

# Pacific Lamprey

## 2017 Regional Implementation Plan

*for the*

## Upper Columbia

## Regional Management Unit



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Projects proposed and discussed within this Regional Implementation Plan are in accordance with direction provided within the *Conservation Agreement for Pacific Lamprey in the States of Alaska, Washington, Idaho, Oregon and California, 2012*. Cooperative efforts through the Agreement intend to: a) develop regional implementation plans derived from existing information and plans; b) implement conservation actions; c) promote scientific research; and d) monitor and evaluate the effectiveness of those actions.

Projects identified in this Regional Implementation Plan do not imply or intend a funding obligation or any related activity from any of the government agencies, tribes or non-governmental entities discussed within this document.

# I. Status and Distribution of Pacific Lamprey in the RMU

## A. General Description of the RMU

Within the Upper Columbia Regional Management Unit (RMU) from the Snake River to Chief Joseph Dam there are 15 HUC 4 subbasins. This assessment and prioritization focused on five tributaries to the Columbia River: Yakima, Wenatchee, Entiat, Methow, Okanogan. The HUC 4 subbasins include: Lower Yakima (#17030003), Naches (#17030002), Upper Yakima (#17030001), Wenatchee (#17020011), Upper Columbia-Entiat (#17020010), Methow (#17020008), Okanogan (#17020006), Similkameen (#17020007).

These subbasins were ranked in the 2012 Nature Serve assessment as S1 (Critically Imperiled) based on rarity, trends, and threats. The Okanogan is now likely SH (Possibly Extinct). The number of adult Pacific Lamprey reaching these upper Columbia tributaries based on Columbia River dam counts is likely less than 5,000 per year with fewer than 100 adults reaching the Yakima, Methow and Okanogan rivers in the past 10 years. The Upper Columbia RMU contains substantial high quality habitats. Restoration of Pacific Lamprey in this RMU is critical to the ecological functions of these subbasins, to ecological contributions during their anadromous migrations, and to the persistence of Pacific Lamprey in the Columbia River basin.

Although historic distribution likely extended into Sanpoil (#17020004), Colville (#17020003), and Kettle (#17020002) subbasins, these areas were excluded from consideration at this time due to existing anadromous passage barriers at Chief Joseph and Grand Coulee dams. Limited or no information was available for Pacific Lamprey in some of the smaller subbasins, including Lower Crab (#17020015), Upper Crab (#17020013), Moses Coulee (#17020012), and Lake Chelan (#17020009).

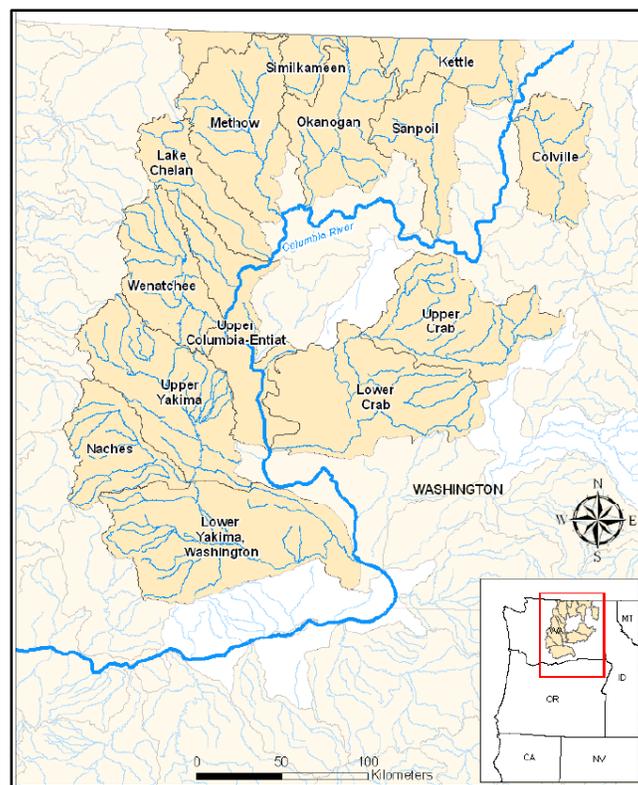


Figure 1. Map of the Upper Columbia Regional Management Unit (from the USFWS Conservation Assessment).

## **B. Status of Species**

### **Conservation Assessment and New Updates**

During the development of the USFWS Conservation Assessment (October, 2011), there was a high level of uncertainty in population status. Historic occupancy is believed to have been relatively high in the Yakima, Wenatchee, Entiat, Methow and Okanogan rivers. Recent field surveys and assessments throughout much of the RMU now provide relatively high certainty of the population status, which appears to be severely diminished in many of the subbasins. Current adult escapement to the subbasins is believed to be very low from near zero to 1000 at most.

### **Distribution and Connectivity**

There are five hydroelectric dams within the UC RMU downstream of Chief Joseph Dam: Priest Rapids, Wanapum, Rock Island, Rocky Reach, and Wells dams. The combined impacts from Columbia River dams have greatly reduced the number of adult that can contribute to the tributary adult escapement. Within the subbasins, there are also many irrigation dams and diversions used for variety of purposes including hydropower, irrigation, water storage and fisheries management. Because of the reduced numbers of Pacific Lamprey reaching the UC RMU and barriers and impediments to movement in the subbasins, the distribution of Pacific Lamprey has been severely reduced to relatively few in two of the major subbasins (Methow and Okanogan) and only the lower reaches in two subbasins (Yakima and Wenatchee) and in several other tributaries.

The Yakima River has multiple diversion dams on the mainstem and many more on its tributary streams. Based on radio telemetry studies in the Yakima River, mainstem dams were found to be an obstacle or barrier for adult Pacific Lamprey upstream migration with passage rates ranging between 0% and 82%. Cumulative passage through successive dams was very low, as less than 5% of adult lamprey successfully passed three or more of the lowermost diversion dams. No lamprey are known to have voluntarily passed Roza Dam, located near the lower end of the Upper Yakima Subbasin.

In the Wenatchee Subbasin, Tumwater Dam, originally built for hydropower but now used for fish management and monitoring, was found to be the upper most distribution point for Pacific Lamprey in recent years. Dryden Dam is passable but has not been evaluated. Tributary dams within Wenatchee Subbasin may also limit distribution. Distribution in the Entiat is not limited by dams. Migratory connectivity in the Methow is generally better, although several structures have not been evaluated. In the Okanogan no lamprey were found during 2016 distribution work and they were last observed in the river in 2010. The Enloe Dam has blocked all fish passage in the Similkameen River since 1919/1920.

### **Brief Narrative**

Larval lamprey surveys have been performed throughout most of the RMU by the Yakama Nation, USFWS, and Wild Fish Conservancy/Methow Salmon Recovery Foundation. In the Yakima Basin there are very few adult Pacific Lamprey; counts at Prosser Dam (river km 75.7) averaged 22 for the past 13years (2002-2015) (Columbia River DART 2016). Lamprey have been found in the Lower Yakima Subbasin and tributaries (Satus, Toppenish, and Ahtanum) and in the Naches River, but are functionally extirpated in the Upper Yakima Subbasin (upstream of the Naches River (river km 191.9) because of lack of passage at Roza Dam (river km 210.5). Over the past 4years the Yakama Nation has implemented an adult translocation program primarily in the Lower Yakima Subbasin tributaries but also in the Upper Yakima Subbasin. This action has significantly contributed to juvenile / larval abundance and distribution. Western Brook Lamprey are widely distributed and reasonably abundant.

Larval and juvenile Pacific Lamprey are present in the lower Wenatchee River downstream of Tumwater Dam (river km 49.6), but have not been found in any lower basin tributaries including two where they were historically documented (Peshastin and Icicle). Pacific Lamprey were historically documented upstream of Tumwater Dam in Lake Wenatchee and the upper mainstem, and likely occupied four large upper basin tributaries.

In the Entiat subbasin rotary screw trap counts of larval and juvenile lamprey have varied from close to 1,200 to just over 5,500 over the past 10 years and are distributed upstream to river km 46.4. In the Methow subbasin recruitment of new larvae has been absent or severely limited in recent years and distribution appears severely reduced. They currently are only found in the mainstem below the Chewuch River confluence and in the Chewuch River. They were last found in the Methow River upstream of the Chewuch River confluence in 2000. Pacific Lamprey are believed to be extirpated in Crab Creek, although there have been no recent surveys.

### C. Threats

#### Summary of Major Treats

Ranking of the RMU threats was developed through existing information and consensus of the participating RMU members (Table 1). Project prioritization in this RMU is based upon and consistent with the High ratings indicated in the Table.

Key Threats	Okanogan	Methow	Entiat	Wenatchee	Yakima	Combined Score (H=3, M=2, L=1)
Adult Passage	M	L	L	H	H	10
Juvenile Passage	L	L	L	M	H	8
Dewatering & Flow Mgmt.	M	M	L	L	H	9
Stream & Floodplain Degradation	L	L	M	M	M	8
Water Quality	H	M	M	M	H	12
Predation	H	L	L	L	H	9
Small Population Size	H	H	M	H	H	14
Mainstem Passage	H	H	H	H	H	15
<b>Combined Score</b>	<b>18</b>	<b>14</b>	<b>13</b>	<b>17</b>	<b>23</b>	

**Table 1: Summary of known or potential key threats within the Upper Columbia RMU tributaries. [H – High (>70% of subpopulation affected), M – Medium (50% of subpopulation affected), L – Low (<30% of subpopulation affected)].**

Among the many threats identified in the Upper Columbia RMU, some showed a pervasive impact in the entire region, such as Mainstem Passage and Small Population Size. Other threats were more location specific, but nevertheless cause severe impacts to the local populations, such as Adult Passage, Juvenile Passage, Dewatering & Flow Management and Predation.

Although Mainstem Passage is a key threat for this region, it was not included in the priority actions because there is an on-going, multi-agency effort with the USACE<sup>1</sup> in the lower Columbia River and the Public Utility Districts<sup>2</sup> in the Mid-Columbia River to assess and reduce this impact. Responsible

<sup>1</sup> US ACE – US Army Corps of Engineers

<sup>2</sup> Includes Douglas County, Chelan County and Grant County PUDs

parties are identified, and we expect to see reasonable progress in mainstem passage improvements.

Adult Passage is a key threat in the Yakima, Wenatchee subbasins as evidenced by radio telemetry (Yakima) and juvenile distribution surveys (Yakima, Wenatchee). Passage in the lower subbasins severely limits distribution into the upper watersheds. Larval lamprey distribution of Pacific Lamprey stops immediately downstream of Tumwater Dam (Wenatchee River) and Roza Diversion Dam (Yakima River). Adult counts from both of these dams also support the hypothesis that adults are not currently moving past these structures. The Okanogan subbasin has several dams that have not been evaluated for Pacific Lamprey passage such as Osoyoos and Lake Control dams on Okanogan River. The Enloe Dam on the Similkameen River is known to be impassable.

Larval/juvenile Entrainment has been examined extensively and intensively by the Yakama Nation within the Yakima Basin and Wenatchee Subbasin. Because of their small size, larval lamprey less than 80 mm in length were easily entrained past the existing fish screens (made exclusively for juvenile salmonids). Diversion waterways were also found to provide ample larval lamprey habitat. However, dewatering in the winter months severely impacts juvenile lamprey and their ability to survive or return back to the river.

Dewatering & Flow Management was also identified as a key threat in the Yakima Basin but meaningful restoration actions will require large scale institutional changes involving water rights and salmonid management and is likely a long-term action. Many of these actions are being addressed within the Yakima Basin Integrated Water Resources Management Plan.

Water Quality is considered a threat in some watersheds within the RMU. Concentrations of a wide variety of contaminants in lamprey tissue as well as larval lamprey habitat (fine sediment) was found to be severely high in the Yakima Basin based on a collaborative research by the USGS, CRITFC, YN, and PNNL.

Predation is likely higher than was initially identified in many of the subbasins from invasive species (Smallmouth Bass, Largemouth Bass, Walleye, etc.) as well as native species (Northern Pikeminnow, River Otters, etc.), especially where these species are more prevalent as in the Lower Yakima and Okanogan subbasins.

Small Population Size is a pervasive threat in the RMU. This threat is essentially the cumulative effect from issues with mainstem dam passage, blockages on subbasin streams and the other threats listed above. Small population size can result in a lack of pheromone attraction to migrating adults, inability of spawning adults to find mates and potential for catastrophic loss of the local population from environmental perturbations.

### **Restoration Actions (Passage, Habitat, and Translocation)**

Within the mainstem Columbia River, improvements to Grant, Chelan, and Douglas County PUD hydroelectric dam fishways to increase adult passage success have occurred and are ongoing. These improvements are generally related to installation of plating over auxiliary water supply gratings and improvements to fish counting stations.

Many instream and floodplain habitat restoration activities have been implemented in the Upper Columbia subbasins, although all of these actions have been designed / funded for salmonid recovery. To date, the primary lamprey restoration activities that have occurred within this RMU include

translocation of spawning adults (Yakima Basin 2012 - 2016) and more recently in the Methow (2015) and the Wenatchee rivers (2016). Recent efforts towards adult passage (lower Yakima River), and salvage of entrained lamprey in irrigation diversions (Yakima Basin and Wenatchee Subbasin [Dryden Diversion]) are encouraging. Coordinated efforts have begun since 2012 in artificial propagation (Yakama Nation, Umatilla Tribes and USFWS) and in the evaluations of juvenile entrainment into irrigation diversions and potential methods to prevent entrainment.

## II. Selection of Priority Actions

### A. Prioritization Process

Prioritization of actions is based on consensus by all participating members of the Upper Columbia RMU. Criteria used in prioritization include: (1) action will provide significant and persistent benefit to the subbasin population, (2) action is supported by all affected parties, and (3) action can and will be implemented contingent upon securing funding.

Based on the USFWS Conservation Assessment, results from monitoring and multi-agency coordination meetings, the following four projects were selected as priorities for the Upper Columbia RMU: (1) Adult Passage, (2) Juvenile Entrainment, (3) Adult Translocation and Larval/Juvenile Supplementation, and 4) Contaminants / Toxics.

### B. Consistency with the Conservation Agreement

Each of these Projects are consistent with the Conservation Agreement, specifically with Objective 6. Other parallel activities associated with this Project are also consistent with the Agreement, including data sharing, public outreach and identification and distribution of Pacific Lamprey throughout the Basin.

### C. High Priority Proposed Project Information

#### Tributary Adult Passage Improvements

The goal of this project is to improve passage for the five lowermost dams in the Yakima Basin (Horn Rapids, Prosser, Sunnyside, Wapato, and Roza dams) and Tumwater and potentially other dams in the Wenatchee Subbasin. Previous evaluations identified that adult passage is blocked at Roza and Tumwater and impeded the other facilities, although Dryden Dam and other tributary dams has not been assessed. Upon implementation, effectiveness monitoring would evaluate the improvements in passage rates as well as to fine tune the passage structures, using direct trapping, PIT tags, automated counters, and/or video monitoring.

- **HUC 5 Location:** Wenatchee River (#1702001107) and various watersheds within Lower Yakima (#17030003) and Upper Yakima (#17030002) subbasins.
- **Facilities ownership:** Bureau of Reclamation and/or irrigation districts (Yakima River) and Chelan County PUD (Wenatchee River).
- **Management responsibilities:** BOR has fish passage responsibilities for most mainstem Yakima River irrigation diversion dams. Chelan County PUD has responsibilities for fish passage at the two lowermost Wenatchee River dams (along with Co-Manager salmonid monitoring). USBOR and USFWS are responsible for Leavenworth National Fish Hatchery structures and Icicle Peshastin

Irrigation District for its diversion dam in Icicle Creek.

- ***Rationale and linkage to the watershed:*** Yakima Basin and Wenatchee Subbasin hold an abundance of low gradient, lamprey spawning and rearing habitat; however, upstream distribution is severely limited by existing dams.
- ***Expected outcome (threats addressed):*** The near-term objective is to identify practical passage solutions, then implement appropriate structures with a focus on Yakima and Wenatchee dams.
- ***Coordination and Consensus with relevant stake holders:***
  - Yakima – BOR, USFWS, WDFW, YN, associated irrigation districts. Coordination has been persistent and strong.
  - Wenatchee – Chelan County PUD, USFWS, WDFW, YN. Coordination is being developed, consensus with Chelan PUD in consultation.
- ***Feasibility and expected timeframes:*** Feasibility is high for this Project. The expected overall duration is approximately 5-6 years.
- ***Proponent Role and Responsibilities:*** Yakima Basin: Yakama Nation, BOR, USFWS will be primarily responsible for coordination and expenditure of funds and activities for these various projects. Wenatchee subbasin: Chelan County PUD will be primarily responsible.
- ***Budget and identification of potential funding sources:*** Partial funding for the pilot passage improvements has been provided for Horn Rapids and Prosser dams through USFWS funding (approximately \$90,000) and for Sunnyside and Wapato dams through NRCS funding (~\$170,000). However, funding for passage improvement at Roza Dam (~\$100,000) and effectiveness monitoring in association with all these passage improvement projects (~\$100,000) is missing. Additional funding may come through the BOR, USFWS, and/or BPA Fish and Wildlife Program. New funding is needed for the Wenatchee passage improvement (~\$100,000).

## **Reduction of Juvenile Entrainment in Tributaries**

The goal of this Project is to identify appropriate and feasible solutions that substantially reduce or eliminate juvenile mortality due to entrainment into major irrigation diversions within the Yakima Basin and Wenatchee Subbasin. Entrainment of juvenile lamprey is well documented and many thousands of fish are lost each year as a result.

Juvenile lamprey entrainment into various irrigation facilities within the Yakima Basin (primarily at Sunnyside, Wapato, and Bachelor-Hatton diversions) and at Dryden irrigation diversion (Wenatchee Subbasin) is well documented and in many cases substantial (an estimate of 10,000~40,000 larvae annually entrained in some of these diversions). Prevention of entrainment by screening is difficult due to the very small size of larvae/juvenile lamprey that enter diversion intakes. Replacement of existing screens (designed for juvenile salmonids) would be expensive and likely impractical because screen mesh size would need to be reduced significantly (<1 mm, less than half the size of current requirement) for significant reduction / prevention of larval lamprey entrainment. However, lamprey can be salvaged from these facilities using electrofishing or dredging.

Other short-term solutions are available, such as using flow barriers (such as ecology blocks) to prevent the accumulation of fine sediment in front of fish screens. Flow barriers can also be established

downstream of the fish screens to prevent passage of larval lamprey further down the canal. There are other potential alternatives, such as Flow Velocity Enhancement System (<http://www.fishpassage.com>), Farmers Screens and Hydrolox (<http://fcasolutions.org>), and Bilfinger Fish Protection Technologies (<http://www.water.bilfinger.com/applications/water-intake/fish-protection-technology>). There is also potential value in re-designing diversion intakes in a manner that significantly reduces sediment intake and maintenance and potentially the entrainment of larvae/juvenile lamprey by building a physical model that provides general guidelines for re-designed diversions and diversion intakes and facilitating individual designs for specific dimensions, for example.

- **HUC 5:** Wenatchee River (#1702001107) and various watersheds within Lower Yakima (#17030003).
- **Facilities Ownership:** Bureau of Reclamation (Yakima River) and Chelan County PUD – (Wenatchee River).
- **Management Responsibility:** BOR / WDFW has fish passage responsibilities for the mainstem Yakima River irrigation diversion canals CCPUD and WDFW have shared responsibilities for fish passage at the lower Wenatchee River irrigation diversion dams along with associated Co-Manager activities monitoring salmonid populations.
- **Rationale and linkage to the watershed:** BOR owns, operates, and/or maintains five major irrigation diversions/ fish passage facilities in the lower Yakima River (Horn Rapids, Prosser, Sunnyside, Wapato and Roza). Each of these diversions withdraws a substantial proportion of flow from the Yakima River and has the potential to entrain large numbers of larval/juvenile lamprey into the canal mouth as well as behind the fish screens.
- **Expected outcome (threats addressed):** The goal of this project is to reduce entrainment and associated mortality by improving effective larvae/juvenile downstream passage at key irrigation facilities that are operated within the Yakima Basin and Wenatchee Subbasins
- **Identification and coordination with relevant stake holders:** The primary stakeholders in the Yakima Basin are the BOR, USFWS, WDFW the Yakama Nation and associated irrigation Districts. Each of these entities have remained in close coordination during the past 5-years of preliminary evaluations. Both BOR and the YN have been active in providing updated information to the irrigation Districts within the Yakima Basin. The same entities and CCPUD are the key stakeholders for Dryden irrigation facility. Considerable conversation associated with juvenile entrainment at Dryden is occurring within the Rocky Reach Fish Forum, a part of the Federal Energy Regulatory Commission process associated with the CCPUD.
- **Feasibility and expected timeframes:** Funding is available (through a NRCS grant) for a pilot project in Sunnyside and Wapato diversions using heavy equipment and dump trucks to salvage and transport deposited fine sediment and entrained larval lamprey into side channel ponds in close proximity. Improvement work in Bachelor-Hatton Diversion (Ahtanum Creek) has advantages as well in that it is a smaller diversion, making fine scale manipulation in the headgate and fish screen areas much easier and simpler. Expected timeframe for this project is 2016-2019. Mechanism of entrainment has been evaluated jointly by the USGS (in laboratory) and the YN (in the field) in recent years. The next logical step is to apply low-cost short-term solutions to mitigate these impacts. Screen technology is not currently available for fish below 60-80 mm size and costs have not been estimated due to lack of final designs. However, physical models can be developed to

reduce movement of fine sediment and larval lamprey into diversions.

- ***Proponent Role and Responsibilities:*** The Yakama Nation, BOR, USFWS, CCPUD will be primarily responsible for coordination and expenditure of funds and activities.
- ***Consensus within the RMU Groups:*** There is high consensus within the RMU group that this project is high priority due to 1) the potential for high lamprey biological productivity within the Yakima Basin and Wenatchee subbasin especially near the facilities of focus, 2) and the recent history of successful collaboration among the USFWS, BOR, WDFW, CCPUD, and Yakama Nation, and 3) the range wide impact of entrainment and this project's applications to other subbasins within and outside of the Upper Columbia RMU.
- ***Expected outcome:*** Mortality associated with entrainment and dewatering in irrigation diversions will be reduced using a variety of proven methods available (electrofishing, transport through heavy equipment and dump trucks, etc.). Pilot projects will be implemented to evaluate various short-term measures to reduce larval/juvenile lamprey entrainment in diversions. Physical modeling is required to evaluate designs for longer-term solutions to reduce entrainment of fine sediment and larval lamprey into irrigation diversions.
- ***Budget and identification of potential funding sources:*** It is reasonable to estimate \$400,000 is needed over the next 5-years for additional research and pilot project design. Funding is secured from NRCS (~\$200,000). A minimum of \$200,000 is needed over the next 5 years to provide meaningful research and solutions to the larval/juvenile entrainment problem. Additional funds may come through the BOR and BPA Fish and Wildlife Program. Smaller contributions from the North Wasco Mitigation Fund are possible.

## Adult Translocation and Larval/Juvenile Supplementation

The goal of this project is to use adult translocation and larval/juvenile supplementation to reintroduce and supplement Pacific Lamprey larvae in currently extinct and functionally extinct subbasins within the Upper Columbia tributaries, including Yakima, Wenatchee, and Methow. Adult translocation is ongoing since 2012; Larval/juvenile lamprey supplementation is scheduled to take place within the Yakima Basin initially starting in 2016-2017. Upon implementation, effectiveness monitoring would evaluate the success of translocation and supplementation by 1) assessing parentage genetics and 2) trends in relative abundance from larval/juvenile index sites and other exploratory sites, and 3) trends in relative abundance from screw traps and other available juvenile monitoring facilities.

- ***HUC 5 Location:*** various watersheds within Upper Columbia (#170200) as well as Lower Yakima (#17030003), Upper Yakima (#17030001), Naches (#17030002), Wenatchee (#1702001107), Methow (#17020008) HUC 4 subbasins.
- ***Land ownership:*** Multiple ownerships within the various watersheds, including city, state, federal, tribal, and private land.
- ***Management responsibilities:*** USFWS, WDFW, and Yakama Nation are co-managers for Pacific Lamprey management.
- ***Rationale and linkage to the watershed:*** Upper Columbia River tributaries, such as Yakima, Wenatchee, and Methow hold an abundance of low gradient, lamprey spawning and rearing habitat;

however, current population segments are severely depressed in many of these tributaries (to the point that assessing limiting factors are impossible using wild fish).

- ***Expected outcome (threats addressed):*** The near-term objective is to initiate larval outplanting in select locations (three sites in Upper Yakima and one site in Naches) and continue adult translocation in Yakima, Wenatchee, and Methow rivers to support restoration and research needs (such as assessment of adult and larval/juvenile passage, entrainment, limiting factors, population dynamics, etc.).
- ***Coordination and Consensus with relevant stake holders:***
  - YN, USFWS, WDFW, and other partners. Coordination has been persistent and strong.
- ***Feasibility and expected timeframes:*** Feasibility is very high for this Project (Master Plan is currently being reviewed by key partners). The expected overall duration for the initial phase is approximately 3-5 years.
- ***Proponent Role and Responsibilities:*** Yakima Basin: Yakama Nation will be primarily responsible for coordination and expenditure of funds and activities for these various projects.
- ***Budget and identification of potential funding sources:*** Funding for the adult translocation work has been provided primarily by BPA funding. Artificial propagation is funded primarily by BOR, BPA, with some new funding from Chelan County PUD. Funding is considerably limited for effectiveness monitoring for both adult translocation and larval/juvenile outplanting; approximately \$100,000 and \$250,000, respectfully, are needed over the next 5 years. Smaller contributions from the North Wasco Mitigation Fund are possible.

## Toxicological Evaluations

Results to date indicate that concentrations of a wide array of contaminants (both legacy and currently used) were severely high in both lamprey tissue and fine sediment in the Upper Columbia Basin, with a focus on Yakima Basin. Because water quality is an integral, key issue in the region, we propose to evaluate the impacts of these contaminants for key sensitive life stages, namely spawning adults and newly hatched larvae. The highest detection frequencies and concentrations of pesticides generally occur during irrigation season, which coincide with Pacific Lamprey adult migration, spawning, and egg hatching period. We will also evaluate how contaminants are transmitted vertically from parents to offspring. Within the Yakima Basin, there will also be opportunities to track contaminant levels in primary restoration areas that coincide with Pacific Lamprey habitat to document changes in contaminant accumulation associated with restoration activities over future years. Samples will be collected and analyzed annually to document when the benefits of restoration in the form of toxics reduction begin to take place. We will also be able to compare the results with samples from other subbasins, funded and analyzed as part of separate concurrent projects. Although this project does not offer direct restoration benefits, we emphasize that improving our understanding of the potential impacts of contaminants, especially at the sensitive stages, will have range-wide ubiquitous benefits for the species as a whole. The primarily lab-associated tasks outlined here will provide the key information to advance our knowledge in this largely neglected field. Yakama Nation and its partners (USGS, USFWS, BOR, WDOE, WDFW, and PNPL) have the unique opportunity to collaborate and test these issues, using adult translocation and artificial propagated larvae.

- ***HUC 5 Location:*** various watersheds within Upper Columbia (#170200) as well as Lower Yakima (#17030003), Upper Yakima (#17030001), and Naches (#17030002) HUC 4 subbasins.
- ***Land ownership:*** Multiple ownerships within the various watersheds, including city, state, federal, tribal, and private land.
- ***Management responsibilities:*** Responsibility for the water quality / contaminants is not clear.
- ***Rationale and linkage to the watershed:*** Water quality / contaminants were identified as a key threat to lamprey survival in the Yakima Basin as well as many of the other subbasins in the Upper Columbia RMU. Enhancing our understanding on the life stage specific impacts of contaminants will help provide guidelines on contaminant loading and summer minimum base flow.
- ***Expected outcome (threats addressed):*** The goal of this Project is 1) to assess the specific impacts of key contaminants previously identified for spawning adults and newly hatched larvae and 2) to evaluate the rate of vertical transmission of key contaminants from parents to offspring. If the impacts are severe during this life stage and/or high rates of vertical transmission of key contaminants are confirmed, it will provide scientific grounds to make recommendations for reduced toxicant loading during key seasons for lamprey. It could also provide evidence for the importance of increasing base flow during this season when hydrograph is severely managed and manipulated.
- ***Identification and coordination with relevant stake holders:*** The primary stakeholders are the BOR, USFWS, USGS, USEPA, WDFW, WDOE, WDOA, Yakama Nation, and associated Irrigation Districts for the Yakima Basin.
- ***Feasibility and expected timeframes:*** Feasibility is high for the stated objectives on contaminant monitoring because 1) baseline information on contaminants were already assessed in 2012-2015 and 2) spawning adults and newly hatching larval lamprey are available through our artificial propagation efforts. The expected overall duration of this initial monitoring period is 5 years.
- ***Proponent Role and Responsibilities:*** The Yakama Nation, BOR, USFWS, USGS, and PNNL will be primarily responsible for coordination and expenditure of funds and activities for these projects.
- ***Consensus within the RMU Groups:*** There is high consensus within the RMU group that the toxicology project is high priority due to 1) the potential for high lamprey biological productivity within the subbasins, 2) the recent history of collaboration among the partners and 3) successes from the past and ongoing work on toxicology studies, which were rated as highly important in many subbasins within the Upper Columbia RMU, especially within the Yakima Basin.
- ***Budget and identification of potential funding sources:*** It is reasonable to estimate that a minimum of \$200,000 is needed over the next 5 years to provide scientific evidence on the impacts of toxicants. Matching funds will be available through USGS (~\$69,000) and CRITFC (~\$53,000) funding, if at least \$90,000 could be funded through other sources over the next 3-5 years. Remaining funding may come from the BOR, BPA Fish and Wildlife Program, Salmon Recovery Funding Board and/or Wasco Mitigation Funds.