The Nason Creek Fill Removal and Oxbow Enhancement Project (N1)



2016 Monitoring Report

Prepared by: Chelan County Natural Resources Department

Adrienne Roumasset, February 2017

Project Description

The Nason Creek Fill Removal and Oxbow Enhancement Project ("N1") was completed in October of 2014 (Figures 1 and 2). The site is located between river mile 3.9 and 4.6 of Nason Creek. Specific construction elements include:

- Remove 1,325 cubic yards of fill near RM 4.6 on river left and remove 1,825 cubic yards of parking lot fill on river right for a total of 0.64 acres of floodplain fill removal. The floodplain fill was placed as part of a historic bridge that crossed over Nason Creek. The bridge washed out in the 1990s but road approach fill (modern use parking lot) on the south side of Nason Creek and bridge abutment fill on the north side remained, resulting in floodplain disconnection on both sides of Nason Creek.
- 2) Install 28 pieces of large wood in the upstream area of a side channel oxbow that CCNRD reconnected in 2007 near RM 3.9.

Nason Creek has been identified as the top priority for habitat restoration actions in the Wenatchee watershed and is a major spawning area for spring Chinook and steelhead. The highest priority ecological concern is the lack of peripheral and transitional habitats. The purpose of the Nason Creek Fill Removal and Oxbow Enhancement Project is to address this concern by restoring floodplain function in the fill removal area and improving habitat complexity in the oxbow. Specific project goals are to:

- Restore channel migration potential and natural stream processes near RM 4.6, including enhancing the activation of an existing relic side channel on river left (located just downstream of the project area)
- 2) Remove floodplain fill on river right near RM 4.6 and provide off-channel rearing and refuge in a side channel created through the floodplain.
- 3) Increase in-stream structure to provide fish cover in the 2007 oxbow by altering sediment deposition patterns and thus promoting future vegetation establishment. Since the wood was placed to alter sediment deposition patterns and increase future vegetation establishment, most of the wood placed is intended to be inundated seasonally during the OHW flow elevation (~700-1000 cfs). Wood placement methods did not allow use of mechanized equipment, therefore, the wood was initially designed to remain stable up to the 5 year event with additional stability being provided in the future through vegetation establishment around the large wood structures.
- 4) Re-vegetate work areas.

Figure 1. Restoration elements of the Nason Creek Fill Removal and Oxbow Enhancement Project (N1)



Figure 2. Pre-construction LIDAR of floodplain elements associated with abutment and parking lot removal. "Channel around fill" is also referred to as the "old channel" in this report.



Monitoring Methods

This site is monitored by Tetra-tech, Yakama Nation and CCNRD. Monitoring components and methods are below.

A portion of this project, the floodplain parking lot fill removal near Hwy 207, is being monitored by Tetra-Tech through the SRFB monitoring program to evaluate floodplain enhancement project effectiveness. Tetra Tech has collected two seasons of pre-construction data (2013 and 2014) and two seasons of post-construction data (2015 and 2016). Monitoring elements include bi-annual snorkel surveys of the constructed side channel and biennial topographic survey. No topographic survey was completed in 2016 – the 2015 survey is incorporated in the 2015 CCNRD Monitoring report. The 2014 Tetra Tech pre-construction monitoring report is available online at http://waconnect.paladinpanoramic.com/project/290/39853 and the 2015 results were incorporated

into a report available online at http://www.rco.wa.gov/doc pages/other pubs.shtml#monitoring

The Yakama Nation conducts snorkel surveys in the 2007 oxbow as a reference site for the Lower White Pine re-connection project. Snorkel survey data from 2012 – 2016 is included in this report and further described in the CCNRD Lower White Pine monitoring report.

Since the Tetra Tech and Yakama nation fish surveys only cover a portion of the project area and the data they are collecting does not document whether or not the project meets all of the four project goals, CCNRD has developed a monitoring plan to collect supplemental data in the project area. CCNRD also collects vegetation and shade surveys to document compliance with permitting (DOE and Corps) and funding (DOE) requirements. The shade monitoring protocol is available at https://fortress.wa.gov/ecy/publications/SummaryPages/1510049.html. CCNRD has visits the site to photo document high and low flow conditions, conduct vegetation monitoring, and track large wood placed in the oxbow. These supplemental monitoring methods are further described below.

Photo point monitoring (i.e. Peak and Low flow Monitoring)

Goals addressed:

1) Restore channel migration potential and natural stream processes on river left, including enhancing activation of the relic side channel located downstream of the project area.

2) Provide high-flow refuge habitat in the excavated channel and increase floodplain inundation on river right (high and moderate flow photos).

3) Provide fish cover in the 2007 oxbow and potentially alter sediment deposition patterns and promote vegetation establishment.

4) Revegetate the fill removal areas (low flow photos).

Photo points were established pre-construction and are repeated post-construction at least twice a year- in the summer during low flow and in the Spring at or near peak flow. In 2016, CCNRD staff took photos on April 21st, when Nason Creek was 1750 cfs and on September 1st at a flow of 36 cfs. Photos document function of the constructed channel on river right, floodplain activation, and condition

of and around large wood placed in the oxbow. Photos are presented with those taken in 2015 to document change within the project area.

Riparian Vegetation Monitoring

4) Revegetate the fill removal areas (river right and left).

Vegetation monitoring documents the re-establishment of floodplain and wetland vegetation following the floodplain fill removal. The HPA permit requires that the project sponsors achieve 80 percent survival of installed plants. Percent survival was calculated by dividing stem count numbers by the number of plants installed in the fall of 2014, following fill removal and side channel excavation. CCNRD staff conducted a stem count of both the river right and river left planted areas on August 20th, 2015, and of river left areas on August 26th, 2016. Staff also collected data per the Shade Monitoring for the Wenatchee Basin Water Quality Restoration Project (see associated Quality Assurance Project Plan, link above, for detailed methods) in the parking lot fill removal area in August 2015 and in both the parking lot and abutment fill removal areas in September 2016.

A brush mattress was installed on the high water mark on river left in the abutment removal area. CCNRD staff noted cover and survival of the mattress during the September 2016 visit.

<u>Fish Use</u>

Goals addressed:

2) Provide high-flow refuge habitat in the excavated channel and increase floodplain inundation on river right.

3) Provide fish cover in the 2007 oxbow and potentially alter sediment deposition patterns and promote vegetation establishment.

Tetra tech conducted snorkel surveys in the constructed channel in Spring of 2014, 2015 and 2016. CCNRD also documented fish use of the constructed channel on May 19th, 2016 when the whole channel was actively flowing (the newly constructed channel is primarily rain-melt fed from the upstream end with some Nason Creek backwater at the downstream end). All snorkel data of the constructed channel to date is presented in this report.

The Yakama Nation snorkeled the 2007 oxbow on March 8th, 2016 at a mainstem flow of 542 cfs and on August 9th, 2016 at a mainstem flow of 69.9 cfs. These results are included with pre-construction surveys conducted in March and August 2014 and post-construction surveys conducted in March and August 2015.

Results

Photo Point Monitoring (Spring runoff)

Goal 1) Restore channel migration potential and natural stream processes on river left (i.e. abutment removal site), including enhancing activation of the relic side channel located downstream of the project area.

Figure 3. Nason Creek 2016 Hydrograph.



The abutment removal area is active and flooded at high flow and has undergone natural process, including channel formation and relic side channel activation, following fill removal. Initial post-construction floods in November 2014 formed a "new channel" that extends across the floodplain from the upstream beaver pond to a breach in the brush mattress that formed during this same flood. The floodplain was under water and both the relic side channel and the new floodplain channel were activated on April 21, 2016 when the Nason Creek gage recorded 1750 cfs (Figure 5). Flood waters were from both Nason Creek and the beaver pond (Figure 2). The brush mattress was inundated, partially out of the water and along with the activated floodplain provided high flow refuge habitat to juvenile salmonids.



Figure 4. Post-construction FEMA lidar flown with locations of relic and new side-channels.

Figure 5. The abutment removal area floodplain was active April 21, 2016 at 1750 cfs.



Goal 2) Provide high-flow refuge habitat in the excavated channel and increase floodplain inundation on river right.

The river right parking lot removal floodplain was inundated on the northwest side of the constructed channel during the April 21st, 2016 visit at a mainstem flow of 1750 cfs (Figure 6). Slash within the flooded area had been mobilized and was built up at the outlet of the constructed channel (Figure 6). The constructed channel was active and its banks were overtopped mid channel adjacent to the floodplain inundation (Figure 6).

Figure 6. Parking lot fill removal area on April 21st, 2016 at 1750 cfs



Flooding on northwest side of floodplain



Mobilized slash from northwest side at downstream end of constructed channel



Constructed channel was activated

Goal 3) Provide fish cover in the 2007 oxbow and potentially alter sediment deposition patterns and promote vegetation establishment.

Large flood events in late fall of 2015 (estimated 10-year flood, Figure 3) resulted in significant change in the 2007 oxbow and the mainstem Nason Creek in the oxbow vicinity (Figure 7). The inlet of the oxbow is located on a side-channel of Nason Creek. A large log jam at the head of this side-channel shifted considerably during the flood, causing more water to be diverted into the side-channel and also into the 2007 oxbow. During their snorkel survey in March 2016, Yakama Nation staff noted a shift in both reaches from the typical slow, off-channel habitat to higher water velocities. In addition, 10 of the 28 pieces of wood that were added to the 2007 oxbow in 2014 were displaced during this flood – wood placed in the oxbow was designed to withstand the 5-year event. All wood still present (8 perimeter logs, 2 near the inlet and 8 in the downstream of the inlet) were partially inundated and provided instream and overhead fish cover on April 21st, 2016, during a typical high flow of 1750 cfs (Figure 8). All wood added complexity and structure to the widened inlet area of the 2007 oxbow.



Figure 7. 2007 Oxbow, December 9th, 2015; 2,730 cfs (just following 10-year event)

Figure 8. Photos during typical high flow, April 21st, 2016; 1750 cfs.



Low Flow Monitoring

Goal 1) Restore channel migration potential and natural stream processes on river left, including enhancing activation of the relic side channel (Figure 2) downstream of the project area.

Low flow monitoring indicates that the natural stream processes continue to change the abutment floodplain and have resulted in enhanced activation of the floodplain, relic side-channel and new channel (Figure 9, PP18). Photo points indicate that while the channel was dry in the summer of 2015, the new channel was flowing at approximately 1 cfs on September 1st, 2016 during a similar flow level (Figure 9, PP9). This and photo points of the channel outlet indicate that the new channel, initially formed in fall floods of 2014, underwent further natural excavation in the late fall flood of 2015 (Figure 9 and 10). The floodplain and relic side-channel were also watered and active on September 1st, 2016 at a mainstem flow of 36 cfs – like the new channel, these elements were both dry on August 20th, 2015 at 29 cfs. The relic side channel was watered from the inlet to approximately 50 feet into the woods east of the floodplain on September 1.

Figure 9. Photo points indicate enhanced floodplain inundation and channel excavation



PP 18 – Aug 20, 2015; 29cfs floodplain dry



PP 18 - Sep 1, 2016; 36 cfs, floodplain active



PP9-Aug 20, 2015; 29cfs



PP 9 – Sep 1, 2016; 36 cfs

Figure 10. Additional photo points



Relic side channel inlet active at 36 cfs

New channel active at 36 cfs

Goal 2) Provide high-flow refuge habitat in the excavated channel and increase floodplain inundation on river right.

As designed, the river right parking lot floodplain was dry during the low flow visit on September 1st, 2016 (Figure 11). Scour that occurred in the late fall 2015 flood was observed in the northwest area of the floodplain and had resulted in an area of cleared slash, exposed cobble, and some willow mortality (Figure 11, see riparian monitoring section for more detail). This is considered natural process and congruent with design goals. No erosion or sediment deposition issues were observed in the constructed channel.

Figure 11. Parking lot floodplain on September 1, 2016, Nason creek flow 36 cfs



PP17-Aug 20, 2015

PP17 – Sep 1, 2016



PP18

PP18. Sep 1, 2016 – exposed cobble in upper right corner due to scour that occurred in Nov 2015 flood

Goal 3) Provide fish cover in the 2007 oxbow and potentially alter sediment deposition patterns and promote vegetation establishment.

CCNRD staff confirmed the displacement of 10 of the 28 added logs in the 2007 oxbow during the low flow visit on September 1, 2016 (Figure 12). Photo points also depict other changes to the 2007 oxbow that occurred as a result of the 10-year flood in late fall 2015, including some shifting of coarse sediment (Figure 12 PP2) and more of the total Nason Creek flow being diverted into the oxbow (Figure 12 PP1). Photo points confirm that although 2015 and 2016 low flow photos were shot during similar flow levels, substantially more water is present in the oxbow during low flow 2016 resulting in higher water velocities (Figure 12). Deposition of fine sediment and willow and cottonwood establishment around wood placed in the oxbow was also recorded (see vegetation monitoring for more detail).

Figure 12. 2007 oxbow on September 1, 2016, Nason creek flow 36 cfs



PP1 - Aug 20, 2015; 29cfs

PP1 – Sep 1, 2016; 36 cfs



PP2, Aug 20, 2015; 29cfs

PP2, Sept 1, 2016; 36 cfs

CCNRD was able to definitively locate 4 of the 10 displaced logs on a float of the oxbow on August 23, 2016. All were hung up on major beaver dams downstream of the widened inlet area (Figure 13 and 14). It was difficult to discern logs acquired for restoration from the large amount of natural wood accumulation throughout the oxbow. Therefore, other restoration logs were likely present but may have been submerged or hidden from view among naturally recruited wood.

Figure 13. 4 of the displaced restoration logs were found on two beaver dams on August 23, 2016.



Figure 14. Four of the ten logs displaced in the November 2015 flood were found on beaver dams downstream in oxbow.



Riparian Monitoring

Goal 4) Revegetate the fill removal areas (river right and left).

Parking lot floodplain:

Results of stem counts on the parking lot removal site indicate an increase in installed plant survival from 89 percent in 2015 to 92 percent in 2016. (Table 1). Natural revegetation and minor error in counts account for the increase. The decrease in willow counts from 77 to 69 (Table 1) was primarily in the north side of the floodplain, where floodplain scour and slash mobilization during the late fall 2015 flood caused substantial willow mortality. Photo points indicate a substantial increase in ground cover site wide, composed of native grasses from seed spread following fill removal and naturally recruited alluvium species (Figure 15). CCNRD staff estimated site wide shrub cover at 10 percent and ground cover at 50-60 percent in 2016.

Table 1. Stem Count Parking lot Floodplain

Species	Count 8/21/2016	Count 8/20/15	Installed 2014	survival 2015 to 2016	survival install to 2016
AMELANCHIER ALNIFOLIA- serviceberry	19	17	17	1.12	1.12
CORNUS SERICEA- red osier dogwood	170	133	136	1.28	1.25
HOLODISCUS DISCOLOR- ocean spray	20	25	32	0.80	0.63
ALNUS INCANA spp. tenuifolia- mountain alder	30	26	40	1.15	0.75
LONICERA INVOLUCRATA- black twinberry	35	25	37	1.40	0.95
PINUS PONDEROSA- ponderosa pine	12	17	15	0.71	0.80
POPULUS BALSAMIFERA- black cottonwood	33	30	50	1.10	0.66
ROSA NUTKANA- nootka rose (count for both spp.)	280	313	360	0.89	0.78
SALIX LASIANDRA- pacific willow	69	77	100	0.90	0.69
SAMBUCUS NIGRA spp. cerulea- blue elderberry	3	4	5	0.75	0.60
SPIRAEA DOUGLASII- Douglas spirea	298	284	300	1.05	0.99
SYMPHORICARPOS ALBUS- common snowberry	118	107	100	1.10	1.18
Vine maple reveg	3				
Thimbleberry	12				
Currant	1				
Aspen	1				
Fireweed	5				
Total Number of Trees/Shrubs or Total Survival	2196	2116	2384	1.04	0.92

Figure 15. An increase in ground cover from 2015 to 2016. Shrub cover 10 percent, ground cover 50-60.



PP12, Aug 20, 2015; 29cfs

PP12, Sept 1, 2016; 36 cfs



PP13, Aug 20, 2015; 29cfs

PP13, Sept 1, 2016; 36 cfs

Data collected along shade transects and in shrub cover plots (Ecology mandated Wenatchee Basin Shade Study) suggest no increase in shrub or shade cover from 2015 to 2016 in the parking lot removal area (Table 3). As noted photo points indicate ground cover has increased and was recorded in plots in 2016 (Table 3). In general, right bank plots had more shrub, ground, and shade cover, as well as more soil and less cobble substrate, than left bank plots. Scour in plot LBX is apparent in the decrease in willow cover. Figure 15. N1 shade Transects and vegetation plots established as part of the Wenatchee Basin Shade Study.



Cover class	Range of cover (%)	Class midpoints (%)
1	<1	0.5
2	1–5	3
3	5–10	7.5
4	10–25	17.5
5	25–50	37.5
6	50–75	62.5
7	75–100	87.5

Table 2. Range of cover that each cover class used in Table 3 and Table 5 represent.

Table 3. Native shrub and ground cover, and invasive cover in vegetation plots on river right.

	Plot LBA		Plot RBA		Plot LBX		Plot RBX		Plot LBC	
	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015
survival		90				80		99		95
total shrub	4 (10-15)	3	4 (~15)	4	3 (~5)	3	4 (~25)	4	4	5
serviceberry			4	4					1	
rose	4	4	4	3	3	5	3	3	4	3
snow			4	4			2	3	4	4
cottonwood			3	3	2		3	3	4	6
pine			3	3			3	3		
ocean spray			2	2			2	2		
dogwood	4	4	4	2			4	4		
elderberry			2	2						
alder	4	3	2	2	3	3	3	2	3	2
willow	3	4	2			3	4	4	4	4
spirea	5	4	2		7	6	4	4	4	3
thimbleberry			2							
total					_		_			_
invasive	2	3	2	4	2	1	0	3	1	2
mullen		3				7			6	4
grass		7		7				7		6
prickly										
lettuce	5		6	2	7				5	
knapweed	6									
bull thistle			6							
total ground	5		6		5		6		6	
alluvium	5		4		5		4		4	
Grass spp.	6		7		6		7		7	

Figure. Parking lot floodplain Shade



Abutment floodplain:

The 2015 stem count on abutment removal site indicated 92 percent survival of installed plants and was not repeated in 2016. Brush mattress cover, composed primarily of willow, was 80 - 90 percent (Table 4, Figure 16). One shade transect and two vegetation plots were established (Figure 15). Shrub cover estimates in plots indicate shrub cover ranges from 5 - 10 percent on both the upland and lowland areas, and is composed primarily of willow and cottonwood in the lowland and rose and cottonwood on the upland. 30 percent of the lowland plot was wetted at the time of the survey (Figure 17). No noxious weeds were noted in the lowland plot. However, a substantial amount of knapweed was recorded in the upland plot, and several clumps of bullthistle observed north of the plot. Shade in the lowland, upland, and stream center plots ranged from 40 - 50 %, whereas shade on the bank was 85%, due to the influence of the brush mattress (Figure 18).

Figure 16. Brush mattress on river left.



PP9, Aug 20, 2015; 29cfs

PP9, Sept 1, 2016; 36 cfs

Table 4. Brush Mattress shrub cover

	Percent cover in Brush Mattress
TOTAL NATIVE COVER	80-90
Willow	70
Spirea	20
Alder	5
Dogwood	5
TOTAL INVASIVE COVER (all tansy ragwort)	< 5

Figure 17. Lowland and upland vegetation plot established low flow 2016.



Lowland plot; Sep 1, 2016

Upland plot; Sep 1, 2016

Table 5. Native shrub and ground cover, and invasive cover in vegetation plots on river left.

	Plot A (lowland	Plot B (upland)
total shrub	3	3
cottonwood	4	4
Alder	3	
snowberry	3	3
rose	3	6
willow	5	
dogwood	3	
pine		3
oceanspray		2
serviceberry		2
total invasive	1	2
knapweed		7
mullen	7	
total native ground	5	5



Figure 18. Abutment fill removal floodplain shade.

Goal 3) Provide fish cover in the 2007 oxbow and potentially alter sediment deposition patterns and promote vegetation establishment.

CCNRD staff observed substantial fine sediment deposition around log jams that remain in the oxbow – both on the upstream island (2 out of 8 logs remain) and the downstream island (all 8 logs remain). Vegetation recruitment has occurred in the sediment and resulted in 50 percent native shrub cover on the upstream island and 70 percent on the downstream island (Table 6, Figure 19). The downstream island is 100 percent covered in native vegetation – the other 30 percent is covered in sedge, rush and lily. Noxious weeds tansy and knapweed were observed on the upstream island.

OXBOW shrub cover							
	downstream island						
total shrub	50	70					
willow	65	100					
alder	30						
cottonwood	5						
total invasive	15	0					
tansy	90						
knapweed	10						
sedge, rush and lily	not recorded	30					

Table 6. Shrub cover around wood placed in oxbow.

Figure 19. Native shrub cover is 50-70 around placed wood in oxbow.



Upstream island

downstream island

<u>Fish Use</u>

2) Provide high-flow refuge habitat in the excavated channel and increase floodplain inundation on river right.

2016 snorkel counts indicate the constructed channel is meeting goals and providing high-flow habitat to ESA-listed species. ESA listed-species counts in the constructed channel were markedly lower in 2016 than 2015 (Table 7). Tetra-tech observed this trend across all nine Wenatchee basin sites (Tetratech 2016 seasonal snorkel report).

		Cons	Constructed channel			
Date	Species	Count	Density	Agency		
NA: 10	Chinook	2		CCNRD		
2016	coho	0	Not available			
2010	O.mykiss	0				
March	Chinook	0	0			
2016 (night)	coho	0	0	Tetratech		
	O.mykiss	6	0.0138			
	Chinook	0				
April 2015	coho	0	Not available	Tetratech		
	O.mykiss	47				
May 2014	Chinook	69	0.1068			
	coho	0	0	Tetratech		
	O.mykiss	0	0			

Table 7. Fish counts to date in the N1 constructed channel.

Goal 3) *Increase instream structure to provide fish cover in the 2007 oxbow by altering sediment deposition patterns and promoting future vegetation establishment.*

Yakama Nation snorkel counts indicate ESA-listed salmonids are using the oxbow – however, how added large wood effects fish-use of the site cannot be inferred from these fish counts since counts represent fish use in the entire oxbow (Figure 24). Like the constructed channel, ESA listed-species counts in the 2007 oxbow were markedly lower in 2016 than 2015 (Table 8). Yakama Nation noted in the snorkel survey memo that ESA listed-species concentrations were also low at the Nason Creek smolt trap during the survey. YN hypothesized low counts were due to downstream displacement during the high water event in November 2015.

Table 8. Ya	akama Natio	n Juvenile Fish	Counts in the	2007 Oxbow	/ before wo	od was added	(2012-2014)
and after (2015-2016)						

	Nason										
Date	Discharge			Salmon	ids		Other				
	cfs	Brook	Chinook	Coho	Steelhead	Whitefish	CC Fry	Dace	Sculpin	Shiner	Sucker
8/23/2012	74	0	165	123	1,438	966	10	0	0	14	0
3/20/2013	423	3	131	39	426	111	0	0	8	7	0
9/3/2013	82	3	601	80	1040	392	1439	5	1	143	171
3/20/14	404	2	171	6	301	6	0	0	7	7	0
8/27/14	67	2	421	0	395	401	0	0	1	4	8
3/25/15	733	1	28	36	178	117	0	0	8	49	13
8/6/15	33.7	0	96	29	372	42	0	7	0	1206	3676
3/8/16	542	0	11	0	83	6	0	0	5	222	3
8/9/2016	69.9	0	30	0	437	124	40	1	2	126	0

Figure 24. 2007 Oxbow. Red circle = area wood was added in 2014. Blue line = extent of the YN's snorkel survey.



Summary, Conclusions and Recommendations

The 2016 monitoring report documents site conditions in year two since project completion. To date, the project is meeting project goals of restoring natural stream (floodplain) processes on river left and river right near RM 4.6. Significant changes occurred to the site as a result of an estimated 10-year flood in Nason Creek that occurred in late fall of 2015. Changes include more water diverted into the 2007 oxbow and wood displacement, scour of the parking lot floodplain, and channel excavation and increased inundation of the abutment removal area. All changes are in keeping with the project goal of enhancing natural process within the floodplain areas of lower Nason Creek. Fish use was also documented in the excavated channel and 2007 oxbow in 2016. Sediment deposition patterns have resulted in vegetation establishment in the oxbow. Revegetation of fill removal areas has increased from 2015, primarily due to an increase in native grasses. Invasive species concentrations are low in most areas – however bull thistle and knapweed are prevalent in the upland of river left and need to be removed.

Goal 1) Restore channel migration potential and natural stream processes on river left (i.e. abutment removal site), including enhancing activation of the relic side channel located downstream of the project area.

Low flow photo points indicate that restoration of floodplain activation of the abutment removal site has resulted in the restoration of natural stream processes that have caused enhanced activation of the relic side-channel and excavation of a new channel across the floodplain. The new channel underwent further natural excavation in the late fall flood of 2015 and remained active on September 1st, 2016 at a mainstem flow of 36 cfs (the channel was dry during low flow 2015). The first 50 feet of the relic channel and the northwest corner of the abutment floodplain, dry at low flow 2015, were wetted and active at low flow 2016 which also indicate natural process. The entire floodplain was active on during high flow on April 21, 2016 at 1750 cfs.

Goal 2) Provide high-flow refuge habitat in the excavated channel and increase floodplain inundation on river right.

2016 monitoring indicates the northwest area of the river right parking lot removal floodplain is inundated during average high flow events – photo points show it was active on April 21st, 2016 at a mainstem flow of 1750 cfs. During low flow, staff observed an area of cleared slash, exposed cobble, and some willow mortality that had occurred during late fall floods of 2015. This is considered natural process and in line with the goals of the project. Snorkel surveys conducted by CCNRD and Tetratech in May and March of 2016 indicate O.mykiss and Chinook use of the constructed channel during spring runoff.

Goal 3) Provide fish cover in the 2007 oxbow and potentially alter sediment deposition patterns and promote vegetation establishment.

Large flood events in late fall of 2015 caused the most significant changes in the 2007 oxbow as compared to other project elements. More of the total flow of Nason Creek is now being diverted into the oxbow as a result of the breakup of a major log jam on the mainstem just upstream of the oxbow inlet. Also, 10 of the 28 pieces of wood that were added to the 2007 oxbow in 2014 were displaced during this flood – wood placed in the oxbow was designed to withstand the 5-year event. CCNRD staff located 4 of the 10 displaced logs hung up on major beaver dams within the oxbow downstream of their original location. Other restoration logs were likely present but may have been submerged or hidden from view among naturally recruited wood. Remaining wood added complexity, structure, and overhead and instream fish cover on April 21st, 2016, during a typical high flow of 1750 cfs.

Deposition of fine sediment and willow and cottonwood establishment around wood placed in the oxbow was recorded on September 1st, 2016 during the low flow visit. Vegetation recruitment has occurred in the sediment and resulted in 50 percent native shrub cover on the upstream island and 70 percent on the downstream island.

Goal 4) Revegetate the fill removal areas (river right and left).

Stem counts and data collected per the Wenatchee Basin Shade Study indicate the project is exceeding permit requirements and continues to fill in with native vegetation. Data indicates survival of 92 percent on both floodplains (based stem counts in 2015 and 2016). Shrub cover ranged from 5-25 percent on river right and 5-10 percent on river left. In the river right parking lot area, results indicate a substantial increase in native ground cover. Willow mortality that occurred as a result of scour was also observed on river right – willows were replaced in the fall of 2016.

Brush mattress cover was 80 – 90 percent in 2016. Invasive weed cover is low in most areas – however several large patches of bull thistle and knapweed on the upland of river left were observed.

Adaptive Management

The project plans specified installation of willow cuttings in the oxbow following sediment accumulation and were scheduled to be planted in fall 2016. However, natural recruitment of cottonwood and willow deemed planting unnecessary. Willow cuttings were installed in the northwest area of the parking lot removal area where scour had caused some mortality in fall 2016. Willow cuttings were also installed in this area in fall 2015 –however the 10 –year flood that occurred shortly after caused high mortality of these cuttings.

Removal of bull thistle and knapweed in the upland of the abutment removal floodplain is recommended in the spring of 2017 before flowering. No other adaptive management actions are currently recommended.

Monitoring in 2016

<u>Oxbow</u>

In 2016, staff will continue to monitor the site during high and low flow. Attempts will be made to visit the site at ordinary high water (OHW) flow levels (~700-1000 cfs) to document the flow that wood in the oxbow becomes inundated. The Yakama Nation will snorkel the entire oxbow in winter (early March) and summer (August or September). CCNRD staff will also snorkel around the added wood at OHW to document fish use during the highest flow that safety allows.

Floodplain fill removal areas

CCNRD will continue to monitor the site during high and low flow to capture natural process and subsequent changes to the floodplain fill removal areas. Vegetation monitoring will include shade transects and shrub plots, as well as site wide shrub cover estimates. CCNRD staff will coordinate with Tetra tech crews to assure a snorkel survey occurs in the constructed channel during activation. High flow photo monitoring will continue to document the flow level that activates the floodplain areas. Low flow photo monitoring will continue to document vegetation establishment.