CRITICAL AREAS REPORT

FARREL-MCWHIRTER PARK

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Executive Summary

This technical memorandum describes the results of a an assessment of the Critical Areas found within the survey area consisting of Farrel-Mcwhirter Park and an additional adjacent 30-foot wide segment of private property located along the western park boundary, in the City of Redmond, Washington.

Fish and Wildlife Conservation Areas identified include Mackey Creek and its South Tributary, which were collectively classified as a Class II stream per-City of Redmond Zoning Code (RZC 21.64.020) because of its potential to host salmonids. This classification was field verified. Thirteen wetlands and two other waters of the U.S. (Mackey Creek, as described above, plus an intermittent stream) were identified in the survey area. Most wetlands were small seep-fed slope wetlands, but one depressional, and four riverine wetlands were also identified.

An examination of City furnished inventory maps, field observations, and other electronic resources, found no Frequently Flooded Areas or Geologically Hazardous Areas in the survey area. Two classifications of Critical Aquifer Recharge Areas were identified for the survey area in online parcel data: Wellhead Protection Zone 2 and Zone 3. Field observations documented that water moves down gradient from east to west as both surface and subsurface flow. As the survey area is upslope of the City's aquifer, groundwater from the survey area has potential to enter the City's aquifer.

General Information

Overview

The City of Redmond (City) is developing a Master Plan for Farrel-McWhirter Farm Park and is considering improvements to its trail system, potentially along with other park features and infrastructure. To facilitate this planning effort, the City contracted with Tetra Tech, Inc. to identify and document all Critical Areas (CAs) within the survey area. As there are not specific plans for facilities at this time, this report documents the CAs present within the park, only, to help guide the City in developing plans that avoid CAs as feasible. Once specific plans are developed, then the evaluation of potential impacts to CAs will be conducted.

As part of the City's planning process, CAs, as defined under the City's Critical Areas Ordinance (*Section RZC 21.64, Critical Areas Regulations*), are required to be identified, documented, mapped, and reported. To support the City's planning process, a complete assessment of the survey area was performed to identify the location and type of any CAs present. This assessment consisted of two components: 1) an in-office data gathering and assimilation exercise, and 2) a field assessment of the survey area.

The Redmond Zoning Code (*Appendix 1. Critical Areas Reporting Requirements*) identifies five types of CAs:

- Fish and Wildlife Habitat Conservation Areas
- Wetlands
- Frequently Flooded Areas
- Geologically Hazardous Areas
- Critical Aquifer Recharge Areas (Wellhead Protection)

A summary of findings for each CA in the survey area is presented below.

Study Area

The survey area includes Farrel-McWhirter Park in its entirety, as well as a 30-foot segment of private property located adjacent to the western park property boundary (West off-Site area). Farrel-McWhirter Park is located in northeastern Redmond, at 19545 NE Redmond Rd., east of Avondale Road, in King County, Washington (Figure 1). The Section, Township, and Range at this location are Section 32, Township 26, Range 6E. Farrel-McWhirter Park is comprised of two parcels: Parcel 312606-9017 which comprises the southern half, and Parcel 312606-9004 comprising the northern half. The private property (Parcel 3126069001) included in the West Off-Site Area is located in unincorporated King County outside the City of Redmond (Farrel-McWhirter Park is an isolated, noncontiguous property within the Redmond city limits). In total, the survey area is approximately 68.5 acres (the Park is 67.5 acres; the West Off-Site Area is 1 acre).

In the 1930s, the McWhirter family of Seattle purchased the property for use as a summer home. Mrs. Elise McWhirter was an avid horse owner who raised and trained her horses here. The single family home located on parcel 312606-9017 was built in 1936. In 1971, the 68-acre parcel was bequeathed to the City of Redmond for use as a park. It took several years to make improvements to the property so that it was suitable for public use. It was opened to the public as a park and educational facility in 1978.

Currently, this unique park provides a diversity of public resources and activities including a children's animal farm in the center of the park, a horse arena with trailer parking in the northwest corner, covered picnic shelters with electricity and running water, multi-use trails that connect to the Puget Sound Energy/City of Redmond Trail, an orienteering course, tire swings, and nature trail system. Several farm animals live and are cared for at the park including ponies, chickens, goats, cats, a rabbit, pig and cow. Farm infrastructure is present within the park and is well maintained for the animals and public. Typical park features are also present, as listed above, but also include large maintained areas of lawn. The nature trail system is spread throughout the park. Nicholls Trail and its adjacent natural areas (falling within 15 feet on either side of the trail centerline), located just outside of the western park boundary, comprises the West Off-Site Area. Approximately one-third of the park is used for farm-related activities; the remaining two-thirds of the park is natural area.

Figure 1. Vicinity Map.

Fish and Wildlife Habitat Conservation Areas

The study area includes all streams identified within Farrel-McWhirter Park, which includes Mackey Creek and its South Tributary, and an intermittent stream in the north part of the park that provides seasonal surface flow into the large wetland area in the western half of the park (Figure 2). The two perennial stream features have been classified as Class II (Redmond 2005b, 2012); the intermittent stream was classified as a Class IV stream. The study area has a number of springs and seeps that flow into the wetlands and may occasionally have defined surface flows. These areas are identified and described (see the Wetlands Section), but were not classified as streams.

Streams and Stream Classification

Mackey Creek is formed from the confluence of two tributary forks that meet within Farrel-McWhirter Park. Flow is from east to west. Mackey Creek is a perennial stream and estimated at 2.65 miles (4.2 kilometers) in length (WDFW 1976) and joins Bear Creek at river mile (RM) 3.15. Many of the tributaries to Bear Creek are spring-fed and this includes Mackey Creek. Soils upslope and within Farrel-McWhirter are predominantly Alderwood soils that are characterized by a surface layer of gravelly sandy loam with consolidated glacial till at depths from 24 to 60 inches below the surface (NRCS 1973). Permeability of the glacial till layer is very low and during the rainy season, water often flows along the surface of the till and can emerge as springs along slopes.

Salmonid species identified by Washington Department of Fish and Wildlife (WDFW) as present in Mackey Creek include sockeye salmon (*Oncorhynchus nerka*), coho salmon (*Oncorhynchus kisutch*), Chinook salmon (*Oncorhynchus tshawytscha*), and steelhead (*Oncorhynchus mykiss*). One additional species; resident coastal cutthroat trout (*Oncorhynchus clarkii*), is identified in the Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species (PHS) Report for the survey area as also present (WDFW PHS 2014) and have been observed by City staff. A summary of all salmonid species in the survey area, including their Endangered Species Act (ESA) status, is presented in Table 1. Chinook and coho were captured in Mackey Creek during sampling by King County in 1986 (Heller 1986).

Table 1. Summary of each salmonid species identified to potentially occur in the survey area.

Species	ESA Status[/1]	Distribution / Accessibility[/2]	Use Type[/2]
Sockeye salmon	Not listed	Modeled	Presence
Coho salmon	Not listed	Documented	Spawning
Coast resident cutthroat	Not listed	Documented	Migration
Winter steelhead	Threatened	Documented	Presence
Fall Chinook	Threatened	Documented	Presence

[/1] NOAA
[/2] WDFW PHS 2014

Methods for Stream Survey

Streams were surveyed over several days during the period between 29 January and 13 February 2014, by being walked along their entirety within the study area that included Farrel-McWhirter Park and a 30-foot wide segment of private property immediately west of the park boundary. The ordinary high water mark (OHWM) and bankfull width was identified as the woody vegetation line on either side of the

streams. Bankfull depth was measured as the height from the streambed to the rooted location of the woody vegetation identified at the OHWM.

Aquatic habitat units were identified generally following the methodology of Pleus, et al. (1999) and ODFW (2013). Mackey Creek and its tributaries were typically less than 16 feet (5 meters) wide at bankfull, so the minimum unit size is 10.75 square feet (or 1 meter square) and the minimum pool depth is 0.7 feet (0.2 meters) deeper than the adjacent pool tail-out or stream thalweg. As wetted depths in all aquatic habitat units were typically 1 foot or less, there were no pools identified that met the minimum pool depth or the minimum unit area size.

Aquatic habitat units documented include: 1) riffles, which are shallow, low gradient areas with surface turbulence; 2) glides, which are areas with generally uniform depth and no surface turbulence and are typically deeper than riffles; and, 3) cascades, which are typically short steep areas with surface turbulence and in this case formed by angular rock step pools or logs. Substrate was visually estimated as percent comprised of gravel, sand, silt or clay. All wood within the bankfull channel was recorded and estimated by diameter and length; but only pieces that were at least 4 inches in diameter and over 6 feet in length were documented as large wood. Riparian conditions were summarized by aquatic habitat unit and included visually estimated percent cover of dominant species and estimated percent canopy cover.

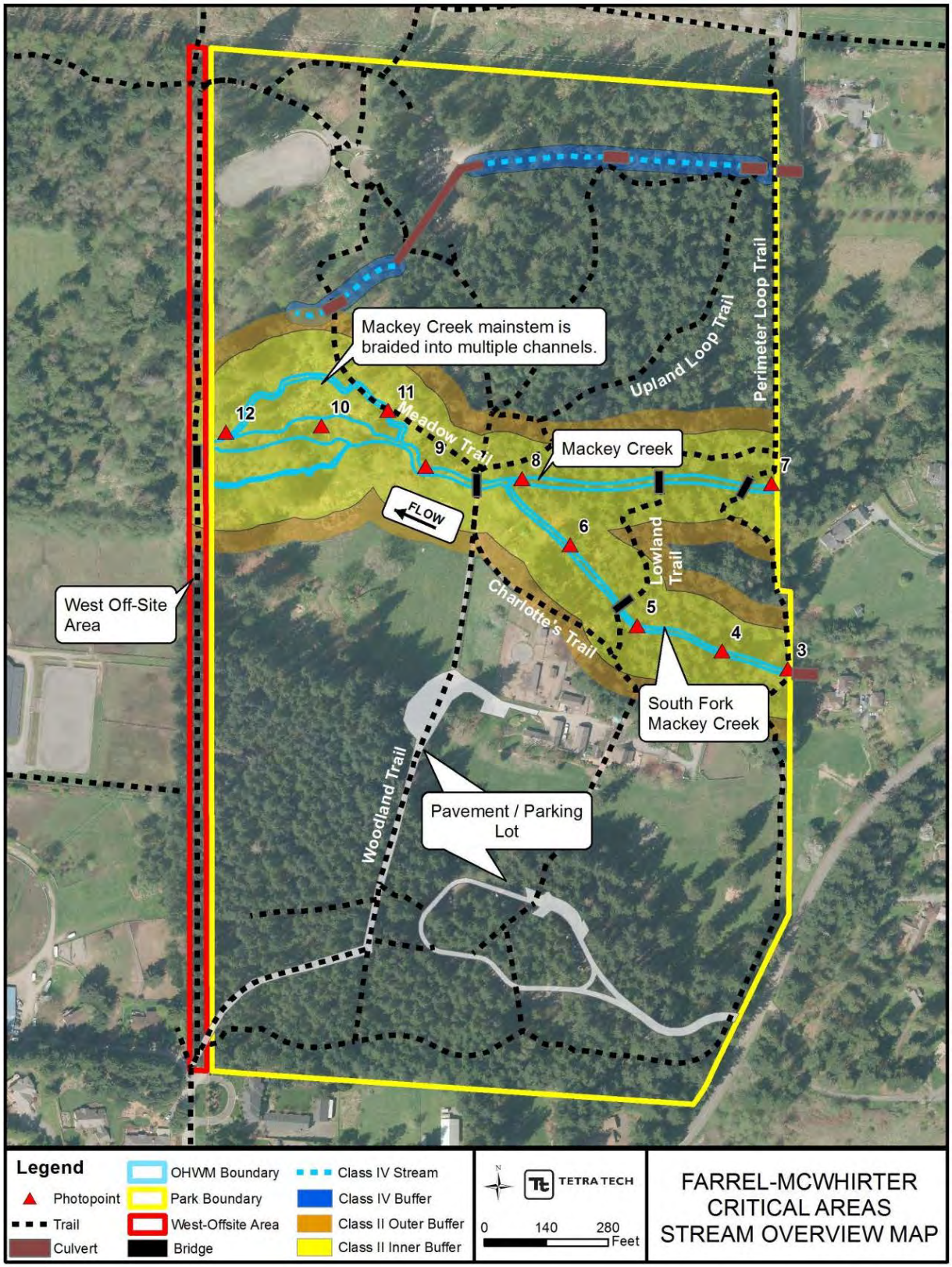


Figure 2. Streams identified in the Farrel-McWhirter Park / West Off-Site Area survey area.

Results

Springs and Intermittent Flows

Intermittent Stream (Unnamed). An intermittent stream was identified in the northern portion of the park that extends for approximately 600 feet from the eastern park boundary and flows west to a culvert that carries surface flows under the parking area and discharges to the large wetland area in the western portion of the park (Wetland #4). This stream was only flowing at the downstream end during the field survey and there is a poorly defined channel. No stream habitat units were identified. Four culverts are present in addition to the culvert under the parking area: a) culvert at the eastern park boundary and perimeter trail, b) culvert at Upland Loop trail; c) culvert at old trail crossing, approximately 300 feet west of the eastern park boundary; and 4) culvert at Meadow Trail crossing west of the parking area. This stream does not contribute surface flow to Mackey Creek, but contributes flow/hydrology to Wetland #4. It was determined to be a Class IV stream and has an average 3% gradient from the eastern park boundary to Wetland #4. Replacing the small culverts at the trail crossings and removing the third culvert at the crossing that is no longer used would allow unhindered flow. The culvert under the parking area does not currently seem to back up flows or cause erosion or deposition problems, but should be hydraulically analyzed to ensure that it would not be a restriction if the other culverts were removed.

Several areas of the study area had springs and may have intermittent surface water flows. These were not mapped as streams during this survey as most areas had very little surface water and also did not have evidence of a channel. These areas are separately described in the wetland section as wetland areas. There are culverts present under trails and parking areas that convey surface flow when present, but in all cases, this surface flow dead ends quickly into a larger wetland area and is not directly connected to the stream segments described in this report. For the following descriptions, photo point locations are shown in Figure 2.

Description of Stream Segments

South Fork Mackey Creek. The South Fork extends for approximately 840 feet from the eastern park boundary to the northwest to the confluence with Mackey Creek. At the eastern boundary of the park the creek flows through a PVC culvert (Figure 3) and drops approximately 6 inches to cobbles. The creek then flows through an 18-inch concrete culvert under the Perimeter Loop Trail into a rock lined channel with a step-pool cascade of approximately 10 feet in length. A second culvert, an older 12-inch corrugated metal culvert, is located parallel to the concrete culvert. It is likely that both culverts are fish passage barriers due to the small size and lack of pools below to allow for jumping. The creek overall drops approximately 12 feet from the culvert/trail crossing to the confluence with Mackey Creek (approximately 1.6% gradient). Upstream of the park, the creek flows through yards and small pastures in a residential area – this south fork is mapped as ending about ½ mile to the southeast (City of Redmond 2014). There are additional fish passage barriers upstream as the creek passes under roads and driveways.

Aquatic habitat units identified for the South Fork were riffles, cascades, and glides. Riffles represent 71% of the length (Figure 4), cascades represent 4% of the length, and glides represent 25% of the

length (Figure 5). No areas were of sufficient depth or area to be counted as pools, although small scour areas were present on bends (lateral scour) or associated with wood (plunging scour). Undercut banks were noted in several areas. The bankfull width ranges from 7 to 14 feet with a bankfull depth ranging from 1 to 3 feet. The wetted width during the field survey in February 2014 was 4 to 6 feet, with a typical depth of less than 1 foot. Estimated flow volume at the time of survey was approximately 8 cfs.

The Lowland Trail crossing (Figure 5) has a very low bridge which, while not obstructing flows at the time of the survey, could back water up during higher flows.

Figure 3. Culvert just upstream of park boundary on South Fork of Mackey Creek.

Figure 4. Riffle along South Fork Mackey Creek.

Figure 5. Glide along South Fork Mackey Creek; note the very low bridge.

Substrate in riffles was generally 30% small gravel (1 to 2 inches) and 60 to 70% silty clay. None of the riffles had suitable spawning habitat for salmon species. The channel showed evidence of incision into the glacial till and the banks were typically nearly vertical for 2 to 3 feet up to the floodplain wetland level or OHWM. Runoff from upstream areas that are predominantly rural residential with grazed pastures and roadways has likely increased in recent years with development. There appears to be fairly large quantities of fine sediments moving through the stream channel, likely from upstream erosion of animal pastures. A total of 27 pieces of large wood were present either spanning or located within the channel (Figure 6). This averages out to 190 pieces of large wood per mile.

Riparian vegetation was primarily native coniferous forest dominated with 50 to 70% canopy cover. Dominant trees include Douglas fir (*Pseudotsuga menziesii*), western red cedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), red alder (*Alnus rubra*), and big-leaf maple (*Acer macrophyllum*). Understory species include sword fern (*Polystichum munitum*), trailing blackberry (*Rubus ursinus*), and salmonberry (*Rubus spectabilis*).

Figure 6. Numerous downed trees and LWD on South Fork Mackey Creek.

<u>Mackey Creek, East Park Boundary to Confluence with South Fork</u>. This segment of Mackey Creek extends for approximately 630 feet from the eastern park boundary to the southwest to the confluence with the South Fork. No culverts are present within this segment or immediately upstream. Several channel-spanning logs create plunging flow that may present fish passage barriers due to the limited pools scoured below. The creek overall drops approximately 30 feet from the eastern boundary to the confluence with the South Fork (approximately 5% gradient), although there are multiple drops over logs so that intervening stretches of creek are more likely about 2% gradient (Figure 7). The creek is

mapped (City of Redmond 2014) as extending for 2 or more miles further to the east into the City's Watershed Preserve. The City has identified four additional fish passage barriers upstream at: a) 204th Avenue NE; b) two driveways off 210th Avenue NE; and c) the Trillium Trail parking area off 218th Avenue NE. The headwaters of the creek are within the Redmond Watershed Preserve and presumably of high quality. The Lowland Trail crosses this segment of Mackey Creek on a bridge that is not a fish passage barrier.

Aquatic habitat units identified for this Mackey Creek segment were riffles and cascades. Riffles represent 88% of the length (Figure 8) and cascades represent 12% of the length. No areas were of sufficient size to be classified as a separate pool unit; however, one plunge pool was of sufficient depth to be considered a pool near the upstream end. Undercut banks were noted in several areas. The bankfull width ranges from 12 to 28 feet with a bankfull depth ranging from 2 to 3 feet. The wetted width during the field survey in February 2014 was typically 6 to 8 feet, with a typical depth of one foot. Estimated flow volume at the time of survey was approximately 15 cfs.

Figure 7. Logs with plunging overflow in upper segment of Mackey Creek.

Figure 8. Mackey Creek looking upstream from confluence with South Tributary.

Substrate in riffles includes 30% cobbles (4 to 5 inches), 30% small gravel (1 to 2 inches) and 30% coarse sand. Even with the much coarser substrate, it is generally not suitable spawning habitat for salmon species. The channel showed evidence of incision into the glacial till and the banks were typically nearly vertical for 2 to 3 feet up to the ordinary high water mark. This segment is generally more of a ravine. Runoff from upstream areas that are predominantly rural residential with grazed pastures and roadways has likely increased in recent years with development. This segment is more capable of transporting gravel, sands and finer materials downstream. A total of 39 pieces of large wood were present either spanning or located within the channel. This averages out to 340 pieces of large wood per mile, which is substantially more than is typical in small streams, but many of these pieces of wood that span the channel do not commonly interact with the channel and are thus not providing stream habitat.

Riparian vegetation was primarily native coniferous forest dominated with 50 to 90% canopy cover. Dominant trees include Douglas fir (*Pseudotsuga menziesii*), western red cedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), red alder (*Alnus rubra*), and big-leaf maple (*Acer macrophyllum*). Understory species include sword fern (*Polystichum munitum*), trailing blackberry (*Rubus ursinus*), and salmonberry (*Rubus spectabilis*).

<u>Mackey Creek from Confluence with South Fork to Western Boundary</u>. This segment of Mackey Creek extends for approximately 920 feet from the confluence with the South Tributary to the western edge of the study area. No culverts are present within this segment; Charlotte's Trail crosses this segment on a bridge that is not a fish passage barrier. The upper 250 feet of this segment flows through coniferous forest dominated habitat, although trails along the creek have reduced the understory substantially. The

creek overall drops approximately 14 feet from the confluence with the South Tributary to the western boundary (approximately 1.5% gradient). There is evidence of substantial deposition of sand and finer sediments in this segment. This material may be carried primarily by the mainstem upstream of the confluence and then as the gradient quickly flattens out, the sand and other material is deposited. It is unclear whether the sediment being transported comes from upstream erosion, such as from pastures, or from the creek's own bed and banks. Approximately 250 feet downstream of the confluence, the channel begins to split and braid through an emergent wetland dominated by the invasive reed canary grass (*Phalaris arundinacea*). Three primary channels were identified during the survey – north, middle, and south channels – with approximately equal flows through each. However, this entire area is likely to be a channel migration zone and the channel alignments change frequently depending on deposition of sediment or wood.

Aquatic habitat units identified for this Mackey Creek segment were riffles and glides. Riffles represent 96% of the length and glides represent 4% of the length. No pools were identified. The bankfull width in the single-thread segment ranges from 8 to 17 feet with a bankfull depth ranging from 2 to 2.5 feet. The wetted width during the field survey in February 2014 was typically 8 to 12 feet, with a typical depth of one foot. Estimated flow volume at the time of survey was approximately 24 cfs. The channel was confined by logs placed parallel to the flow in some locations (Figure 9). In the braided segment, bankfull width extended across all channels to 112 feet (Figure 10), with a bankfull depth of 2 feet. The wetted channels ranged from 3 to 8 feet.

Figure 9. Mackey Creek upstream of braided reach; note log on left, likely to have been placed for stream bank stability and to maintain the stream channel position.

Figure 10. Upper end of braided segment of Mackey Creek.

Substrate in riffles was about 50% fine gravel (<1 inch) and 50% coarse sand upstream of the braided area. It is generally not suitable spawning habitat for salmon species. The channel is not incised and bank heights were 1 to 2 feet. Moving into the braided channels, substrate became dominated by sand, and in some cases, silt or muck. Gravel was typically only present in small patches. Only 6 pieces of large wood were present upstream of the braided segment and some of these had been intentionally placed. In the braided section, only two pieces of large wood were present. This averages out to 47 pieces of large wood per mile. The North Braided Channel follows the course of a trail for the upper portion of the segment (Figure 11). The downstream part of the North Braided Channel, where the channels converge back together, is incised into glacial till and all channels drop up to 2 feet over the till into the outlet channel (Figure 12). This is likely a fish passage barrier as there are no pools below the drops to allow for jumping.

Riparian vegetation along the single-thread segment changed from cedar-dominated canopy cover to Douglas fir to red alder and then opened up to around 50% canopy cover in the braided section dominated by red alder, cottonwood (*Populus balsamifera*), and Pacific willow (*Salix lasiandra*). The understory was almost entirely reed canary grass.

Figure 11. North braided channel follows trail initially.

Figure 12. Drop over glacial till of North Braided Channel near western survey boundary.

All identified stream habitat units are shown on Figure 13.

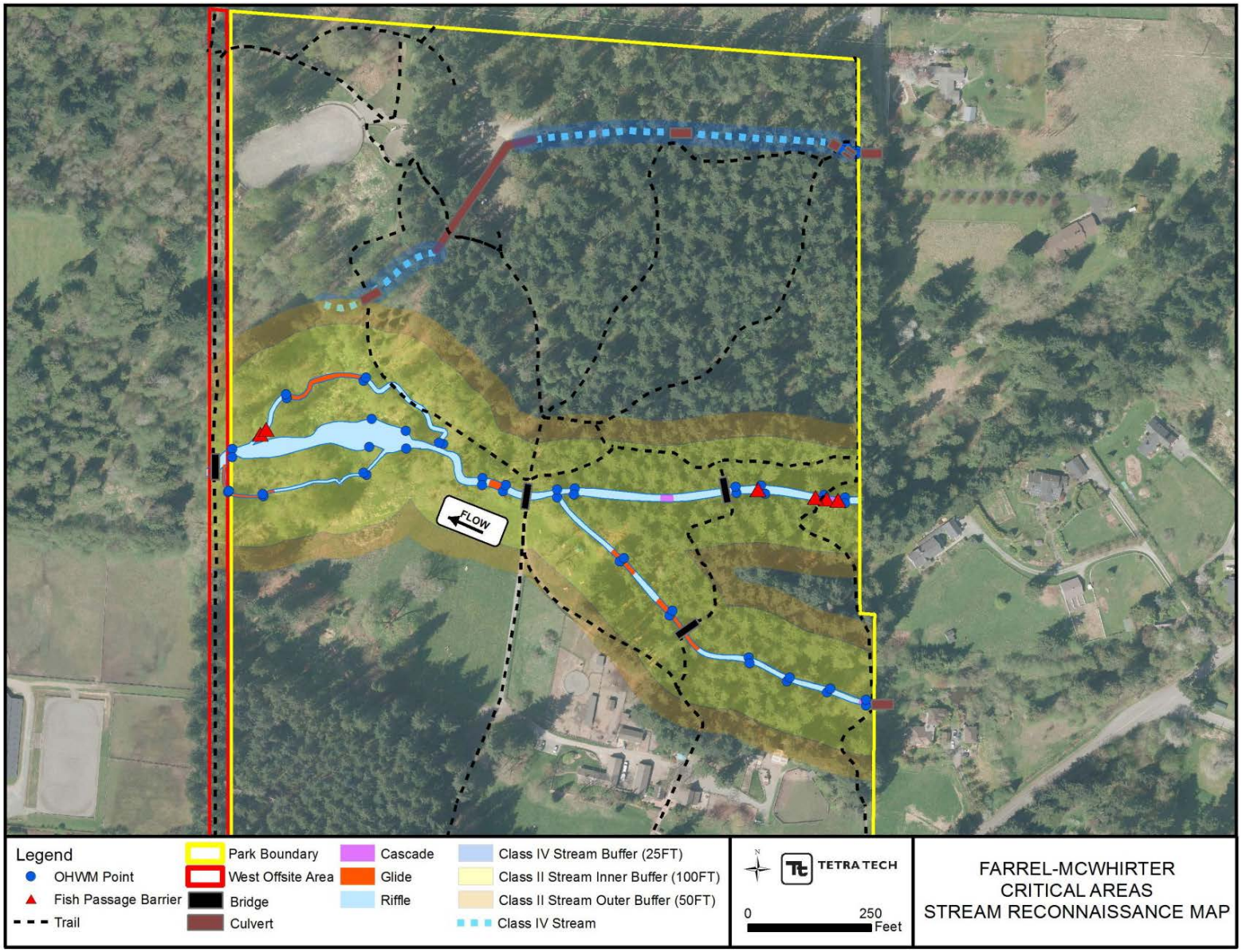


Figure 13. Stream habitat map

Summary of Quality of Stream Habitat

Both Mackey Creek and its South Tributary are Category II Streams due to potential use by anadromous salmonids as a tributary to Bear Creek, and have buffer requirements of 150 feet on each bank from the OHWM outward (RZC 21.64.020). This section summarizes the quality of the aquatic in-stream habitat and riparian conditions based on the descriptions provided above of habitat unit types, riparian conditions, and fish passage barriers. This evaluation of quality is described in the context of NOAA's properly functioning conditions concepts (1996) and explained in both text and Table 2 below. As the intermittent stream did not have a defined channel and no habitat units were identified, it is not discussed in this section.

Aquatic Habitat and Fish Use

Water Quality. Water temperatures are likely of good quality due to the multiple spring sources, although temperatures are at risk due to segments of limited riparian cover upstream of the park; primarily on the South Tributary. There are greater than 17% fines that may be eroded from the channel bed and banks and from upstream hobby farms, and turbidity can be high after rainfall events. The hobby farm uses may contribute fecal coliform and nutrients to the creek, although no data is available.

Fish Barriers. While WDFW's Salmonscape (2014) identifies that Chinook, coho, and steelhead access Mackey Creek up to the confluence with the South Fork, it is unlikely that this occurs very often due to shallow water depths in the braided channels and the drops over glacial till near the western boundary of the park. Stream habitat above the braided reach is of higher quality so if fish were able to pass upstream through the braided reach, they could access higher quality habitat. Upstream of the park, four additional fish passage barriers have been identified on Mackey Creek and one on the South Fork. Approximately an additional ¾ mile of stream on Mackey Creek and 150 feet of stream on the South Fork would be accessible upstream of the park, if fish passage barriers within the park were addressed.

Habitat. The South Fork is dominated by fine substrate with only small patches of gravel. Mackey Creek has gravel and cobble dominance in the upstream reach, transitioning to sand dominance in the braided reach. No areas within the park are likely suitable for spawning by salmonids. Large wood is present in good quantities above the confluence, but in low quantities below the confluence. However, much of the wood present is spanning the channels above the OHWM and does not provide in-stream habitat except during flood flows. The aquatic habitat is dominated by riffles and there are essentially no pools present. The lack of pools is likely due to three factors: 1) fairly resistant bed (glacial till) that resists scour, 2) high sediment load that fills in any scoured areas; and 3) lack of wood in the wetted channel to promote scour. No off-channel habitats were identified, although upstream of the confluence the banks are resistant and the channels are unlikely to migrate substantially. In the braided reach, off-channel habitats could form or wetlands could provide high flow refugia, but the dominance by reed canary grass tends to fill in any aquatic areas quickly, reducing refugia and contributing to stranding.

Channel Condition and Dynamics. The individual channels are generally of typical width to depth ratios (less than 10), but in the braided segment the multiple channels while narrow, are also shallow. This could contribute to higher water temperatures and also impeded fish passage. Streambanks are

moderately stable due to the resistance of glacial till, although it is likely that bank erosion is contributing fine sediments to the system. Floodplain areas upstream of the confluence appear to be slightly disconnected due to a foot or so of channel incision. In the braided reach, floodplain areas are connected very frequently due to excessive sediment deposition and braiding.

Hydrology. It is not known how much base flows may have changed due to upstream development, but likely to some extent due to removal of forested areas, although spring flows still substantially occur.

Watershed and Riparian Conditions. The upstream watershed has a moderate number of roads and driveways. Riparian conditions are very good within the park upstream of the braided segment, and continue upstream on Mackey Creek for at least several hundred feet east of the park boundary, and then upstream in the Redmond Watershed Preserve where the headwaters are located. The riparian corridor upstream of the braided segment should maintain cold water and microclimate temperatures and does provide good woody debris recruitment to the stream, although the stream is not very capable of transporting this wood downstream. The forested zone within the park also provides excellent wildlife habitat. The South Fork is ditched within a rural residential hobby farm immediately upstream of the park. Within the braided reach, the extensive adjacent wetland provides habitat for songbirds and amphibians, but the dominance by reed canary grass limits habitat diversity and the potential for formation of off-channel habitats. There is limited large wood in this segment and limited potential for recruitment. A few plantings have taken place within the wetland and will contribute to shading and large wood recruitment over time.

Table 2 shows a summary of existing conditions and is also used by NOAA and other agencies to evaluate potential effects of actions – which have not yet been proposed.

Table 2. Matrix of Pathways and Indicators

Pathways	Indicators	Environmental Baseline			Effects of the Action		
		Properly Functioning	**At Risk**	**Not Properly Functioning**	**Restore**	**Maintain**	**Degrade**
Water Quality	Temperature	X					
	Sediment		X				
	Chemical Contamination/ Nutrients		X				
Habitat Access	Physical Barriers			X			
Habitat Elements	Substrate			X			
	Large Woody Debris		X				
	Pool Frequency			X			
	Pool Quality			X			
	Off-channel Habitat			X			
	Refugia			X			
Channel Condition & Dynamics	Width/Depth Ratio	X					
	Streambank Condition		X				
	Floodplain Connectivity		X				
Flow/ Hydrology:	Peak/Base Flows		X				
	Increase in Drainage Network		X				
Watershed Conditions	Road Density & Location		X				
	Disturbance History		X				
	Riparian Reserves	X					

Wildlife Areas

Much of the park is comprised of coniferous forested areas, including the southern third of the park and the northeastern area. It consists of large trees up to approximately four feet in diameter at breast height; growing within what was likely an old growth cedar forest (many old Western red cedar [*Thuja plicata*] stumps are present). Most plant species in this forest are native, although a few exotic invasives are present in low densities. Typical tree species include Douglas fir (*Pseudotsuga menziesii)*, Western red cedar, and Western hemlock (*Tsuga heterophylla*), and typical deciduous species include vine maple (*Acer circinatum*) and big-leaf maple (*Acer macrophyllum*). Sub-canopy forest species are diverse and include sword fern (*Polystichum munitum*), salal (*Gaultheria shallon*), dull Oregon-grape (*Mahonia nervosa*), oso-berry (*Oemleria cerasiformis*), red huckleberry (*Vaccinium parvifolium*), salmonberry (*Rubus spectabilis*), lady fern (*Athyrium filix-femina*), piggyback-plant (*Tolmiea menziesii*), and giant horsetail (*Equisetum telmateia*).

Forested habitats provide important habitat for a variety of wildlife and birds in the area, including mammals such as coyote, mule deer, black bear, bobcat, raccoon, striped skunk, moles, and shrews. Non-native mammals include Virginia opossum and Eastern gray squirrel. Birds include pileated woodpecker, red-tailed hawk, great-horned owl, Northern flicker, Steller jay, American crow, common raven, black-capped chickadee, red-breasted nuthatch, American robin, varied thrush, and song sparrow. Amphibians include ensatina, Western redback salamander, and Pacific treefrog. Many other species likely also occur.

Important habitat components include nuts and seeds from the tree species, berries, downed wood, forest leaf litter (duff), seasonal wetland habitats, stream corridors, and the relatively low level of disturbance within the park.

Farrel-McWhirter is not currently listed as part of the King County Wildlife Network (King County 2012), but the Redmond watershed is an important component of the wildlife network with connections towards the Snoqualmie River and to the south. The Mackey Creek corridor could provide an important wildlife corridor from Bear Creek into the Redmond watershed and beyond.

Wetlands

The goal of the wetland assessment (i.e., delineation) is to document all resources in the survey area that may fall under the jurisdiction of the U.S. Army Corps of Engineers (USACE) and Washington Department of Ecology (Ecology). Key outcomes include the delineation of all wetlands present, establishing the classification or type of each, and rating them on attributes such as function, rarity, and value. A formal Wetland and Other Waters of the U.S. delineation was performed for the entire survey area and is provided in a stand-alone report submitted as a separate document.

Existing Conditions

Vegetation

Three general habitat-based vegetation types are present in the survey area: coniferous forest, herb-dominated flats, and maintained parkland. All vegetation types have been altered by human activities in the past, and continue to be influenced to some extent today. Vegetation types are typical for the region and are, collectively, of moderate quality.

The coniferous forest, as described above in the Wildlife section, includes small patches of wetlands in the northern portion of the park. These areas are typically dominated by Western red cedar, salmonberry and lady fern (*Athyrium filix-femina*).

Herb-dominated flats are found in the northwestern quarter of Farrel-McWhirter Park. This vegetation type is strongly influenced by Mackey Creek and multiple springs and seeps, which converge and collect in this low-lying area. The single dominant species is reed canary grass (*Phalaris arundinacea*), although patches of woody shrubs and small trees are also present in low densities. Other common species in this area include red alder (*Alnus rubra*), Sitka alder (*Alnus viridis sinuate*), Pacific willow (*Salix lucida*), black cottonwood (*Populus balsamifera*), red elderberry (*Sambucus racemosa*), trailing blackberry (*Rubus ursinus*), clustered rose (*Rosa pisocarpa*), red-osier dogwood (*Cornus sericea*), black hawthorn (*Crataegus douglasii*), Douglas spirea (*Spiraea douglasii*), and scouring rush (*Juncus effusus*). The understory in this vegetation type is almost exclusively reed canary grass.

Maintained parkland is located in a central strip that spans from the east and west borders of Farrel-McWhirter Park. This vegetation type is composed of large expanses of maintained lawn, interspersed with a few native and ornamental trees. Of the vegetation types present, maintained parkland is the most altered by human activities. Although disturbance is present within all vegetation types, facilitated by the extensive trail system and park infrastructure, the area of maintained parkland is the most frequently and extensively disturbed. The majority of the park infrastructure, including that related to the farm, is found in maintained parkland. Maintained parkland, which is the lowest quality habitat in the survey area, is composed of typical herbaceous lawn/pasture species such as spreading bentgrass (*Agrostis stolonifera*), tall fescue (*Festuca arundinacea*), dandelion (*Taraxicum officinale*), and creeping buttercup (*Ranunculus repens*), with a few remnant native forest trees.

Several invasive exotic species were present in the survey area and include reed canary grass, Himalayan blackberry (*Rubus armeniacus*), cut-leaf blackberry (*Rubus laciniatus*), yellow flag iris (*Iris pseudacorus*), English ivy (*Hedera helix*), lesser periwinkle (*Vinca minor*), dandelion, and Saint John's wort (*Hypericum perforatum*). The majority of these species were restricted to in and around the herb-dominated woody shrubland, although English ivy, blackberry species, and periwinkle were also found in the forested areas.

Soils

The soil survey report of the survey area (NRCS 1973, 2014b) indicates that six soil types (i.e., map units) are present in the survey area. The three primary soil types are discussed below; a map and additional

details of the soils within and around the survey site is provided in Appendix A, Figure 3; hydric ratings are also provided).

- ***Indianola loamy fine sand, 0 to 4 percent slopes (InA)***: The Indianola loamy fine sand component makes up 90 percent of the map unit; the remaining 10 percent is composed of the minor components; Norma, Shalcar, and Tukwila. Slopes are 0 to 4 percent and this component is found on terraces. The parent material consists of glacial drift. Depth to a root restrictive layer is more than 80 inches, and the natural drainage class is somewhat excessively drained. Water movement in the most restrictive layer is high (1.98 to 5.95 in/hr). This soil has no flooding or ponding frequency. Although the soil major components do not meet hydric criteria, the minor components do (NRCS 2012). The upper portion of this soil (0 to 15 inches) is described as being brown (10YR 4/3) to dark yellowish-brown (10YR 4/4) (NRCS 1973). Indianola loamy fine sand comprises approximately 40 percent of the survey area and is mostly distributed from the center to southwestern boundary.

- ***Alderwood gravelly sandy loam, 0 to 6 and 6 to 15 percent slopes (AgB and AgC, respectively)***: Alderwood gravelly sandy loam (major component) comprises 75 percent of the map unit; the remaining 25 percent is composed of the minor components; Buckley, Norma, Tukwila, Bellingham, and Shalcar. Slopes are 0 to 6 percent in AgB and 6 to 15 percent in AgC, and it is found in moraines and till plains. The parent material consists of basal till with some volcanic ash. Depth to a root restrictive layer is 24 to 40 inches to densic material and the natural drainage class is moderately well drained. Water movement in the most restrictive layer is very low to moderately low (0.00 to 0.06 in/hr). This soil has no flooding or ponding frequency. Although the soil major components do not meet hydric criteria, the minor components do (NRCS 2012). The upper portion of this soil (0 to 12 inches) is described as being very dark brown (10YR 2/2) or dark brown (10YR 4/3) (NRCS 1973). Alderwood gravelly sandy loam comprises approximately 25 percent of the survey area and is mostly distributed in the northeastern quarter and along the eastern survey boundary.

- ***Norma sandy loam (No):*** The Norma sandy loam component makes up 90 percent of the map unit; the remaining 10 percent (7 percent, according to the soil report) is composed of the minor components; Norma, Seattle, Shalcar, Alderwood, and Tukwila. Slopes are 0 to 2 percent and this component is found on flood plains. The parent material consists of alluvium. Depth to a root restrictive layer is more than 80 inches, and the natural drainage class is poorly drained. Water movement in the most restrictive layer is high (1.98 to 5.95 in/hr). This soil has no flooding frequency, but ponds frequently. All components of this soil meet hydric criteria (NRCS 2012). The upper portion of this soil (0 to 10 inches) is described as black (10YR 2/1) (NRCS 1973). Norma sandy loam comprises approximately 26 percent of the survey area and is mostly distributed in the northwestern quarter down along the western boundary.

Hydrology

Hydrology (water) generally moves down-gradient from the northeast to the southwest, and is present as both groundwater and surface water. This complex hydrologic pattern is likely due to the glacial till

soils that dominate the area, which cause hydrology to transition between surface water and ground water in many locations. Surface water, whether ponded or flowing, typically transitions to subsurface when it reaches areas of more permeable soils. The opposite is true for groundwater, which daylights when the restrictive layer on which it is perched, comes near to the surface, resulting in seeps. The distribution of these areas is sporadic, however, and results in either a mosaic of ponded or saturated areas intermixed with dry soils, or in intermittent streams. In general, seeps are located either on or at the toe of slopes, causing the water to ultimately accumulate on downslope flats where the soils become saturated and/or ponded. Precipitation runoff generally exits the park by way of channels that connect to Mackey Creek, which flows off-site to the west. It is likely that Mackey Creek also sends surface water onto adjacent flats when flows exceed bank-full height, although there is little evidence of this occurring frequently upstream of the confluence with the South Fork. Flooding in the braided reach of Mackey Creek occurs very frequently. Most runoff originates upslope to the north and east of Farrel-McWhirter Park, where it readily sheets from pastures, lawns, and impervious areas.

Methods

The wetland assessment consisted of 7 nonconsecutive days of field work that occurred from the 29th of January to the 13th of February, 2014. A supplemental site visit was conducted on the 15th of April 2014 to reconfirm wetland indicators for some wetlands. Tetra Tech biologists Jeff Barna and Merri Martz conducted all aspects of the field survey with support from GIS scientist, Greg Woloveke.

This investigation was conducted via field investigations following the 1987 *Corps of Engineers Wetland Delineation Manual* (USACE manual) (USACE 1987), the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (Version 2.0)* (regional supplement) (USACE 2010), and the *Washington State Wetlands Identification and Delineation Manual* (Ecology 1997). Wetland ratings were performed using the Washin*gton State Wetland Rating System for Western Washington; Revised* (Hruby 2004) and the W*ashington State Wetland Rating Form – Western Washington, Version 2* (Ecology 2008).

Findings and Results

A total of thirteen wetlands were identified (Table 3). Wetland features included forested and woody shrub and/or herb dominated wetlands that were seep or stream fed, or both. In addition to wetlands previously mapped by NWI (USFWS 2014), several wetlands were identified in the northern half of the survey area. The single wetland identified by NWI, a Palustrine Emergent Temporally Flooded wetland located in the northwestern corner of Farrel-McWhirter Park, corresponded to a wetland identified during this survey (Wetland 4) but is smaller. The other 12 wetlands not identified by NWI were generally small, seep fed, and mostly located under forest canopy. Hydrogeomorphic (HGM) wetland classifications for each wetland identified in the survey area are presented in Table 3.

Table 3. Summary findings from Wetlands and Waters of the U.S. delineation.

Wetland/Waters of the U.S.	HGM Class[\1] or Other Waters Description	Size (acres)
WETLANDS		
1	SLOPE: Seasonally Saturated/Overland Flow, Human Altered Flat with Back slope, *maintained lawn/forested*	0.67
2	RIVERINE: Depressional, Naturally Disturbed, *forested*	0.13
3	SLOPE: Flat with Back slope, Saturated/Overland Flow, *shrub/forested*	0.47
4	RIVERINE (SLOPE): Seep-fed with Perennially Saturated/Stream Flow, Lowland, *herb-dominated/small trees*	5.96
5	RIVERINE: Occasionally Flooded, Swale, *forested*	0.02
6	RIVERINE: Occasionally Flooded, Floodplain, *shrub-dominated*	0.03
7	SLOPE: Saturated, Human Altered Flat, *forested/shrub*	0.12
8	SLOPE: Saturated/ Intermittent Overland Flow, Human Altered Flat/Channelized, *forested/shrub*	0.63
9	SLOPE: Saturated, Human Altered Flat, *forested/shrub*	0.04
10	SLOPE: Seasonally Saturated, Human Altered Flat, *forested/shrub*	0.04
11	DEPRESSIONAL: Seasonally Ponded/Saturated, Human Altered Lowland, *forested/shrub*	0.48
12	SLOPE: Seasonally Saturated, Human Altered Flat, *forested/shrub*	0.21
13	SLOPE: Seasonally Saturated, Human Altered Flat, *forested/shrub*	0.14
	TOTAL:	**8.80**
OTHER WATERS OF THE U.S.		
Mackey Creek and South Tributary	Perennial, seep/runoff fed, altered salmon bearing tributary of Bear Creek with several fish passage barriers	1.07
Unnamed Intermittent Stream	Intermittent, seep/runoff fed, ill-defined channel	N/A

[\1] NRCS 2008; also referenced Cowardin 1979

Hydrology for some of the wetlands has likely been altered by the establishment of trails that have impounded water on the upslope side or otherwise changed flow patterns. Hydrophytic vegetation is established in these areas, and generally obvious wetland/non-wetland breaks in vegetation communities. Soils, in some cases, did not meet the standard hydric soil indicators; this may be due to the dark colors of Alderwood soils (the predominant soil type on the hillslopes) that can mask hydric indicators such as mottles. The supplemental field visit in April 2014 was undertaken, in part, to reconfirm areas where soil indicators were not visible in January and February 2014 when the soils were inundated.

Wetland Descriptions

The thirteen wetlands identified in the survey area are described below. Each of these wetlands is shown on the overview map (Figure 14). Details of each wetland including size and HGM classification are presented in Table 3.

Wetland 1: Wetland 1 is located on the east end of the area of maintained parkland between the eastern park boundary and the flats to the west, and extends north into the forested area behind the cow pen. In general, the wetland appears to be caused by sheet-flow and springs at the park boundary. Water flowing overland from the muddy adjacent pasture (off-site to the east) into Wetland 1 was apparent. Subsurface water movement was also obvious and notably rapid through mole tunnels adjacent to some sample plots. Because of surface water flow on the upslope edge of the wetland, Wetland 1 is considered a slope wetland (Hruby 2004). Despite wetland hydrology being present, hydric soil indicators were not present in some sample plots. The supplemental field visit in April 2014 yielded better visibility of hydric soil indicators and the boundary was slightly adjusted to ensure all areas mapped within the wetland had the presence of strong wetland indicators. Wetland 1 encompassed two vegetation communities: maintained parkland and coniferous forest. The area of maintained parkland is dominated by spreading bentgrass (FAC) and creeping buttercup (FAC); the coniferous forest was primarily dominated by Western red cedar (FAC). Both vegetation types consistently met dominance test criteria. A few, small non-wetland hummocks were identified in the forested portion of Wetland 1, however, their small size (<10 square-feet) rendered delineating them out of the wetland impractical; these hummocks are likely decomposed stumps or logs. Substantially altered features present within Wetland 1 include maintained lawn, barn, and a hiking trail (on the east side) and two associated small culverts. Unlike with the adjacent Wetland 7, located to the north, hydrology flows mostly unimpeded through Wetland 1.

The culvert that conveys surface flows into Wetland 1 is a six-inch plastic pipe under the Perimeter Loop Trail where it drains the upslope east side into the downslope west side. A small ponded area is present upslope of the trail due to the inlet being partially blocked by rock and other debris.

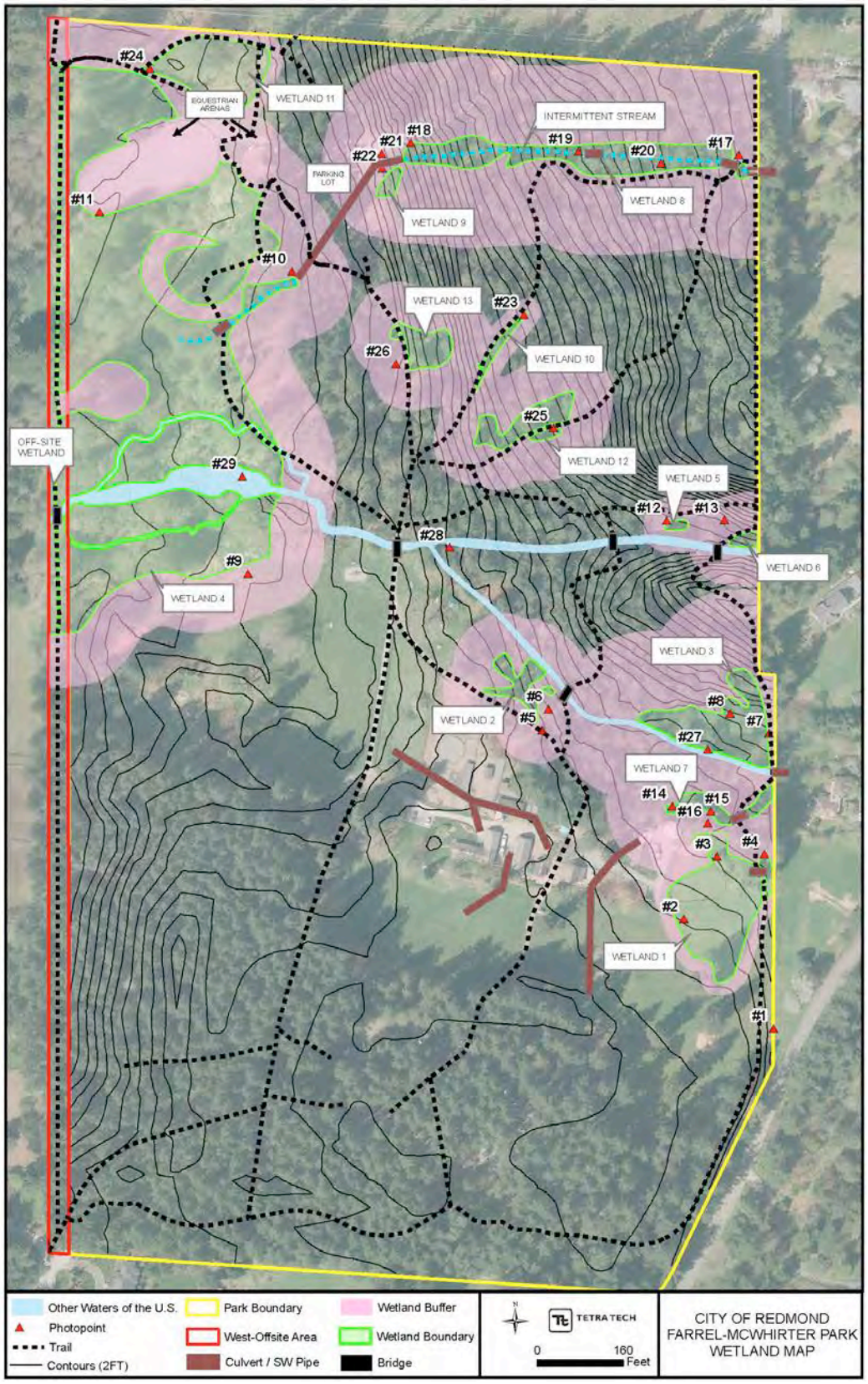


Figure 14. Overview map of wetlands identified in the survey area.

Wetland 2: Wetland 2 is a seep-fed riverine (slope) wetland (Hruby 2004) located adjacent and south of the South Fork of Mackey Creek. This wetland appears to have been largely created in 2006 when a strong windstorm occurred, toppling several Douglas-firs and other conifers in the forested area. The subsequent root-wad depressions now pond water from both precipitation and groundwater flows from the South Fork of Mackey Creek. The wetland contains small upland hummocks. The short time since the blow-down event may not have been long enough to allow the development of hydric soils, creating problematic conditions. Evidence of a shallow water table is present in many upturned root-wads, which show shallower than expected roots, root ends growing upward towards the soil surface, and buttressed trunks, all of which are indicators of wetland hydrology. Presence of a shallow water table may have made the felled trees susceptible to toppling by the strong winds of the 2006 storm.

Wetland 3: Wetland 3 is an obvious wetland located adjacent and upslope (i.e., north) of South Fork Mackey Creek. Its boundary on the north and east is the Perimeter Loop Trail. Hydrology comes from several seeps along the upslope edge, where they daylight and flow downslope into the basin that forms the bulk of the wetland. A small upland hummock partially separates the central portion of Wetland 3 from the South Fork of Mackey Creek and may contribute to retaining water in the wetland. Water eventually seeps from Wetland 3 into the creek. Many plant species with wetland ratings of FAC, FACW, and OBL are present in Wetland 3. Soils in Wetland 3 were all hydric and met the F3 indicator. Wetland 3 is considered a slope wetland (Hruby 2004).

Wetland 4: Wetland 4 is a large open canopy reed canary grass-dominated wetland located on the northwestern border of the park and was considered connected to the wetland located in the northern portion of the West off-site area. Source hydrology is primarily from seepage and direct overland flow from Mackey Creek (downstream of the confluence of the two forks), as well as from upslope seeps and the intermittent stream located northeast of the wetland. The intermittent stream from Wetland 8, flows through a 24-inch CMP culvert on the east side of the parking area nearest to the equestrian arena and then disperses into Wetland 4. Although reed canary grass is dominant, additional species include woody shrubs and a few smaller trees. Several large, dead conifers are present, suggesting conditions such as hydrology have changed since their establishment (likely due to substantial sediment deposition from Mackey Creek that may have raised the water table). The West off-site area wetland is dominated by cottonwood overstory and salmonberry understory. A few small patches of upland are also present within Wetland 4 as well as the Nicholl's trail. Areas of placed fill were observed, including the equestrian arena and trails composed of raised sand, gravel and/or asphalt. These fill areas were not included in the wetland, but were likely part of Wetland 4 prior to placement of fill (prior to the 1970s).Although hydrology indicators were present in these areas, soils and vegetation were fundamentally altered. Hydric soil indicators were not obvious in some sample plots, such as those with the previously described dark colors or when recent sand deposition was present. Wetland 4 is considered a riverine/slope wetland (Hruby 2004).

Wetland 5: Wetland 5 is a small riverine wetland (Hruby 2004) located adjacent to and north of Mackey Creek. The swale that bounds Wetland 5 is likely an old side channel but is now perched approximately 1 foot above the current adjacent active channel. Standing water and saturated soils were observed during field sampling, and source hydrology is likely from a combination of runoff from upslope areas

and hydrostatic pressure from creek water. Human disturbance bisects Wetland 5 where an informal trail crosses through to Mackey Creek. A few planted Sitka spruce are in or near Wetland 5 but most of the area is devoid of vegetation except for sparse herbs. Soils in Wetland 5 are primarily a combination of sand and cobble and were lacking indicators.

Wetland 6: Like with Wetland 5, Wetland 6 is a small riverine wetland (Hruby 2004) located adjacent to and north of Mackey Creek. Wetland 6 is perched approximately 1 foot above the current adjacent active channel on a small floodplain terrace. Saturated soils were observed throughout Wetland 6, and source hydrology is likely from a combination of runoff from upslope areas (possibly via seeps) and hydrostatic pressure from creek surface water elevation. Most of Wetland 6 is dominated by salmonberry with a few small hydrophytic herbs also present. Soils in Wetland 6 are primarily a combination of sand and cobble and were lacking wetland indicators.

Wetland 7: Wetland 7 is very similar and closely related to the portion of Wetland 1 that is located in the secondary growth conifer forest. Wetland 7 is shaped by several human constructed features including a shed, a hiking trail (on the east side) and associated small culvert, and a small levee constructed from a large downed log reinforced with sandbags and adjacent excavated drainage ditch (located directly upslope of the barn. It is likely that Wetland 7 and Wetland 1 were part of the same wetland prior to disturbance, but now are separated by a upland complex composed of the small levee and channel, and patch of Douglas fir-dominated upland. Wetland 7 is considered a slope wetland (Hruby 2004).

Wetland 8: Wetland 8 is long linear wetland that initiates and ends with the intermittent stream moving through a barely distinguished channel. The majority of Wetland 8 has either intermittent flow, surface ponding, or subsurface flow. Hydrology is conveyed into Wetland 8 through a culvert that drains adjacent privately owned pasture to the east, and exits to the west into another culvert under the parking area near the equestrian arena (that connects to Wetland 1). Two other culverts channelize water in and through Wetland 8. Vegetation is mostly wetland shrub bordered by forest. Soils are similar to neighboring wetlands and are composed of two separate components of dense silt, which acts as a restrictive layer, and sand. Various trails run adjacent and/or across Wetland 8, and somewhat degrade its quality while also likely maintaining its structure by dictating water movement. Wetland 8 is considered a slope wetland (Hruby 2004).

Wetland 9: Wetland 9 is a small seep-fed slope wetland (Hruby 2004) positioned in a low alcove bound to the north and south by two large big-leaf maples (demarking upland), by a back slope to the east, and to the west by the parking lot for the equestrian arena. Hydrology is likely connected via subsurface to Wetland 8, which seeps downslope to Wetland 9 where it daylights at the toe of the slope. Surface water exits Wetland 9 along the western edge where it sheets across the parking lot pavement. The presence of the parking lot may enhance the size of Wetland 9 by impeding water flow.

Wetland 10: Wetland 10 is a small linear seep-fed slope wetland (Hruby 2004) located east of and adjacent to the Upland Loop Trail. It is created by a point-source seep draining downslope and parallel to the trail. Although source hydrology is unknown, the trail is likely responsible for daylighting the

groundwater and creating the wetland. Tree blow-down adjacent to Wetland 10 is at least partly responsible for expanding the wetland through ponding. Wetland hydrology flows subsurface downslope under the trail where it again daylights on the west side, but again goes subsurface shortly thereafter. Wetland 10 has characteristics of a well-established wetland, including strong hydric soil indicators, hydrophytic vegetation composed almost exclusively of an herb layer, and obvious wetland hydrology.

Wetland 11: Wetland 11 is a depressional wetland (Hruby 2004) surrounded by slightly raised hiking trails composed of fill. The trail system functions to both enhance and isolate Wetland 11 from its surroundings through acting as a levee, restricting surface water movement. This wetland receives hydrology from precipitation as well as from subsurface sources including Wetland 4, located adjacent to and south of Wetland 11. Wetland 11 was likely connected to Wetland 4 (and to the off-site wetland to the north) prior to the establishment of the trails. The geomorphic position of Wetland 11 is in an obvious low area that captures and ponds water from upslope sources. Disturbance to vegetation is ongoing through enhancement activities including the clearing of Himalayan blackberry. A wetland enhancement was recently completed to the north of Wetland 11 in an off-site wetland in the transmission line right-of-way.

Wetland 12: Wetland 12 is a seep-fed slope wetland (Hruby 2004) located adjacent to and bisected by the Upland Loop Trail. It is created by what appears to be a relatively broad seep or multiple point-seeps that drain downslope on either side of the trail. Although source hydrology is unknown, the trail-cut is likely partially responsible for daylighting the surface water and creating the wetland. Tree blow-down adjacent to Wetland 12 is partly responsible for expanding the wetland through ponding. Wetland hydrology moves subsurface downslope (from east to west) under the trail where it saturates soils and ponds on the west side in a geomorphic depression. Wetland 12 has characteristics of a well-established wetland, including hydrophytic vegetation and clear hydrology.

Wetland 13: Wetland 13 shares most features with Wetland 12. Wetland 13 is a seep-fed slope wetland (Hruby 2004) located adjacent to and is bisected by the unnamed paved path linking the Mackey Picnic Shelter to the parking area near the equestrian arena. It was created by what appears to be a relatively broad seep or multiple point-seeps that drain downslope on the east side of the trail. Although source hydrology is unknown, the path is likely responsible for impounding and impeding water flow. Limited tree blow-down adjacent to Wetland 13 is also partly responsible for expanding the wetland through ponding. Wetland hydrology both sheet-flows and moves subsurface downslope (from east to west) across and under the trail where it saturates soils on the west side.

Conclusion

According to the 1987 Manual and implementing guidance, there must be positive indicators of each parameter (hydrophytic vegetation, hydrology, and hydric soils) present to make a wetland determination (USACE 1987). However, because this wetland delineation was in an area with problematic soil characteristics (very dark colors and/or sandy textures, and past disturbance), as well as evidence of alterations to vegetation in some areas (i.e., mowing and past farming activities), sample plots that were determined to be wetland, in some cases, did not have all three positive indicators. All

wetland sample plots did, at a minimum, have two strong indicators, most commonly being wetland hydrology and hydrophytic vegetation. Sample plots with two positive indicators also typically had several other indicators of wetland conditions including water marks, stunted or stressed plants, drainage patterns, and geomorphic position. Hydrology had the potential to be naturally problematic due to a dryer than average winter, with substantial precipitation only occurring immediately prior to the first day of the survey. Re-examining several sample plots during the three-week period, reaffirmed that wetland hydrology was still present many days after heavy precipitation. The presence of wetland hydrology was the single best indicator of wetland conditions, although hydrophytic vegetation was also a good indicator.

Because wetlands were determined to be present in the survey area, Washington State Wetlands Rating forms were completed for each of the thirteen wetlands identified and can be made available on request. Ecology wetland ratings categories and corresponding classifications and associated buffers are presented in Table 4, below.

Table 4. Wetland/Waters of the U.S. summary of results including potential Jurisdictional features assessment. Included are Ecology wetland rating categories and corresponding classifications and buffers.

Wetland	Size (acres)	Wetland Ratings[/1]	Wetland Classification[/2]	Buffer width (feet)[/2]
1	0.67	IV	IV	25
2	0.13	III	III	75
3	0.47	III	III	150
4	5.96	II	II	100
5	0.02	III	III	40
6	0.03	III	III	75
7	0.12	III	III	110
8	0.63	III	III	150
9	0.04	III	III	75
10	0.04	IV	IV	25
11	0.48	IV	IV	25
12	0.21	III	III	75
13	0.14	III	III	75
Total:	**8.80**			

[/1] Ecology wetland ratings (Ecology 1997)

[/2] 20D.140.30 Classification and Rating of Wetlands

Frequently Flooded Areas

To promote consistent application of the standards and requirements of the Zoning Code for the City, Frequently Flooded Areas within the City of Redmond have been rated or classified according to their characteristics, function and value, and/or their sensitivity to disturbance. Frequently Flooded Areas Classifications include the following features:

- **Floodplain:** The total area subject to inundation by the base flood (the flood that has a one percent chance of occurring in any given year).
- **Flood Fringe:** The portion of the floodplain outside of the floodway which is generally covered by flood waters during the base flood and is generally associated with standing water rather than rapidly flowing water.
- **FEMA Floodway:** The channel of the stream and that portion of the adjoining floodplain which is necessary to contain and discharge the FEMA base flood flow without increasing the FEMA base flood elevation more than one foot.
- **Zero-Rise Floodway**: The channel of the stream and that portion of the adjoining floodplain which is necessary to contain and discharge the base flood flow without increasing the base flood elevation. The zero-rise floodway will always include the FEMA floodway.

The classification of frequently flooded areas was determined using consideration of several factors. Maps adopted pursuant to this Zoning Code include the Frequently Flooded Areas map, which identifies the approximate location and extent of the 100-year floodplain. This map should be used as a general guide only for the assistance of property owners and other interested parties; boundaries are generalized. The City has employed hydrologic models to define the extent of the zero-rise floodway. In the absence of a City hydrologic model, FEMA data will be acceptable. Other sources of information are Flood Insurance Rate Maps published by the Federal Emergency Management Agency, the application of the criteria contained in these regulations, and consideration of the technical reports submitted by qualified consultants in connection with applications subject to these regulations.

Data specific to parcels has been made available by the City (Redmond 2013). Although this data should be definitive, Frequently Flooded Areas were assessed during the field survey.

Results

Assessing Frequently Flooded Areas in the survey area included referencing available online parcel data, mapping sources, and searching the site for evidence of flooding.

Available map sources including the *Frequently Flooded Areas Critical Areas Map* (Redmond 2005c) developed by the City and the 2013 Draft FEMA Flood Insurance Rate Maps from King County's recent floodplain updates (FEMA 2013) did not show any mapped floodplains, floodways or frequently flooded areas. This would be considered a Zone X area by FEMA that has not been mapped due to the small drainage area. Data provided by accessing parcel information (Redmond 2013), also did not indicate the presence of Frequently Flooded Areas in the survey area.

The field survey assessed the area for signs of frequent flooding such as the presence of wrack, drift deposits, significant erosion or deposition, and/or sloughing slopes in the area. Sediment deposition is obvious along the western portion of Mackey Creek within the park and flows have braided multiple channels in this area. As no hydrologic analysis has been done for Mackey Creek, a floodplain or floodway cannot be precisely defined or mapped until such an analysis has been conducted. For general purposes, it can be assumed that the extent of Wetland #4 is the approximate extent of potential flooding from Mackey Creek.

Geologically Hazardous Areas

Geologically Hazardous Areas, as defined by the City's Zoning Code (*21.64.060 Geologically Hazardous Areas*), are areas susceptible to erosion, sliding, earthquake, or other geological events.

Geologic Hazard Areas are classified as three types: Erosion Hazard Areas, Landslide Hazard Areas, or Seismic Hazard Areas. Each are described below:

- **Erosion Hazard Areas**: Lands or areas underlain by soils identified by the U.S. Department of Agriculture Soil Conservation Service as having "severe" or "very severe" rill and inter-rill erosion hazards. Rill erosion occurs when development of a concentrated flow of water in a very small channel that begins to cut into the soil surface producing a rill. Inter-rill erosion is caused by the impact of rain on the surface. This includes, but is not limited to, the following group of soils when they occur on slopes of 15 percent or greater: Alderwood-Kitsap (AkF), Alderwood gravelly sandy loam (AgD), Kitsap silt loam (KpD), Everett (EvD), and Indianola (InD).

- **Landslide Hazard Areas**: Areas potentially subject to significant or severe risk of landslides based on a combination of geologic, topographic, and hydrogeologic factors. They include areas susceptible because of any combination of bedrock, soil, slope, slope aspect, structure, hydrology, or other factors. Geologic Hazard areas include any area with a slope 40 percent or steeper with a vertical relief of 10 feet or more.

- **Seismic Hazard Areas**: Lands subject to severe risk of damage as a result of earthquake-induced ground shaking, slope failure, settlement, soil liquefaction, or surface faulting.

Results

An evaluation of materials available from the City as well as county, state, and federal sources indicated that no Geologically Hazardous Areas are present in the survey area.

Erosion Hazard Areas were not identified in the survey area despite the presence of Alderwood soils. Alderwood gravelly sandy loam, an indicator soil, was identified in the survey area, and has a slope range from 6 to 15 percent (NRCS 2014). Although this soil type occupies the northeastern corner of the survey area, the field survey and topographic mapping indicates that slopes were generally less than 15 percent. Signs of erosion were very limited and localized; primarily just small areas of bank erosion along Mackey Creek or where flowing water from seeps crossed over hiking trails and caused small areas of

erosion on the trail. In addition, the *Erosion Hazard Areas Critical Areas Map* created by the City (Redmond 2005a), does not indicate Erosion Hazard Areas are present in or near the survey area.

Landslide Hazard Areas were determined to not be present in the survey area. Areas potentially subject to significant or severe risk of landslides based on a combination of geologic, topographic, and hydrogeologic factors were not mapped in or near the survey area on the *Landslide Hazard Areas Critical Areas Map*, created by the City (Redmond 2005d). The field survey verified this assessment. Although multiple seep were identified in the survey area and sub-surface water movement was apparent in some places, no areas of downslope movement of soil and/or rocks and that are separated from the underlying stationary part of the slope by a definite plane of separation were apparent. Soils and hydrology characteristics, however, were likely partly responsible for the instability of conifers in the flat areas (see discussion of Wetland 2 in the Wetland Section), as indicated by patches of trees that succumbed to wind blow down, which exposed their shallow roots.

Seismic Hazard Areas were determined to not be present in the survey area. A review of the *Seismic Hazard Areas Critical Areas Map*, created by the City (Redmond 2005e), indicates no Seismic Hazard Areas are present in or near the survey area. Although field indicators of seismic hazards (settlement, sloughing slopes, fissured ground, etc.) are rarely obvious in the field unless conditions are extreme, the field survey did not identify any of these features in the area.

Critical Aquifer Recharge Areas

Critical Aquifer Recharge Areas are those areas with a critical recharging effect on aquifers used for potable water, as discussed in the City's Zoning Code (*21.64.050 Critical Aquifer Recharge Areas*). Wellhead protection involves the management of activities that have a potential to degrade the quality of groundwater produced by a supply well. The City has classified four wellhead protection zones that are based on proximity to and travel time of groundwater to the City's public water source wells, and are designated using guidance from the Washington Department of Health Wellhead Protection Program pursuant to Chapter 246-290 WAC. The four wellhead protection zone classifications are described below:

- Wellhead Protection Zone 1 represents the land area overlying the six-month time-of-travel zone of any public water source well owned by the City.
- Wellhead Protection Zone 2 represents the land area that overlies the one-year time-of-travel zone of any public water source well owned by the City, excluding the land area contained within Wellhead Protection Zone 1.
- Wellhead Protection Zone 3 represents the land area that overlies the five-year and 10-year time-of-travel zones of any public water source well owned by the City, excluding the land area contained within Wellhead Protection Zones 1 or 2.
- Wellhead Protection Zone 4 represents all the remaining land area in the City not included in Wellhead Protection Zones 1, 2, or 3.

Results

An assessment of the survey area for Critical Aquifer Recharge Areas identified two classifications that are present: Zone 2 and Zone 3 (Redmond 2013), and are shown on Figure 15 that includes all CAs present in the survey area. Essentially, the entire park is within these wellhead protection zones. This finding is consistent with the hydrology and location of the survey area. Hydrology moves down gradient from east to west as surface and subsurface flow. The location of the survey area upslope and east of the City limits indicates hydrology moves though the survey area towards and likely into the City's water supply area at rates indicated above. These rates were not independently confirmed.

The City's wellhead protection zone performance standards require the following considerations:

<u>Zone 2</u>

- Provide secondary containment for storage of potentially hazardous or other deleterious substances in aggregate quantities greater than 20 gallons liquid or 200 pounds solid (i.e. fuels, pesticides, paints, lubricants). Hazardous materials stored in tanks subject to regulation by the Department of Ecology are exempt from secondary containment, provided, that compliance with Ecology's regulations can be demonstrated.
- For construction within Zone 2, if vehicles will be refueled on-site, or materials will be stored, dispensed, used or handled greater than the quantities above, a detailed monitoring plan and construction standards must be developed, and an on-site person must be designated as responsible for supervising the use of the materials and who has appropriate knowledge and training to take mitigating actions necessary in the event of a spill or fire.

Zone 3

- Compliance with performance standards for vehicle fueling and storage, and best management practices during construction.
- Fill material shall not contain concentrations of contaminants that exceed cleanup standards for soil under WAC 173-340-740, Model Toxics Control Act.

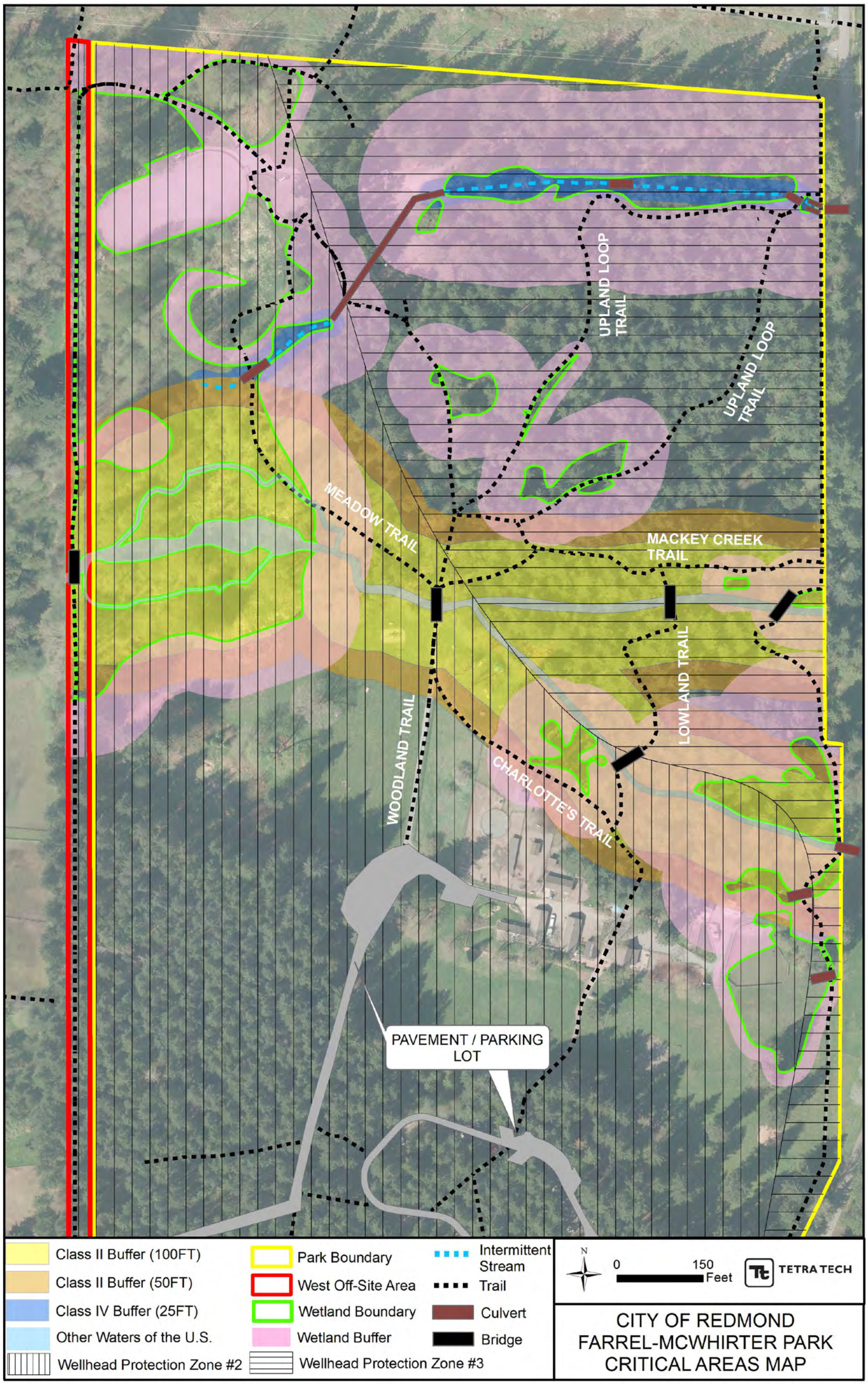


Figure 15. Map of critical areas within Farrel-McWhirter Park

Stream and Wetland Enhancement

There are several opportunities for habitat enhancement within the park to address the primary issues that currently degrade stream and wetland habitat quality. These enhancement opportunities are primarily described for the streams and for Wetland #4 and are listed below in Table 5 and general locations are shown in Figure 16. The wetlands located in the forested area are of generally good quality and dominated by native species; the wetlands that are subject to frequent disturbance (i.e. Wetland #1) are likely to continue to be disturbed, so no specific recommendations are made herein.

Table 5. Habitat problems and opportunities for enhancement.

Functional Category	Problem	Opportunity for Enhancement
Water Quality	Potential for stream temperature increases	• Increase tree/shrub cover in braided segment
	Sediment and nutrient inputs	• Provide in-channel wood for sediment trapping to build up channel bed to re-access the floodplain and provide further sediment trapping and nutrient cycling
Fish Passage Barriers	Culverts and drops prevent fish upstream passage	• Replace culvert under trail on South Tributary, and culvert upstream of park boundary within City right-of-way, provide downstream pools at each new culvert location; • Place large wood to accumulate sediment downstream of drops to build up channel
Sediment/Substrate	Erosion of channel bed/banks and excessive sediment deposition in braided segment	• Place large wood to trap sediment in upper reaches, • Excavate reed canary grass to enlarge main channel in braided segment
Large Wood	Lack of large wood in braided segment	• Place some large wood in braided segment, although design to minimize sediment trapping, and increase tree cover for future recruitment
Aquatic Habitat Diversity	Lack of pools	• Place large wood to form pools
Floodplains and Refugia	Poor connections to floodplains and refugia and potential stranding	• Build channel back up to reconnect to floodplain in upper reaches; • Control reed canary grass in braided segment to reduce stranding potential
Hydrology	Increased intensity of runoff	• Build channel back up to reconnect to floodplain in upper reaches; • Enlarge culverts, including at intermittent stream, to reduce velocities and scouring flows

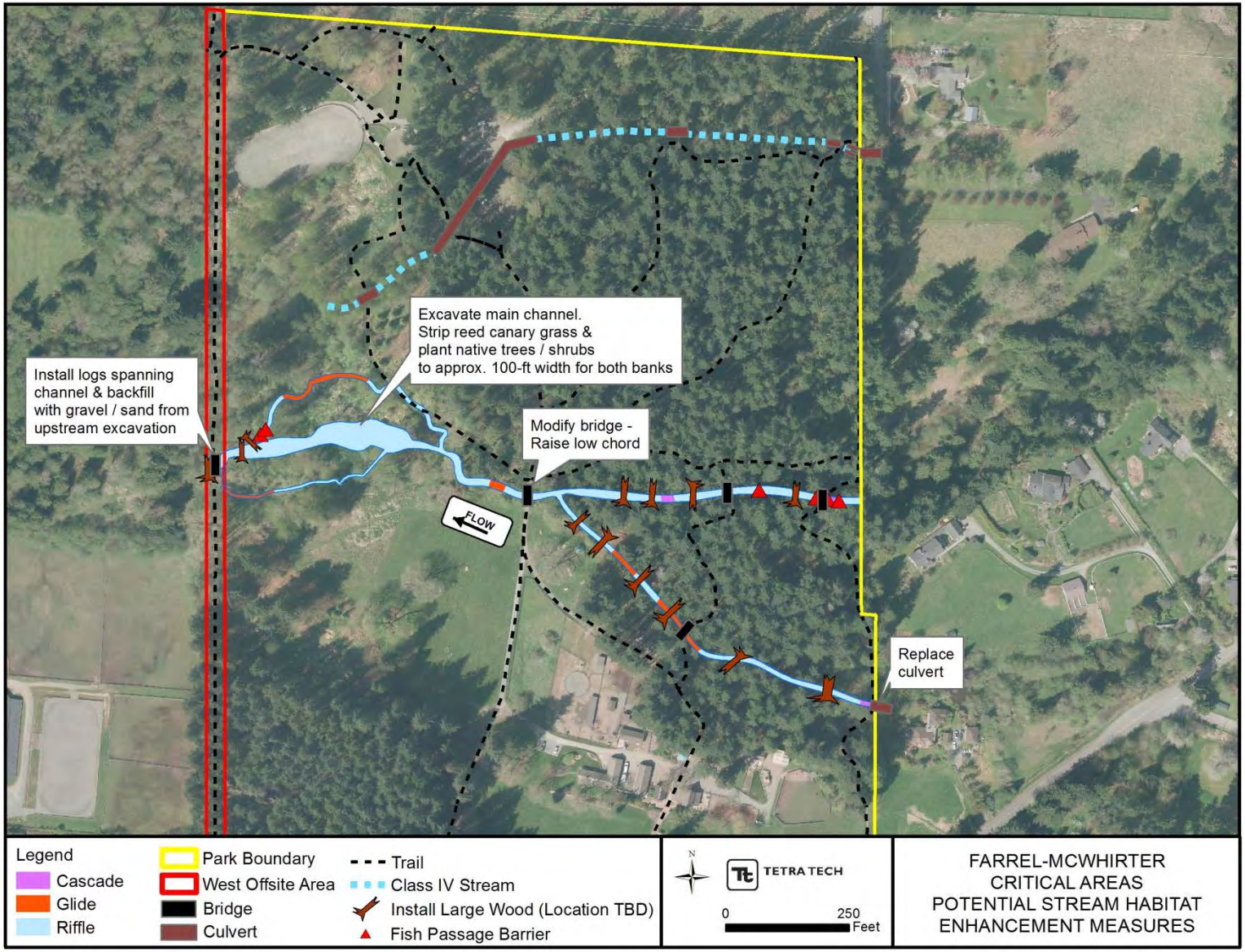


Figure 16. Potential stream restoration opportunities.

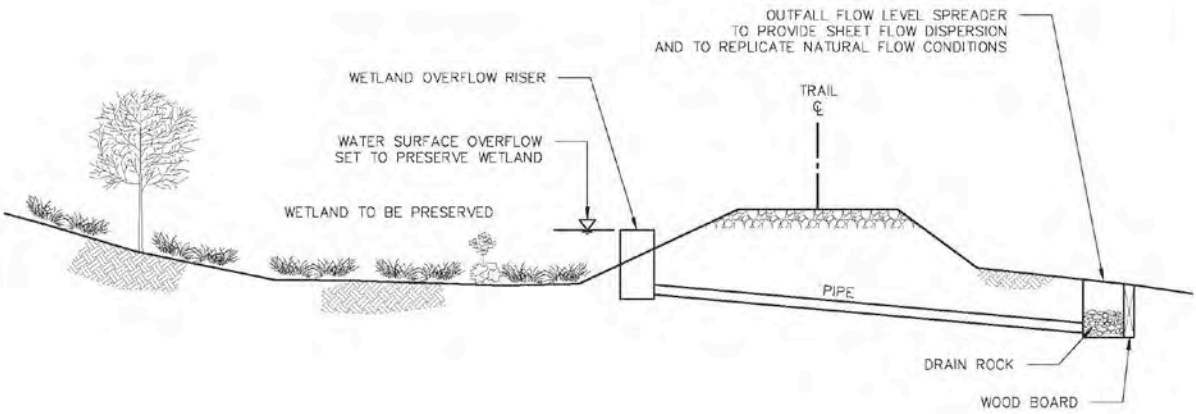
Trail Maintenance Considerations

Some of the trails within the park experience periodic inundation from the wetlands and streams and may also cause increased wetland ponding such as when a trail is constructed along a hillslope and may prevent surface water from flowing on downslope. For example the Upland Loop Trail appears to impound water in Wetlands 10 and 11. This water may occasionally overflow and run across the trail causing muddy conditions and erosion. This can cause undesirable environmental impacts: a) generating sediment-laden runoff coming from the trail surface which then discharges into the streams and wetlands downstream; and/or b) causing a disturbance and damage to vegetation by hikers trying to "go around" the flooding problem and widening the trail.

The protection of the wetland and the prevention of the recurring flooding of the trail can be accomplished with the construction of a simple overflow structure next to and under the trail. The overflow structure consists of a vertical pipe constructed along the trail corridor and at the wetland edge. The top of the overflow pipe establishes a maximum water surface elevation in the wetland but allows the wetland to still function, by allowing seasonal fluctuations of the water surface in the wetland to continue up to a point that prevents overflow of the trail. The overflow riser is connected to a pipe that directs the overflow under the trail and then out onto the downhill side with a sheet flow dispersal trench, to emulate natural flow conditions down the sloping hillside. See Figure 17 which shows a conceptual plan of the overflow structure.

The overflow structure is small, so it can be readily constructed with small equipment and even hand-tools, if need be, to preserve the surrounding natural environment. Building this type of overflow structure allows the ecological functions of the wetland to continue without causing inundation and flooding of the adjacent trail. The protection of the wetland plant and animal communities depends on maintaining the existing wetland hydroperiod. By maintaining the annual fluctuations in water depth protection of the natural environment is achieved.

OVERFLOW RISER EXAMPLE
INCLUDES A LOWER LOW FLOW PIPE (OPTIONAL)



WETLAND OVERFLOW AND PRESERVATION STRUCTURE
STORM OVERFLOW TO PREVENT FLOODING OF TRAIL

Figure 17. Example wetland overflow structure.

Summary

In summary, there are three primary types of critical areas within Farrel-McWhirter Park: 1) streams; 2) wetlands; and 3) wellhead protection zones. Streams occur in the center of the park and in the northeastern corner with buffers of 150 feet for the Class II perennial streams (Mackey Creek and its South Fork) and 25 feet for the Class IV intermittent stream. Wetlands total 8.8 acres within the park and have buffers ranging from 25 to 150 feet. Wellhead protection zones 2 and 3 encompass the entire park area.

Once the City has identified specific park improvements, further analysis of the potential impacts to critical areas and their buffers will be conducted. If adverse effects to critical areas are identified, then measures to avoid, minimize, and mitigate for adverse effects would also be considered. If any mitigation were required, then a mitigation and monitoring plan would be developed per City code.

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