APPENDIX C:

Prioritization: Wetland Strategies

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1.0 INTRODUCTION

Wetlands provide a variety of ecological, water quality, and landscape services and functions. Washington Department of Ecology (Michaud 2001) elucidates why wetlands are important to the health of natural ecosystems, and these services and functions specifically include:

- protecting water quality by trapping sediments and retaining excess nutrients and other pollutants such as heavy metals.
- providing flood protection by holding the excess runoff after a storm, and then releasing it slowly, thereby maintaining streamflows.
- recharging groundwater systems/aquifers, which, in turn, provide water for drinking, irrigation, and maintenance of streamflow and lake and reservoir levels.
- providing habitat for species of birds, fish, mammals, reptiles, and amphibians that rely on wetlands for breeding, foraging, and cover.

All these functions contribute to the health of a watershed, and they are also all goals of this Bear Creek Watershed-scale Stormwater Management Plan (the Plan). In other words, many of the goals of the Plan, including improved water quality, improved flood protection, and better fish habitat, are also benefits that wetlands may provide. Therefore, protecting, enhancing, and in some cases creating wetlands are all potential best management practices (BMPs) . A comprehensive local watershed management strategy includes wetland conservation and restoration because of the many watershed services wetlands provide (Wright et al. 2006).

Managing wetlands at the watershed scale can help minimize indirect impacts caused by urbanization. Impacts may include altered hydrology, increased pollutant loadings, and buffer encroachment. There are two general strategies available to improve, enhance, and conserve wetland conditions and functions in the Bear Creek watershed study area:

- Land conservation—protecting the wetlands and surrounding buffers by acquisition or easement.
- Wetland restoration—enhancing the function of existing or former wetlands by using different restoration techniques.

Each of these strategies is examined in detail in this report.

2.0 METHODS

The "*Assessment of Bear Creek Watershed Wetlands*" (King County 2017b) conducted for the Plan includes an inventory of wetlands currently mapped in the study area from multiple data sources. The combined, merged wetland dataset from seven available data sources shows 327 wetland polygons[1] in the study area totaling 1,793 acres. That wetland data was used to analyze and identify wetland protection via conservation and restoration.

2.1 Land Conservation Strategies to Protect Wetlands

Wetland buffers in the watershed are protected by critical areas regulations. Regulatory buffer sizes were established based on the best available science for the protection of various wetland functions. Buffers range from 25 to 300 ft in the study area depending on the wetland category (or rating), type, and intensity of planned activity adjacent to the wetland. However, for the following reasons, land conservation is a viable alternative to relying solely on regulatory buffers to protect the wetland resources of the Bear Creek watershed:

- It is possible that established buffers are not always adequate to protect wetland functions.
- Some wetlands had been degraded prior to wetland regulations, and public ownership would facilitate restoration activities.
- Regulations are not always adhered to.
- Regulatory buffers may be reduced as a result of alterations exceptions under specific circumstances outlined in agency code.

Land conservation of wetlands is accomplished by one of the following means:

- Land acquisition: acquisition in fee, which provides full control of the land.
- Conservation easement: conveyance of development rights necessary for protection of specific conservation values from a property's landowner to a municipality, land trust, or other nonprofit organization. The terms of easements vary, but generally speaking, in the areas covered by the easement, no new development may take place.
- Tax incentives: programs such as current use taxation programs in King County that offer an incentive (a property tax reduction) to landowners to voluntarily preserve open space on their property. Once enrolled, a participating property is assessed at

[1] Polygons are a GIS feature class used to represent features and areas, such as wetlands. Because of how the original wetland datasets were combined and merged, a single wetland polygon does not necessarily represent a single wetland – it may be several wetlands in a wetland complex, or it may contain surrounding upland area, depending on the accuracy of the original dataset. Because referring to these areas as "wetlands" implies a greater level of accuracy than is present, they are sometimes referred to as "wetland polygons" in this analysis. See King County 2017b for more detailed discussion of the original wetland datasets.

a "current use" value, which is lower than the "highest and best use" assessment value that would otherwise apply to the property.

Of these three strategies, acquisitions and easements are the two examined in this Plan. Because tax incentive programs cannot be guaranteed in the long term, they were not included in this analysis. However, in many instances the landowner will likely never withdraw from the incentive program, because, for example, the parcel is too small to divide and the portion in the incentive program is wetland or stream riparian area. In these instances the protection is effectively permanent. The Waterways 2000 Program (King County 1996) mapped parcels in the Bear Creek watershed they recommended for tax incentive programs, and many of those parcels were subsequently enrolled. Programs such as the Public Benefit Rating System in King County are worthwhile and should be actively pursued as a valid conservation measure.

Land conservation, especially acquisition in fee, may result in additional lands for King County to manage. The implications of increasing the management requirements by King County is not addressed in this analysis.

2.1.1 Criteria for Selecting Wetlands for Conservation

According to Cappiella et al. (2006), wetlands that are likely candidates for conservation are generally high quality wetlands that have high functional value and are in good condition or wetlands that provide some special social or economic value. There are other useful criteria available in addition to value and condition for prioritizing wetlands for conservation, although data is not always available for some or all of the wetlands in the study area. Table 1 outlines a set of criteria that may be used to prioritize land for conservation as well as provides notes on the availability of relevant data. Each of the criteria in Table 1 are discussed in more detail in Section 2.1.1.1.

Table 1. Criteria for selecting wetlands for conservation strategies (adapted from Cappiella et al. 2006).

Criteria		Priorities for Conservation	Availability of Data
Science-based criteria ***(descriptions in Section 2.1.1.1)***	Type	Sensitive, locally rare, or difficult-to-replace wetland types. Prioritize Sphagnum bog and non-Sphagnum bogs over other wetland types.	Data available.
	Function	High for functions of interest (flood control, water quality, groundwater recharge, and habitat)	Wetland functional analysis not performed. No function data available.
	Condition	Good or excellent, as determined by preliminary estimate of wetland condition.	Data available for percent impervious surface, which is one indicator of condition.
	Connectivity	King County Wildlife Habitat Network intersects wetland or parcel associated with wetland.	Data available.
		Part of a wetland complex.	Limited data available, including distances and land cover between wetlands.
		Adjacent to other protected undeveloped open space (public lands, Tract parcels, Home Owners Associations (HOA) green space).	Data available.
	Location in watershed	Located in headwaters.	Data available.
Other criteria ***(descriptions in Section 2.1.1.2)***	Development pressure	Defined as parcels that are not currently subdivided as small as zoning allows.	Data available.
	Special designation	Identified in riparian analysis (King County 2017a) or King County Land Conservation Initiative (which includes salmon recovery priorities).	Data available.
	Ownership	Willing landowner.	Willingness of landowners required but currently unknown

2.1.1.1 Ecological and other science-based criteria

Science-based criteria are used to identify the most valuable wetlands from an ecological perspective.

Type. Classifying wetlands as sensitive or non-sensitive to development and its effects, including stormwater runoff, provides a useful framework for not just managing stormwater inputs to different types of wetlands but also for prioritizing wetlands for conservation (Cappiella et al. 2006). Some wetlands are sensitive to any disturbance, and will become degraded with even low-level inputs of urban stormwater. This degradation is typically expressed as reduced diversity and abundance of plant or animal species. The most sensitive wetland type in the Bear Creek watershed study area are Sphagnum bogs. As discussed in King County (2017b), *Sphagnum*-dominated peat bogs are included in the King County Comprehensive Plan (Comp Plan) as a habitat of local importance because

they (a) support a unique plant and animal community, (b) have declined as a result of development, and (c) are a fragile ecosystem that can be easily destroyed but cannot be easily restored. Because bogs are the most sensitive wetland type in the watershed, they are therefore a high priority for conservation.

Function. Wetland functions include flood protection, retention of sediments and other particulates such as pollutants, maintaining streamflow, recharging groundwater, and provision of fish and wildlife habitat. Assessments of wetland functions generally measure the wetland's capacity to provide one or more specific functions (Cappiella et al. 2006). Wetland function is arguably the most important criteria to use to prioritize wetland conservation, but wetland functional assessments have not been conducted for the wetlands in the Bear Creek watershed.

Condition. Wetland condition describes how well the wetland is providing its functions (Cappiella et al. 2006). Wetland condition also affects how sensitive a wetland is to stormwater and other impacts. Landscape-scale estimates of wetland condition focus on identifying indicators of disturbance in and around wetlands. The assumption is that wetlands that have a greater number of disturbance indicators will have a more degraded condition (Cappiella et al. 2006). A variety of indicators can be used to estimate wetland condition, including hydrologic alterations, number of vegetation classes, buffer condition, and surrounding land cover. Other factors that may be used to derive disturbance indicators include: fragmentation, percent standing or open water, proximity to other wetlands, proximity to roads, road density, size and shape of wetland, population density, water quality impairments, Breeding Bird survey data, connectivity, wetland type, and more (NEIWPCC and RIDEM 2006). Connectivity and proximity to other wetlands are already being used as a criteria for prioritization in this analysis. Aside from impervious surface, most of the rest of the indicator data is not available, and when it is, it is only available from some of the wetland data sources.

Wetland condition likely degrades with increasing impervious cover and when urban land uses are dominant (Taylor et al. 1995). Amount of impervious surface per contributing drainage area for each mapped wetland was used as the indicator of condition for this analysis. Each wetland in the study area was labeled with the amount of impervious surface within 300 ft of its edge, as mapped in King County (2017b). Cappiella et al. 2006 suggest 300-500 ft. Three hundred feet was chosen because that size more than encompasses the largest possible regulated buffer size for a wetland in the study area (250 ft). Further, because the majority of mapped wetlands in the study area are within 500 ft of another wetland, using 300 ft will include less overlap of potential drainage area.

Connectivity. Wetlands that are connected to other wetlands and naturally vegetated areas such as forest provide valuable wildlife habitat and movement corridors. For this exercise, connectivity was evaluated in three ways:

- Whether a given wetland was part of a wetland complex.
- If a wetland is connected to King County's Wildlife Habitat Network.
- If a wetland is connected to other protected lands.

Wetland Complex. Groups of wetlands, called a wetland complex, may exhibit more wildlife diversity than isolated wetlands of similar sizes. Protection of wetland complexes is important to stem wetland isolation and habitat fragmentation. The King County Critical Areas Ordinance (CAO) uses a complicated set of criteria to identify a wetland complex. Those criteria are intended to be used during the permitting of relatively small areas, such as individual or small groups of parcels, when data may be collected in the field on many wetland parameters, including wetland category. When trying to determine the connectivity of several hundred wetlands using GIS, a simpler method is needed. For this exercise, the following criteria were used to consider a wetland part of a complex:

- wetland is not a farm field or any sort of wet field, and
- wetland is within 300 ft of another non-field wetland, and
- wetland is not severed from all nearby wetlands by any sort of road unless they are connected by a stream and the stream travels under the road, and
- wetlands are connected by either native vegetation or are within 50 ft of each other and are connected by some form of vegetation.

Wildlife Habitat Network. The King County Wildlife Habitat Network (WHN) is a network of contiguous vegetated corridors that are intended to link wildlife habitat with critical area buffers, priority habitats, trails, open space and other areas to provide for wildlife movement and alleviate habitat fragmentation. The WHN is defined and mapped in the King County Comp Plan, and it is regulated via the CAO. The WHN form one contiguous track or setback area that enters and exits properties where the network crosses the property boundary. To the maximum extent practicable, the WHN must be maintained at a width of 300 ft and not be less than 150 ft wide at any point.

Other protected lands. Parcel types that are assumed to provide protection to the wetlands and streams within them include:

- Publicly owned lands and conservation easements.
- Undeveloped, vegetated parcels that are associated with Home Owners Associations (HOA).
- "Tract" parcels, which are parcels held in undivided interest. It is possible some of these areas will not provide permanent protection; however, they appear to be vegetated areas mostly around streams and wetlands and associated with developments (similar to HOA green spaces).

These parcel types are also important because if most parcels around a wetland are either publicly owned or otherwise already in permanent protection, it may take relatively little effort to conserve the remaining parcels.

Location in watershed. Wetlands were identified as headwaters if a stream originates in the wetland. The most important geographic location for wetlands is in the headwaters. Headwaters streams and wetlands are important because they exert critical influences on the character and quality of downstream waters (Meyer et al. 2007; Alexander et al. 2007).

Headwater streams contribute to maintaining hydrologic connectivity and ecosystem integrity at regional scales (Freeman et al. 2007). The natural processes that occur in such headwater systems benefit humans by mitigating flooding, maintaining water quality and quantity, recycling nutrients, and providing habitat for plants and animals (Meyer et al. 2007).

A wetland may be divided in two by a road and still have both portions count as headwater wetlands. A wetland may be mapped "upstream" of the mapped stream (that is, the stream is not mapped as flowing out of the wetland), but if the topography and aerial imagery indicate the wetland likely drains the stream, it is included as a headwater wetland.

2.1.1.2 Other criteria

Additional non-scientific criteria may be used to help prioritize wetlands for land conservation strategies. These criteria are intended to be applied to parcel data (see Section 2.1.2 on prioritizing parcels).

Development pressure. If wetlands are located in parcels that are vulnerable to subplatting, they are a higher priority than those that are not, because they may represent multiple houses, etc., in the future.

Special designation. Parcels and areas prioritized in other programs and analyses will be prioritized over parcels that are not. Some of these other programs and analyses include the riparian analysis (King County 2017a) and those parcels that are identified via the King County Conservation Lands Initiative, which includes parcels identified specifically for salmon recovery and other goals.

Ownership. Willingness of landowner to sell their property or participate in a conservation easement is necessary. No surveys have been conducted yet to determine which landowners are or would be in the future willing to participate in these types of land conservation actions, so to include that criteria might falsely imply acquisitions would be pursued regardless of willingness. Owner willingness would be addressed once priorities have been identified and funding secured.

2.1.2 Prioritizing for Wetland Conservation

The criteria described above are all useful and valid for identifying the relative value of wetlands. In order to know where to start conservation efforts, the wetlands must be evaluated, and the parcels they are found on need to be prioritized. This section addresses prioritizing wetlands and the parcels associated with them.

2.1.2.1 Scoring wetlands

The geospatial data file containing all mapped wetlands in the study area was attributed (labeled) with the following information, all of which are ecological criteria associated with the wetlands:

- If the wetland is a bog.

- The percentage of impervious land cover within 300 ft of the wetland.
- Whether the wetland was part of a wetland complex, as defined above.
- Whether the wetland was connected to the King County WHN.
- Whether the wetland is partially or fully on public lands, Tract parcels, or HOA green space parcels.
- Whether the wetland was located in the headwaters.

After the wetlands were attributed, the point system shown in Table 2 was applied to each of the wetlands. The scoring is based on the criteria in Table 1, and the questions derived from the criteria are the "Evaluation questions" in column one of Table 2.

Table 2. Scoring system for prioritizing wetlands for conservation strategies. These points apply to wetlands.

Evaluation questions	Land conservation score	Rationale for point assignment
Is the wetland a bog?	Yes = 100 No = 0	Because of the sensitive and relatively rare nature of bogs, the point value assigned for them is high enough to elevate them to a top priority.
Percent impervious land cover within 300 ft of the wetland?	0 = 30 <5% = 20 5-10% = 10 >10% = 0	No impervious surface within the buffer of a wetland should indicate a wetland in relatively better condition than those with buffers that do have impervious surface. Above 10% impervious surface in a wetland buffer area is assumed to degrade wetland condition.
Is the wetland part of a wetland complex?	Yes = 10 No = 0	Wetland connectivity is very important for wildlife survival and biodiversity. But because of the limitations of identifying wetland complexes geospatially, the scoring for wetlands defined herein as being in a complex is relatively low. Additionally, many of the single wetland polygons are actually wetland complexes.
Does the King County Wildlife Habitat Network (WHN) intersect the wetland or parcel associated with wetland?	Yes = 20 No = 0	Regulated connectivity increases the wildlife habitat value of the wetland.
Is the wetland already fully or partially protected (e.g., public lands, Tract parcels, HOA green space)?	Partially protected = 40 Fully protected = -100 Not protected = 0	If the wetland is partially protected, completing the level of conservation is considered highly desirable. If the wetlands is fully protected, it does not need further conservation, so the negative score serves to filter it out.
Is the wetland located in headwaters?	Yes = 20 No = 0	Headwaters of streams impact water quality, including water temperature. Lowering a headwater wetland's water temperature should also lower the stream water temperature.

2.1.2.2 Prioritizing parcels

Because wetlands are contained within parcels and sometimes spread across many parcels, it is the parcels or the development rights to the parcels associated with the wetlands that would need to be purchased. Therefore, all relevant wetland scoring data discussed above and shown in Table 2 must be attached to the corresponding parcels.

Using orthoimagery in GIS, each wetland in the study area was visually examined in relation to parcel data. The following parcels were imported into a new "wetland conservation parcel" file:

- Undeveloped parcels in the study area that contained all or a part of a mapped wetland.
- Undeveloped forested parcels that were adjacent to parcels with wetlands.
- Parcels with development that also contained wetland and wetland buffer, if a conservation easement looked possible.

There were two main reasons that a parcel containing part or all of a mapped wetland might not be identified as a candidate for land conservation:

- A mapped wetland was clearly no longer present in the mapped location and had little chance of one being re-established (buildings, roads, or farm fields covered the entire polygon).
- The mapped wetland was a lake with residential development around the entire lakeshore.

Small parcels that were mostly developed but contained a sliver of wetland or wetland buffer were still generally included despite that (a) it may be cost prohibitive to try to purchase many of these properties for such the relatively small area of wetland protection, and (b) an easement would presumably make no difference with buffer regulations already in place. It is assumed that the scoring system used to prioritize parcels for conservation will put these parcels at the bottom of the list.

In a few instances, parcels adjacent to CAO wetlands were included, because although the mapped portion of the wetland did not extend into those parcels, it was clear it would have if the delineation had occurred on the adjacent properties.

In order to attach the wetland scores to the relevant parcels, the wetland data listed in Table 2 was intersected with the potential wetland conservation parcel file. For each criterion attributed to the wetlands, the highest value was assigned for any given parcel. For example, if two wetlands intersected one parcel, and one wetland was associated with the WHN but the other was not, the parcel would be attributed as being associated with the WHN, and it would get those 20 points.

Parcels in the potential wetland conservation parcel file were attributed with information associated with the criteria in Table 3. A parcel was attributed as to whether it is:

- Currently not subdivided as small as zoning allows.

- Identified as part of the riparian analysis (King County 2017a), King County Land Conservation Initiative, or similar program.
- Adjacent to public lands, Tract parcels, or HOA green space parcels.

After the parcels were attributed, the point system shown in Table 3 was applied to each parcel. The scoring is based on the criteria in Table 1, and the questions derived from the criteria are the "Evaluation questions" in column one of Table 3. Final prioritization for wetland conservation was based on the summation of all land conservation scores – the wetland-specific scores from Table 2 and the parcel-specific scores from Table 3.

Table 3. Scoring system for parcels associated with wetlands. These points apply to parcels.

Evaluation questions	Land conservation score	Justification for point assignment
Is the parcel currently not subdivided as small as it can be? That is, can the parcel be subdivided?	Yes = 10 No = 0	If the parcel associated with the wetland can be further subdivided, the development pressure is assumed to be higher than undividable parcels.
Are associated parcels identified as part of the riparian analysis (King County 2017a), King County Land Conservation Initiative, or similar program?	Identified by another program = 10 per occurrence	Assumes that if there are multiple values associated with preservation versus only one conservation target, parcel is more valuable from a conservation standpoint.
Are associated parcels adjacent to other protected undeveloped open space (e.g., public lands, Tract parcels, HOA green space)?	Yes = 10 No = 0	This attribute is already partially covered by tagging the wetland polygons for whether they are already protected. In some instances the parcels will be connected to protected lands when their associated wetlands are not. Parcels therefore also play an important role in overall connectivity.

2.2 Wetlands Restoration Strategies

Different agencies use different definitions for the same term or use different terms to define the same action. The Wetlands Subcommittee of the Federal Geographic Data Committee (see US EPA 2017) developed definitions for wetland restoration and related activities designed to aid agencies in accurately reporting wetland increases resulting from their program activities. This report adopts those definitions, which include:

Restoration: the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to former or degraded wetland. For the purpose of tracking net gains in wetland acres, restoration is divided into:

- **Rehabilitation**: the manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions of degraded wetland.

Rehabilitation results in a gain in wetland function, but does not result in a gain in wetland acres.

- **Re-establishment**: the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former wetland. Re-establishment results in rebuilding a former wetland and results in a gain in wetland acres.

In general, wetland rehabilitation improves the functions of existing wetlands, whereas wetland re-establishment builds a wetland where one does not currently exist but did exist within the past 100-200 years. Wetlands may also be created to perform water quality functions; however, site selection for created wetlands was not in the scope of this report. Information regarding created wetlands is provided in Section 2.2.3.

2.2.1 Rehabilitation

Goals associated with wetland rehabilitation are generally associated with the primary four functions of wetlands in the Bear Creek watershed: water quality improvement, flood water retention, groundwater recharge, or wildlife habitat. Rehabilitation results in a gain in wetland function but does not result in a gain in wetland acres. The terms rehabilitation and enhancement are often used interchangeably. Gwin et al. (1999) define enhancement as "the modification of specific structural features of an existing wetland to increase one or more functions based on management objectives, typically done by modifying site elevations or the proportion of open water. Although this term implies gain or improvement, a positive change in one wetland function may negatively affect other wetland functions."

Wetland rehabilitation is defined in this plan as planting native vegetation (trees and shrubs) in areas of the wetland and its buffer that are currently covered in grass, impervious surface, or some other non-native vegetation.

2.2.1.1 Identifying

All 327 wetland polygons were visually examined in GIS, and notes were made as to indicators of degradation. Degraded wetlands generally fell into the following categories:

- The wetland contains reed canarygrass.
- The open-water wetland is mowed to the edge along all or some portion of the wetland.
- The area with a mapped wetland is in some form of agricultural use (pasture, livestock yard, etc.). Sometimes wet areas are visible, and other times they are not. No forest or other native vegetation is present.
- A mapped wetland partially contains lawn, driveway, buildings, or other form of non-native land cover.
- The wetland is fully or partially on a powerline corridor.
- A mapped wetland is a farm pond with livestock access.
- A mapped wetland is a stormwater pond.

- A mapped wetland is a pond on a golf course.
- No wetland is visible: the polygon contains a house, road, or other development, so wetland area has either been lost or it was never wetland to begin with.

2.2.1.2 Prioritizing

Tree planting is assumed to improve water quality and wildlife habitat. Prioritizing wetlands for tree planting should therefore be done with improvements to water quality and wildlife habitat functions in mind. Prioritizing wetlands for rehabilitation is a multi-step approach:

- Polygons with wetlands clearly not present were removed from consideration.
- Any wetland polygons that appeared in 2015 aerial imagery to have no need for rehabilitation were removed from consideration. These wetland polygons did not fall into any of the categories listed in Section 2.2.1.1, and any vegetation present appeared to be native vegetation.
- For the final set of wetland polygons, a set of criteria indicating the functions and values of the wetlands were applied to score them for rehabilitation (Table 4). Points were also assigned for type of degradation present (reed canarygrass, mowed edges) as well as whether degradation was occurring on public lands.[2]

Final prioritization for tree planting around wetlands was based on the summation of the restoration scores shown in Table 4. The scoring is intended to indicate greatest potential to rehabilitate one or more wetland functions, prioritized by those wetlands that otherwise have the greatest value in terms of connectivity, the least amount of impervious surface, highest potential for improving water temperatures, and are most easily accessible (publicly owned, therefore most feasible). This information is intended to be used to get the most out of rehabilitation dollars.

[2] Publicly owned lands get one score, and publicly owned lands with reed canarygrass and/or mowed water edges gets another score, guaranteeing a high score for those areas most ripe for rehabilitation projects. Because these lands are already publicly owned, it is assumed that permission to do rehabilitation activities would be easiest to obtain.

Table 4. Criteria for prioritizing wetlands for rehabilitation strategies (adapted from Cappiella et al. 2006). [Points in each category and sub-category are additive.]

Criteria	Evaluation questions	Restoration score	Notes / Assumptions
Type	Is the wetland a bog?	Yes = 40 No = 0	If a bog is damaged, it should be a priority for repair.
Condition	Percent impervious land cover within 300 ft of the wetland.	<5 = 20 5-10 = 10 >10 = 0	Wetlands with little to no impervious surface in their immediate draining area are assumed to be in better condition or have the potential for better condition once repaired.
Connectivity	Is the wetland along the King County Wildlife Habitat Network (WHN)?	Yes = 20 No = 0	Regulated connectivity increases the wildlife habitat value of the wetland.
	Is the wetland part of a wetland complex?	Yes = 10 No = 0	The wildlife habitat value is higher if wetlands are connected (part of a wetland complex), because amphibians and other wildlife are able to move between them.
Location in watershed	Is the wetland located in the headwaters?	Yes = 20 No = 0	Headwaters of streams impact water quality, including water temperature. Lowering a headwater wetland's water temperature should also lower the stream water temperature.
	Does the stream water temperature exceed the standards?	Yes = 20 No = 0	If the wetland is located along a stream reach with elevated water temperatures, it is assumed that tree planting may help alleviate the high water temperatures.

Table continued on next page.

Criteria	Question derived from criteria	Restoration score	Notes / Assumptions
Gain in function	Does the wetland have reed canarygrass present? Is the wetland mowed on some portion of its shoreline? (These questions are intended to be surrogates for the following questions: Can water quality functions be improved? Can wildlife habitat functions be improved?)	Mowed = 20 Reed Canarygrass = 10	The two primary wetland-related problems that may be addressed with rehabilitation (tree planting) are lack of shade and invasive species. Planting trees along a shoreline is assumed to provide both water quality and wildlife benefits, hence the higher score for "mowed." Even in the absence of an open-water component, replacing reed canarygrass with native vegetation will improve wildlife habitat.
	Is there water present?	Yes = 30 No = 0	This question addresses both feasibility and the impact a planting project will have. If the wetland is agriculture field full of reed canarygrass, planting trees will not results in cooling water temperatures. This element raises the priority for wetlands that have water present to some degree.
Feasibility	Is the wetland in need of rehabilitation on protected lands such as public land, HOA green space, Tract parcels, or conservation easements? This questions gets at whether the current land use is compatible with restoration. The second part of this question, which further subdivides exactly what form of degradation is present, helps filter out which lands will benefit most from rehabilitation.	Yes = 30 Partial = 15	It is assumed that it will be much more feasible to conduct wetland restoration projects on public lands over private lands.
		Mowed & fully located on public land = 30 RCG & fully located on public land = 20 Mowed & partially located on public land = 20 RCG &partially located on public land = 10	Because these rehabilitation projects are assumed to be associated with either invasive species (reed canarygrass) or lack of shade around wetland edges, these scores separate out wetlands with these types of degradation from all the other wetlands.

2.2.2 Re-establishment

A change analysis was conducted in the "Assessment of Bear Creek Watershed Wetlands" (King County 2017b), which showed wetland loss that has occurred over the past 35 years. Additionally, 70 percent of the smaller wetlands delineated as part of the CAO permit process did not intersect with National Wetlands Inventory (NWI) or King County Wetland Inventory wetlands, and if that type of smaller wetland had been filled in the past, there would be no record of their potential historic presence whatsoever. It is almost certain that wetlands have been filled in the past; the number and acreage of filled wetlands are unknown. Finally, as part of the rehabilitation analysis above, 9 of the 327 wetland polygons were found to be not wetlands currently, and several (approximately 30) are currently agricultural fields with no open water component and some or all of the area with no native vegetation present. Although those fields may be technically wetlands (based on hydrology and soil conditions plus the obligate wetland species present, reed canarygrass), they have no wildlife habitat function, no flood storage capacity, and no groundwater recharge function greater than surrounding terrestrial landcover. All of these functions are provided by healthy wetlands and could be provided by re-established wetlands.

Wetland re-establishment is the rebuilding of a former wetland. Knowing the locations of former wetlands helps identify sites that may be suitable for wetland re-establishment (Cappiella et al. 2006), however, little to no data exists for the Bear Creek watershed that shows definitively where wetlands were located historically but are no longer present. Potential re-establishment sites can be identified using other data, such as former wetlands with effectively drained hydric soil map units, filled areas with no development (based on NWI data), impounded areas, excavated areas, and farmed wetlands Tiner (2005).

For this analysis, wetland polygons were intersected with soil data to identify all polygons that intersect mapped hydric soils. All wetland polygons showing open water were removed from consideration, because a wetland typically already exists in those locations or they are addressed above under "Rehabilitation." Wetland polygons showing native vegetation were removed from consideration under the assumption they may be forested or scrub-shrub wetlands.

Because of the small number of potential sites and affected landowners (see Section 3.0 Results and discussion), it may not be necessary to prioritize them. It might be worthwhile to contact all the landowners to inquire about interest in creating a wetland feature on their property. If prioritization were needed, wetland polygons could be prioritized based on:

- Number of affected landowners (prioritize single landowners over multiple landowners)
- Proximity to stream or other wetlands.

2.2.3 Wetland Creation

Natural wetlands should not be specifically used to treat stormwater runoff, as it increases the depth of temporary or permanent ponding in a wetland (Wright et al. 2006). Over time,

the altered hydrology transforms a natural wetland into a stormwater wetland with loss of biological diversity and functional value. Wetlands may be created for this purpose, and although wetland creation was not examined as a part of this analysis, this section presents a small amount of information on wetland creation to complement the other restoration BMPs examined in this report. Additional information on wetland creation may be found in Section 6.4.3 of the King County Surface Water Design Manual.

When wetlands are lost or degraded as a result of land development, the services they provide must often be replaced by water treatment and flood control infrastructure (Wright et al. 2006). Stormwater ponds and other facilities are a common tool to help deal with stormwater. Created wetlands can be built to serve the same water quality and quantity functions for stormwater controls and impacts. Because wetlands provide functions beyond what stormwater ponds typically provide, in some instances wetland creation may be a preferred alternative to stormwater facilities.

Wetland creation is defined as establishing a wetland where one had not existed in the past. The Wetlands Subcommittee of the Federal Geographic Data Committee uses the term Establishment to mean wetland creation. They define establishment as "the manipulation of the physical, chemical, or biological characteristics present to develop a wetland that did not previously exist on an upland or deepwater site. Establishment results in a gain in wetland acres" (US EPA 2017).

Constructed wetlands are treatment systems that use natural processes involving wetland vegetation, soils, and their associated microbial assemblages typically to improve water quality (US EPA 2017). Wetlands created to mimic the sediment and nutrient removal processes occurring in natural wetlands are designed based on holding or slowing the passage of effluent through the wetland, where a range of physical, chemical, and biological processes can operate to store, transform, or remove various pollutants (Cappiella et al. 2005).

Wetland creation occurs when a wetland is placed on the landscape on a non-wetland site (Lewis 1989). Typically, a wetland is created by excavation of upland soils to elevations that will support the growth of wetland species through the establishment of an appropriate hydrology (US EPA 2017).

3.0 RESULTS AND DISCUSSION

This section includes results for the wetland polygons and associated parcels when applicable. Because this analysis is GIS-based, the results are limited by the accuracy and availability of disturbance indicators as well as the accuracy of the mapped wetland polygons. Outreach and field visits may be used to verify wetland hydrologic and habitat value.

3.1 Wetlands Identified for Conservation Strategies

The wetland dataset used for this analysis included 327 mapped wetland polygons. Visual inspection of aerial photos revealed that 9 of the polygons were clearly not wetlands (buildings, roads, or relatively dry-appearing farm fields covered the entire polygon). Another 50 wetlands were already in public ownership or under some other form of permanent protection (Tract or HOA greenspaces). The distribution of the remaining 268 wetland polygons is as follows:

- King County: 168
- Redmond: 18
- Redmond and King County shared: 1
- Snohomish County: 54
- Snohomish County and King County shared: 1
- Woodinville: 25

The 268 wetland polygons had scores ranging from 0 to 200. Figure 1 indicates a ranking of high, medium, low, and very low, where:

- High = 100-200 points
- Medium = 50-80 points
- Low = 20-40 points
- Very Low = 0-10 points

Table 5 presents a sample of the final prioritization of the wetland polygons by jurisdiction. Lists of all parcel data will be provided to all partnering jurisdictions.

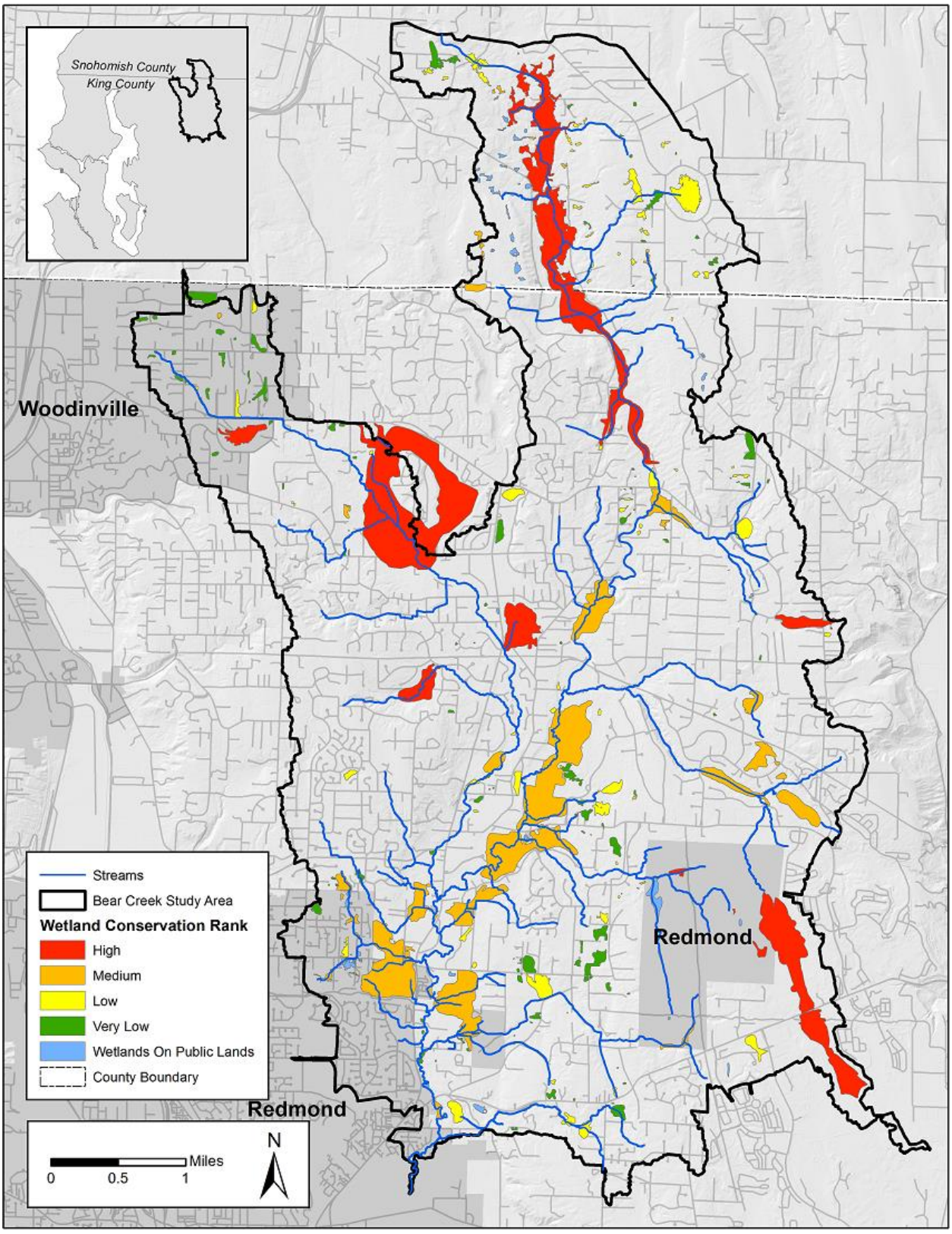

Figure 1. Prioritization of wetland polygons for conservation strategies (acquisition or easement). Note that some wetland polygons span across study area boundaries.

Table 5. Sample of prioritized wetlands for conservation strategies by jurisdiction. [Points shown here do not include parcel-related points. Wetlands scoring the same points are ordered by size. The top five wetlands per jurisdiction are shown; the full lists will be given to the partner jurisdictions to aid in conservation implementation.]

Jurisdiction	Wetland ID	Ranking	Acres	Head-waters	WHN	Bog	Already protected	Complex	Impervious category	Aerial photo interpretation notes
King County	39	High	55.33	Yes	Yes	Yes	Partial	Yes	11-20%	includes powerline corridor
	215	High	308.38			Yes	Partial	Yes	>20%	Lake; RCG; vegetated
	161	High	17.48			Yes	Partial	Yes	11-20%	Scrub-shrub; road cuts through
	153	High	25.73			Yes	Partial		>20%	Vegetated; including powerline
	165	High	45.36	Yes		Yes			>20%	forested; continues to next parcel
Redmond	94	High	90.89	Yes	Yes	Yes	Partial	Yes	5-10%	forested; in good shape
	87	High	0.31	Yes	Yes		Partial	Yes	0	Beaver pond, bigger than mapped
	72	High	3.24	Yes			Partial	Yes	0	forested
	107	High	2.79		Yes		Partial	Yes	0	Beaver pond, way larger than mapped
	53	Medium	1.81	Yes			Partial		11-20%	forested
Snohomish County	327	High	9.98	Yes			Partial	Yes	0	Beaver ponds with RCG
	269	Medium	2.31				Partial	Yes	0	Vegetated - scrubby; possibly way bigger
	261	Medium	0.58				Partial	Yes	<5%	Vegetated - forest and scrub
	294	Medium	0.48				Partial	Yes	<5%	Vegetated; road down center
	303	Medium	0.40				Partial	Yes	<5%	Scrub-shrub; larger than mapped
Snohomish Co. - King County*	323	High	284.84		Yes	Yes	Partial	Yes	5-10%	Is actually many wetlands; roads, RCG
Woodinville	213	High	17.70			Yes	Partial	Yes	>20%	Lake Leota - residential w/docks
	245	Medium	0.68				Partial		5-10%	Forested; landscaping. Wetland to east?
	221	Low	3.20				Partial		>20%	Several small scrub-shrub wetlands; development
	247	Low	1.75				Partial		11-20%	Vegetated; house, yard, driveway
	218	Low	0.17				Partial		>20%	forest & sidewalk - mismapped? no wetland?

Notes:
*This is a large wetland complex that spans across county boundaries.
WHN = Wildlife Habitat Network

A total of 588 parcels were identified that were associated with the 268 wetland polygons:

- 107 undeveloped privately owned parcels containing all or part of a mapped wetland polygon.
- 462 developed residential parcels that might be candidates for conservation easements or partial acquisition because they contain part or all of a wetland.
- 19 undeveloped forested parcels directly adjacent to parcels with wetlands.
- 17 parcels with easements already in place.

The parcels were ranked for conservation by combining the wetland scores with points from parcel-specific criteria (see Section 2.1.2.2). The 588 parcels had scores ranging from 0 to 220. Parcels were ranked as high, medium, low, and very low, where:

- High = 160-220 points
- Medium = 80-150 points
- Low = 20-70 points
- Very Low = 0-10 points

Parcels that scored only 0 or 10 points are assumed to not be a priority for conservation. The analysis reveals the following data for parcels that scored at least 20 points for conservation:

- King County – 335 parcels out of 409 scored; points ranging from 20 to 220
- Redmond – 21 parcels out of 23 scored; points ranging from 20 to 80
- Snohomish County – 71 parcels out of 94 scored; points ranging from 20 to 210
- Woodinville – 22 parcels out of 62 scored; points ranging from 20 to 180

Undeveloped parcels are candidates for acquisition or easement; cost analyses assume acquisition, which is more costly. Parcels with development are assumed to be candidates for easements and not acquisitions, though there may be some circumstances when a developed parcel is purchased and any structures demolished.

Costs of acquisition were calculated by first obtaining the combined assessed land value and assessed improved value (value of improvements, such as houses) from King County parcel data and the combined market land value and market improved value from the Snohomish County parcel data. Next, a multiplier of 115 percent[3] was applied to those values to account for the difference between the assessed value and appraised value. Costs of easements were calculated by taking the assessed land value from King County parcel data and the market land value from the Snohomish County data and using a multiplier of

[3] 15 percent is added to the assessed value because appraisals were running higher than assessed value by about 15 percent in 2015 and 2016.

40 percent[4]. Easement calculations assumed less than half the parcel would be put in easement.

For the cost analysis, in all instances where parcels in the riparian analysis in Section 7.3 overlapped parcels in this wetland analysis, they were removed from this wetland analysis.

A total of 126 parcels were identified for potential wetland acquisition (had no development). Sixty-four (64) of those parcels were also identified in the riparian analysis for acquisition. This wetland cost analysis for acquisition only includes the remaining 62 parcels.

Costs for acquisition for each partner jurisdiction are present in Table 6. Costs were separated out for priority basins in addition to the priority ranking described in this strategy. Total costs for acquisition in priority basins and remaining High and Medium ranked parcels would be approximately $5,520,000.

[4] 40 percent assumes the following: (a) the amount of the parcel that would be placed under easement would be less than 50 percent and more than 1 percent, and 25 percent is the average between 1 and 50, and (b) 15 percent is added to the 25 percent to account for the difference between assessed value and appraised value.

Table 6. Cost estimates for all 62 parcels identified for potential acquisition. Priority catchments described in Section 4.2 are identified separately.

Prioritization Ranking	Catchment	Cost	number of parcels
King County			
High	All others	$1,431,000	4
Medium	BEA120	$99,000	1
Medium	All others	$2,650,000	9
Low	BEA120	$86,000	1
Low	All others	$5,271,000	10
Very Low	All others	$3,705,000	9
Unknown	All others	$1,750,000	3
Redmond			
Low	All others	$7,626,000	5
Very Low	All others	$1,000	2
Snohomish County			
High	BEA660	$600	1
High	All others	$1,000	1
Low	BEA660	$488,000	2
Low	All others	$156,000	2
Very Low	BEA660	$264,000	1
Very Low	All others	$264,000	1
Unknown	BEA660	$289,000	3
Unknown	All others	$601,000	3
Woodinville			
Low	All others	$2,279,000	3
Very Low	BEA850	$210,000	1

A total of 462 parcels had some development on them and thus were identified for potential wetland easements. One hundred and eighty-seven (187) of those parcels were also identified in the riparian analysis for easements. This wetland cost analysis for easements only includes the remaining 275 parcels. The total estimated value of the 275 parcels is approximately $69,688,000.

Costs for easements for each partner jurisdiction are presented below in Table 7. Costs were separated out for priority basins in addition to the priority ranking described in this strategy. Total easement costs are estimated to be approximately $41,053,000 if easements were purchased on all 275 parcels identified for potential easements, including those prioritized as Low and Very Low. Total costs for easements in priority basins and remaining High and Medium ranked parcels would be approximately $12,104,000.

Table 7. Cost estimates to for all 275 parcels identified for potential easements. Priority catchments described in Section 4.2 are identified separately.

Prioritization Ranking	Catchment	Cost	number of parcels
King County			
High	All others	$1,632,000	12
Medium	All others	$6,835,000	48
Low	BEA120	$205,000	2
Low	All others	$8,362,000	55
Very Low	All others	$7,396,000	58
Redmond			
Medium	All others	$975,000	10
Low	All others	$6,217,000	2
Snohomish County			
High	BEA660	$410,000	5
High	All others	$183,000	2
Medium	All others	$112,000	1
Low	BEA660	$581,000	6
Low	All others	$1,437,000	17
Very Low	BEA660	$252,000	3
Very Low	All others	$618,000	8
Unknown	All others	$58,000	1
Woodinville			
Low	BEA850	$162,000	1
Low	All others	$1,178,000	7
Very Low	BEA850	$756,000	6
Very Low	All others	$3,683,000	31

3.2 Wetlands Identified for Restoration Strategies

The primary focus of wetland restoration in this study is rehabilitation, which is defined as tree planting in this plan and discussed in Section 3.2.1. Re-creating wetlands where they were once likely located is discussed in the Section 3.2.2 on Re-establishment.

3.2.1 Rehabilitation

Of the 327 mapped wetland polygons, as discussed above, 9 were clearly no longer wetlands. Of the remaining 318 wetland polygons, 121 did not appear to need rehabilitation judging from aerial imagery (they appeared to only have native vegetation present in and around them). Of the remaining 198, 67 were identified as having reed canarygrass present, and 55 were mowed along at least some portion of the edge plus 3 appeared to be degraded from livestock access (for a total of 58 generally referred to as "mowed"). These 112 wetlands are potential targets for rehabilitation, which is defined

herein as planting native trees and shrubs. The distribution of the wetland polygons with reed canarygrass and/or mowed edges is as follows:

- King County: 89
- Redmond: 5
- Snohomish County: 14
- Snohomish County and King County shared: 1
- Woodinville: 3

Of the 58 wetlands identified as being mowed to the edge:

- 6 are fully on public property and 3 are partially on public property.
- 13 also have reed canarygrass.
- 5 are also in the riparian corridor (total of 8.4 acres in need of trees around the wetlands).
- 2 have concrete paving around some of the edges, and one has a gravel driveway.
- 5 are ponds on golf courses.

Of the 67 wetland polygons identified as having reed canarygrass present:

- 11 are fully on public lands, and 16 are partially on public property.
- 3 are beaver ponds, which pose extra challenges for tree plantings because they are so wet.
- 25 do not have an open-water component associated with them, and approximately 8 of these are farm fields with no other indication of a wetland present beyond the reed canarygrass.

Not including golf course ponds and lawns along residential lakes, approximately 34.5 acres could be planted in trees and shrubs around these "mowed" wetlands if all landowners cooperated 100 percent (Table 8).

Wetlands identified as benefiting from tree-planting were evaluated for restoration cost. The cost of tree-planting is assumed to be about $30,000 per acre in 2018. The cost of restoring wetlands on public lands is estimated to be $306,000 (Table 8). The total cost to restore wetlands on private lands (excluding any costs to acquire the land or easement to the land) is estimated to be $2.95 million.

Table 8. Acres of land, by jurisdiction and ownership, that would benefit from tree-planting restoration. Includes areas around wetlands mowed to the edge of the open-water component and areas covered in reed canarygrass. For areas that are mowed and have reed canarygrass present, acreage is included with mowed wetlands. Area in this table does not overlap with restoration areas identified in *Appendix D – Prioritization: Riparian Corridor Strategies*.

Jurisdiction	Mowed to edge				Reed canarygrass			
	Total	Public	Private	Est. Cost	Total	Public	Private	Est. Cost
King	30.5	2.7	27.8	$915,000	70.5	5.6	64.9	$2,115,000
Snohomish	1.8	0.0	1.8	$54,000	2.0	0	2.0	$60,000

Redmond	1.6	1.6	0	$48,000	1.5	0	1.5	$45,000
Woodinville	0.6	0.3	0.3	$18,000	0	0	0	$0

Many of the wetlands that have reed canarygrass present but are not identified as being mowed to the edge are in stream riparian corridors, and there is no open water component to the wetland other than the stream. These riparian areas would benefit from tree planting. Many of these areas are captured in the riparian analysis (*Appendix D – Prioritization: Riparian Corridor Strategies*). Other areas with reed canarygrass but no "mowed edges" are farm fields. Planting trees in these farm fields would have terrestrial habitat benefits but likely very low benefits for wetland function. Reed canargrass areas not associated with the riparian analysis, not included in the mowed estimates, and not including farm fields total approximately 74 acres and are shown in Table 8.

The remaining 85 wetland polygons showing some form of degradation other than being mowed to the edge or having reed canarygrass planted were also scored. Often these polygons are active farm fields, scrub-shrub wetlands severed by roads, and polygons with some portion native vegetation and some portion lawn. Although they were scored as part of the prioritization, in most cases there is very little to be done in terms of tree planting in these areas.

Figure 3 indicates a ranking of high, medium, low, and very low for wetland rehabilitation, where:

- High = 110-165 points
- Medium = 70-105 points
- Low = 20-65 points
- Very Low = 0-10 points

Table 9 provides a sample of the wetlands ranked highest for planting trees in each jurisdiction. All information generated from this analysis for tree planting will be provided to all of the partnering jurisdictions. They will make their choices how to proceed with tree planting and other wetland restoration.

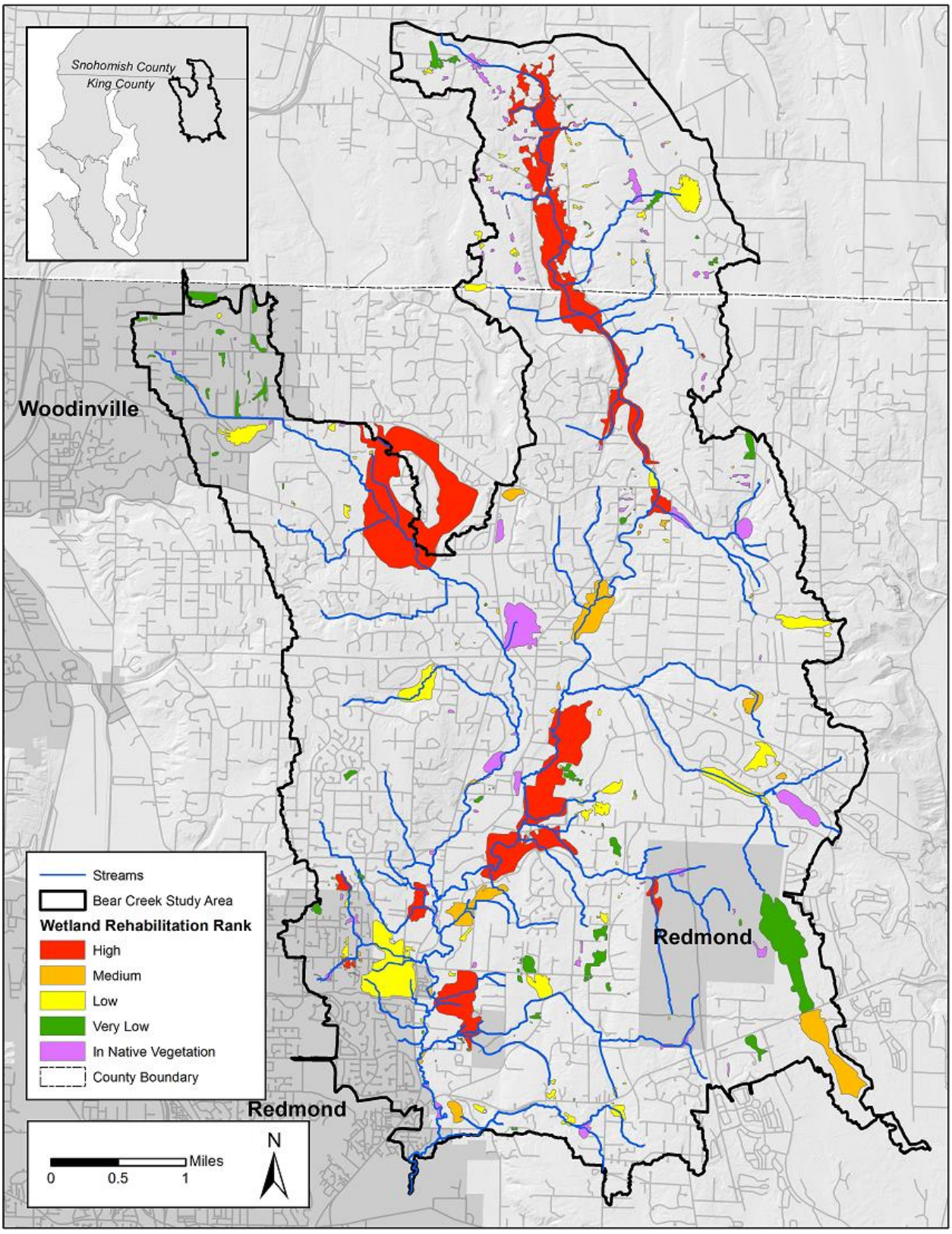

Figure 2. **Prioritization of wetland polygons for rehabilitation strategies (tree planting). Note that some wetland polygons span across study area boundaries.**

Table 9. Sample of prioritized wetlands for rehabilitation strategies by jurisdiction. [Wetlands scoring the same points are ordered by size. The top five wetlands per jurisdiction are shown; the full lists will be given to the partner jurisdictions to aid in implementation of tree planting projects.]

Jurisdiction	Wetland ID	Points	Acres	Reed canarygrass	RCG & on Public Land	Mowed	Mowed & on Public Land	Aerial photo interpretation notes
King County	233	150	0.23	Yes	Yes	Yes	Yes	RCG in stormwater pond
	215	145	308.38	Yes	Yes			Lake; RCG; vegetated
	118	125	79.79	Yes	Yes			vegetated; some mismapping
	105	125	6.64	Yes	Yes			half is degraded RCG pasture
	113	120	0.13			Yes	Yes	Pond – stormwater
Redmond	103	140	9.94	Yes	Yes			Beaver ponds, many. RCG
	62	120	3.15	Yes	Yes			Pond; forest; scrub/shrub/tons RCG
	68	90	0.44	Yes	Yes			vegetated, including RCG
	61	90	0.23	Yes	Yes			degraded scrub-shrub with some RCG
	95	80	1.78					forested: half okay, half parklike
Snohomish County	327	125	9.98	Yes	Yes			Beaver ponds with RCG
	284	90	0.09	Yes	Yes			RCG; scrubby area - bigger than mapped
	288	80	25.05			Yes		degraded - Echo Lake - home along shore
	260	80	0.22			Yes		Pond - could use bigger buffer
	249	70	0.07	Yes		Yes		Pond - RCG buffer
Snohomish Co. – King County*	323	165	284.84	Yes	Mix			many wetlands; roads, RCG
Woodinville	240	110	0.06			Yes	Yes	Pond - fully mowed & mismapped
	223	70	0.43			Yes		Pond - two back yards; mowed
	213	95	17.70					Lake Leota - residential with docks
	219	40	0.08					vegetated; likely degraded on private land
	245	25	0.68					Forested; landscaping. Wetland to east?

*This is a large wetland complex that spans across county boundaries.

3.2.2 Re-establishment

There are 9 wetland polygons that fit the criteria for re-establishment. Six of the 9 polygons are on farm fields or pasture, and 2 of the polygons are actually in a single farm field. Two of the areas have reed canarygrass. These 9 wetland polygons intersect a total of 15 parcels, and none are publicly owned. All of the potential re-establishment sites are all in King County's jurisdiction.

These potential re-establishment sites could be evaluated further in the field to confirm assumptions based on mapping data and further evaluate restoration feasibility. As mentioned above, these locations may in some instances technically be wetlands, but they are providing little if any wetland function. Excavation combined with native vegetation planting would transform these sites from fields to wetlands with habitat value, flood storage, and groundwater recharge functions. It is very possible that the landowners with farm fields in active use will be reluctant to give up their fields for wetlands. The properties with potential re-establishment sites composed of reed canarygrass and shrubs may be more willing to allow wetland re-establishment on their properties. In all cases, the potential impacts of beavers should be evaluated if and when they were to move into the newly established ponds, and that information should be shared with cooperative landowners.

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