Strategic Plan for Assessing Restoration Needs In and Near Depressional Wetlands and Wet Meadows in the Cedar River Municipal Watershed

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1.0 Introduction

Ponds, wet meadows, and other wetlands in the Cedar River Municipal Watershed (CRMW) provide unique habitat for a wide range of plant and animal species. Wetlands distributed throughout the watershed range in character from large open water systems to small wet depressions in meadows. Depressional wetlands provide the primary breeding habitat for amphibians in the watershed as they typically hold water pockets during the early spring when eggs are laid and maintain pools of water for developing larvae. Also important at higher elevations are small wet meadows scattered across the landscape between forest patches.

Historically wetlands were not protected during timber harvest in the watershed and most often wetlands and meadows were completely cut over. These practices altered the canopy cover as well as the condition of surrounding forest and riparian areas at wetlands of all types. In addition, some wetlands were near human settlements and thus now have heavy infestations of non-native invasive plants. Sediment input from roads is the other primary threat to wetlands. Despite this history, most depressional wetlands in the CRMW are considered to have few lingering threats to key ecological processes. This document describes methods for assessing the conditions at depressional wetlands and wet meadows in the CRMW, outlines linkages with other restoration activities, and provides suggestions for restoration/enhancement activities near depressional wetlands.

2.0 Historical Analysis

We conducted a preliminary search of the photographic archives at the Cedar River Watershed Education Center for photos showing wetland habitat. A few wetlands had several photos associated with them, but in general very little information documenting previous conditions in the watershed existed (Table 1). More detailed information may exist for individual wetlands in other forms (site records) in the archives, and should be examined more closely as specific restoration project sites are chosen.

Table 1. Photos showing ponds or wetlands located in the archives.

Location	*Date*	*Photo Number*	*Description of Photo*
T22R7S9	12/30/1910	0140	Basin #2 associated with Taylor settling ponds – forest harvested
T22R7S9	12/30/1910	0141	Basin #2 associated with Taylor settling ponds – forest harvested
T22R7S9	12/30/1910	0191	Basin #5 associated with Taylor settling ponds – forest harvested
T22R7S4	1/6/1911	0185	Looking south toward Walsh Lake – forest harvested
T22R7S4	1/6/1911	0186	Looking south toward Walsh Lake – forest harvested
T22R8S23		0767	Jury Lake, old forest around lake
T21R10S2		0706	Bear Lake – forest in background
T22R10S35	6/23/1912	0879	Bear Lake – forest in background

3.0 Criteria for Assessment of Current Conditions and Desired Future Conditions

3.1 Wetland Classification in the CRMW

The hydrogeomorphic method (HGM) for classifying wetlands categorizes wetlands based on the landscape position and the hydrologic regime supporting each wetland. CRMW wetlands were classified into four major categories including riverine, depressional, lacustrine fringe, and slope (Brinson 1993). Under the HGM approach, wetlands within each category are expected to function in a similar manner and are affected by similar geomorphic processes. For a complete description of wetland classes, see the CRMW Aquatic Restoration Strategic Plan (Bohle et al. 2006).

3.2 Hydrologic Conditions

Assessing the current hydrologic conditions surrounding depressional wetlands and wet meadows provides the foundation upon which other habitat based assessments can be made. The Cedar River Watershed Aquatic Strategic Plan (Bohle et al. 2006) outlines specific key attributes for assessment as well as desired future conditions for hydrologic conditions of wetlands in the watershed. Often these elements can be assessed through a Geographic Information System (GIS) evaluation of the wetland polygon, using high-resolution ortho-photography, Lidar, and other GIS data layers.

3.3 Roads

Roads near depressional wetlands and those running through upland habitat near depressional wetlands (amphibian breeding ponds) and wet meadows should be evaluated for decommissioning. These roads can create a migration barrier for amphibians, especially during drier summer conditions when juveniles are migrating away from breeding ponds. GIS tools can be used to evaluate the position of the road in relation to wetlands. Additional threats posed from roads include fine sediment deposition, which can fill wetlands altering the hydrologic regime and plant community, as well as altering surface or shallow subsurface flow. Evaluation of these threats can be accomplished through examination of current road sediment data and is further described in the Aquatic Restoration Strategic Plan (Bohle et al. 2006). By 2014, several roads in and near wetlands had been decommissioned. However, this is only one of many factors considered when making decisions about which roads will be decommissioned.

3.4 Non-native Invasive Plants

Control of invasive plant species is important around ponds and wetlands to maintain healthy native plant communities that foster the moist microclimates preferred by amphibians and forage plants needed by other wildlife. Dense monocultures of knotweed, Himalayan blackberry, or reed canary grass can out-compete native plants. Surveys for invasive species have been conducted at all wetland sites with disturbance history in the lower municipal watershed, as well as in several wetlands in higher elevations. Extensive control efforts over many years have occurred in major wetlands in the lower watershed, where the majority of invasive species problems occur (described below).

3.5 Wetland Habitat for Amphibians and Other Wildlife

Amphibians are dependent on all wetland classes for various portions of their life history including, breeding, rearing, and refuge habitat during summer. However, depressional wetlands comprise the majority of breeding habitat for most species. Several frog and salamander species require multiple habitat types to complete their life cycle, making them an ideal species group for integrating restoration of different landscape components. An amphibian breeding inventory of a large portion of depressional wetlands in the watershed has been conducted. This allows a preliminary assessment of the value of each depressional wetland as amphibian breeding habitat. Many of the small wet meadows have not been surveyed to determine their importance as breeding habitat. In general, however, we have found that if a wet meadow contains an open water component, it is used as breeding habitat by amphibians. Appendix 1 lists the amphibian species found in the 72 CRMW wetlands where surveys were conducted.

Feeding and refuge habitats are important to the adult and newly metamorphosed life stages of amphibian species in the watershed. Amphibians depend on connective pathways between the upland forest and the breeding pond, although some individuals may remain in the breeding pond all year, especially at higher elevations. They may also use wet meadows and the streams that run through these meadows as natural migration corridors between forest and pond habitat.

Several characteristics are important to consider when assessing a site for restoration potential.

- Distance to forest edge – amphibians prefer areas with high humidity and will preferentially move through woody debris, plants, or leaf litter that retains moisture (deMaynadier and Hunter 1999). Distance to the forest edge and previous stump patterns at each site should be assessed and professional judgment used to determine if enhancement of existing cover would improve habitat conditions for amphibians.
- Plant species composition (in wetland) – several salamander and frog species attach their eggs directly to vegetation in the water column. A list of favored emergent vegetation for lowland ponds is provided in Appendix 2 (adapted from Richter 1997) for each amphibian species found in the watershed. The presence of these plant species should be noted and a range of plant diameters should be available at each site.
- Plant species composition (in riparian zone) – diverse plant species in the zone between wetlands and upland forest help protect moist microclimates favored by amphibians and necessary for refuge during movements between upland and pond habitat. Professional judgment should determine whether or not restoration steps could help improve the habitat quality for amphibians and other wildlife species.
- Amount of Coarse Woody Debris (CWD) – downed logs provide important refuge and travel habitat for salamanders and frogs and help retain moisture near the forest floor (Dupuis et al. 1995). The relative amount of CWD present in and near the wetland should be examined to see if augmenting this habitat component would be justified.
- Number of snags – although not critical to amphibians, snags provide roosting, foraging and nesting habitat for a variety of bird and bat species. Protecting existing snags around ponds and potentially enhancing snag distribution around ponds will benefit many species.

3.6 Adjacent Riparian and Upland Forest Habitat Suitability for Amphibians

The characteristics of the surrounding forest are also important when assessing the condition of a depressional wetland for amphibian use. Studies show that forests with higher levels of surface material (leaf litter, loose bark, and down logs) have higher relative abundances of amphibians (Walls et al. 1992, Dupuis et al. 1995). Migrating juvenile amphibians preferentially move into closed canopy habitat where foliage is dense in both the canopy and understory layers (DeMaynadier and Hunter 1999).

Assessment for restoration projects immediately adjacent to ponds and wetlands should include 1) assessment of condition of the forest overstory and understory, 2) assessment of stand structure, and 3) assessment of CWD levels needed for migration and refuge sites for amphibians. Below are several key characteristics to consider in forests immediately adjacent to wetland habitat. These traits will help to restore natural processes and provide the microhabitat conditions necessary to amphibians and other wildlife species.

- Spacing of trees and canopy closure – dense stands with closed canopies tend to have little understory development and in many cases past harvest practices removed much of the CWD needed as migration corridors and refuge sites for amphibians.
- Understory composition – assessment of the forest understory should include a quick inventory of plant species present, and a professional judgment call on the likelihood that the forest will continue to developing a vigorous understory. If restoration techniques could enhance understory conditions, amphibians may indirectly benefit through increased invertebrate diversity in the forest nearest their breeding ponds as well as improved microclimate conditions (Dupuis et al. 1999).
- Stand structure – some forest habitat surrounding depressional wetlands and wet meadows is naturally patchy due to the wet nature of soils and unique geology of the local area. In these cases, the forest is often developing structural variability without intervention. Assessment of stand structure should note the relative patchiness of the local area, presence of legacy trees or snags, and wet draws or patches in the immediate area.
- CWD providing migration corridors and refuge habitat—CWD, especially logs of larger diameter, is important to amphibians for foraging, migration to upland habitat and as refuge sites. The relative levels and sizes of CWD in forests surrounding ponds should be assessed.

3.7 Climate Change

Climate change in the Pacific Northwest is expected to result in drier than normal summers, and more rain and less snow in winters. The combination of less snowmelt in the spring to fill ponds and drier conditions in the summer during larval development and juvenile migration will likely negatively affect amphibians. A study in Oregon showed that lower water levels in lakes (due to climate change) increased exposure of larval toads to UV-B and consequently either killed developing larvae or made them more prone to disease (Kiesecker et al. 2001). Evidence for effects of climate change on amphibians and other wildlife continues to mount and should be considered in restoration of depressional wetland sites in the CRMW (Blaustein et al. 2001, Corn 2005). The effects of climate change may be more pronounced in wet meadows because they are reliant on spring snow melt to fill and maintain water levels in the meadow. Changes in the amount and timing of snow melt may have great effects on wet meadows and the suite of species they support.

3.8 Desired Future Conditions for Depressional Wetlands and Wet Meadows

Restoration or enhancement prescriptions will be developed that either move the site towards reference conditions (based on historic data including photographs or data collected at similar undisturbed sites) or towards higher habitat value as determined through professional opinion and literature review. In many cases we do not know the historic conditions of a site, but can evaluate when important habitat features are lacking on the landscape. Desired future conditions for depressional wetlands and wet meadows were designed to provide guidelines for improving habitat quality but do not outline specific target values. We recognize that a gradient of habitat values exist at these sites and also note that habitat values in the literature for these wetlands is limited.

Table 2 outlines key attributes of hydrologic conditions, non-native invasive plant issues, and current habitat conditions that should be considered when determining prioritization of depressional wetland and/or wet meadow restoration work. Desired future conditions for these indicators are listed in Table 3.

Table 2. Criteria for evaluating condition of wetland habitat and prioritizing restoration needs in the Cedar River Municipal Watershed.

Linkages to Figure 1	Key Ecological Attributes	Indicator	Technical Rationale	Data Source	Knowledge Gap
Hydrology	Sediment Input	Culvert discharging directly into a wetland	See Aquatic Restoration Strategic Plan. This is an indication of potential sediment input to the wetland polygon. The close proximity of a given culvert may contribute higher than normal levels of sediment.	Use WARSEM model to determine potential areas of high sediment input.	
	Flow regime and hydroperiod	Roads intercepting depressional wetlands	See Aquatic Restoration Strategic Plan. This is an indicator that wetland hydrology is not properly functioning. The road bisects wetland habitat, restricting the flow of water, plants and animals.	Have all needed GIS data.	
		Ratio of number of culverts to road length	See Aquatic Restoration Strategic Plan. An adequate spacing of culverts relative to the length of road upslope of a wetland is necessary to maintain natural flow pathways into the wetland.	Have all needed GIS data.	
		Gaps in forest to increase snow retention	Dense young forests intercept much of the snow that falls and create a monotypic canopy where drifts of snow cannot accumulate. Consequently, pockets of deep snow that are shaded by the forest to melt slowly rather than all at once are not created. Creating gaps in younger forests may help open up spaces where these processes can continue as the forest develops.	Experimental study initiated in the CRMW in 2007	Unknown if gaps will function, how many are needed, and how they change as forest develops.
Invasive Plants	Invasive plants	Dominance of knotweed	See Aquatic Restoration Strategic Plan and Invasive Species Management Plan. Knotweed threatens natural riparian recruitment processes by preventing the establishment and growth of conifers or other native species. Knotweed also does not provide overhanging cover and has weak root structure that reduces its effectiveness at promoting bank stability.	Botanical invasive species inventory – 2007-08. Annual invasive species inventories	
		Dominance of other invasive plants	See Aquatic Restoration Strategic Plan and Invasive Species Management Plan. Invasive species threaten natural riparian recruitment processes by preventing the establishment and growth of conifers or other native species. Invasives also tend to have lower value for wildlife, nutrient cycling and other ecosystem functions.	Botanical invasive species inventory – 2007-08. Annual invasive species inventories	
Restore or Enhance Wetland Habitat	Wetland Vegetation Composition/Structure	Wetland plant species composition	A mix of species assemblages provides greater richness of food sources and refuge habitat for invertebrates, amphibians and other wildlife (Hruby et al. 2005).	Use plant surveys to establish plant lists by elevation. Develop "reference" ponds & wetlands using relatively undisturbed sites.	Need reference conditions for ponds by elevation.
		Vegetation structure	Two salamander species require plants with distinct stem diameters for oviposition sites. Diameters preferred range between 1-2mm for long-toed salamanders and 3-4mm for northwestern salamanders (Richter 1997).	Use list provided in Appendix 2 to ensure that at least some portion of the wetland	Need reference conditions for ponds by elevation.

Table 2. Criteria for evaluating condition of wetland habitat and prioritizing restoration needs in the Cedar River Municipal Watershed.

Linkages to Figure 1	Key Ecological Attributes	Indicator	Technical Rationale	Data Source	Knowledge Gap
				habitat supports species with stems in this range (note that this list covers lower elevation ponds).	
	Biotic community composition	Presence of pond-breeding amphibians	See Aquatic Restoration Strategic Plan. Amphibian breeding surveys provide a method to compare changes in habitat conditions, changes in species assemblages, or monitor changes in population levels. Because amphibians congregate in relatively small areas to breed, these surveys are easily repeatable over time.	F&W pond breeding amphibian distribution surveys and repeated egg mass surveys in key wetlands (Appendix 1)	Many wet meadows not yet visited to determining breeding status.
Restore or Enhance Neighboring Forest	Diverse overstory composition	Species composition of riparian zone	Potential LWD recruitment, shade, structural complexity.	Remotely sensed data (Lidar, high resolution orthophotos)	
	Dead Wood function; Habitat complexity; Corridors to upland habitat	Snag density	Large numbers of wildlife species depend on snags for breeding, roosting, foraging		Reference conditions in undisturbed forest
		CWD size, abundance	CWD provides movement corridors for amphibians, small mammals and other wildlife between aquatic habitat and the surrounding upland forest. In addition, CWD provides cover from predators, a moist microclimate for movement or resting habitat and foraging habitat for many species (Castelle et al. 1992).	Develop range of variation using reference ponds.	Reference conditions for ponds and meadows by elevation.
	Riparian and upland forest understory conditions	Plant species diversity – canopy and understory	A mix of species assemblages provides greater richness of food sources and refuge habitat for invertebrates, amphibians and other wildlife (Hruby et al. 2005).	Evaluate data from plots near wetlands	Reference conditions in undisturbed forest

Table 3. Desired future conditions for depressional wetlands and wet meadows in the Cedar River Municipal Watershed.

Key Attribute	Indicator	Desired Future Condition
Flow regime and hydroperiod	Culvert spacing to ditch length	Enable natural flow pathways to depressional wetlands by placing adequate number of culverts to ditch length.
Sediment supply and movement	Presence of culverts across roads within 200 feet of the wetland	No runoff directly into a wetland based on WARSEM modeling.
Biotic community composition	Presence of expected amphibian species for elevation and wetland type, and egg mass count trends through time	No net loss of species expected to be present at a depressional wetland and comparable egg mass count trends to those observed in other similar systems within Washington State.
Biotic community composition	Presence of knotweed or other invasive plant species	No new infestations of invasive plant species and reduction in extent of already existing patches.
Size of trees in riparian zone	Diameter of trees within 50 feet of the depressional wetland.	Range of variation consistent with reference conditions.
Plant species composition of riparian zone	Presence of expected plant species in canopy and understory.	Range consistent with reference conditions.
CWD abundance	Diameter and length of CWD pieces within 50 feet of the pond or wetland.	Range of variation consistent with reference conditions.
Upland plant species composition	Presence of expected species in canopy and understory.	Range consistent with reference conditions at similar elevations.
Wetland plant species composition	Presence of species at the margin of the wetland (in water shallower than 2 feet).	Range consistent with reference conditions at similar elevations.

4.0 Linkages between Depressional Wetland and Wet Meadow Restoration Efforts and other Restoration Programs

4.1 Landscape Synthesis Prioritization Guidance

At a watershed scale, a "landscape synthesis" process has identified areas where synergies of restoration efforts in aquatic, riparian, and terrestrial ecosystems can best occur. These are priority areas for restoration treatment among all restoration programs.

The intent of the landscape synthesis process was to "…provide an overall, landscape-level approach to planning restoration in an integrated fashion to most efficiently and effectively achieve the goals of the HCP" (Erckmann et al. 2006). One of the primary goals of the synthesis was to develop a watershed landscape template (or vision) that would be a guide for conservation and restoration of key ecosystems, communities, and species. The landscape template was derived from four themes representing different aspects of watershed biodiversity:

- Fish – which includes the distribution of anadromous salmon and bull trout within the watershed;
- Forest connectivity – which shows areas where existing late seral – old growth or high quality second growth forests occur and where the most effective areas for reconnecting occur;
- Amphibian habitat – includes complexes of aquatic, riparian, and upland areas most likely to be important for amphibians in the watershed (mainly depressional wetlands);
- Areas adjacent to biodiversity hotspots – which include areas that either have high species diversity or contribute to overall diversity, such as rock, meadows and shrub lands, non-depressional wetlands, and old growth forest.

Buffers of varying widths were applied to these areas, and overlaps of habitat-buffers among themes were identified within the GIS. Weightings were given to the different themes, and areas of theme overlap were then ranked based on number of overlaps and theme weightings. Areas that rank high in this process were then considered priority areas for upland forest, riparian forest, or aquatic restoration. That is, these areas provide opportunities for synergy of restoration actions among upland, riparian, and aquatic areas. By focusing primarily on these identified “synergy areas”, this strategic plan provides a process to prioritize sites (or ponds/wetlands) for implementing restoration actions.

4.3 Aquatic Restoration

The Strategic Aquatic Restoration Plan for the CRMW (Bohle et al. 2005) outlines specific goals relative to maintaining hydrologic connection and reducing sediment input to wetlands. The Aquatic Restoration ID Team is responsible for addressing hydrologic and road sediment problems associated with ponds and wetlands.

4.4 Restoration Thinning

The HCP Restoration Thinning program actively thinned dense young second-growth forest stands (generally less than 30 years old) to facilitate ecological development towards old-growth forest habitat conditions. The program was active in the CRMW from 2000 through 2013, when the program concluded. Selecting restoration thinning units near ponds and wetlands provided synergistic benefits and may have helped to accelerate forest development and add diversity to the area. Historically, logging practices did not require protective buffers adjacent to streams and wetlands, and all restoration thinning units were comprised of these historic logging units.

The ecological objectives for restoration thinning included: 1) accelerating the stand development pathway through the stem exclusion stage, 2) maintaining or increasing the growth rate of trees, 3) facilitating future recruitment of large diameter snags and coarse woody debris, 4) increasing plant species diversity, 5) protecting special habitats, and 6) protecting water quality. While objectives for the forest surrounding ponds and wetlands are not inconsistent with those listed above, there were other objectives to also consider.

Additional objectives for the habitat immediately adjacent to the pond or wetland (wetland riparian zone) included: 1) maintaining moist microclimates, 2) protecting the temperature regime of the wetland in the short term, 3) providing plant species diversity to increase the leaf litter and nutrient inputs in riparian habitat through planting, and (4) maintaining characteristic hydrology.

In 2013, an evaluation of the forested areas surrounding all classified wetlands within the CRMW was conducted (Nickelson and Paige 2013). A total of 130 depressional wetlands were evaluated, with a total wetland acreage of 1130 acres. There was a total of 2180 acres in 300-foot buffers surrounding each wetland. Of this, no forested buffers were less than 20 years of age, and only 109 acres were less than 40 years old. Of these young forests, most were located in the upper watershed and by 2013 were restoration thinned.

These restoration thinning efforts utilized a variety of prescriptions including, but not limited to:

- a no-thin buffer
- deliberately allowing cut trees to fall into and across streams and ponds
- a zone around the wetland where trees were thinned at a denser spacing
- a zone around the wetland where trees were thinned and deciduous species and shrubs planted
- creation of a small gap at one edge of the pond while leaving the rest of the trees
- a treatment in which the dominant trees were retained, codominant trees cut, and all the small young trees left to provide short-term shade around the wetland/pond
- large gaps cut in upslope forest to increase roughness of the forest canopy and as pockets to retain snow

4.5 Ecological Thinning

Ecological thinning occurs in forest stands typically greater than 30 years in age and less than 60 years in age. Forests in this age range often have a fairly uniform canopy, although some diversification in the canopy may exist. In forests where ecological thinning and wetland habitat overlap, potential treatment options for forest habitat immediately adjacent to wetland habitat include:

- Thinning some trees in the forest adjacent to the pond by dropping them into the wetland as well as on the forest floor near the wetland.
- Planting deciduous species to increase the diversity of habitat immediately surrounding a wetland site.
- Planting native shrub species to improve understory habitat conditions.

4.6 Upland/Riparian Forest Planting

The restoration planting program aims to return species critical to ecosystem functioning to areas where the establishment, reproduction, or persistence of these species was known or assumed to be reduced by past land management. Planting is used in conjunction with pond and wetland restoration to restore ecosystem processes including wildlife habitat, nutrient cycling and prevention of establishment or expansion of invasive, non-native species.

4.7 Synergy of Road Decommissioning and Depressional Wetland Habitat Restoration

The road decommissioning program in the CRMW focuses on removing segments of roads that are unnecessary for current or future operations, as well as removing roads that contribute excessive sediment to streams, those with drainage problems, or instability. In addition, removing roads that bisect wetland habitat improves connectivity within the wetland and removes a source of sediment to the wetland and eventually the stream network.

When road decommissioning is planned in close association with wetland habitat, several opportunities to improve the quality of wetland habitat exist:

- Restore hydrologic connections, if the road prism bisected wetland habitat, by removing the road fill from the wetland.
- Design bridges or culverts so that amphibians and other wildlife can move along the floodplain and do not have to cross a road.
- Removal of the road prism and regrading to near natural slopes thereby removing a physical barrier between the wetland and upland forest habitat.
- Add course wood debris creating a movement corridor across the road for wildlife species. The wood should be larger diameter and in direct contact with the soil.
- Design planting efforts to restore the native plant community connecting wetland and upland forest habitat, while discouraging invasion by non-native species.

5.0 Prioritization of Depressional Wetland and Wet Meadow Restoration Projects

5.1 Prioritizing Depressional Wetland Projects

After our initial assessment work (section 3) identified which ponds and wetlands need restoration or enhancement, limited funds and staff resources required that we prioritize the candidate ponds and wet meadows. We used the following elements to prioritize the work: problems with hydrologic connections of wetland, presence of invasive plants, opportunity to make the most difference in pond or wetland habitat conditions, and opportunities to link with other projects. Of highest priority are hydrologic conditions such as roads intercepting flow that would naturally route to wetlands and sediment discharging into wetlands. Secondary priority for initiating work at wetlands falls to those locations where invasive plants are documented. And lastly, depressional wetlands or wet meadows where specific habitat conditions warrant additional restoration or enhancement projects will be addressed (Figure 1).

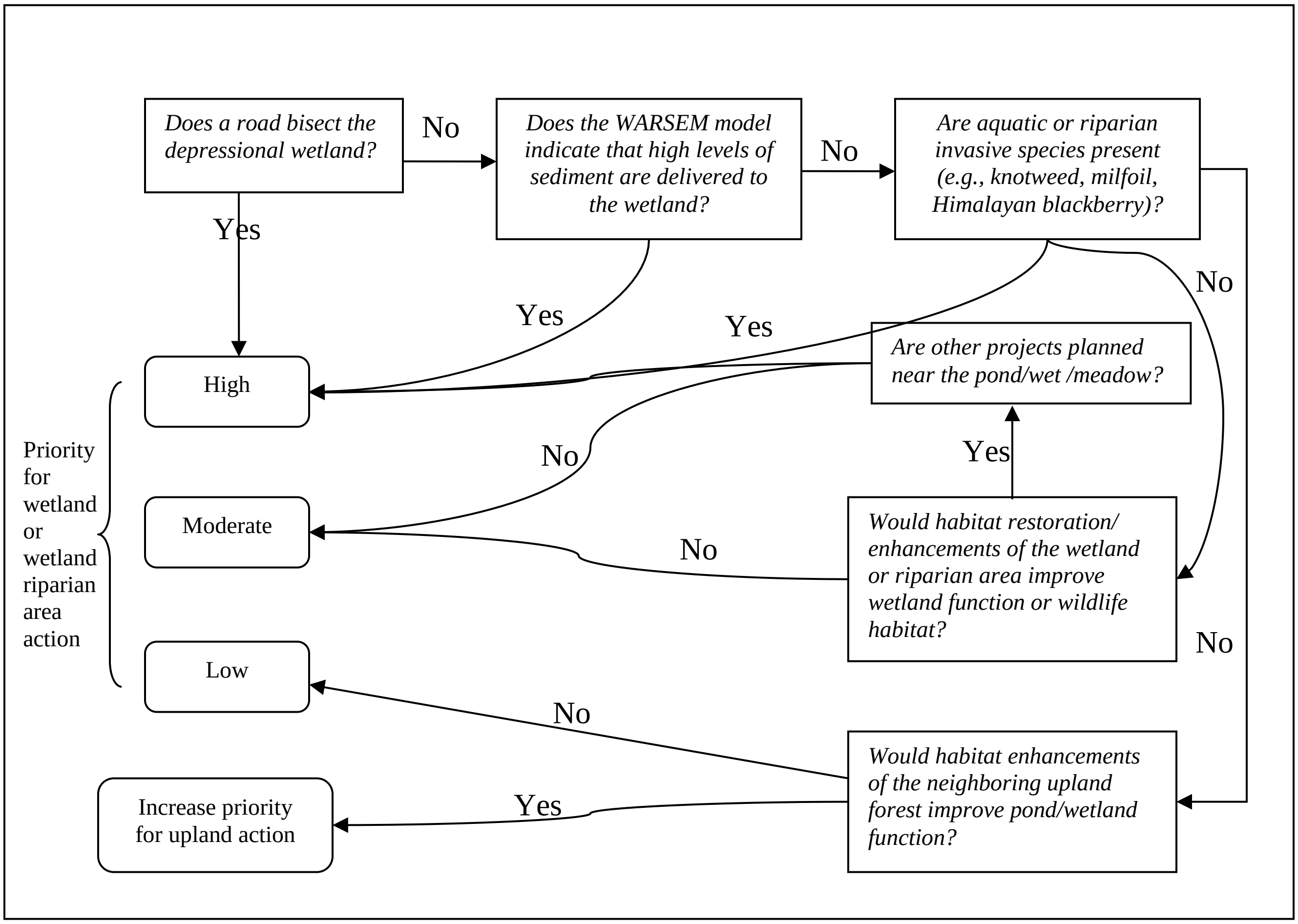


Figure 1. Depressional wetland and wet meadow project prioritization.

5.2 Hydrologic Conditions

Areas noted with hydrologic problems will be considered high priority sites for restoration. Improving water quality and ensuring that pond/wetland hydrologic processes are intact is of highest importance in prioritizing work. An initial GIS survey of depressional wetlands in the CRMW indicated that no obvious problems exist with depressional hydrologic connectivity to depressional wetlands. A full assessment of sediment input to wet meadows is needed, however.

5.3 Presence of Invasive Plant Species

Areas found to have invasive species present are considered high priority for restoration or enhancement. Invasive species are likely the largest threat to pond and wetland habitat in the CRMW as forestry practices within the watershed are currently limited to ecologically-based thinning. Although it may be tempting to ignore smaller invasions in the short-term, we have seen that the effort to remove invasive plants can grow exponentially in just a few years. Ponds and wetlands with small cover of invasive species should be prioritized for work whenever an invasion is noted. Similarly, attention should be prioritized among non-natives to target those that are the most invasive in wetland, riparian or aquatic zones. A comprehensive survey for invasive species during 2007-08, as well as on-going annual surveys, provides documentation of species present at many depressional wetlands and wet meadows in the watershed (especially those that have experienced highest levels of disturbance). We use this inventory annually to refine the project prioritization list.

5.4 Opportunity to Make the Most Difference

Wetlands that have recently or significantly been impacted by human activities are prioritized for restoration and enhancement. Impacts include habitat alterations such as clearcutting to the pond/wetland edge, removal of CWD around the perimeter of the wetland and adjacent forest, forest regeneration limited to only conifer species, or exclusion of understory species due to closed canopy forest regeneration. This makes most of the ponds and wetlands in the upper watershed higher priority since they were most recently clear-cut.

Additionally, the position of each depressional wetland compared to other wetlands or unique habitats (e.g. talus slopes, meadows) should be considered. Attempting restoration activities in sites within close proximity to other wetlands or important overwinter or summer refuge will provide the best habitat enhancements for species such as amphibians that require several habitat types to complete their life history. These factors can be evaluated by using the CRMW Landscape Synthesis Plan (Erckmann et al. 2006) and other GIS exercises.

5.5 Opportunities to Link with Other Projects

As discussed in Section 4, there are several program areas which work near depressional wetlands and wet meadows. We anticipate having wetland or amphibian experts involved in other programs in two ways.

First, projects (most likely upland or riparian forest thinning or road decommissioning) planned near depressional wetlands and wet meadows will be elevated to a high priority for assessment of pond/wetland needs. If wetland restoration or enhancement opportunities exist, we will work with the project team to define and plan activities near the ponds/wetlands (e.g., directional tree felling). Regardless of the need for intervention, we will work with the project team to mitigate the risk of potentially damaging the existing habitat value of the area.

Second, during the assessment process, ponds and wetlands that would benefit from work managed by other program areas will be identified. This includes areas where thinning, road decommissioning or planting could restore or enhance habitat qualities. These areas will be brought to the attention of appropriate team members in the other program areas. If the area is high enough priority to the other programs, we will design a joint project to address restoration concerns in multiple areas.

6.0 List of Project Sites

The following is a list of ongoing, completed, and potential project sites, as of 2015. They are listed in approximate order of importance, and include a brief description of habitat conditions, any work completed, and project objectives at each site.

6.1 Ongoing Projects

- **14 Lakes** – Five kettle ponds located in the lower CRMW provide some of the best amphibian breeding habitat in the watershed. These ponds do not contain fish populations and therefore provide habitat with fewer predators for developing larvae. The pond levels fluctuate widely from year to year, sometimes filling almost to the mature forest edge while in other years water level is several hundred feet from the forest edge. Invasive plants such as blackberry and tansy ragwort are dominant in some sections of 14 Lakes. Habitat restoration and enhancement work was initiated in 2005 and is ongoing. Projects conducted at 14 Lakes included removing invasive species, planting native trees and shrubs, and felling trees to provide CWD for amphibians migrating to and from the ponds for breeding, as well as breeding substrate in the pond itself. ***Project objectives***: Reduce the spread of invasive plants and control current known patches. Restore native riparian plant communities. Provide amphibian travel corridors and breeding substrate.

- **Rock Creek Wetland** – The Rock Creek Wetland complex provides diverse habitat for many species of amphibians, birds, and other wildlife, and lies in an important area of synergy. The forest around the wetlands is second growth forest that is relatively diverse. Large portions of the wetland have patches of invasive species, including knotweed, blackberry, nightshade, and reed canary grass. Habitat restoration and enhancement work started in 2005 and is ongoing. Projects include removing invasive species and planting native trees and shrubs. ***Project objectives***: Reduce the spread of invasive plants and reduce or eradicate current known patches. Restore native wetland plant communities.

- **Small Low-Elevation Wetlands –** There are several small low-elevation wetlands associated with rivers and creeks in the CRMW that had moderate to high infestations of invasive species. These include two wetlands along the mainstem of the Cedar River (Boardwalk wetland and unnamed wetland on the opposite bank), and two wetlands associated with small unnamed tributaries to the Cedar (off the 40 and 42 roads). Work in the Boardwalk wetland started in 2005, while work in the smaller sites started in 2011-13. Initial invasives species removal is complete, and all sites are now maintained with a small effort every two to three years. Some sites have been planted with native trees and shrubs to increase plant species diversity. ***Project objectives***: Reduce the spread of invasive plants and reduce or eradicate current known patches. Restore native plant communities.

- **Meadow and Wetlands off 250.3 Road -** Several wet meadows with some small depressional wetlands are adjacent to the 250.3 Road, which is slated for decommissioning in 2017. There are several invasive species associated with the road and starting to invade the meadows and wetland. Control of these invasives started in 2014. ***Project objectives***: Control or eradicate the invasive plants prior to road decommissioning. Reconnect the wetlands and meadows through road fill removal.

- **BPA ROW Ponds** – Several very small depressional wetlands are located along the portion of the BPA line cleared in 2003. These sites provide breeding habitat for several salamander species and the Pacific treefrog. Two of the sites had heavy invasive species infestations, primarily Himalayan and evergreen blackberry. Control efforts started in 2005 and are ongoing. Experimental planting plots were established, and an assortment of native trees and shrubs were planted and are being maintained. ***Project objectives***: Reduce the spread of invasive plants and eradicate or control current known patches. Establish native plants that are acceptable to BPA under the ROW.

- **Barneston Mill Pond** – The Barneston Mill Pond was created in the early 1900s by diverting water through a ditch from Williams Creek to the pond. A dam was built at the west end of the pond to maintain water levels. This depression retains water today and provides amphibian breeding habitat in the lower watershed. Invasive plants, especially blackberry, are present at the site and may outcompete native understory vegetation. One effort to control the blackberry was conducted in 2006. However, due to limited resources, no further invasives control work has been conducted. In 2013, native conifer trees were planted amongst the salmonberry and alder, to help provide a more diverse riparian habitat. ***Project objectives***: Reduce the spread of invasive plants and control current known patches. Establish a native plant community.

6.2 Completed Projects

- **McClellan Creek Headwater Meadows -** A meadow system with some small depressional wetlands in the headwaters of McClellan Creek. This network of meadows provides habitat connectivity for amphibians that might breed in Alice Lakes to the north. Restoration thinning was completed around one of these meadows during the summer of 2007. Six 30x100-foot canopy gaps were placed to enhance snow retention, which should help prolong late season snowmelt to help provide water to maintain the wet meadow system. In 2008 a road bisecting one meadow was decommissioned, to help reconnect the wetland system. ***Project objectives***: Enhance snow retention around the meadow. Reconnect the meadows.

- **Rex Pond -** This pond is situated in a patch of young forest off a main watershed road. Restoration thinning was completed in the area in 2009. At that time several trees were dropped into the pond to provide amphibian breeding habitat, and numerous canopy gaps were created to enhance snow retention, to help prolong late season snowmelt. ***Project objectives***: Improve and maintain the meadow habitat surrounding the pool, as well as the riparian forest.

- **Jury Lake** – A small pond off the 68 road supports breeding of several amphibian species. The forest surrounding the pond is primarily conifer and was quite dense. There was very little understory in the forest and wood on the forest floor was small. Historical photos indicate that the conifer forest bordered the pond much as the forest does today. The area around the lake was thinned in 2011 to allow individual tree growth and understory development. At that time numerous trees were dropped into the lake to enhance amphibian breeding habitat. In 2014 the adjacent road was decommissioned, with the road surface broken to allow easier plant establishment and better reconnect the pond with the forest. ***Project Objectives***: Improve understory conditions in the neighboring forest. Improve connectivity between the pond and forest over the road corridor.

- **Meadow off 208 road** - Small meadow in a forest patch that was restoration thinned in 2007. The area surrounding the meadow, as well as the north side of the meadow was not thinned, to provide a heavily shaded corridor to nearby old-growth forest habitat as well as connectivity to other meadows that lie in the basin. Patches of forest to the south were thinned to varying leave tree densities, to provide future spatial heterogeneity. ***Project objectives***: Maintain connectivity to old growth forest.

- **Pond off 200.8 road** - Small pond with legacy riparian old growth trees surrounded by young forest. The young forest was thinned in 2008. Heavily shaded connectivity with nearby old-growth forest and other small wetlands was maintained via two unthinned corridors. Thinned areas contained several skips and gaps, to provide future structural heterogeneity in the forest. ***Project objectives***: Maintain connectivity to nearby old-growth forest.

6.3 Potential Project Sites

The following potential restoration sites are related to synthesis locations, forest thinning, road decommissioning, or general habitat enhancement. They all require further investigation to see if restoration work is warranted.

- **Headwaters of Lost Creek** - A depressional open wetland is located within a completed restoration thinning unit. Additional slope wetlands and a small stream run through the thinning unit as well. A site specific prescription should be developed for the area accounting for habitat connectivity between all wetland types. ***Project objectives***: Encourage growth of large trees that will provide coarse woody debris for amphibian and other wildlife habitat. Maintain a natural ecotone between wet meadows and the upland forest through thinning. Maintain and/or restore habitat structure within the forest. Encourage connectivity between differing habitat types including old growth, shrub habitats, young forests, and wet meadows in the headwaters of Fish and Lost Creek basins. Maintain heterogeneity of habitat types and structural characteristics of the upland forest.

- **Lost Creek Bog** – A small bog lies at the headwaters of Lost Creek. The habitat should be investigated to see if treatments could improve connectivity or habitat structure at this site. ***Project objectives***: To be developed if the site warrants restoration/enhancement.

- **Lower Sutton Lake** – The lake itself has very little wood in it and trees in the neighboring forest will not be tall enough to reach the lake for more than a decade. The meadow area around the pond does not have any evidence of tree stumps and shows annual evidence of wildlife usage. The meadow does not support the diversity of plant species it historically did before the surrounding forest was harvested (D. Paige field notes and photos). ***Project objectives***: Improve amphibian breeding habitat with down wood if deemed necessary. Maintain meadow habitat and increase growth rate of surrounding forest to provide future LWD.

- **Meadow off 78.1 road** – Wet meadow system with open water depressions that provide breeding habitat and summer refuge habitat to amphibians. The habitat should be investigated to see if treatments could improve connectivity or habitat structure at this site. The road system was decommissioned in 2010, so access is now extremely limited. ***Project objectives***: To be developed if the site warrants restoration/enhancement.

7.0 References

Blaustein, A.R., L.K. Belden, D.H. Olson, D.M. Green, T.L. Root, and J.M. Kiesecker. 2001. Amphibian breeding and climate change. Conservation Biology 15(6): 1804-1809.

Bohle, T., D. Beedle, H. Barnett, M. Joselyn, A. LaBarge, B. Lackey. 2006. Cedar River Municipal Watershed Aquatic Restoration Strategic Plan. Seattle Public Utilities. Available online: http://www.seattle.gov/util/EnvironmentConservation/OurWatersheds/Habitat_Conservation_Plan/ManagingtheWatershed/StrategicPlanning/index.htm

Brinson, M.M. 1993. A hydrogeomorphic classification for wetlands. Wetland Research Program Technical Report WRP-DE-4. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Castelle, A.J., C. Conolly, M. Emers, E.D. Metz, S. Meyer, M. Witter, S. Mauermann, T. Erickson, S.S. Cooke. 1992. Wetland Buffers: Use and Effectiveness. Adolfson Associates, Incl, Shorelands and Coastal Zone Management Program, Washington Department of Ecology, Olympia, Pub. No. 92-10.

Corn, P.S. 2005. Climate change and amphibians. Animal Biodiversity and Conservation 28(1): 59-67.

DeMaynadier, P. G. and M. L. Hunter. 1999. Forest canopy closure and juvenile emigration by pool-breeding amphibians in Maine. Journal of Wildlife Management 63(2):

Dupuis, L. A., J. N.M. Smith, and F. Bunnell. 1995. Relation of terrestrial-breeding amphibian abundance to tree-stand age. Conservation Biology 9(3): 645-652.

Erkmann, J et al. 2009. Landscape Synthesis Framework for the Cedar River Municipal Watershed Habitat Conservation Plan. Available online: http://www.seattle.gov/util/EnvironmentConservation/OurWatersheds/Habitat_Conservation_Plan/ManagingtheWatershed/StrategicPlanning/index.htm

Hruby, T., T. Granger, K. Brunner, S. Cooke, K. Dublanica, R. Gersib, L. Reinelt, K. Richter, D. Sheldon, E. Teachout, A. Wald, and F. Weinmann. July 1999. Methods for Assessing Wetland Functions Volume I: Riverine and Depressional Wetlands in the Lowlands of Western Washington. WA State Department of Ecology Publication #99-115.

Kiesecker, J.M., A.R. Blaustein, and L.K. Belden. 2001. Complex causes of amphibian declines. Nature 410: 681-683.

Messere, M. and P.K. Ducey. 1998. Forest flood distribution of northern redback salamanders, *Plethodon cinereus*, in relation to canopy gaps: first year following selective logging. Forest Ecology and Management 107: 319-324.

Richter, K.O. 1997. Criteria for the restoration and creation of wetland habitats of lentic-breeding amphibians of the Pacific Northwest. Published in – Macdonald, K.B. and F. Weinmann (eds.). 1997. Pp 72-94. *In* Wetland and Riparian Restoration: taking a broader view.

Walls, S. C., A. R. Blaustein, and J. J. Beatty. 1992. Amphibian biodiversity of the Pacific Northwest with special reference to old-growth stands. The Northwest Environmental Journal 8: 53-69.

Witt, D. 2006. Use of prescribed fire in ecological restoration: lessons from Chittenden Meadow, Skagit Valley, British Columbia. Master's Thesis. Simon Fraser University.

Appendix 1: List of Amphibian species present at surveyed sites in the CRMW and ranking of priority project sites.

	Site No. (see Figure 2)	Elevation (Feet)	*Are high levels of sediment entering wetland according to WARSEM?*	*Invasive plants*	*Restoration thinning units?*	*Road decommissioning likely near wetland?*	*Potential to improve habitat in/immediately near wetland*	*Potential to improve connectivity with upland forest*	*Amphibian species diversity*	*Overall ranking*		*Long-toed salamander*	*Roughskin Newt*	*Northwestern salamander*	*Pacifc Treefrog*	*Red-legged frog*	*Cascades frog*	*Western toad*
Lower Watershed																		
Rock Creek Wetland – 16 Road portion	1	760	N	Y	N	N	L	L	H	**H**		X	X	X	X	X		
Rock Creek Wetland – Corner	2	760	N	Y	N	N	L	L	H	**H**		X		X	X	X		
Rock Creek Wetland – Triangle	3	760	N	N	N	N	L	L	H	**L**		X	X	X	X	X		
Rock Creek Wetland Bog	4	760	N	N	N	N	L	L	M	**L**		X			X			
14 Lakes	5	800	N	Y	N	N	M	L	H	**H**		X	X	X	X	X		
Culvert 80.5-1 (Bonus Creek)	6	1240							M					X	X		X	
Ellen's Pond (82.3B road)	7	1560	N	N	N	?	L	L	H	**L**		X	X	X			X	
Wetland off 82.2 road	8	1380	N	N	N	N	L	L	M	**L**		X		X			X	
82.3A Bog	9	1580	N	N	N	N	L	L	L	**L**				X				
Barneston Mill Pond	10	880		Y	Y	N	M	M	H	**H**		X		X	X	X		
40 Road scrub-shrub wetland	11	920		N	N	N	L	N	L	**L**								
45 Road Wetland	12	640		?	N	N	M	L	M	**M**				X	X	X		
Wetland East of 57 Road	13	800		N	N	N	L	L	H	**L**		X	X	X	X	X		
Scrub-shrub wetland west of 55 road	14	800	N	N	N	N	L	L	L	**L**		X						
Kerriston Marsh	15	1500		?	N	N	L	L	H	**L**		X	X	X	X			
Various culverts	--								M			X		X	X			
Pond to the northeast of the 40/18	16	740	N	N	N	N	L	L	M	**L**				X	X	X		
Beaver pond along Rock Creek	17	740	N	?	N	N	L	L	M	**?**				X		X		
Wetland near Walsh Lake	59	760	N	?	N	N	L	L	M	**?**		X		X	X			
20 Road Pond	18	2460	N	N	N	N	L	L	M	**L**				X	X	X		
Pond below culvert 20-36	19	2280		N	N	N	L	L	L	**L**				X				

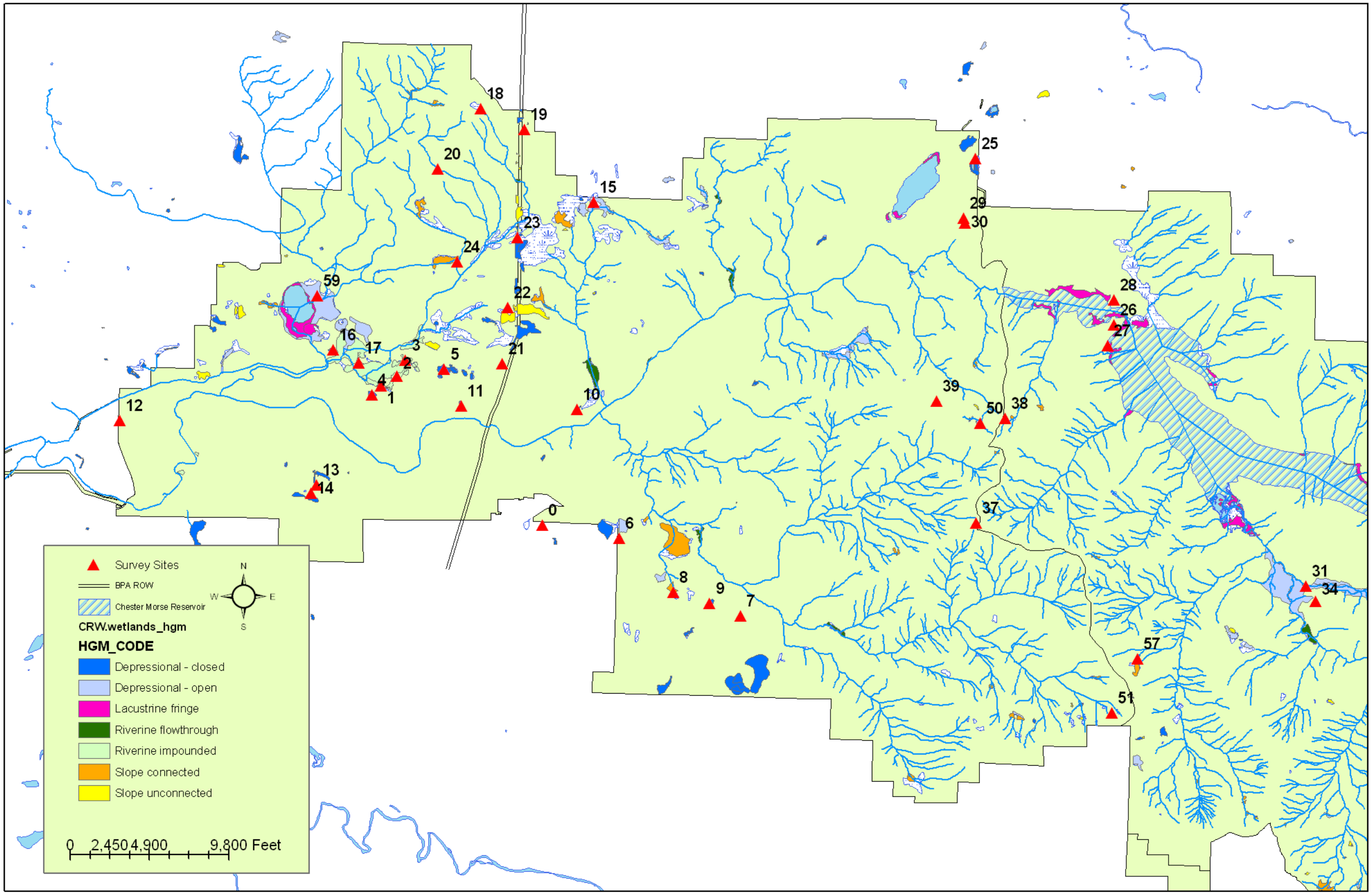
	Site No. (see Figure 2)	Elevation (Feet)	*Are high levels of sediment entering wetland according to WARSEM?*	*Invasive plants*	*Restoration thinning units?*	*Road decommissioning likely near wetland?*	*Potential to improve habitat in/immediately near wetland*	*Potential to improve connectivity with upland forest*	*Amphibian species diversity*	*Overall ranking*		*Long-toed salamander*	*Roughskin Newt*	*Northwestern salamander*	*Pacifc Treefrog*	*Red-legged frog*	*Cascades frog*	*Western toad*
25 Road Roadbed	20	2120										X	X	X				
Fairy Shrimp Pond, BPA ROW	21	1000		Y	N	N	L	L	L	**M**				X				
BPA Pond north of 30 Road	22	1160	N	?	N	N	M	M	M	**M**		X			X			
BPA pond north of Kerriston Road	23	1360	N	?	N	N	M	M	M	**M**		X		X	X			
Wetland above King Couty fish ladder (Kerriston Road)	24	1120	N	N	N	N	L	L	L	**L**				X				
Christmas Lake	25	960	N	?	N	N	L	L	M	**L**			X		X			
Selleck Pond	61	1300		?	?	N	M	M	M	**M**				X	X		X	
Around Chester Morse Lake																		
Temporary pool South of Masonry Pool Bridge	26	1600		N	N	N	L	L	H	**L**		X		X	X	X		X
Chester Morse Lake	27	1600										X			X	X	X	X
107 Road Pond	28	1600		Y	N	N	M	M	L	**M**					X			
Oliver Lake - North	29	1360		N	N	N	L	L	M	**L**					X	X		
Oliver Lake - South	30	1360		N	N	N	L	L	L	**L**								
Coyote Pass Gravel Pit	31	1680							L						X		X	
Eagle Ridge Meadow Pond	32	1600		N	N	N	L	L	H	**L**				X	X	X	X	
Morse Creek	33	1600		N	N	N	L	L	H	**L**					X	X	X	
300 Road Pond	34	1620												X	X		X	
Cedar River delta	35	1600										X		X	X	X	X	
Pool on Cedar River near outlet to WBC 4	36	1600												X			X	

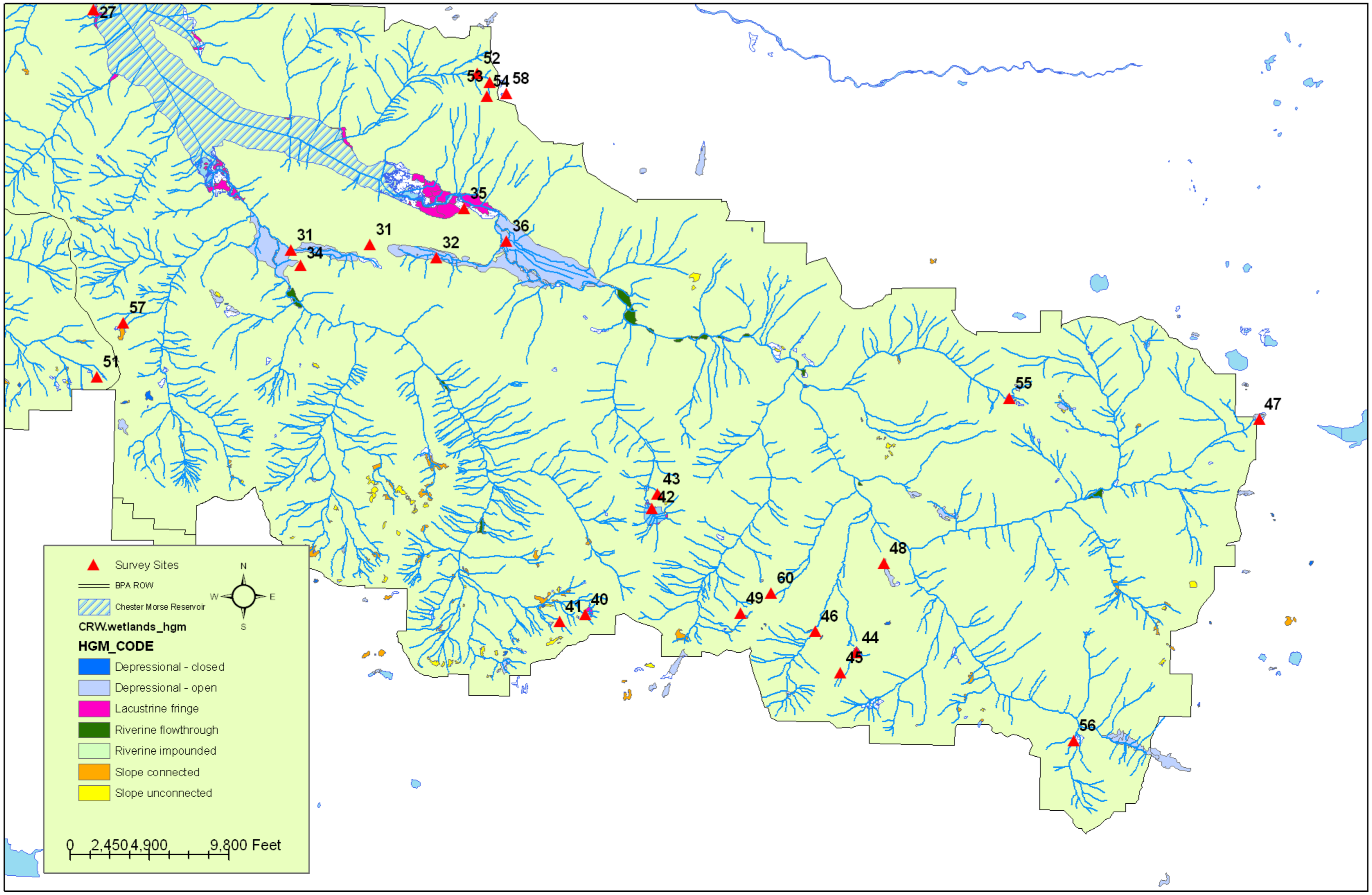
	Site No. (see Figure 2)	Elevation (Feet)	Are high levels of sediment entering wetland according to WARSEM?	Invasive plants	Restoration thinning units?	Road decommissioning likely near wetland?	Potential to improve habitat in/immediately near wetland	Potential to improve connectivity with upland forest	Amphibian species diversity	Overall ranking		*Long-toed salamander*	*Roughskin Newt*	*Northwestern salamander*	*Pacifc Treefrog*	*Red-legged frog*	*Cascades frog*	*Western toad*
Upper Watershed																		
Jury Lake	37	3800		N	Y?	Y?	L	M	M	**M**				X			X	
Lost Creek Bog	38	3560		N	Y	N	L	M	L	**M**							X	
Meadow with 3 Ponds off 78.1 Road	39	3720		N	?	?	L	M	M	**M**				X	X		X	
Rex Pond	40	3880		N	Y	Y	M	M	H	**M**				X	X		X	
Rex Headwater Meadows	41	3900-4100															X	
Findley Lake	42	3720	N	N	N	N	L	L	H	**L**			X	X	X		X	X
Findley Marsh	43	3720	N	N	N	N	L	L	H	**L**			X	X	X		X	
Lower Sutton Lake	44	3640		N	Y	Y	M	M	H	**M**			X	X	X		X	
Upper Sutton Lake	45	4200	N	N	N	N	L	L	?	**L**								
Goat Creek Pond	46	3000		N	?	Y	M	M	?	**M**					X			
Twilight Lake	47	3600	N	N	N	N	L	L	H	**L**				X	X		X	
610 Wetland	48	2520		N	N	N	L	L	H	**L**				X	X		X	
Meadow off 610.1A3 Road	49	3920		N	N	?	L	L	M	**L**							X	
Headwaters of Fish Creek – wet meadows	50, 62, 63	3720	N	N	Y	N	M	M	M	**M**							X	
Abandoned Road System 200	51	3400															X	
McClellan Creek Headwaters 1	52	4120		N	?	N	M	M	M	**M**							X	
McClellan Creek Headwaters 2	53	4320		N	?	?	M	M	H	**M**					X		X	X
McClellan Creek Headwaters 3	54	4400		N	?	?	L	M	M	**M**		X					X	

	Site No. (see Figure 2)	Elevation (Feet)	*Are high levels of sediment entering wetland according to WARSEM?*	*Invasive plants*	*Restoration thinning units?*	*Road decommissioning likely near wetland?*	*Potential to improve habitat in/immediately near wetland*	*Potential to improve connectivity with upland forest*	*Amphibian species diversity*	*Overall ranking*		*Long-toed salamander*	*Roughskin Newt*	*Northwestern salamander*	*Pacifc Treefrog*	*Red-legged frog*	*Cascades frog*	*Western toad*
McClellan Creek Headwaters 4	65	4160		N	Y	?	L	M	M	**M**							X	
Bear Lake	55	4200	N	N	N	N	L	L	H	**L**		?	?	?	X		X	?
Wet meadow near 650/651 junction	56	3160	N	N	N	N	L	L	L	**L**							X	
Wetland off 211.3 Road	57	3480	N															
Alice Lakes	58	4520															X	
Headwaters of Viola Creek	60	3920															X	
Wet meadow off end of 208 Road	64	3640	N	N	Y	Y	M	M	L	**M**								
Wet meadow off 200 Road	66	3720		N	Y	N	L	M	M	**M**							X	
Small pond in old landing off 200 Road	67	3840	N	N	Y	?	M	H	L	**L**				X				
Wet meadow in RT unit 61.1 off 200 Road	68	3840	N	N	Y	?	M	H	L	L							**X**	
Pond in RT unit 61.1	69	4040	N	N	Y	Y												
Wet meadow complex off 208.1 Road	70	3800	N	N	Y	Y	L	H	M	L				**X**			**X**	
Wet meadow south of 207 Road	71	3760	N	N	Y	Y	L	H	L	L							**X**	

	Site No. (see Figure 2)	Elevation (Feet)	*Are high levels of sediment entering wetland according to WARSEM?*	*Invasive plants*	*Restoration thinning units?*	*Road decommissioning likely near wetland?*	*Potential to improve habitat in/immediately near wetland*	*Potential to improve connectivity with upland forest*	*Amphibian species diversity*	*Overall ranking*		*Long-toed salamander*	*Roughskin Newt*	*Northwestern salamander*	*Pacifc Treefrog*	*Red-legged frog*	*Cascades frog*	*Western toad*
Wet meadow south of 280 Road	72	3360	?	N	?	Y	M	H	L	L								
NUMBER OF SITES WHERE EACH SPECIES WAS PRESENT												**20**	**11**	**39**	**37**	**16**	**40**	**4**

Figure 2. Map showing sites visited in the CRMW.

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Survey Sites
BPA ROW
Chester Morse Reservoir
N
W
E
S
CRW.wetlands_hgm
HGM_CODE
Depressional - closed
Depressional - open
Lacustrine fringe
Riverine flowthrough
Riverine impounded
Slope connected
Slope unconnected
0 2,450 4,900 9,800 Feet

Appendix 2. Suggested wetland plants used as amphibian oviposition sites (adapted from Richter 1997).

Amphibian Species	*Plant Common and Scientific Name*
Long-toed Salamander Pacific Treefrog	**<u>1-2 mm diameter, thin-stemmed emergent plants</u>** Shortawn foxtail (*Alopercurus aequalis*) Water foxtail (*A. geniculatus*) Alaska bentgrass (*Agrostis aequivalvis*) Bluejoint reedgrass (*Calamagrostis canadensis*) American mannagrass (*Glyceria grandis*) Tall mannagrass (*G. elata*) Western mannagrass (*G. occidentalis*)
Northwestern Salamander Red-legged frog	**<u>3-6 mm diameter, medium-stemmed emergent plants</u>** Slender-beaked sedge (*Carex athrostachya*) Beaked sedge (*C. utriculata*) Slough sedge (*Carex obnupta*) Buckbean (*Menyanthes trifoliata)* Water parsley (Oeananthe sarmentosa) Water smartweed (*Polygonum amphibium*) Waterpepper (*P. hydropiperoides*) Dotted smartweed (*P. punctatum*) Floating-leaf pondweed (*Potamogeton natans*) Emersed pondweed (*P. emersum*) Grass-leaved pondweed (*P. gramineus*) Simple-stem bur reed (*Sparganium eurycarpum*)
Rough-skinned Newt Western Toad	**<u>Variable diameter emergent plants</u>** Woolgrass (*Scirpus cyperinus*) Small-fruited bulrush (*S. microcarpus*)