Amphibian Distribution Surveys in the Cedar River Municipal Watershed

Summary Report, 2002-2005

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1.0 Introduction

1.1 Project Overview

Amphibian distribution in the Cedar River Municipal Watershed (CRMW) was investigated during 2002 and 2003. The distribution of species in the watershed and location of important habitats for these animals on the landscape was largely unknown at the beginning of this inventory. Amphibians require several habitat types to complete their life cycle making them an ideal species group to consider integration of restoration techniques on the landscape. A better understanding of amphibian species distribution in the CRMW will provide information guiding integration of restoration actions between upland forest, riparian forests and wetland habitat. Connective pathways between forests and aquatic habitat help to ensure that all ecological processes are protected.

1.2 Objectives

The objectives for amphibian distribution surveys were as follows.

- Determine species presence and distribution of pond breeding amphibians in the CRMW.
- Conduct egg mass surveys for pond breeding amphibians each year at several sites providing baseline data to document long-term trends in populations.
- Determine species presence and distribution of stream breeding amphibians in the CRMW.
- Determine species presence and distribution of terrestrial breeding salamanders in the CRMW.
- Maintain a GIS database cataloging amphibian distribution and abundance information.

1.3 Cedar River Municipal Watershed

The 90,546-acre CRMW is managed to supply the City of Seattle with high quality drinking water, generation of electrical power, instream flow management downstream, and some degree of flood control. The Cedar River Watershed Habitat Conservation Plan (CRW-HCP, 2000) outlines management goals and objectives for habitats of the CRMW. Forests are managed to promote late-successional forest structure and diversity, and aquatic habitat is protected and in some cases enhanced to restore natural stream processes and ecosystem health. Overall, the CRW-HCP encompasses management objectives that protect all species, including amphibians by conserving and restoring habitat.

Elevation in the CRMW ranges from a low of 600 feet to a high of 5,414 feet. Douglas fir and hemlock forests dominate the lower portion of the CRMW, while pacific silver fir forests exist at higher elevations in the upper portion of the CRMW. Various types and sizes of wetlands, lakes and ponds are scattered across the watershed at all elevations. Approximately 14,000 acres of mature forest remains, mostly at higher elevations. The

table below provides an estimation of acreage by habitat type in the CRMW (From CRW-HCP Resource Maps).

Cover Type	Acres
Aquatic and Riparian Ecosystems	
Lake, pond, and open water	2,214
Forested wetlands	1,063
Palustrine scrub-shrub wetland	464
Palustrine emergent wetland	236
Riparian habitat	4,223
Headwall basins	1,861
Inner gorges	2,364
Forest	
Old growth	13.889
Second growth	62,077
Special Habitat	
Vegetated talus and felsenmeer	329
Rock Formation	1,244
Upland meadow and persistent shrub	203
Developed area	346

1.4 Wetland Characteristics

The hydrogeomorphic method (HGM) for classifying wetlands categorizes wetlands based on the landscape position and the hydrologic regime supporting each wetland. Western Washington wetlands are classified into six major categories including riverine, depressional, lacustine fringe, slope, flats, and estuarine fringe. Under the HGM approach, wetlands within each category are expected to function in a similar manner and are affected by similar geomorphic processes.

Wetland polygons within the Cedar River Municipal Watershed (CRMW) were classified using the HGM approach. The polygon layer that was classified came from several sources. These included 1) the NWI wetland layer, and 2) a special habitats layer developed by watershed staff. The special habitat layer documented all wetlands from aerial photos and in the field, and then described vegetation types at wetlands as well as open water wetlands. Many polygons in this layer were field checked by staff. Several of the HGM classes found in the CRMW were divided into subcategories. These classes and subclasses include lacustrine fringe, depressional (closed or open), riverine (flow-through or impounded), slope (connected or unconnected). We determined that approximately 230 acres of wetland habitat was *depressional closed* while 850 acres was *depressional open*. Just over 275 acres in the CRMW was classified as *lacustrine fringe*, 115 acres was *riverine flow-through*, 200 acres *riverine impounded*, 250 was *slope connected* and 135 was *slope unconnected* wetland habitat. The depressional wetlands were expected to support the primary breeding habitat for amphibians in the watershed as they typically hold shallow water pockets during the early spring when eggs are laid and developing.

1.5 Amphibian Life History

Seven species of pond breeding amphibians, two species of stream breeding amphibians and two species of terrestrial breeding salamanders were documented in the CRMW. Amphibians have permeable skin and as a species group are sensitive to pollution, water quality, temperature, and in extreme temperature conditions can desiccate. Additionally, they are dependent on aquatic and riparian habitat for breeding and as a refuge during dry summer months as well as terrestrial forests for dispersing to new habitat and overwintering. Of amphibian species found in the Pacific Northwest, 73.5% are forest dwellers and 60% of these species are dependent on ponds or wetland habitat for breeding (Walls et al. 1992).

The amphibian species group provides an opportunity to monitor the linkage between aquatic and forest ecosystems, and long-term trends in local populations contribute to the regional understanding of the worldwide decline in amphibians (Hayes and Jennings 1986, Blaustein and Wake 1990, and Adams 1999). Baseline inventory surveys conducted in several national parks and privately owned land in the state inform land managers about regional amphibian population trends (Richter and Ostergaard 1999, Bury and Adams 2000, Tyler et. al 2003).

2.0 Methods

2.1 Pond Breeding Surveys

Wetland and pond habitat was highlighted on maps and aerial photos prior to the 2002 spring breeding season. Habitat at lower elevations was surveyed first while snow continued to restrict access to higher elevation ponds. Surveys for pond breeding amphibians began in late February and continued into the late spring and even summer at higher elevation aquatic habitats. Visual encounter surveys (VES) are the most commonly employed technique for estimating abundance of amphibians during the breeding season. A VES survey consists of predetermined transects or quadrants or can be a search of the entire habitat (Heyer 1994). For initial surveys in the CRMW, I chose to search the entire habitat at each site to ensure the highest likelihood that all amphibian species present were detected. Surveys were conducted with one or two people at ponds and wetlands. The entire perimeter of the pond was walked slowly at approximately one and a half feet in depth. If the pond or wetland was shallow enough, I walked in a criss-cross pattern through the middle to cover as much area as possible. While surveying I recorded the species of amphibians encountered, the life history stage present (e.g. tadpole, juvenile or adult), and the number of egg masses encountered during surveys as well as any habitat notes of importance. Occasional net sweeps with a D-ring net collected any small larvae that could easily hide from view.

Amphibian egg masses are easy to distinguish and when counts are documented through time can provide hints at trends in amphibian species populations. I tallied all egg masses by species at most sites. In some cases, only species presence was noted to save time. For example, pacific treefrogs are abundant throughout the CRMW and in some cases counting all egg masses of the species was too time consuming. In this case, I noted that egg masses were abundant throughout the wetland and continued searching for other species. Benefits of egg mass surveys include minimal disturbance or harm to animals and minimal time and equipment costs. A list of sites surveyed during 2002 and 2003 is provided in Table 1 and pictured in Figure 1 and 2. Table 2 and 3 provide tallies of the number of egg masses documented at each site.

A detailed egg mass survey of the Road 16 wetland complex in 2002-2005 was completed. Surveyors conducted an egg mass survey to gain baseline documentation of amphibian use in the wetland prior to the opening of Landsburg Diversion Dam to anadromous salmon and in conjunction with a road decommissioning project. We will continue monitoring the wetland to document changes that might occur in the amphibian community due to the recolonization of habitat by anadromous species.

2.2 Stream Breeding Amphibians

Stream breeding amphibian surveys in the CRMW have been opportunistic to date. While performing other work, surveyors note those amphibian species present in a stream and consolidate distribution records in a GIS database. These records may help to plan road decommissioning in areas of high tailed frog abundance to reduce road sedimentation to the stream. Information regarding these species is incomplete and samples were taken randomly at road crossings or at points where streams were encountered while conducting work in the forest. Methods for determining the presence of amphibians involved, minnow traps (incidental catch when trapping for bull trout juveniles), electrofishing (incidental catch when conducting bull trout stream distribution studies), and visual sightings of animals in the stream.

2.3 Terrestrial Amphibian Surveys

Opportunistic surveys for terrestrial amphibians involved a timed visual encounter survey (VES) in early spring. Surveyors turned rocks and small pieces of wood that amphibians use for cover. One species of special note is the Larch Mountain Salamander that has been documented in the Green River Watershed but not in the CRMW to date. Several surveys were conducted in 2002 and 2003 to target potential habitat for the species, but no animals were located. The species resides at higher elevations in talus slopes and rocky forested habitats. Additionally, the presence of terrestrial amphibians is noted as they are encountered when conducting other fieldwork.

2.4 Species Descriptions

Appendix 1 contains distribution maps for each of the pond-breeding amphibians listed below. As some sites in the watershed were surveyed later in the summer when snow melted enough to allow access to the site, some earlier breeding species like long-toed salamanders may have been missed.

Pacific Treefrog, *Pseudacris regilla*
Pseudacris regilla is the most commonly documented species in the CRMW. The species is also the most common frog of Oregon and Washington and can be heard chorusing loudly during the spring around lakes and wetlands (Corkran and Thoms 1997). Breeding habitat includes shallow ponds, seasonal pools, slow streams and disturbed habitat often choosing water shallower than 0.5 meter. No accounts of species decline in the region are reported and the species is abundant in the CRMW.

Northwestern Salamander, *Ambystoma gracile*
Ambystoma gracile is the second most common species found in the CRMW also ranging from low elevations to the highest wetlands in the watershed. Adults live in moist forests and migrate annually to breed in permanent ponds, beaver ponds and slow moving streams. The species has paratoid glands that produce a toxin making the larvae and adults distasteful to predators. *A. gracile* is more often found in habitats without fish but can coexist with fish due to this toxin. Several studies documented that when fish are present, the salamander's behavior is altered and animals seek cover more often when fish are present (Tyler et al. 1998). Salamanders may overwinter one or more years in a larval form providing the wetland does not freeze completely during the winter. In some cases, individuals become sexually mature without going through the process of metamorphosis and are called neotenes (Petranka 1998). No accounts of *A. gracile* decline in the region are reported.

Cascades frog, *Rana cascadae*
Rana cascadae is able to use a wide variety of habitats from mountain meadows to moist forests and riparian areas along many streams. Frogs breed in shallow water, at times less than 20 centimeters, where eggs develop quickly and hatch. Eggs are often laid communally with many egg masses piled together. *R. cascadae* is quite common at higher elevations, but habitat at the lower edge of its range has disappeared due to development. Consequently, cascades frogs are rarely found below 1,700 feet elevation (K. McAllister, K. Richter pers. com.). The CRMW supports several breeding ponds near 1,700 feet elevation providing important lower elevation habitat for the frogs.

Long-toed salamander, *Ambystoma macrodactylum*
A. macrodactylum was found in over 30% of all wetlands surveyed in the CRMW. The species is typically the earliest breeding pond amphibian beginning in February in the CRMW before the danger of frost and cold temperatures has passed. *A. macrodactylum* breed along shallow lake edges, seasonal pools and often can be found using disturbed habitat (Corkran and Thoms 1997). Early breeding allows the larvae to gain a size advantage over later breeding species and in some habitats they may become predators on

other species eggs. During 2002, larvae of the long-toed salamander were observed eating developing cascades frog tadpoles before they hatched in a small temporary pool. No cascades frogs survived to metamorphosis while several long-toed salamanders were observed metamorphosing and leaving the pond. No reports of declines for this species have been made.

Red-legged frog, *Rana aurora*
R. aurora was not a commonly documented species in the CRMW, but is locally abundant when present. The wetlands around the Road 16 and 14 Lakes provide important breeding habitat for the species and hundreds of egg masses are found at these sites each year. Adults live in moist forest habitat, forested wetlands, and riparian areas. Frogs make a seasonal migration of up to 1.5 miles to a breeding site (Hayes et al. 2001). The relatively low occurrence of *R. aurora* in the CRMW is likely mainly due to habitat availability at lower elevations. The presence of fish and the nonnative bullfrog is known to negatively effect the species (Lawler et al. 1999). However the species is still found throughout its range and is not a species thought to be declining in Washington State.

Western toad, *Bufo boreas*
B. boreas was found breeding only in Chester Morse Reservoir. The immense size of the reservoir prohibits a complete egg mass survey. However, mass groups of toadlets are observed migrating through several main river corridors each year (Boulder Creek, Cedar River, and Rex River). Juvenile western toads were found in habitats on the north and south borders of the watershed. However, no additional breeding sites were documented. Adult female boreal toads (*B. boreas*) were found to move 0.45 miles from a breeding pond in Rocky Mountain National Park (Muths 2003). The historic breeding distribution for the species in the CRMW is unknown and further surveys to document additional breeding sites is recommended.

The western toad is currently a state candidate for the Washington State threatened and endangered list (Washington Department of Fish and Wildlife 2004) and a federal species of concern. Tyler et al (2003) found fewer than expected western toads in the Mount Rainier National Park while conducting an inventory of aquatic breeding amphibians across the park. In a recent inventory of the North Cascades and Olympic National Parks, western toads were also observed less frequently than expected and were found absent from several suitable habitats (Bury and Adams 2000). In King County, surveys between 1993 through 1997 found western toads present at only 4 wetlands. Of these four wetlands they disappeared from 3 within the study time period (Richter and Ostergaard 1999). Similarly, western toads were encountered less frequently than expected in the CRMW.

Tailed Frog, *Ascaphus truei*
Opportunistic surveys for *A. truei* documented the species in most perennial stream systems in the lower CRMW. Eggs are laid in the late summer and hatch as tiny larvae that overwinter amongst the substrate. These larvae may remain as tadpoles in the stream for 1 or 2 more years before metamorphosing. For this reason, several streams east of Chester Morse Reservoir on south facing slopes would not be suitable habitat. These

streams such as Greenpoint and McClellan Creeks have subsurface flow during the summer and could not support tadpole development. Fine sediment accumulation associated with forest harvest and road runoff has been shown to negatively affect *A. truei* populations (Dupuis and Steventon 1999). The species has also been a recent focus of research related to headwater streams in Washington State (Tim Quinn, Marc Hayes 2004). The tailed frog is a state candidate for listing for the Washington State threatened and endangered list.

Pacific Giant Salamander, *Dicamptodon tenebrosus*
D. tenebrosus were documented in most perennial streams investigated in the CRMW. Larger individuals are encountered in the larger river systems and smaller individuals tend to be collected more frequently in smaller streams. Pacific giant salamanders are wide spread throughout their range and not thought to be in decline.

3.0 Pond Breeding Survey Results

3.1 General Pond Breeding Survey Results

Between the breeding seasons of 2002 and 2003, a total of 60 wetland sites were surveyed for pond breeding amphibians (Table 1, Figure 1 and 2). Some sites were surveyed in consecutive years while others were opportunistically added during other fieldwork as located. Only one site had no amphibian presence or breeding in either 2002 or 2003.

Table 1. Species present at surveyed sites in the CRMW (2002 and 2003).

	Site No. (see maps)	Elevation (Feet)	*Long-toed salamander (AMMA)*	*Roughskin Newt (TAGR)*	*Northwestern salamander (AMGR)*	*Pacifc Treefrog (PSRE)*	*Red-legged frog (RAAU)*	*Cascades frog (RACA)*	*Western toad (BUBO)*
Lower Watershed									
Road 16 Wetland – Road portion	1	760	**X**	**X**	**X**	**X**	**X**		
Road 16 Wetland – Corner	2	760	**X**		**X**	**X**	**X**		
Road 16 Wetland – Triangle	3	760	**X**	**X**	**X**	**X**	**X**		
Road 16 Bog	4	760	**X**			**X**			
14 Lakes	5	800	**X**	**X**	**X**	**X**	**X**		
Culvert 80.5-1 (Bonus Creek)	6	1240			**X**	**X**		**X**	
Ellen's Pond (82.3b road)	7	1560	**X**	**X**	**X**			**X**	
Wetland off 82.2 road	8	1380	**X**		**X**			**X**	
82.3A Bog	9	1580			**X**				
Barneston Mill Pond	10	880	**X**		**X**	**X**	**X**		
40 Road scrub-shrub wetland	11	920							
45 Road Wetland	12	640			**X**	**X**	**X**		
Wetland East of 57 Road	13	800	**X**	**X**	**X**	**X**	**X**		
Scrub-shrub wetland west of 55 road	14	800	**X**						
Kerriston Marsh	15	1500	**X**	**X**	**X**	**X**			
Various culverts	--		**X**		**X**	**X**			
Pond to the northeast of the 40/18	16	740			**X**	**X**	**X**		
Beaver pond along Rock Creek	17	740			**X**		**X**		
Wetland near Walsh Lake	59	760	**X**		**X**	**X**			

	Site No. (see maps)	Elevation (Feet)	*Long-toed salamander*	*Roughskin Newt (TAGR)*	*Northwestern salamander (AMGR)*	*Pacifc Treefrog (PSRE)*	*Red-legged frog (RAAU)*	*Cascades frog (RACA)*	*Western toad (BUBO)*
20 Road Pond	18	2460			**X**	**X**	**X**		
Pond below 20-36	19	2280			**X**				
Roadbed of 25 road	20	2120	**X**	**X**	**X**				
Fairy Shrimp Pond	21	1000			**X**				
BPA Pond north of 30 Road	22	1160	**X**			**X**			
BPA pond north of Kerriston Road	23	1360	**X**		**X**	**X**			
Wetland above King Couty fish ladder (Kerriston Road)	24	1120			**X**				
Christmas Lake	25	960		**X**		**X**			
Selleck Pond	61	1280			**X**	**X**		X	
Around Chester Morse Lake									
Temporary pool South of Masonry Pool Bridge	26	1600	**X**		**X**	**X**	**X**		**X**
Chester Morse Lake	27	1600	**X**			**X**	**X**	**X**	**X**
107 Road Pond	28	1600				**X**			
Oliver Lake - North	29	1360				**X**	**X**		
Oliver Lake - South	30	1360							
Coyote Pass Gravel Pit	31	1680				**X**		**X**	
Eagle Ridge Meadow Pond	32	1600		**X**	**X**	**X**	**X**	**X**	
Morse Creek	33	1600				**X**	**X**	**X**	
300 Road Pond	34	1620			**X**	**X**		**X**	
Cedar River delta	35	1600	**X**		**X**	**X**	**X**	**X**	
Pool on Cedar River near outlet to WBC 4	36	1600			**X**			**X**	
Upper Watershed									
Upper Taylor wetland	74	3240			**X**	**X**		**X**	**X**
68 Road Pond	37	3800			**X**			**X**	
Lost Creek Bog	38	3560						**X**	
Meadow with 3 Ponds off 78.1 Road	39	3720			**X**	**X**		**X**	
Rex Pond	40	3880			**X**	**X**		**X**	
Rex Headwater Meadows	41	3900-4100						**X**	
Findley Lake	42	3720		**X**	**X**	**X**		**X**	**X**
Findley Marsh	43	3720		**X**	**X**	**X**		**X**	

	Site No. (see maps)	Elevation (Feet)	*Long-toed salamander*	*Roughskin Newt (TAGR)*	*Northwestern salamander (AMGR)*	*Pacifc Treefrog (PSRE)*	*Red-legged frog (RAAU)*	*Cascades frog (RACA)*	*Western toad (BUBO)*
Lower Sutton Lake	44	3640		**X**	**X**	**X**		**X**	
Upper Sutton Lake	45	4200							
Goat Creek Pond	46	3000				**X**			
Twilight Lake	47	3600			**X**	**X**		**X**	
610 Wetland	48	2520			**X**	**X**		**X**	
Meadow off 610.1a3 Road	49	3920						**X**	
Headwaters of Fish Creek	50	3720						**X**	
Meadow in headwaters Fish Creek	62	3440							
Meadow in headwaters Fish Creek	63	3720							
Abandoned Road System 200ish	51	3400						**X**	
Meadow off 200 rd (upper Lindsey)	64	3600							
Pond off 200 rd (near 200.8)	66	3840			**X**				
Meadow off 200 rd (near 200.8)	67	3840						**X**	
Meadow off 208.1 rd	68	3800						**X**	
McClellan Creek Headwaters 1	52	4120						**X**	
Meadow south of 207 road	69	3760						**X**	
Meadow south of 270 road	70	3400							
Meadow west of 200 road near 207	73	3720						**X**	
McClellan Creek Headwaters 2	53	4320				**X**		**X**	**X**
McClellan Creek Headwaters 3	54	4400	**X**					**X**	
Meadow in upper McClellan Creek	65	4160						**X**	
Bear Lake	55	4200				**X**		**X**	
Wet meadow near 650/651 junction	56	3160						**X**	
Old Wetland off 211.3 Road	57	3480							

	Site No. (see maps)	Elevation (Feet)	*Long-toed salamander*	*Roughskin Newt (TAGR)*	*Northwestern salamander (AMGR)*	*Pacifc Treefrog (PSRE)*	*Red-legged frog (RAAU)*	*Cascades frog (RACA)*	*Western toad (BUBO)*
Alice Lakes	58	4520						**X**	
Headwaters of Viola Creek	60	3920						**X**	
NUMBER OF SITES WHERE EACH SPECIES PRESENT			**20**	**12**	**38**	**38**	**16**	**37**	**5**

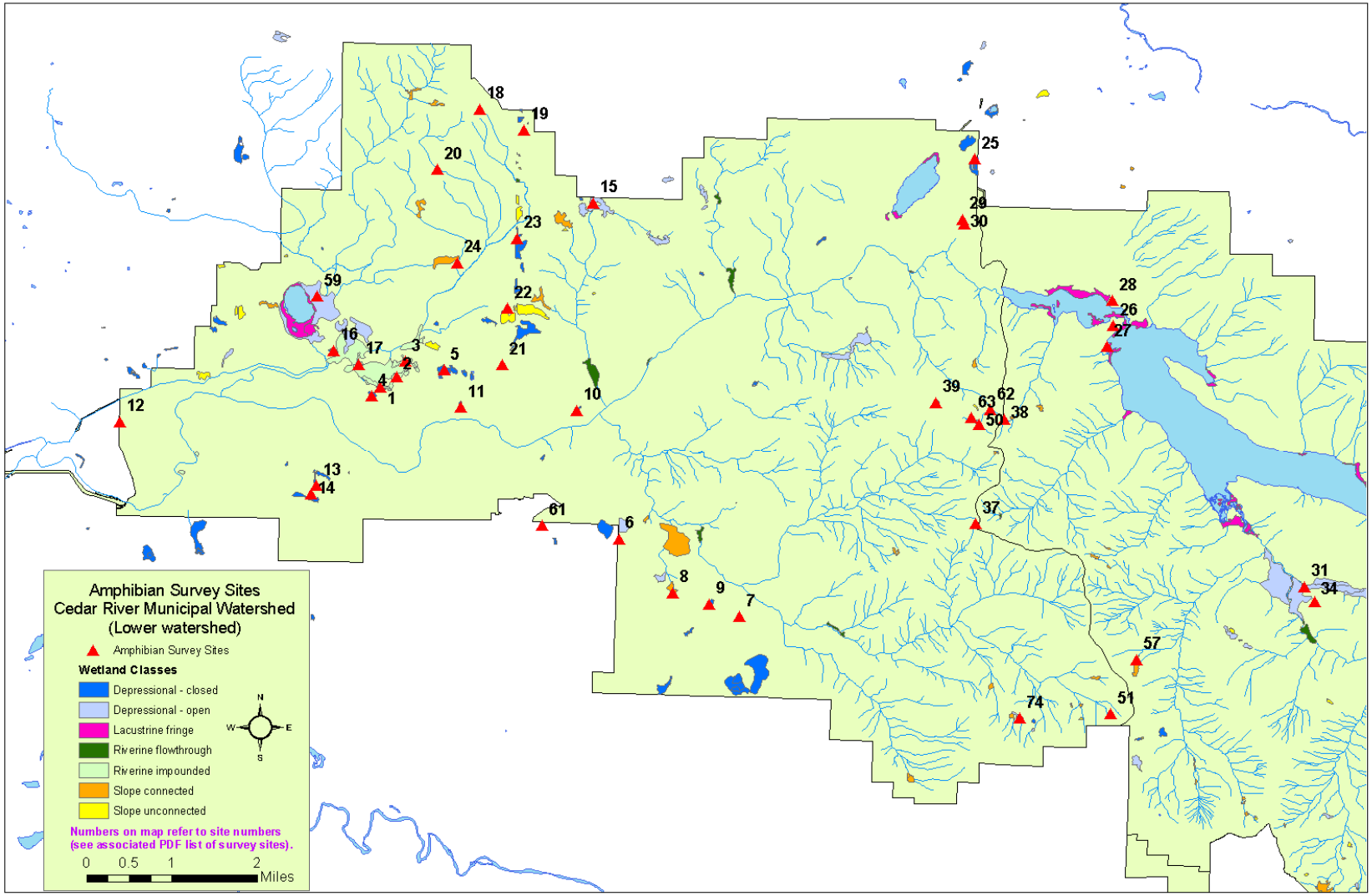

Figure 1. Survey sites in the lower Cedar River Municipal Watershed.

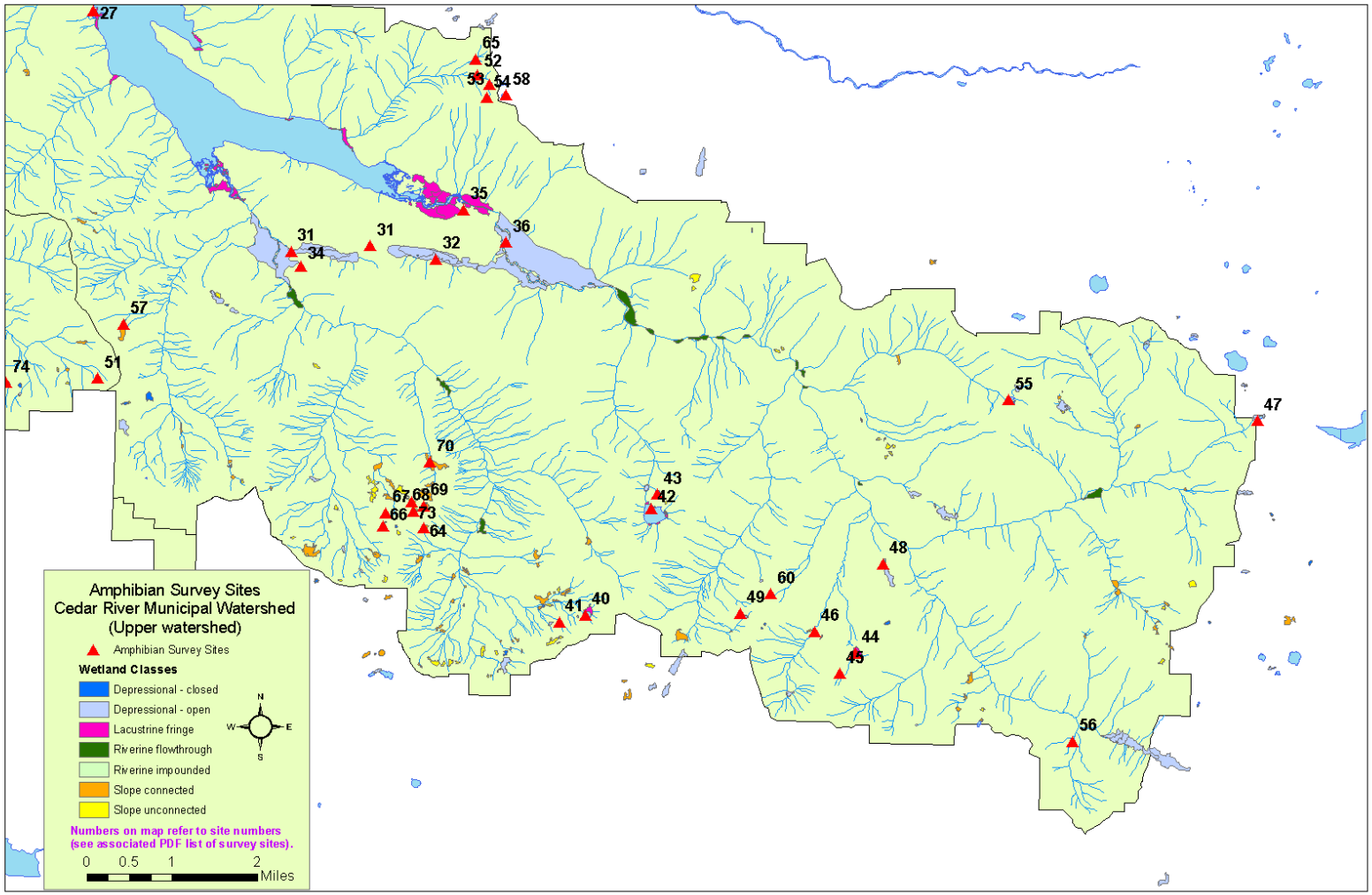

Figure 2. Survey sites in the upper Cedar River Municipal Watershed.

Species Presence. Pacific treefrogs and northwestern salamanders were the most commonly documented species, each found at 61% and 59% of the sites surveyed in the CRMW respectively (Figure 3). The next most common species was the cascades frog, present at over 50% of sites surveyed (Figure 3). The cascades frog is commonly found along stream corridors as well as wet meadows and around larger ponds and lakes. Some breeding sites occur in highly disturbed habitat such as old roadbeds where water ponds while other breeding sites were located within old-growth forest stands. The wide range of suitable habitat conditions increases likelihood of encountering cascades frogs.

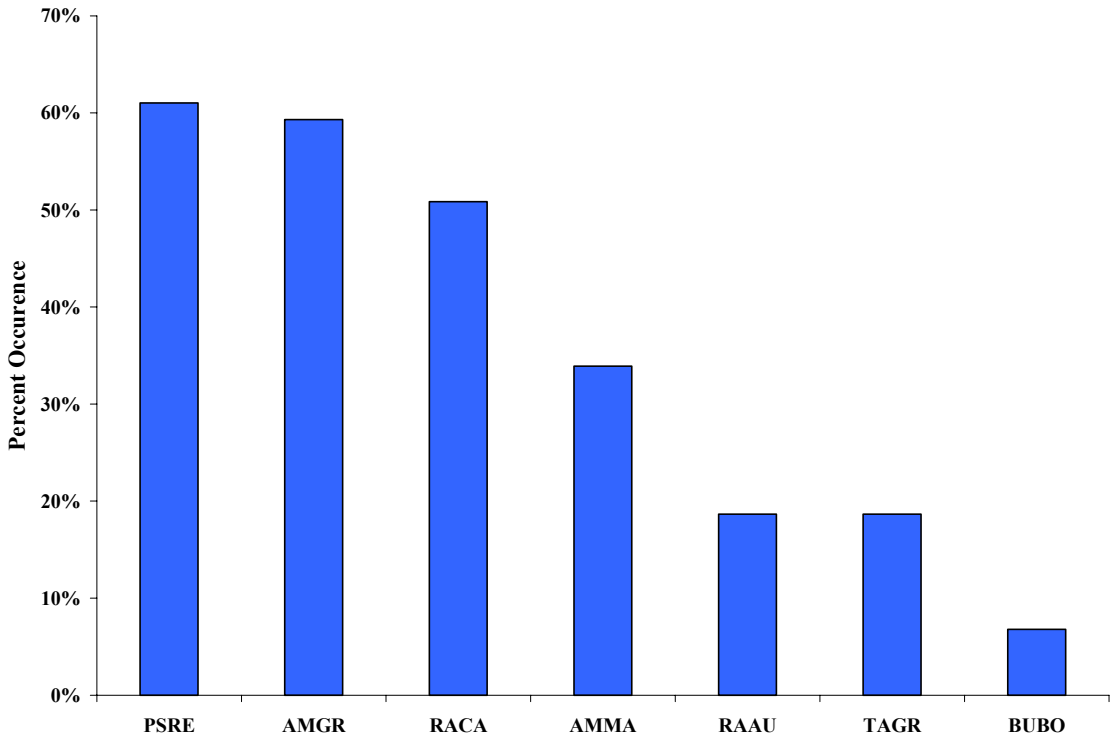

Figure 3. Percent occurrence of pond breeding amphibians at surveyed sites in the Cedar River Municipal Watershed. (Abbreviations: PSRE-Pacific treefrog, AMGR-Northwestern Salamander, RACA-Cascades Frog, AMMA-Long-toed Salamander, RAAU-Red-legged frog, TAGR-Roughskin Newt, BUBO-Western Toad).

The species documented at the fewest sites in the watershed is the western toad, confirmed breeding only in Chester Morse Reservoir and present at only four sites. Note that the distribution map (Appendix 1) for this species details more than four locations, but most of the sightings were directly around the perimeter of Chester Morse Reservoir. However, because the reservoir provides a great amount of breeding habitat for this species, their low abundance at other sites may not be of concern. The bullfrog, a non-

native species shown to negatively effect native amphibians, was not found anywhere in the CRMW (Kiesecker and Blaustein 1997, Lawler et al. 1999).

Breeding Sites. Pacific treefrogs and northwestern salamanders were documented breeding at the highest percentage of sites in the CRMW. Roughskin newts and long-toed salamanders have extremely small egg masses and are especially difficult to document breeding before larvae are present and can be identified. The tiny egg masses of these species can easily be missed during surveys, so the percentage of sites at which they were found breeding is likely underestimated. In many cases however, the wetland was visited later in the year and larvae were found indicating breeding activity in the wetland. Northwestern salamanders were the most commonly documented breeding species in the CRMW at nearly 60% of all sites visited. Cascades frogs, although present at over 50% of all sites, were only found breeding at 32% of wetland sites visited.

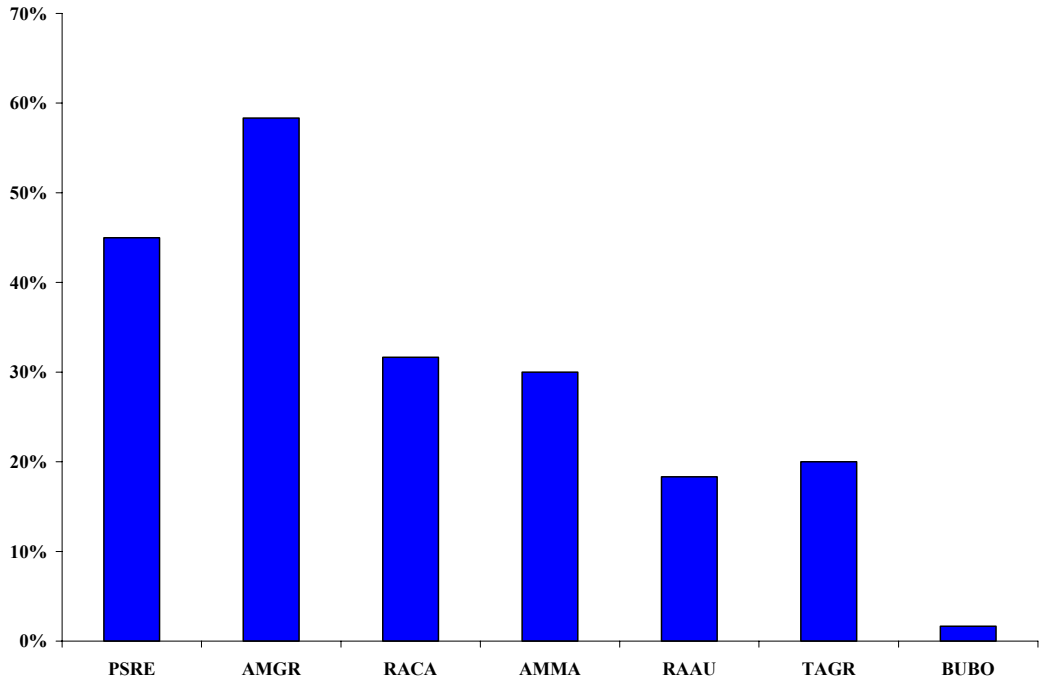

Figure 4. Percent breeding of pond breeding amphibians at surveyed sites in the Cedar River Municipal Watershed. (Abbreviations: PSRE-Pacific treefrog, AMGR-Northwestern Salamander, RACA-Cascades Frog, AMMA-Long-toed Salamander, RAAU-Red-legged frog, TAGR-Roughskin Newt, BUBO-Western Toad).

Elevation. Thirty-eight sites were surveyed for pond breeding amphibians during 2002 and 36 sites were re-surveyed during 2003. A greater number of wetland sites are available in the lower watershed for pond breeding amphibians than are available at higher elevations (Figure 5). The lowest site surveyed was located at 640 feet elevation and the highest site at 4,520 feet. This figure may indicate that aquatic habitat between 1,900-3,500 feet in elevation is important to protect for pond breeding amphibians as it may serve as important sites for colonization by dispersing individuals from both low and higher elevation habitat.

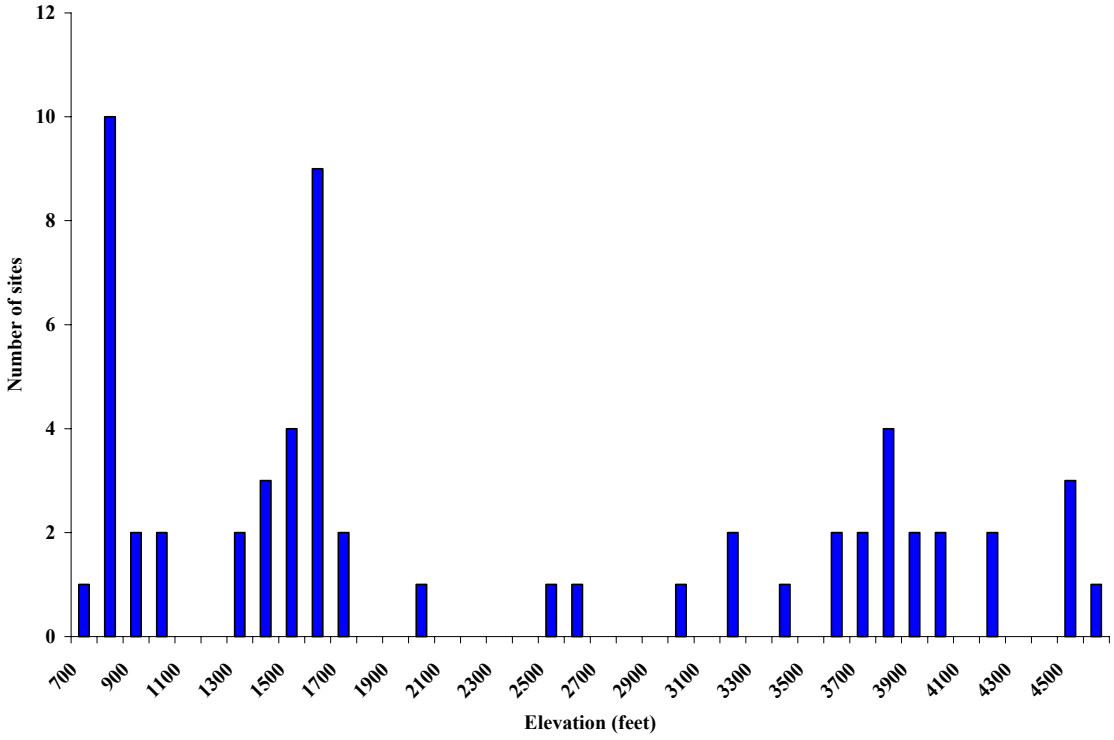

Figure 5. Frequency of surveyed sites by elevation in the CRMW.

3.2 Results of Habitat Site Characteristics

Several general habitat attributes were collected at each site to investigate amphibian distribution in the CRMW. Many factors influence amphibian choice of breeding habitat. Most adult amphibians are philopatric and continue to breed in a wetland their entire lives (Breden 1987). Other factors such as substrate size, wetland shoreline features, vegetation for attaching egg masses, vegetation species, emergent vegetation cover and wetland orientation to solar input influence the choice of oviposition site (Richter 1997). Results from data collected on canopy closure, maximum depth, fish presence are presented below.

Canopy Closure. Canopy closure was visually estimated based on light penetration to the open water portion of each site. Three broad classes were designated (0-25%, 25-50%, or >50%) and the site was placed into one of these categories. A greater number of amphibians were found breeding at sites with 0-25% canopy closure (Figure 6). This result is likely due to the open nature of many subalpine lakes and larger ponds important to breeding amphibians in the CRMW. These habitats often are large enough that the tree canopy does not cover the entire open water habitat. Amphibians generally prefer open canopy habitats as the sunlight can reach eggs and warm water thereby speeding hatching time and development of larvae (Richter 1997).

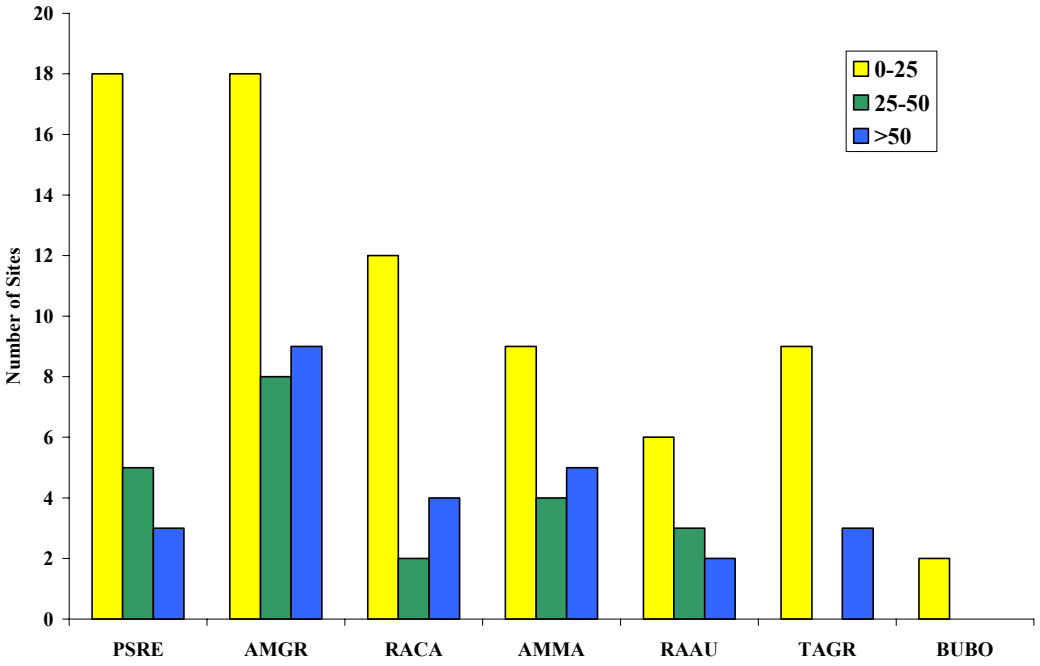

Figure 6. Forest canopy closure and the presence of pond breeding amphibians. Abbreviations: PSRE-Pacific treefrog, AMGR-Northwestern Salamander, RACA-Cascades Frog, AMMA-Long-toed Salamander, RAAU-Red-legged frog, TAGR-Roughskin Newt, BUBO-Western Toad.

Maximum Depth. Secondly, maximum depth of each wetland was put into one of three categories (<1m, 1-2m, or >2m). In general amphibians prefer shallow sites for breeding, and these sites typically lack fish predators, are warmer, and have fewer invertebrate predators (Richter 1997). The only species showing a clear selection for breeding habitat with maximum depth less than one meter in depth was the cascades frog (Figure 7). This species is known to deposit egg masses in extremely shallow waters so that at times tadpoles can be stranded in the moisture on top of egg masses as water recedes. In these cases, tadpoles depend on rain or snowmelt to help them move to deeper waters where they continue development (Corkran and Thoms 1996). All other species were documented breeding in a wide range of habitat types from temporary wetlands to deep lakes. Red-legged frogs, northwestern salamanders, pacific treefrogs and roughskin newts were found more frequently in the habitat with 1-2 meter maximum depths. Even when amphibians were found breeding at wetlands of all depths, eggs were deposited at the margins of the wetlands in shallow water (<1 meter deep). These shallow areas of wetlands are very important to breeding amphibians.

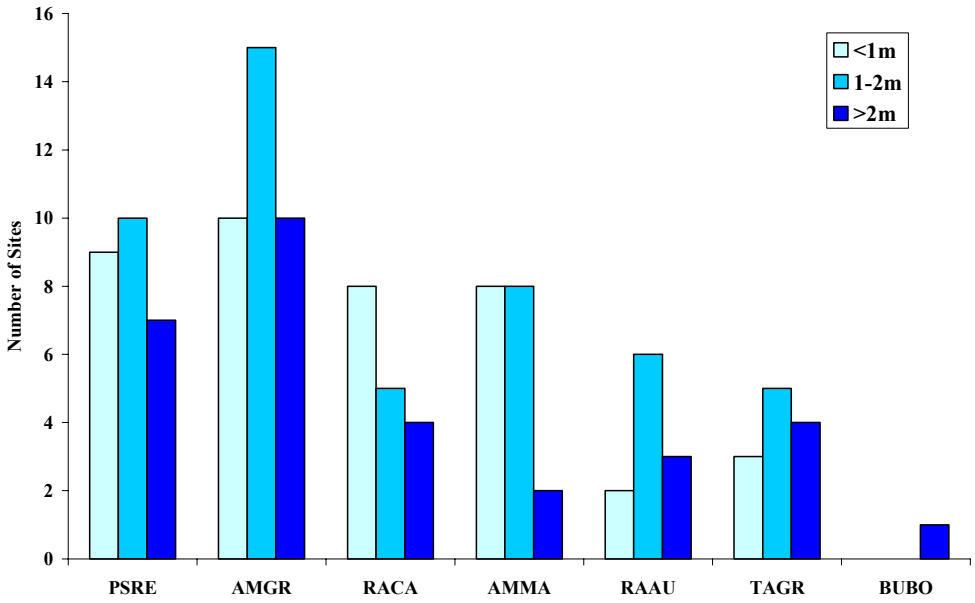

Figure 7. Maximum depth and the presence of pond breeding amphibians. Abbreviations: PSRE-Pacific treefrog, AMGR-Northwestern Salamander, RACA-Cascades Frog, AMMA-Long-toed Salamander, RAAU-Red-legged frog, TAGR-Roughskin Newt, BUBO-Western Toad.

Fish presence. Amphibians may choose to avoid breeding habitat where fish are present as they are a potential predator. Fish are known to prey directly on amphibian egg masses and developing larvae. In some areas, fish were introduced to habitat that naturally did not support fish. It is well documented that these introductions have caused local declines in amphibian populations (Knapp and Matthews 2000). Fish can also have a non-lethal effect on amphibians causing them to feed less and consequently metamorphose at smaller sizes (Lawler et al 1999, Kiesecker and Blaustein 1998). In the CRMW, amphibians breed in Chester Morse Reservoir and the Road 16 wetland complex, both of which support fish populations (Figure 8). These habitats are large and have abundant shallow water sloughs and backwater areas where fish are less likely to venture. All amphibian species were found breeding at more sites where fish were absent. Pacific treefrogs were found breeding in Twilight Lake during 2002 but not during 2003. The lake was stocked in 2003 with trout.

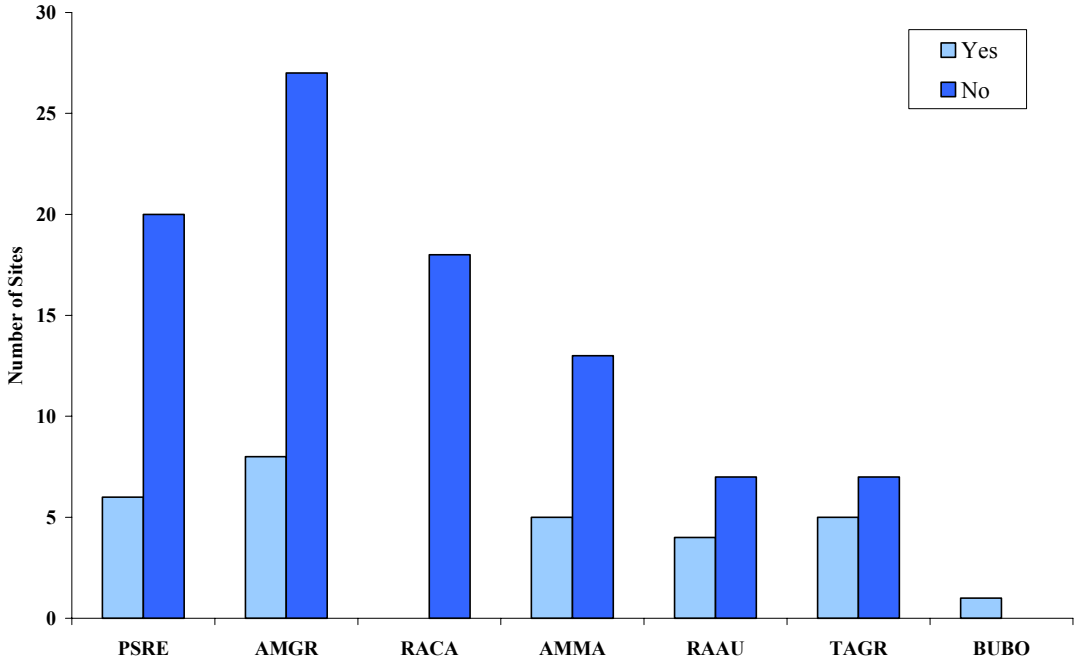

Figure 7. Number of sites where fish are present with each pond-breeding amphibian species in the Cedar River Municipal Watershed. (Abbreviations: PSRE-Pacific treefrog, AMGR-Northwestern Salamander, RACA-Cascades Frog, AMMA-Long-toed Salamander, RAAU-Red-legged frog, TAGR-Roughskin Newt, BUBO-Western Toad).

3.3 Results of Pond and Stream Breeding Species Distribution and Abundance in the CRMW

Table 1 in Appendix 2 provides a summary of results from 2002 egg mass surveys at all sites visited. The site number column can be referenced to Figure 1 and 2 to identify the location of habitat within the CRMW. Table 2 in Appendix 2 provides a summary of all egg mass survey results from 2003. These data serve as a baseline for documenting amphibian distribution and abundance in the CRMW.

3.4 Field Notes from Pond Breeding Surveys

Field notes taken at each site and a brief description of each site is provided below.

Road 16 Wetland, Site 1-3

2002. The Road 16 wetland complex provides important habitat to amphibians in the lower watershed with an abundance of diverse habitat with varying water levels. Habitat changes from deep open water to seasonally flooded shallow emergent areas. Beavers continually inundate new areas and alter existing habitat. The wetland crossing the 16 road has the deepest water due to beaver activity. Fish are present in this wetland and can

migrate upstream through Rock Creek. Spawning gravel is limited to fish in this wetland system, but during 2004 cutthroat trout were observed spawning in the upper reaches of one of the wetlands. They had cleaned through a layer of fine sediment and located gravel in which they were excavating a redd. The wetland will serve as excellent rearing habitat for coho salmon following the return of anadromous fish to the CRMW. Parts of the wetland were surveyed during the breeding season and numbers and approximate locations of egg masses were carefully noted (see Appendix 2 for complete results and location of egg masses).

Minnow traps were set to capture species that might not be observed otherwise and were collected on March 25, 2002. Cutthroat trout were caught using minnow traps immediately below the 16 road, and redds were observed on the surface of the 16 road during March of 2002. Other fish species known to be present in the wetland include sculpin species and speckled dace.

Road 16 Bog, Site 4

2002. There is a small bog near the junction of the 40 and 16 roads. Labrador tea, bog cranberry and sphagnum moss were the main plant species noted during surveys. The bog was visited in 2002, but not in 2003. Rick Sugg, conducting invertebrate surveys in the bog, noted that all water dried up during the summer of 2002.

Fourteen Lakes, Site 5

2002. Habitat at 14 Lakes is ideal for aquatic breeding amphibians for several reasons: 1) isolation from stream outlets excludes fish; 2) hydrology creates open shoreline providing sunlight to developing eggs and encourages algal growth. This area provides an important fish free wetland system in the lower watershed. An egg mass survey was conducted on 28 March and again on 17 April 2002.

On July 15, 2002, the two largest lakes were surveyed to check for bullfrog presence. Many treefrogs and red-legged frogs were metamorphosing from 14 Lakes. Tadpoles were thick in the lake and salamander larvae were also netted quite commonly. Algae was abundant and plenty of aquatic plants grew in the lakes providing cover for larvae and newly emerged froglets. Several garter snakes were observed at the margins of the water indicating that the 14 Lakes were becoming an attraction for predators.

On 27 September, I returned to the 14 Lakes to observe metamorphs. Light dew was present around the lake and metamorphic northwestern salamanders and roughskin newts were observed out in the open around the perimeter of the largest lake. Virtually all rocks turned revealed either northwestern salamanders or roughskin newts that had recently metamorphosed. Interestingly, northwestern salamander densities were much higher on the south and western side of the 14 Lakes, while roughskin newt densities were higher on the northern perimeter. The northern perimeter contains habitat with drier conditions and would likely be more suitable for roughskin newts. Very few large trees

span from the pond to the upland forest and this might provide a good restoration site to benefit amphibians by connecting the aquatic and upland habitat.

2003. On March 25, 2003, three of the ponds were surveyed for amphibian presence and an egg mass survey was conducted. The level in the largest lake (second lake from the west) is approximately 10-15 feet lower than it was in 2002, as is the water level in the first lake. The level in the third lake from the west is approximately the same as it was in 2002. The third lake has a much steeper shoreline than the other two lakes. Northwestern salamander eggs are likely in this pond but hidden by the deep water. Surveys in successive years indicate that water levels fluctuate dramatically within and between years in these ponds.

Culvert 80.5-1 (Bonus Creek), Site 6

While driving to another site, I happened to notice a pile of cascades frog egg masses in the ditch on the upstream side of this culvert. The young adjacent forest has recently been thinned and a small stream with some small associated wetland patches runs through the forest. Water does not remain long enough in the ditch to support development of the tadpoles. It is possible that forest harvest in the immediate area has altered the hydrology and made the tiny wetland pockets unsuitable for cascades frogs. Breeding activity was also observed to the SE in a tiny wetland patch just inside a mature forest boundary. Breeding populations at this low of an elevation are rare for cascades frogs (McAllister, pers. com., Richter, pers. com.). The young forest stand may have wetland pockets that would be candidates for wetland enhancement.

Ellen's Pond (82.3b Road), Site 7

On the roadbed of the 82.3b road, a pond has developed holding water through most of the year. An initial visit to the pond revealed high numbers of long-toed salamanders and northwestern salamanders breeding. The pond measures approximately 100 ft x 6 ft x 9 inches depth. Virtually every stick suitable for attaching an egg mass was used by these salamander species. Cascades frog egg masses were deposited in the shallowest area of Ellen's Pond. As the water warmed, salamander larvae became active. And on April 22, a 1.1g northwestern salamander larvae was captured. It is most likely that the salamander overwintered in the pond, however, it is possible that this animal hatched extremely early during the spring of 2002. These animals began feeding on the long-toed salamander larvae that were moving around in egg masses just prior to hatching. When the cascades frog and northwestern larvae began moving within their egg sacs, they were eaten as well. Picture (p.) shows northwestern larvae lined up on top of cascade frog egg masses waiting for tadpoles to move. Consequently, no tadpoles or larvae from the 2002 cohort survived more than a few days. The habitat in the pond is extremely simple and provided no refuge for young hatchlings from the northwestern salamander larvae.

On June 20, 2002, a froglet that metamorphosed during the summer of 2001 was found sitting in the middle of the 82.3a road puddle, approximately 0.5 miles away from Ellen's Pond. It is possible that the salamander larvae will metamorphose and the pond will be

"reset" so that tadpoles may be successful next year. A habitat enhancement project could be done to create a pond similar to Ellen's Pond on the 82.3a road. Structural complexity could be increased in the new pond to try to minimize the likelihood that salamander larvae could eat all hatchlings in a given year. On July 19, 2002 one long-toed salamander very nearly completed metamorphosis and one northwestern salamander larvae were the only animals remaining in the pond. On August 22, 2002, Ellen's Pond was dry although the middle did have wet mud.

Wetland off 82.2 road, Site 8

A small-forested wetland is found south of the 82.2 road near the Bonus Creek area. Vegetation in the wetland includes skunk cabbage and water parsley. The maximum depth observed during any survey visits was approximately one foot depth. Several species including cascades frogs, long-toed salamanders and northwestern salamanders are known to use this wetland in some years. However, the open water portion of the wetland has dried quickly in both 2002 and 2003 and it likely only holds water long enough to have metamorphic individuals of any species in certain years where the wetland is recharged by rainfall during the development of larvae.

Puddle on 60 road by Gravel slide and outhouse (Middle Fork Taylor Creek)

While driving around the Taylor basin on 21 June 2002, I noticed cascades frogs in nearly every puddle on the road. The concentration was especially high in a silty puddle at this location. Seven adults and at least eight juveniles were present in the small puddle. The Taylor drainage appears to have high concentrations of cascades frogs during the summer although breeding sites are likely in the headwaters of this system. Some slow backwater offchannel streams may also provide breeding habitat. The riparian area in the Taylor drainage provides cool summer habitat for this species and puddles such as this one will be full of frogs in the spring and summer months.

Bog at end of 82.3a road, Site 9

An old bog can be found off the end of the 82.3a road. Trees have begun to grow up in the middle of the bog and the water table is low. Sphagnum moss is prolific and the open area and patches of open water can be seen in early spring. A forested wetland borders the entire bog area and provides breeding habitat for salamander species.

Barneston Mill Pond, Site 10

2002. Barneston Mill Pond was surveyed on March 28, 2002. This pond is a temporary pond that no longer contained water after June of 2002. The only species found breeding in the pond were long-toed salamanders. Several egg masses were discovered in the pond—the fate of these individuals is unknown. It is possible that long-toed salamanders could complete development quickly enough to escape the drying conditions.

Blackberry is thick around the pond and habitat extremely degraded likely due to past human activities in this area. Removal of the blackberry and other non-native plants

would improve the habitat, although the duration the pond holds water would likely remain the same. Because the pond dries so quickly, it is doubtful that it would become a favored amphibian breeding site. However, the pond is important to dispersing individuals, providing a moist area and potential food source.

2003. In 2003, red-legged frogs, pacific treefrogs and long-toed salamanders were found using the pond. The pond dried by early June.

40 Road scrub-shrub wetland, Site 11

This site was visited in 2002 and in 2003, but no amphibians were found. Spirea grew throughout the wetland and wood was present in the water. One fairy shrimp was (Oregon Fairy Shrimp, *Eubranchipus oregonus*) collected on May 1, 2003 at the site.

Wetland at Edge of 45 Road thinning unit, Site 12

A small wetland exists at the westernmost boundary of the watershed. It is temporary and metamorphic success of frog species is questionable. However, because it is the westernmost pocket of water in the watershed, it is an important feature to the dispersal of amphibians. Although long-toed salamanders were not observed in the wetland, it is likely that this is an important breeding location for the species. In 2003, 5 fairy shrimp were found in the pond during amphibian surveys (Oregon Fairy Shrimp, *Eubranchipus oregonus*).

Himalayan blackberry is found growing around the pond and because it is located on the county road, garbage is tossed from the road. Sedges are present in the pond as is an abundance of woody debris.

Wetland East of 57 Road, Site 13

2002. The wetland (located north of the pole line road, and east of Trude Road) was surveyed on April 23, 2002. The most abundant species in this wetland complex was the pacific treefrog. There were far too many egg masses to count and adults were loudly chorusing. No other species was observed using this habitat, although long-toed salamanders could have used it earlier in the year that had already hatched when the survey was conducted. The habitat consisted of shallow water (<1-foot depth), with silty substrate and numerous aquatic plants and duckweed growing in the wetland. Western red-backed salamanders were found immediately adjacent to the wetland.

There are also other wetland and temporary ponds in the area. Pacific treefrog egg masses and chorusing adults were found at all ponds. A pond, located south of the pole line road, and west of the 55 road contained shagnum mosses and sedges. The vegetation also consisted of salal and other shrubs making surveying for eggs extremely difficult.

2003. During 2003, pacific treefrogs were found using the wetland in large numbers. Additionally, both long-toed salamanders and northwestern salamanders were found in the wetland.

Scrub-shrub wetland west of 55 Road, Site 14

The site was visited in 2002 and in 2003. No amphibians were documented during 2002 and one long-toed salamander larvae was collected during 2003. The wetland is temporary and water dried in early June 2003.

Kerriston Marsh, Site 15

Cutthroat trout are known to reside in this wetland based on minnow trapping efforts in past years. I was unable to completely survey this area, but did several spot checks over the spring to document species present and to check for bullfrog presence. On May 30, 2002, I found northwestern salamanders and pacific treefrogs breeding in the area. The water temperature was a warm 20ºC. A single scoop in the water with a dip net brought up a larva of the northwestern salamander. Long-toed salamanders were observed at many culvert crossings in the area and I expect that they also use many parts of the wetland as a breeding site. Further work is needed to characterize amphibian use of the wetland. Minnow trapping would likely show that roughskin newts use this marsh (DKP remembers seeing newts here several years ago). It is highly likely that red-legged frogs use some parts of the wetland. However, interactions with this species and fish are known to be negative, and the frogs may opt to breed elsewhere.

Temporary pool South of Masonry Pool Bridge (along conifer line, by Education Center lunch shelter), Site 26

This pond was surveyed on 30 April 2002. Species present included red-legged frog, northwestern salamanders, pacific treefrogs, and western toads. The pond dimensions on this date were approximately 200 ft by 75 ft, the air temperature was 16°C and the water temperature was 15.2ºC. Tallies of egg masses observed documented 27 red-legged frogs, 5 northwestern salamander egg masses, and many pacific treefrog eggs. In addition, nine adult western toads were in the pond including two amplextic pairs. The water level in this pool dropped quickly, and many of the egg masses were stranded and desiccated. On May 10, the red-legged frogs had hatched and adults as well as juveniles of the species were using the pond. By 3 June, the pond was dry and the no metamorphosis was possible. Western toadlets were observed frequently in this area.

Coyote Pass Gravel Pit, Site 31

2002. A pool developed at the base of the gravel pit and was chosen as a breeding site by cascades frogs and pacific treefrogs in 2002. Adult cascades frogs have been observed at the pool on several occasions. The pool has very little aquatic vegetation and is exposed to sunlight for the majority of the day, but has cover for the tadpoles against the gravel hillside. The temperature in the pond was consistently near 20ºC providing excellent

larval development conditions. Over the 4th of July weekend, rain filled the pond enough to allow the tadpoles to continue developing. On July 9th, metamorphs of both cascades frogs and pacific treefrogs were found at the margins of the pool. Most tadpoles remaining have developed legs and are approaching metamorphosis. The size of these frogs ranged from 10-20 mm.

Coyote Pass gravel pit shows that simple and temporary wetlands are important to amphibians. These pools and puddles lack predators such as dragonfly larvae, predacious diving beetles, and fish that cause problems for young tadpoles.

2003. A pond did not develop at Coyote Pass during 2003.

Eagle Ridge Meadow, Site 32

Although only parts of this habitat have been checked, several species are known to use the area. High densities of pacific treefrogs breed in the bog, the chorus is extremely loud and eggs numerous. Northwestern salamanders lay eggs in the ponded areas as well. Both cascades frog and red-legged frog adults have been observed around the water in Eagle Ridge Bog. However, no definite concentrations of breeding sites were located this year. The area deserves further attention, especially since it is also used as rearing grounds for juvenile bull trout.

300 Road Pond, Site 34

Approximately 200 feet up the 300 road, a small wetland can be found on the left side of the road. The pond measures approximately 30 feet by 10 feet. The average depth is one foot. One northwestern egg mass and four pacific treefrog egg masses were found in the pond. On 20 June 2002, seven adult cascades frog were found at the pond. Although this wetland does not appear to serve as adequate breeding habitat, it is an important feature as frogs migrate across the landscape.

Cedar River Floodplain Terrace near Chester Morse Lake, Site 35

Small depressions fill with water on the floodplain and provide excellent habitat for amphibian breeding. Reservoir water fluctuations cover the entire area each spring, yet the amphibians continue to use the habitat. It is likely that the hatchlings move with the water to the shallowest areas and develop fully to metamorphosis. Species present and breeding on the Cedar River floodplain include red-legged frogs, pacific treefrogs, northwestern salamanders, western toads and cascades frogs. Of special interest in this area is the fact that both red-legged frogs and cascades frogs use the same habitat for breeding. It is unknown whether they hybridize at these sites.

On September 7, 2002 metamorphs of western toads, red-legged frogs, and treefrogs were observed on the reservoir beach near the Taco Stand. The western toads migrate long distances to overwinter and during the month of September cross the 100 and 200 roads in massive groups. Boulder Creek, the Cedar River and likely many of the

tributaries on the lake provide a corridor for the toads to move uphill to areas where they will overwinter.

Pond off 68 Road, Site 37

The pond was partially surveyed on July 2, 2002, and two species of salamander were found present. The forest around the pond consists of mainly noble fir and is quite young. The pond contains numerous pieces of large wood giving cover for amphibians. In spots, the pond is deep and the young forest is growing right to the edge making walking around the edge difficult. The pond does not contain any emergent vegetation, but does have some shallow area that Cascades frogs use for breeding.

Meadow with Three Ponds off 78.1 road, Site 39

Species present include northwestern salamanders, pacific treefrogs and cascades frogs. The meadow maintained moist to wet conditions throughout with three small ponds located along a channel running through the meadow. Amphibians were using these sites for breeding locations. At least fifteen adult cascades frogs and over ten juveniles were observed along the channel through the meadow. There were many pacific treefrog egg masses and adults as well as eight northwestern salamander egg masses. There was no evidence of cascades frogs reproducing at this site—no tadpoles, no egg mass jelly.

Rex Pond, Site 40

An egg mass survey was conducted at Rex Pond to determine the number of breeding amphibians. I expected to find a healthy population of cascades frogs but found none at Rex Pond. A loud chorus of treefrogs was evident when I arrived at the pond. A recent slide deposited fresh tree branches and other debris and may have hidden several egg masses frog view. Snow was still present around the south side of the lake. This pond was logged to the edge and hydrology appears to be much lower than in the past. A wet meadow is present on the western edge of the pond and has channels running through it.

Rex Meadows in Headwaters, Site 41

These areas contain water pockets throughout the year and provide a mosaic of breeding sites throughout the head of the Rex Basin. Virtually all meadows I visited had either and adult or juvenile cascade frog in them (several others confirmed by R. Sugg and J. French).

Findley Lake, Site 42 and 43

On the trail to Findley Lake, a smaller pond sits on the east side of the trail. The pond contained some large pieces of wood and the bottom was covered with a thick layer of sediment. The pond contained too many cascades frogs to accurately count. Each step taken startled five to ten frogs. Additional species present include adult roughskin newts, northwestern salamander egg masses, pacific treefrogs chorusing and western toad

juveniles. An egg mass survey was conducted and located 12 northwestern egg masses, over 250 cascade frog egg masses, and many pacific treefrog egg masses.

I surveyed approximately one third of Findley Lake and found 20 adult cascades frogs, 12 juvenile cascades frogs, six roughskin newts (2 pairs breeding), one western toad juvenile and a chorus of pacific treefrogs. Snow still remains around some of the edge of the lake and it is possible that additional breeding will occur this year as the temperature consistently warms. The lakeshore is steep in many areas and does not provide ideal breeding habitat for cascades frogs. If they use Findley Lake as a breeding site, they are most likely located on the southeastern edge of the lake where a small meadow slopes gently into the lake.

Lower Sutton Lake, Site 44

The lake was visited on the 22 of July. A flat portion of ground around the lake was logged and young trees are now growing. Tree removal reached the lakeshore and the northern two-thirds of the lake is now exposed and extremely dry. The lake has no outlet and at this time, no inlet either except for subsurface flow from the upper lake. Large boulders and some small wood are sprinkled about the lakeshore at the high water mark. A small strip of old growth remains on the southern lakeshore and is surrounded by talus and rock. This strip of trees provides the only moist microclimate available to amphibians at the lower Lake. During a visual encounter survey, 26 adult cascades frogs, one juvenile, one pacific treefrog adult, five pacific treefrog egg masses, four terrestrial northwestern salamander adults, six northwestern salamander larvae and two cascades frog tadpoles were observed in the lake. The substrate consists mainly of grasses with some rock outcrops. Animals have abundant escape locations. Predaceous diving beetles were abundant in the lake as well.

Twilight Lake, Site 47

2002. Twilight Lake was surveyed on the afternoon of July 24, 2002. The forest immediately surrounding the lake has been cut and is now regenerating. The lake has an extensive meadow associated with it through which shallow channels run with water even late in the summer. The lake has mud substrate and a layer of peat that is easy to break through when walking the edge. Elephant's head, sundew and shooting star are common in the meadow north of the lake. The center of the lake is deep. The water temperature at the margin of the lake was 23.1ºC in the mid afternoon. No adult cascades frogs were observed around the lake or in the meadow and tadpoles were only located in the meadow channels.

2003. In 2003 fish were observed jumping to capture numerous damselflies at the lake. No treefrogs were found breeding in the lake during 2003. Cascade frog tadpoles were again located in the shallow channels running into the lake but not in the lake itself.

Wetland off 610 Road, Site 48

The 610 wetland has a pond right at the road edge and then many deep channels running through the wetland. There are numerous places where a shallow finger stretches away from deeper channels, providing warm shallow water to developing amphibians. The cedar stumps in this wetland are enormous and it may be a good candidate for restoration planting in the future. On August 2, 2002, cascade frog tadpoles were in the process of metamorphosing and all stages of development could be found in the wetland. Also extremely abundant were larvae of the northwestern salamanders found by taking random scoops with a net. Similar results were documented during 2003.

Meadow off 610.1a3, Site 49

This meadow is located in the headwaters of the Seattle Creek Basin. The forest surrounding the meadow is young and in the process of being thinned now. When I walked in a bull elk was bedded down in the meadow with the chainsaw activity humming nearby. Blueberries and huckleberries are abundant and the meadow is clearly important to a variety of wildlife. The center of the meadow holds water all year and provides breeding and rearing habitat for the cascades frog. Numerous recently metamorphosed individuals (14-16mm length) were observed in the water at the meadow. Water temperature was 22.4ºC.

McClellan Creek Headwaters, Site 52, 53, 54

Two small watering holes are present in a meadow at the headwaters of McClellan Creek off the 127.1 road. Alice Lakes are located just over the ridge from this meadow (David Chapin noted cascades frogs). On the 19 of July, one adult cascades frog and one western toad juvenile were observed during a visual encounter survey in the wet meadow. On September 18, 2002, Sally Nickelson observed numerous juveniles in the wet meadow and confirmed that these areas still contained water. It is likely that they came over the ridge from Alice Lakes. Snow was present on the north facing slopes and the weather was overcast. No signs of larvae or egg jelly were present in the watering hole areas.

Another small pond further north off the 127.1 road, had a maximum depth of 24 inches. The substrate consisted of grasses and silt. During a visual encounter survey at this location, two cascades frog adults and one juvenile were observed.

Bear Lake, Site 55

Cascades frogs and pacific treefrogs were present at this lake when it was visited in early August by J. French. She did not observe any tadpoles or egg masses in any of the wetlands, but a complete survey was not conducted.

Culvert #610.1-2 (Below Gravel Pit), Headwaters of Viola Creek, Site 60

Five adult cascades frog were observed in the pool above culvert 610.1-2. This pool originates from groundwater and is extremely cool even during the driest part of the summer. Although no puddles existed in the gravel pit on September 20, 2002, I would guess that in early spring there are some puddles that the frogs use for breeding. It is highly unlikely that these individuals would be successful. However, there are many meadows in the area that may successfully rear tadpoles during some years. I checked one meadow at the end of the 610.1c road but did not find any evidence of frogs using the site.

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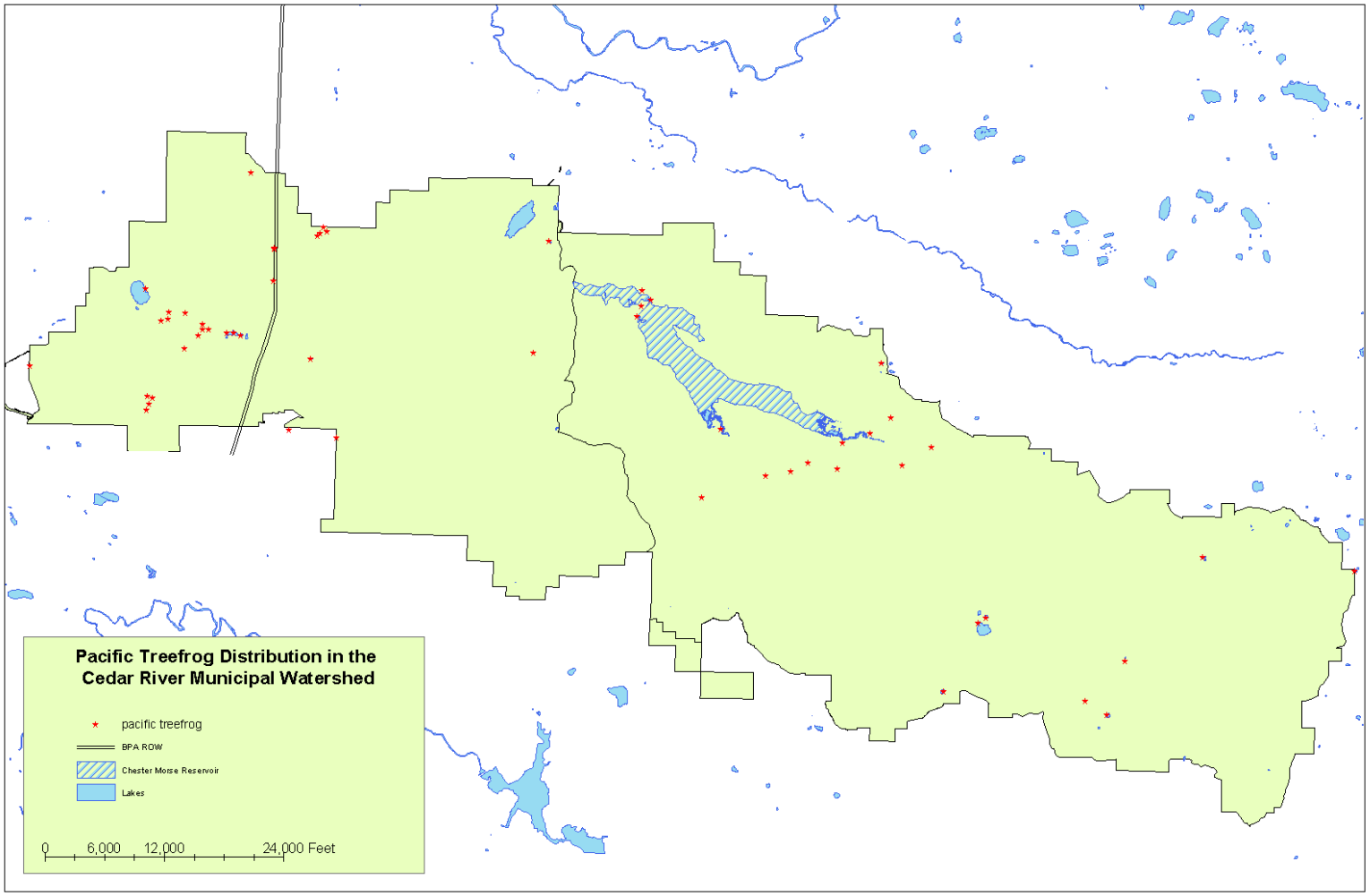
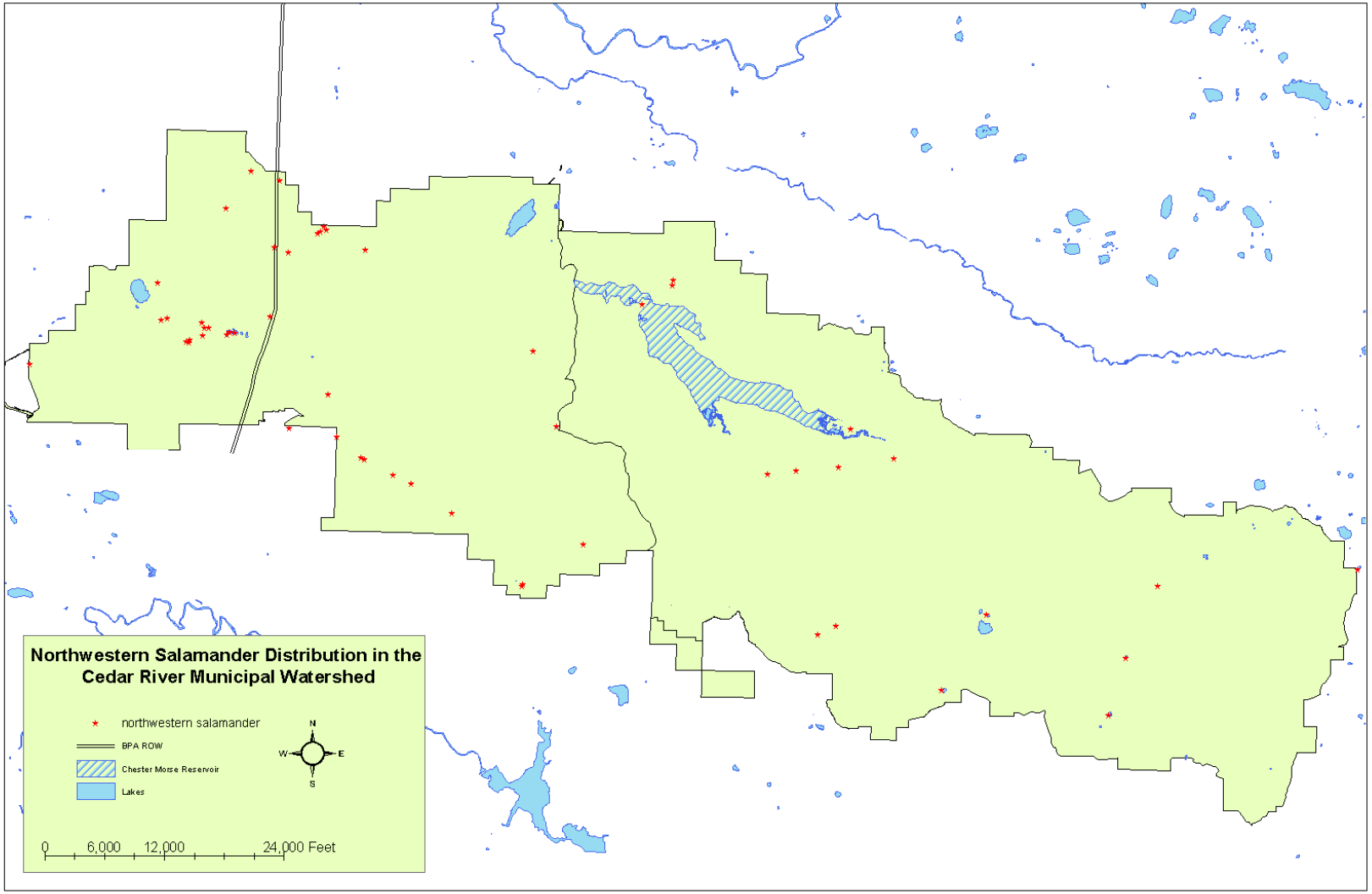
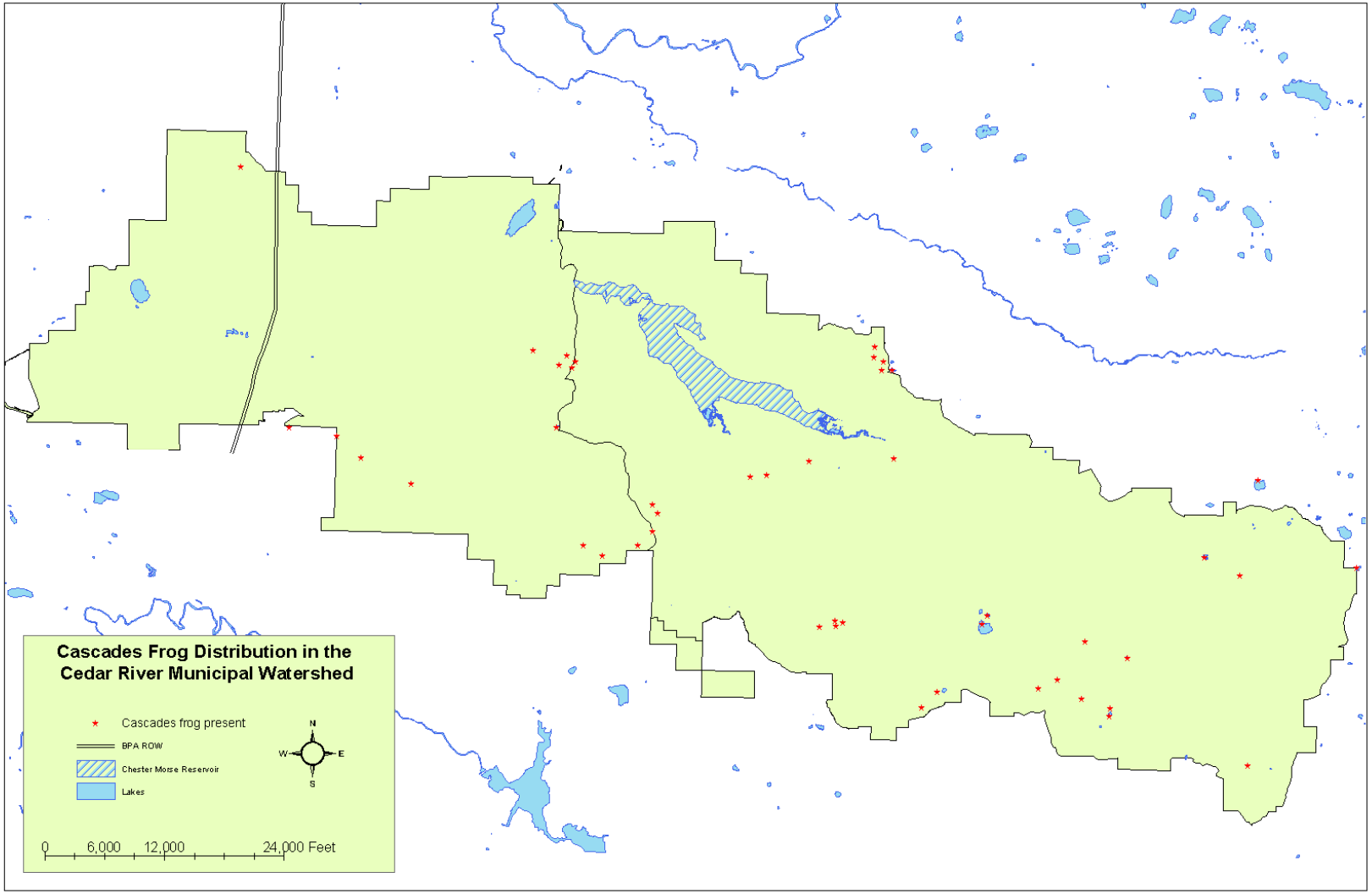
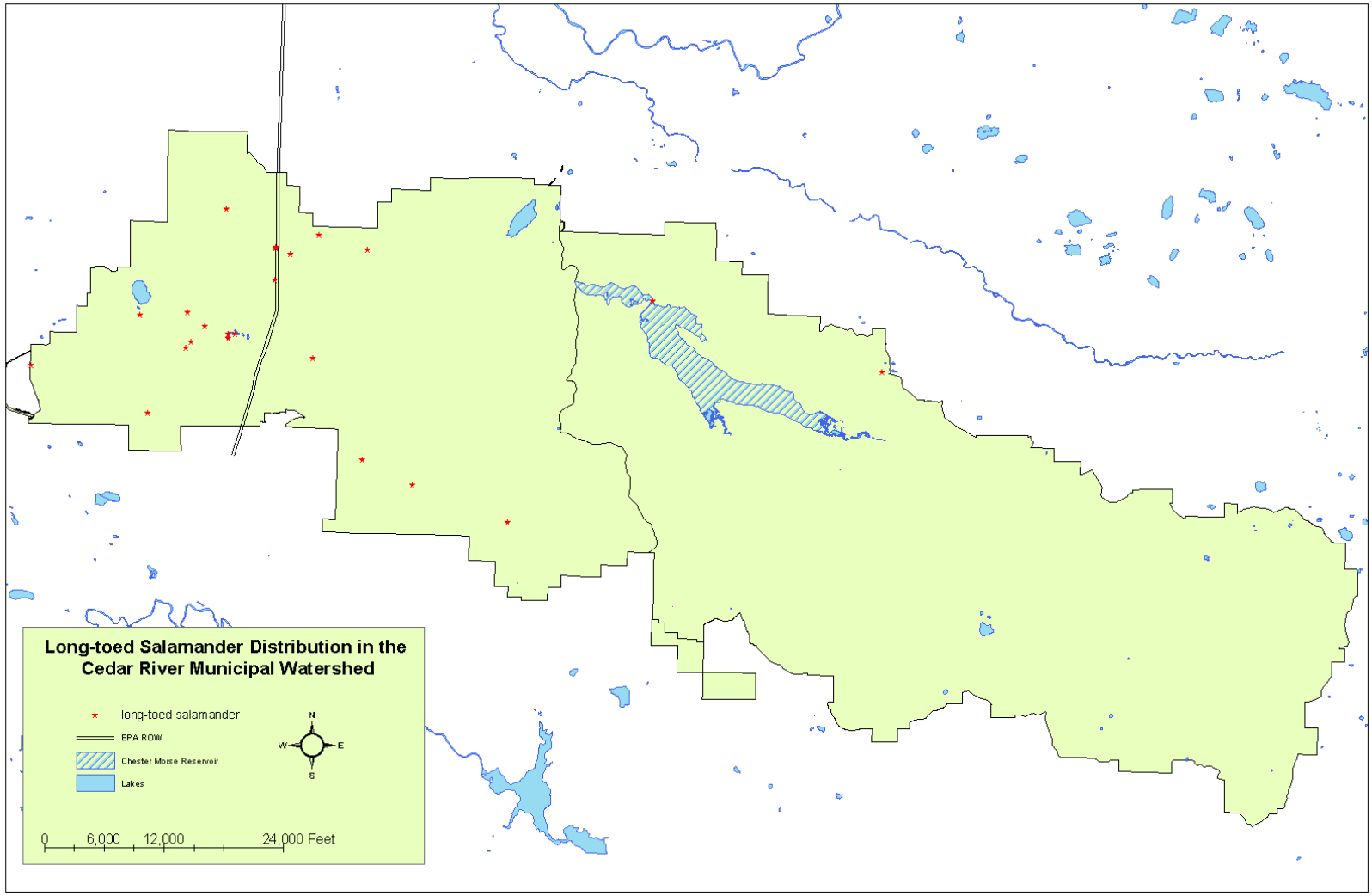
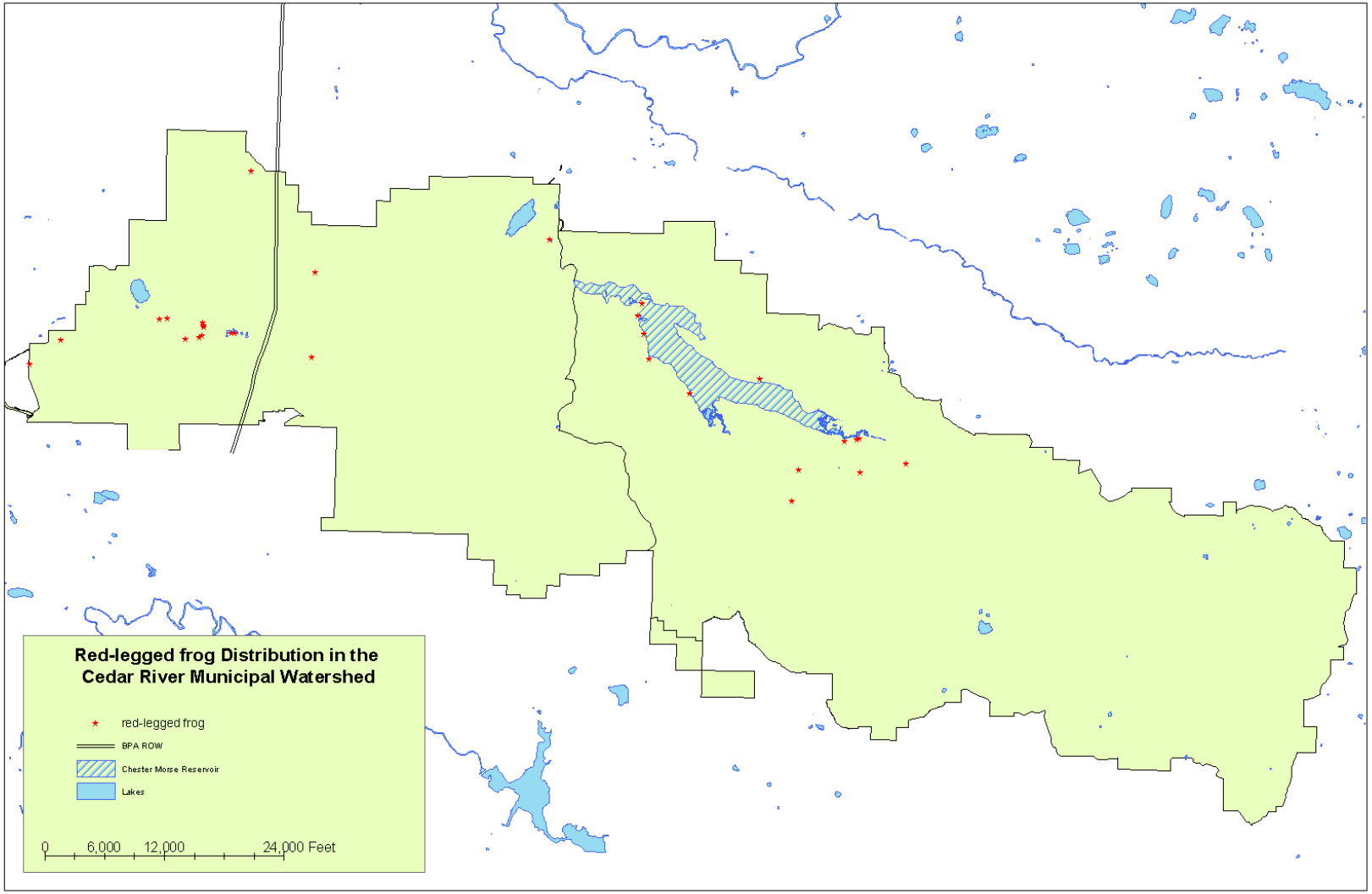
Appendix 1. Pond-Breeding Amphibian Species Distribution Maps.

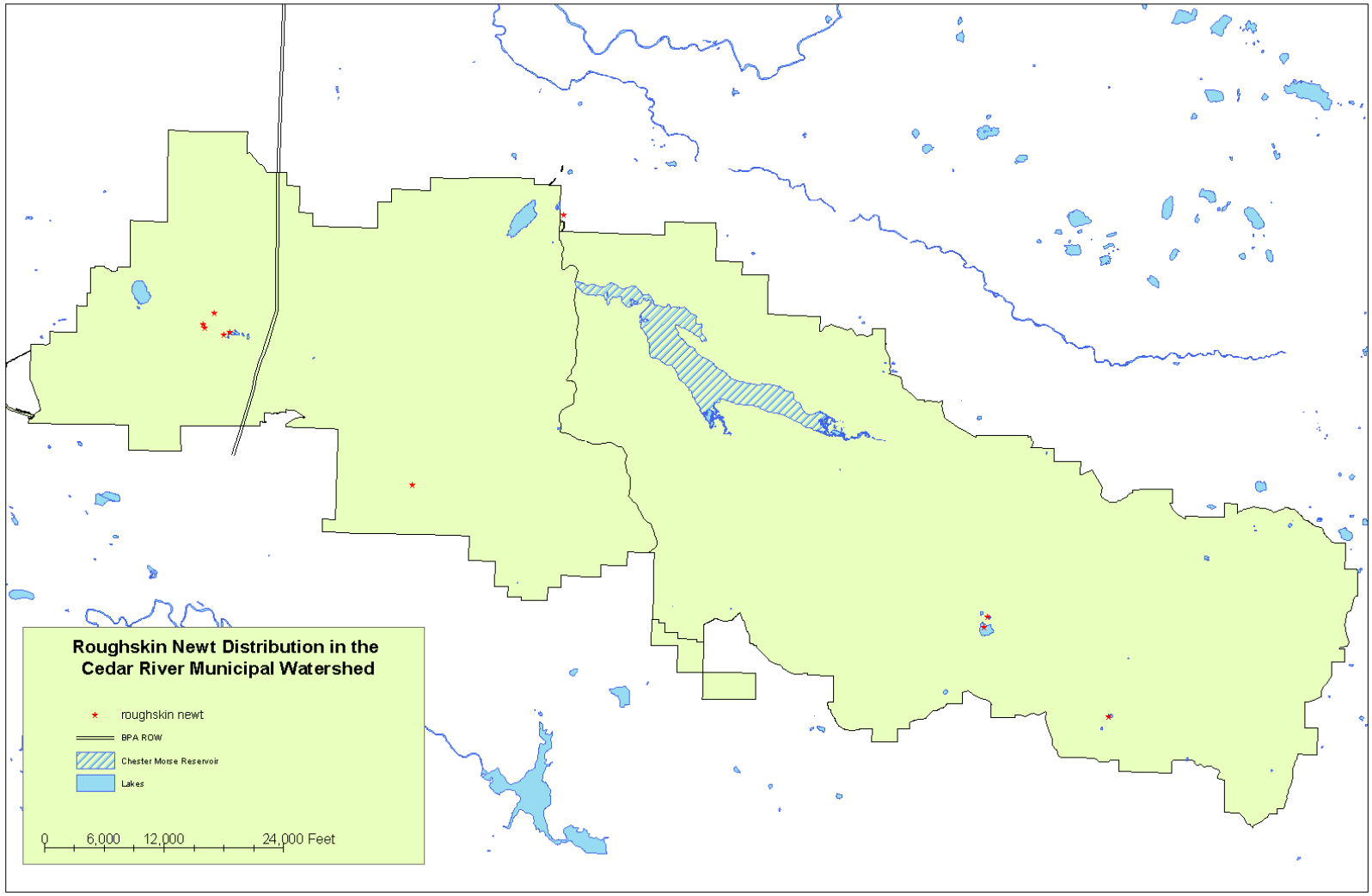


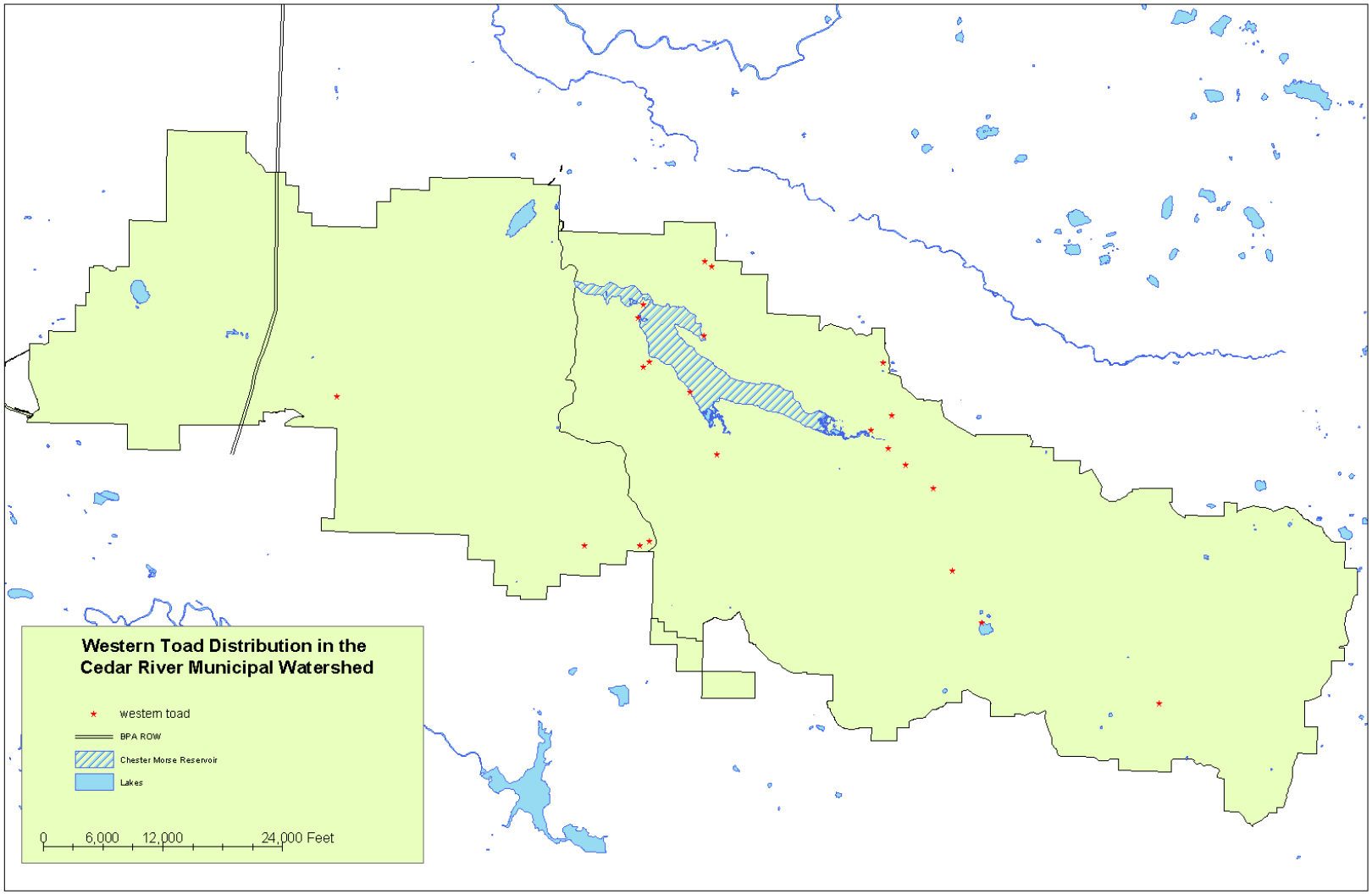

Northwestern Salamander Distribution in the Cedar River Municipal Watershed
northwestern salamander
BPA ROW
Chester Morse Reservoir
Lakes
N
W
E
S
0
6,000
12,000
24,000 Feet


Cascades Frog Distribution in the Cedar River Municipal Watershed
Cascades frog present
BPA ROW
Chester Morse Reservoir
Lakes
N
W
E
S
0
6,000
12,000
24,000 Feet


Long-toed Salamander Distribution in the Cedar River Municipal Watershed
long-toed salamander
BPA ROW
Chester Morse Reservoir
Lakes
N
W
E
S
0
6,000
12,000
24,000 Feet


Red-legged frog Distribution in the
Cedar River Municipal Watershed
red-legged frog
BPA ROW
Chester Morse Reservoir
Lakes
0
6,000
12,000
24,000 Feet


Roughskin Newt Distribution in the
Cedar River Municipal Watershed
roughskin newt
BPA ROW
Chester Morse Reservoir
Lakes
0
6,000
12,000
24,000 Feet


Western Toad Distribution in the
Cedar River Municipal Watershed
western toad
BPA ROW
Chester Morse Reservoir
Lakes
0
6,000
12,000
24,000 Feet