these steps have been simplified and consolidated to aid in project streamlining.

1) Define objectives

a. Stream shading
b. Prevent stream-bank erosion
c. Weed control
d. Water retention (trap sediments and runoff before it enters stream)
e. Conversion to different plant community (change structure from tree to shrub)
f. Wildlife enhancement
g. Aesthetics

2) Gather pre-field information
    a. Climate. This is more important for folks who are new to the area.
    b. Soils. This information is available on the web, however mapped soil units are for undisturbed locations. Search for "Soil Survey of Chelan Area, Washington Parts of Chelan and Kittitas Counties.
    c. Seed zones. This information can be provided by plant nurseries.
    d. Pollinators. This information is more important for large-scale highway projects that could disrupt activities of important pollinators, but is interesting to think about, especially for farmers.
    e. Plans. Activities planned for this site now and in the future.

3) Define size and restoration units
    a. Square feet or acreage of revegetation area.
    b. Units are areas of similar environments (stream bank, top of bank, moist, dry, etc.) and similar treatments. For example a 75' long eroding bank will be treated as one unit.

4) Identify reference sites. These are sites with similar aspect, soils and other environmental conditions with native plants that are providing desired role/function.

5) Gather field information.
    a. Develop plant list from the site (including weed species) and the reference site.
    b. Soils information. Texture (sandy, loamy, silty), rock fragments, depth of top soil, litter/duff layer present or not, compaction (can you push a planting spade into the ground with body weight?), infiltration (does it appear to be well-drained, poorly drained or in between?)
    c. Aspect/exposure. Does the site receive a lot of sun or shade?

6) Desired future condition. Envision the site in 5, 10, 20 and 50 years to determine what type of plant community(s) would be appropriate for the site. Is there a powerline overhead, maybe a fast-growing ponderosa pine would not be appropriate?

7) Limiting factors for plant establishment. This is usually the crux component of revegetation design and the determining factor(s) of whether or not a planting project is successful.

    a. Water input.

i. Irrigation. Typically, sites are irrigated during July-September for first 3-5 years to establish plantings.
ii. Precipitation.
iii. Runoff. Is the site in a natural swale or sub-irrigated from adjacent stream or orchard irrigation?

b. Water storage and loss. This is where soil structure, presence of leaf litter and exposure are important. Mitigation for low infiltration rates can be achieved by treating soil compaction, mulching and other methods.
c. Nutrients. Topsoil and leaf litter can contribute to successful plant establishment. Mycorrhizal fungi presence improves nutrient uptake and availability. Native soils from undisturbed locations can be used to "seed" these fungi.
d. Surface and slope stability. Is the site prone to erosion from heavy rainfall or floodwaters? Is a bioengineering approach appropriate at the site?
e. Weeds. Competition from weeds can limit productivity of new seedlings. Selecting for pioneering type (weedy) natives can aid in revegetating exposed areas.
f. Pests. Beavers, voles, deer and other species can damage buds, tree boles and other plant parts. Even if no signs of these pests are found during field visits, they can be assumed to be active in most riparian corridors.

8) Select site improvement/plant protection treatments. In this section, treatment options are outlined to address the limiting factors for plant establishment.
    a. Water input, storage and loss.
        i. Plan for irrigation if needed. One good soaking per week is preferable to many short duration watering periods for drought period.
        ii. Avoid compaction during management activities.
        iii. Tillage/loosening of soil, if necessary. This must be done carefully, so as not to encourage erosion. If area is prone to stream flows, another approach might be considered.
        iv. Additions of organic matter to topsoil and mulch to soil surface are important considerations. 2-4" of wood chips, weed free straw or even leaves can provide an excellent mulch to prevent drying.
    b. Nutrients.
        i. Additions of organic matter to topsoil and mulch to soil surface are important considerations. 2-4" of wood chips, weed free straw or even leaves can provide long term nutrients.
        ii. Mycorrhizal inoculants can be purchased and some native plant nurseries add it to plant pots. Also consider using small amounts of native soil as an inoculant.
    c. Surface and slope stability.
        i. Re-grading steep-vertical slopes and applying erosion control fabric, especially where stream flows are present.
        ii. Contour raking and surface roughening is a good method to be used in conjunction with mulch to treat areas prone to overland flow. Additionally, branches and small logs can be placed on contour and staked to trap sediment and encourage infiltration.

iii. Mulch in the form of wood chips, weed-free straw and native leaf litter and duff are effective for covering exposed surfaces.
iv. See Site Preparation/Erosion Control section.

d. Weeds. As with water, the presence of weeds can make or break a restoration site success. Be careful to assess what is on the site prior to treatment and be careful about importing weed species into the site, either in mulching materials, plant materials or just by activity. It is common for an area treated for one weed species to be overrun by another soon after. There are numerous approaches to treating these areas (chemical, manual, weed barriers), so consider the alternatives in consultation with technical support to achieve the greatest likelihood for success.

e. Pests. A variety of products like plant tubes, deer fencing and bud caps can be used to provide protection against deer and voles. Beaver damage on large cottonwoods can be mitigated with galvanized fencing around tree boles, but protection of new plantings and live staked areas can be more challenging. Insects and plant disease can target specific species, so consider the health of the species you see in reference sites when selecting plants.

9) Select plant species for propagation and plant establishment method. In small-scale revegetation projects in highly disturbed sites such as Lower Mission Creek, plant propagation is not usually necessary unless you do not have access to a local native plant nursery. In most cases within this stream reach, excellent plant materials derived from local stocks will be available at local nurseries. Additionally, local native grass seed mixes are developed for different precipitation zones and are effective for establishing cover.

a. Seeds. These are usually utilized for grass and forb species and local nurseries have existing mixes based on precipitation levels (low, med, high) or can develop a custom mix. Large scale restoration projects that recreate plant successional stages often depend on either natural re-seeding from adjacent plant communities of pioneering type trees like alder or cottonwood or incorporate collecting and re-seeding these species.

b. Cuttings (live stakes). Typically, live stakes are collected from nearby locations, and installed using a pilot hole. Local nurseries will collect and store.
-Willows (most reliable), dogwood and cottonwood cuttings
-Collect and install while dormant, 2-3’ long, 45° cut at bottom, 90°cut at top
-Trim off side branches, take only 1/3 of individual plant
-Cut straight stakes, >1/2” dia., 2-year old wood preferred over 1 year
-Storage (34°–38°, 90%+ relative humidity)
-Soak prior to planting-24 hours, (non-willow specie use rooting hormone)
-Use steel form stakes or similar for pilot holes,
~2/3 of the cutting in the ground, right side up, tight with no air pockets
-Needs to be long enough to reach the mid-summer water table
-3+ buds above the ground (trim top after placing esp. if driven with hammer)
- Live stakes should be kept covered with moist burlap

c. Plants. Shrubs and trees are usually derived from nursery stock. This provides the plants with a well-developed root mass and increases the chances for success. The

plants have a head start and are better prepared to compete for resources with grasses, forbs and weeds. In riparian plant communities like Mission Creek, there are a few species that tend to be the focus for establishing cover in a short time frame. These species are referred to as "workhorse" species based on their adaption to occur repeatedly throughout the eco-type, abundance and ease of propagation. This is evident in the thick stands of red-osier dogwood, willow, snowberry and rose species found along the stream corridor.

-Plant genetics from local ecotypes and within 1000 feet elevation
-Install during dormant season (fall or winter)
-Inspect at time of delivery
-No signs of disease or stress (e.g. black mold causes mortality)
-No mechanical damage
-Several fibrous roots coming from the stem
-Bareroot deciduous seedlings = or > 3/8" caliper at 1 inch above root collar
-Seedlings should have at least 12 inches of top growth (shoot)
-Root to shoot ratio of 2:1
-Keep bareroot plant roots moist, store plants in shade if possible
-Plant within 72 hours of leaving cold storage.

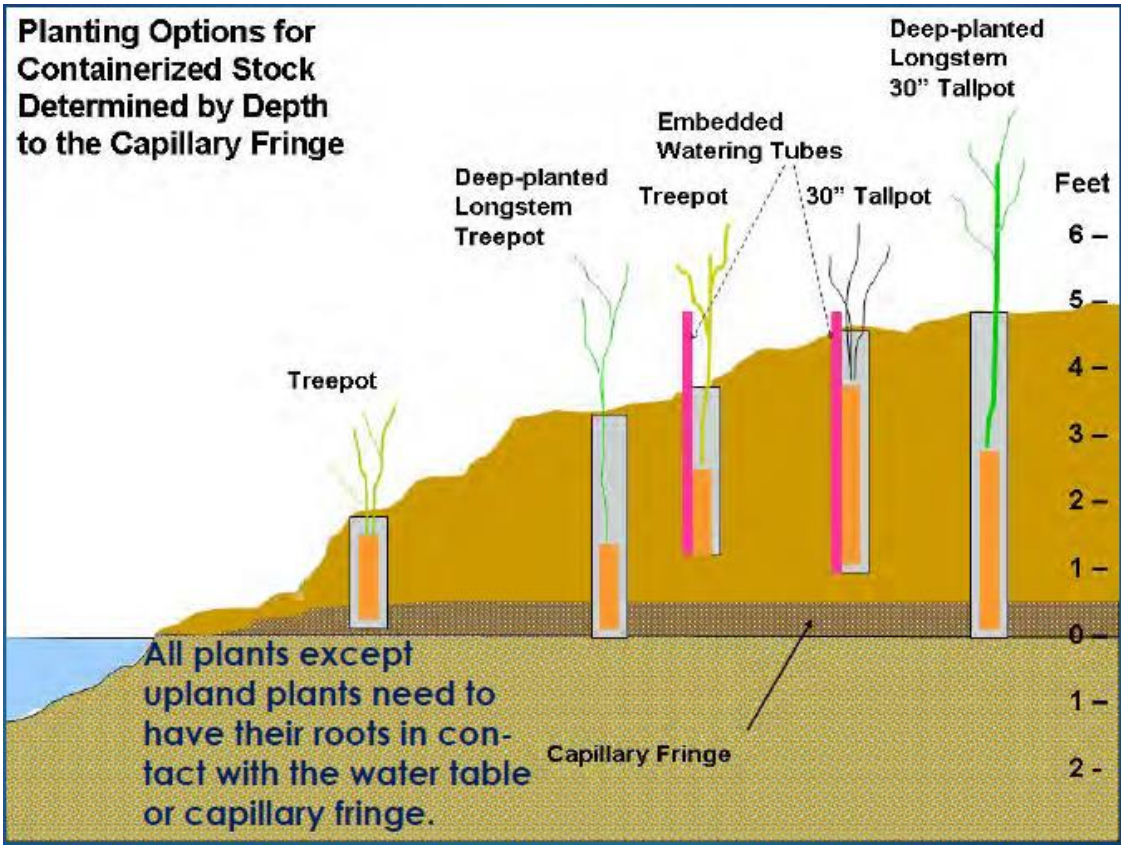

Figure 4 . Diagram shows placement of plants in relation to sub-surface zone above groundwater, capillary fringe. Deep-planting is appropriate for willow, dogwood and cottonwoods (Fleenor 2017).

5.2.2 Riparian Planting Zones

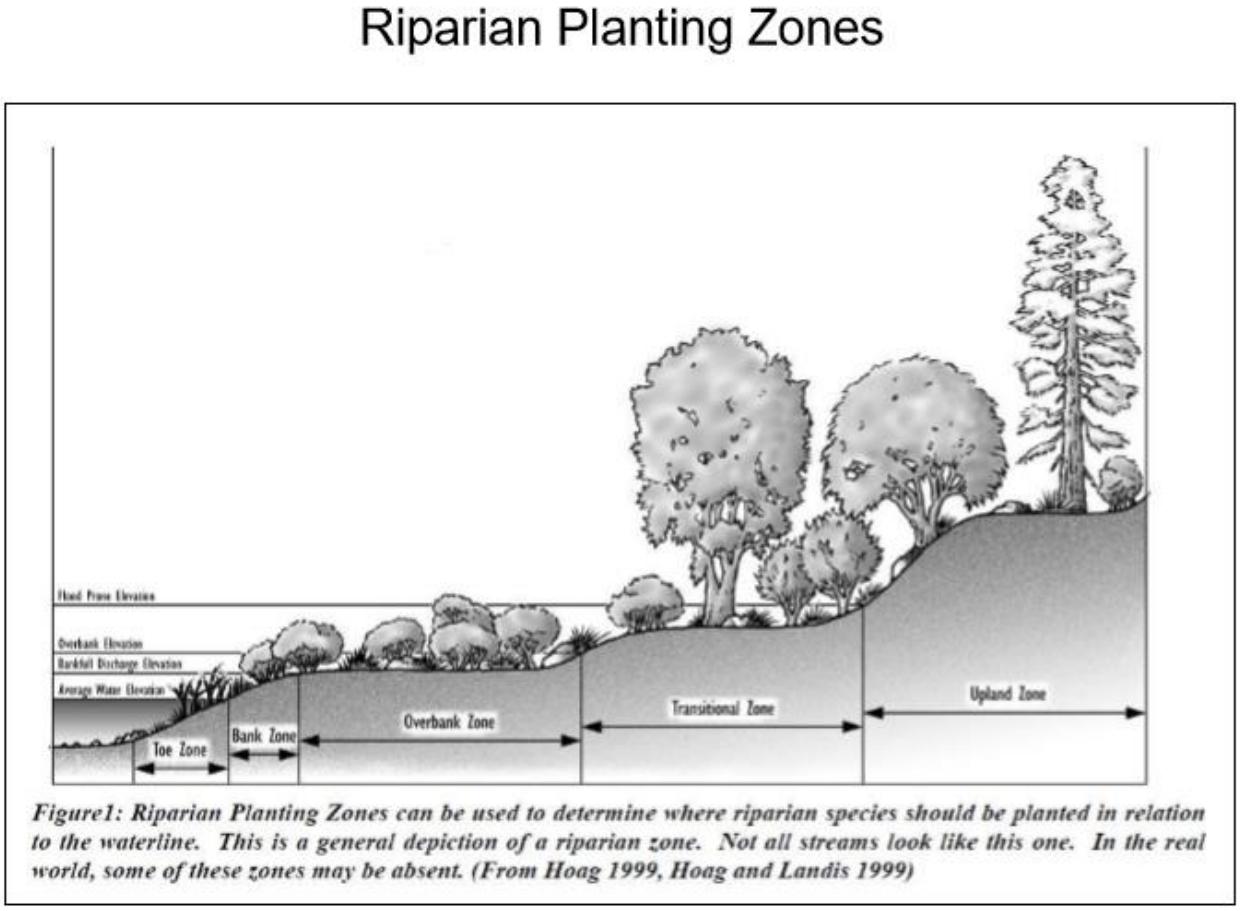

Figure 5: Riparian Planting Zones (Hoag et al 2001)

Toe Zone

The toe zone is the zone that is located below the average water elevation, also called the baseflow. The baseflow is that level where there is flow throughout summer months. The toe zone will rarely contain dense vegetation, due to its inundation with water for most of the year. Woody species, in particular are very difficult to establish here, because of the abundant water levels. In some cases, common wetland plants such as cattails (Typha) and bulrush (Scirpus) can be established in the toe zone. However, be advised that wetland plants do not establish or survive well in areas where velocities are high. They are generally found in low energy streams or areas such as backwaters.

Bank Zone

The bank zone is the area between the average water elevation and the bankfull discharge elevation. The bank zone will generally be vegetated with early seral or colonizing herbaceous species, flexible stemmed willows (Coyote willow), and low shrub species. This zone will be inundated with water far less frequently than the toe zone. Soil moisture levels in this zone will be much lower after spring runoff.

Bankfull Discharge – The discharge corresponding to the stage at which the natural channel is full. This flow typically has a recurrence interval of 1.5 to 2 years.

Overbank Zone
The overbank zone is located between the bankfull discharge elevation and the overbank elevation. It is generally flat and sporadically flooded about every 2-5 years. Vegetation in the overbank zone should be flood tolerant. Normally, the vegetative composition is about 50% hydrophytic plants. Shrubby willows with flexible stems, dogwoods, alder, birch, in particular, will predominate here. Larger shrub type willows will generally occur on the higher end of the zone. Cottonwoods and tree type willows may survive well at the higher end of this zone. Species that have large inflexible stems should not be part of the planting plan in this zone. They can cause significant disruption to the stream dynamics.

Transitional Zone
The transitional zone is located between the overbank elevation and the flood prone elevation. The flood prone elevation is flooded about every 50 years. The transitional zone will be where bulrush and other hydrophytic species will transition to upland species. For the most part, species in this zone are not flood or inundation tolerant. This is the zone where the larger tree species are typically found.

Upland Zone
The upland zone is found above the flood prone elevation. As the name would suggest, vegetation in this zone is predominantly upland species. Drought tolerance is one of the most important factors when determining what species to plant here. In low precipitation areas, supplemental irrigation may be necessary for plant establishment. Soil moisture meters are a small investment to ensure that that supplemental irrigation inputs are employed appropriately, thereby eliminating over-use of limited, costly water resources.

Cross-section and Definitions are taken from Hoag, J. Chris, Forrest E. Berg, Sandra K. Wyman, and Robert W. Sampson. Riparian/Wetland Project Information Series No. 16 March, 2001 (Revised).

5.2.3 Calculating Plant Quantities
First calculate the area to be planted with each plant type and convert to square footage (1ac=43,560 sq. ft.). The next step is to determine the plant density and spacing. Next you will need to multiply area by square footage. Typical spacing is:
Trees 10ft. on center (o.c.) (100 sq. ft.)
Shrubs 6 ft o.c. (36 sq. ft.)
Live stakes/ground cover 2 ft. o.c. (4 sq. ft.)

Example
Plant quantities for a 0.5 acre forested riparian area: 0.5 acre x 43,560 ft2/acre = **21,780 ft2**
Assuming that you want to plant the entire area with trees and shrubs:
Trees: 10 ft o.c. (average spacing) 21,780 ÷ 100 ft2 = **218 trees,** Shrubs: 6 ft o.c. (average spacing) 21,780 ÷ 36 ft2 = 605 shrubs – 218 (space occupied by trees) = **387 shrubs.**
Contact CCNRD for a template spreadsheet for calculating plant quantities.

Table 1. ***Trees and Shrubs for Riparian Plantings. NRCS Washington State. 2010.***

Shrub and Tree Species for Planting Riparian Areas in MLRA 6										
						early seral	often hydro-phytic	mix of species	upland species	
					in the water	typically flooded	often flooded	rarely flooded	never flooded	
Major Land Recource Area 6					Riparian Zones					
Common name	Scientific name	T = tree, S = shrub, T/S = short tree/ tall shrub	Minimum Spacing	Height (feet)	Toe Zone	Bank Zone	Overbank Zone	Transition Zone	Upland Zone	Notes
redosier dogwood [1,4]	*Cornus sericea*	S	6	7-10	Herbaceous Zone	x	x	x		
Drummond's willow [3,4]	*Salix drummondiana*	T/S	6	↑12		x	x			cuttings ok
coyote willow [2,3,4]	*Salix exigua*	T/S	4	3-15		x	x			cuttings ok
Geyer's willow [3,4]	*Salix geyeriana*	T/S	6	10-15		x	x			cuttings ok
Lemmon's willow [3,4,9]	*Salix lemmonii*	T/S	5	3-10		x	x	x		cuttings ok
planeleaf willow [3,4]	*Salix planifolia*	T/S	4	4		x	x			high elevation
thinleaf alder [1]	*Alnus incana* ssp. *tenuifolia*	T	8	↑40			x	x		nitrogen fixer
Sitka alder [1]	*Alnus viridis* ssp. *sinuata*	T/S	6	3-20			x	x		nitrogen fixer
water birch [1]	*Betula occidentalis*	T	8	↑50			x	x		
Mackenzie willow [3,4]	*Salix prolixa*	T/S	6	↑30			x			cuttings ok
black hawthorn [1]	*Crataegus douglasii*	T/S	7	14-35			x	x		has thorns
black cottonwood [1,4]	*Populus balsamifera* ssp. *Trichocarpa*	T	12	↑160				x		large tree
quaking aspen [1]	*Populus tremuloides*	T	8	30-45				x		
peachleaf willow [3,4]	*Salix amygdaloides*	T	8	20-40				x		cuttings ok
Engelmann spruce [1]	*Picea engelmannii*	T	12	↑120				x		for wetter sites, conifer
western white pine [1]	*Pinus monticola*	T	12	↑200				x		conifer
ocean spray [1]	*Holodiscus discolor*	S	8	5-15	Herbaceous Zone			x		
bitter cherry [1]	*Prunus emarginata*	T/S	5	↑50				x		Tree on moist sites
Nootka rose [1]	*Rosa nutkana*	S	5	↑9				x		
Douglas-fir [1]	*Pseudotsuga menziesii*	T	12	↑110				x		conifer
mockorange	*Philadelphus lewisii*	S	5	4-8				x	x	
serviceberry	*Amelanchier alnifolia*	T/S	5	↑15				x	x	
blue elderberry	*Sambucus nigra* ssp. *Cerulea*	T/S	6	↑23				x	x	
red elderberry	*Sambucus racemosa*	T/S	6	10-30				x	x	
common snowberry	*Symphoricarpos albus*	S	4	2-5				x	x	rhizomes
ponderosa pine	*Pinus ponderosa*	T	14	↑223				x	x	conifer
chokecherry	*Prunus virginiana*	T/S	5	↑25				x	x	
golden currant	*Ribes aureum*	S	5	↑10				x	x	
wax current	*Ribes cereum*	S	4	2-6				x	x	
Woods' rose	*Rosa woodsii*	S	5	2-6				x	x	
smooth sumac	*Rhus glabra*	S	6	↑12				x	x	
Siberian peashrub [6]	*Caragana arborescens*	S	6	↑14					x	non native
Rocky Mt. Juniper	*Juniperus scopulorum*	T	6	↑50					x	slow growing, conifer
Oregon Grape, Tall	*Mahonia aquafolium*	S	4	↑8					x	evergreen

For species not listed consult with Area or State Specialists.

Base species composition of project planting on reference site species composition.

↑ Indicates species may grow up to the listed height

[1] Roots of all non-upland species need access to ground water for at least part of the growing season.

[2] Indicates the part of the riparian zone (either upper or lower) appropriate for the given species.

[3] Cuttings need to be planted deep enough so as to have at least 8 inches of the cuttings submerged into the mid-summer water table.

[4] Caution - Cottonwood, dogwood or other willows may or may not do well as cuttings.

[5] Mulch is particularly important for these species in this MLRA, as is first year supplemental water

[6] Non-native species, reserve use of these species for upland areas in agronomic landscapes. Limit to no more than 10% of total stems/acre.

[7] Northwest Puget sound and San Juan Is

[8] In certain situations may be appropriate to plant in the Toe Zone, confirm with Area or State Office Specialists.

[9] More common in Oregon

5.2.4 Revegetation Plan Timeline

Table includes recommended schedule for site prep, planting, mulching, irrigation, maintenance and monitoring.

Activity	Year 1									Year 2								
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Site Preparation																		
Planting-containers																		
Planting-live stakes																		
Planting-emergnts*																		
Seeding																		
Irrigation																		
Mulching**																		
Maintenance***																		
Monitoring																		

*Emergents refers to wetland sedge or rush type species typically planted as plugs during growing season after high water has receded. Wetland sod is included in this category.
**Mulching is usually completed after planting. If done before planting, care must be used during planting to keep mulch out of planting hole.
***Maintenance can include weed treatments, but specifics are not included here as treatments and timing vary depending on species.

5.2.5 Site Preparation/Erosion Control

Site preparation includes a variety of techniques that prepare the site for planting, including loosening compacted soil, treating non-native species, amending soils and stabilizing slopes.

As previously mentioned in the site improvement section, slope stability may need to be treated prior to or in conjunction with revegetation. Mission Creek has been channelized and in places the banks hardened to minimize natural channel migration. This results in powerful sheer forces during runoff events that can lead to erosion of stream banks. This can create problems for water quality, not only because of the introduction of sediment into the stream, but the legacy DDT that is found in orchard soils. Stabilizing the banks with “hard” techniques like rock or concrete rip rap is not only difficult to permit, but it does not provide the same level of habitat enhancement benefit as “soft” techniques, commonly referred to as Bio-engineering.

Bioengineering uses live plant materials placed to resist erosive forces. In the example below of a cross-section of a brush mattress, the bank is reshaped to a 1:1 slope, covered with a coir cloth and live willow stakes (cuttings) are placed in a trench at the toe of the slope and then protected with a willow wattle. The structure is held in place with manila rope lashed between stakes. Over time, the rooted portion of the live stakes and the brushy vegetation will protect the slope from erosion, whereas the initial protection is provide by the erosion cloth, woody material and stakes.

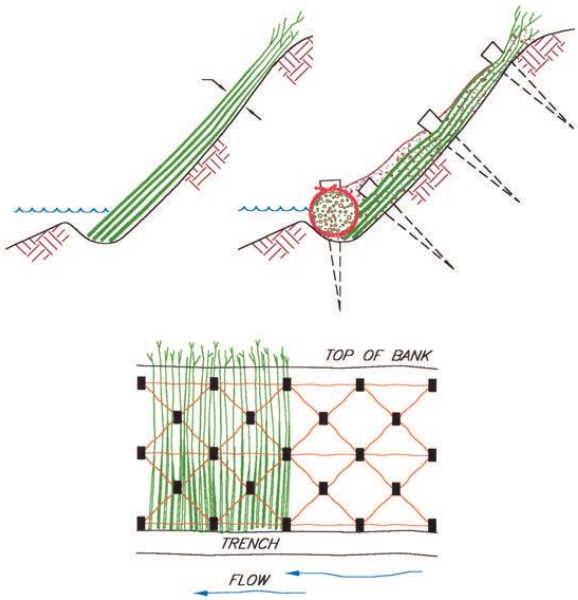

Figure 7. Brush mattress installed along Icicle Creek in 2010.

The technique outlined above is one of many that have been developed over the years and can be found in various publications online, including, Streambank Soil Bioengineering Field Guide for Low Precipitation Areas by Chris Hoag and Jon Fripp in 2002 for the NRCS (Hoag 2002).

Another method that has been used locally with good success for erosion control along streambanks is wetland sod application. Wetland sod is a pre-vegetated coir erosion control mat that has native wetland sedge type species pre-grown in the 16'x3' coir (coconut fibre) mat. The mat is placed on moist soils at or near the waters' edge (toe-low bank) and initial erosion control is provided by the coir and over time the roots take hold in the soil to increase the stability. These are installed at low water during the growing season and are subject to inundation for part of the year.

Figure 8. Mission Creek before bioengineering bank stabilization project in 2017.

Figure 9. Mission Creek After bioengineering bank stabilization project in 2017. Slope was contoured, coir fabric was tucked under at toe of slope and secured with stakes and soil, willow wattle constructed at toe of slope and live stakes placed throughout the structure.

5.2.6 Installation (seeding/planting)

Technical assistance on inspecting plants, caring for plants while in the field, planting techniques, watering and mulching are best provided by partnering with an agency or organization that specializes in riparian planting projects. Farmers will have plenty of experience with planting and growing crops and many of the same rules apply to native plants that apply to farm crops, including soil amending and pest protection. Many of the details specific to native riparian planting techniques are already outlined in the Site Assessment and Planning section.

The landowner will have to decide which approach to use for plant installation and bear in mind, it can be a fun activity for a family, boy scout troop or church group. If there is a lot of wood chip mulch to apply in an area not accessible to trucks or tractors, the "bucket brigade" is a good way to move mulch in 5 gal. buckets.

- Landowner install plants
- Hire crew to install plants
- Volunteer event

5.2.7 Monitoring

There are two main types of monitoring associated with revegetation, implementation and effectiveness. Implementation monitoring is conducted once to confirm that sites have been revegetated as specified and this usually includes a count of plants and possibly a map or sketch of the planting area.

Effectiveness monitoring is conducted annually to determine the success of revegetation efforts and to identify problems that may need to be corrected. Bare areas or gaps identified during monitoring should be replanted, erosion repaired, and weeds treated. Some areas, particularly those associated with erosion control and wetland or habitat restoration, may require longer-term and more intensive monitoring to ensure success.

Most monitoring programs include quantitative objectives for plant survival and cover, and weed and erosion control over a 3- to 5-year period. Eighty percent survival is an objective usually outlined in permit specifications after a 3-year period. Monitoring techniques may include transects to record plant cover, plot frames to record plant density, and/or photo points, but the simplest approach and most likely to be used for this scale of effort would be a count of plants and comparison with the number originally installed, .
Potential problems that can affect a revegetation project after initial planting include the following:

- The establishment of noxious weeds or other non-native invasive species.
- Foraging by wildlife, which may affect plant survival or growth.
- Erosion that damages plant materials and/or removes substantial amounts of soil.
- Flooding, windstorm, hail, etc. that severely damage plants or remove soil.
- Failure or lack of vigor in introduced plantings.
- Unexpected successional changes that shift species composition or abundance.
- Unfavorable amounts of moisture (too little, too much, or wrong time of year).
- Mulch layers that are too thick and inhibit seed germination.

6.0 References

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