Amphibian Egg Mass Surveys, 14 Lakes
Cedar River Municipal Watershed
2003- 2014

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Background

14 Lakes consists of a series of five small lakes in the lower Cedar River Municipal Watershed, at an elevation of about 800 feet above sea level. They are kettle lakes that formed in glacial outwash deposits as a result of the melting of large pieces of glacial ice enclosed within outwash sediments. The resulting depressions in the landscape became small lakes as a result of groundwater input, as there are no perennial streams entering the lakes and they have no outlets. This is a unique habitat within the municipal watershed.

The five lakes include: Small Lake (0.8 acres), Big Lake (4.3 acres), Deep Lake (3.5 acres), Blackberry Lake (2.1 acres), and Wood Lake (1.9 acres) (Figure 1). They are ideal for pond-breeding amphibians because there are no fish present and the open shorelines provide sunlight for developing eggs and algal growth that is used for food once the tadpoles hatch. This report summarizes the annual amphibian egg mass surveys of these lakes starting in 2003.

Figure 1. 14 Lakes wetland complex in the Cedar River Municipal Watershed.

In 2002 the area was surveyed to document which amphibian species were present. Red-legged frogs (*Rana aurora*), Pacific treefrogs (*Pseudacris regilla*), roughskin newts (*Taricha granulosa*), northwestern salamanders (*Ambystoma gracile*), and long-toed salamanders (*Ambystoma macrodactylum*) were all found to be breeding at 14 Lakes. Amphibian egg mass surveys began in 2003 and continued annually. Surveys are conducted in late March or early April in dry, calm weather. The perimeter of each lake is walked by qualified biologists. All egg masses and adult amphibians encountered are recorded by species at the approximate location on or near the shore where it is seen. The only exception is Pacific treefrog, whose egg masses can be too numerous to document within the time allotted for the survey. Only Small, Big, and Deep Lakes were surveyed from 2003 through 2005. All five lakes were surveyed

annually starting in 2006, unless the water was too high to allow the survey to be conducted safely.

In 2005 an amphibian habitat enhancement project was completed on Big, Deep, and Blackberry Lakes. A total of 27 trees (26 Douglas-fir and one red alder) were dropped from the forest edge into these three lakes to provide a safe travel corridor for adult amphibians migrating from the forest to the lakes to breed and for newly metamorphosed amphibians migrating to upland habitat to overwinter. Additionally, the tree tops were felled into the lakes to provide additional egg attachment sites. From 2006 through 2011, the annual survey data included whether the egg masses were attached to the tops of the tree felled during this habitat enhancement project.

For a complete report on this habitat enhancement project, see 14 Lakes Riparian Habitat Enhancement Project Plan and As-Built Report, found on the City of Seattle Habitat Conservation plan website:
http://www.seattle.gov/util/EnvironmentConservation/OurWatersheds/Habitat_Conservation_Plan/Species/Amphibians/Pond-Breeding/HCPProgress/index.htm

Red-legged Frogs

14 Lakes is the most productive breeding site for red-legged frogs in the municipal watershed. In years when there were similar survey conditions (2004, 2005, 2006, 2008, 2009, 2010) number of red-legged frog egg masses in the original survey areas of Small, Big, and Deep Lakes ranged from 550 to 840 (Figure 2). During years with high water levels (2007, 2011, 2012, 2013) survey conditions are difficult because the slope drops off steeply near the forest. There are few attachment sites for the egg masses this high up the slope, making it difficult to see any egg masses that might occur in deeper water. Consequently, far fewer red-legged frog egg masses are documented during these years. In 2014 water levels were so high that surveys were impossible to safely conduct and were canceled.

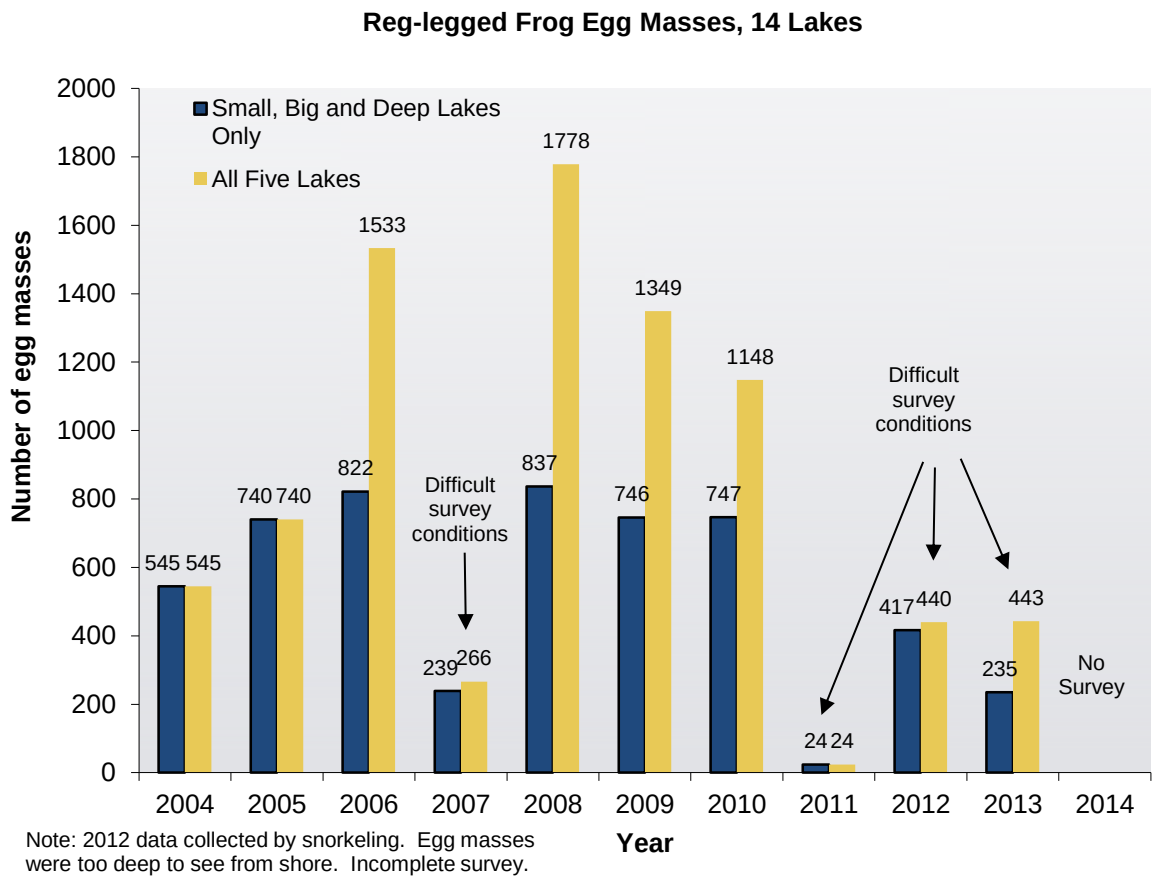


Figure 2. Number of red-legged frog egg masses counted at 14 Lakes, 2003-2014.

There is a large amount of annual variability in red-legged frog egg mass counts between the five lakes. It is unknown what causes the frogs to preferentially select one lake over another during a given year. Factors such as temperature, congregation of males at a particular lake, water level, number of attachment sites, or combinations of these factors might explain some of the observed annual variability (Figure 3).

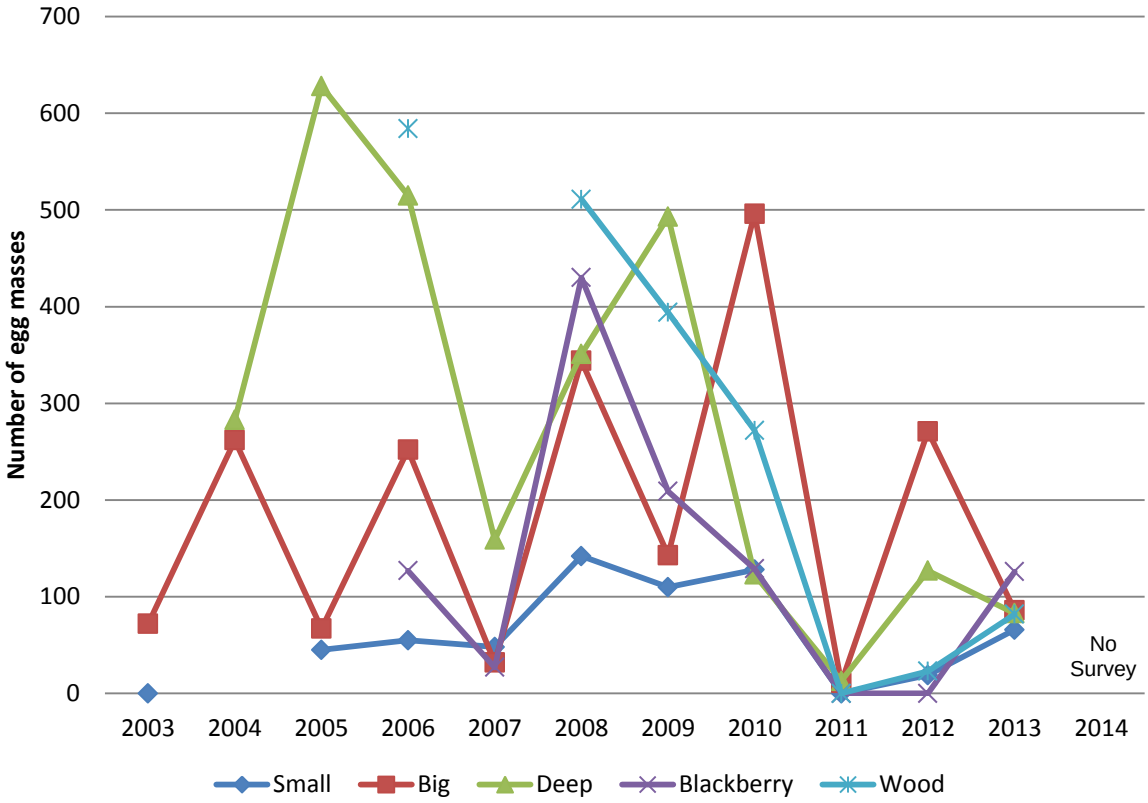


Figure 3. Annual red-legged frog egg mass counts by lake

Photo Points

Photo points were established at each lake, to document the general survey conditions and water level each year. One photo point each was established at Small, Wood, and Blackberry Lakes, two at Deep Lake, and four at Big Lake (Figure 4). A numbered metal tag was fastened to a large tree facing the pond. Each year the biologist stands with their back at the tag, facing the same direction to take the picture. They carry a photo from the previous year and attempt to duplicate the area in the picture. Each photo is taken in late March or early April during or shortly after the egg mass survey.

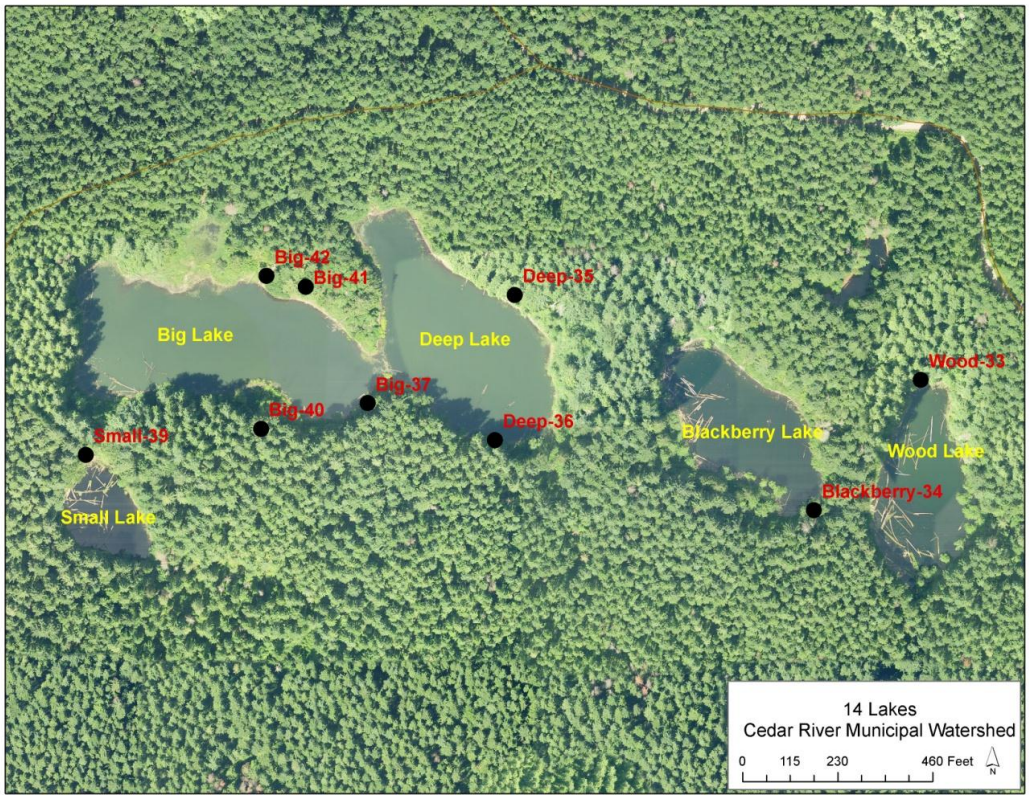


Figure 4. Photo point locations at the five lakes.

Survey Data

Number of egg masses by species and year are presented separately by lake (Small, Big, Deep, Blackberry, and Wood). Also included are the annual pictures from each photo point for each lake. As can be seen from these pictures, water levels vary dramatically within the lakes from year to year, which greatly affects the ability of the surveyors to see egg masses from the shore, and thus the egg mass counts.

In 2012 the water was so high that virtually no egg masses were seen from the shore. Consequently, the most productive portions of Big and Deep Lakes were snorkeled in mid-April to determine if red-legged frog egg masses were present in deeper water, and if so, whether numbers were comparable to previous years. The snorkel survey found there were numerous egg masses present in more than seven feet of water, and thus not visible from the shore. All of the red-legged egg masses recorded for Big and Deep Lakes in 2012 were obtained from this snorkeling survey. The portions of Big and Deep Lake that were snorkeled were then compared to data collected from the same areas along the shore in previous years. Totals from walking surveys along these areas from five years ranged from 296 to 595 egg masses, and the 398 egg masses found by snorkel survey in 2012 fits within this range. These data demonstrate that during difficult walking survey years of very high water, the frogs are apparently still breeding in comparable numbers to that seen in lower water years.

Small Lake

This small lake has steep edges around most of its perimeter. Most egg masses are found in the southeast end of the pond, where it is shallower, it receives more sunlight, and numerous tree branches provide attachment sites. The lake was completely dry in 2004, so no survey was conducted. High water in 2007, 2011, and 2012, combined with the steep dropoff near the forest edge made the survey very difficult to navigate and egg masses difficult to see. Extremely high water in 2014 forced cancellation of the survey. No photo points were taken in 2014.

Table 1. Amphibian egg mass survey results at Small Lake, by species and year.

	2003 25-Mar	2004 no survey	2005 1-Apr	2006 23-Mar	2007 27-Mar	2008 25-Mar	2009 30-Mar	2010 22-Mar	2011 28-Mar	2012 26-Mar	2013 2-Apr	2014 no Survey
Red-legged Frog	0		45	55	48	142	110	128	0	19	66	
Northwestern Salamander	12		106		1	84	9	87	2	0	152	
Pacific Treefrog			21				2	13			2	
Long-toed Salamander	1			1								
Total	**13**		**172**	**56**	**49**	**226**	**121**	**228**	**2**	**19**	**220**	

The single photo point (labeled PP39) at Small Lake has been recorded annually since 2006, except in 2014 (see following page). The high water levels seen in 2007, 2011, and 2012 correspond with fewer egg masses recorded.


Small Lake (PP39) 2006


Small Lake (PP39) 2007


Small Lake (PP39) 2008


Small Lake (PP39) 2009


Small Lake (PP39) 2010


Small Lake (PP39) 2011


Small Lake (PP39) 2012


Small Lake (PP39) 2013

Big Lake

Each year the majority of red-legged frog egg masses are found along the north edge of the pond, which has a more gradual slope and receives more sunlight than the south edge. A total of 11 Douglas-fir trees were dropped in Big Lake in 2005. In 2006 only one red-legged frog egg mass was associated with the tree tops. But in 2008 28% of the egg masses were on dropped trees. In 2009 27% and in 2010 44% of the egg masses were associated with dropped trees.

High water in 2007, 2011, and 2012 made survey conditions very difficult. All red-legged frog egg masses recorded in 2012 were from the snorkel survey along a portion of the north shore, and were in water deeper than seven feet. Water levels in 2013 were comparable to those seen in 2009, and there were very similar total numbers of egg masses, although the proportion of red-legged frog and northwestern salamander masses varied. Extremely high water in 2014 forced cancellation of the survey. No photo points were taken in 2014.

Table 2. Amphibian egg mass survey results at Big Lake, by species and year.

	2003 25-Mar	2004 23-Mar	2005 1-Apr	2006 23-Mar	2007 27-Mar	2008 25-Mar	2009 30-Mar	2010 22-Mar	2011 28-Mar	2012 17-Apr	2013 2-Apr	2014 no survey
Red-legged Frog	72	262	67	252	32	344	143	496	11	271	86	
Northwestern Salamander	54	2	1	2		44	14	152			58	
Pacific Treefrog	6	111	Many	1	Many	7	0	81			3	
Long-toed Salamander				4								
Total	**132**	**375**	**68**	**259**	**32**	**395**	**157**	**729**	**11**	**271**	**147**	

The four photo points (labeled PP37, PP40, PP41, PP42, and PP43) at Big Lake have been recorded annually since 2006, except in 2014 (see following pages).

Big Lake #1 (PP37) 2006

Big Lake #1 (PP37) 2007

Big Lake #1 (PP37) 2008

Big Lake #1 (PP37) 2009

Big Lake #1 (PP37) 2010

Big Lake #1 (PP37) 2011

Big Lake #1 (PP37) 2012

Big Lake #1 (PP37) 2013

Big Lake #2 (PP40) 2006

Big Lake #2 (PP40) 2007

Big Lake #2 (PP40) 2008

Big Lake #2 (PP40) 2009

Big Lake #2 (PP40) 2010

Big Lake #2 (PP40) 2011

Big Lake #2 (PP40) 2012

Big Lake #2 (PP40) 2013

Big Lake #3 (PP41) 2006

Big Lake #3 (PP41) 2007

Big Lake #3 (PP41) 2008

Big Lake #3 (PP41) 2009

Big Lake #3 (PP41) 2010

Big Lake #2 (PP41) 2011

Big Lake #3 (PP41) 2012

Big Lake #3 (PP41) 2013

Big Lake #4 (PP42) 2006

Big Lake #4 (PP42) 2007

Big Lake #4 (PP42) 2008

Big Lake #4 (PP42) 2009

Big Lake #4 (PP42) 2010

Big Lake #4 (PP42) 2011

Big Lake #4 (PP42) 2012

Big Lake #4 (PP42) 2013

Deep Lake

This is the deepest of the five lakes, and retains the most water during dry years. It has a very steep drop off from the forest around the majority of the lake, with only one shallow area in the northernmost portion of the lake. The vast majority of the red-legged frog egg masses are found in this shallow area. Very few, if any, are found on the south side of the lake, which has an extremely steep drop off.

In 2005 11 Douglas-fir and 1 red alder trees were dropped in Deep Lake to provide travel corridors and improve amphibian breeding habitat by providing more egg mass attachment sites. In 2006 3% of the red-legged frog egg masses were associated with dropped trees; in 2009 21% and in 2010 72% of the egg masses were associated with branches from the dropped trees.

High water in 2007, 2011, and 2012 made survey conditions very difficult. All red-legged frog egg masses recorded in 2012 were from the snorkel survey, and were in water deeper than seven feet. No northwestern salamander egg masses were seen during the snorkel survey. . Extremely high water in 2014 forced cancellation of the survey. No photo points were taken in 2014.

Table 3. Amphibian egg mass survey results at Deep Lake, by species and year.

	2003 25-Mar	2004 23-Mar	2005 1-Apr	2006 23-Mar	2007 27-Mar	2008 25-Mar	2009 26-Mar	2010 22-Mar	2011 28-Mar	2012 17-Apr	2013 2-Apr	2014 no survey
Red-legged Frog		283	628	515	159	351	493	123	13	127	83	
Northwestern Salamander		33	82	14		11	11	11			67	
Pacific Treefrog		153	Many		Many		2	18			17	
Long-toed Salamander												
Total		**469**	**710**	**529**	**159**	**362**	**506**	**152**	**13**	**127**	**167**	

The two photo points (labeled PP35, PP36) at Deep Lake have been recorded annually since 2006, except in 2014 (see following pages).

Deep Lake #1 (PP35) 2006

Deep Lake #1 (PP35) 2007

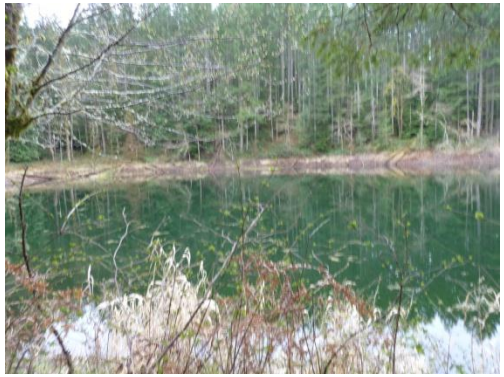
Deep Lake #1 (PP35) 2008

Deep Lake #1 (PP35) 2009

Deep Lake #1 (PP35) 2010

Deep Lake #1 (PP35) 2011

Deep Lake #1 (PP35) 2012



Deep Lake #1 (PP35) 2013

Deep Lake #2 (PP36) 2006

Deep Lake #2 (PP36) 2007

Deep Lake #2 (PP36) 2008

Deep Lake #2 (PP36) 2009

Deep Lake #2 (PP36) 2010

Deep Lake #2 (PP36) 2011

Deep Lake #2 (PP36) 2012

Deep Lake #2 (PP36) 2013

Blackberry Lake

This lake had an extensive Himalayan and evergreen blackberry infestation along the entire western edge, making this area impossible to survey. The blackberry was removed and replaced with native shrubs in a riparian restoration project starting in 2005. The lake edge was then accessible and amphibian egg mass surveys were possible starting in 2006.

In 2005 four Douglas-fir trees were dropped in Blackberry Lake to provide travel corridors and improve amphibian breeding habitat by providing more attachment sites. In 2008 84% of the red-legged frog egg masses were associated with dropped trees; in 2009 29% and in 2010 56% of the egg masses were associated with branches from the dropped trees.

Water levels were too high to safely survey this lake in 2011, 2012, and 2014

Table 4. Amphibian egg mass survey results at Blackberry Lake, by species and year.

	2006 23-Mar	2007 27-Mar	2008 25-Mar	2009 30-Mar	2010 22-Mar	2011 no survey	2012 no survey	2013 2-Apr	2014 no survey
Red-legged Frog	127	27	430	209	129			126	
Northwestern Salamander			30		93			28	
Pacific Treefrog	2		18		67			1	
Long-toed Salamander									
Total	**129**	**27**	**478**	**209**	**189**			**155**	

The single photo point (labeled PP34) at Blackberry Lake has been recorded annually since 2006, except in 2014 (see following page).

Blackberry Lake (PP34) 2006

Blackberry Lake (PP34) 2007

Blackberry Lake (PP34) 2008

Blackberry Lake (PP34) 2009

Blackberry Lake (PP34) 2010

Blackberry Lake (PP34) 2011

Blackberry Lake (PP34) 2012

Blackberry Lake (PP34) 2013

Wood Lake

This lake contains a large amount of wood, much of it floating. The wood is primarily large tree boles, so does not provide the small branches used by amphibians as egg attachment sites. The shallowest area of this pond is along the northernmost shore. Here a number of emergent aquatic plants grow, and this area is heavily used by breeding amphibians.

Water levels were too high to safely survey this lake in 2007, 2011, and 2014. The 2012 and 2013 surveys were only partial surveys, focusing on the northern end of the lake. The remainder of the shore was inaccessible due to high water.

Table 5. Amphibian egg mass survey results at Wood Lake, by species and year.

	2006 23-Mar	2007 no survey	2008 25-Mar	2009 30-Mar	2010 22-Mar	2011 no survey	2012 26-Mar	2013 2-Apr	2014 no survey
Red-legged Frog	584		511	394	272		23	82	
Northwestern Salamander	14		49	3	141			40	
Pacific Treefrog	5		4	2	101				
Long-toed Salamander									
Total	**306**		**564**	**399**	**514**		**23**	**122**	

The single photo point (labeled PP33) at Wood Lake has been recorded annually since 2006, with the exception of 2007 and 2014 (see following page).

Wood Lake (PP33) 2006

Wood Lake (PP33) 2008

Wood Lake (PP33) 2009

Wood Lake (PP33) 2010

Wood Lake (PP33) 2011

Wood Lake (PP33) 2012

Wood Lake (PP33) 2013