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2016 Chehalis ASRP
Egg Mass Surveys in Off-Channel Habitat
3rd (30 June 2016) Progress Report for Post-Feasibility Effort

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EXECUTIVE SUMMARY: The purpose of egg-mass surveys was to detect and determine the distribution of stillwater-breeding amphibians and other Aquatic Species Restoration Plan (ASRP) non-salmonid target species in floodplain off-channel habitats of the mainstem Chehalis River. Our focus was six of the nine ASRP non-salmonid target species, all of which have some potential of being detected during egg mass surveys, including:

- American beaver (*Castor canadensis*),
- Northern red-legged frog (*Rana aurora*),
- Olympic mudminnow (*Novumbra hubbsi*),
- Oregon spotted frog (*Rana pretiosa*),
- Western pond turtle (*Actinemys marmorata*), and
- Western toad (*Anaxyrus boreas*).

This report updates the effort begun in 2015 with data from the 2016 season. This study is part of a larger effort addressing off-channel habitats supporting the Chehalis Basin ASRP. Its goals are to help identify the patterns of occupancy of the biota in the Chehalis floodplain, to support occupancy modeling that characterizes the distribution of ASRP target species in the floodplain, to support PEIS development, to couple to inundation modeling to evaluate potential changes in off-channel habitats in the Chehalis floodplain as a result of flood control alternatives, and to inform and prioritize restoration efforts in the Chehalis floodplain.

We surveyed 56 sites for the 2016 segment of this effort across the length of the Chehalis mainstem floodplain, 37 sites were new (not surveyed in 2015). At each site, the primary survey approach was visual encounter (VES), and involved a slow walk across shallow aquatic habitats. We supplemented VES with systematic dipnet surveys to enable identifying presence of non-egg amphibian life stages and fishes. At most sites, we did three surveys at least 20 days apart through late winter-early spring to capture the egg-laying interval for both early and late breeding amphibian species. In 2016, we also added electrofishing surveys to the third survey because of concern that selected fish species may have been previously missed.

We recorded American beaver (hereafter Beaver), six stillwater-breeding amphibian species and at least 19 fish species during the 2016 egg mass surveys. We recorded four of the six ASRP non-salmonid target species; the Oregon spotted frog and Western pond turtle were not found. Three ASRP targets (Beaver, Northern red-legged frog, Olympic mudminnow) are relatively widespread (21-50 of 56 sites), but Western toad is rare and may not reproduce in floodplain off-channel habitats (3 of 56 sites). The four other native stillwater-breeding amphibian species and introduced American Bullfrogs (*Lithobates catesbeianus*) were all at least relatively

widespread (19-48 of 56 sites) in floodplain off-channel habitats. Except for western toad, all stillwater-breeding amphibian species found in 2016 had been recorded in 2015. Lastly, the proportion of sites where most non-fish species were found in 2016 was quite similar to the proportion of sites where they were recorded in 2015 except for the Long-toed salamander (*Ambystoma macrodactylum*) and beaver. We recorded Long-toed salamanders and beaver at a much greater proportion of sites in 2016 than in 2015 (Long-toed salamander: 79% vs 51%; Beaver: 68% vs 37%). For Long-toed salamander, we believe this reflects our slightly delayed survey start during the 2015 drought year because Long-toed salamander lays eggs earlier seasonally than any other stillwater-breeding amphibian. For Beaver, we believe this reflects the disproportionate number of new sites added in lower Chehalis mainstem in 2016, where beaver are thought to be more prevalent.

Of fishes, only Three-spined stickleback (*Gasterosteus aculeatus*) and Northern pikeminnow (*Ptychocheilus oregonensis*) were found at over half the sites (30-31 of 56 sites respectively), but exotic sunfishes (*Lepomis* sp.), sculpins (*Cottus* sp.), Redside shiner (*Richardsonius balteatus*) and Speckled dace (*Rhinichthys osculus*) were recorded at over one quarter of the sites (15-21 of 56 sites). Remaining fishes were found at less than one quarter of the 56 sites. Four fish species (Chum salmon [*Oncorhynchus keta*], Peamouth [*Mylocheilus caurinus*], Smallmouth bass [*Micropterus dolomieu*] and Black crappie [*Pomoxis nigromaculatus*]) were recorded in 2016 that had not been recorded during the 2015 egg mass surveys. Conversely, one fish species (Goldfish [*Carassius auratus*]) was recorded in 2015 that was not found in the 2016 egg mass surveys. Additionally, most fish species were found at more sites in 2016 than in 2015; this pattern does not reflect the electrofishing addition because only three fish taxa (Brown bullhead [*Ameiurus nebulosus*], Lamprey [all species collectively], and Pumpkinseed [*Lepomis gibbosus*]) were recorded at more sites with electrofishing than with the non-electrofishing part of the survey. We believe greater numbers in 2016 is a year effect related to the 2015 drought, though some of the pattern may also reflect the slightly more delayed sampling start in 2015 (e.g., long-toed salamander). Lastly, we detected fewer fishes and bullfrogs in off-channel habitats at the upper and lower tails of the floodplain in both years.

The 2016 effort added the second third to the egg mass survey effort planned for this biennium, so the last third (over the next year) will determine whether any patterns seen to date change significantly. Adding electrofishing to the third survey pass improved fish detection for three fish species, but also enabled detection of selected other fishes at a few other sites where non-electrofish sampling had not recorded these fishes. We intend to add electrofishing to the first two egg mass survey passes in 2017 as well because it may capture unrecognized earlier seasonal patterns. With the addition of 2016 data, incorporation of egg mass survey data into preliminary modeling can now begin. Lastly, integration of the 2016 season provides enough data to preliminarily inform off-channel habitats restoration options.

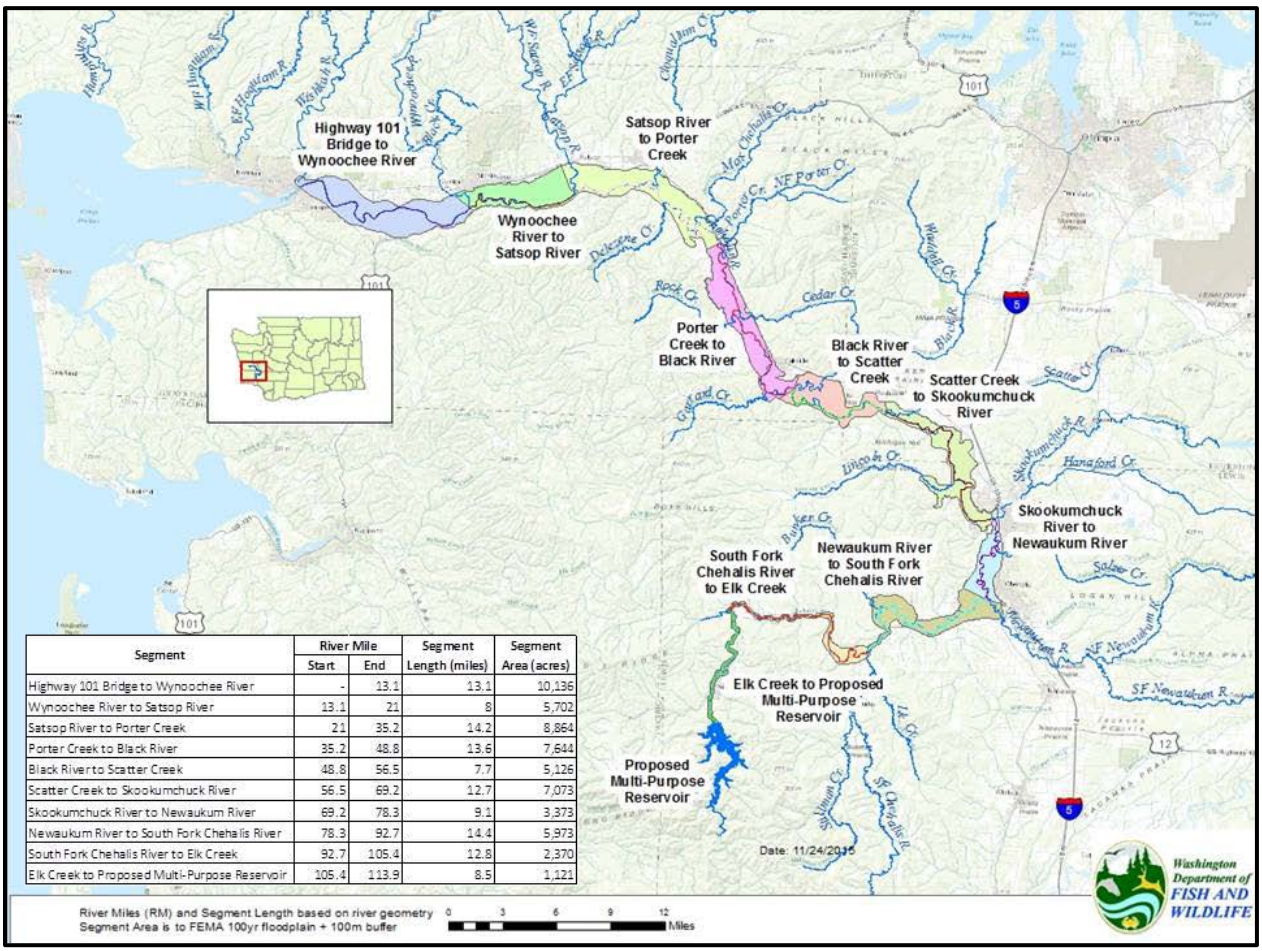
***INTRODUCTION*:** Egg mass surveys were designed to determine the distribution of stillwater-breeding amphibians and other non-salmonid species in floodplain off-channel habitats of the

mainstem Chehalis River. A focus of this effort was the six Aquatic Species Restoration Plan (ASRP) non-salmonid target species, all of which had some probability of occurring in off-channel habitats in the Chehalis floodplain: American beaver (*Castor canadensis*), Northern red-legged frog (*Rana aurora*), Olympic mudminnow (*Novumbra hubbsi*), Oregon spotted frog (*Rana pretiosa*), Western pond turtle (*Actinemys marmorata*), and Western toad (*Anaxyrus boreas*). This report updates the egg mass surveys with the 2016 effort and summarizes the patterns obtained from egg mass surveys to date.

SITE SELECTION: As we did in 2015, we chose sites for sampling in 2016 from a large pool of off-channel habitats spanning the entire floodplain of Chehalis mainstem from the proposed dam location (just above Pe Ell) to the 101 bridge in Aberdeen. The original pool of 324 off-channel habitats was developed in GIS from the 2011 and 2013 NAIP aerial photographs taken in late summer. We defined the mainstem floodplain footprint as the FEMA-specified 100-year flood line plus an added perpendicular 100 meters of width on each side of the river. Surface water during late summer conditions (as reflected in the aerial photographs) does not necessarily reflect inundated conditions during the late winter-spring period when egg mass surveys are conducted. For this reason, we cross-checked aerial photographs against field conditions early during our survey interval; this effort captured a few additional sites including a relic mill pond and some seasonally-inundated fields. Further, we also intentionally captured seven sites lapping the margin of the sampling footprint to increase the sample size in the upper floodplain, where off-channel habitats are few and access permission was more limited. These latter modifications increased the size of the site selection pool to 332. However, the GIS-developed original pool included 25 sites that we removed from consideration. Of these, 23 were manure lagoons at dairies, one was an industrial wastewater treatment holding pond, one was a high school high jump mistakenly identified as aquatic habitat in GIS, and one was a lagoon converted to a hatchery pond without wildlife access. All these sites were removed from sampling for health considerations and/or inappropriateness. Lastly, ground truthing determined that three sites originally identified as multiple polygons in GIS turned out to be functionally single sites; thus the total site pool was further reduced by three to avoid double counting. Hence, the final count of off-channel sites at the end of egg mass sampling in 2016 was 307.

We stratified our selection of sites across 10 segments of the Chehalis mainstem partitioned primarily on the entry of major tributaries (**Figure 1**). Our sampling effort is distributed over three years, so Table 1 shows the number of sites originally available (i.e., that based on 2011 NAIP aerial photograph) contrasted to the number of sites targeted for random selection over the three-years, the number of sites targeted for sampling in 2016 and 2015, and the number of sites actually sampled in those years. An important focus of this effort was to inform evaluation of proposed dam alternatives. As effects of those alternatives are expected to be most evident in mainstem river segments nearest the proposed dam, and off-channel habitats

in mainstem river segments nearest the proposed dam were few, we intentionally sampled more sites in segments nearest the proposed dam. Specifically, we selected all the sites in the two mainstem river segments nearest the dam and 50% of the sites available in the mainstem segment that was the third nearest the dam. In the remaining seven further downstream segments, we selected sites in proportion to the numbers available such that about 36% of all sites from all segments (including the three nearest the dam) would be sampled over the three years of study. Beyond the emphasis on more sampling nearer the dam, we randomized site selection within each segment. We did this with the realization that it was unrealistic to expect to obtain permission for access from every landowner; the randomization allowed us to be able to select the next site(s) in the randomized sequence within any particular segment if selected permissions for access were refused. This enabled us to reach our target numbers in both years.



Segment	River Mile		Segment Length (miles)	Segment Area (acres)
	Start	End		
Highway 101 Bridge to Wynoochee River	-	13.1	13.1	10,136
Wynoochee River to Satsop River	13.1	21	8	5,702
Satsop River to Porter Creek	21	35.2	14.2	8,864
Porter Creek to Black River	35.2	48.8	13.6	7,644
Black River to Scatter Creek	48.8	56.5	7.7	5,126
Scatter Creek to Skookumchuck River	56.5	69.2	12.7	7,073
Skookumchuck River to Newaukum River	69.2	78.3	9.1	3,373
Newaukum River to South Fork Chehalis River	78.3	92.7	14.4	5,973
South Fork Chehalis River to Elk Creek	92.7	105.4	12.8	2,370
Elk Creek to Proposed Multi-Purpose Reservoir	105.4	113.9	8.5	1,121

Figure 1. Chehalis River mainstem segments used to stratify sampling of off-channel habitats. The inset describes the start and end points (by river mile (RM), length (in miles based on measurement along the mainstem) and area (in acres) for the 10 segments (each with a unique color on the map).

SAMPLING: In 2016, we conducted three surveys of each site with a minimum of two people with the exception of three sites; two of these sites were surveyed only once, at one of these the landowner refused access after the first survey, and the third site the landowner delayed access after our second survey until it was too late seasonally to effectively conduct egg mass surveys. In 2015, we conducted three surveys at all 49 of our selected sites. In both years, the primary survey method was visual encounter (VES) but that was supplemented with dipnet sampling; specifically, we obtained 50 dipnets samples distributed across each wetland. In addition, we added electrofish sampling to the third survey in 2016 because of concerns that we might be missing selected fish species. The VES is the gold standard for detecting stillwater-breeding amphibians because their egg masses are not mobile and easily identified to species. We conducted the surveys at water depths of up to 1 m (3 ft), the focal footprint. We were able to walk into most sites, but used inflatable kayaks to facilitate access to and enable complete survey of some sites. We recorded the identity and life stage of all species encountered. We photographed at least one individual of all amphibians or fishes using a photo box with a scale to enable estimating animal size. For some species, such as beaver, we also recorded sign (chews, lodges, runways, scat, scent mounts, etc.) and also made a determination of the freshness of that sign to suggest whether or not occupancy was recent.

In 2016, we surveyed 100% of the focal (wetted) footprint of all 56 sites surveyed. In 2015, we surveyed 100% of the focal (wetted) footprint of all 49 sites surveyed except one; we surveyed about 80% of the exception because the co-owning landowner of this unit disallowed permission to access the rest of this site.

***RESULTS*:** The aforementioned selection pattern resulted in our surveying two to ten sites in 2016 across each of the 10 river segments, and three to eight sites across the same segments in 2015 (see "Completed" columns in **Table 1**). In 2016 we exceeded our target by 7 sites, with extra sites (1-3) being completed in 5 segments (compare "2016 Target" and "Completed in 2016" columns in **Table 1**).

In 2015, sites surveyed closely matched target numbers (compare "2015 Target" and "Completed in 2015" columns in **Table 1**). The sole under target exception was the Newaukum River to South Fork Chehalis River segment, which was one site short of its target. Two other segments, Elk Creek to Proposed Dam and Porter Creek to Black River, each had one site above their target number. Site sampled in remaining seven segments matched their target numbers

In 2016, we recorded four of the six possible ASRP non-salmonid target species across the 56 off-channel habitats sampled: American beaver, Northern red-legged frog, Olympic mudminnow, and Western toad. Except for Western toad, we recorded the same ASRP non-salmonid target species in 2015; Western toad was not recorded at any of the 49 off-channel habitats surveyed during egg mass surveys in 2015. In 2016, at least one of these four ASRP non-salmonid target species was detected at 98% (55 of 56) of sites surveyed; whereas in 2015, at least one of the three ASRP non-salmonid target species detected was found at 94% (46 of

49) of sites surveyed (**Table 2**). The two remaining possible ASRP non-salmonid target species that might be found, Oregon spotted frog and Western pond turtle, were not recorded in any off-channel habitats sampled in either year.

Northern red-legged frogs were the most frequently detected ASRP target species in both years (**Table 2 and Appendix Table 1**). We recorded them in every floodplain segment in both years; at 89% of sites (50 of the 56 sites) in 2016 and 88% of sites (43 of the 49 sites) in 2015. In 2016, Northern red-legged frogs were recorded at an average of 87% of the sites per river segment (range: 50-100%), and were not found at 100% of sites in four river segments (**Table 2**). In 2015, Northern red-legged frogs were recorded at an average of 88% of sites per segment (range: 33-100%), and were not found at 100% of sites in three river segments (**Table 2**).

In 2016, beaver or their sign were recorded in two-thirds (68%; 38 of 56) of sites surveyed (**Table 2)**, whereas in 2015, beaver or their sign were recorded in just over one-third (37%; 18 of 49) sites surveyed (**Appendix Table 1**). In 2016, 52% of the sites at which beaver were recorded were downstream of Scatter Creek, whereas in 2015, 72% of the sites at which beaver were recorded were downstream of Scatter Creek. Beaver were unrecorded in the downstream-most river segment in the floodplain in both years, but found in all other river segments in 2016; in contrast, beaver were unrecorded from two river segments upstream of Scatter Creek in 2015.

In 2016, we recorded Olympic mudminnow in 38% (21 of 56) of sites surveyed (**Table 2)**, whereas in 2015, Olympic mudminnow were recorded in 51% (25 of 49) of sites surveyed (**Appendix Table 1**). In 2016, 67% of the sites at which Olympic mudminnow was recorded were downstream of Scatter Creek, whereas in 2015, 80% of the sites at which Olympic mudminnow was found were similarly located. Olympic mudminnow were unrecorded in the upstream-most river and the Skookumchuck to Newaukum river segments in both years, but in 2016, was also unrecorded from the South Fork Chehalis to Elk Creek river segment (see **Table 2**).

In 2016, we recorded Western toad at only 5% (3 of 56) of sites surveyed (**Table 2**), whereas in 2015, Western toad was not recorded at any of the 49 sites surveyed (**Appendix Table 1**). In all three cases where Western toad was recorded in 2016, post-metamorphic life stages (i.e., juveniles or adults) were encountered.

In both years, we also recorded the same five non-ASRP target amphibian species: four native (Northwestern salamander [*Ambystoma gracile*], Long-toed salamander [*Ambystoma macrodactylum*], Pacific treefrog [*Pseudacris regilla*], and Rough-skinned newt [*Taricha granulosa*]) and one exotic species (American bullfrog [*Lithobates catesbeianus*]; **Table 2** and **Appendix Table 1**). In both years, Northwestern salamanders and Pacific treefrogs were widespread in a manner parallel to the Northern red-legged frog, both were recorded in all 10 river segments and both were recorded at the same percentage of sites in each year (2016: 86%: 48 of 56, **Table 1**; 2015: 86%: 42 of 49, **Appendix Table 1**) sites. Rough-skinned newts were also recorded at very similar percentages of sites each year, but this was only about one-third of sites surveyed (2016: 34%: 19 of 56, **Table 1**; 2015: 35%: 17 of 49, **Appendix Table 1**). In

contrast, Long-toed salamanders were recorded at a substantially greater proportion of sites in 2016 than in 2015 (2016: 79%: 44 of 56, **Table 1**; 2015: 51%: 25 of 49, **Appendix Table 1**). Though in 2015, we found Long-toed salamander to have a distributional pattern somewhat inverse to Beaver and Olympic Mudminnow (being recorded in over 70% of the sites in which it was found upstream of Scatter Creek), we did not observe that pattern in 2016. The American bullfrog was also found at the same percentage of sites in both years (2016: 63%, 35 of 56, **Table 1**; 2015: 63%: 31 of 49, **Appendix Table 1**). Bullfrogs were not recorded in the downstream-most river segment (i.e., below the Wynoochee River) in both years and appeared to drop in occupancy markedly above the South Fork of the Chehalis River. Overall, at least one species of amphibian was recorded at nearly every off-channel habitat sampled in both years (2016: 100%: 56 of 56, **Table 2**; 2015; 98%: 48 of 49, **Appendix Table 1**).

In 2016, besides Olympic mudminnow, we also recorded at least 19 fish species during the off-channel egg mass surveys. At least 11 of those fish species were native (**Table 3**) and at least eight fish species were not native (**Table 4**). In 2015, we recorded at least 17 fish species. At least 10 of those fish species were native (**Appendix Table 2**) and at least seven fish species were not native (**Appendix Table 3**). However, we have also received the genetic verification for some of the sculpins recorded in 2015; this includes the Prickly sculpin (*Cottus asper*), the Torrent sculpin (*C. rhotheus*), and a taxon belonging to the Riffle/Reticulate sculpin complex (*C. gulosus*/*C. perplexus* complex). Hence, the species total for 2015 is now actually at least 20. Moreover, because we are awaiting species verification for the remainder of sculpin samples in 2015 and all the sculpin and lamprey samples for 2016, we expect the species totals for both years to increase.

Of fish species, only Three-spined stickleback (*Gasterosteus aculeatus*) was recorded at over 50% of the sites in both years and it was found at nearly identical levels (2016: 54%: 30 of 56 sites, **Table 3**; 2015: 55%: 27 of 49 sites, **Appendix Table 2**). Three-spined stickleback also generally declined in occupancy with upstream position; in both years, the two downstream-most river segments had 100% occupancy and the upstream-most river segment was unoccupied.

Northern pikeminnow was also recorded at over 50% of sites in 2016 (2016: 55%: 31 of 56 sites, **Table 3**), but at only about one-third the sites surveyed in 2015 (18%: 9 of 49, **Appendix Table 2**). Northern pikeminnow appears to decline at the tails of the floodplain.

Olympic mudminnow, previously discussed, was the only other species recorded at over 50% of sites in at least one year.

Table 1. Site Numbers Summary by Chehalis Mainstem Floodplain Segment for Sites Sampled during the Egg mass-based Off-Channel Sampling. River segments are displayed in an upstream sequence. The "Available" column were the number of sites obtained from the original GIS exercise; the "3-year Target" column is the number of sites that we anticipate sampling over the three study years; the "Target" is the number of sites that should be sampled in that year; and the "Completed"" columns are the number of sites that were actually sampled in either 2015 or 2016.

River Segment		Available	3-year Target	2015 Target	Completed in 2015	2016 Target	Completed in 2016	Repeated from 2015
1	Highway 101 Bridge to Wynoochee River	18	6	2	2	2	3	0
2	Wynoochee River to Satsop River	31	10	3	3	3	4	0
3	Satsop River to Porter Creek	74	24	8	8	8	9	3
4	Porter Creek to Black River	64	21	7	8	7	7	1
5	Black River to Scatter Creek	21	8	3	3	3	3	0
6	Scatter Creek to Skookumchuck River	51	17	6	6	5	8	2
7	Skookumchuck River to Newaukum River	24	8	3	3	2	2	0
8	Newaukum River to South Fork Chehalis River	30	15	5	4	5	6	2
9	South Fork Chehalis to Elk Creek	8	8	8	8	10	10	7
10	Elk Creek to Proposed Dam	3	3	3	4	4	4	4
Totals		**324**	**120**	**48**	**49**	**49**	**56**	**49**

Table 2. Species Detection of ASRP Target Species and Non-ASRP Target Amphibians based on Numbers of Sites per Segment during Amphibian Egg Mass based Off-Channel Surveys, January-June 2016. River segments are displayed in an upstream sequence. Detection data on fishes other than Olympic mudminnow are in Tables 3 and 4. The totals in the columns labeled "Totals Sites with ASRP Targets" and "Total Sites with Amphibians" do not equal the sums of their dependent columns because more than one species often occurred at different sites.

River Segment		Sites (n =)	ASRP Target Species				Total Sites with ASRP Targets	Non-ASRP Target Amphibians					Total Sites with Amphibians
			American beaver	Northern red-legged frog	Olympic mudminnow	Western Toad		Northwestern salamander	Long-toed salamander	Pacific treefrog	Rough-skinned newt	American bullfrog	
1	Highway 101 Bridge to Wynoochee River	3	0	2	2	0	3	2	2	3	1	0	3
2	Wynoochee River to Satsop River	4	3	2	3	0	4	3	3	4	2	4	4
3	Satsop River to Porter Creek	9	8	8	7	1	9	8	5	7	2	7	9
4	Porter Creek to Black River	7	6	7	0	0	7	7	6	5	0	5	7
5	Black River to Scatter Creek	3	3	3	2	0	3	3	3	3	0	2	3
6	Scatter Creek to Skookumchuck River	8	7	8	5	0	8	6	7	6	4	6	8
7	Skookumchuck River to Newaukum River	2	2	2	0	0	2	2	2	1	1	2	2
8	Newaukum River to South Fork Chehalis River	6	4	4	2	1	5	5	5	5	3	6	6
9	South Fork Chehalis to Elk Creek	10	4	10	0	0	10	8	8	10	3	2	10
10	Elk Creek to Proposed Dam	4	1	4	0	1	4	4	3	4	3	1	4
	Totals	**56**	**38**	**50**	**21**	**3**	**55**	**48**	**44**	**48**	**19**	**35**	**56**

Of the remaining nine native fish taxa, all nine were found at a greater proportion of sites in 2016 than in 2015 (compare **Table 3** and **Appendix Table 2**). Hence, of the entire suite of 11 native fish species, only Olympic mudminnow and Three-spined stickleback were detected at a greater proportion of sites in 2015 than in 2016. Except for Three-spined stickleback, essentially all native fish species decline in occupancy at the tails of the floodplain. Outside of Olympic mudminnow, Speckled dace, and Three-spined stickleback, the only other native fishes recorded at over a quarter of the sites in either year were Redside shiner (2016 only) and unidentified sculpins (both years). The latter undoubtedly represent a species suite. Two native fish species (Chum salmon [*Oncorhynchus keta*] and Peamouth [*Mylocheilus caurinus*]) were recorded in off-channel habitats in 2016 that were not recorded in 2015 (compare **Table 3** to **Appendix Table 2**).

In 2016, we recorded at least eight non-native fish species in off-channel habitats. Two non-native fish species, Black crappie (*Pomoxis nigromaculatus*) and Smallmouth bass (*Micropterus dolomieu*), were recorded in 2016 that were not detected in 2015 (compare **Table 4** and **Appendix Table 3**). One non-native fish species, the Common goldfish (*Carassius auratus*), was recorded in 2015 but not 2016. Only two non-native fish taxa were recorded at at least 20% of the sites in either year or both years; these were Rock bass (*Ambloplites rupestris*) and unidentified sunfishes (*Lepomis* sp.). Unidentified sunfishes are likely to represent more than one taxon, which might include Bluegill (Lepomis macrochirus), Pumpkinseed (Lepomis gibbosus), hybrids between the two, or a unique sunfish taxon.

We resampled 19 off-channel sites in 2016 that had been sampled in 2015. For amphibians, we recorded no change (i.e., the same species present or undetected) at at least 16 of the 19 sites for all species except long-toed salamander (**Table 5**). Across all amphibian species, of the 16 instances where the same species was not recorded between years at a site, the species was recorded in 2016 when it had not been recorded in 2015 88% of the time (n = 14); for the remaining 12% (n = 2), it was recorded in 2015 when it had not been recorded in 2016. Long-toed salamander was detected at a substantially greater number of repeat sampled sites in 2016 (84%) than in 2015 (58%; **Table 5**). However, for a few species where little change (American bullfrog) or no change (Rough-skinned newt) in number of sites at which the species detected was identified, number similarity conceals detection at a few different sites between years. Specifically, for the American bullfrog, we recorded it at two sites in 2016 where it had been unrecorded in 2015, and also recorded it a one site in 2015 where it was unrecorded in 2016. Likewise, we recorded Rough-skinned newt at one site in 2016 where it had not be recorded in 2015, and vice versa.

Of the 11 native fishes recorded in the 19 repeat-sampled off-channel sites, all except two were recorded at a greater proportion of sites in 2016 than in 2015 (**Table 5**). That suite included five species recorded only at these sites in 2016: Chum and Coho salmon, Largescale sucker, Redside shiner, and Unidentified lamprey. The two species that were recorded at a

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Table 3. Detection of Native Fish Species based on Numbers of Sites per Segment during Amphibian Egg Mass based Off-Channel Surveys, January-June 2016. River segments are displayed in an upstream sequence. Olympic Mudminnow data are provided in **Table 2** and Non-native fish species detection data are provided in **Table 4**. Unidentified lamprey and sculpin detections may represent more than one species; fin clips from unidentified sculpin detections will be processed to determine species identities. The "Total Sites with Native Fishes column includes Olympic mudminnow (data from **Table 2**) and the totals do not equal the sum of their dependent columns because more than one species often occurred at different sites.

	River Segment	Sites (n =)	Chinook salmon	Chum salmon	Coho salmon	Largescale sucker	Northern pikeminnow	Peamouth	Redside shiner	Speckled dace	Three-spined stickleback	Unidentified lamprey	Unidentified sculpin	Total Sites with Native Fishes
1	Highway 101 Bridge to Wynoochee River	3	1	2	0	1	1	1	1	0	3	0	1	3
2	Wynoochee River to Satsop River	4	1	0	0	3	4	0	2	2	4	0	1	4
3	Satsop River to Porter Creek	9	1	2	2	4	6	0	3	3	6	5	5	9
4	Porter Creek to Black River	7	0	0	0	0	6	0	2	2	4	0	3	6
5	Black River to Scatter Creek	3	0	0	0	0	2	0	1	1	3	0	1	3
6	Scatter Creek to Skookumchuck River	8	2	0	1	3	3	0	2	2	4	0	4	6
7	Skookumchuck River to Newaukum River	2	0	0	0	0	0	0	0	0	1	0	1	2
8	Newaukum River to South Fork Chehalis River	6	1	0	2	2	6	1	3	2	4	1	3	6
9	South Fork Chehalis to Elk Creek	10	0	0	2	0	3	0	2	2	1	0	2	5
10	Elk Creek to Proposed Dam	4	0	0	0	0	0	0	0	1	0	0	0	1
	Totals	**56**	**6**	**4**	**7**	**13**	**31**	**2**	**16**	**15**	**30**	**6**	**21**	**45**

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Table 4. Detection of Non-Native Fish Species based on Numbers of Sites per Segment during Amphibian Egg Mass based Off-Channel Surveys, January - June 2016. River segments are displayed in an upstream sequence. Olympic Mudminnow data are provided in **Table 2** and Native fish species data are provided in **Table 3**. Unknown sunfish detections may represent more than one species; fin clips from unknown sunfish detections are currently being processed to determine species identities.

River Segment		Sites (n =)	Black crappie	Bluegill	Brown bullhead	Largemouth bass	Pumpkinseed	Rock bass	Smallmouth bass	Yellow perch	Unidentified sunfish	Total Sites with Non-native Fishes
1	Highway 101 Bridge to Wynoochee River	3	0	0	0	0	0	1	0	0	1	1
2	Wynoochee River to Satsop River	4	1	0	0	0	0	0	0	0	0	1
3	Satsop River to Porter Creek	9	1	2	2	1	2	3	0	1	6	6
4	Porter Creek to Black River	7	1	0	0	2	1	0	0	0	4	3
5	Black River to Scatter Creek	3	0	1	0	1	1	1	0	0	1	1
6	Scatter Creek to Skookumchuck River	8	0	1	1	1	0	3	0	0	4	4
7	Skookumchuck River to Newaukum River	2	1	1	1	1	1	0	0	0	1	1
8	Newaukum River to South Fork Chehalis River	6	0	1	0	2	3	3	1	1	2	6
9	South Fork Chehalis to Elk Creek	10	0	0	0	1	0	1	1	0	1	1
10	Elk Creek to Proposed Dam	4	0	0	0	0	0	0	0	0	0	0
	Totals	**56**	**4**	**6**	**4**	**9**	**8**	**12**	**2**	**2**	**20**	**24**

Table 5. Comparison of amphibian and fish species at of the 19 sites repeat sampled between 2015 and 2016. To enable this comparison, prickly sculpin (*Cottus asper*) from 2015 were lumped into unidentified sculpin for that year and electrofishing data obtained at the third pass in 2016 were excluded. Three species recorded elsewhere during the 2015-2016 egg mass surveys were not recorded at any of the 19 repeat-sampled sites; these were Chinook salmon, Common carp, and Peamouth.

Species	Native (N) or Exotic (E)	2015 Sites Detected	2015 %	2016 Sites Detected	2016 %
Amphibians					
Long-toed salamander	N	11	58	16	84
Northern red-legged frog	N	17	89	19	100
Northwestern salamander	N	17	89	18	95
Pacific treefrog	N	17	89	18	95
Rough-skinned newt	N	10	53	10	53
Western toad	N	0	0	2	11
American bullfrog	E	8	42	9	47
Fishes					
Black crappie	E	0	0	1	5
Bluegill	E	4	21	3	16
Brown bullhead	E	1	5	0	0
Chum salmon	N	0	0	2	11
Coho salmon	N	0	0	3	16
Goldfish	E	1	5	0	0
Lamprey sp.	N	0	0	2	11
Largescale sucker	N	0	0	3	16
Northern pikeminnow	N	2	11	7	37
Olympic mudminnow	N	6	32	3	16
Pumpkinseed	E	1	5	3	16

Redside shiner	N	0	0	4	21
Rock bass	E	2	11	3	16
Largemouth bass	E	0	0	2	11
Smallmouth bass	E	0	0	1	5
Speckled dace	N	2	11	3	11
Three-spined stickleback	N	7	37	3	16
Unidentified sculpin	N	2	11	3	16
Unidentified sunfish	E	4	21	6	32
Yellow perch	E	2	11	1	5

greater proportion of the repeat-sampled sites in 2015 than in 2016 was Olympic mudminnow and Three-spined stickleback.

Of the 10 non-native fishes recorded in the 19 repeat-sampled off-channel sites, all except three were recorded at a greater proportion of sites in 2016 than in 2015 (**Table 5**). That suite included three species recorded only at these sites in 2016: Black crappie and Large- and smallmouth bass. The three species recorded at a greater proportion of the repeat-sampled sites in 2015 than in 2016 were Bluegill, Brown bullhead, and Goldfish; Brown bullhead and Goldfish were recorded exclusively in 2015.

DISCUSSION: The 2016 egg mass surveys represent about a third of the planned effort for this particular study in the Chehalis, so at this stage roughly two-thirds of the egg mass survey effort has been completed. Assessment to date is based on naïve occupancy patterns, but the dataset is now large enough to integrate into modeling efforts, and selected statistical analysis await the larger dataset. Nonetheless, selected patterns appear to be emerging, which are:

1) With the exception of Western toads, four of the remaining native species of stillwater amphibians (namely, Long-toed salamanders, Northern red-legged frogs, Northwestern salamanders, and Pacific Treefrogs) make widespread use of Chehalis floodplain off-channel habitats for reproduction and rearing. Long-toed salamander was found at a considerable smaller proportion of sites in 2015, but we believe this simply reflects the delayed start of sampling during a drought year. Further, a fifth species, Rough-skinned newts are also relatively widespread use of Chehalis floodplain off-channel habitats for reproduction and rearing, but newts appear to be about half as frequent as the aforementioned four species. We make the latter conclusion with caution because Rough-skinned newts were evaluated exclusively based on larval and post-metamorphic life stages, which may limit detectability. Further, non-egg newt life stages typically favor warmer water, and hence, are generally less active during the time interval egg mass surveys were conducted, which could have contributed to missing newts at some sites. However, larval newts are also highly vulnerable to fish predation, especially exotics, so newt detection may have been influence by the presence of predatory exotic fishes. Bias in detection as a function of the early season egg mass survey interval can be assessed by comparison to the late spring and summer trapping-based extensive surveys of off-channel habitats; bias due to predatory exotic fishes can be assessed by examining the same data for the suite of exotic predatory fishes that may be present. The exotic American bullfrog also makes relatively widespread use of floodplain off-channel habitats for parallel reasons. We expect naïve (unmanipulated) data (presented here) to somewhat underestimate the off-channel habitat use for all these species because despite being a rigorous approach, the three-pass VES/dipnet/electrofish sampling system may miss populations occurring at very low densities. We also anticipate that American bullfrog presence may also be underestimated if this species either did not successfully

reproduce or its reproductive output failed (complete mortality of pre-metamorphic life stages) in 2015, because post-metamorphic American bullfrogs are less frequently surface active during the late winter-early spring interval when we conducted egg mass surveys. Projected modeling will provide meaningful (confidence interval-bounded) occupancy estimates for these taxa in off-channel habitats and enable deducing patterns from habitat co-variates that can estimate limiting factors and inform restoration options. The late spring and summer-based extensive sampling effort in off-channel habitats (in a companion report) will help gauge how much post-metamorphic bullfrogs may have been missed during the egg mass survey interval.

2) Our infrequent detection of Western toad in Chehalis mainstem floodplain off-channel habitats was unexpected; no Western toad life stages were found in 2015, and Western toad life stage were recorded at only three sites in 2016. Furthermore, at all three sites, few post-metamorphic life stages were found. Since Western toads can move multi-kilometer distances following metamorphosis (Bartelt et al 2004, Adams et al. 2005, Bartelt et al. 2010) and all three sites where post-metamorphic toads were recorded are within expected travelling distances of known either riverine or major tributary breeding sites, Western toads may not breed in off-channel habitats in the Chehalis floodplain. However, Western toads are well known to favor stillwater habitats for breeding (Jones et al. 2005), so the lack of Western toad breeding in the off-channel habitats we surveyed suggests that in their current state, Chehalis floodplain off-channel habitats are somehow unsuitable for Western Toad. Unsuitability could be related to lack of breeding habitat (western toads deposit eggs in unvegetated shallow water), exotics disfavoring toad presence, or another unidentified factor or combination of factors. The remaining years of egg mass survey effort in off-channel habitats will enable identifying whether lack of Western toads in off-channel habitats represents a real pattern, and if it is, analysis of off-channel habitat co-variates can suggest the basis of unsuitability. Lastly, given our frequent encounters of breeding Western Toad in the Chehalis mainstem after the water levels dropped seasonally in both 2014 and 2016 using VES/dipnet sampling, the lack of Western toad in floodplain off-channel habitats is unlikely to result from any kind of a sampling issue.
3) Olympic mudminnow and American beaver were recorded more frequently in the lower Chehalis River below Scatter Creek. This may reflect the greater extent of off-channel habitat in the lower river. We caution, however, that our diurnal VES/dipnet sampling system was not designed to detect typically nocturnal beaver and we expect to integrate several other datasets to develop a more complete picture of beaver distribution in the floodplain. Still, though we recognize that our diurnal VES/dipnet/electrofish sampling system is biased against detecting typically nocturnal beaver, we do not expect that bias to change as a function of floodplain location; hence, we expect the pattern of more

beaver in the lower floodplain to hold up regardless of what other data sources are added. Similar to the amphibian species discussed in number 1 above, we expect that three-pass VES/dipnet/electrofish sampling system may miss Olympic mudminnow populations occurring at very low densities. We expect that the alternative (trapping) sampling systems implemented during the extensive summer sampling program will help gauge where Olympic mudminnow may have been missed.

4) American bullfrog was not recorded in off-channel habitats above Elk Creek and below the Wynoochee River. In both cases, it may reflect a lack of suitable habitat for bullfrogs, but the alternative (trapping) sampling systems implemented during the extensive summer sampling program in 2015 suggested that this pattern will hold up.

5) Northern pikeminnow, Olympic mudminnow and Three-spined stickleback were the only three fish species detected in over 50% of off-channel habitats in either one or both years. We speculated previously for the latter two of these species that this pattern might reflect the ease with which they can be captured with dipnet sampling because most other fish sampled except for sculpins represent faster-swimming species. However, our addition of electrofishing, while it improved detection of Brown bullhead, Lamprey, and Pumpkinseed, it did not improve the capture of other so-called faster swimming species. In fact, we also captured four times as many salmonids using dipnet sampling as we did with electrofishing in 2016. Since the dataset reveals a very large asymmetry in the proportion of species that were captured at a greater proportion of sites in 2016 versus 2015, we believe that another better suited explanation exists. We believe the explanation lies in the sharp contrast between extreme wet conditions in the October-March 2016 interval with the extreme drought condition over the same period in 2015, and that this limited the aquatic footprint of off-channel habitats in 2015 and likely fish access.

We should also note that genetic verification of species identities for sculpins and sunfishes will likely change the picture of the fish species assemblage as well as selected analyses. Genetic verification is currently underway and we await species verification on the remainder of the samples of sculpin for 2015, and all the lamprey, sculpin, and juvenile sunfish samples for 2016.

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In 2015, This work was conducted with permission of the Archdiocesan Housing Authority, Cedarville Farms, Claquato Farms, Confederated Chehalis Tribes, City of Centralia, City of

Montesano, Gordon Dairy Inc, Green Diamond Resource Company, Harold LeMay Investment Company, KBT Farms Inc, Lantbruk LLC, Masco Petroleum, McFarland Cascade, Port of Grays Harbor, Stillwater Estates Inc, Weyerhaeuser Company, Washington Department of Fish and Wildlife, Washington State Parks, Woods at Sylvia Creek and 35 other private landowners that allowed access to their lands.

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Appendix Table 1. Species Detection of ASRP Target Species and Non-ASRP Target Amphibians based on Numbers of Sites per Segment during Amphibian Egg Mass based Off-Channel Surveys, February-May 2015. River segments are displayed in an upstream sequence. Detection data on fishes other than Olympic mudminnow are in Tables 3 and 4. The totals in the columns labeled "Totals Sites with ASRP Targets" and "Total Sites with Amphibians" do not equal the sums of their dependent columns because more than one species often occurred at different sites.

River Segment		Sites (n =)	ASRP Target Species			Total Sites with ASRP Targets	Non-ASRP Target Amphibians					Total Sites with Amphibians
			American beaver	Northern red-legged frog	Olympic mudminnow		Northwestern salamander	Long-toed salamander	Pacific treefrog	Rough-skinned newt	American bullfrog	
1	Highway 101 Bridge to Wynoochee River	2	0	2	2	2	2	1	1	1	0	2
2	Wynoochee River to Satsop River	3	2	3	3	3	3	1	2	1	3	3
3	Satsop River to Porter Creek	8	3	6	8	8	7	0	6	3	7	8
4	Porter Creek to Black River	8	6	8	6	8	7	5	7	3	7	8
5	Black River to Scatter Creek	3	2	3	1	3	3	0	3	1	3	3
6	Scatter Creek to Skookumchuck River	6	0	6	2*	6	4	5	6	1	5	6
7	Skookumchuck River to Newaukum River	3	2	1	0	2	2	1	1	0	2	2
8	Newaukum River to South Fork Chehalis River	4	0	4	2	4	4	3	4	1	3	4
9	South Fork Chehalis to Elk Creek	8	2	6	1	6	6	6	8	2	1	8
10	Elk Creek to Proposed Dam	4	1	4	0	4	4	3	4	4	1*	4
	Totals	**49**	**18**	**43**	**25**	**46**	**42**	**25**	**42**	**17**	**31**	**48**

*An asterisk indicates that the species in one site in the indicated cell represents a sighting unverified by a photograph or other direct evidence.

Appendix Table 2. Detection of Native Fish Species based on Numbers of Sites per Segment during Amphibian Egg Mass based Off-Channel Surveys, February-May 2015. River segments are displayed in an upstream sequence. Olympic Mudminnow data are provided in **Table 2** and Non-native fish species detection data are provided in **Table 4**. Unidentified lamprey and sculpin detections may represent more than one species; fin clips from unidentified sculpin detections are currently being processed to determine species identities. The "Total Sites with Native Fishes column includes Olympic mudminnow (data from **Table 2**) and the totals do not equal the sum of their dependent columns because more than one species often occurred at different sites.

River Segment		Sites (n =)	Chinook salmon	Coho Salmon	Largescale Sucker	Northern Pikeminnow	Prickly Sculpin	Redside Shiner	Speckled Dace	Three-spined Stickleback	Unidentified Lamprey	Unidentified Sculpin	Total Sites with Native Fishes
1	Highway 101 Bridge to Wynoochee River	2	0	0	0	0	0	0	0	2	0	0	2
2	Wynoochee River to Satsop River	3	0	1	0	1	0	0	0	3	0	1	3
3	Satsop River to Porter Creek	8	0	0	0	1	2	0	1	7	0	4	8
4	Porter Creek to Black River	8	0	2	0	2	0	1	2	5	0	1	6
5	Black River to Scatter Creek	3	0	0	0	0	0	1	0	2	0	0	2
6	Scatter Creek to Skookumchuck River	6	1	1	0	2	1	1	2	3	1	1	3
7	Skookumchuck River to Newaukum River	3	0	0	1	2	1	0	1	1	0	2	3
8	Newaukum River to South Fork Chehalis River	4	0	0	0	1	0	0	0	4	0	0	4
9	South Fork Chehalis to Elk Creek	8	0	0	0	0	0	0	0	0	0	1	1
10	Elk Creek to Proposed Dam	4	0	0	0	0	0	0	0	0	0	0	0
	Totals	**49**	**1**	**4**	**1**	**9**	**4**	**3**	**6**	**27**	**1**	**10**	**32**

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Appendix Table 3. Detection of Non-Native Fish Species based on Numbers of Sites per Segment during Amphibian Egg Mass based Off-Channel Surveys, February-May 2015. River segments are displayed in an upstream sequence. Olympic Mudminnow data are provided in **Table 2** and Native fish species data are provided in **Table 3**. Unknown sunfish detections may represent more than one species; fin clips from unknown sunfish detections are currently being processed to determine species identities.

River Segment		Sites (n =)	Bluegill	Brown Bullhead	Goldfish	Largemouth Bass	Pumpkinseed	Rock Bass	Yellow Perch	Unidentified Sunfish	Total Sites with Non-native Fishes
1	Highway 101 Bridge to Wynoochee River	2	0	0	0	0	0	0	0	0	0
2	Wynoochee River to Satsop River	3	0	0	0	0	0	0	0	1	1
3	Satsop River to Porter Creek	8	1	1	0	1	1	0	1	4	5
4	Porter Creek to Black River	8	0	0	0	1	0	1	1	2	3
5	Black River to Scatter Creek	3	0	0	0	0	0	0	0	0	0
6	Scatter Creek to Skookumchuck River	6	2	0	0	0	0	1	1	1	3
7	Skookumchuck River to Newaukum River	3	0	0	0	0	0	0	0	1	1
8	Newaukum River to South Fork Chehalis River	4	0	0	1	0	0	1	0	1	1
9	South Fork Chehalis to Elk Creek	8	1	0	0	0	0	1	0	0	1
10	Elk Creek to Proposed Dam	4	0	0	0	0	0	0	0	0	0
	Totals	**49**	**4**	**1**	**1**	**2**	**1**	**4**	**3**	**10**	**15**